The Mesolithic-Neolithic transition in the South Caucasus:
Cultural Transmission and Technology Transfer

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Abstract

The development of Neolithic in the South Caucasus remains a poorly understood phenomenon. The first agricultural communities have been identified at sites such as Aratashen and Aknashen. They are semi-sedentary group living in mud brick houses, with the earliest layers of these sites already showed fully domesticated species Conflicting hypotheses have suggested both a local independent agricultural development or a full population replacement by neighboring Near Eastern groups. Therefore, my project was dedicated to the identification of possible contacts between groups in this region and external groups, and how to characterize these interactions in order to understand how Neolithic came into being in the South Caucasus.

The lithic model that I have developed focuses on the social aspect of technological practices. It assumes that stone tool production sequences are culturally specific, and that they may be shared in full only through complete access to the place of teaching, the enculturating environment.

I have studied five lithic assemblages from four different sites were studied and compared. Two sites were "Mesolithic", i.e., relying on hunter-gatherer modes of subsistence (Kmlo-2 and Bavra-Ablari), and two sites were Neolithic (Aknashen and Aratashen).

Therefore, we were able to reconstruct this scenario, putting forth that the first contact between Near Eastern farmers and groups living in the South Caucasus may have taken place during the 9th millennium BCE. These contacts remained outside of the enculturating environment, but led to the diffusion of a very specific tool type known as the Kmlo, or Çayonu, tool. Early in the 6th millennium BCE, groups settled in the southwest Caspian belt moved within the South Caucasus, settling in the river valleys of the Kura and the Araxes. There, they interacted with existing Mesolithic communities following an open-static-parasitic frontier model involving unilateral movement of goods from the Neolithic to the Mesolithic groups. Such contact, taking place outside of the enculturating environment, was probably the result of transhumance of agricultural groups entering Mesolithic ecological niches. However, this did not lead to the adoption of agriculture by local groups, who were most likely pushed out of the areas in which they had previously lived.

Table of Contents

Glossary

Technology

Aknashen tool: Retouched blade with a back created by an overshot burin. The edge opposed to the back shows systematically retouching or usewear.

Kmlo tool*:* Hooked tools with continuous parallel pressure-flaked retouch on one side. These tools are carried out on irregular blades or blade-like flakes.

Know-how**:** A series of operational instructions and specific knowledge, conscious and unconscious, physical and intellectual, collective and individual (Karlin 1991; Chamoux 2010). Know-how also includes the ability to perform or to operationalize this set of instructions (Pelegrin 1991:15). The term signifies the possession of learned instructions as well as of knowledge, gained through experience, that allows for a critical response to the evolution of the operational sequence (Pelegrin 1991).

Knowledge: Set of conceptual instructions about the global goal of the actions, or a group of mental representations of shapes and materials, associated with a set of gestures necessary to achieve the goal in mind (Pelegrin 1991:12)

Chaîne opératoire: Sequence of steps necessary for the manufacture and transformation of a product. *Chaîne opératoire* is an analytical tool that allows us to look at the entirety of this production sequence from raw material acquisition to the discard of the finished product. It can also be adapted to look more specifically into sequences within the production sequence, i.e., blank production, retouching, etc.

Modes (following Pelegrin 2012): the 3 modes referred to in this work follow the definition developed by Pelegrin (2012):

Mode 3: Pressure flaking using a small abdominal crutch, most likely in a sitting position. This system allows an increase regularization of the product compared to other modes of pressure flaking with smaller implements. Overall, the flint blades produced with mode 3 reach 10-12mm wide.

Mode 4: Pressure flaking with a long crutch using the entire weight of the body. The system requires proper immobilization of the core and the use of a flexible material for the crutch. The flint blades produced (Pelegrin 2012) with this mode are 20-21mm wide.

Mode 5: Pressure flaking using an implement, like the lever, that allows for the multiplication of human force. This mode relies on the assumption that the mechanism of the lever was well known by the Neolithic groups, who erected massive buildings at sites such as Catal Hoyuk or Gobekli Tepe. It requires a control and immobilization of the core, and "a lever, fixed through a socket in a tree or against a stone" (Pelegrin 2012: 478). The flint blade produced with mode 5 can reach 32mm wide.

<u>Skill</u>: a capacity to reach a given goal "using the affordance of a given environment"(Reed 1989:15).

<u>System</u>*:* A set of techniques, articulated into sequences of production and industries. These techniques, productions, industries and crafts form a set of systems (technical) within any society. Every system interacts with other systems (ritual/symbolic, economic, etc…).

<u>Techniques</u>: Ways of action upon matter. Following Mauss' definition, a technique involves gesture, knowledge, and tradition. The movement follows knowledge about the

material and equipment and the goal of the action. These elements are taught and learned. Example: direct percussion, microburin, pressure flaking.

Technology: In this work, technology is understood both as a set of tools, techniques, crafts used in a society (as a technological system) and as the field that studies this system.

Periods

Epipaleolithic: A post-Last Glacial Maximum continuation of Upper Paleolithic traditions until the Younger Dryas, traditionally connected to the study of pre-Neolithic Near Eastern cultures.

Mesolithic: An interglacial continuation and/or adaptation of Late Glacial specialized hunters for a more temperate climate, and especially for a mostly forest environment, which dominated the entire continent from the first half of the 11th millennium Cal. BC

Neolithic: A lifestyle in which a predominant group of behaviors show trends towards increasing control over plant and animal resources. From the local chrono-cultural sequence, these behaviors are known to ultimately lead to the development of morphological phenotypes and genotypes of at least one group of a species being managed, and to a set of social and technical adaptations (social technology, architecture, irrigation, trade).

Models

Agricultural frontiers: Agricultural frontiers (Moore 1985, Dennel 1985) models characterize different types and degrees of interactions between two groups; i.e. *static*, in which two groups will have no advantage in expanding, retreating, colonizing; and *mobile*, generally associated with changing contexts (ibid.). Several variants account for the nature of forager-farmer relationships and the process of diffusion of farming technologies (assimilation, migration, colonization, absence of contact).

- *Static border:* Several groups living in the same area. Due to specific environmental, adaptive, or social conditions, each group will remain in its original area or ecological niche and the border does not move.
    - *Closed*: This border is impervious and no exchange occurs between the groups.
    - *Open*: The border is open. Some degree of contact and exchange occurs. Different types of relationship develop between the groups.
        - Symbiotic: This relationship is characterized by an equilibrium reached through bilateral communications and movement of goods and knowledge. It involves peaceful interactions, and groups gain access to each other's enculturating environment.
        - Parasitic: This relationship is characterized by a unilateral movement of goods and knowledge in one direction possibly in the context of theft or raid by one group.
- *Mobile border:* Several groups living in the same area. The border moves moving as one group enters the territory of the other. This situation leads to several types of interaction.
    - *Impervious*: Despite the location of the groups in the same territory, no exchange and no interactions occur. The movement of the frontier further within the hunter-gatherer territory, without any

interaction, can result in the colonization of the new territory, through the displacement of the local groups or their evacuation from the said territory.

- *Porous*: The groups interact in the following ways:
    - Assimilation: Through increased interactions, hunter-gatherer are progressively assimilated in farming communities.
    - Acquisition: Hunter-gatherer groups acquire farming resources and eventually farming technology
    - Migration: Resources move into hunter-gatherer areas

Availability Model**:** The availability model distinguishes three phases (availability, substitution, consolidation), each expressing a different degree of interaction between the two communities, and a progressive transfer/adoption of the farming strategies.

Demic diffusion and wave of advance : Demic diffusion is a model first introduced by Ammerman and Cavalli-Sforza (1971, 1973) to illustrate how a given population will expand at the expense of its neighbors due to a given adaptive cultural or biological advantages. As a migratory model, it was refined to address more specific types of migration (gender/age-biased, apex families, migratory scouts, etc.) (Bocquet-Appel 2002, 2011). The archaeological signature ranges from a total replacement of a defined material culture by another within the same territory to more complex situations requiring our ability to identify specific social units in prehistoric context.

Pioneer Colonization Model: The PCM focuses on aspects of selective colonization (Cauvin 1994) in which the areas optimal for the development of agriculture (valleys, coastal plains) are settled first, followed by suboptimal areas in a second phase. This model thus accounts for the coexistence of foragers and farmers within the same region.

Archaeological Culture

Shulaveri-Shomu: The Shulaveri-Shomu culture (or Shulaveri-Shomutepe, or Aknashen-Shulaveri-Shomutepe) is an archaeological culture associated with the first fully agricultural societies in the South Caucasus as early as 5900 BCE. It was defined on the basis of three eponymous sites: Shulaveri (Georgia), Shomutepe (Azerbaijan), and Aknashen (Armenia). The culture is characterized by villages of round mudbrick houses, a subsistence pattern relying on the exploitation of domesticated crops (hulled barley, naked wheat) and animals (ovicaprins, pigs), and a lithic assemblage of long obsidian blade production.

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Chapter 1:

Introduction

How did the Neolithic way of life—the development of a food production economy that occurred in the Early Holocene—come into being in the South Caucasus? Historically, the field of anthropology has been particularly concerned with addressing how groups interact, how cultural traits are developed and transmitted, and how technology is transferred, especially in the context of socio-cultural and economic transition. Our current understanding of the development of the food production economy in this area is drawn from several contradicting approaches, some of which argue for local independent orgin of this technology, with others in support of an external origin. While much research has focused on the spread of domesticated crops and animal species, we lack a strong framework for understanding the mechanisms of technological transfer and knowledge sharing that would have been fundamental to this transition. This project examines four sites and five assemblages from Armenia and Georgia in order to improve our understanding of the chronological evolution of socio-economic behaviors. , Through the study of lithic assemblages at these sites, we can address if and how Neolithic-related technologies were integrated in the South Caucasus cultural landscape.

The Neolithic period represents the development of new forms of interaction between humans and their environment. In the Near East, this period occurred between 12,000 and 10,000 years ago (Bar-Yosef and Meadow 2005). The Neolithic is identified as a dramatic evolution of subsistence patterns that, in relation to shifts in technology, social behaviors, and symbolic expression, spread across thousands of kilometers of land and water (Bar-Yosef and Meadow 2005). However, despite the multiplication of case studies around the world, many studies of the Neolithic transition suffer from several theoretical and methodological shortcomings. First, the acceptance of multiple chronological, typological, and economic definitions of the Neolithic have led to an imprecise study of its diffusion, adoption, and development. Next, the primacy of a long-standing unilateral core-periphery model (Smith 1995) has precluded archaeologists from viewing the agency of Mesolithic foraging communities in the adoption, rejection, and adaptation of new subsistence patterns. Lastly, few studies have attempted to go beyond a simple assessment of inter-group contact and influence in order to understand the mechanisms and socio-economic impacts of these interactions. These issues are partly connected to the paucities of economic (i.e. food acquisition strategies) and radiocarbon data available, the limits of a traditional analysis of material assemblages associated to the sites, and the intellectual history of the discipline in the South Caucasus.

I have developed in this work a methodological framework that identifies behaviorally significant aspects of lithic assemblages and connects them to group interactions. By doing so, this work aims to shed light on the processes that led to the agricultural transition in continental part of the South Caucasus. The transition from Mesolithic hunter-gatherers to Neolithic farmers can be understood in two terms: local *indigenist* development (Whittle 1996) vs. external *migrationist* input (Rowley-Conwy 2011).

1.1. Models of Neolithic development

1.1.1. Definition

Addressing the Mesolithic-Neolithic transition requires first the proper definition of the concepts involved in this process.

1.1.1.1. The Mesolithic

The transition to food producing economy in the South Caucasus has traditionally involved several stages: Epipaleolithic or Mesolithic, Early Neolithic or Aceramic Neolithic, Neolithic or Late Neolithic, Eneolithic or Chalcolithic. The variables that defined these periods, and justified the attribution of a site and its assemblages to one of these chronocultural categories, have evolved for the past decades. These changes result from the evolution of knowledge about a specific topic, but also from the desire to integrate one's work into a given research tradition.

This is best illustrated by the diverging attribution of Late Pleistocene sites to the Mesolithic or the Epipaleolithic. This particular debate is not specific to the South Caucasus. However, in this area, it is particularly significant in the context of intellectual traditions. Kozlowski's review of the several approaches to Mesolithic for the past 40 years (2009) leads him to suggest the following definition. The Mesolithic is a postglacial continuation and/or adaptation of Late Glacial specialized hunters for a more temperate climate, and especially for a mostly forest environment, which dominates the entire continent from the first half of the 11th millennium Cal. BC.

This definition is chronological, environmental, and cultural. The concept of the Mesolithic was first introduced by Hodder Westropp in the 1860s to add an intermediary period to Lubbock's classification. The definition was mainly developed by European archaeologists to address particular, mostly post-glacial, cultural groups that had adapted to a new environment in Europe and whose social evolution would eventually lead to a shift towards a food production societies (Kozlowski 2009). On the other hand, the term Epipaleolithic was suggested in order to emphasize the continuity between certain late

Paleolithic groups and post-glacial groups. Golovanova (et al. 2012:2) suggests, on the other hand, that Epipaleolithic should designate all groups from the LGM to the Younger Dryas, 21,000/22,000 through 9,500 BCE. Traditionally, the term Epipaleolithic is preferred in modern Near Eastern studies, whereas Mesolithic refers to an older tradition of research (Garrod, 1936-1937). One could argue that the preference given to the term Mesolithic in the South Caucasus (Childe 1942, Formozov 1953, Khoshtaria, 1940, Kushnareva 1997, Lioubin 1993, Munchaev 1975) refers to a desire to create a coherent approach at the scale of the U.S.S.R., and to bolster the creation of a coherent scientific approach as well as a prehistoric cultural entity. The South Caucasus is thus integrated into a European sphere rather than a Near Eastern one, and has been compared to other Mesolithic cultures across the U.S.S.R., Siberia or Eastern Europe (Kozlowski 2007, Munchaev 1975). Eventually, in the Caucasus, the Mesolithic came to be defined as a period hosting Holocene cultures that did not show evidence of food production (Kiguradze and Menabde 2004), a preference that is still present today (Gabunia and Tsereteli 2003, Meshveliani 2013, Chataigner et al. 2014).

1.1.1.2. The Neolithic

The evolution of the identification of the first steps of the Neolithic phenomenon is closely connected to the evolution of our understanding of the process itself.

In identifying the Neolithic, archaeologists rely on the identification of specific morphological changes, such as crop dispersion mechanisms, pulse size, or reduction of animal body size (Weiss and Zohary 2011, Zeder 2011). This strongly limits our ability to properly identify the totality of the process and to suggest adapted models, a case well illustrated by the delayed morphological domestication of donkeys in Pre-Dynastic Egypt

(Marshall and Weissbrod 2011). Indeed, traits characterizing the end-result of domestication are different than those that indicate a cultivation process. To some extent, the latter set of characteristics could potentially be identified in groups that are not in a "Neolithization" dynamic, therefore making the identification of Neolithic teleological. A focus on an ecological approach overcomes these limitations by allowing us to look more closely into the evolution of the relationship between humans and their environment. Considering, for instance, age and sex-based variability in a herd, an archaeologist is not simply studying the morphological traits associated with domestication, which are often delayed in appearance, but the existence of "domesticatory relations" in the context of herd management (Marshall and Weissbrod 2011). Another issue with a strict morphological approach has been the misunderstanding of the parallel processes of crop and animal domestication. It is traditionally accepted that about 1000 years separate the first morphologically domesticated versions of crops and animals (respectively 9,500 and 8.500 BCE) (Price and Bar-Yosef 2011). However, it is also suggested that crops will display certain morphological changes in response to an intensification of their reproduction that occurs faster than animal reproduction (Price and Bar-Yosef 2011) and which thus involves possible parallel initiation of cultivation and herd management behaviors. Furthermore, several episodes of domestication occurring at different paces have now been identified in the Near East and other areas (Zeder 2011).

Therefore, as the definition of Neolithic has shifted from polished stone tools, to the presence of domestic morphologies, to an evolution of the relationship between humans and their environment, one encounters the issue of a definition that is too large to be useful. The amount of case studies showing "low-level food production" and the use of domesticates in a mixed economy dominated by foraging and hunting behaviors has weakened a strict application of this definition. On one hand, a broad definition that does not focus on the end-goal can integrate as "Neolithic" subsistence strategies that might have taken place during previous periods in prehistory, including the Upper Paleolithic. On the other hand, if neither intense cultivation of wild species nor low-level production of domesticates is included, the spectrum of behaviors accepted as Neolithic becomes too narrow to properly integrate the variety of strategies that occurred within the core regions throughout the world during the Early Holocene.

We therefore suggest the following definition. Neolithic is a lifestyle in which a group of predominant behaviors show trends towards increasing control over plant and animal resources. If not already the case, these behaviors are known, from the local chrono-cultural sequence, to ultimately lead to the development of morphological phenotypes and genotypes of at least a group of a species being managed, and to a set of social and technical adaptations (social technology, architecture, irrigation, trade).

1.1.2. Models of Neolithic transition.

1.1.2.1. Near Eastern Neolithic.

Until twenty years ago, most of the research addressing this transition used the dichotomy between core and periphery as an interpretative framework, involving a model that emphasized the development of Neolithic-related technologies in a specific area (innovative core) followed by their diffusion into adjacent regions (receiving periphery). This model implied an automatic adoption of a Neolithic way of life by hunter-gatherer groups (Palumbi 2007). It is accepted, however, that agriculture developed independently only in a limited number of centers around the world (Bellwood 2005), also known as centers of origins (Badalyan et al. 2007).Thus, for societies relying on a food production economy outside of the Neolithic core area (Badalyan 2010), specific explanations are required, and new interpretations modeling hunter-gatherer and farmer interactions must be developed. For instance, for the spread of the Neolithic "way of life" into Western Europe, indigenism is largely interpreted as adoptionism (Rowley-Conwy 2011). Recent DNA studies (Smith 1995) suggest the adoption of agriculture by a group of local Mesolithic foragers in Eastern Europe, and their diffusion throughout the continent (Smith 1995).

Three phenomena explain the development of a food production economy in a given area: movement of people, movement of ideas, and/or local development. Studies have focused on genetic data, paleoanthropological data (Vavilov 1926) and cultural data (Fuller 2006). Each of these aspects has been used in order to identify which of these processes of cultural contact, population migration, or behavioral diffusion are at the origins of the development of a food production economy.

Demic diffusion is a model first introduced by Ammerman and Cavalli-Sforza (1971, 1973) to illustrate how a given population will expand at the expense of its neighbors due to a given adaptive cultural or biological advantages. As a migratory model, it has been refined to address more specific types of migration (gender/age-biased, apex families, migratory scouts, etc.) (Bocquet-Appel 2002, 2011). The archaeological signature ranges from a total replacement of a defined material culture by another within the same territory, to more complex situations requiring our ability to identify specific social units in prehistoric context.

Subsequent attempts, known as Pioneer Colonization models, have focused on aspects of selective colonization (Cauvin 1994) in which the areas optimal for the development of agriculture (valleys, coastal plains) are settled first, followed by suboptimal areas in a second phase. This model thus accounts for the coexistence of foragers and farmers within the same region, and has thus led to the development of the concept of agricultural frontiers (Moore 1985). The frontier concept characterizes different types and degrees of interactions between the two groups: *static*, in which two groups will have no advantage in expanding, retreating, colonizing; and *mobile*, generally associated with changing contexts (Moore 1985). Several variants account for the nature of forager-farmer relationships and the process of diffusion of farming technologies (assimilation, migration, colonization, absence of contact).

However, Zvelebil (1986) suggests that these forms of frontier can occur simultaneously within the same territory (Fix 1999). This Availability model distinguishes three phases (availability, substitution, and consolidation), each expressing a different degree of interaction between the two communities, and a progressive transfer/adoption of the farming strategies.

If the latter approach emphasizes the role and the agency of foraging communities in the adoption or rejection of new subsistence pattern, it does not account for the actual mechanisms underlying the transfer of such knowledge. Indeed, while some of these models have been proven appropriate to describe the format of the diffusion, there is still a need to address the nature of the mechanisms supporting it (Burmeister 2000) as well how to identify these mechanims of transition in the archaeological record.

1.1.2.2. The Neolithization of the South Caucasus

The definition and adoption of one model over another is initially limited by our ability to extract a sequence of economic behavior from a securely dated context. The lack of proper sequence is one of the main obstacles to identifying the mechanisms underlying the development of agriculture in the South Caucasus. This situation explains why current hypotheses for the transition in this region involve almost all possible scenarios witnessed in other areas around the world.

Indeed, the rich ecological diversity in the South Caucasus first led scholars to identify the region as a possible case of indigenous development of farming ((Lisitsina 1984, Lisitsina and Prischepenko 1977). It is located in the natural habitats of cereal species that were later domesticated, such as *Triticum colchicum* and *Tr. macha,* or again naked wheat (*Triticum turgidum* and *aestivum*) (Hamon 2008) as well as spelt wheat (*Tr. spelta*) and broomcorn millet (*Panicum miliaceum*) (Badalyan, et al. 2007). The ancestors of several animal species that became domesticated during later periods are also present, such as aurochs, ovicaprids (possibly *Capra caucasica)* and wild boars (Badalyan, et al. 2007). However, the domestication processes of these species was not identified in the South Caucasus, as they first occur in Neolithic sites like Aratashen and Aknashen as fully domesticated species.

Furthermore, other evidence suggests possible contact between South Caucasus groups and Near Eastern cultures as early as the 9th millennium BCE. This is the case of typological parallels between tools from Mesolithic sites in Armenia and Georgia and Southeastern Anatolia (Arimura et al. 2010, Chataigner et al. 2014). Several pottery sherds found in the earliest agricultural layers (Shulaveri-Shomu culture) in the South Caucasus have also been identified as originating from Near Eastern Late Neolithic groups (Badalyan et al. 2007).

Considering the brief evidence above, the development of farming in the South Caucasus seems connected with mechanisms involving domestication of species not found in the so-called “Near Eastern core”, while presenting some elements suggesting contact of local groups with the Near Eastern cultures. In any event, this phenomenon involved complex group interaction. The characterization of such mechanisms thus requires the construction of a chrono-cultural sequence associated with a good assessment of subsistence pattern evolution as well as the development of a model allowing us to identify these interactions. The model developed in the framework of this project relies on the most ubiquitous type of archaeological remain, lithic assemblages.

1.2. Methods and hypothesis

1.2.1. Stone tools, group interaction, and Neolithization

Technology in prehistoric societies has almost been addressed almost exclusively through the techno-typological study of lithic assemblages' variability (Tostevin 2011). Representative of a structuralist French school, Leroi-Gourhan (1964) developed a methodological framework in which a tool represents an *acte technique* and a social action. The choice of one technique over another is influenced, then, by representations, beliefs, or ideas (Lemonnier 1992). Associated with other approaches, the *chaîne opératoire* has the potential to address how variations in technological processes can inform us about non-technological phenomena, especially those involved in the transmission and adoption of new cultural behaviors. Parallel approaches to material culture as encoding various types of social meanings (i.e. assertive vs. emblemic) have been suggested, but these approaches did not integrate the manufacturing process as etically and emically meaningful until the work of Lechtman (1977), Sackett (1982,

1986) and Carr (1995a, 1995b). These approaches all address questions of style in technology as well as the physicality of the *chaîne opératoire*, offering a theoretical framework to address 1) the social context of technological transfer and 2) the social meaning embedded in the manufacturing process.

Going beyond the simple typological description and mapping of stone tool types calls for the development of a methodological framework to address the context in which such transfer occurs. It is believed here that the spatial, temporal, and social framework of these groups' interaction constrains technology transfer so that the different contexts and mechanisms of inter-group interactions will create particular archaeological signatures in the material record. For instance, Petrequin and Petrequin (1993) have shown how specific parts of the reduction sequence will take place in public or in private spaces.

Experimental and ethnographic works (review in Tostevin 2012) have emphasized the complexity of technical decisions, like core orientation and management, platform maintenance, direction of exploitation, angles, and convexity, that are involved in a given reduction sequence (Wiessner 1983). Those studies allowed the definition of etically measurable phenomenon that may be used "as proxies for what the observer saw as he learned" (Tostevin 2012:109), such as specific retouch techniques, or pressure blade-making. The degree of access to the enculturating environment, also known as "social intimacy" (Tostevin 2012) is thus likely to impact the ability to reproduce a given technology. Indeed, the differences in the location of contact from unsocial encounters on the edge of a forager's territory to social intimacy in the residential heart of the foragers' encampment, result in differential amounts of exposure to information and behaviors of each group. Therefore, acquisition of techniques and reproduction of blanks and toolkits will require varying degrees of social intimacy, and thus different types of interaction overall.

1.2.2. Hypothesis

Considering the evidence presented in brief above, we suggest that development of farming in the South Caucasus is the result of complex mechanisms involving interactions between local groups and outsiders. Such interactions can be identified through a lithic-based model. Accepting that the locus of expression for these interactions is to be found in traditional, learned technical—and social—behaviors allows us to discuss the different socio-cultural and demographic processes that led to the transition from the forager to farmer subsistence mode. These phenomena may be embodied, to varying degrees, in lithic assemblages.

In the following chapters, I first lay out existing models of Neolithic development and diffusion, supported by examples from the Near Eastern area. I present what these models imply in terms of group interactions, and introduce the expectation for these models in the lithic assemblage. The third chapter outlines the theoretical basis for the lithic approach and describes how stone tools can be used to infer social processes. Chapters four and five present a literature review of the history of the discipline in the South Caucasus, and an overview of the current state of the art for the Mesolithic-Neolithic transition in the region. Chapter six is dedicated to the results of my fieldwork in Armenia and Georgia, and thus presents surveys and excavations, as well as an introduction to the lithic assemblages studied in this work. Finally, the seventh chapter integrates the lithic data into the expectation models. These results are then interpreted along with other datatsets about chronology, subsistence patterns, and other aspect of material culture. Taken together, this evidence allows me to identify interaction types and make some suggestions about the mechanisms that led to the transition to farming in the South Caucasus.

Chapter 2:

Transitions to agriculture, Near Eastern models and South Caucasus characteristics

The analysis of Neolithic transition in the South Caucasus requires an examination of Near Eastern culture history. I address here the models historically suggested to explain the emergence and diffusion of food production in the Near East, along with its subsequent spread through the Mediterranean. I will analyze the demographic, economic, genetic implications of Neolithization and highlight the processes that have been suggested to study it.

2.1 Near Eastern Neolithic: Culture history and models

2.1.1. Chronocultural development

From the temperate highlands of Turkey, to the Syrian Desert, to the Mediterranean coastal areas, the Near East is an extremely heterogeneous area both in terms of topography and phytogeography (Figure 1). It is constrained to the north-northeast by the Taurus and Zagros mountains, and to the south by the Red Sea and the Arab-Persian Gulf. This area encompasses the Levant (Israel-Palestine, Jordan, Lebanon, Syria) as well as Cyprus. Several mountains, coasts, and rivers (the Tigris and Euphrates) define ecological biotopes that had a great influence on the socioeconomic development of local prehistoric groups. The geology and topography of the area was created by intense tectonic activity involving the collision of the Eurasian plate with the Arabian plate, which led to an intense volcanism that produced many obsidian sources (Cauvin et al. 1998). This heterogeneity resulted in differential impact of environmental change and the potential for higher density of socioeconomic adaptations (Goring-Morris and Belfer-Cohen 2011).

Figure 1*: Map of the main Neolithic sites in the Near East*

2.1.1.1. Epipaleolithic and Natufian

In the course of the environmental change that occurred from the LGM onward in the Near East, a range of socioeconomic adaptations took place throughout the territory. Mobile bands of Epipaleolithic hunter-gatherers occupied the entire region and adapted their strategies to the evolution of their environment, exploiting a broader spectrum of resources and developing a more flexible toolkit (Henry 1995). Some of these adaptations are already apparent at refugium sites such as Ohalo II, a Kebaran open-air settlement that produced a broad-spectrum plant-exploitation strategy (Weiss et al. 2006).

The climatic improvement that took place during the Bolling-Allerod interstadial seems to have been accompanied by a population increase that led to competition for territory (Bar-Yosef 2011). Subsequently, this may have caused the intensification of available resources within the territory, carried out through technological improvements, and triggered sedentism, at least in partial form. It is therefore in the course of this warmer, wetter phase that the Natufian phenomenon appeared (Valla 1998) around 12,900 BCE (see Table 1).

Table 1: *Chronological sequence of the Near Eastern Neolithic*[1]

Period	Range BCE	Culture
Early-Middle Epipaleolithic	22,000 -13,000	Kebaran, Nizzanan
Late Epipaleolithic	13,000 – 9,600	Natufian
PPNA	9,600 -8,500	Khiamian, Sultanian
Early PPNB	8,500 – 8,100	Mureybetian, Nemrikian
Middle PPNB	8,100 – 7500	Mid.PPNB
Late PPNB	7500 - 6750	Late PPNB
Final PPNB/PPNC	6750 - 6400	Final PPNB/PPNC
Early-Mid Pottery Neolithic	7400 - 5000	Hassuna, Samarra, Halaf

While the Natufian culture was by no means the earliest to present evidence of sedentism or intensification of plant foraging, it is generally characterized as the first clear socioeconomic step towards the development of agricultural society in the Near East—the "point of no return" (Bar-Yosef and Belfer- Cohen 1989, Valla 1990). This stage was characterized by the development of small villages of 75-100 people living in round houses (Valla 1990), mostly in the Southern Levant, with settlements at Carmel,

[1] after Belfer-Cohen and Gorring-Morris 2011

Galilee, and the Jordanian plateau all showing specific sub-regional characteristics. Natufians produced complex artistic and spiritual behaviors, burying their dead under the floor of their pit-houses and manufacturing bone objects as well as stone and bone beads (Bar-Yosef 2011, Belfer-Cohen and Bar-Yosef 2000). Their mode of subsistence relied on the intensification of plant foraging and hunting a broad range of species, most prominently the gazelle (Goring-Morris and Belfer-Cohen 2011, Munro 2004). This subsistence pattern was accompanied by the development of specifically adapted technology, like lunates, sickle blades, grindstone tools, which were comprised of diverse raw materials (Delerue 2007).

With the onset of the Younger Dryas in 10,800 and 9,500 BCE, the Late and Final Natufian exhibit signs of adaptive shift in their strategies (Bar-Yosef 2011). Possibly connected to the beginning of the cold and dry climatic event, diminution in crop yield and fluctuations in rainfall may have impacted the main resources of the Natufian groups. At this point, the archaeological record shows a return to strategies involving increased mobility and, generally, a decrease in instances of artistic expression and architectural achievement (Delerue 2007).

At the same time, on the other side of the Fertile Crescent, the Zarzian culture in the Zagros, with sites at Palegawra, Shanidar, and Zarzi, (Aurenche and Kozlowski 1999, Mellaart 1976) is suggested as another Epipaleolithic culture that took part in Flannery's (1969) broad-spectrum revolution. During the same time period, hunter-gatherer groups resettled in Cyprus at Akrotiri Aetokremno (10,776–10,461 BCE) (Simmons 1999, Simmons and Mandel 2007) and may have brought with them wild boars (Vigne et al. 2011).

2.1.1.2 PPNA

If the first socioeconomic modifications can be seen in the context of the Natufian culture, intensification of selection and possible cultivation of crops are generally thought to have taken place during the PPNA and the Khiamian (Zeder 2011). The PPNA thus shows a clear change in subsistence pattern, architecture, and lithic. This short period started in the midst of the Younger Dryas, a climatic event possibly leading populations to contract in several refugium areas (Bar-Yosef 2011). The terms was originally coined by K. Kenyon, who discovered in the layers of Jericho a culture she identified as Neolithic and characterized by round houses and a "sultanian" industry (Kenyon 1952). The buildings of this layer generally preserved a circular shape, with walls of plano-convex mud bricks covered with flat roofs (e.g. Mureybet, Jerf el-Ahmar, Jericho) (Stordeur and Abbès 2002). Villages increased in size, up to 300 people, a change that involved dramatic shifts in social organization, as demonstrated by the presence of large, communal buildings characteristic of Northern Levantine sites at Jerf el-Ahmar or Dja'de (Coqueugniot 2000, Stordeur and Abbès 2002). This social evolution also involved increased investment in the spiritual sphere (Hautpmann and Schmidt 2007), as seen in evidence of large-scale ritual events at places such as Gobekli Tepe.

The subsistence pattern concentrated on the hunting of gazelle and wild boars, as well as a number of smaller species (Vigne et al. 2011, Zeder, 2011). It also included foraging and early cultivation of several crops and pulses. Indeed, while no morphologically domesticated plant species are known until the end of PPNA, evidence point towards the development of intentional cultivation (Bar-Yosef 2011, Zeder 2011) that focused on crops like emmer wheat, barley, einkorn, and wheat (Weiss and Zohary

2011), and pulses, especially lentils, peas, and vetch (Weiss and Zohary 2011). The presence of species such as *Aegilops* and *Stipa* at Tel Qaramel, as well as the development of siloes, might be connected to the presence of culling and tilling activities (Willcox, Fornite, and Herveux 2008).

In dry areas, the Khiamian culture was, technically speaking, connected to the Natufian (Cauvin 1994). Groups dwelling at sites such as Gilgal, Nahal Oren, and Salibiyah X produced clay figurines along with architecture more complex than that of the Natufians. Valla (2003), following Cauvin (2000) suggests that the reorganization of the symbolic system that took place during the Khiamian was linked to the devaluation of hunting activities. This process can also be observed in the adaptation of the lithic assemblage, which provides evidence for the production of larger arrowheads, including the El-Khiam point. This type of assemblage also appears at Cyprus at Akrotiri-Aetokremnos (Simmons 1991) and Ayios Tychonas Throumbovounos (Briois et al. 2005).

Possibly connected to increased sedentism around 9.000 BCE was the densification of a regional exchange network (Delerue 2007, Varoutsikos 2008). Obsidian moved from Central Anatolia to the Southern Levant, while chlorite from southeast Anatolia and shell beads from the Red Sea reached the Middle Euphrates. In southeast Turkey, towards the end of the PPNA, sites like Asikli Höyük, Demirkoy, or Hallan Cemi provide evidence of the settlement of groups heavily involved in cultivation of cereals (Binder 2005:129). The PPNA cultures thus represent a coherent group that ranged geographically from the Southern Levant to southeast Anatolia, all the way to the Zagros Mountains. In this area, sedentary groups practiced intensive cultivation, which eventually led to the domestication of crops. These groups cohabited the area alongside the late Epipaleolithic hunter-forager groups that were likely responsible for the movement of raw material throughout the territory.

Towards the end of the PPNA, Middle Euphrates groups increased agricultural activity at Jerf el Ahmar, Tell Abra, Tell Qaramel, and Dja'de (Willcox, Fornite, and Herveux 2008), a transformation that foreshadowed the socioeconomic mutations that would come to pass during the PPNB.

2.1.1.3. PPNB

Despite previous socioeconomic evolution, there was a significant break between the PPNA and the PPNB. The nature of the transition that occurred around 9,000 BCE is not properly understood, but it seems to have resulted from local evolution of Middle Euphrates groups at sites like Mureybet, Dja'de, and Tel Hallula (Stordeur and Abbes 2002). From the very start, PPNB villages displayed impressive technological skills, as seen in lithic technology (Barzilai and Goring-Morris 2007, Binder 2005), architecture at Nevali Cori and Çayönü (Ozdogan 1999), and evidence of symbolic behaviors at Dja'de (Coqueugniot 2000). Four phases of PPNB are generally identified: the Early, Middle, Late, and Final, with the Final PPNB phase often coinciding with the PPNC.

The Early PPNB ushered in fully the transformations initiated during the late PPNA. It is particularly well represented in the Northern Levant, in the Middle Euphrates and Taurus areas, at sites such as Mureybet, Dha'de, and Cheikh Hassan. At those sites, there is some degree of continuation with the PPNA "Mureybetian" culture. The rectangular plan became the most widespread house template (Aurenche and Kozlowski 1999), and the specific naviform core technology was developed (Abbès 2002), allowing for the production of blanks used to manufacture much longer arrowheads, such as Byblos points. Another technological innovation has been identified in the Taurus region, where the pressure flaking technique was used to detach regular blades, a technique rooted in Pleistocene traditions that originated in Central Asia (Desrosiers 2012). In the Taurus area, notable technological behaviors included the conception of stone vessels or pendants, as well as the manufacture of Çayönü tools (Cauvin 1997). The skills involved in the manufacture of these tools has been interpreted as heralding the rise of art and craft specialization (Barzilai 2008; Belfer-Cohen and Goring-Morris 2011), which necessitated long distance movement of goods and material: In one example, a naviform core from Central Anatolia found in Cyprus (Binder 2005, Briois et al. 1997). The PPNB may indeed be characterized by the scale of its exchange network, both in terms of geographic extent and its flow. Even though some sub-regional variations exist, large-scale standardization existed to a growing degree, in concert with an increase in social interactions across long distances. This phenomenon can be observed in the colonization of Cyprus (Guilaine and Le Brun 2003, Peltenburg and Wasse 2004).

It is evidence from the early PPNB that allows us to observe the establishment of fully agricultural villages based on combinations of farming, herding, hunting, fishing and foraging. Domesticated emmer has been found at Tell Aswad (Stordeur 2003; Weiss and Zohary 2011), along with hulled barley at Shillourokambos in Cyprus (Colledge and Conolly 2007), and einkorn at Çayönü and Cafer Höyük (Nesbit 2002). Although there are no morphological markers for animal domestication, there exists possible evidence for herded caprines at Nevali Cori and Cafer Höyük between 8.5 and 7.5k BCE (Peters, von den Driesch, and Helmer 2005, Zeder 2011). In Dja'de and Tel Hallula, patterns of sexual dimorphism are consistent with “an ongoing process of domestication” (Zeder 2011; Helmer and Gourichon 2008). The first morphologically domesticated animals can be seen in the archaeological record by the end of the Early PPNB and the first Middle PPNB.

The Middle PPNB marks the intensification of the cultural and economic traits from the previous period, as well as their extension to new territories. This fully agricultural system benefited from the Early Holocene Climatic Optimum, allowing for a population increase and supporting the development of large villages with complex systems of surplus management (Kujit and Finlayson 2009). Middle PPNB villages such as Abu Hureyra or Tell Halula reached 6 to 8ha (Aurenche and Kozlowski 1999). The domestication of crops was complete (Tanno and Willcox 2006), and the first morphologically domesticated animals were present both in the Middle Euphrates, southeast Anatolia, and Cyprus, with domesticated pigs present at Tell Aswad, in present-day Syria (Helmer and Gourichon 2008).

Outside of the Middle Euphrates, agricultural villages preserved some of their regional characteristics. In the Taurus Mountains region, Çayönü and Cafer Höyük featured characteristic “cell-building” structures, which were markedly different than dwelling structures seen in the Middle Euphrates (Molist 2001). In the Southern and Central Levant, large sites such as Abu Gosh and Beida also show local characteristics, like Abu Gosh points and the modeled clay skulls of Jericho and Tell Aswad (Khawam and Stordeur 2007). However, despite some local variation, the cultural coherence and the identification of intense exchange networks justifies the use of the term *koine* to define the standardized, regional nature of archaeological phenomenon (Delerue 2007, Rollefson 1989).

During the Late PPNB Neolithization, or the diffusion of agricultural practices outside of its core area, began to occur. The phenomenon was first present in coastal areas, including Ras Shamra, arid margins sites like El Kowm, and the Eastern Jezireh. The first evidence for the full implantation in Central Anatolia is at the site of Askili Höyük, which had already been producing and exporting obsidian since at least the mid-PPNB (Balkan-Atli et al. 2001, Binder 2005). New species were domesticated, with caprins becoming increasingly exploited (Molist and Stordeur 1999). In the northern part of the Levan, centers like Catal Höyük, Can Hasan, Cafer Höyük, Abu Hureyra, or Çayönü gathered large populations and, during this time, saw the evolution of social technology as well as development of social hierarchy and methods for the large-scale management of surplus. The social cohesion was possibly supported by the development of religion (Whitehouse and Hodder 2010). By the end of the late PPNB, we can observe the demise of the lithic industry accompanied by the invention of ceramic. This transition is well documented at Çayönü and Catal Höyük. With the development of Hassuna, Samarra, and Halaf cultures, the center of innovation in technology then shifted from the Near East towards Northern Mesopotamia.

2.1.1.4. Pottery Neolithic, Hassuna and Halaf

The first evidence of pottery manufacture and use can be observed at sites such as Jericho or Yarmuk, dating from the first half of the 7th millennium BCE, during the Early Pottery Neolithic (Bellwood 2005). While some sites, like Sabi Abyad, Tell Seker al-Aheimar, Mezraa Teleilat, Tell Halula, and Bouqras, show a certain degree of continuity between the aceramic and the pottery Neolithic layers (Portillo et al. 2014, Verhoeven

2004) they also demonstrate a clear change in settlement pattern in comparison to earlier periods, including large-scale abandonment of sites (Verhoeven 2004) At Tell Halula, Tell el-Kerkh, and Chagar Bazar, rectangular plans are found along with beehive-shaped circular domestic structures, or “tholos” (Akkermans 2010). A large part of the lithic assemblage at such sites was carried out on obsidian from southeastern Anatolia, which provided the raw material for the production of long blades, scrapers and borers (Akkermans 1989). Bone industry was comprised primarily of awls and spatulas (Akkermans 1989).

Settlement patterns specific to the Late Neolithic have been connected to evidence for a socioeconomic collapse resulting from over-exploitation of the environment, as seen at sites such as Ain Ghazal, Beidha, and in the Balikh Valley (Akkermans 1989, 2000, Bar-Yosef 1996, Rollefson 1989). This situation would have triggered increasing regional interaction, higher mobility, and greater population dispersal, along with a global alteration of subsistence activities towards pastoral economies. Veroheven (2004) has argued that this restructuration was accompanied by a return to tribal society, but no evidence supports this hypothesis (Akkermans and Schwartz 2003:111).

Overall, early Pottery Neolithic and proto-Hassuna site are rare, and there is little indicating settlement in the piedmont of the Anatolian plateau (Akkermans 2000). Evidence found at Sabi Abyad point to a Late Neolithic starting at 6900-6400 BCE (Akkermans 2000, Campbell 2007). At this site, buildings are rectangular except for a few domestic structures (Portillo et al. 2014), and the subsistence economy involved farming, herding, and in particular the pastoralism of domestic species (Verhoeven 2004).

The pottery identified in the Late Nesolithic assemblages may not have played an important role at first, and many communities surrounding these villages remained aceramic (Akkermans et al. 2005). The wider use of pottery can be observed in the Hassuna and Samarra cultures, which developed mainly in central and Northern Mesopotamia around 6500BCE at sites such as Tell Hassuna or Shimshara in Iraq. At these sites, there is a clear differentiation in ceramic production, and evidence for a "fluid economic barrier" (Verhoeven 2007) across which village-dwellers and hunter-gatherers interacted, probably in the context of the pastoralist activities.

The Halaf period is characterized by a "complex mobility pattern with small, periodically shifting hamlets, interspersed with camps" (Pollock and Bernbeck 2010), and, therefore, increasingly complex interaction and organization among groups (Akkermans 2000). This settlement pattern change might be connected with the 6200 BCE event that caused acidification of the land in northern Mesopotamia (Kobashi et al. 2003) and led some groups to create strategies for adapting to their new environment, or to settle in new ecological niches. This new system is supported by new types of artifacts, like stamp seals, found at Sabi Abyad, which shed light on control of production and movement of goods. During the late Halaf, large sites such as Domuztepe, Arpachiyah, and Yarim Tepe became centers of production as well as ritual (Campbell et al. 1999:395, Frangipane 2007).

2.1.2. Models of Neolithic development and diffusion

Two phenomena represent extremes of a range of behaviors leading to the presence of agricultural societies in the area: On one end of the range is fully independent local development; while at the other is spread and adoption. Based on these processes, some suggestions can be made regarding the several existing hypothesis explaining the transition from Mesolithic to Neolithic in the South Caucasus.

One is local independent development, while the other one is spread and adoption. Chronological, genetic, and cultural data gathered in the Near East and Europe over the past twenty years now suggest that rather than looking at these models as separate categories, we can express them as limits of a range of phenomenon with varying degree of implications of external agents (Figure 2).

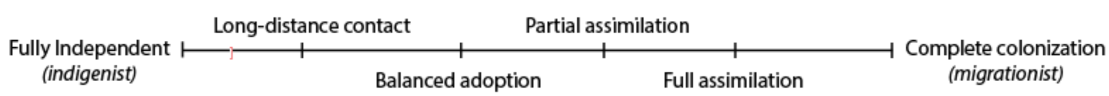


Figure 2: *Range of processes explaining the development of agriculture*

On one end of the range, a fully independent model relies on local domestication initiated by local agents on local species. Long distance contact involves a low degree of interaction between farming societies and hunter-gatherer group that might have led to transfer of ideas, but domestication is still resulting from a local process on loca species. Partial and full assimilation represent different degree of integration of hunter-gatherer group in colonizing farming groups and complete colonization involves a full replacement of hunter-gatherer population.

2.1.2.1 Neolithic Development

A series of models has been developed to explain how agriculture started and how it spread. Some archaeologists emphasize the role of a universal agent, generally identified as climate (Bar-Yosef 2001, 2005, 2011). If a dramatic climate shift took place from the Late Glacial Maximum to the Younger Dryas, causing an environmental change that impacted all human cultures, this change triggered extremely different human reactions. These reactions did not necessarily lead to the development of agriculture, and thus no single explanation can be accepted.

The broader Near East has been identified as the origin for agriculture at least since Braidwood (1952) and Childe (1928, 1957). The association of this development with the Younger Dryas led, early on, to climate-focused explanations in which an abrupt environmental change triggered a series of new behaviors aimed at minimizing risk through intensification of food acquisition strategies. Gordon Childe's "Oasis hypothesis" thus suggests that the devastation of the environment during the YD led to the exploitation of the same patches of territory by both animals and humans, leading to the domestication of one by the other.

A demographic approach focused on the role of demographic growth as generating the need for more diverse, predictable, and reliable food sources to control the population-resource imbalance (Cohen 2009). To some extent, ecological explanations are based on the same concept of optimization and efficiency (Gremillion and Piperno 2009). Other models, including Flannery's Hilly Flank hypothesis, have looked at the parallels between the natural habitats of wild species that would later be domesticated (Lisitsina 1984).

Still another set of explanations prioritized the importance of cognitive changes, which led humans to materialize their changing conception of their relationship with their environment (Cauvin 1994). One model looked at social disequilibrium, putting forth the idea that status competition created a need for surplus production, which eventually led to cultivation and domestication (Hayden 1992, Sahlins 1974).

However, there are several issues with the models. It is, for instance, generally accepted that the impact of the Younger Dryas in the Near East has been overestimated (Sanlaville 1996). Furthermore, the length of the process, which at least 2000 years), and the variability in observed adaptations requires more complex explanations. Furthermore, the chronological resolution available limits our ability to understand the relationships of causality among all the elements involved in this socioeconomic change.

There is, to this point, not a good understanding of the mechanisms behind the development of agriculture. Archaeologists will be able to define better this evolution by abandoning the issue of "why" and the attendant problems of reasons and agency, in favor of a focus on "how." Several aspects of the phenomenon are known: First, socioeconomic behaviors leading to agriculture began to develop in a period of drastic environmental change, but these behaviors generally evolved during periods of climate amelioration. Second, agricultural development generally took place in areas with abundant resources, which minimized the trial-and-error risks inherent to the domestication process (Price and Bar-Yosef 2011). Furthermore, domestication is also closely associated with demographic growth (Bocquet-Appel 2011), some degree of sedentism, and the appearance of new symbolic behaviors, like large ritual centers and new funerary rituals, among others.

A general issue in most existing models is the monolithic, monocentric understanding of the phenomenon of agricultural development. Contrary to the conception of a unique center of innovation, recent data on the Near Eastern Neolithic suggests a more complex regional organization. Considering the accepted definition of Neolithic, the current size of the possible "core" of development ranges from the Southern Levant, where early traces of cultivations are found, to the Zagros Mountains region, where herd management occurred early on at sites like Ganj Dareh and Ali Kosh (Hole 1977, Matthews et al. 2010).

The idea of a unique location or group of villages domesticating a set of plants and animals renders "place" a more flexible and fluid concept. Neolithic development occurred in a large region, within which different species were domesticated several times at different places. People, material, and ideas constantly moved, and the concept of cultivation spread so quickly that it has no one specific place of origin or direction of motion. One can imagine a region in which different locations developed a set of loosely parallel adaptations to new environmental conditions. These adaptations were then that channeled into more systematic behaviors, which, when grouped together, become the system we know as "agriculture."

In addition to these groups, the entire Near Eastern area witnessed a complex range of socioeconomic behaviors involving pastoral-foragers, hunter-gatherers, and farmer-fishers, all of whom interacted intensely, thus participating in the distribution of ideas and techniques. Such intensity of exchange can be observed in the movement of raw materials, like obsidian, shell beads, chlorite, jade, and flint, along with the techniques used for exploiting these materials. Some of these groups went on to become total agricultural societies, while others remained hunter-gatherers who still participated fully in the "Neolithization" process.

2.1.2.2 Neolithic diffusion.

Early models of diffusion of farming in new territories were based largely on the assumption, conscious or not, that agriculture was a superior way of life that hunter-gatherers would ultimately all adopt (Cauvin 1994, Childe 1928). Models such as the wave of diffusion (Ammerman and Cavalli-Sforza 1971, 1984) undermined the agency of local foragers and overestimated the "colonizing power of farmers" (Zvelebil 1986:13).

Extension of archaeological work along with the improvement of chronological resolution painted a new picture of the hunter-gatherer of temperate Europe and their first interaction with incoming farming groups (Kozlowski 2009). This also adjusted our understanding of the timing of the distribution and highlighted a phenomenon that was arrhythmic (Guilaine 2000).

In opposition to the migrationist paradigm, a new framework of explanation was developed to emphasize the role of hunter-gatherer in the development of agriculture (Dennell 1985, Rowley-Conwy and Zvelebil 1984, Zvelebil 1986). This model was largely based on a "Natural Habitat" explanation and was in part supported by the local nature of some of the Neolithic culture in Western Europe such as the Villeneuve-Saint-Germain in the Parisian basin (Otte et al. 2008).

Finally, an integrationist approach was developed as a middle ground between the two previous models. Integrationism supports a progressive colonization of a territory that includes local cultural and genetic features in the colonizing body. Most of these processes took place at a small scale and participated in a larger-scale phenomenon of colonization.

The integration of genetic and precise chronological data in the study of Neolithic diffusion in Western Europe has provided a more precise understanding of the process. Apart from a few exceptions, most of the domesticates present in LBK or Mediterranean groups originate from the Near East (Larson et al. 2007). However, if a small portion of the human gene pool from western Europe also comes from the original core, recent studies show that the farmers who colonized that area could mostly be identified as local European population, most likely coming from the Eastern European/Balkan area (Soares et al. 2010). The human genetic pattern can possibly be explained by different models involving porous frontier and long term interaction between the local and near eastern groups. A leap-frog colonization model (Zvelebil 2000) suggests the movement of small groups of Near Eastern farmers settling in new territories (such as the Balkans). These group are progressively genetically assimilated to the local Mesolithic population but transmitted some elements of agricultural technology in the process. The newly "neolithized" group then carried farming technology through Europe at a fairly rapid pace (Rowley-Conwy 2011). In this particular situation, indigenism becomes mostly adoptionism and actual transitional economies are rare (Rowley-Conwy 2011). Some examples of long-term contact through the agricultural frontier existed. There was for instance local domestication took place but they were rare such as with wild boars (Soares et al. 2010). There was also the adoption of pottery by Mesolithic groups at La Hoguette (Jeunesse 1987). But overall, the process of Neolithization of Western Europe seems to have been carried out rapidly, by local, eastern European groups transporting the technology of farming and some associated cultural expression.

The implications of the European Neolithization process for the development of agriculture in the South Caucasus are important. First, it depicts the development of Neolithic itself as a heterogeneous phenomenon involving very different group with different subsistence patterns, within a dense network of exchange of ideas and material. Neolithic groups have since the very beginning, interacted and exchanged with hunter-gatherers, despite possible barrier of culture or language. It also emphasizes the rapid adoption of agriculture by hunter-gathers groups. Finally, it underlines the difficulties, to properly highlight phenomenon related to human group diffusion without supporting genetic evidence.

2.1.2.2.1 The advent of diffusionism (wave of advance model)

The “wave of advance” (Figure 3) simulates the spread of Neolithic groups along a large-scale expansion front, a region that stretches from the Near East and Anatolia into the European landscape. The first attempts at explaining diffusion of Neolithic traits across the European continent through the lens of diffusion rates was carried out by Edmonson (1961), who calculated the speed of cultural spread to be of 1.2 miles (1.9 km) per year or about 47.5 km per generation. Ammerman and Cavalli-Sforza (1971, 1984) attempted to address this phenomenon in terms of human diffusion, focusing on the concept of demic diffusion to illustrate how a given population will expand at the expense of its neighbors due to adaptive cultural or biological advantages (Clark 2001; Fix 1999). Using a single point of origin (Jericho), they calculated a diffusion rate based on the dating of 53 European sites and identified a constant rate with no temporal variations (1971). The average rate of diffusion in that region was 1 to 1.1 km per year and about 25 km per generation (Cavalli-Sforza et al. 1994). The “wave of advance” model is originally based on Fisher’s Advantageous Genes (1937 *in* Pinhasi 2003), which assumes a regular, constant growth rate of biological entities until saturation is achieved. Once the carrying capacity of a given environment is reached, the entity moves away from the center in all directions (Fisher 1937, Bocquet-Appel 2002).

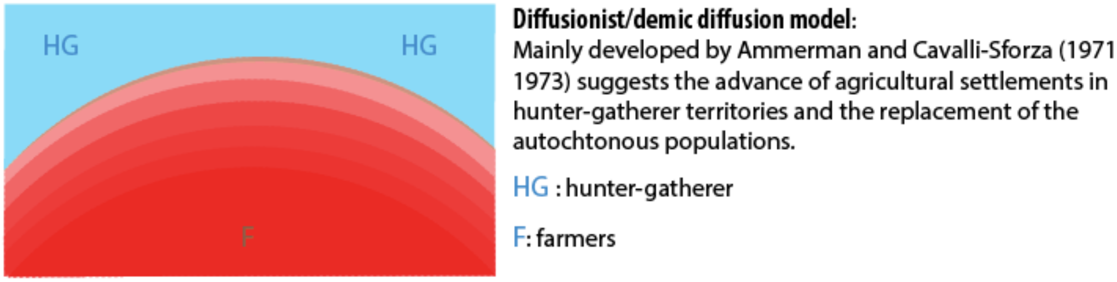


Figure 3: *Diffusion of farmers (red) in hunter-gatherer territory (blue) following a wave of advance model.*

Overall, this model is very close to Jacques Cauvin's image of the "colonizing farmer" conquering the European landscape with sheep and cattle at his side (Cauvin 1994). And like the "colonizing farmer," the model is built on several problematic assumptions. First is the assumption that the authors make about the nature of interactions between early farming and Neolithic people. Ammerman and Cavalli-Sforza argue that "people carry with them their own culture." Even more, they argue, "If for some reason, they expand geographically, so does their culture" (Ammerman and Cavalli-Sforza 1971:23). In emphasizing the motion of people as carriers of distinct cultures, the model makes no space for diffusion of knowledge rather than of people. Furthermore, the authors assume a linear and continuous process of colonization: This model discounts the possibility that original culture may arise as a result of complex interactions between hunter-gatherers and farmer, and ignores possible impact from environmental factors. Instead, the authors envision a landscape devoid of significant cultural entities before the arrival of colonizers, or inhabitants who would have adopted a food-producing economy rapidly and without issue or opposition. Basing assumptions, in part, on ethnographic examples showing low acculturation rates of hunter-gatherer groups among African pygmies, Ammerman and Cavalli-Sforza supported the of agriculture as a self-evident option for foraging groups (Braidwood 1958, Childe 1928). This model was, at the time, found to be compatible with the available genetic data (Zvelebil 1986).

However, while new data using Y-chromosome markers tend to provide some support for a demic diffusion model, they also emphasize the complexity of the process and highlight the intense interaction between agriculturalists and local populations (Chikhi et al. 2002, Pinhasi et al. 2005). MtDNA analysis has also shown the small impact of the first Neolithic farmers on modern European female lineages (Haak et al. 2008, Semino et al. 2004). While, in some cases, population replacement may have occurred—notably, in the Bering Sea region (Schurr et al. 1999)—chronological, cultural and genetic data shed light on a more complex phenomenon involving interactions with the Mesolithic populations (Rowley-Conwy 2011).

However, as a migratory model, the “wave of advance” was refined to address these problematic assumptions, to incorporate a new dataset, and to address more specific types of migration, including gender/age-biased, apex familial, and migratory scouting, among others (Burmeister 2000, Leslie and Richardson 1961). The archaeological signature associated with this model ranges from a total replacement of one assemblage by another within the same territory, to more complex situations that require our ability to identify specific social units in prehistoric context. The model also led archaeologists to take into account Mesolithic populations: It required archaeologists to reconstruct recursive and dynamic relationships between the different groups and to consider a range of possible interactions between these groups. These advances in the “wave of advance” model became key aspects of the development of the Agricultural Frontier Concept.

2.1.2.2.2. Dennell's agricultural frontiers.

The concept of archaeological frontier was first developed during the 1974 Leicester symposium. A series of case studies and theoretical essays regarding the interactions between farmers and hunter-gatherers, built upon Clark's *World Prehistory* (1969), set the foundations for this particular topic. At the symposium, attendees discussed the understanding of agricultural colonization as very much rooted in historical examples of agricultural expansion from the 18th and 19th century (Alexander 1977). Assumptions based on the modern experience of agricultural colonization are certainly illustrated by the first versions of the "wave of advance" model. Dennell (1985) suggests that there are several differences between prehistoric agricultural expansion and the modern agricultural colonization from which early "wave of advance" proponents took their cues, such as the differing degrees of technological gap between, on one hand, prehistoric farmers and hunter-gatherers, and, on the other, the groups involved in the pre-modern global expansion. Dennell also underlines the differences in agricultural productivity of prehistoric and 18th or 19th century farming societies, as well as the comparatively high efficiency of prehistoric foragers. Dennell emphasizes these discrepancies in order to emphasize the need to create models specific to the prehistoric context, taking into account differences in explanatory potential and data availability.

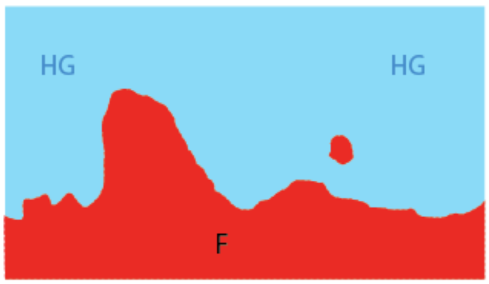
Alexander (1977, 1978) identifies two main categories of frontiers: mobile and static. To Alexander, the mechanisms underlying the processes that occur during the transition from mobile frontier to static frontier are connected to specific socio-economic behaviors. When addressing the movement of agricultural societies in new environments, mobile frontiers generally move following several models. First is a steady horizontal spread such as the “wave of advance” (Ammerman and Cavalli-Sforza 1971). Second is a “selective horizontal spread” that involves a degree of selection for new territory, most likely based on water availability or soil quality. Selective horizontal spread also be impacted by the presence of other human groups. In this model, Alexander (1977) suggests pioneer groups with *ad hoc* foraging behaviors colonize new territories and progressively implement a longer-term subsistence strategy. The third model is a selective vertical spread, close to the idea of transhumance. In this model, the frontier generally stops moving under three circumstances: one, when group encounters a physical boundary like a mountain, large river, or sea; secondly, when the ecological tolerance of crops or domestic animals has been reached (Alexander 1977); or, finally, when a group reaches an already-occupied land, which can lead to different interactions between farming groups and local foragers.

These interactions can be modeled to account for different variables like population growth or ecological availability. Indeed, demographic pressure can impact the flexibility and resilience that accompany different types of frontiers and group interaction. Dennell (1985) suggests a classification of agricultural frontiers that attempts to account for the range of possible inter-group behaviors. Within the static frontier territory, two options exist. One is “open frontier”, in which a symbiotic interaction between the two groups will lead to the movement of goods across the frontier, whereas a parasitic interaction involves the “theft of agricultural goods/resources” by hunter-gatherers (Dennell 1985). Symbiotic interactions have been identified in the case of La Hoguette culture in France (Jeunesse 1987). The second option is a “closed frontier,” in which there is no contact. If the frontier is mobile, there are two existing options: porous and impervious. In the case of a porous frontier, the contacts between groups can be expressed through a progressive assimilation of hunter-gatherer groups, an acquisition of farming technology, or a migration of farming groups into the hunter-gatherer area. On the other hand, an impervious frontier can lead to a colonization that results in the displacement of a hunter-gatherer population or its complete elimination.

However, the identification mechanisms as "theft" versus "acquisition" or as "displacement" versus "migration" is necessarily problematic. Furthermore, Dennell's model is "farmer-centric", following Childe (1928) or Braidwood (1958), as it assumes a natural production superiority of the farming group that fails to consider their ability to adapt their subsistence strategies to their environment. Dennell's model can be used intermittently, and is helpful in characterizing some interactions that occur between farming and hunter-gatherer groups, but it remains limited. For this reason, despite the production of a large amount of literature on agricultural frontier from the 1960s to 1980s (Alexander 1977, 1978, Bohannan and Plog 1967), more recent approaches to the diffusion of agricultural practices, with few notable exceptions (Fuller 2006; Zilhao 1993), have favored more flexible and adaptive models.

2.1.2.2.3. The Pioneer Colonization Model (PCM)

The PCM model (Figure 4), based on Alexander's "selective horizontal spread" model (1977), describes the progression of a pioneer group within unknown territories. It is assumed, for the sake of the model, that a "new" territory is occupied by hunter-gatherers. Pioneer colonization is thus most likely encountered in the context of mobile frontier. It describes the migration of one group, which must be part of a larger agricultural community, in order to settle in a new environment. It is expected that the newcomers will either settle in a familiar ecological niche, in which they will be able to carry on traditional agricultural practices (Fuller 2006), or that they will settle in a new ecological niche and adopt more flexible subsistence strategies, which may include larger proportions of foraging and hunting activity than was found in the previous agricultural population.



Pioneer colonization mode:
This model (Kruk 1973) suggests a colonization in stages, that first selects areas most suitable for agriculture (see Danubian example), allowing the survival of HG groups in the same geographical area and potentially leading to exchange and contacts.

HG : hunter-gatherer

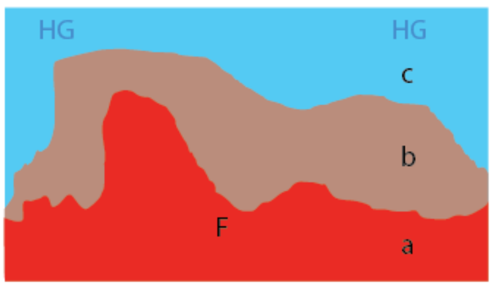
F: farmers

Figure 4: *Pioneer Colonization model with farmers (red) and hunter-gatherer territory (blue)*

In some cases, this colonization involves "leap-frogging" of different groups that end up isolated from each other. In the course of this colonization, those pioneers will encounter and interact with hunter-gathers groups in accordance with behavior patterns that are summarized by Dennell (1985). In their settlements, agricultural groups expand to integrate hunter-gathers populations through an acculturation process, or they chase the hunter-gatherers away from the ecological niche. The pioneer colonization model is an attempt at describing processes of selective colonization (Zvelebil and Rowley-Conwy 1984; Zvelebil 1986). Because of this selective perspective, it does not account well for the colonization of new ecological niches and the possible agricultural adaptations necessitated by such a process. Furthermore, it does not offer a relative chronological framework for these interactions, an issue that was subsequently resolved by Zvelebil's availability model.

2.1.2.2.4. Zvelebil's Availability Model.

The Availability model (Figure 5) was developed by Zvelebil and Rowley-Conwy (1984) in order to account for the range of varied interactions that take place in time and space and to present the concept of agricultural frontiers from a chronological perspective. The basic premise of the Availability model is that all formats of interactions can take place at the same time, within the same territory. Within this framework, the diffusion of farming is seen as a replacement of subsistence patterns rather than as the introduction of farming economy (Zvelebil 1986:11).



Availability model:
This model (Zvelebil 1984) suggests several phases of colonization taking place within the same territory. a- *Availability phase*: farming is known to the foraging groups, exchange of materials, and information bewteen them, but no adoption of farming. b- *Substitution phase*: farming replace hunting and gathering strategies. socio-economic transition from a HG way of life to a farming way of life takes place. c- *Consolidation phase*: society becomes dependent on agriculture, old frontiers mature to hinterland conditions.

Figure 5: *Zvelebil Availability mode*

In the understanding of Zvelebil and Rowley-Conwy, the frontier operates as an entire region rather than as a single line or a front. Their model involves three phases that illustrate the degree and type of relationship between farming groups and hunter-gathers in a given territory. First is the availability phase, which takes place at the beginning of the contact period between the different groups. In the course of this phase, some goods are exchanged, and the foraging groups are aware of the existence of farming technology. However, of the farming and foraging groups, Zvelebil writes, "The two still operate as culturally and economically independent units" (Zvelebil 1986:12). During the next phase, the foraging groups begin to adopt several farming strategies, or the farming group itself will settle in hunter-gathers territory. In either case, the percentage of domesticates and cultigens in the foraging area increase, encompassing up to 50% of the total remains of faunal and botanical assemblages of these sites and, as a result, pushing back the original frontier.

Competition between the groups takes place at both an ecological and social level, involving each group's claims to available land and raw material as well as to status, information, and social space (Alexander 1978,Anderson 1981, Sahlins 1974, Zvelebil 1986). Following this stage, the final stage of the transition takes place during the consolidation phase. As farming strategies produce more than 50% of the group food's income, the area originally considered to be the frontier becomes a new center of farming practices, characterized by a fully developed Neolithic economy. This occurs either through a full adoption of agricultural practices by local hunter-gatherers, through the acculturation of hunter-gatherer groups by Neolithic communities that move into their territory, or through the complete replacement of the local population by food-producing societies.

2.2. Neolithization of the South Caucasus.

2.2.1. A history of diverging hypotheses

2.2.1.1. Independent development

Over the course of the past century, several hypotheses have been suggested to explain the development of farming societies in the Caucasus, based on different types of material. As addressed in the description of "Early Neolithic" settlements, the misidentification of sites and chronological attribution led to the creation of unnecessary, or unsupported stages in Neolithic developments, leading to contradicting hypotheses, ranging from independent innovation to demic diffusion, also taking into account the possibility of a local development of food-producing economy under the influence of external, most likely Near Eastern stimuli. However, most of these hypotheses were developed on the basis of undated botanical evidence, an unquantified assessment of the "archaic" aspect of specific lithic assemblages. I will here review these hypotheses developed in the context of Soviet Archaeology before present a current state of the art after 20 years of international collaborations in the Caucasus.

The South Caucasus as an independent center of agricultural development gathered a broad consensus among soviet academics who based their hypothesis on the botanical and archeobotanical work carried out by Vavilov, Prischipenko, Zhukovsky, and Lisitsina from the 1930s onward. Vavilov (1926) was a highly recognized soviet botanist and geneticist who coined the term "center of origin" and suggested that all places of agricultural development were predominantly located tropical and subtropical mountain areas, plateaus and valleys, for their rich diversity (Vavilov 1926). Among these mountain areas, Vavilov saw the Caucasus as belonging to a broad SW Asian center of origins, with a high ecological diversity, hosting more than 6000 plant species (Grosseym 1948 *in* Kushnareva 1997). Indeed, the modern ecological landscape of the region shows the presence of numerous species that were domesticated from the 6th millennium BCE onwards, such as *Tr. colchium, Tr. mach, Pan. miliaceum* (Lisitsina 1984; Lisitsina and Prischepenko 1977) and, in Armenia alone, more than 200 indigenous wheat species, first because of the very limited area of emmer sweat occurrence (i.e. Armenia), but also because of "elements pointing towards a single chain of evolution of wheat in Georgia" (Bregadze 1982 *in* Kushnareva 1997). The history of wheat domestication takes place throughout the entire Caucasus, based on its wild population distribution but also several elements coming from the Neolithic layers of Chokh (Lisitsyna 1984), and other early agricultural settlements (Lisitsina and Prischepenko 1977). The Neolithic layer at Chokh produced an important amount of einkorn, emmer wheat and naked wheat, along with six-row barley (Amirkhanov 1987, Wechler 2001), that have first been interpreted as evidence of local domestication. These evidence seemed to be supported by micro-wear analysis showing the use of flints blades as sickle blades (Korobkova 1996), and the faunal analysis, identifying mouflon, but also possibly domesticated goat, red deer, bison, and boar (Vereschagin 1959). Kushnareva identifies two pre-conditions to identify the hearth or center that are fulfilled by the cultural and environmental context of the Mesolithic groups: presence of natural conditions conducive to the development of agriculture; communities with high enough production level and an appropriate economy with potential to adopt new type of economy.

Overall, the botanical dataset supporting a local, independent domestication process is based on ecological characteristic of the Caucasus. This situation involves a "developmental" stage of domestication that is generally characterized as Early or Aceramic Neolithic. The Early or Preceramic Neolithic was originally defined in several sites in two regions: western Georgia as early as in the 1930s, and Dagestanese mountains. This chrono-cultural entity was then adopted to describe any pre-Shulaveri Shomu assemblage that would retain some Mesolithic elements while producing some seemingly agricultural tools. This proposition was mostly based on the assumption that layers in specific sites (Darkveti, Nizhnaya Shilovka, Anaseuli I) represented homogeneous sedimentary and cultural entities that produce both Mesolithic features such as microliths technology, along with Neolithic elements such as polished stone told and pottery (Mesvheliani 2013, Nebieridze 1986). Kushnareva (1997:3) identifies the Early Neolithic between the 8th to 6th millennium cal. BC. Traditionally, *a terminus ante-quem* for the Early Neolithic was set by the first traces of Shulaveri-Shomu culture at around 6000BCE at sites such as Aruchlo 1 (Hansen et al. 2007) or Aratashen (Badalyan et al. 2007). On the other hand, the Terminus post-quem is generally associated with the Mesolithic layer of Kotias Klde at 7,939-7,306 BCE (Meshveliani et al. 2007 Mesvheliani 2013). However, the chronological attribution of Early Neolithic sites ranges from 10th to 6th millennium BCE (Cherlenok 2013). The arbitrary limit set for the end of the Mesolithic becomes a self-serving system that creates a chrono-cultural gap between the 9th to 6th millennium BCE that is then interpreted as a "developmental" phase. If, as we'll see, there might have been new economic processes taking place during this time period, there are only hypothetical. Indeed, not only are there almost no date for the early Neolithic settlements, in western Georgia and in the rest of the South Caucasus, but they are also identified either as sites with problematic stratigraphies (Anaseuli I, Darkveti, Kmlo II), or surface collection (Anaseuli II, Gurianta). Therefore, the majority of information regarding the so-called early Neolithic comes from sites with a basic typological description involving overall little information about the actual subsistence economy or the dating of these groups

However, only a very limited number of these sites actually provided undisturbed layers, and an even more tenuous amount of them produced radiocarbon dates. Recent work, supervised by T. Meshveliani, aimed at reassessing most of the sites used in the creation of the original Neolithic sequence in Western Georgia (Mesvheliani 2013). The project visited and, when possible, re-excavated over the course of 3 seasons, the sites of

Anaseuli I and II, Gurianta, Mamati, Urta, Kobuleti, Odishi, and Paluri. The study allowed to shed new lights on the chrono-cultural attributions of these layers, and provided new dates, stratigraphic sequence, and lithic analysis of the assemblages. In some sites, the lithic material was identified as typically Mesolithic or late Upper Paleolithic instead of Early Neolithic. In others, almost no agricultural tools were identified. Finally, most of the sites were either surface assemblages, or produced problematically thin layers. Mesvheliani concludes that the project "raised grave doubts as regards previous claims concerning the very existence of Neolithic (…) in the region". Therefore, the first presence of agricultural and permanent settlements in Western Georgia seems to be only identifiable with the development of Eneolithic and Bronze Age from the 5th mill BCE onwards.

2.2.1.2. Adoptionism and external influences

Another approach to the development of food-producing societies in the South Caucasus underlines the possible role of near eastern influences, whether seen as the main motor of agricultural development (Masson 1971) or simply a wave of new cultural behaviors following an independent, local innovations (Kushnareva 1997). The increasing number of sites reattached to the Shulaveri Shomu culture led Kiguradze to suggest a chronological sequence for the development of farming societies. Identifying in the lower layers of Hacilar in Turkey, the traces of parallels with Shulaveri-Shomu material culture (Kiguradze 2001). This evidence support Masson's hypothesis, who was the first to suggest that the presence of food-production economy in the South Caucasus was the result of an "influence" from Near Eastern culture (Masson 1971:124). Kiguradze (2001) thus identifies in the Shulaveri-Shomu group, a "Late Neolithic" that represented the first occurrence of food producing societies in the area, a statement also supported by other authors (Merpert 1978, Munchaev 1975). If Kushnareva's also support these contact between the Caucasus and the Near East, especially through the identification of parallels in ceramics manufacture and decorations from Mashtots Blur, Shulaveris-Gora, Imiris-Gora, and sites from the Syrian-Cilician Neolithic Amuq A and B (Kushnareva 1997), the author stresses pre-existing domestications processes before these contacts took place.

2.2.2. What model for the South Caucasus?

This series of hypothesis can be formalized into the following chart that associates each explanation with a specific type of agricultural frontier (Figure 6). The model is largely based on the assumption of a new group coming in the South Caucasus and carrying agriculture-related technology. It suggests several options for group interaction (Mesolithic and Neolithic). This model will be operationalized into a series of technological expectation in the assemblages studied. Eventually, the results are reintegrated into a broader framework of interpretation involving chronological and cultural data that allows the selection of a model over another (in the case of equifinality).

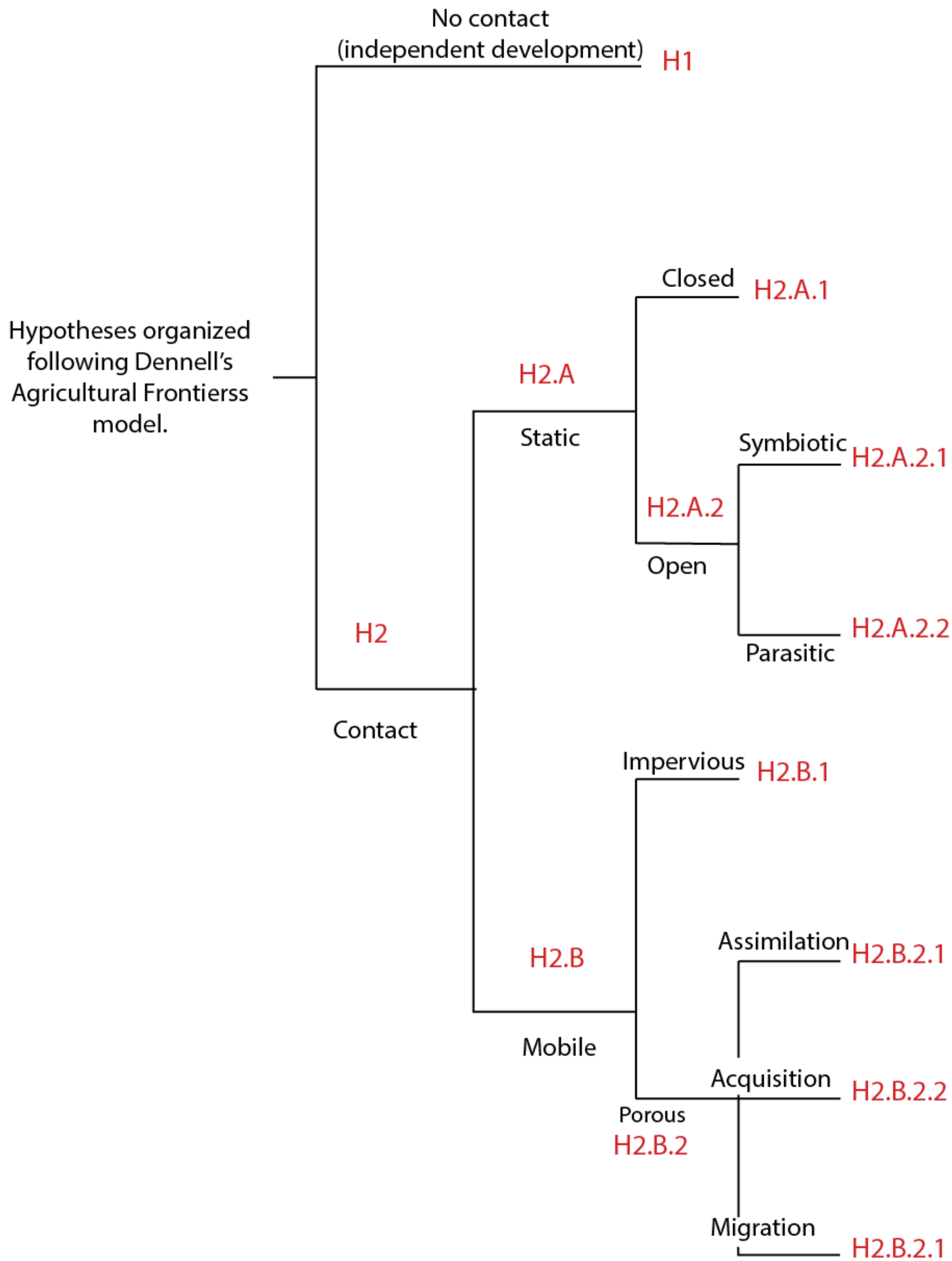


Figure 6: *Hypotheses of Neolithization process following Dennell's agricultural frontier structure*

H1) – The development of food production economy in S. Caucasus is a fully local independent process.

- No contact, no cultural transmission
- No contemporaneous Neolithic and Mesolithic settlements
- Fully local domestication processes

H2) – Some degree of contact took place between Near Eastern and Caucasus group, involving some degree of cultural transmission, either before or after the late 7th mill. BCE.

H2A) – The interactions between the groups are organized around a static agricultural frontier

H2.A.1) – If the static frontier is closed, very limited contact take place no exchange occur.

- Possible contact, no cultural transmission.
- Contemporaneous Neolithic and Mesolithic settlements

H2.A.2) – Open frontier, involving group interaction

H2.A.2.1) – Symbiotic relationship leading to long-term contact and intense exchange of goods across the frontier and full access to enculturating environments.

- Contemporaneity of the Mesolithic and Neolithic sites for 500-1500 years
- The two population occupy different ecological niches and interact
- Some degree of local domestication can be identified

H2.A.2.2) – Parasitic relationship, theft of resources, limited exchange, possible interaction at the raw material sources.

- Contemporaneity of the Mesolithic and Neolithic sites for 500-1500 years
- The two population occupy different ecological niches and interact
- No local domestication, very limited cultural exchange

H2.B) – The interactions between the groups are organized around a mobile agricultural frontier.

H2.B.1) – Impervious, mobile frontier but no interactions between Mesolithic and Neolithic groups, leading to displacement of hunter-gatherer and colonization of the area by farmers.

- Contemporaneity of the Mesolithic and Neolithic sites for less than 500 years
- Neolithic settlements replace Mesolithic sites in similar ecological niches
- No local domestication occur

H2.B.2) – Porous mobile frontier, leading to

H2.B.1.1) – Assimilation of hunter-gatherer into farming communities

- Contemporaneity of the Mesolithic and Neolithic sites for 500 years
- Fast disappearance of Mesolithic settlement
- No local domestication occur

H2.B.1.2) – Acquisition of farming technology by hunter-gatherer

- Contemporaneity of the Mesolithic and Neolithic sites for 500-1500 years
- The two population occupy different ecological niches and interact
- Local and imported domesticated species

H2.B.1.3) – Migration of resources into hunter-gatherer territory

- Contemporaneity of the Mesolithic and Neolithic sites for 500-1500 years
- Persistence of Mesolithic sites well after Neolithic groups arrived
- Some degree of local domestication can be identified

Chapter 3:

People and rocks: expectation model for lithic assemblages.

3.1 – Anthropology of Technique: history and theoretical background

Addressing cultural contact through exchange of stone tools relies on our ability to highlight socially and behaviorally significant aspects of techniques. An important tradition of anthropology of techniques has helped us built a framework to suggest some elements of answer.

3.1.1. Introduction to the concepts

The origin of the word technique, τέχνη in Greek (techné), lies in a verb used by Homer to express the concept of making or producing. It was, from the very beginning, closely associated with the idea of producing and sharing as well as with the idea of an efficient and effective means of materialization. It was, however, under Plato that the concept of “technique” moved beyond the material act of production. In his work, the word took on the meaning of an abstract entity. Rather than the physical action of production itself, technique came to refer to a concept of knowledge, or know-how.

Heidegger’s work (1954) encapsulates the multifaceted nature of a technique. It is, first, a means to an end. However, moving beyond simplistic causal determinism as the dominant mode of human activity, Heidegger defines the essence of technique not only as the means to an end, but also as the expression of an end in itself. A technique is the illustration of an intention towards the realization of a specific goal, through which potentialities are uncovered and shaped. This process is realized through the management of the different connections between the several “causes” of an item: its creator; the material, shape, and production sequence that go into its making; and its ultimate destination,

How technique acts on the material world, and how it is structured and organized is also the object of constant redeterminations. A technique is best understood through biological analogy. A technique is part of both the cultural and natural worlds, and it is conditioned by natural laws and culturally-acquired knowledge. In our modern world, technique is seen as creating its own system of law, both driving and circumscribing knowledge development (Ellul 1977).

A broad definition of technique is, following Lemonnier (2010), human's action upon matter, and we may extend this definition to include the actions of non-human primates as well as most of the animal world (Leroi-Gourhan 1964; Galef and Laland 2005). Marcel Mauss' ethnographic insight into the connections between humans' social environments and actions provide a more specific and analytically useful definition. A technique is an *effective traditional act* (Mauss 1935) of which there are three components: action, tradition, and effectiveness. There is no technique without action or tradition. Miller (1932) suggests an organic analogy for the role of techniques while Marcel Mauss presents the body as the first and most natural tool for humans. This tool is activated and "made effective" through knowledge and know-how, which are acquired consciously and unconsciously during one's exposure to a given socio-cultural context. A technique cannot be understood outside of this context.

On the other hand, technology, a term developed and popularized between the 17th and early 19th centuries, defines the study of techniques, or technical facts, and their uses in society (Coupaye et Douny 2009). It is the science of human activities, according to both Leroi-Gourhan (1943) and Haudricourt (1964), two students of Marcel Mauss (Soressi and Geneste 2011).

Most advances in our understanding of the roles of techniques and technology in our society have been made through the fields of epistemology and history of sciences, theoretical industrial design, and anthropology of technique. The latter, especially, has offered precious insights into the interdependent dynamics that exist between techniques and society. Moreover, both in the Anglophone and the Francophone world, the development of Anthropology of techniques has been parallel to the development of the anthropological discipline as a whole. Disparities and differences in that field are directly connected with existing discrepancies in the disjointed objectives of two scientific and philosophic French and English traditions (Coupaye and Douny 2009).

Broadly speaking, if the rejection of determinism led the English-speaking world to stay away from a holistic approach to technology, the French departure from positivism prevented scholars from possessing a quantifiable understanding of the social phenomenon that they studied. This dichotomy in approaches is not unexpected, as it has its basis in divergent philosophic and scientific developments that occurred in the English and French traditions over the course of the 19th and 20th century.

At the same time, though, several points of convergence have emerged over the course of the past 30 years. First, a structuralist and Marxist approach has been used in England within the field of consumption and exchange studies (Coupaye and Douny 2010). Post-processualism also has reintegrated, especially through a phenomenological approach (Tilley 1994), a direct relationship between the body and its environment and the individual and its object. This trend has offered new conceptions in terms of the recursive relationships that exist between material and immaterial and structure and practice.

Despite the inherent differences in their methodological and theoretical frameworks, both the Anglophone and French approaches to material culture studies eventually came to regard the object as creating social interactions, and perceived a recursive relationship between material culture and social systems. One aspect of the French approach gave special attention to technical practice. This emphasis allowed scholars to develop a holistic and goal-oriented framework that addresses conceptual knowledge about the relationship to one's body to its environment. At the same time, this approach was limited by its lack of quantifiable data hampering its potential to access etic meanings. English-speaking anthropologists, on the other hand, have developed a succession of concepts originating from different theoretical backgrounds, such as affordance, agency, tendency, or empathy, that all aim to preserve a post-structuralist interest in the reintroduction of the individual—the subject—as existing at the heart of society (Coupaye and Douny 2010: 33).

3.1.2. Applications to Archaeological questions

In France, the concepts and principles that formed a theoretical framework dedicated to interpreting techniques and technology, both in archaeology and ethnology, were proposed around the middle of the 20th century (Leroi-Gourhan 1952, 1971, Mauss 1935). Despite the clear implications for the domain of anthropology as a whole, and, in particular, for interpretational potential within the field of archaeology, technological approaches were left out until fairly recently, and did not trigger as many developments as focuses on technology did in other fields (Geneste 2010: 4). Until the late 1980s, objects themselves, rather than the process than created them, remained the main focus for archaeologists (Cresswell 1983).

Despite the late development of the study of processes as a robust and regular part of archaeological inquiry, doing so was not without precedent. As early as 1857, Boucher de Perthes looked into the particularities of Levallois making process (Karlin 1991). His work was followed by that of Commont (1909) who suggested sequences of movements for the fabrication of the same artifact (Karlin 1991, Boeda 1994). The paradox is indeed that the result of production processes—of techniques—comprises the bulk of the material available to archaeologists, particularly prehistorians. If, as Lemonnier (1991), put it the field of ethnology has created a body of concepts to support a coherent theory of the technique—namely cultural technology, or *technologie culturell*e—one might consider the slow formalization of a framework to fortify its connections with related scientific domains especially relevant in the case of Paleolithic archaeology, which also considers evolutionary processes (Bar-Yosef and van Peer 2009, Geneste 2010, Tostevin 2013).

In the Anglophone world, on the other hand, and especially in the United States, scholars have made progress on creating a framework to address technological questions. This development may be due to a tendency towards "theoretical introspection" that characterizes the field of anthropology in North America. Besides J. Evan's efforts (1872) to connect archaeological artifacts to ethnographic production processes of Amerindian and Inuit groups (Karlin 1991:100), no direct technological approach similar to the *chaîne opératoire* was integrated into the body of archaeological methods (Collins 1975). The role of technique as a structural component of human societies became a source of interest to archaeologists during the late 1970s and early 1980s, when several groups of scholars suggested new frameworks to understand artifact variability (McGuire and Schiffer 1983, Sackett 1982, 1985, Schiffer 1976, Wiessner 1983, Wobst 1999). By addressing the relationship between style and function, as well as utilizing behavioral chain analysis approach, these authors aimed at understanding the recursive relationship between the artisan and his/her social, cultural, economic, and natural environment, and how this relationship drives the choices made at different point of the creation of an artifact.

3.1.3 Key-concepts in Anthropologie des Techniques

Despite the epistemological dichotomy between the Francophone and Anglophone traditions, several aspects of the technique have been the focus of common interest. Mauss' seminal threefold definition offered a starting point from which several connected concepts and divergent interpretations were suggested. He placed techniques within a broader framework, proposing the existence of a *système technique*, or a system of the interdependent entities of technique, industries, and work present in every society (Lemonnier 2010, Mauss 1935). Both in the Anglophone and Francophone approach, we see in Mauss's definition of the *système technique* a formulation of key concepts around which the study of techniques revolves, and through which techniques may be articulated within the correct social context.

3.1.3.1. Systems and sub-systems

Throughout the history of the field, the very context in which techniques are developed, enacted, and transmitted has been subject to different definitions. In turn, divergent views on this context have conditioned anthropologists' choices about the information they will seek to obtain through technological studies.

Marcel Mauss first suggested a definition of the concept of the technical system: L'ensemble: techniques, industries et métiers, forme le système technique d'une société" (Mauss 1947: 29).

As he focuses on the components of a technical system, Mauss presents a specific category of social system—again, from a Marxist perspective — that hosts the different nexus of expression of techniques, but does not articulate it with the other existing social institutions. The integration of social system is suggested by Levi-Strauss: In Levi-Strauss's definition, in parallel to the work of Bernard Gilles on the *History of Techniques*, a technical system is clearly presented as a coherent system, comprised of a set of interdependent techniques that constitute the technical *fabric* of a given society at a given time (Gilles 1978). To use the term *system* reaffirms the interdependent character of techniques in society, and underscores the continuous interactions of the varied material, social, ritual, economic elements— all in themselves systems or part of systems—that serve to structure the larger system (Sigaut 1991). Using this term also emphasizes the interchangeable nature of some technical elements of this system, putting forth the idea that specific technical features can be trans-systems. Eventually, as Gilles (1978) and Caron (1997) suggested using a historical perspective, a *social system* is also defined as a technological step, *étape*, in the evolution of technique and society.

The definition of social system used in this work focuses on analytical potential of a technical system. First and foremost, we will view it as a sub-system (*sensu* Lemonnier

1992), and then as a set of interdependent techniques that exist within a larger social context, and that are both physically determined and embedded in a network of meanings that shape them. Interactions within and outside of the sub-system conditioned the evolution and transmission of the technique. In this sense, it is not fundamentally different from the *milieu technique*, which is the material expression of society's thoughts as embodied in concrete application (Lemonnier 1992). The *milieu technique* can be defined as a pool of combined knowledge and know-how for all the technical actions practiced by all members of a group (Tostevin 2013). The contents of this pool are and embedded in the group's global consciousness, whether consciously as taught/learned elements or unconsciously as a *habitus* (*sensu* Bourdieu). Thus, the *milieu technique* connects the technical act to the social system as a whole, since the combined study of the different *chaînes opératoires* of the technical sub-systems, and their interconnections with the other *milieux* of a society, is one of the goals of Anthropology of Techniques. First, then, it is thus necessary to address the main components of the *milieu technique.*

3.1.3.2. The materiality of technique: knowledge and know-how

The first of the *milieu technique*'s components is the definition of **knowledge** and its *prolongement* in the human body, the **know-how**. Knowledge is a set of conceptual instructions about the global goal of the actions, or a group of mental representations of shapes and materials associated to a set of gestures necessary to achieve the goal in mind (Pelegrin 1991:12). Know-how, on the other hand, is a series of operational instructions and specific knowledge, conscious or unconscious, physical and intellectual, collective and individual (Chamoux 2010, Karlin 1991). Know-how also includes the ability to perform or to operationalize this set of instructions (Pelegrin 1991:15). Know-how signifies the possession not only of learned instructions, but also of knowledge gained through experience that allows for critical response to the evolution of the operational sequence (Pelegrin 1991). Thus knowledge and know-how both are connected to the intellectual and the material, gestural, physical domain. Each concept can be individual or communal, and both are structured around the limitations of the relationship between humans and physical laws (Chamoux 2010).

Know-how—in French, *savoir-faire*—has two meanings (Chevallier 1991): first, it denotes the ability to conceptualize and operate a given skill; secondly, it means the actual mastering of that said skill. Skill here is best explained in connection to Gibson's concept of affordance (1986), as a **capacity** to reach a given goal "using the affordance of a given environment"(Reed 1989:15). The use of the affordance concept allows for the inclusion of the technical process within a social and natural landscape and taskscape (Roux et al. 1995). This capacity refers to a body of psychological and neuro-psychological items of knowledge (Roux et al. 1995) that become manifest during the technical process as, respectively, knowledge and know-how. This dichotomy echoes the duality already existing in the nature of practice reflected in Latour's reaction, as previously noted: i.e., the existence a distinction between the description of a technique, le *discours technique*, and its realization, the *processus technique* (Karlin 1991:117-119). This distinction is known as the ***geste,*** the **gesture** or **movement**, an integrative part of the *chaîne opératoire* and social as much as it is a physical phenomenon (De Beaune 2007). Broadly speaking, *geste* refers to the difference between performance and competence, or, as Karlin puts it: "*L'absence de faire n'est pas l'absence de savoir-faire"* (Karlin 1991:117).

One theory, put forth by Pelegrin (1990), emphasizes the dichotomy between *ideational* and *motor* know-how. *Ideational* know-how is the operationalization, or mental expression, of the representations (concepts) carried in knowledge. On the other hand, Pelegrin suggests, "motor know-how corresponds to the intuitive operations on the assessed adequacy of the knapping parameters involved in the current operation" (1990:118). Skills are expressed at both levels of the know-how, and are assessed based on the result of the process with consideration of the original intentions of the knappers along with the raw material constraints (Roux et al. 1995).

A second dichotomy of know-how is suggested by Barel (1977), who focused on the transmission of this set of information. According to Barel, one know-how is incorporated*, incorporé*, and is inherently connected to the individual or the limited group of individual that practice and conceptually own that know-how: its existence is a result of an individual's personal experience, experiments, and skills. Because of this attachment to the individual, it can be transmitted through only through oral instructions and a long and thorough mimetic process of teaching (Chamoux 2010). To Barel, this know-how is distinguished from the algorithmic, the *savoir-faire algorithmisé*, which is a set of precise instructions and algorithms that act as a technical recipe (Barel 1977).

3.1.3.3.The sociality of techniques: rituals and identity

Techniques in society are neither merely functional cultural items that allow humans to interact with their environment; nor are they solely determined by utilitarian necessities. Furthermore, the role of adaptation as the sole explanation of evolution of techniques has been questioned (Gould and Lewontin 1979, Lewontin 1974, Sinclair 1995). Anthropologists disagree as to what sort of inference can be made about a given society based on its technology (e.g. Lemonnier vs. Latour) but is assumed that, when provided with a proper body of low- to middle-range theories, virtually all aspects of a group can be addressed: how a technique is formed; degrees of intra-group variation and evolution (Potts 2012); when the technique is displayed, taught, and learned (Petrequin and Petrequin 1994, Roux et al. 1995); and the context of social life in which it was produced (Petrequin and Petrequin 1994, Stout 2002). The symbolic aspect of technology—the understanding of technology not only in terms of its physical uses but for with regards to its social meaning—places technology at the nexus of larger questions of identity and social rituals (Sinclair 1995, 1998).

From Lechtman's (1977) work on the impact of Andean cosmology on the nature of technological practices, to Hayden's (1989) dichotomy between practical and prestige technologies, technologies have been presented primarily as performances (Lechtman 1977:13). Lechtman's *technological style* concept (1977, Lechtman and Merrill 1977) introduced the idea that different operational sequences from different social contexts create recognizable patterns that act, at different levels, as social signals. Hayden (1998) suggests, on the other hand, the existence of two concomitant and to some degree interdependent technological systems. *Practical technologies* are, according to Hayden, "meant to solve practical problems of survival and basic comfort" (Hayden 1993:20), and include actions like cutting trees, obtaining food, and building shelter. Practical technologies are thus easily distinguished from *prestige technologies*, which are processes intended to create objects dedicated to the display of social success, wealth, and power (Hayden 1993:11). Hayden's dichotomy involves the creation of a hierarchy of the constraints and emphasizes the utilitarian factors that are at play in technology, following Schiffer's behavioral chain analysis (1975, McGuire and Schiffer 1983). Other studies have examined the integration of ritualistic imperatives into the industrialization of the operational sequence (Bonte 2010), the integration of the operational sequence itself within a ritual process (Petrequin and Petrequin 1994), and, finally, the inscription and dictation of the operational sequence as a result of the particular cosmogony and the mythology of a group (Lemonnier 2004).

Not only does the embedded nature of techniques in social rituals reinforces the range of social phenomena attainable through technological analysis, but it also triggers a change in our ways to approach technological studies (Gosselain 1999, Hayden 1989, Lemonnier 1992, Sinclair 1995).

3.1.3.4. Transmission of techniques

We have presented here the different components of the technological system as well as and the recursive relationship between technology and society. How these technological—and ultimately social—choices are instructed, repeated, and modified is at the core of this project. We must thus consider technological systems of any society as fluid and dynamic entities, in which existence and development are subject not only to organismic, environmental, and task-related constraints (Newell 1986) but also to the social structure of the transmission process itself. Indeed, returning to Mauss' definition, a technical act only exists as one that is both effective and traditional. Stating that a technique can only exist in a given tradition assumes that, in order to exist, it needs to be taught or learned (Sigaut 1991). The diversity of elements that must be transmitted and acquired in the teaching and learning of stone tool making—know-how, knowledge, skill, technique, *chaîne opératoire*—creates different educational processes that are shaped by the practicalities related to the entity transmitted as well as the agency of the protagonists involved in the said process.

The straightforward relationship between master and student is impacted by a number of physical and social constraints that lead to the development of several learning/teaching processes. Some types of technology can or will not be transmitted to everyone. Furthermore, who is permitted to teach and to learn is highly dependent on her/his place within the incorporating channel (Chamoux 2010). Looking at the textile production within a Mexican village, Chamoux identified two types of knowledge: general knowledge, which can be communicated to all, without distinction of kin or class; and particular knowledge, which is selectively transmitted.

Thus, the teaching of a technology involves a set of spatial, temporal, social, and behavioral instructions that connect both to knowledge and know-how. The reader will find the answers to several important questions about the flintknapping action: where and when does the flintknapping take place? How do I place my body while flintknapping? What is the orientation of the core? What is the final product? These instructions might have been part of the visual landscape of any child growing up in prehistoric societies. This stage of the teaching process is a "passive impression" as well as a case of "conditioning" (Chevallier 1991). Parts of it can be actively explained, repeated, demonstrated, and confirmed through the request for imitation (Chevallier 1991). The final acquisition of knowledge and know-how is a combination of these processes, along with the active and explicit inculcation of elements of knowledge about a technique. Therefore, what is ultimately passed along or learned, is not merely a technical program, pattern of movements, or sequence of instruction. Instead, it represents a more global "functional organization of action systems" (Reed 1989:15). In other word, it is a skill.

These variations are inherently connected to the nature of learning and teaching, and the nature of technique itself, if we understand learning not as a reproduction but as an adaption of a sequence of information. Indeed, the performance of a technique often results in a difference between what is shown and what is seen, for the observer does not have access to the emic decision-making process of the flintknapper—it is during this decision-making process, Tostevin argues, that variation is created. Proceeding from Boyd and Richerson's critique of meme theory, he argues that, in a situation of transmission, the unit of information is shaped by the process, rather than the process being shaped by the unit of information (Tostevin 2013:100). However, not all aspects of the operational sequence will be impacted equally. Specific manufacturing steps that are more visible are more easily transmissible, while other stages that involve more specialized gesture require longer times of adaptation (Gosselain 2000).

This variation is particularly important in the context of our question. Its implication is that different steps of the chaîne opératoire necessitate different degree of enculturating environment to be transmitted, or, equally, that the context of learning itself can impact differently the steps of the sequence.

The transmission of a given knowledge cannot be conceived outside of the realm of the social structure (Chevallier 1991). As such, knowledge is subjected to the functional limitations imposed by the group; at the same time, it can also impact the socioeconomic structure. This recursive relationship involves a phenomenon of interdependent evolution, whereby the material and behavioral complexity of the technology transmitted is modeled by the temporal, spatial, and social context in which the teacher and the student interact. On the other hand, during the transmission process, the students recreate not only the technology but also aspects of the society itself, thus re-affirming the existing structure (Roux and Corbetta 1989).

This is particularly clear in the case of operational sequences that are carried out over a large space-time frame. Studies of pottery production in the Maluku Islands present specific data regarding the social organization of technology (Petrequin and Petrequin 1994). There, younger artisans are asked to carry out the most repetitive task of the operational sequence of pottery-making. It is during this process that they acquire the necessary basic knowledge—controlling the thickness of the pot and the humidity of the clay, rotating the pot on the legs, choosing the angle of striking of the paddle and counter-paddle—in order to access more complex phases of the production sequence. In this situation, the functional aspect of apprenticeship, or learning skills required to make pottery, also serves a social purpose, as the young artisans are confined to a specific classes (Petrequin and Petrequin 1994). A similar process exits in the context of polished axe production in the Iran Jaya region (Petrequin and Petrequin 1994). There, the complex *chaîne opératoire* of raw material acquisition, preforming, knapping, bushhamering, and polishing can involve different artisans, and may occur in a number of spaces—both inside or outside the village and in private or public space. During the public phases of the sequence, which takes place on the main square of the village, each knapper carries out bushammering on their different perform. This part of the sequence be ritualized, with the knapping process is accompanied by songs that helps actors keep the pace of the activity. The activity is thus not only for the utilitarian purpose of creating a polished axe; it also becomes a space for social encounters and exchange, as well as a forum for the display of skills. In this case and in the instance of Maluku pottery production, the division of the operational sequence along the lines of ages or social status makes the transmission process easier, and it also reproduces and preserves existing social structure (Deforge 1985).

At the same time, these structures can be impacted by the requirements of the transmission process itself. Depending on the complexity of the transmission process, the acquisition and apprenticeship of skills will affect either the techniques being transmitted or the social structure in which the transmission occurs. In the first case, some simpler techniques may be preferred (Roux and Corbetta 1989). In the latter situation, the structure may need to adapt to favor long-term apprenticeship that represents a more extensive investment in the young artisans (Roux et al. 1995).

3.2. Behaviorally significant traits in lithic assemblages

We use here the structuralist concept of technical system as a set of techniques and industries of a society. Each technique involves a group of cognitive and biomechanic abilities achieved through passive and active learning as well as short- to long-term apprenticeship. During this process, an artisan will acquire specific knowledge about a technique and develop, through practice, a related know-how. The know-how involves both implicit information and developed skills about the achievement of a technique. Functionally equivalent tasks can be performed using very different tools, and each tool can be produced through different technical processes. Thus, the choice of a specific technology is strongly connected to the *enculturating* environment of the artisan, underscoring the importance of the questions of how, when, where, and with whom the technology was learned and practiced. The answers to such questions embed the technological performance in a social, temporal, and spatial landscape.

This complex relationship between socioeconomic structures and technology constitutes the point of departure of this work. One of the premises of this project is that changes in social structure will be reflected in changes in technology, evidence of which is accessible through a society's material culture. More specifically, it is assumed that the technological features of any assemblage can, to some extent, represent the social context of the learning and post-learning processes. These technological features can thus help us identify specific intra- and inter-group behaviors that may then be operationalized in support of specific models of Neolithic-Mesolithic group interaction.

Any technology embeds some type of social meaning, a portion of which has been unconsciously acquired. The reality of unconscious acquirement means that not every technique can be taught equally to all groups, and that some technical pre-requirement can be necessary. Such a requirement may be practical, like the ability to manipulate a punch. It may also be more conceptual in nature—for instance, the ability to visualize a core as a volume rather than a surface, a process that involves both gestures and know-how. Furthermore, each technical act is performed in a space that is never neutral, geographically or socially. All spaces will impact the transmission of a technique in a unique fashion, and many discrete acts will be performed at different places. Following Tostevin’s reconstruction of the tasks cape concept, we thus suggest different degree of visibility of the technique (Figure 7):

1. Different sequences of the *chaîne opératoire* will take place in every part of the physical and social landscape.

2. Access to all the elements of a given section of the sequence itself will be limited by the type of technical movements performed.

3. The transfer process is impacted by the relationship between teacher and learner, and by varying degree of access to the enculturating environment.

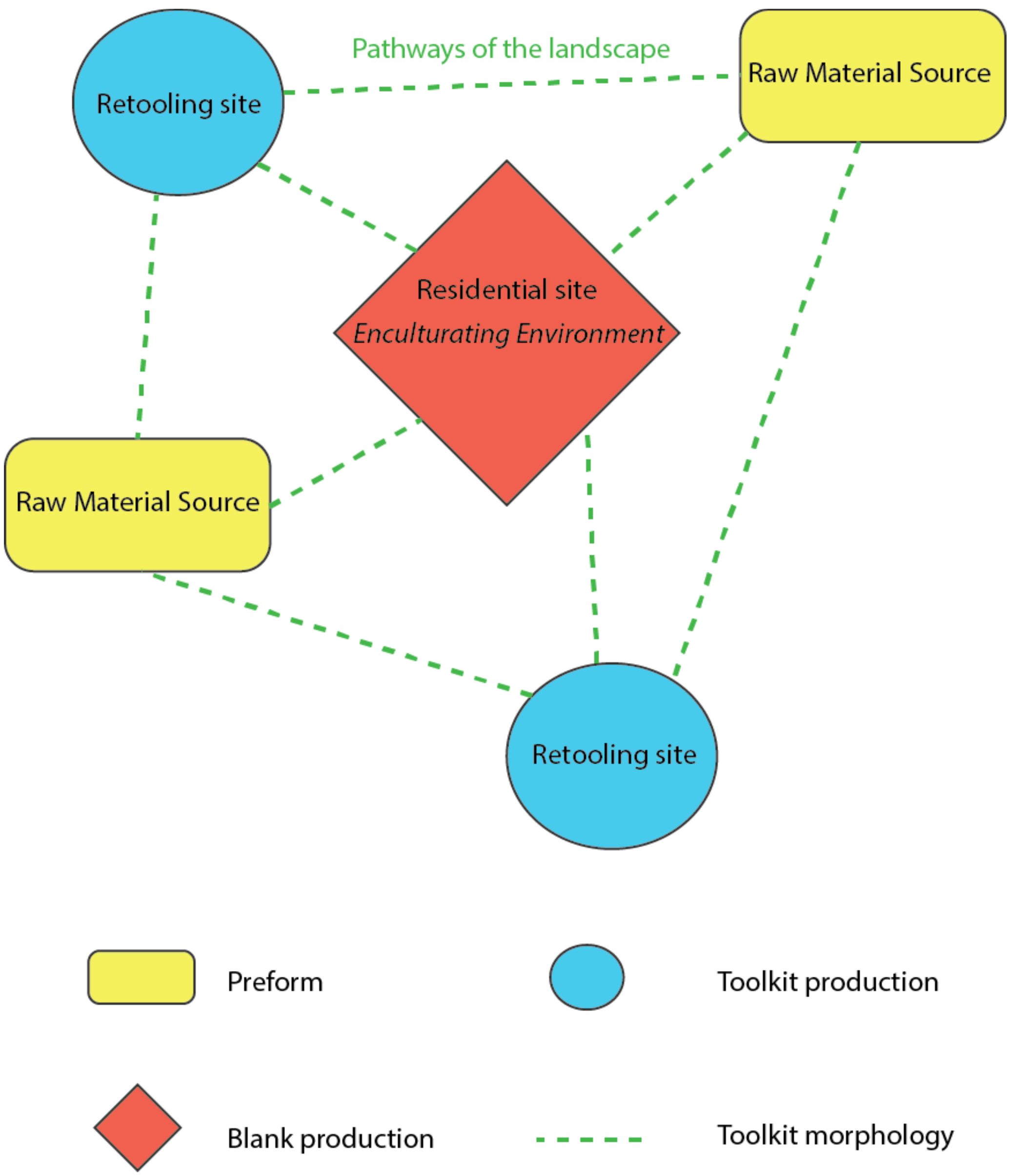


Figure 7: *Repartition of the chaîne opératoire on the landscape.*

3.2.1 Preforming at the outcrop

The activities associated with raw material procurement generally take place at the outcrop itself. Existing examples of activities surrounding these outcrops show that a significant amount of production can take place with no specific settlements attached to it (Binder 2005). In some cases, the entire **chaîne opératoire** will take place at the source, as in the case of the pointed blade from naviform core production at Golludag East (Binder 2005). Several types of observations have been made in the course of this research regarding behaviors taking place around these outcrops in the South Caucasus. The sites directly surrounding the outcrops have generally shown a production of preform, or early preparation of blocks later to be exploited on other sites (except for the Middle Paleolithic period where examples of workshop at "Abri Perrin" support an entire *chaîne opératoire* in situ (Montoya et al. 2011). In Armenia at the Gutansar outcrop, several large flakes of preparation and décorticage have been found. Although they could not be dated, they seemed consistent with the production of large blocks of 10x20x10cm, which are more likely to have been used for the large core production that occurred from the mid-Holocene onwards (Neolithic blade core, Chalcolithic bifacial pieces).

The implication of these observations is that contact around raw material outcrops can lead only to exchange of behaviors related to the early stages of the *chaîne opératoire*, including opening the block, cleaning the majority of the cortex, and possibly transforming, at a basic level, of the block into a preform. Therefore, one can expect parallels at our sites in cortex ratio and type of imported preform to signal possible contact around the outcrops. Indeed, outcrops of quality raw material, such as obsidian, are known to be point of focus and exchange between different groups. This is the case for Golludag East, where hunter-gathers and farmers interacted in the context of obsidian exploitation. This approach assumes, however, the lack of intermediary stages having occurred between the outcrop workshop and the site where the assemblage was found.

3.2.2. Chaîne opératoire

We have early in this work, defined the concept of *chaîne opératoire* following Leroi-Gourhan's use as a sequence of actions and decisions from raw material acquisition to the discarded artefacts. Here, we particularly focus on the production sequence of blanks. Blank production is the most complete and complex aspect of the broad *chaîne opératoire*. It is also the one that is associated ethnographically associated with performances in enculturating areas (Petrequin and Petrequin 1994). Both the complexity of the techniques associated with the production, as well as the limited social access to these techniques, involve long-term group interactions as well as close integration of individuals within the enculturating environment. Only through longstanding interactions can specific techniques be transmitted. Identification of these techniques and their associated productions can help identify the occurrence of such interactions.

3.2.3. Techniques and methods

Therefore this works focus also on the techniques used in the chaîne opératoire. Techniques such as pressure flaking, indirect percussion, or microburin have specific variations that are assumed to be culturally specific. The identification of the techniques involved in the production sequence allows us to address degree of access to enculturating environment between groups.

3.2.4. Toolkit production

There are two aspects of the toolkit that can be subjected to transfer: its production process (after the blank manufacture) and its morphology.

1. *Production*: Production of the toolkit can take place at different places in the landscape. Within the Shulaveri-Shomu group, toolkit production takes place within the community and the enculturating environment. In the case of more mobile group of hunter-gatherers, the enculturating environment itself moves within the territory. Tool production and retooling (management and reparation) is most likely to take place at retooling sites or short-term small hunting camps. The transfer of technology associated with retooling, such as specific retouch, can thus take place in a limited enculturating environment. If the production strategies associated with exchange of toolkits are noticed, they involve small to average access to the taskscape of production.

2. *Morphology*: Toolkit morphology refers to the overall shape of the finished product. Despite issues related to typological approaches (see Bordes vs. Binford and Dibble), it is assumed here that, in specific situations, the inter-assemblage identification of parallels to a specific shape, the creation of which requires specific technical knowledge, can be identified as significant. One of the examples used in this work is the Çayönü-Paluri-Kmlo tool. Its presence in the South Caucasus and the Near East results from a stimulus diffusion process (see Kroeber 1940, Tostevin 2013). A diffusion of this type does not require access to an enculturating environment, and is most likely to have happened in the context of short-term interactions on the pathways of the landscape.

3.3. Lithic assemblage and group interaction: a model of expectation

We have defined behaviorally significant elements within the lithic assemblage. The chaînes opératoires, techniques, and tool types can be used to identify various types of interactions between Mesolithic and Neolithic groups in the South Caucasus. We can now integrate this model for interaction into a model of expectation in lithic assemblages.

This model suggest different combinations of lithic transfer depending on the type of interaction. It is assumed that the initial situation, as the new farming groups arrived in a region, can be characterized by two distinct lithic assemblages in sites that are characterized as either Mesolithic or Neolithic based on their subsistence pattern (see rows "Meso" and "Neo"). In each site, these assemblages are confidently identified as associated with Mesolithic, hunting-gathering tradition (A), or Neolithic, farming groups (B). As the quantification of these expectations did not seem relevant here, we are only expressing differences between a major technological trend (A) and a minor technological trend (a) in the assemblage. The model shows how assemblages are expected to evolve following different scenario of group interaction.

For instance, in hypothesis H1, the total absence of parallels in any of the lithic assemblage category (Chaîne opératoire: CO; Tech.: Techniques; Tool) can be interpreted as the **absence of contact** (Figure10) between the said groups.

	CO	Tech.	Tool
Meso	A	A	A
Neo	B	B	B

Figure 10*: Expectation mode: no contact*

On the other hand, hypothesis H2.A.2.1 suggest a **symbiotic interaction** in the context of an **open static border** (Figure11). It involves partial access to the enculturating environments of both group and exchange of goods across border. The expectation in terms of lithic assemblage is that both groups will keep their respective chaînes opératoires and blank production methods but, while still maintaining their techniques, will also partially integrate techniques from the other groups, and exchange some of their tools.

	CO	Tech.	Tool
Meso	A	A-b	A-b
Neo	B	B-a	B-a

Figure 11***:*** *Expectation model: open static symbiotic border. Each group preserves its chaîne opératoire but borrows technical elements and tools from the other group.*

In case of equifinalities in some of these expectations (H1, H2.A.1, H2.B.2.1 for instance), the model is reintegrated into a larger framework of interpretation that involves spatial, chronological, and cultural data. The expectations in terms of the lithic assemblages for each hypotheses is therefore as follow (Figure 12):

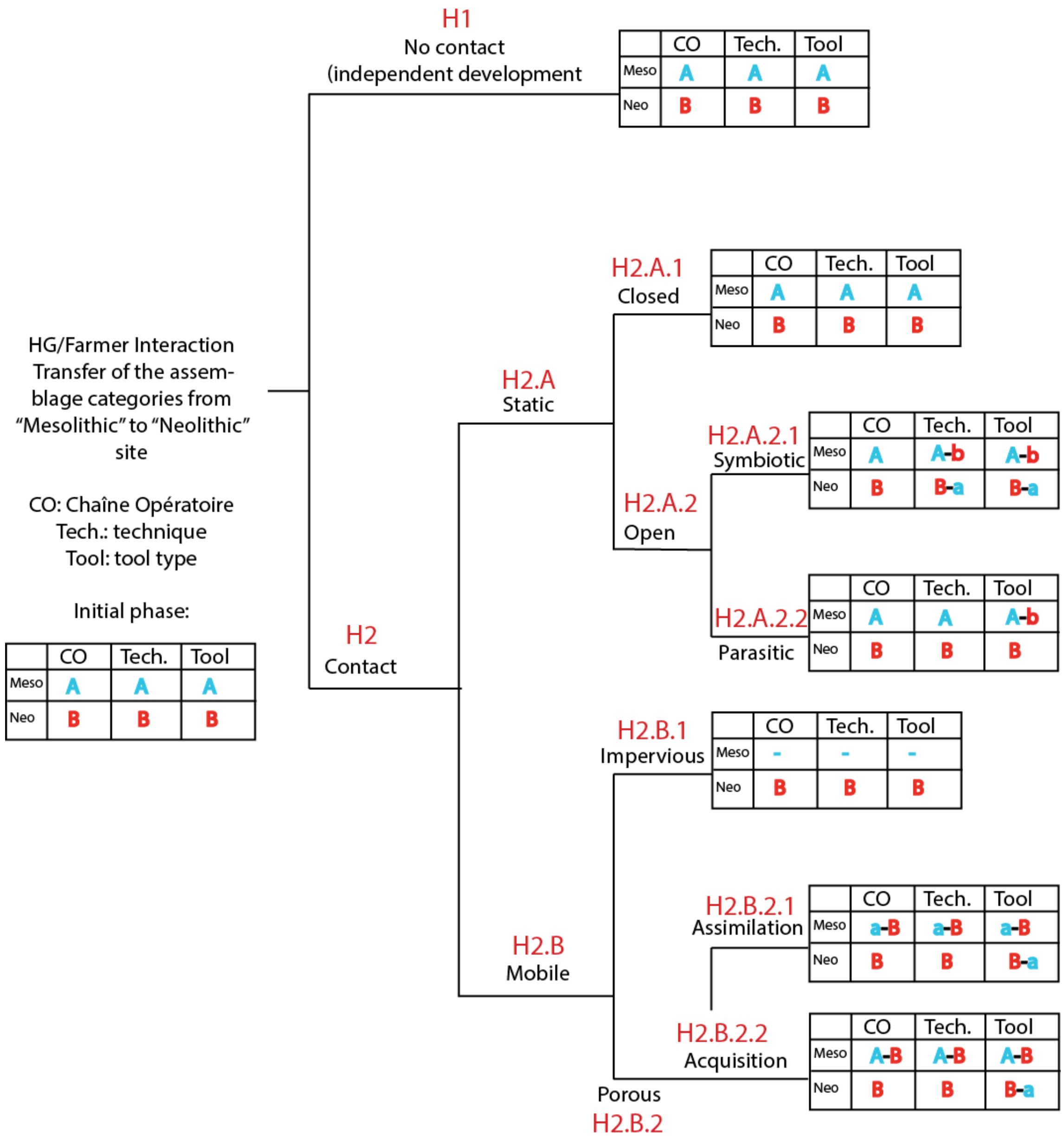


Figure 12: *Expectation model*

- H1: **No agricultural frontiers**. Groups are not present in the same territory and their assemblages will progressively adapt to agricultural practices but with a clear “local” technological background.
- H2: **Agricultural frontiers**. Two groups present in the same territories.

- H2.A: **Static**, they occupy different ecological niches

    - H2.A.1: **Closed border**, two groups evolving separately, and assemblages remain different at chaîne opératoire (CO), techniques (Tech.), and Typology (Tool).

    - H2.A.2: **Open border**, contact take place:

        - H2.A.2.1: symbiotic. Long-term, intense contact between agriculturalists and hunter-gatherers. The contact lead to exchange of techniques and tools, but no assimilation and only limited access to enculturating environment leads to COs remaining unchanged.

        - H2.A.2.2: parasitic border. Contact on pathways of landscape or retooling site. Assemblages show integration of Neolithic tool types in Mesolithic assemblages. No adoption of techniques or COs.

- H2.B: **Mobile**, movement of inside hunter-gatherer territory

    - H2.B.1: **Impervious,** no interaction, absence of Mesolithic assemblages in phase 2.

    - H2.B.2.: **Porous**, interaction, persistence of local Mesolithic groups.

        - H2.B.2.1: **Assimilation** of Mesolithic groups within Neolithic communities. Possible persistence of Mesolithic sites and some Mesolithic behaviors but assemblage relies now mostly on Neolithic CO and Techniques and tools.

Parts of the Mesolithic tool types can be found in Neolithic assemblages, especially in connection to hunting activities.

- H2.B.2.2 : **Acquisition** of agricultural resources and techniques by hunter-gatherers. This situation suggests a unilateral movement of technology and goods from agriculturalists to hunter-gatherer groups. Neolithic CO, Tech., and tools are integrated into Mesolithic assemblages. This is accompanied by a progressive integration of agricultural technologies, involving possible domestication of local species.

The Neolithization and lithic models presented above can now be tested against data from the South Caucasus, especially Armenia and Georgia. After a short review of the intellectual history of the discipline in the region, and its impact on the reconstruction of the Neolithic phenomenon, I will present the sites and assemblages involved in this study.

Chapter 4

Soviet Archaeology in the South Caucasus

The origin of Neolithic studies and models in the South Caucasus are best understood in the broader historical framework of the discipline in the region. The intense archaeological activity that took place in the Caucasus as early as the 19th century was also accompanied by constantly evolving theoretical framework of interpretation. These intellectual dogmas were not systematically nor consistently applied, but they did impact to some extent the interpretations suggested for prehistoric and historic socio-economic evolution in this area.

4.1. Intellectual history

Throughout its history, the Caucasus has been a region defined by those who ruled it, often meaning that it is understood from the perspectives of neighboring—not native—civilizations: Russian, Greek, Turkish, English, French, or German (Lindsay and Smith 2006). Political powers have often competed to control the region due to its strategic location, making entering the fray for the Caucasus a "longstanding tradition of sovereign ambition" (Grant and Yalçin-Heckmann 2007:3). The South Caucasus has seen the influence of the Hellenistic and Roman, Persian, Ottoman, and Russian Empires. Throughout each of these eras, the region has often represented the border between two lands, a perception reinforced during the Cold War. Both politically and scientifically, the South Caucasus has long been considered a margin (Gebel and Kozlowki 1994), a border, or a periphery (Kohl 1993), of the Near East, of Europe, and of the Russian world.

The geographic and political history of the Caucasus has had three main consequences for the evolution of scholarly traditions in the region: First, within the context of the ongoing conflicts between various political powers over territory in the region, archaeology has been tied to political ideology, military expansionism, and economic necessity. Second, the status of the Caucasus as a periphery or a border area far away from historical centers of decision-making like Moscow and St. Petersburg, led to favorable conditions for scientists, who could work in this region with limited enforcement of ever-changing policies linked to shifting political power. Finally, because of geographic and political marginalization, western scholars have defined the region through a culture history and a terminology created for the neighboring Near East, a problem exacerbated by the intermittent impossibility for western and Soviet scholars to communicate during the Cold War era. This lack of dialogue between scholars led to divergent interpretations of the same phenomena: while Western scholars developed migrationist or diffusionist explanations of specific processes observed in the region, Soviet scholars interpreted the same processes within the framework of an adapted Marxist perspective on culture history that favored local developments (Miller 1956).

More recently, however, since the post-Perestroïka attempts to open the Soviet bloc to the western world, increased instances of international collaborations (Lindsay and Smith 2006) in the South Caucasus are creating a context particularly suitable for the production of good research. Reacting to the unrest in Syria and increasingly strict policies regarding foreign archaeological work in Turkey, a new wave of scholars has reoriented its research towards the South Caucasus, making the South Caucasus an independent center of interest for the archaeological community.

From both a theoretical and methodological standpoint, modern archaeology revolves around scholars' ability to manage 'shifting relations between local traditions and global transformations' (Smith 2005:230). In this chapter, present the evolution of intellectual and scientific traditions in the south Caucasus and consider how the practice of archaeology was impacted by local socio-economic history and large-scale political phenomena. The switching theoretical paradigms have thus supported diverging interpretation of archaeological data, which resulted in the development of conflicting hypothesis for the reconstruction of Neolithization of the area.

4.2. Theoretical tenets: historical materialism and Marxist Archaeology.

In order to properly understand the roots of Soviet Archaeology and the origin of its ideological tenets in the context of the USSR, we need to define the philosophical framework at its base.

During the early period of Soviet Russia, Social Sciences were required to fit a Marxist approach, based on the principles of historical materialism. Marx wanted to address the "conditions of material life of society, so that the chief determinant force […] is the method of procuring the means of life », food, shelter, fuel. Broadly, these forces also include humans and non-humans, as well as scientific knowledge (Trigger 2006) so that ultimately, each society contains in itself the requisite conditions to its social development.

The adaptation of Marx's philosophy to archaeology is first carried out through his views on primitive society (Miller 1956). Social evolution can thus be interpreted following Marx' five stages of socio-economic evolution: primitive or pre-class society (that is already practicing some form of proto-communism), slavery (a class society illustrated by « oriental societies »), feudalism, capitalism, and classless societies (evolving from socialism to communism). The definition of a society's stage is carried out through the study of its modes of production (Smith 2005).

The imposition of a new Soviet philosophy on the intellectual life was the goal of a massive state campaign (Trigger 2006). In archaeology, this movement was initiated by Vadislav I. Ravdonikas (1930), the scholar most linked with the Soviet History of Material Culture (Smith 2005). In 1929, Ravdonikas delivered a speech entitled "For a Soviet History of Material Culture" (*Za Sovietskuyu Istoriyu Materialnoy Kultury),* in which he called for a new Marxist archaeology of material culture (Miller 1956:75) that would bring the discipline "under the auspice of political agenda" (Miller 1956, Bulkin et al. 1982). Archaeology itself was replaced by Marxist history of material culture (Miller 1956), while social evolutions were necessarily explained in Marxist terms, in the framework of a new historical science of pre-capitalist societies. Within this framework, the explanation of social evolution in terms of the spontaneous development of stages of production (and technological development), was regarded as a western bourgeois invention, as was reference to processes such as migration of diffusion (Lindsay and Smith 2006) and even terms like Stone, Bronze, or Iron Age.

As Trigger notes, the post-Stalin Soviet Archaeology was characterized by "a rejection of dogmatism and trend towards theoretical diversification, although always within the framework of Marxist philosophy" (Fortes 1980:xix in Trigger 2006). Key concepts in Stalin's Historical Materialism, such as the autochthonous development, lost their explanatory potential. If Soviet Archaeology was more "historical-descriptive" than "analytical-explanatory" (Trigger 2006) Soviet scholars attempted to overcome this issue through the development of variety of theoretical and methodological trends (Bulkin et al. 1982, Trigger 2006). Increasingly, they attempted to integrate natural sciences into the discipline, resulting in works that discussed prehistoric technology or archeo-technology (Bulkin et al. 1982:283), petrography, metallography (Chernykh 1992, Gevorkyan 1980), faunal analysis (Mezhlumyan 1972), use-wear analyses (Semenov 1964), and ecological analysis (Dolukhanov 1978, Lisitsina 1984, Smith 2005). While the techniques used to quantify these phenomena were often beyond the framework of Marxist biases (Trigger 2006), some of the questions addressed, such as the relationship between prehistoric societies and their environment, had not been taken into consideration until that point (Dolukhanov 1979, Smith 2005). Multi-linear scenarios of cultural evolution involving processes of full diffusion were, until this time, behaviors alien to Soviet archaeologists, but such scenarios were quickly integrated into their historical narratives (Klejn 2012). By the end of the 1960s, the amount of data produced allowed the creation of large monographs and regional syntheses (Formozov 1966, Lindsay and Smith 2006, Telegin 1987, Potushniak 1984).

In the Caucasus, an important development began in the 1960s and continued almost uninterrupted until the end of the Soviet period. An emphasis was put on political development that took place in the region during prehistoric periods, with a special focus on the Bronze to Iron Age. During a half-century of conducting frequent fieldwork projects and studies, local archaeologists undertook the task of building regional syntheses and chronologies.

In the Northern Caucasus, this period is best represented in the massive work of R.M. Munchaev who, in 1961, produced a monograph entitled “Earlier Culture of the NE Caucasus” (Munchaev 1961). The focus on early agricultural societies is seen in the work of M.G. Gadzhiev, V.G. Kotovich and A. Amirkhanov, and D.M. Ataev, who published the sites of Galgalatli, Cohk, Chinchi, and Ginchi (Korenevskii 2011). In 1965, Formozov published another monograph, *Makennyi vek i eneolit Prikuban'ia* (*The Stone Age and ENeolithic of the Kuban Region*). This work was followed, ten years later, by Munchaev's monograph, *Kavkaz na zare bronzogovo vela* (*The Caucasus at the Dawn of the Bronze Age*). Munchaev, who served at this time as the head of the Soviet Iraqi archaeological project, was able to enrich his work with the parallels he built between the Bronze Age Caucasus and Near Eastern archaeological cultures (Korenevskii 2011, Munchaev 1975).

A trend towards studies of early agriculture was also present in the South Caucasus where, developing on Kuftin and Baiburtyan's ideas and chronologies, a group of scholars dedicated themselves to the study of agriculture in Armenia, Azerbaijan and Georgia. In Georgia, a group of new sites were discovered and excavated during the 1960s: Anaseuli, Vakijvari, Sairme for the Neolithic (Mesvheliani 2013, Nebieridze, 1972) and Edzani, Darkveti and Djamdeli for the Mesolithic (Guceinov 1959). Taken together, these discoveries allowed the construction of a chronology for Georgia's Neolithic (Meshveliani 2013, Nebieridze, 1972:108–118).

The mass of data created between the 1960s and the collapse of the Soviet Union, along with increased international collaborations and the integration of natural sciences in the practice of Archaeology triggered a context suitable for the creation of large pluridisciplinary monographs, regional chronologies, and international debates[2] (Lindsay and Smith 2006). Increased contacts with foreign scholars through literature and international conferences improved the chronological sequences and integrated them in a

[2] see the Lioubin vs. Mansurov and Korobkovo for the Soviet equivalent of Binford vs. Bordes

wider regional scale. Furthermore, the expression of different theoretical trends (archaeological ethnogenetics, archaeological history, archaeological sociology, descriptive archaeology, theoretical archaeology among others) (Bulkin et al. 1964:279-280), was, despite that they still operated within a Marxist framework, characteristic of a more liberal political agenda for historical sciences (Trigger 2006). Stalin's russification agenda had been replaced by local expression of patriotism for the several republics that composed the Union, expressions of patriotism that were tolerated as long as they did not transform into nationalist and separatists movements (Smith 2005).

This new theoretical framework emphasized a focus on local development of archaeological culture, not as a result of Marxist social evolution anymore, but as a consequence of a unilinear perspective on local ethnogenesis history.

By the end of the 1980s, Soviet Archaeology had been the most generously funded of its generation and was the" world's largest centralized network for archaeological research" (Trigger 2006), funding more than 5000 expeditions a year that produced thousands of published reports. For the Party, the role of Archaeology was to promote a materialist understanding of human history in its cultural and ethnic diversity (Miller 1956). Archaeology was thus meant to be used as a medium to educate the public on history and culture following the official guidelines, and the amount of exhibitions and publications are a testimony to the dedication of the government to achieve those goals.

However, as the state progressively loosen its grip, a variation of practices and theoretical approach have been developed (Bulkin et al. 1982) and Soviet Archaeology before the collapse if a fully developed field. The last years of the Soviet Period were particularly fruitful in archaeology. The policies of liberalization were associated with a larger opening to the west and the development of new programs of international collaboration.

In the South Caucasus of international collaborations, this is witnessed first with the work of P. Kohl and A. Sagona on Bronze Age culture (Kohl, Gardin, and Francfort 1984; Sagona 1984). Kohl's work in the Caucasus created a suitable context for the study trans-cacucasian phenomena such as obsidian distribution, in collaboration with R. Badalyan and Z. Kikodze (Badalyan et al. 2004). Kohl and Badalyan initiated the first international collaborative project in Armenia with the Interntional Program for Anthropological Research in the Caucasus (IPARC), initiating a tradition that will go on until the post-soviet era.

The increase in international collaboration, associated with the multiplication of expeditions thus led to new paradigms in Neolithic research.

4.3. Terminology and sequence – The impact of intellectual traditions on Mesolithic-Neolithic research in the Caucasus.

4.3.1. Mesolithic vs. Epipaleolithic

Several issues of taxonomy emerged when looking at the Mesolithic to Neolithic transition in the South Caucasus. The position of the region at the outpost of the Soviet intellectual traditions in the Near East created parallel, sometimes competing approaches to the same topic. This situation is also caused by the inherent qualities of the topic studied. At the core of our understanding of the development of Neolithic in any given region is the definition of the attribute given to the different chrono-cultural stages, and their means of identification in archaeological record. These definitions are created in specific intellectual, historical, and political contexts, as well as by the physical state and the cultural nature of the archaeological record (see below). In Soviet times, the historicism rooted in 18th century's practice of archaeology was still present (Smith 2005), and cultural evolution was very much addressed in terms of local social evolutions. These combined approaches may have created a culture history more likely to equate modes of production (and thus, the products themselves) with particular groups of people, and attach importance to chosen variables within the archaeological record to determine stages of social evolution. The attribution of sites and assemblages to different chrono-cultural categories in the South Caucasus provides a few examples of the way this intellectual paradigm has impacted archaeological interpretation.

The transition to food producing economy in the South Caucasus have traditionally involved several stages: Epipaleolithic or Mesolithic, Early Neolithic or Aceramic Neolithic, Neolithic or Late Neolithic, Eneolithic or Chalcolithic. The variables that defined these periods, and justified the attribution of a site and its assemblages to one of these chronocultural category, have evolved for the past decades. These changes result from the evolution of knowledge about a specific topic, but also the desire to integrate one's research into a given research tradition.

This is best illustrated by the diverging attribution of Late Pleistocene sites to Mesolithic or Epipaleolithic. This particular debate is not specific to the South Caucasus, however, it is, in this area, particularly significant of choices of intellectual traditions. Kozlowski's review of the several approaches to Mesolithic for the past 40 years (2009) leads him to suggest the following definition:

"The Mesolithic is a postglacial interglacial continuation and/or adaptation of Late Glacial specialized hunters for a more temperate climate, and especially for a mostly forest environment, which dominates the entire continent from the first half of the 11th millennium Cal. BC" (Kozlowski 2009: 52)

This definition is chronological, environmental, and cultural. On the other hand, the term Epipaleolithic was suggested in order to emphasize the continuity between certain late Paleolithic groups and post-glacial groups. Golovanova (et al. 2012:2) suggests on the other hand that Epipaleolithic should designate all groups from the LGM to the Younger Dryas, 21,000/20,000 through 9,000 BCE. Traditionally, the term Epipaleolithic is preferred in modern Near Eastern studies, whereas Mesolithic refers to an older tradition of research (Garrod, 1938). One could argue that the preference given to the term Mesolithic in the South Caucasus (Childe 1942, Formozov, 1953, 1962, Khoshtaria 1940, Kushnareva 1997, Lioubin 1993, Munchaev 1975) refers to a desire to create a coherent approach at the scale of the USSR, and bolster the creation of coherent scientific approach as well as a prehistoric cultural entity. The South Caucasus is thus integrated in a European sphere rather than a Near Eastern one, and was compared to other Mesolithic cultures across the USSR, Siberia or Eastern Europe (Kozlowski 2009, Munchaev 1975). Eventually in the Caucasus, Mesolithic came to be defined as a period hosting Holocene cultures that did not show evidence of food production (Kiguradze and Menabde 2004), a preference that is still present today (Chataigner et al. 2014, Gabunia and Tsereteli 2003, Meshveliani 2013).

4.3.2. Mesolithic and Early Neolithic

The nature of evidence of "Neolithic" has been varied and, short of faunal or ethnobotanical data, the distinction between Mesolithic and aceramic Neolithic in the South Caucasus has created confusion in the chronocultural attribution of sites. This confusion is emphasized by the number of sites that did not benefit from a good understanding of site formation processes, and suffered from a lack of radiocarbon dates.

This resulted in the creation of an aceramic Neolithic, taking place during the early Holocene, and defined by sites presenting specific chipped stone tool assemblages (polished stone tools, or sickle hafts) but with no ceramic (Lioubin 1966:63). In case where no food processing artifacts could be recovered, some of these sites have even been attributed to a proto-Neolithic, such as Kobuleti, Khutsubani, or Choloki (Kiguradze and Menabde 2004). The definition of Early Neolithic, and its differentiation from Mesolithic is thus solely base on the absence of pottery and some typological specificity of the lithic assemblage. This phenomenon is necessarily bound to create some confusion, and limit our ability to differentiate between different populations (Hamon 2008).

Several incentives can be identified for the need to create an intermediary period between a Mesolithic and a fully agricultural society. First is the influence carried by studies of Neolithization in the Near East. The Pre-Pottery Neolithic layers at Jericho were created by Kenyon to identify assemblages with an agricultural economy but without ceramic (1952). They also came to define several thousand years of agricultural experiments, domestication processes that witness a truly local phenomenon (although the scale of the location is yet to be clearly defined). As I will explain below, it is possible that the emphasis that a Marxist framework stressed on independent, spontaneous social development, away from migrationist and diffusionist explanatory concepts, resulted in the adoption of a Near Eastern sequence and scenario to explain the development of agriculture in the South Caucasus.

In South Caucasus the first identification of agricultural societies was done by Kuftin (1941) in layers he attributed to the *Eneolithic*. This term often stands for Chalcolithic. It often stands for the period following the Neolithic, in which copper tools and artifacts are found. Not only did Kuftin (1941), and later Krupnov (1963) supported the idea that the first expression of agricultural societies were associated with copper-producing group, they also suggested these groups were connected to the Kuro-Araxe culture (Kiguradze and Menabde 2004). Telegin (1987) notes that it was quite common among soviet archaeologist to consider as Neolithic, prehistoric sites which had pottery but no artifact metal. Indeed, the similarities between sites that we now identify as Neolithic and the Chalcolithic (or Eneolithic) sites can be striking, leading to the attribution of assemblages to both periods (Dzhaparidze 1989). Furthermore, Narimanov (1987) identifies the presence of copper beads and copper objects, in very small quantities but nonetheless associated with early Shulaveri-Shomu Tepe sites, a tendency that is also identified at sites such as Aratashen, Aknashen, Nakhichevan Kültepe I, Khramis Didi-gora, Arukhlo, and Gargalar tepesi (Chataigner et al. 2014). Narimanov (1987) suggests these beads are imported and more recent studies carried out on Aratashen samples show at least part of them were made from pure copper (Meliksetian et al. 2011).

Due to the assumption of an early or aceramic Neolithic, and the integration of these culture in a broader Near Eastern frame of reference, the first phases of Shulaveri-Shomu Tepe—the first expression of agricultural society in the South Caucasus—are associated with the Late Neolithic (Narimanov 1971), whereas Late Shulaveri Shomu is associated with early Eneolithic. However, some publications still address Shulaveri-Shomu sites as Eneolithic to account for the presence of copper bead and the lack of microlithic stone tools (Masson, Merpert, Munchaev and Chernysh in Kiguradze and Menabde 2004), although recent publications have disproved this finding (Chabot 2012, Varoutsikos and Chabot 2013). Finally, the development of Kuro-Araxe culture out of the Chalcolithic also poses some problems. Kiguradze and Menabde (2004) suggest a sequence in which Shulaveri-Shomu stage I-III is Neolithic, and IV-V is Late Neolithic. These stages were followed by Eneolithic-Chalcolithic (represented among others by the Sioni types) and eventually by the Kura-Araxes culture. This sequence is criticized (Chatiagner et al. 2014) and most scholars consider Shulaveri-Shomu a uniquely Neolithic phenomenon.

Neither the limit from Mesolithic to Neolithic nor the transition from Neolithic to Eneolithic-Chalcolithic have been properly identified. As for the Mesolithic-Early Neolithic, the problem lies in the parallel use of concepts that define different archaeological variables: artifacts, chronology, subsistence pattern, and geography.

Chapter 5

The Mesolithic-Neolithic transition in the South Caucasus: State of the Art.

5.1 Geography, Topography, Geology

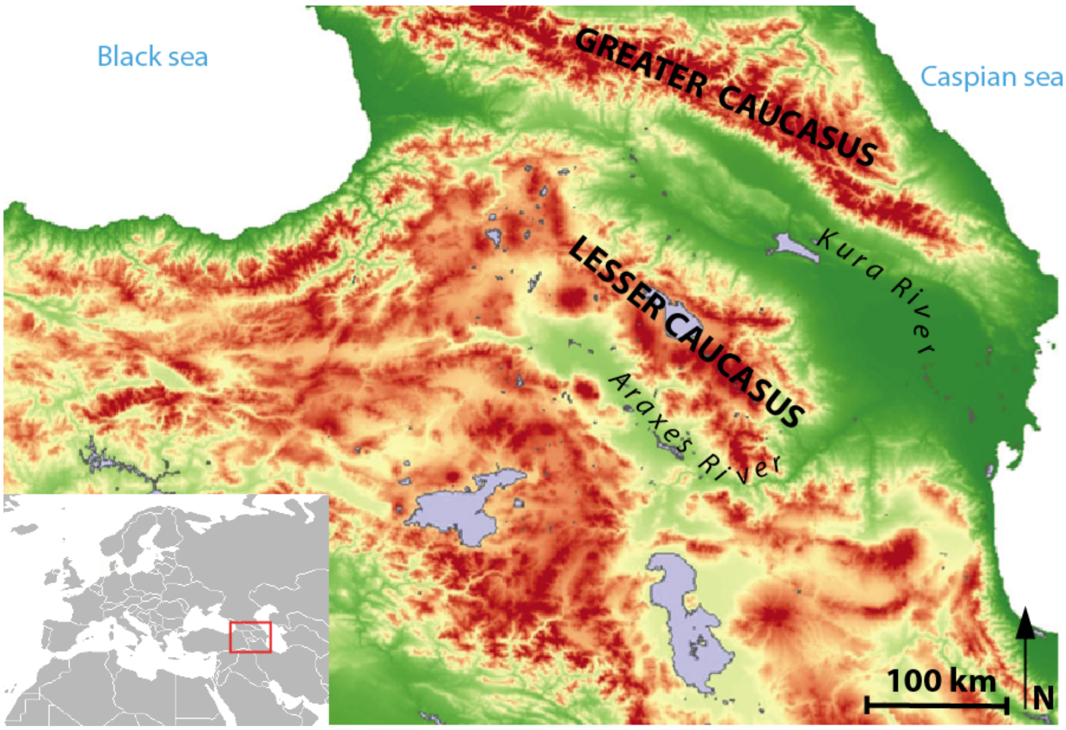


Figure 13*: The South Caucasus: topography*

The Caucasus region takes its name from two geographical features: the Greater Caucasus and the Lesser, or South, Caucasus (Figure 13). The Greater Caucasus is a mountain range that spreads west to east, across approximately 1200km between the Black Sea (from the strait of Kertch) to the Apcheron peninsula of the Caspian Sea, making this entire region a continental isthmus. It belongs to the Alpine-Himalayan orogenic belt, where the collision between tectonic plates created high, abrupt volcanic mountains. It reaches the immense Eurasian steppes to the north, and the highlands of southwest Asia to the south, with altitudes up to 5642m (Mt Elbruz), thus representing the "most northerly part of western Asia and grades into the near eastern highlands"

(Golovanova et al. 2012). These mountain ranges have alternatively been presented as barrier or as a land bridge.

5.1.1. Topography, ancient text and modern passes

There are two chief passes crossing the chain of the Caucasus, both of which were known to the ancients. The first is between the eastern extremities of its chief north-eastern spur and the Caspian sea, near the modern Derbend. This was called "Albaniæ," and sometimes, "Caspiæ Pylie," the "Albanian" or "Caspian Gates." The other, which was nearly in the centre of the Caspian range, was called "Caucasiæ" or "Sarmaticæ Pylæ," being the same as the modern pass of Dariyel, and probably the one here referred to. Pline the Elder (6.12) One is to the east and known as the Caspian Gates. Herodotus mentions them as shutting out the kingdom of Parthia (17:4:1), most likely referring to the modern city of Derben (Derben itself deriving from the Persian Dar-ban, locked gates).

> *"The reason of these passes receiving the name of "Gates," is the same that has been stated above. The chain of mountains is suddenly broken by a passage of such extreme narrowness that, for a distance of eight miles, a single chariot can barely find room to move along"*(Herodotus 17.4:1)

The other pass is located in nearly in the center of the Caspian range. Known as the "Caucasiæ" or "Sarmaticæ Pylæ," in antiquity, in modern times it became known as the pass of Darial. Located in modern-day Georgia, this pass is located where the Georgian military road connects Tbilisi to Vladikavkaz in Russia. Both the Caspian Gate and Darial passes have been the locus of conflict between the major geopolitical actors of the region at various points throughout history.

The Lesser Caucasus is a smaller mountain range to the south. It is approximately

600km in length, and this feature traditionally marks the limit of the Armenian Highlands, although no clear boundaries have been defined (Kohl 1993:224). It is connected to the Great Caucasus by the Likhi mountain ranges and two coastal plains, the Kura River valley, in Azerbaidjan, and the Colchis, in Georgia

Overall, the region known as the South Caucasus (or Caucasia, or Transcaucasia from a Russian perspective) is a geographical space delimited by the greater Caucasus to the north and the boundaries of modern-day Turkey and Iran to the west and south. Modern boundaries defined by the Treaty of Lausanne include three countries, Georgia, Armenia, and Azerbaidjan, and four disputed regions (Abkhazia, South Ossetia, Nakhichevan, Nagorno-Karabagh). However, the topographic extension is considered to reach out to the limit of the Armenian Highlands, creating a controversial geographic entity (Smith 2006) that extends beyond the basin of the Araxes River to the west, in an area including modern-day Nakhichevan. The region is also structured around two major waterways, the Araxes and Kura Rivers, and their drainage basins. This work focuses on the Southern part of Transcaucasia: it covers an area of an average elevation of 1200-1800m ASL, with borders at the highlands of Armenia and South Georgia (Djavakheti plateau and Kvemo-Kartli) to the north, extending to the southernmost portion of the Araxes River, an area mostly structured around a system of open steppe plain with a continental climate (Connor and Sagona 2007).

5.1.2. Modern Environmental setting

Modern climatic and environmental conditions in the Caucasus are extremely varied, possessing an important altitude amplitude as well as marked seasonality (Lioubin 1992). To the North, located in a temperate area, the high mountains of the Great

Caucasus form a barrier to the arctic air. Paleoenvironmental reconstructions suggest that the northern slope of the mountain range would have hosted glaciers up to three times as large as those in the south (Chataigner 1995). Modern conditions vary from large forest environments in Northern Armenia to the drier steppe environment of the south. On the other end of the spectrum are the fertile areas of the Kura Valley (Chataigner 1995), and the coastal plain of western Georgia, Colchis, which is drained by the Rioni and Inguri rivers and lies directly under the influence of a humid sub-tropical zone. Up until the Late Pleistocene, it is most likely that the Black Sea coast of the Colchis plain was located several kilometres westward (Anthony 2007, Ballard et al. 2000). The Kura Valley and Colchis regions, known for their fertile soil and their humid climates, with an average annual rainfall of 2500mm (Connor and Sagona 2007) have been the most densely settled historically. Finally, the region characterized as South or Lesser Caucasus, delimited by the highlands of Armenia and South Georgia (Djavakheti plateau and Kvemo-Kartli), is much drier, mostly structured around a system of open steppe plain with a continental climate (Connor and Sagona 2007). The area of the Araxes basin, however, experiences hot and dry summers and long and cold winters in a mostly steppe environment (Smith 2006:232). However, both the Kura and the Araxes Valleys are rich in fertile soil, providing a suitable environment for farming societies (Chataigner et al. 2014, Connor et al. 2004). At the same time, the complex topography of the area created several refuge areas during glaciations as along wth a rich system of natural karstic, or post-volcanic, caves and rock shelters (Lioubin 1992).

This environmental configuration creates within the South Caucasus a context particularly suitable for the development of plant and animal species. Currently, it is home to more than 6000 plant species and 130 mammal species (Lioubin 1992). The South Caucasus is also located in the natural habitats of cereal species that became domesticated, such as *Triticum colchicum* and *T. macha*, or naked wheat (*Triticum turgidum* and *T. aestivum*) (Hovsepyan and Willcox 2008), as well as spelt wheat (*T. spelta*) and broomcorn millet (*Panicum miliaceum*) (Hovsepyan and Willcox 2008, Lisitsina and Priscepenko 1977, Zohary and Hopf 2000;). This diversity has, for the past century, led several authors to suggest the existence an independent locus of domestication in the South Caucasus, as a "center of origin" (Vavilov, 1926).

5.1.3. Environmental reconstruction

While scholars completed archeobotanical reconstructions during the Soviet period (see Janusevich 1975, 1976, 1978, Lisitsina 1981, Lisitsina & Prischepenko 1976, Schultze-Motel 1989) and immediately after independence, at the time these reconstructions were not systematically associated to radiocarbon dating. Additionally, they generally resulted from the identification of pollens in archaeological sites, and thus did not necessarily account for issues of contamination (Lyonnet 2007:12). However, climate reconstruction in Transcaucasia is the subject of an increasing number of contemporary research projects, which use updated techniques of excavations and analysis (Figure 14) (Connor et al. 2004, Connor and Kvavadze 2008; Messager et al. 2013). However, the complex topographic configuration of the area also prevents a global description of the climatic and environmental changes that occurred between the Late Glacial Maximum and the 4th millennium BCE. Several areas can be defined based on their geography, present ecology, paleoenvironmental reconstruction, and archaeological relevance to the topic studied here, including Western Georgia (Colchis and Caucasus piedmont), Southern and Eastern Georgia, the Araxes Valley, the Kura Valley, the Armenian Highlands, and Northwestern Iran.

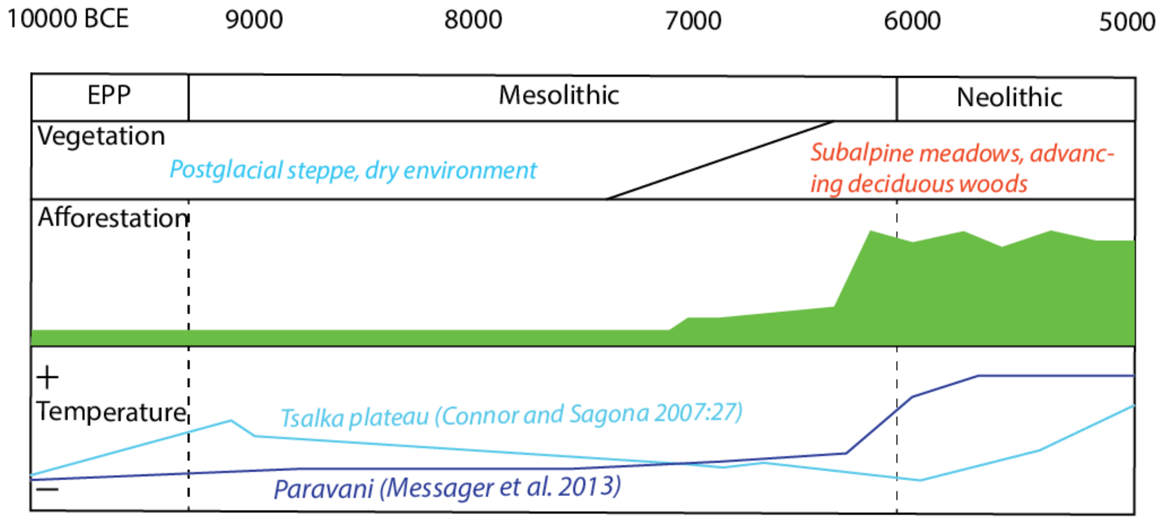


Figure 14*: Environmental change on the Javakheti plateau from the Younger Dryas to the mid-Holocene (Compiled from Connor and Sagona 2007, Messager et al. 2013)*

Generally speaking, climatic conditions during the Younger Dryas were marginally cold and dry. Clear evidence exists for glaciation, although the phenomenon would have been felt less strongly than in Western Europe. Indeed, if the signal of Younger Dryas seems to be identified in this region (Varoutsikos et al. 2013), it seems that during the Early Holocene in the continental South Caucasus, steppic vegetation prevails even in areas where orographic rains could be expected (Varoutsikos et al. 2013). Despite certain claims of favorable climatic environment throughout the region (Gabunia and Tsereteli 2003), current results evoke the presence of septic semi-arid environments (Conor and Sagona 2007, Messager et al. 2013) rapidly transitioning towards a mixed-oak (*Carpinus caucasicus, Quercus, Ulmus*) (Maraglitadze 1995). Pollen cores found in highland and lowland regions of Armenia, S. Georgia, SE Turkey, and NW Iran indicate this transition occurred around 6000BCE, almost 3000 years later than the transition in areas surrounding the Mediterranean (Djamali et al. 2008, Messager et al. 2013, Ollivier et al. 2010, Wick et al. 2003). These paleoenvironmental data seem to emphasize a certain degree of ecological homogeneity in the entire area, excluding a few glacial "refugia" such as Colchis, until at least the 6th mill. BCE—a period also associated with the development of the earliest agricultural society in the South Caucasus, known as the Shulaveri Shomutepe culture (Chataigner 1995, Kiguraze and Menabde 2004). It seems that a climatic optimum was reached at some point between 4000 and 2000 BCE, in which both humidity and temperatures increased (Connor and Sagona 2007:30). These changes might have become manifest in more significant rainfalls and higher summer temperatures (Connor and Sagona 2007), in which case the highlands—relatively unaffected by drought or flooding—would have become a more favorable environment.

Little is known about the climate and environment of the Late Pleistocene/Early Holocene in the South Caucasus. As presented earlier, evidence of the Younger Dryas' signal as found in a few archaeological sites suggests that it was a less brutal climatic change in this region than in the Near East. Some climatic improvements are indicated by palynological evidence (Connor and Sagona 2007) from the Colchis area. The Black Sea coast, serving as one of few glacial refugia in western Asia (Röhrig 1991), shows traces of *thermophilous* plants that slowly gained territory up the mountain slopes (Kvavadze et al. 1992). Most data extrapolated from faunal and botanical remains in eastern and central Georgia support the presence of both forest and steppe landscapes. Recent analysis of pollen records from different lakes in southern Georgia (Paravani, Aligol) (around 1300-2000m ASL) indicate the existence of arid wormwood Ephedra steppe containing fragments of hazel and birch pioneer woodland (Connor and Sagona 2007). This high-altitude environment is thus characterized by a steppe environment as well as an arid and cold climate throughout the Younger Dryas, which lasted far into the Holocene, until about 6500 BCE (Messager et al. 2013). It is likely, however, that lower altitudes hosted landscapes with denser forecast (Connor and Sagona 2007), especially in the Piedmont of western Georgia. However, climatic modeling tends to suggest that the climate remained very arid (Davis et al. 2003), a reality that could be connected in part to the climatic instability present in the South Caucasus around 8000-7000BC (Kvavadze et al. 1992).

It is therefore only in the course of the 7th millennium cal. BC that we notice a global, systematic climatic amelioration. In the northern Kura Valley, around the site of Mentesh Tepe, evidence suggests the presence a of a steppe environment, although warmer conditions are noted (Guliyev and Lyonnet 2013), thus allowing agricultural groups to settle on the rich LGM alluvial deposit (Ollivier and Fontugne 2013). In the Araxes Valley, presence of deer and beaver in the faunal assemblage at Aratashen and Aknashen can possibly be connected to woods and dense vegetation existing along the watercourse (Lombard and Chataigner 2004). Anthracological studies show evidence for the presence two ecological groups: some species, like *Quercus*, *Acer*, and *Amygdalus*, associated with plains and hills along with other taxa, including *Salix sp.* and *Tamaris sp.* that are connected to humid environments (Hovsepyan 2009) and that were probably used as fuel. This evidence suggests the existence of a warmer climate, and a potentially dry environment on the plain except in proximity of the river course. This situation is also likely in eastern Georgia, where the vegetation mostly consists of extensive dry savanna, as was also the case in Kwemo-Karlti around 6000BC (Janelidze 1984), when the region possessed “dense gallery forests along river courses” (Connor and Sagona 2007). This landscape is completed by oak-hornbeam forests located on the foothills, possibly associated with the increase during this time in the presence of red deer in faunal assemblages from the sites of the region (Gogichaishvili 1990). The expansion of oak-woods took place in the course of the 6th millennium BCE, probably connected to the stabilization of the Black Sea, which resulted in an increase of atmospheric moisture (Gogichaisvhili 1984, Wick et al. 2003). This phenomenon is particularly noticeable in the coastal Colchis, where, in association to an increase in temperature (Kvavadze and Jeiranashvili 1989, Kvavadze and Rukhadze 1989) the Neolithic period was accompanied by an expansion of chestnut (*Castanea saltva*), oak *Quercus*, and *Zelkova* forests (Connor and Sagona 2007). The spread of these species is associated with a retreat of conifers as well as species like beech, better adapted to low temperature and higher altitudes (Connor and Sagona 2007). Throughout the Neolithic, in the lowlands, the oak savanna environment persisted despite the climatic amelioration, a phenomenon that can be associated with the fires recorded in the pollen record and might also “illustrate the deliberate management of woodland on a landscape scale connected to specific agricultural practice” (Connor and Sagona 2007).

By the end of the Neolithic (*Eneolithic*), even arid areas underwent a process of afforestation. This was the case of the foothills located in the Tbilisi area, where an oak-juniper scrubland developed during the late 5th millennium BCE (Connor and Sagona 2007). The climatic amelioration and optimum, associated with the more humid environment of the lowlands, may have caused flooding or high valley temperatures that would have made the highlands more attractive as dwelling places. This could explain the seeming increase in Chalcolithic settlements found at high altitudes (Varoutsikos et al. 2013). The mountain environment then may have been fully forested and integrated into a larger semi-nomadic settlement pattern between the highlands and the lowlands. Such a scenario seems to be supported by the numerous pieces of evidence for transhumant behaviors and long-distance contact between distinct points in the South Caucasus (Palumbi et al. 2014).

5.2. Chronological sequence: Mesolithic-Neolithic transition

5.2.1. Significance of the North Caucasus data

5.2.1.1. Mesolithic

Mesolithic groups based in the North Caucasus are associated with hunter-gatherer communities that appear directly after the Younger Dryas (Golovanova et al. 2012). The Caucaso-Caspian group (following Koslowsky attribution, *in* Kozlowski 2009) is gravettoid in nature, but has strong component of geometric microliths. Kozlowski (2009) suggests the existence of two sub-groups, the Trialetian, in the Caucasus, and the Shan-Koban, located around the Crimean peninsula, as well as several variants on the northern slopes of the Caucasus (Kholodniy: Trialetia, Javakheti, Black Sea coast, Rioni-Qivrila Basin, and Chokha, the only cultural region located in the North Caucasus (Figure 15)

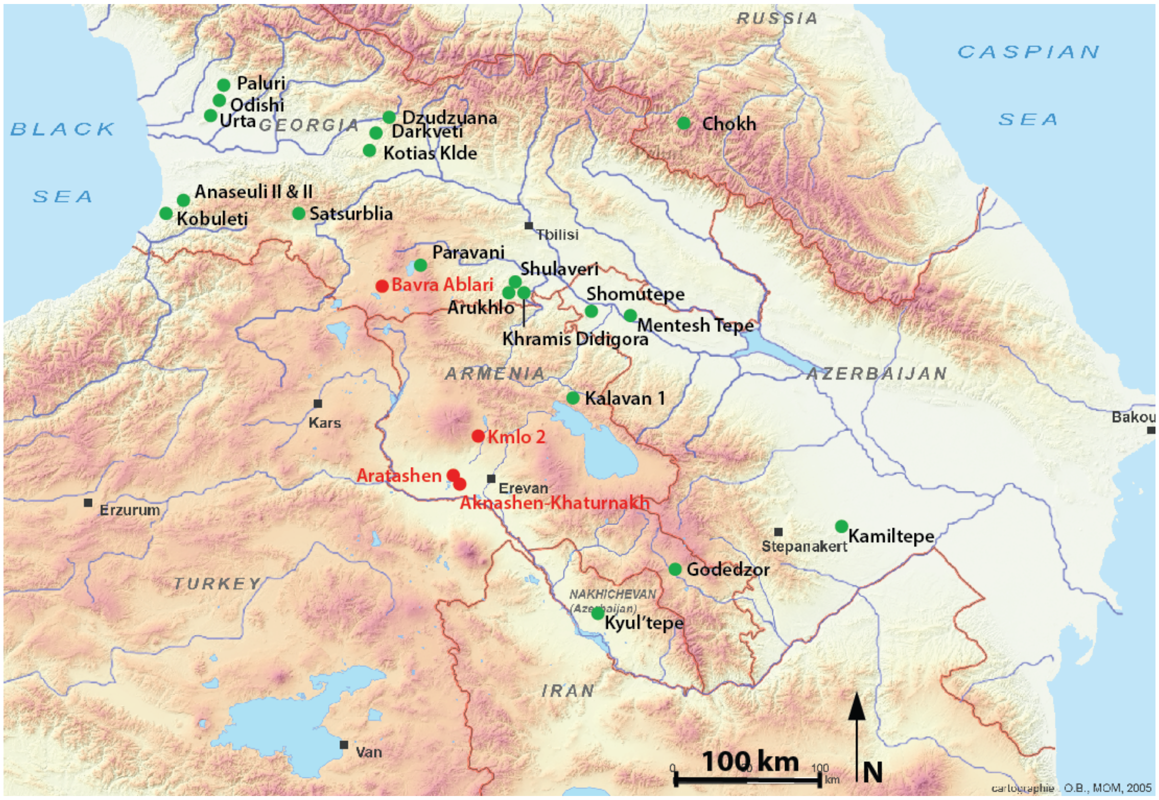


Figure15*: Main sites mentioned (green) and the sites studied in this work (red)*

3.3.1.3 A Mesolithic-Neolithic transition at Chokh?

The site of Chokh constitutes a major settlement in the Late Pleistocene to mid-Holocene history of socio-economic and cultural development in the Caucasus. Chokh is a multi-layered rock shelter (Figure 16) located on the northeastern slope of the Caucasus, located on the Turchidagi plateau, in the Republic of Dagestan, at 1725m ASL (Amirkhanov 1984, Kiguradze 2001). Several Mesolithic sites in the area are found in similar ecological niches, which feature high mountains along with nearby water sources and river canyons, such as Mekegi or Kozma-Nokho (Lisitsina 1984, Korobkova 1986, Kushnareva 1997). However, among this landscape, only Chokh has produced seemingly undisturbed cultural occupations, which span from the Mesolithic to the ENeolithic (8-6th mill. BCE). Among the levels of occupation, there are two Mesolithic layers (E-D) and one Neolithic layer (C) (Amirkhanov 1987), separated by a short hiatus. However, the chronology of Chokh is not based on radiocarbon dating but on paleoenvironmental sequence (Amirkhanov 1982a, 1982b, 1987).

Figure 16*:* *view of Chokh rockshelter (courtesy of Prof. Magomedov)*

Kotovich first excavated the site in the 1950s (Kotovich 1957, 1964). He identified six cultural layers spanning from the Early UP to the Late Mesolithic, structured in four cultural horizons. Excavations resumed in the 1980s under the direction of Amirkhanov, who led a team of palynologists, paleoethnobotanists, and geomorphologists and suggested a corrected stratigraphy for the site (Amirkhanov 1982, 1987). This stratigraphy included four cultural layers: two Mesolithic, one Neolithic, and one Middle-Bronze-Age, which ranged from the 8th millennium BCE to the 4th or 3rd millennium BCE (Amirkhanov 1987). The revision of the stratigraphy was accompanied by a reassessment of the material culture of the site, resulting in the suggestion of the following new interpretations.

The Mesolithic layers of Chokh are associated with the early Holocene, most likely between the 8th and 7th millennium. Both typological evidence and comparison with circum-Caspian assemblages (Brunet 2002, Lyonnet 2004) suggest that the groups that settled at the Chokh rock shelter originated at points located to the south of the Caspian Sea. On the other hand, Korobkova (1996) identifies the center of a Mesolithic culture called Trialetian in the Late Mesolithic layers of the site. No structures were found associated with the late Mesolithic layers (8th-7th millennium BCE). In these layers, the lithic assemblage is constituted mostly of black flint and grey flint that originated within a radius of 30 to 40km from the site (Kushnareva 1997), as well as obsidian, coming either from Armenian sources or the Baksan outcrop in the North Caucasus slopes (Armikhanov 1987, Badalyan et al. 2010, Korobkova 1996). The industry (Figure 17) is based on microbladelet production on prismatic, pyramidal, and pencil-shaped cores, along with a smaller flake production on discoidal and Levallois-like cores (Gabunia and Tsereteli 2003). This assemblage is defined by Koslowsky (1996) as typically Trialetian: it consists of scalene triangles, asymmetrical trapezoids (Amikrhanov 1994), and "Chokh points," thin-based and diagonally-truncated points that are said to be local (Amirkhanov 1994: 203-204, Chataigner et al. 2014, Lyonnet 2004).

The main interest of the site lies in its late 7th to early 6th millennium cultural deposits, presented as "early Neolithic". Two oval-shaped, dry-stone dwellings, with a corridor-shaped entrance and hearths in the center, are found in association with this layer (Abakharov and Davudov 1993, Amirkhanov 1987, Gadjiev 1991, Kiguradze 2001). The possibility of a local domestication in the Caucasus has been widely supported based on

Figure 17: *Lithic assemblage from Chokh Mesolithic layer.*

1-2: bladelet core; 3-10:geometric microliths the data from Chokh (Lisitsina 1984; Amirkhanov 1987, Kushnareva 1997). On one hand, the site's Neolithic faunal assemble provides evidence for domesticated goats and sheep as well as domesticated crops (*Tr. monococcum*, *Tr. dicoccum*, *Tr. aestivum*, *H. vulgare*, *Panicum Sp*.) (Amirkhanov 1999, Lisitsina 1984, Willcox and Hovsepyan 2008). However, there are currently no data supporting an actual *in situ* domestication process, as no wild species have been identified (Wechler, 2001), despite the existence of these crops in the area today (Alexeev 1991). The "transitional phase" that Lisitsina describes occurring at Chokh (Lisitsina 1984) also dates from the beginning of the 6th millennium BCE, when the first agricultural societies appeared in the South Caucasus.

Therefore, considering the lack of radiocarbon dates, the only support for a local development relies on a possible typo-technological continuity between the Mesolithic and Neolithic chipped stone tool assemblages (Amirkhanov 1982a, Kushnareva 1997). The lithic assemblage found in the Neolithic layers is dominated both by blade production (Kiguradze 1991) and micro blade techniques (Korobkova 1996). Blade production is characterized by byproducts of blade production found alongside a comparatively small amount of blade blanks (Kiguradze 2001). The bladelet production results in a higher percentage of microlithic blanks in comparison with the Mesolithic layer (27% vs. 14%) (Korobkova 1996). Bladelet production is also associated with the production of smaller microliths such as "elongated asymmetrical obtuse-angled triangles (symmetrical ones are rare), wide trapezes with both sides obliquely retouched, trapeze-shaped truncations without any retouch and rare lunates" (Korobkova 1996). On the other hand, Kiguradze suggest that microlith geometrics are instead characterized by high trapeze (Kiguradze 2002). Pencil-shaped cores became more frequent during the Neolithic, along with Chokh points and short scrapers. However, several tools that are more characteristic of farming societies are also identified, including oval-shaped polished stones, possibly used as grinder (Alexeev 1991).

Some interpretations that present Chokh as an evidence of local, independent process of domestication in the Caucasus are not entirely convincing. First, the chrono-stratigraphic context itself calls for caution. Indeed, according to Kushnareva (1997:10), "In Soviet Archaeological terminology, a horizon is equal to 50cm". However, Alexeev 1991 underlines the mere one-inch thickness of both Mesolithic, and Neolithic layers. If a hiatus has been identified between Mesolithic and Neolithic periods (Amirkhanov 1987), these discrepancies call for caution, especially when considering the lack of absolute date and the use of a site chronology based on an palynological sequence built on coastal sites, which is not as applicable in mountainous environment. Furthermore, no faunal or genetic data supports local domestication of animals or crops.

This lack of overall evidence suggests that, even though it is likely that some degree of continuity can be observed in the lithic assemblage, several elements point towards the introduction of domesticated species at the site of Chokh by external groups. Several elements, such as archeobotanical data and typology of carinated scrapers and blade-pyramidal cores, seem to point towards a connection between the groups living at Chokh during the late 7th to early 6th millennium and the groups associated to the Shulaveri-Shomu culture (Shulaveri, Aknashen, Aratashen). If the stratigraphic position of the lithic assemblages studied is correct, Chokh could represent an example of local Mesolithic group adopting farming-related technology after making contact with

"Neolithic" groups. Such a situation, if it is indeed the case, is not so different that what we have witnessed in the archaeological record at the site of Bavra Ablari, Georgia.

5.1.2.2. North Caucasus Neolithic

The Neolithic represented at Chokh can thus be characterized as a late Neolithic. However, despite the presence of cultural elements possibly associated with Shulaveri-Shomu culture, the material culture remains fairly different this culture, whereas in chipped-stone tool (Korobkova 1996) or macrolithic implements (Hamon 2008, Nekhaev 1990). Indeed, it seems that agriculture was not as important in the North Caucasus as it was in the South, and that societies in the southern region focused instead on raising stock and engaging in transhumant activity (Lyonnet 2004). However, the closer parallels built between ENeolithic groups that settled on both sides of the mountains during the 5th to 4th millennium could have resulted from the movement of groups from the plains of the Kura Valley to the northeast Caucasus (Narimanov 1992).

This process of abandonment of the plains during the 5th and 4th millennium BCE existed in parallel with the development of the first Chalcolithic societies. These societies first appeared in the North in the context of the Svobodnoe-Meshoko-Samok culture, around 4500 BCE (Courcier 2004, Lyonnet 2007), the date given for the first metal objects discovered on the slopes of the Caucasus (Chernykh 1991). Although, as Courcier (2014:34) points out, it is possible that a crucible identified by Formozov at the site of Veselego would "support the hypothesis of extractive metallurgy in the North Caucasus during the 5th millennium BCE". In the northeastern part of the Caucasus, the Ginchi culture, named after the site of the same name, came into being at about 4300 BCE. It was contemporaneous with the Sioni culture in the South Caucasus, and with the beginning of the Maijkop culture (Courcier 2014). The Ginchi groups were more agriculturally-focused their local agricultural ancestors, with an industry based on the production of big blades (Korobkova 1996). The industry comprises, in large majority, flint, but a few obsidian implements have also been identified as originating from a number of Armenian and Georgian sources located as far as 400km away (Badalyan et al. 2010).

In the course of the 4th millennium, Chalcolithic cultures underwent significant socio-economic and cultural changes (Lyonnet 2007). Some of these processes are not well understood; however, the development of the large cultural phenomenon known as the Kura-Araxe is generally associated with significant population movement, indicating that the Caucasus range was no longer an impermeable frontier. Some of these complex phenomena can be better understood in the light of the socio-cultural developments that occurred in the South Caucasus during the Holocene.

5.2.2. The South Caucasus Mesolithic

5.2.2.1. Concept and issues

The chronocultural sequence of the Mesolithic in the South Caucasus was mostly developed on typological basis. This approach led to the definition of large lithic technocomplexes such as the Zarzian (Campana 1989, Hole and Flannery 1967, Peasnall 2002) and the Trialetian (Coon 1951, Kozlowski 1998, McBurney 1968). In the South Caucasus itself, the dataset is largely biased towards Georgian sites, and the current chronocultural sequence is based on large-scale study of inter-assemblage variation within the Georgian territory (Korobkova 1996, Kushnareva 1997)

The large majority of Mesolithic sites in the Caucasus suffer from a lack of both stratigraphic context and proper dating, and their chronological attributions are typically based on their lithic assemblage variability. Bader and Tseretseli (1989) suggested that the origin of these Mesolithic sites lies in the 8th millennium BCE. Kozlowski (2009), on the other hand, associated this "Mesolithic" development with the end of the Pleistocene around the 12th to11th millennium BCE. He defined these cultures as a post-gravettoid and integrated into a large Caucasian-Caspian complex that included the large "Shan-Koban" industries (Kozlowksi 2009).

The Trialetian

Traditionally, the Mesolithic in this area has been associated with a cultural phenomenon known as the Trialetian, which emerged from the Imeretian Upper Paleolithic (Gabunia 1976; Kozlowski 1994; 1999). Originally defined as an industry (Bader and Tseretseli 1989) parallel to the Natufian in the Near East or the Zarzian in the Zagros, its meaning in the scientific literature progressively came to describe a cultural entity within a broad techno-complex utilizing sub-regional varieties (Kozlowski 1996; 1999). These varieties are based on the transformation of bladelet blanks, made by indirect percussion, into large geometrics like scalenes, obliquely truncated bladelets, and lunates. Later on, these implements underwent some degree of bipolar retouch, accompanied by the production of trapezes and truncates and the microlithization of the assemblages, which took place around 9000BC (Kozlowski 1999). Trialetian affinities have been identified in sites as far-reaching as Edzani and Zurtaketi in Georgia, Halla Çemi and Demirkoy in southeastern Turkey, Chokh in Dagestan, Belt Cave in Iran, and Dam Dam Chechme in Turkmenistan, typically beginning in 10,500 BCE.

There is, however, currently a lack of evidence to support the relevance of the concept of Trialetian as a regional "culture" or even a coherent technocomplex. Furthermore, some proponents of a local, independently developed food production identify in this "culture" the origin of the transition to this new economy (Amirkanov 1982a, Lisitsina 1984). However, the presence or absence of specific types of tools does not allow for a reconstruction of social and demographic processes. Furthermore, it is clear that several typo-cultural entities (Mesvheliani et al. 2007), including different modes of adaptations, and possibly different ethnic groups, coexisted in the region.

In Armenia, most of the Mesolithic culture was represented through a typological association of a few surface finds with known collections, or an assessment of the typology as being neither Upper Paleolithic nor Neolithic. This led Gasparyan (2001, 2007) to suggest the presence of up to 41 sites on the Armenian territory. His work was based largely on previous publications of excavations (Sardaryan 1967, Martirosyan and Munchaev 1968) and his own assessment of surface finds from varied museum collections (Gasparyan 2007). The differences between early and late Mesolithic, or Early Neolithic, could not be properly assessed. Thus sites have been grouped together on typological basis. Therefore, it is difficult to accept the chronocultural attribution of sites such as Aghvorik 3, Katnakhpyur, Beniamin, Paghakn, and Anipemza due to a lack of proper chronostratigraphic data (Gasparyan 2007, Dolukhanov et al. 2004) (Figure 18).

It is during this early Holocene stage that several authors have identified what is thought to be evidence of contact with Near Eastern groups (Kushnareva 1996) or early local agricultural development (Lisitsina 1984, Amirkhanov 1982). However, even if a case for possible contact with PPN groups from southeastern Anatolia can be made, there is no evidence supporting evolution of subsistence patterns in ways that led to cultivation and domestication of crop species.

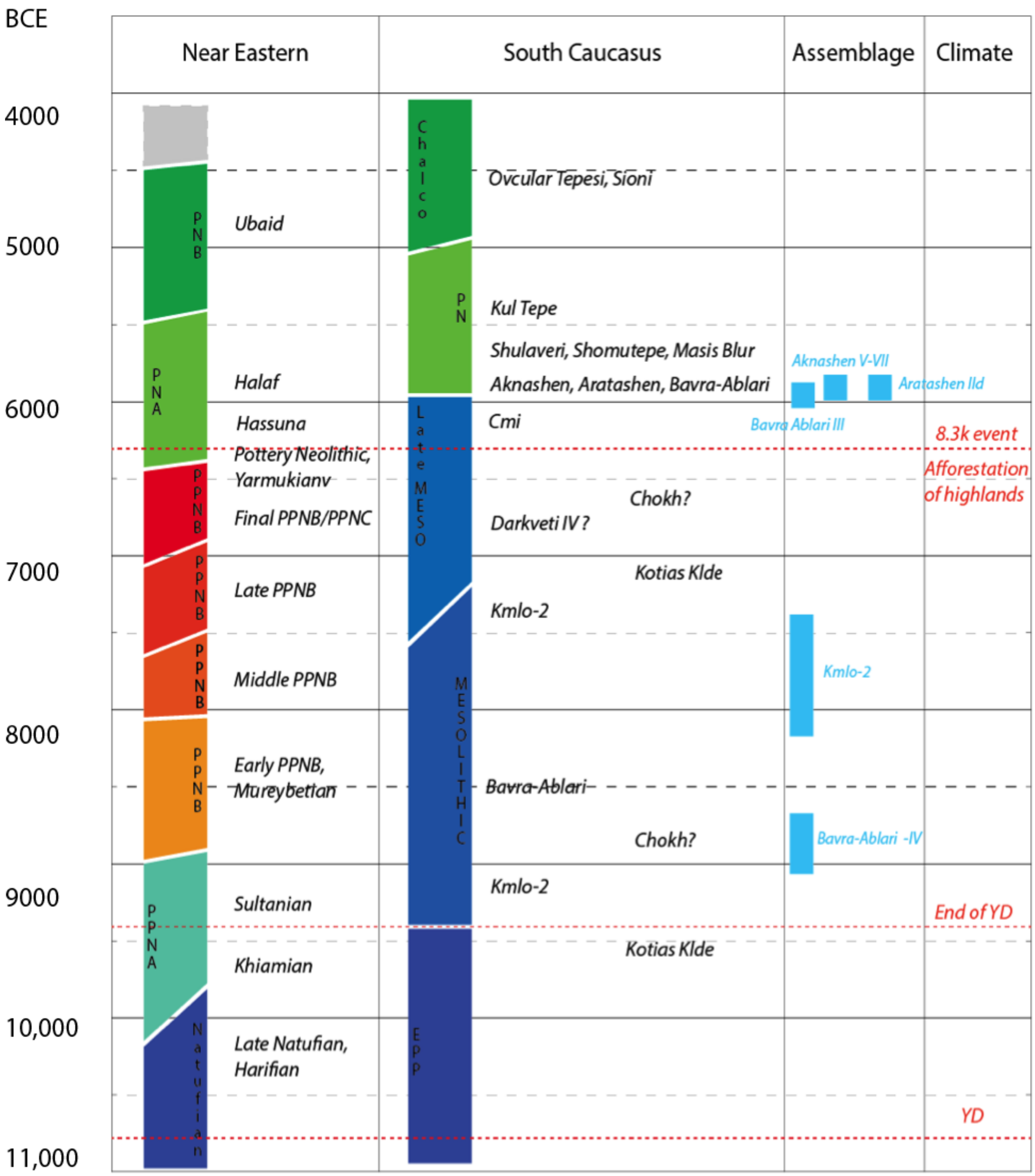


Figure 18: *Chronocultural Sequence*

Chataigner (et al. 2014) suggest a two-stage chronology for the South Caucasus Mesolithic: an Early Mesolithic occupation, spanning from 11th to 9th millennium BCE at sites such as Kotias Klde (Layer B), Kmlo (phase V-IV), (Kvachara, Darkveti Layer V), and a Late Mesolithic period, most likely associated with sites that have been interpreted in the literature as Early Neolithic.

Another division exists at the geographic level, generally associated with Mesolithic cultural entities (Gabunia and Tsereteli 2003). Five "provinces" (Figure 19) are represented: the Black Sea coastal area; the Rioni Valley; the Trialetian "provinces" of Edzani and Zurtaketi; and Javakheti (Bavra), themselves associated with cultural groups such as the Trialetian, Imeretian, Javakhetian. Javakheti is located in the Chokh region, which has been addressed above.

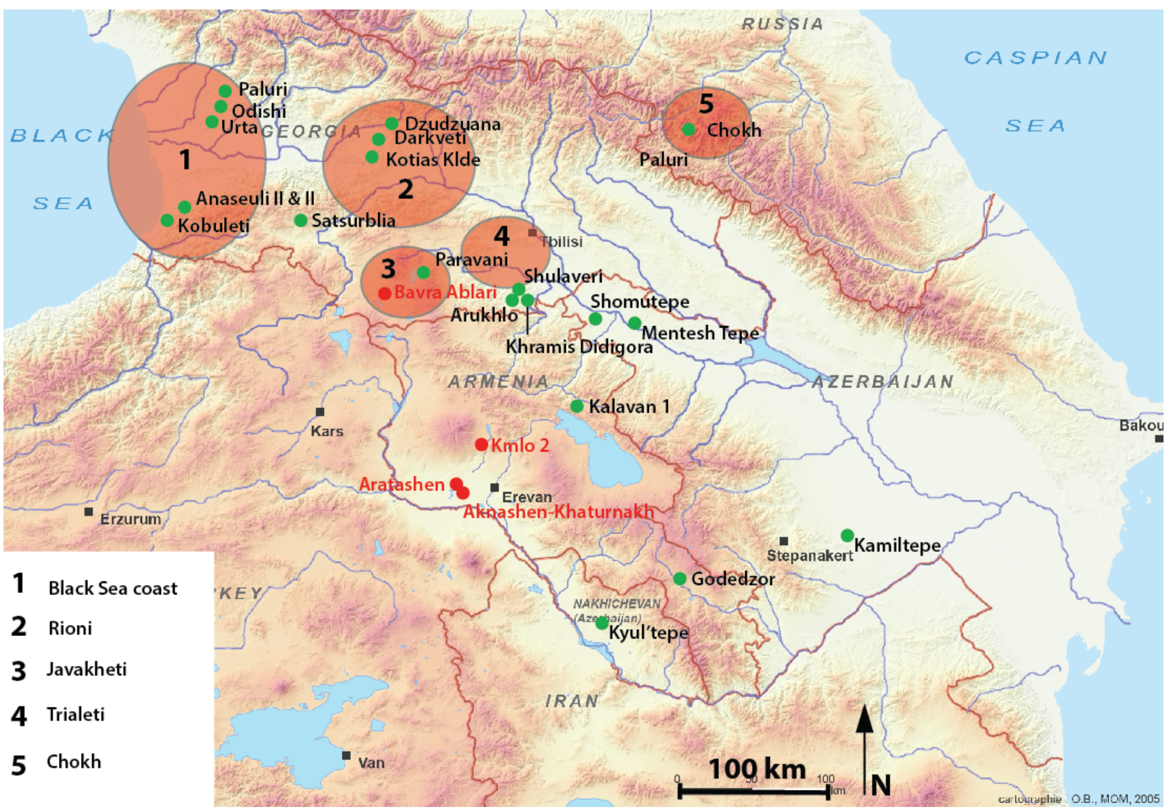


Figure 19: *Mesolithic "groups" in Georgia and Russia.*

5.2.2.2. Early Holocene contact between the Near East and the Caucasus.

In the Georgian highlands, Early Neolithic sites are traditionally associated with the Paluri-Nagutni culture. The eponymous site of Paluri, also known as Zhir Suki, was investigated by Grigoliya beginning in 1977. During this first excavation at Paluri, archaeologists identified small rectangular houses of about 2.5 to 2.8m in width (Grigoliya 1977:111). However, a review of the material excavated does not allow a clear association between these structures and what is considered an Early Neolithic layer, as no radiocarbon dates were provided. The Paluri-Nagutny culture (or tradition) is defined by the presence of flake-based assemblages, as well as the presence of specific types of hook-like, or "lekala" tools (Grigolia 1977, Lioubin 1966). "Lekala" tools are generally identified in northern Georgia, South Ossetia, Svaneti, and are found at sites such as Kotias Klde (layer A2, Matskevich and Mesvheliani 2009), and possibly Paravani I on the Djavakheti plateau (Cherlenok 2013, Kikodze and Koridze 1978). This type of tool shows a hooked projection or protrusion, a feature that has been included in tools found at several other sites in the South Caucasus in South Ossetia, Svaneti, the Paravani region, and Central Armenia, where they are identified as "Kmlo tools" (Arimura et al. 2010). These tools are realized both on flakes and blades (Kiguradze and Menabde 2004) and show an abrupt, continuous, and parallel to sub-parallel retouch that is direct or inverse on one or both lateral edges (Arimura et al. 2010). In most situations, their creation also seems to have involved pressure flaking techniques used in the retouching of the lateral edges.

Typologically, some parallels can be suggested with similar artifacts found in southeastern Turkey and northern Mesopotamia known as Çayönü tools (Redman 1982, Caneva et al. 1994). However, use-wear analyses have shown clear differences between Kmlo tools and Çayönü tools, both in terms of technology and use (Arimura et al. 2010), and the author thus argues that no technological parallel exists. This Kmlo tool, and the technology associated with its production, do not appear before the 9th millennium BCE. Furthermore, it is mostly, though not exclusively, identified sites located in mountainous areas. Some evidence suggests that the tool was continually produced until the 4th millennium BCE (Gasparyan, comm pers). However, as a whole, the phenomenon seems clearly connected with a type of Early Holocene cultural development.

In Armenia, several surface finds have been associated with this period, at locations such as Beniamin (7th mill. BCE), or Paghakn (7th mill BCE) (Khachatryan 1997, Gasparyan 2007) and a bullet-core, associated with Tchojounjou tools (parallel to Kmlo tools), as well as a polished stone axe in serpentine, which originated in Chirakavan and has been attributed to the PPNB (Martirossov 1979, Gasparyan 2007). However, merely two Mesolithic sites have actually been excavated: Pechka grotto (Aslanyan et al. 2006) and Kmlo II (Arimura et al. 2010). Furthermore, only the latter provided radiocarbon dates connecting it to the early Holocene. Pechka Grotto is located in Northern Armenia on the Somkhetian ridge, at an altitude of 1670m. A small scale excavation identified 4 undated layers, among which layers 3 and 4 produced Mesolithic looking artifacts, including prismatic and pyramidal cores, microliths (segments), backed micro blades and blades, and a few microborers (Aslanyan et al. 2006). The site of Kmlo 2 is located on the Aragats massif in Armenia and is part of the sites studied in the context of this dissertation. Phases III and IV of the stratigraphy are associated with the early Holocene, during the mid-9th to mid-8th millennium BCE and the 10th to mid-9th millennium BCE, respectively. Layer IV is identified as Early or Middle Mesolithic. This layer produced an abundance of microliths, including backed bladelets, scalines, and several lunates, manufactured using the micro-burin technique. Kmlo tools also been identified in surrounding sites, although they only appear at the end of the layer IV and might be more closely connected to cultural developments that took place at the end of the 9th millennium. It seems that Early Mesolithic groups from phase V and phase IV continued to rely on microlithic technology to hunt large bovids and mountain caprids (Chataigner et al. 2014)

Independent lithic technology and subsistence pattern change predating Shulaveri- Shomu groups.

The so-called Early Neolithic culture, identified at sites such as Anaseuli I, Khutzubani, and Kobuleti, is said to have evolved from the Late Neolithic found at sites like Odishi, Anaseuli 2, or Kistrik (Korobkova 1996). The distinction between Early and Late Neolithic is based on Fromozov's two-stage Neolithic (Formozov 1965). According to Fromozov, the earlier stage retained some Mesolithic features (bladelet blanks, hand pressure flaking technique), while the later stage includes "Neolithic" elements such as polished tools (Mesvheliani 2013). Several sites have been attributed to the Early Neolithic period, such as Kobuleti, Kistriki, or Anaseuli I. Anaseuli I refers to a concentration of artifacts and potential open-air sites, located in the SE part of Georgia. First investigated by Kalandadze (1939), the area was then studied by Nebieridze in the 1960s (Nebieridze 1972). Based on Nebieridzes's typological studies, it has long been considered a key site in the study of Neolithic development in the area (Kiguradze and Menabde 2004, Korobkova 1996, Kushnareva 1997, Meshveliani 2013). In 2008, Matkevisch and Mesvheliani carried out a new series of surveys and test pits to assess the archaeological potential of the stratigraphy. The result of this inquiry was evidence of two layers, both of which produced artifacts. The majority of the site's assemblage was found in the first, thin layer (2.5cm). Neither bone remains nor bone tools were found, and only a few artifacts could possibly be identified as "polished tools" or polishers (Mesvheliani 2013). Archaeologists found a cache with five long blades , and the rest of the industry showed parallels with Mesolithic industries, especially due to the presence of bullet-cores, or possibly even earlier periods (Mesvheliani 2013). Some tools, like grinders, sickle blades, and ground stone tools, have been linked to agricultural activities (Chataigner et al. 2014, Korobkova 1996, Meshveliani 2013). Chernelok (2013) suggests that both the presence of trapeze microliths and evidence for the processing of soft stones bear significant similarities to the behaviors noticed in Darkveti layer IV. However, recent dating from both layers suggests dates ranging from 11,287-10.929 BP to 6840BP, emphasizing a certain degree of mixing (Mesvheliani 2013). Close to Anaseuli I, the site of Kobuleti, also assigned to the Early Neolithic (Gogitidze 1977, Kushanreva 1997) was also recently re-analyzed. Although no dates have been provided thus far, it is typologically and technologically associated with the Late Upper Paleolithic (Mesvheliani 2013).

In the late 1970s, Nebieridze (1978) and Grigoliya (1977) identified the same pattern of an "evolved" Mesolithic in the aceramic sites of Darkveti and Paluri. The site of Darkveti played a particularly important role in the definition of the Early Neolithic. A stratified, possibly undisturbed settlement, Darkveti produced four layers: EBA (layer I), Chalcolithic (II-III), Early Neolithic (IV) and sterile layer (V), Mesolithic (VI). It is based on the comparison with its layer IV assemblage that archaeologists have attributed most other Caucasian sites to the Early Neolithic (Cherlenok 2013). Darkveti IV's description poses several problems. The sediment first described is extremely similar to layer II and III, although no ceramics were found. A recent review of the technology at Darkveti suggests the presence of a consistent flintknapping technology in layer IV and VI (Early Neolithic and Mesolithic). However, the retouch on Mesolithic microliths shows more "asymmetry" and backed technique than does the "early Neolithic" microliths (Chernelok 2013). The presence of rock and rubble in the stratigraphy may be evidence that the phenomenon of admixture occurred. In any case, the assemblage is composed of thin blades, microliths, bladelets with distal retouch, end scrapers and round scrapers (Nebieridze 1978). In the layers II, III and IV, faunal assemblages are characterized by the presence of *Bos, Capra, Canis* and *Sus*, the latter being the dominant taxa (Nebieridze 1978). However, there was clear shift in relative representation of wild fauna between layer IV, characterized by 83% of wild mammals resulting possibly from hunting activity (Berton 2014). However, the identification of domesticated species—including sheep, goats, pig and cattle—from Layer IV is unsure, as "no information is provided for the criteria used for the determination of the domestic status of these bones" (Berton 2014:43).

This review of the data available does not support the hypothesis of a "developmental" stage of Neolithic during the first millennium of the Holocene I the South Caucasus. Not only does the association between Mesolithic and Neolithic lithic traits have shown to result from mixing of layers, there is also no evidence supporting changes in subsistence patterns before the 6th millennium BCE.

5.2.2.3. Mesolithic chronocultural sequence

The earliest controlled dates available for the Mesolithic in the South Caucasus come from the sites of Kotias Klde (10,400-8,300 BCE) (Meshveliani et al. 2007) and Kmlo-2 (Arimura et al. 2012), while the latest Upper Paleolithic dates are provided by Kalavan 1 (13th millennium BCE) (Montoya et al. 2010) and Dzudzuana (14,500–11,200 BCE) (Bar-Yosef et al. 2011). Most of the stratified sites available today are caves sites or rockshelters like Pechka (Aslanyan et al. 2006), or Apiancha (Bader and Tsereteli 1989), which are located for the most part in river valleys (Meshveliani et al. 2007; Gasparyan 2001; Arimura et al. 2010).

The modern territory of Georgia hosts the majority of Mesolithic sites: Gudaleti, Pichijini, Nagutini I, II, Tsipleti, Dzagina, Lashebalta, Zura-Akho, Jijoeti, Dzari, and Ucheleti, among others (Gabunia and Tsereteli 2003). The density of settlement in this area led to the division into regional variants that I presented earlier: Imeretie, or the Rioni Valley; Javakheti; Trialeti; and the Black Sea coast (Gabunia and Tsereteli 2003, Kushnareva 1997). Recent climatic data seems to emphasize the lack of evidence for a cold and arid Younger Dryas on the Black Sea coast (Arslanov, Dolukhanov, and Gei 2007). This might explain why, along with the Imeretian region, western Georgia, as a refugium, has provided the largest amount of Mesolithic settlements in the South Caucasus. Most of the known sites in the area are caves or rock shelters (Mesvheliani et al. 2007, Meshveliani 2013), such as Apiancha, Darkveti, Kvachara cave Atsinskaya, or Navalishenskaya (Bader 1984, Golovanova et al. 2012, Kushnareva 1997).

The layer B of Kotias Klde is the best-dated context for early Holocene Mesolithic culture. Typologically associated with Darkveti V and possibly Kvachara

(Mesvheliani et al. 2007), the site of Kotias Klde is located in Imeretia, south of the Kvirila River, and has produced two layers with a series of radiocarbon dates ranging from 10850-8240 cal BC to 7690-7300 cal BC (Meshveliani et al. 2007, Bar-Oz et al. 2009). Layer A2 is presented as "Early Neolithic," a naming decision that we will discuss later. Layer B has provided interesting lithic and faunal assemblages. Kotias Klde's Mesolithic industry is resolutely microlithic (Figure 20). It is characterized by an important amount of backed bladelets of less than 20mm, sometimes obliquely truncated—with these truncations often carried out on the proximal side—and some geometrics that could be associated with scalene and isosceles triangles, obtained through unidirectional knapping of cores with one to three platforms (Mesvheliani et al. 2007). The micro burin technique is also attested in two situations, and some bladelets and blades show traces of bipolar retouch (Matskevich et al. 2007: 52). Finally, the Mesolithic layer produced a rich faunal assemblage with red deer, red deer, wild boar, brown bear, fox, porcupine and fish represented (Bar-Oz et al. 2009). Finally, I will point out the presence of bears in association with late spring-early summer occupations of the shelter, interpreted by Bar-Oz (et al. 2009) as possibly related to ritual killings.

In the Trialeti region, located in central Georgia, the two most representative sites are Edzani and Zurtaketi (Gabunia 2000). Both sites have been associated with the Mesolithic on typological basis, but neither has provided any dates. The type of industry identified by Gabunia is a local variant of broader Mesolithic patterns. A preliminary study of the Edzani assemblage has been carried out by the author and will be presented

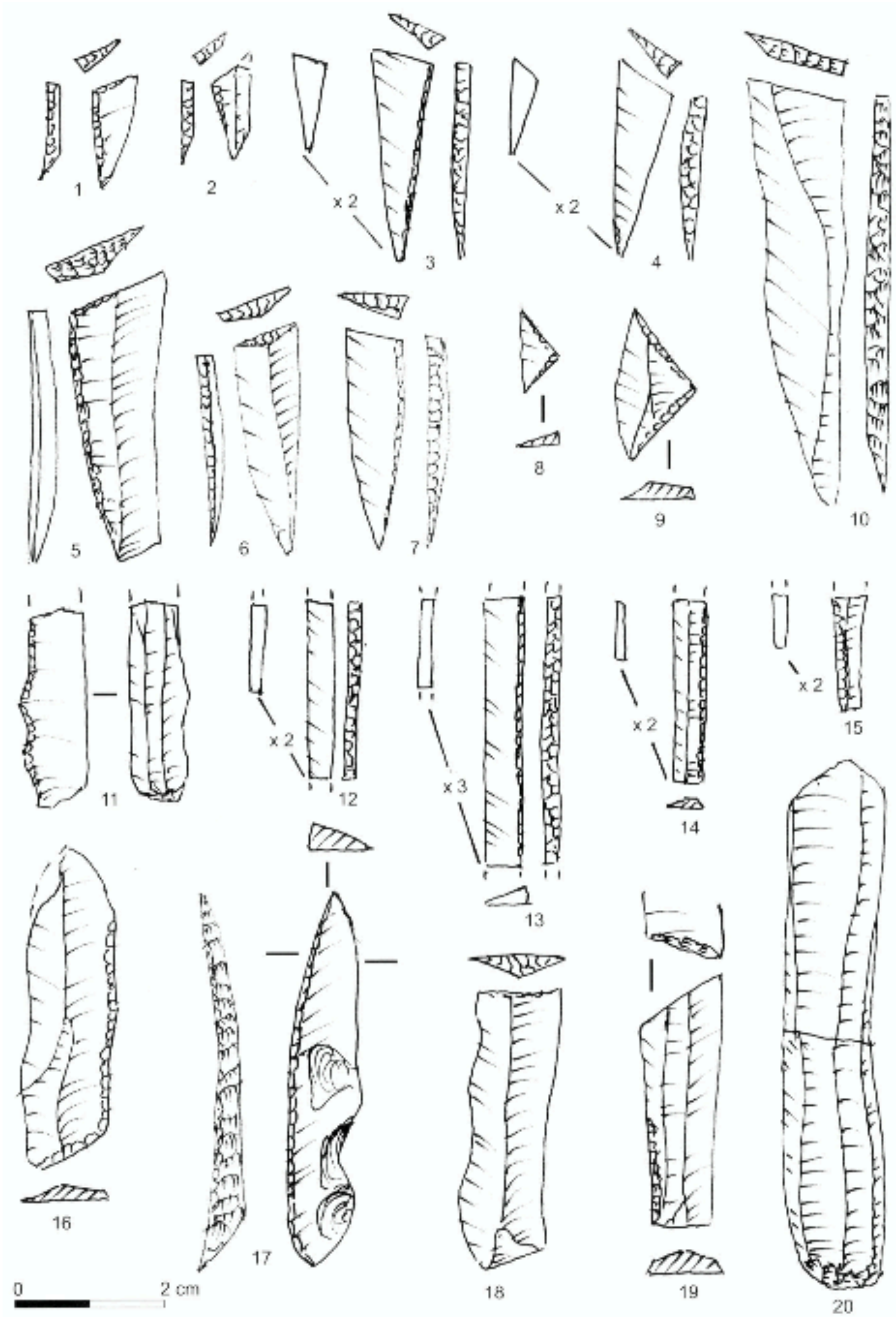


Figure 20: *Lithic assemblage from Kotias Klde: 1-7,10: elongated triangle, 8-9, isoceles triangle, 11, 12,14, 15, retouched bladelet, 16,19, retouched and truncated blade, 17, backed bladelet, 18, truncated bladelet, 20, blade (Meshveliani 2007: 53)*

later. The industry is represented by bullet-cores, with no micro-burins identified in the partial study of the collection that was done. There are also several elements supporting the production of larger blades (8-10cm) and the transformation of these blades into end and side scrapers as well as into geometrics like scalenes. The fauna identified at both sites ranges from large to small mammals, including bear, fox, fish, and deer.

The Javakheti plateau has also yielded several Mesolithic sites, which were excavated in the 1970s and 1980s by Manana Gabunia. Located in the Paravanistkali Canyon, the site of Bavra, across the river from Bavra-Ablari, produced an important number of lithic artefacts although, despite the quality of the excavations carried out, which provided no dates associated with the layer (Gabunia 2000). Their Mesolithic characteristic is estimated on the basis of stone tool types identified, along with the presence of bullet cores, backed bladelets, burins (with a possible identification of micro burins) (Gabunia comme pers.), lunettes, scalenes and trapezoids (Gabunia 2000).

Broadly, the Mesolithic findings show some degree of continuation of EPP and UP productions, although they also reveal a larger focus on backed and retouched bladelets, backed points, and the development of the micro burin technique, associated with new types of microliths such as the scalene, and, to a lesser degree, lunettes and trapezoids (Chataigner et al. 2014). These groups were small hunting bands, who engaged in short term, but repeated, occupations of caves or rock shelters, apparently without constructing structures or dwellings. The presence of obsidian at almost every sites supports the idea of a high mobility. Additionally, these groups hunted a wide range of prey, including large mammals—especially bears, the remains of which have been found at Kvachara cave and as Kotias Klde (Bar-Oz et al. 2009, Mesvheliani et al. 2007), and Bavra Ablari (Varoutsikos et al. *in press*)—to fish, wolves, foxes, rabbits, and tortoises (Gabunia 1982). Some of these Mesolithic cultures, such as Edzani, Chokh, or Darkveti (Amirkanov 1984, Gabunia and Tsereteli 2003) and, especially, the Trialetian (Kozlowski 2009) have been identified as the origin of an Early Neolithic development.

In conclusion, while it is not yet possible to provide first-hand evidence that support the presence of a developmental stage of Neolithic in the South Caucasus, a case can be made for the significant cultural developments taking place from the 9th and 8th millennium onwards. Indeed, keeping in mind the limitations imposed by the small sample size associated with the dated stratigraphic context available, certain interesting features of this period seem to stand out. Several authors have first noted clear differences between Early and Late Mesolithic lithic assemblages (Amirkhanov 1984, Arimura et al. 2009, Chataigner et al. 2014, Korobkova 1996, Kushnareva 1997, Mesvheliani 2013). Indeed, there seems to be a shift in the lithic industry between the 11th-10th millennium and the 9-8th millennium BCE, with the production of larger blades or even flakes beginning to occur. Although microliths, mostly triangles and lunettes, remain dominant, they tend to become shorter—largely transverse arrowheads. In addition, scalene triangles and backed bladelet become more rare (Chataigner et al. 2014). The late Mesolithic also saw the production of worked soft stones, previously interpreted as polished stones. They are present at sites a number of sites. At Anaseuli I, traceological studies have shown their use as hafts (Chernelok 2013, Matskevich and Meshveliani 2009, Mesvheliani 2013), and at both Chokh (Amirkhanov 1982a, 1984) and Bavra Ablari (Varoutsikos et al. *in press*), we observe a groove and several decorative marks. Archaeologists have attributed multiple purposes to these tools, suggesting their use as sickles at Chokh (Amirkhanov 1984, Lisitsina 1984) and polishers at Anaseuli I (Mesvheliani 2013). While the chronological attribution of the tools is uncertain, they do represent technological behaviors that were unknown before this point, and disappeared afterwards with the development of Shulaveri Shomu culture. Finally, the Late Mesolithic sees the appearance of a complete new tool type, the Kmlo tool (or Paluri-Nagutni hooked tool). The use of the Kmlo tools as sickles has been suggested (Korobkova 1996) but recent microwear analysis tends to support a use on wooden material (Arimura et al. 2010), although the issues inherent to microwear studies on obsidian call for caution. Some of these technological elements persisted into the 5th millennium BCE, thus raising the question of how pre-Shulaveri Shomu cultures were integrated into these new agricultural societies, which began to develop at the very beginning of 6th millennium BCE.

5.2.3. The Neolithic of the South Caucasus

Disregarding the data from western Georgia, where agricultural sites can be safely identified only as Eneolithic (Mesvheliani 2013), it is possible to divide the distribution of Shulaveri-Shomu sites into three areas, or oases (Chataigner et al. 2014): the mid-Kura Valley, including northwest Azerbaijan and southern Georgia; the Kura plain in Azerbaijan, and the Araxes River valley in Armenia and Nakhichevan (Figure 21).

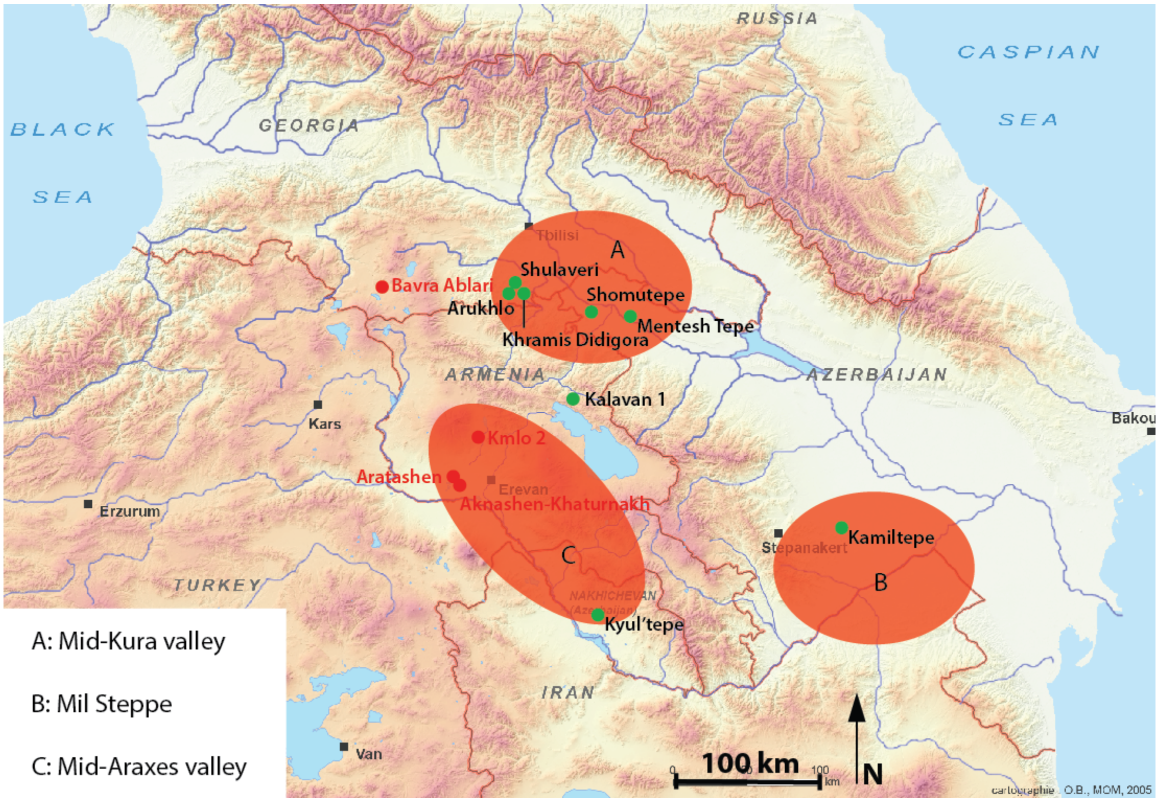


Figure 21: *Neolithic "areas" in the South Caucasus.*

A: Mid-Kura valley; B: Mil Steppe; C: Mid-Araxes valley

5.2.3.1. The Mid-Kura valley

The mid-Kura Valley *(*Figure 21:A) hosts the sites of Shulaveris Gora, Imiris Gora, Arukhlo, Gadachrili Gora, and Khramis Gora in Georgia, and Shomutepe, Goy Tepe and Mentesh Tepe in Azerbaidjan. Narimanov first excavated the site of Shomutepe during the early 1960s, when he identifies a 1ha tell, out of which 400m2 were excavated. Due to its "Late Neolithic" nature, with reference to the Near Eastern sequence, Narimanov 1987:12) categorized the site as Eneolithic. The excavations at Shomutepe produced a high density of round mud-brick building, with an average of 3m of diameter. Some of the buildings were subterranean and may have been domed. The material culture at the site is composed of long obsidian blades and scrapers, a significant concentration of mortars and grind stone tools, and a high number of bone tools (Narimanov 1966). Similar features were identified in later excavations or surface collections at the sites of Rustepesi, Toiretepe, Gargalartepesi, and Kechili. The mid-Kura Valley area comprises the Kvemo-Karli and Kakheti region in Georgia and the western part of Azerbaijan. Although the Kakheti area has traditionally been less studied, the rest of the middle Kura basin has produced an important number of sites. However, variations in charcoal sampling, dating methods have created a somewhat confusing picture.

Western Azerbaijan is an area located on the mother foothills of the Lesser Caucasus, generally south of the Kura river, on the alluvial plain composed of silt and clay. Is it characterized by several fairly shallow streams, in addition to tributary bayous that exist seasonally. In the 1960s through the 1980s, I. Narimanov led a team that carried out the foundational work on agricultural settlements in this particular region. He identified about 20 tells or artifact concentrations that he qualified, sometimes simultaneously, as Early Neolithic and Eneolithic (Narimanov 1987). The degree of homogeneity in material culture and construction techniques between these sites led him to propose the existence of a Shomutepe culture, named after the eponymous site, also identified by Narimanov in the 1960s. The large tell was investigated over 400m2, and produced a single layer characterized as Eneolithic (*Aenolithic)*. At the site, succession of clay and ashy layer, also noticed as Goy Tepe (Kadowaki et al. 2015) was connected to a series of circular buildings built from sundried or unbaked bricks, preserved to up to 1.2m of height and up to 3.7m of diameter. Inside of the structures and arranged around a courtyard between the dwellings, excavators found small storage structures as well as several hearths. The material culture, defining the Shulaveri-Shomu group, is composed of grinding stones, pestles and mortars, polished stone axes, bone industry (shovel and mattocks, spoons, awls), several bone female figurines, and a blade-based lithic industry in obsidian and flint, with a high density of tools and a production of sickle blades (Hamon 2008, Narimanov 1987). The lack of dating did not allow a proper sequencing of the occupations or identification of synchronism, but certain traits have led to the classification of two general episodes: first are the tell sites of Shomutepe, Toiretepe (Narimanov and Rustamov 1960), Dzhinnitepe, Gurbantepei, Arzamastepesi, Goytepe, Mentesh Tepe (or Mentezhtepesi), among a few others. These are characterized by important amounts of material, straw-tempered ceramic (although in small quantities), round and sometimes subterranean structures, sickle inserts, and bone and horns artifacts (Narimanov 1987). The second category includes the sites of Kichiktepe, Alchaktepe, Barbadevish, Yatageri, Mamedalibektepesi, Rustepesi, among others. These sites did not produce as much material or dwellings as the first category, the construction techniques used in buildings was also different from the other sites. The second category also showed some traces of grit-tempered ceramic or copper beads. Recently, several international projects resumed excavations of some of these sites and have provided new data on economic and cultural behaviors.

The site of Mentesh Tepe is a tell Age located in the Tovuz district, with layers ranging from the Neolithic to Early Bronze. Discovered by Narimanov in the 1960s, part of the site's upper layers have been destroyed by construction work. However, excavations directed by Guliyev and Lyonnet (2011, 2013) have produced Neolithic burials, interesting lithic assemblages, Halaf-related pottery sherds, and faunal and botanical data (*ibid.*). The earliest Neolithic layers have been dated to 5700BCE, and

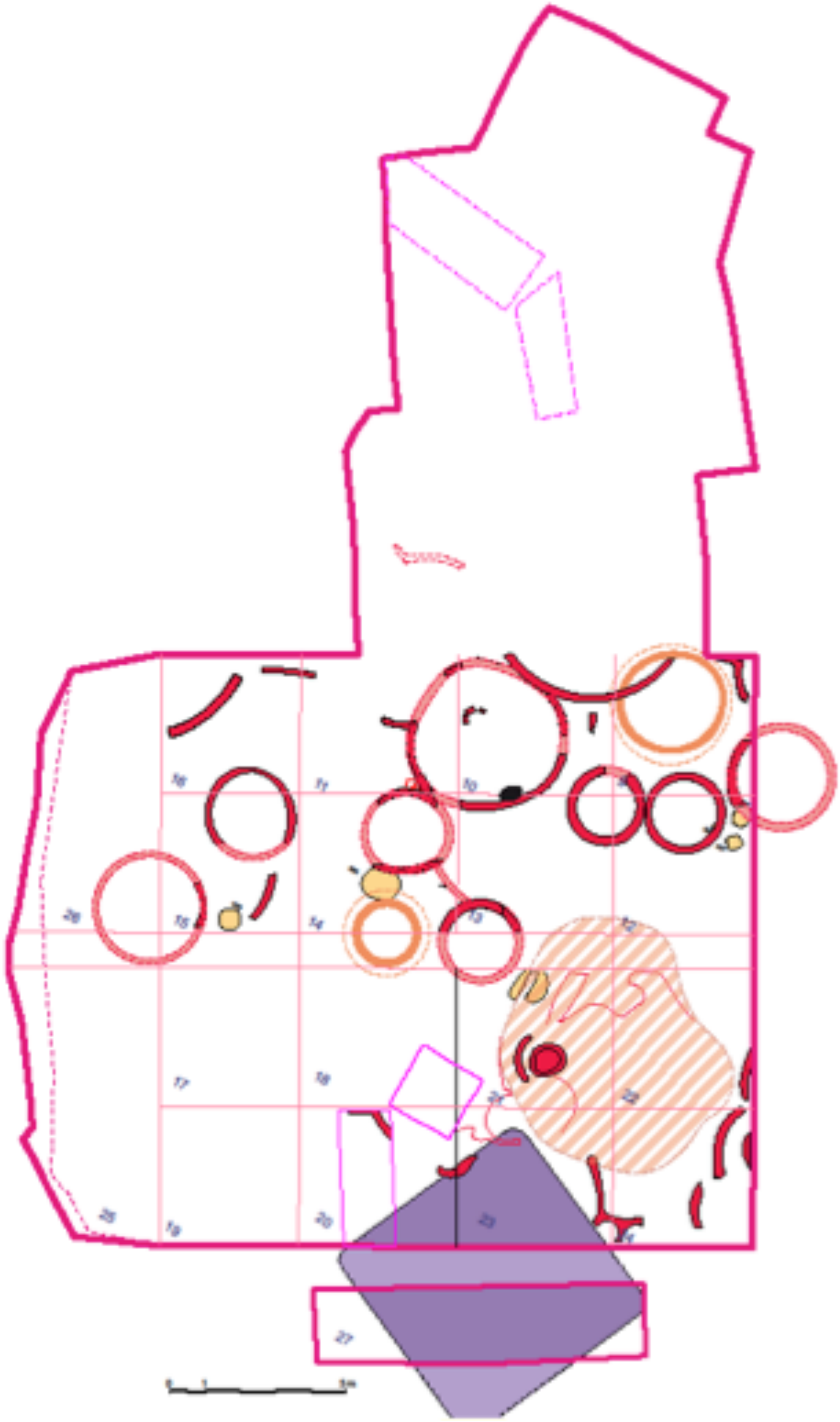


Figure 22: *Plan of the Neolithic layer at Mentesh. Note the succession of circular structure (Guliyev and Lyonnet 2013)*

these layers show an accumulation of circular and sub-circular sun-dried mud brick structures for habitation and storage (Figure 22). Some of these structures sit on brick "assise", and the pits have a diameter of up to 1.50m. Despite possible issues of admixture between the Neolithic and Chalcolithic layers (Astruc et al. 2013), analysis of the lithic assemblage has highlighted interesting features associated with food-producing activities. The majority of the assemblage is obsidian (96.5%) dedicated to the production of blade and flake tools, such as burring, backed bladelets, truncations, burin spalls, end and side scrapers, denticulates, notches, piece esquires, drills, and pointed tools. Micro-wear analysis has shown that some of the sickles were used to harvest cereals, and were hafted longitudinally (it is traditionally believed that oblique inserts are older than longitudinal one in the Shulaveri-Shomu tradition), traces of bitumen having also been identified. However, no technical pieces or subproducts of these *chaîne opératoire* have been identified aside from a small crested bladelet. However, archaeological evidence does suggest a systematic selection for homogeneous blanks coming from *plein débitage*, as even lateral blades are scarce (Astruc et al. 2013). These blades could have been detached by pressure, using the lever technique (Pelegrin and Chabot 2012), but it is possible that this action was not carried out on the site itself. Indeed, up to nine different obsidian groups are represented in the entire Chalcolithic and Neolithic assemblage. Some of these sources are relatively near to the site, including one source at Tsakhkunjats, but others are as far as 150-200km away, such as the sources of Chikiani, Gegham, or Siunik obsidians (Pelegrin and Chabot 2012). The two layers produced a rich bone industry (N=161) with pointed tools, hafts, and, possibly hammers, as well as very interesting beads manufactured on fish vertebra. Finally, the site has produced a Neolithic burial with 27 individuals, 18 of them having been excavated. The bioanthropological analysis identified 10 adults (4 men and 5 women), as well as children of all ages. The bodies were accompanied by bone parure, and one obsidian blade found in the hand of an individual (Lyonnet and Guliyev 2013).

Further to the southeast lies the site of Goytepe, also originally investigated by Narimanov (1987). Located south of the Kura River, 10km east of the city of Tovus, the tell is a round mound 145m in diameter and 8m in height. More than two decades after Narimanov's initial work at the site, excavations resumed in the early 2010s under the direction of Guliyev and Nishiaki (2012). Their team has identified levels from Bronze Age to Neolithic (Guliyev and Nishiaki 2012, Kadowaki et al. 2015, Nishiaki and Hasanov 2014).

Figure 23: *Neolithic structure at Goytepe with mudbricks and entrance (Guliyev and Nishiaki 2014)*

The Neolithic layer yielded the same type of circular structures (Figure 23) as those that exist as Mentesh Tepe, built with plank-convex grey or yellow mud-bricks with a straw temper of up to 50cm in length. Several postholes have also been found, suggesting the presence of a roof that might have been made out of mud bricks (Guliyev and Nishiaki 2012). At least twelve occupation layers are connected to the five or six buildings that may have existed at the site. In the “courtyard” among the postholes, domestic features such as pits, ovens, stone tools, and pottery vessels have been found. The ceramics found in this area are largely undecorated. The lithic assemblage is composed of obsidian sickle blades, manufactured through pressure and indirect percussion and then hafted obliquely into bone or wooden elements. Several arrowheads (trapeze) are also found at Aruchlo, and to some extent in Aknashen. Guliyev and Nishiaki (2012) suggest some parallel with other Syrian Neolithic assemblages like Sabi Abyad II (Copeland 1996). Pelegrin and Chabot (2013) previously suggested this connection in reference the blade production techniques, offering more evidence for potential connections with the Upper Mesopotamian region. Several structures were identified as storage for free-threshing wheat (Guliyev and Nishiaki 2012). Hulled wheats and lentils are also present, although in smaller proportions (Guliyev and Nishiaki 2012). Up to 80% of the faunal assemblage is comprised of domestic sheep, goats, cattle and pigs. Some of these structures also may have been used as caches for chaff, a feature also common in stone tool caches. The appropriation of these structures as chaff caches may be interpreted as the anticipation of a reoccupation after short-term absence, in the context of a planned, seasonal occupation of the site (Henry et al. 2014, Kadowaki et al. 2014, Stevenson 1982). Another occupation identified at Elamxanli Tepe, located near

Goytepe, provided the earliest date for agricultural settlement in the area and is currently being published (Nishiaki et al. *in press*).

The Shulaveri-Shomu culture in Georgia is concentrated in the Kwemo-Kartli plain around four different centers: Arukhlo, Shulaveri (in the Marneuli region), Tsiteli-Sopeli (a compound of five mounds, most likely attributed to the late Neolithic) and the Kachagani village area (five mounds). The idea that Paluri Early Neolithic groups preceded Shulaveri-Shomu groups is commonly accepted. However, as I argued earlier, the lack of proper dating and evidence for an evolution of subsistence economy means that there is no clear evidence for this developmental stage. The material culture is also characterized by pottery with some incised decorations–a feature now associated with later periods of the culture—along with blade-based obsidian assemblages with high proportion of burins, denticulates, drills, scrapers (Hamon 2008), and a dense faunal industry. Some metal objects in arsenic copper have been found in low layers at Aruchlo and Khramis Didi Gora (Narimanov 1987). Let us also note that several anthropomorphic figures, which likely represent seated women (Hamon 2008), have been found in several sites in the area (especially at Khramis Didi Gora). During the 6th millennium BCE, the region was “characterized by a dry continental to semi-arid climate” (Connor and Sagona 2007 in Hamon 2008). However, the dry climate was ameliorated by dense forests along the river courses and oak-honrbeam forests on the foothills (ibid), which allowed for the development of numerous settlements such as Khramis Didi-Gora, or Imiris Gora. These groups’ subsistence economy relied heavily on domesticated crops (hulled wheat, barley, hemmer wheat, lentils, rye, and millet) and animals (goat, sheep, pigs, cattle, along with a wide range of wild mammals such as deer, wolf, aurochs) (Hansen et al. 2007). The lower layers (XI-VI) of the eponymous site of Shulaveri Gora was long considered to be the earliest settlement in the area (Narimanov 1987, Kushnareva 1997). Located on the right slope of the Khrami River, this mound is 100m by 40m, with a height of two meters. Round, mud-brick structures made of a single course of bricks have been found, along with several occupation floors, some of them showing traces of an ocreous solution. Bone mattocks and shovels are only found in the upper layers, and the first ceramics of the sequence are straw-tempered and extremely simple in type (Djavakhishvili 1973). About 50% of the lithic assemblage is made of tools (end scrapers, chisels, sickle blades, adzes), also based on blade blanks (Djavakhishvili 1973). The bone industry is comprised of spoons, spatulas, needles, awls, and arrows (Hamon 2008). Although some variation exists, there is a significant homogeneity in the assemblages when compared to the several sites in the area. Khramis Didi Gora is the largest tepe (4.5ha, 6m high) and this site contains a significant number of postholes, storage pits, and anthropomorphic figurines (Hamon et al. *in press*). Furthermore, a higher variation in bone tool production than that seen at Shulaveri Gora exists, with the manufacture of large perforated axe, mace heads, and splintered tools in antler (Narimanov 1987). While early excavations did not use modern techniques, this reality has been progressively changed as archaeologists bring more international projects into the area.

The site of Aruchlo I is a mound of 150m by 100m, and 6m high, located in the Lower Kartli region. First excavated by Kubinishvili and Gogeli between 1966 and 1985, G. Mirtskhulava and S. Hansen began a new series of excavations in 2005. In the Neolithic layers dated from 6000 to 5400 BCE, the site shows the typical circular mud brick structures, with a diameter ranging from 1.8 to 4.6 meters (Chelidze and Gogeliya

2004) (Figure 24). Numerous storage pits accompany these structures, and two ditches surround either side of the mount itself. Five horizons have been identified, and can be characterized according to their slightly different pottery traditions. Overall, the ceramic assemblage is fairly limited in type repertoire. Coarse, ovoid pottery appears in the first horizon. This type was progressively replaced with mineral-tempered (mostly basalt, sand, and, in rare cases, obsidian) and organic-tempered (straw) ceramic vessels that

Figure 24: *Brick wall at Neolithic Aruchlo (Hansen et al. 2008)*

appear perforated under the rim, with projecting handles and occasionally decorated with knobs. Some vessels are burnished and have thus been interpreted as imports, while others present a red polish or red painting (Hansen et al. 2007). The rich organic remains have allowed the identification of a varied botanical assemblage, including wheat

(*Triticum diccoccum, T. mono- coccum, T. aestivum, T. turgidum T. compactum, T. Durum, T. spelta, T. macha, T. paleo-colchicum*, barley (*Hordeum vulgare and Hordeum distichum*), oat (*Avena sativa*), rye (*Secale cereale*) and millet (*Panicum miliaceum*),” *T. Aestivo-compactum* was the dominant taxon represented, followed by *T. diccoccum* and *T. spelta* (Hansen et al. 2007). Other taxa like barley and lentils were also present. Recent DNA studies at Aruchlo have shown a high variability in mt haplotypes in sheep and cattle, indicating long-term processes that involved significant interactions between different populations (Chataigner et al. 2014). The bone industry at Aruchlo can be characterized by biconical needles and perforated antler artifacts (Hansel et al. 2007), with some of these bones found in two burials located beneath house floors (Hansel et al. 2007). The material culture includes groundstone tools, obsidian blades, bone tools as well as stone beads (Figure 25).

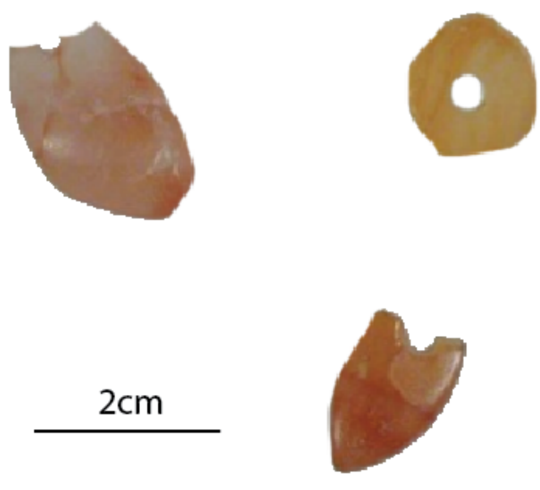


Figure 25: *Stone beads from Aruchlo, cornaline (Hansen et al. 2008)*

The stone tool assemblage is mostly made out of obsidian. Analysis of 8000 pieces highlighted a blade-oriented assemblage, although the low frequency of cores, cortical pieces, and sub-products tends to support the idea of a production that occurred off-site

(Gatsov and Nedelcheva 2012). Some unidirectional pyramidal cores were found at an advanced stage of exploitation, most likely from a *plein débitage*, to produce 18-20cm long blades using punch of pressure. The blanks were then transformed into end-scrapers, perforators, drills, denticulates, and truncations. The blades show marginal, apparently unorganized, retouched patterns on one or two edges. Some tools, including trapezes—more high than wide, and generally associated with hunting activities in other Shulaveri-Shomu sites—are also clearly identified in other sites (Badalyan et al. 2007, Varoutsikos and Chabot 2013). Finally, in phase IV and V, the production switched to a flake-based assemblage (Hansen et al. 2007). The obsidian originates from different sources

Gadachrili Gora is a tell located at about 360-370m ASL. The Lower Kartli Archaeological Expedition identified the site as part of the Shulaveri group, along with Shulaveris Gora, Imiris Gora, and Dangreuli Gora (Djavakhishvili and Djaparidze 1975; Hamon et al. *in press*). Excavations, resumed in 2012 under the direction of C. Hamon and Jalabadze (Hamon 2012, 2013), have shown two horizons, separated by a sterile layer of clay (Hamong et al. *in press*), with three dates placing the site between 5920 and 5650 BCE. The same circular structures exist here, comprised of plank-convex bricks (of two colors, dark and light, sometimes used alternately) bound together with a clay mortar. Domestic occupation is evident due to the presence of a high density of storage pits and structures, located both inside and outside of the dwellings. Houses are associated with a series of layers alternating between hard, compacted layers that archaeologists have interpreted as floors or circulation levels, and ashy layers thought to be cleanings. The structures seem to be organized differently in the two horizons: in I, there is a sizeable area of circulation with large buildings, possibly organized around a main circula building of greater dimension. In II, there is a higher density of small to medium-sized dwellings, with empty spaces between the structures that were used for storage. Overall, there is a small density of finds, although some pollens and residue analysis on material from the Neolithic layer (dated 5815 to 5783 BCE) have provided traces of wine making (Kvavadze et al. 2012).

5.2.3.1. The Mil Steppe

The Mil steppe, located in southwest Azerbaijan, spreads from the site of the confluence of the Araxes and Kura rivers to the piedmont of Karabagh, and extends into the Mughan steppes in northwest Iran. The steppe is a new focus of contemporary research on the development of farming societies, although archaeologists identified settlements in the area as early as the 1950s (Iessen 1965). Recent research programs (Aliyev and Helwing 2009, Guliyev and Lyonnet 2011, Ricci et al. 2012) have identified a Neolithic culture that seemed distinct from the Shulaveri-Shomu and Aratashen cultural complexes (Chataigner et al. 2014) at sites such as Kamiltepe and Shahtepe.

The excavations carried out at the site of Kamiltepe from 2012 onwards have revealed an extensive Neolithic occupation by the Qarasu River (Aliyev and Helwing 2009). The settlement seems to have been organized around a monumental central mud brick platform (Figure 26) surrounded by domestic dwellings and storage structures, generally dated to the middle of the 6th millennium BCE (Aliyev and Helwing 2009). Several pieces of evidence suggest that some structures were also erected on top of the construction (Ricci et al. 2012). The faunal assemblage consists mainly of domestic caprids, cattle, and pigs, as well as several wild species such as gazelle and red deer, and fish and mollusks, the remains of which suggest fishing activity (Aliyev and Helwing

2009, Chataigner et al. 2014). The pottery production is chaff-tempered with black or raid red decoration (Aliyev and Helwing 2009). Obsidian material was used in the production of blade-bladelet blanks (and a few flakes) for end scrapers, side scrapers, trapezes, and sickle elements. Non-obsidian material was generally used in the manufacture of long flakes from tabular blocks or pebbles that were transformed into sickle elements. Excavators found no technical pieces, like cores or sub-products, in obsidian:

Figure 26: *Monumental mudbrick platform from Kamiltepe (Ricci et al. 2012*)

the obsidian itself, which has been shown to originate from several sources in Armenia—in the Gutansar, Gegham, and Syunik-Vardeis groups— “very frequently show traces of use" (Astruc et al. 2013). Along with these productions, some shell, carnelian, and turquoise beads have been uncovered occasionally (Chataigner et al. 2014).

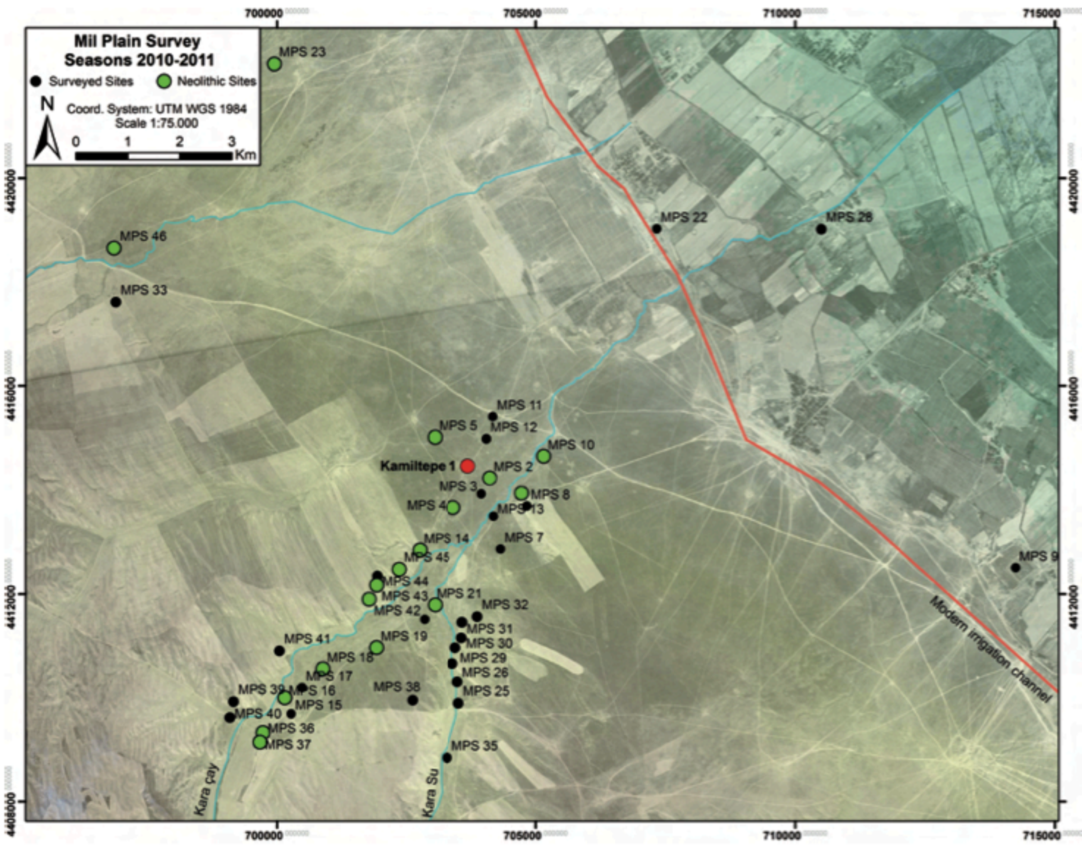


Figure 27: *Distribution of Neolithic settlement (green) and location of Kamiltepe (red) (Ricci et al. 2012)*

The landscape around Kamiltepe is also rich in various types of Neolithic settlements. Up to eighteen sites have been identified, between 0.5 to 1ha each (Figure 27). The Kamiltepe sites each produced an important amount of Neolithic artifacts, although all seem to show less investment in the structures (Ricci et al. 2012). Some sites, such as MPS 4 and MPS 5, have semi-subterranean round brick-mud structures (Chataigner et al. 2014) showing evidence of shell bead production (Lyonnet et al. 2012). The lithic assemblage at these sites is fairly balanced between obsidian and non-obsidian material, as it is composed of quartzite, flint, jasper-like material, and chalcedony flint (Astruc et al. 2013). This landscape organization could suggest a particular socio-economic structure involving several mobile groups conducting a number of short-term, but frequently visited, occupations, while gathering regularly at “pivotal” sites such as Kamiltepe (Ricci et al. 2012). This proposed organization, along with the material culture associated with the lower layers of Kamiltepe, does not have many parallels with the Shulaveri Shomu group presented so far, but could potentially be connected with northwest Iranian cultures (Guliyev and Lyonnet 2012).

5.2.3.2.The mid-Araxes river

The mid-Araxes River region includes parts of Armenia, Nakhichevan, and Turkey. This area has been the focus of intermittent research on early farming societies (Abibullaev 1982, Aslanyan et al. 2002, Mustafayev 1964, Sardaryan) since the late 19th century. Both geomorphological and botanical data have shown that the landscape along the midstream of the river was composed of mixed deciduous forest and “a mosaic of gallery/riparian forests,” (Badalyan et al. 2007). At the same time, this data suggests that the Ararat plain was, at the level of the Kasakh basin, an area of small lagoons and lake (Chataigner et al. 2014). In this ecological niche, several tell-sites, known as *blur* in Armenian, have been identified: Aknashen-Khaturnakh,Tsakhkunk, Kyakh Blur Aratashen, Masis Blur, and Ada-blur in Armenia, and Kultepe (Abibullaev 1982, Badalyan et al. 2010, Kushnareva 1997, Sardayan 1967).

The site of Kultepe, also known as Kyul tepe or Aşağı Gültəpə, is located in modern-day rayon of Babek, in Nakhichevan. Discovered in the early 1950s, Kultepe is an extremely large tell, containing more than twelve meters of cultural deposit that range in date from the Neolithic to the Early Iron Age. The series of buildings associated with the undated Neolithic layer contains structures that are rectangular and circular, made of cob—mud mixed with organic remains—rather than bricks. The site produced several large, clay-tempered ceramic vessels, along with a significant amount of grindstone tools and mortars and pestles. Excavators also uncovered around 85 burials of children and adults, sometimes located under the floor of the houses, and associated with red pigments and votive artifacts, including ceramic, obsidian blades, and bone beads (Abibullaev 1982). Along with some "cultivated cereals" (Abibullaev 1982) in the lower layers of the site, scholars have identified the remnants of "dwarf wheat," a grain that was also present in the Indus Valley during the 6th to 5th millennium BCE (Mustafayev 1964). Faunal assemblages are composed of domestic cattle and sheep-goat. The dating of Kultepe remains problematic due to preservation issues, but it is traditionally placed in the "second phase" of Shulaveri-Shomu development (Korobkova 1996), which takes place during the late 6th millennium BCE.

The lack of dating for early agricultural settlement of the mid-Araxes basin has recently been remedied, in part, by new international projects at the sites of Aratashen and Aknashen, which I will present in the next chapter, and Masis Blur—all sites located in Armenia. The site of Masis Blur is a tell at 852m ASL. Surveyed in the late 1960s by Areshian and Sardaryan, the site quickly became associated with Shulaveri-Shomu culture. In 1986, a short series of excavations resumed under the directed of G. Areshian, whose team identified a total cultural deposit of up to six meters before the top of the tell was partially destroyed by bulldozers during agricultural work (Martirosyan-Olshansky et al. 2013). New excavations carried out in 2012 and 2013 identified two horizons of occupation dating from 5880 to 5630 BCE. The structures associated with both layers are round with an average diameter of three meters, found alongside smaller domestic structures such as pits, hearths, and work platforms (Martirosyan-Olshansky et al. 2013). The material culture of Masis Blur (Figure 28) is similar to that of Aratashen and Aknashen. It is characterized by a large industry in obsidian, based on the production of blade blanks intended to be used as sickle elements or side scrapers, along with a large production of burins, borers, drills, and large carinated round scrapers characteristic of the area. The site also yielded beads and pendants from shells and bone, and stone horizontal shaft straighteners (Martirosyan-Olshansky et al. 2013). The subsistence economy at Masis Blur seems to have been based on domestic sheep-goat, oxen, along with wild species of birds, turtle and fish. Evidence also points to the cultivation of naked wheat and emmer, as well as naked and hulled barley.

Figure 28: *a - Bone tool (spoon); b - steatite seal from Neolithic Masis Blur (Martirosyan-Olshansky et al. 2013)*

5.2.3.3. Discussion

Among the 150 farming sites identified throughout the Caucasus by Abibullaev (1959), only a very few have been excavated using modern techniques. However, there is a clear presence of an undated, yet extremely rich, variety of cultural remains associated with pre-Bronze Age farming settlement in the area. About a dozen early agricultural settlements in the plains and the mountains represent more than 3000 years of agricultural development. The chronology of these sites is not properly understood, and the lack of systematic botanical and faunal analyses limit our understanding of both the development of farming societies and the regional variations that existed in the cultural expressions and economic adaptation of these groups. This situation led several scholars to suggest a developmental stage of the Neolithic, and to emphasize a large variety of cultural and economic manifestations of these farming societies from the 8th millennium BCE onwards. Different processes of Neolithization have been historically identified, with some, like the Shulaveri-Shomu, very homogeneous, and others—like those in western Georgia—more heterogeneous and unclear.

In the mid-Kura valley, both in Georgia and Azerbaijan, settlements are characterized by circular structures made out of sun-dried mud bricks, agglomerated to domestic structures like storage pits and hearths. The ceramic is generally coarse, brown unpolished, and eventually painted, but this kind of ceramic is rare in the earliest horizons of the Shulaveri-Shomu culture. The bone assemblage is very well represented in the overall material culture of the group, and the lithic industry is characterized by a heavy reliance on the production of long blades from pyramidal cores, possibly with the some—though certainly not systematic—use of pressure with a lever. Their subsistence economy was based on domestic crops, possibly raised using system of artificial irrigations, along with cattle and sheep-goat. Several attempts at relative chronology have been made: the lowest levels of Shulaveri Gora (levels IX-IV) are the earliest of this culture, and the upper levels (levels III-I) are considered to be contemporaneous with the lowest level of Imiris Gora (levels VII-VI). The upper levels of this site (levels IV-I) are themselves contemporary with the lowest level of Khramis Didi Gora (levels IX-VI). This difference is addressed geographically from a subsistence economy perspective. There is, in general, a varied exploitation of the environment both in the Araxes area (Balacescu et al. 2010) and the Mil Steppe (Guliyev and Lyonnet 2012:155; Berthon 2014). However, several groups have been noted by Berthon (2014):

1) Damtsvari Gora, Shulaveri, Alikemek Tepesi and Baba-Dervish assemblages, which feature more cattle, but less pig and caprinae, than the other assemblages

2) Arukhlo I, Gargalar Tepesi, Toyre Tepe and Kamiltepe assemblages, which contain larger numbers of pigs and caprinae than the first group

3) Shomu Tepe and Mentesh Tepe assemblages, which show sheep and goat herding to be the main subsistence strategy of these sites

The difference noticed in Kamiltepe is to be connected with other cultural manifestation taking place in this area such as the architecture (Lyonnet et al. 2012), settlement pattern (Ricci et al. 2012) and to some extent the lithic technology (Astruc et al. 2013). It has been argued that these groups could not be attributed to the Shulaveri Shomu culture (Chataigner et al. 2014) and would represent a contemporaneous expression of agricultural society in the South Caucasus.

In Western Georgia, it has long been suggested that an original, independent development of farming societies had taken place in an area that was particularly suitable for practice of agriculture. This development would have had very sub-regional expression and was represented by the variety of material culture between the Colchis, the Black Sea, or the Imeretian area. However, the small number of sites and settlements considered to be connected to this particular process have not provided enough evidence in the context of their recent reexamination using modern archaeological methods (Meshveliani 2013). It is therefore possible that the only coherent farming cultural entity existing in Western Georgia is associated with a late manifestation of external agricultural societies, such as the Shulaveri Shomu complex, at sites such as Samele-Klde or Konobili, Dzudzuana. Although several differences have also been noted in terms of material culture between the Shulaveri-Shomu culture and these Western Georgian groups (i.e., chaîne opératoire of the adze and axe making).

Three groups representing possibly the first manifestations of early agricultural societies in the South Caucasus have been presented above (Western Georgia, Shulaveri-Shomu, and Mil Steppe). Data from Western Georgia are currently not sufficiently reliable to be considered in the development of models of Neolithization of the area. Indeed, in that region, agriculture, ceramic, and new settlement pattern appear at different periods. Even though some evidence of cultural change during the early Holocene have been noticed, but none were clearly associated with a clear shift towards food production until the 5th mill BCE. The Shulaveri Shomu Aratashen groups have some variations both in lithic technology, site structure, and subsistence pattern, but are all dense agricultural villages living in mud circular houses with storage pits and hearths, with a limited pottery assemblage, and producing obsidian sickles and large round scrapers using pressure technique with a lever. They also manufacture a wide range of bone tools, and have sometimes produced painted ceramics associated to Halaf or, in later layers, Samarra groups. On the other hand, another contemporaneous cultural complex discovered at Kamiltepe in the Mil Step (Aliyev and Helwing 2009) have shown interesting differences and seem to result from a different process.

5.2.3.4. Evidence for a Near Eastern Neolithic connection

In the light of the information gathered from almost a dozen sites throughout the Caucasus in the past twenty years, several hypotheses have been suggested in regards to the processes that led to the origin of the development of agricultural society in that area. These hypotheses take into account all cultural and economic developments that occurred following the beginning of the Holocene, but they generally rely mostly on our ability to identify changes in subsistence patterns and in contact between groups. Kushnareva's suggestion is of an initial independent change towards food production at some point during the 9th to 7th millennium BCE. This transformation slowly led to the development of groups, showing Near Eastern influences, that began to show features of the Shulaveri-Shomu culture and eventually became fully agricultural societies. This assumption is partly based on Devey and Devey's (1960) calculation of the world's population increase during the early Holocene and the impact of this growth on population movement. If the Near Eastern "flavor" in assemblages seems now unquestionable, this "flavor" remains difficult to define. A review of available evidence is necessary before we may address the mechanisms—including demic diffusion, cultural exchange, and assimilation—that may have led to this phenomenon.

Masson has suggested parallels with Near Eastern groups. Underlining the integration of the South Caucasus in a broader southwest Asian sphere, he saw in the Levant and the Zagros the origin of an agricultural influence for the Shulaveri-Shomu culture (Masson and Merpert 1982). First and foremost, the parallels between the Levant and Zagros and the Shulaveri-Shomu settlements may be seen in specific elements of material culture. However, if one is to go beyond typological resemblances in lithic assemblages, there are only a few studies that address the possible existence of technological behavior parallels across the South Caucasus and the Near East. On one hand, Arimura (et al. 2010) looked into the possible connections between Kmlo tools, Çayönü tools, and Paluri "hooked" tools. Carrying out both technological and micro-wear analysis, Arimura and his team concluded that, while the shape itself betrays similarities, neither the *chaîne opératoire* nor the use of the tool was like those utilized by groups from the South Caucasus or southeast Turkey. Another study examined the production of long blades by pressure in the Araxes Valley and northern Mesopotamia (Chabot and Pelegrin 2012). The authors show technical parallels between the 6th millennium BCE layer from Aratashen in Armenia and the production of "Canannean blade" at Near East sites along the Khabur. If the specificity of the technique involved—in this case, the use of a crutch or lever—is highlighted, the study does not necessarily allow for the identification of a direct correlation between the two areas. This is due in part to the difficulty of identifying such techniques and their filiation. Most importantly, however, because blades were produced by pressure in southeast Turkey and northern Mesopotamia between the 8th and mid-7th millennia BCE, and again in the late 4th millennium BCE, the blade production in the South Caucasus in the 6th millennium BCE in fact has no contemporaneous parallels. One last interesting aspect of the stone production is the presence of shaft straightener in the Shulaveri-Shomu sites. These artifacts are known both in the Zagros and the Levant, although they tend to show a transversal groove in the former, and longitudinal in the latter (Chataigner et al. 2014), highiliting possible integration of the South Caucasus with the Zagros rather than the Levant.

Another aspect of material culture that has the potential to show connections between this region and the Near East is ceramic production. Kiguradze (1986) finds, in the beads from Shulaveris Gora's earliest layers, some correlations with those found at Haçilar in Turkey. The several anthropomorphic figurines of Khramis Didi Gora are reminiscent of the Hassuna, Halaf, and Samarra cultures (Hamon 2008:88). While the early layers of Shulaveri-Shomu sites reveal almost no pottery, some painted sherds are clearly associated with Halaf culture. According to Christidou, this analogy can also be applied partially to the bone and antler tool industry, as much in technique as in typology (Christidou 2012). Furthermore, Lyonnet's work shows the relations between the sherds and architectural features associated with early layers in the Mil steppe with ceramic and building production from the Iranian plateau (Guliyev and Lyonnet 2012).

Dwellings and associated structures have also found parallels within the Near Eastern world. The construction technique and overall settlement organization characteristic of the Shulaveri Shomu sites are reminiscent of several southern traditions. In the case of the predominance of rectangular buildings in Early Neolithic, some analogies with pre-ceramic Cyprus have been highlighted (Hansen et al. 2007). Furthermore, and although rectangular shapes remain prevalent, the Halaf culture has shown an important amount of circular and sub-circular structures, especially at the site of Khirbet Esh-Shenef (Hansen et al. 2007). The construction technique using three rows of brick bound with a mortar also finds some parallel at other Ceramic Neolithic sites in Choga Mami (Oates 1969) and Choga Banut (Kantor 1978), located in Iraq and Iran, respectively (Hamon 2008). The organization of these sites has also generated some hypotheses related to settlement patterns and landscape occupation. Underlining the "transient nature of Afro-pastoral societies" (Kadowaki et al. 2015), some authors compare the organization of the Shulaveri-Shomu groups and their landscapes—settlements connected as parts of a regional network occupied following a seasonal pattern—with other Late Neolithic societies in Upper Mesopotamia and the Levant (Banning et al. 1994, Kadowaki et al. 2008). This evidence could be connected to recent zooarchaeological data regarding herding strategies, which suggests significant mobility of the herds supported by a generally higher presence of the sheep over the goat (Berthon 2014). Finally, connections with the Near East are also suggested in the faunal assemblages from Eneolithic layers at Ovçular Tepesi that have shown the presence of commensals (house mice) that originated from the Northern Levant (Cucchi et al. 2013).

These results finds interesting echo in the limited, yet compelling, evidence resulting from paleogenetic data found in human, faunal, and botanical assemblages. Ancient genetic information from faunal assemblages, on the other hand, seems to support an opposite option. Recent studies have shown, at Arukhlo I, a high rate of mitochondrial haplotype variability in sheep and cattle, a situation that does not support a scenario of singular wide-scale spread of a small animal population from one remote domestication center (Berthon 2014, Georg 2011, Lyonnet et al. 2012, Scheu 2011).

We have already addressed some of the sometimes-contradicting human genetic evidence regarding the explanation of the current phenotypic and genotypic landscape of the South Caucasus. High-resolution study of the Y-chromosomes in present-day populations has revealed direct links between lineages of current Armenian and Near Eastern populations that originated during Neolithic expansion in the South Caucasus (Herrera et al. 2011). The authors point out specific affinities in STR haplotypes of those living in Armenia with members of groups originating from Jordan and Lebanon. This phenomenon seems to have also occurred in Azerbaijan and Dagestan, as supported by mtDNA studies (Nasidze et al. 2003, 2004). The timing and frequency of these processes are matters still under scholarly discussion. Postglacial recolonization of the South Caucasus took place around the Younger Dryas (Schonberg et al. 2011). Divergence between South Caucasian and Iranian groups occurred more or less at the same time, between 10,000 and 7,000 BCE (Schonberg et al. 2011). The evidence presented by Herrera is compelling, but seems to emphasize estimates from haplogroups that are more connected to Chalcolithic events than Neolithic ones. Herrera's argument does not provide a satisfactory chronological resolution to support, without corroborating evidence, the hypothesis of a Near Eastern demic diffusion during the 7th to 6th millennium BCE in the South Caucasus.

The large dataset accumulated over the past fifty years on botanical and paleobotanical assemblages from the South Caucasus is complemented by several genetic studies highlighting interesting phenomena. Several species are found in Late Neolithic layers (6th millennium) on different Shulaveri Shomu sites, such as *Tr. monococcum*, *Tr. dicoccum*, *Tr. aestivum*, *Tr. durum*, *Tr. spelta*, *Hordeum vulgare*, and *H. distichum*

(Janushevich 1984, Lisitsina and Priscepenko 1977, Willcox and Hovsepyan 2008, Zohary and Hopf 2000). These species are also identified in most Near Eastern sites (Zohary and Hopf 2004). Armenian sites in particular are extremely rich in two species of naked wheat, *Tr. turgidum* (tetraploid) and *Tr. aestivum* (hexaploid). In the mid-Kura area, there has also been evidence of *Tr. aestivum* along with an interesting variety of hulled hexaploid wheat known as *Tr. spelta* (Chataigner *comm. pers.).* In the South Caucasus, genetic studies have shown that *Tr. spelta* is a different variety there than in Europe, and that, within the South Caucasus, it results from the hybridization of tetraploid wheat (*Tr. turgid*) with *Aegilops tauschii* (Dvorak et al. 1998). Biogeography suggests that the primary distribution of *Ae. tasuchii* is found in North Iran, the South Caucasus, and the Western part of Central Asia (Giles and Brown 2006). Genetic evidence, on the other hand, suggests that it only overlapped with *Tr. turgid* following the beginning of the expansion of the tetraploid from its original zone of distribution in the Levant (Zohary and Hopf 2000), probably reaching the area at some point before the 6th millennium BCE (van Zeist 1976, Zohary and Hopf 2000). The distinction between Near Eastern hexaploid and the resulting South Caucasus hexaploid is shown by the existence of two different lineages, respectively possessing alleles TAE 2 and TAE 1 (and later one T3). This is also supported by the genome D found in South Caucasus hexaploid wheat, which is closer to the native *Ae. tauschii* than the one from the Levant (Dvorak et al. 1998, Lelley et al. 2000, Giles and Brown 2006). The genetic evidence would therefore support a hybridization of *Tr. turgid*, imported from the Near East, with a local variety of *Ae. tauschii*, that occurred in an area ranging from the South Caucasus to the southwestern area of the Caspian sea. The timing of the hybridization is unknown, but such an event would not have taken a long period of time, as hulled wheat may be transformed into naked wheat with only two mutations (Zohary and Hopf 2004). Considering that fully domesticated and largely cultivated naked wheat was present in the South Caucasus by the very beginning of the 6th millennium BCE, this domestication process, although not yet identified, must have taken place in this area at some point in the 7th millennium BCE.

Chapter 6

Dataset: geological and archaeological survey, and presentation of the assemblages.

6.1. Geological survey in the NW Iranian region (2012) (Appendice 1.1)

(dir. B. Varoutsikos, H. Nazari, and M. Khalabtari Jafari)

Obsidian sources in the South Caucasus have been the object of fairly exhaustive studies (Chataigner et al. 1995). However, several publications have suggested the presence of a yet unknown obsidian source located in northwest Iran (Burney 1961; Blackman 1984; Ghorabi et al. 2008; 2010; Khazaee et al. 2011; Niknami et al. 2010). However, neither the macro visual description of the samples nor their geochemical characteristics provide supporting evidence for the presence of primary sources of obsidian in this region. Several areas are generally presented as outcrops: Leylan, the source of an obsidian block that was discovered and then moved to the Tabriz Archaeology museum; the Mianeh region (Agh Kend and Shirinbulag); the northeastern slope of the Sahend mountain, and the Savalan. The presence of unidentified obsidian groups in some archaeological assemblages from the South Caucasus raises the question of their possible origins in Iran. The connection between the Urmiah Lake region and the Lesser Caucasus is well documented, as Iranian ceramics are frequently found at Armenian Chalcolithic sites such Godedzor (Palumbi et al. 2014). The localization and chaacterization of these obsidian sources could thus allow the identification of networks involving northwest Iran and, possibly, the southeast Caspian area

6.1.2. Methods

I conducted this survey with Dr. Morteza Khalabtari Jafari and Mohammad Faridi, two local geologists from the Geological Survey of Iran (GSI). We targeted areas surrounding the two volcano complexes of Sahend and Savalane. On one hand, we focused on locations identified in the existing literature as obsidian outcrops (Didon and Germain 1976; Niknami et al. 2010). At the same time, we identified on the GSI maps several areas that had the potential to produce this type of material, i.e. silicate rich areas, or those with extremely acidic (>65% SiO_2) to mildly acidic (52-65%) environments that are younger than 15 to 20 million years. Our group thus visited 12 locations connected to the two volcano complexes.

6.1.3. Results

Almost no obsidian was found at any of the locations visited. Only one block was identified in the Leylan area, where Niknami (et al. 2010) had suggested the presence of an outcrop. Indeed, one of the villagers from Leylan brought a block of obsidian (4kg, 17x10x10cm) with no cortex but presence of neo-cortex on 30 to 40% of its surface. His family found the block more than twenty years ago, in the village, as they were digging to build a bread oven. We were allowed to sample this block, which we then sent to MURR (Missouri University Research Reactor) for ICP-MS analysis by M. Glascock. The analysis revealed an Armenian origin for the block, most likely from the Arteni sources in the southern part of the country. It is possible that these obsidian blocks were either carried by the Araxes River to the northern border of Iran, or that they resulted from the exchange of large amounts of raw material that occurred during the Late Chalcolithic and Bronze Age (Palumbi et al. 2014).

6.2. The Gegham Range survey (2012-2013) (Appendix 1.2)

(Dir. B. Varoutsikos and R. Badalyan)

In the course of the summers of 2012 and 2013, two survey seasons were carried out in the Armenian part of the Ararat plain, in the Araxes basin. This project was intended to identify early Holocene sites in a region that was, for this period, relatively unknown. This project allowed for the identification of two dozen artifact concentrations as well as at least seven archaeological sites with structures and stratigraphy, ranging from the Neolithic to the sub-modern period, including identifiable layers of almost all chronocultural periods in between.

The Araxes valley is one of the main axes of communication in the South Caucasus. This has been apparent historically through the development of several archaeological cultures in this area, from late prehistory to medieval times. It is also in this valley that the earliest Neolithic culture in Armenia was identified, at the sites of Aratashen and Aknashen-Khaturnakh. Furthermore, recent archaeological studies have highlighted the presence of Late Pleistocene/Early Holocene sites in the Armenian plateau. However, the three main valleys connecting the Armenian plateau to the Araxes Valley are still relatively unknown archaeologically. With this project, archaeologists aimed to identify Holocene sites in the hydrographic systems of the Azat, Narek, Lanjar and Vedi, which constitute an axis of movement between the Sevan Lake and the Araxes Valley (Figure 29).

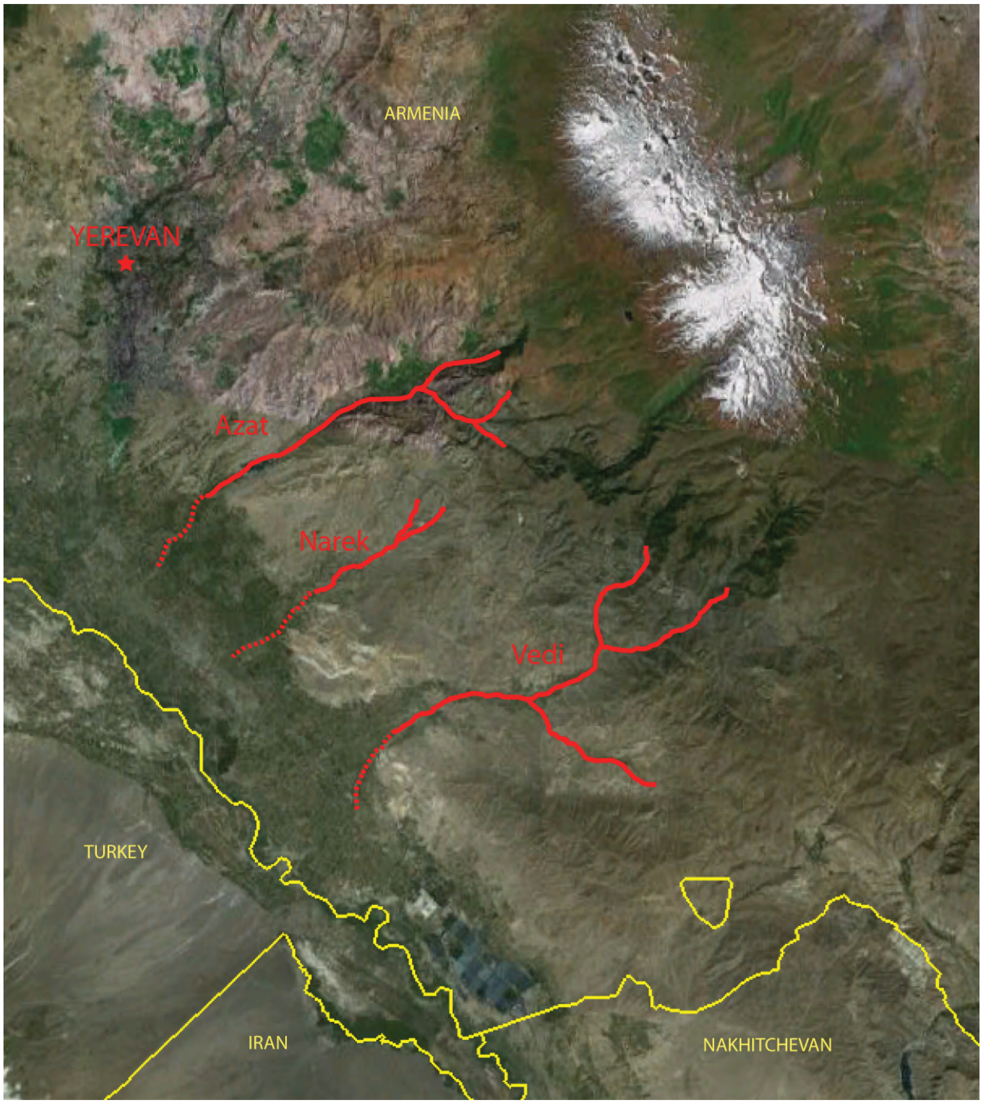


Figure 29: *Hydrographic system of the Gegham, and Azat, Narek, and Vedi valleys*

6.2.1. Methods

The design of the survey targeted the identification of two different type of sites: rock shelters/caves and open-air sites.

The first step was to build a list of locations with potential caves and rock shelters. This required, first, the study of local toponyms. Due to the lack of recent quality maps of Armenia, a series of maps (scale 1:10000 to 1:20000) made from 1970 to 1975 by the local branch of the USSR Geological Department were used to identify locations associated with the Armenian word for cave, *k'arandzav*. Two villages were found in the Azat and Narek River valleys. In addition to this method, we visited the three main river valleys and their tributaries, and identified 8 more potential locations. We dug test pits of 1x1m at each of these ten caves and rock shelters, but only two (GPS 244 and 250) yielded preserved stratigraphic sequences including pottery sherds associated with the local Iron Age.

The identification of open-air sites was more challenging due to the significant degree of sedimentation of the valley. Our research was carried out following three main methods. First was a preliminary work intended to identify tell-like shapes on Google Earth and toponyms including the name *blur* (tell in Armenian), yielding 8 potential sites. We visited each of these tells, but only two yielded any archaeological remains on their surface (Tell Sisavan and Tell Aygevan). The two tells showed evidence of excavation and looting, but we found no published information connected to these sites. However, we gathered material from the section belong to the Middle Bronze Age to the Medieval periods.

The second method involved the planning of transect surveys on the terraces of the Azat and Vedi River valleys. After identification of the terraces on Google Earth and the Soviet maps, we randomly selected areas of approximately 50-100 x 200m with equivalent visibility. Each transect was delimited by two red flags deployed 5m apart, at its ends. Each of the three members of the survey team was given three bags ("lithic", "pottery", and "other") and collected all the material found within 2 meters of its transect. A total of 25 areas were surveyed.

Finally, in addition to these areas, more random and *ad hoc* transect surveys were carried out in 32 other locations. In this situation, only one person would conduct the survey and the entire area was only identified through a GPS point (Figure 30).

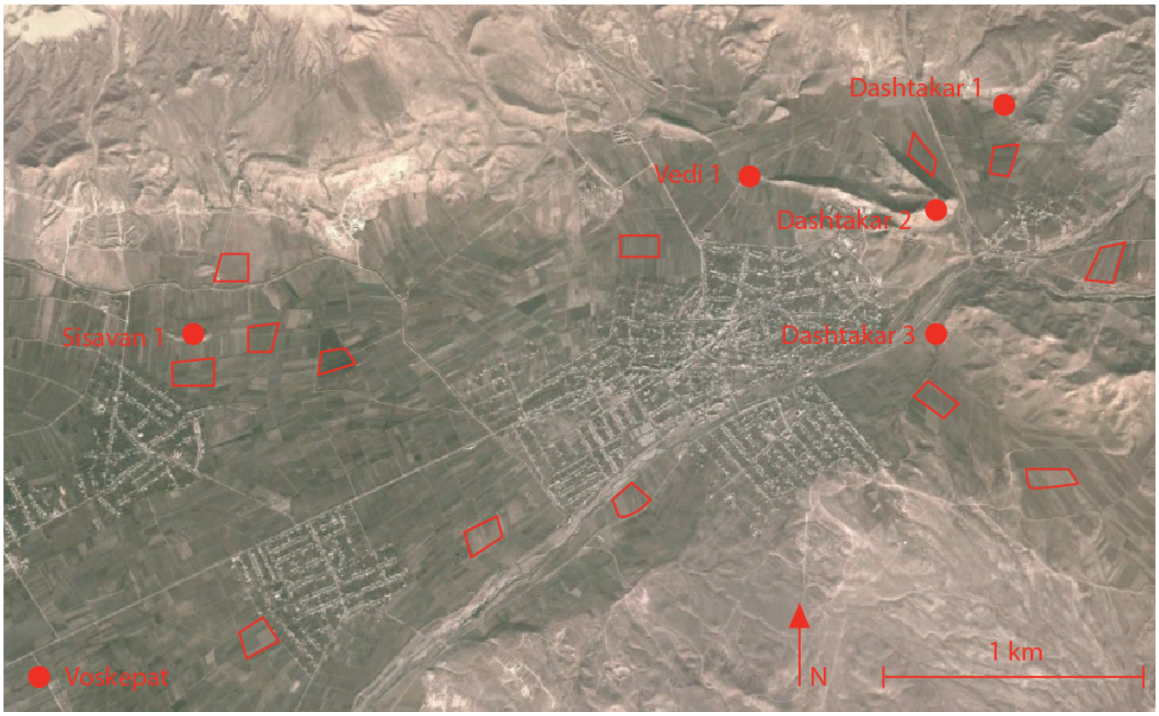


Figure 30: *Fields selected for transects in the Dashtakar-Vedi area*

6.2.2. Results

Two seasons of survey in the Gegham range allowed the identification of 2 caves/rock shelters with cultural deposits, 7 open-air settlement with structures and stratigraphic sequence, and 22 artifact concentrations. The material culture was typologically attributed to periods from the Late Chalcolithic to the Medieval, with the identification of almost all of the chronocultural periods in between.

The difficulties encountered in the identification of early Holocene settlements (both open-air and in caves) are consistent with surveys carried out in other parts of Armenia (Kandel et al. 2011, Gasparyan 2007). The Mesolithic period is almost unrepresented in Armenia, and the several sites found in Georgia are generally located in the highlands. On the other hand, Neolithic sites are only found as tells in the Araxes River valley.

6.3. Javakheti plateau survey (2012-2013)

(C. Montoya, M. Arimura, M. Mgeladze, B. Varoutsikos, C. Chataigner, E. Kikodze, T. Agapishvili, M. Gabunia)

The first exploration of the Javakheti Plateau was carried out during the summer of 2011. It targeted the surroundings of the Paravani Lake, as well as the canyon of the Paravanistkali River (Figure 31). The team selected the Paravani Plateau and its surroundings, as the area is thought to be one of the passes between the Kura Valley and the northern Armenian plateau, and is also zone of transition between western and eastern Georgia. Furthermore, the only obsidian source in Georgia, Chikiani, is located on the northeastern end of the lake. Finally, previous surveys (Kikodze and Koridze 1970; Kiguradze and Menabde 2004) mentioned the presence of several kurgans and artifact concentrations ranging, possibly, to the Lower Paleolithic. Most importantly, several "Kmlo tools" were found at some locations around the lake.

In collaboration with Koridze, the 2011-2012 survey identified several artifact concentrations around the lake as well as two sites: the Paravani I and II rock shelters on the east bank of the lake, south of the Radionovka village. Radiocarbon samples provided Chalcolithic and Upper Paleolithic dates (Arimura et al. 2012). I participated in the 2012-2013 seasons and directed the 2013 excavation.

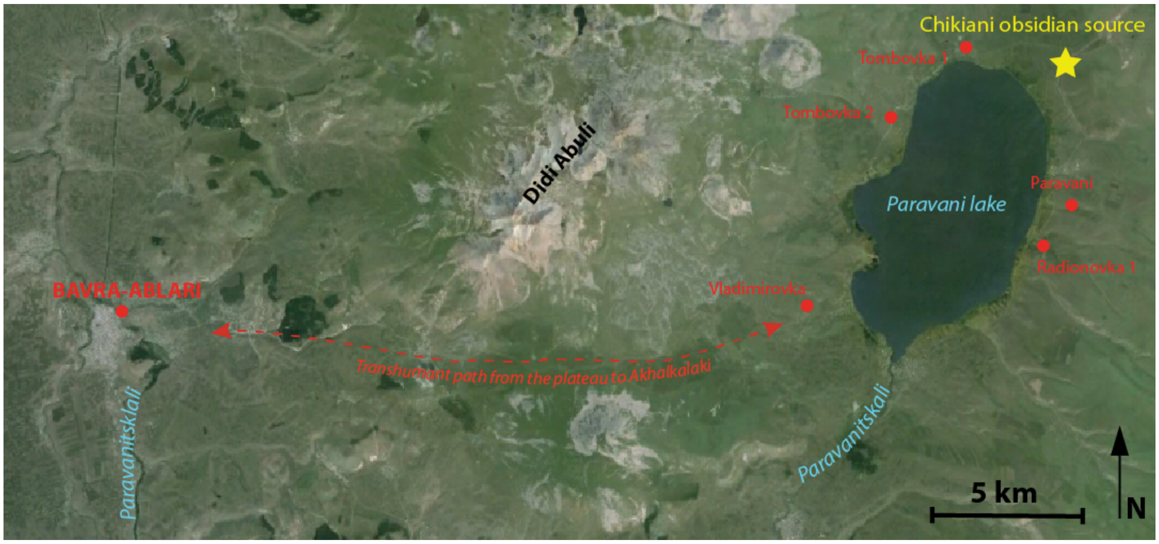


Figure 31: *Southern Javakheti region and the Paravani lake area. Several prehistoric sites were identified during unsystematic survey in 2012-2013. Northeast of the lake is the Chikiani obsidian outcrop. About 40km from the lake is the site of Bavra Ablari in the Paravanistkali canyon*

Three phases of occupations have been identified: medieval (13th-14th century AD); Chalcolithic (mid-5th millennium BCE; and Upper Paleolithic (15-13th millennium BCE). The UP layer has produced a laminar assemblage, including tools that were manufactured on blade blanks and several bipolar cores (Arimura et al. 2014). The main categories represented are bladelets and scrapers on blades. The site is significant in many respects: first, it provides evidence for Chalcolithic occupation around the obsidian outcrop roughly contemporaneous of Bavra-Ablari, presenting archaeologists with interesting information about occupation of the region and the routes of transhumants during the mid-5th millennium BCE. The site also provides a glimpse into the Upper Paleolithic occupation on the plateau at the end of the Pleistocene.

In the course of the 2011 season, our team surveyed portion of the Paravanitskali River canyon. This route is still in use by transhumants at present, and it also provided several "Mesolithic" sites investigated during the 1980s by M. Gabunia. It is in the course of this survey that the Bavra-Ablari rock shelter was identified. A test pit opened at the site revealed it as a potential host of stratified cultural remains.

6.4. The excavation of Bavra-Ablari rockshelter (2012-present)

(dir. B. Varoutsikos and A. Mgeladze)

The Djavakheti region is a volcanic plateau that spreads across Georgia and northern Armenia. The plateau, which reaches 2500m altitude and connects to the tributaries of the Kura River (Khrami and Mashavera Rivers). This a path used by modern transhumants as looking for alpine pastures. The rock shelter of Bavra-Ablari is located at 1660m ASL, at the confluence of the Paravanitskali and Ablari rivers, below the city of Akhalkalaki (Varoutsikos et al. *in press*).

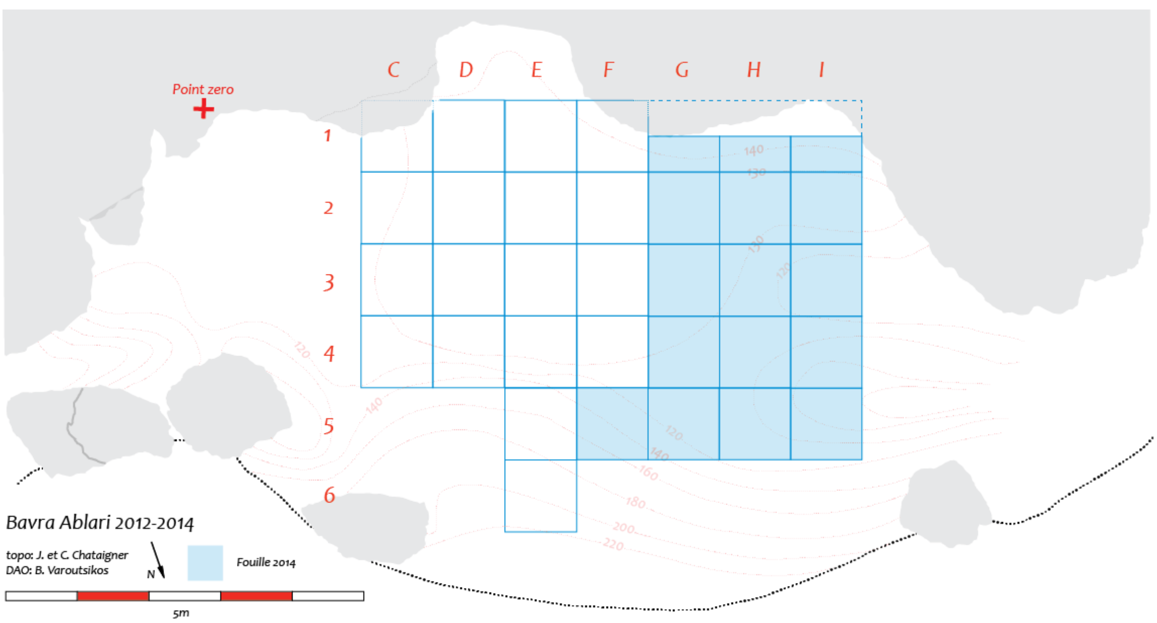


Figure 32: *Surface open at Bavra-Ablari*

The site is 15m x 8m (Figure 32), on a small terrasse, created by an agglomerate of sediment and boulders, 8m above the river. The entire surface of the original terrasse is likely to have been 20-30% longer in the past, but its northern section collapsed during the construction of a road below the shelter. The excavations were directed by Dr. A. Mgeladze (National Museum, Tbilisi) and myself, and were funded by the French Ministry of Foreign Affairs (dir. C. Chataigner), and are still ongoing, but the 32m^2 opened in 2012-2014 have already provided information that contribute to our understanding of the cultural and economic processes taking place in the South Caucasus during the Holocene.

6.4.1. Stratigraphic Sequence and Taphonomy

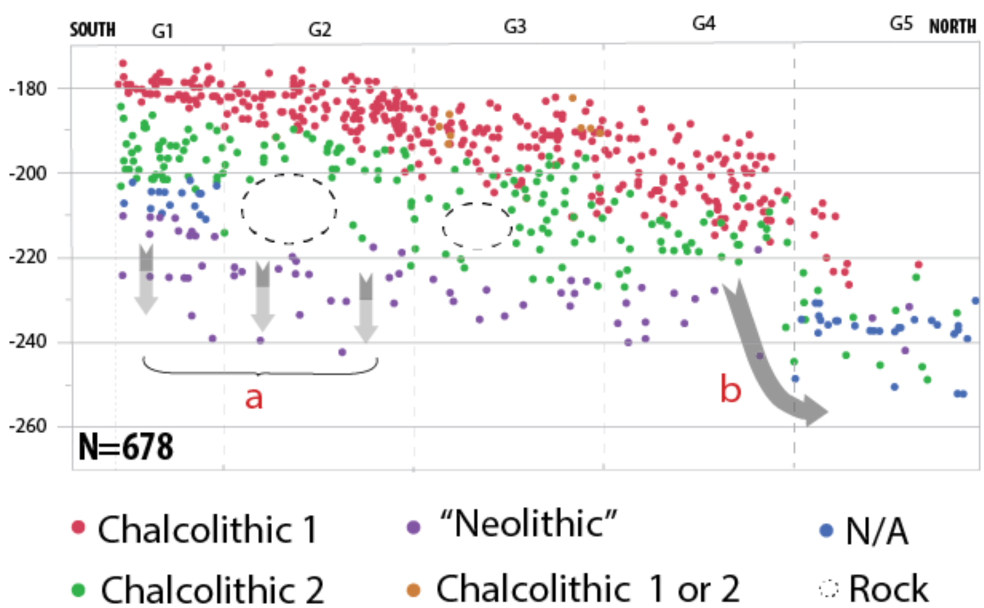


Figure 33: *Modeling of postdepositional processes. In (a), an ancient spring spread out the Neolithic layer over 20cm of depth. In (b), layers have shifted due to the road construction below.*

At Bavra-Ablari, the presence of fallen boulders limits the identification of stratigraphic units from one square to the other, and may have also caused lateral and horizontal movement of material. Despite these limitations, a fairly coherent chrono-stratigraphic sequence has been reconstructed, supported by different types of evidence: sedimentology radiocarbon dating (Figure 33) (Appendix 2.1), 3D plotting of artefacts, and lithic refitting. Seven layers have been identified (Figure 33):

- Niv. 0A: a mixed layer with modern, sub-modern and medieval material culture, such as imperial ruble coins, medieval ceramics, and several modern gun shells connected to recent conflicts in the region.
- Niv. 0B: a mixed layer that still produced medieval pottery sherds, but also a majority of obsidian flake-based industry. An association with Early to Middle Bronze Age can be suggested based on the presence of a characteristic obsidian arrowhead known as Bedeni
- Niv. 1: Late Chalcolithic layer (1st half 4th mill. BCE). This layer has a light brown sediment, much denser than in previous layers, and it produced faunal assemblage, lithic and ceramic productions.
- Niv. 2: Early and Middle Chalcolithic layer (ca 5000-4250 BCE). Several hearths show a repeated occupation over short periods of time. Large lithic and faunal assemblages are also represented, with several potsherds.
- Niv. 3: Late Neolithic layer, dated to ca 6000-5350 BCE. Very dense sedimentary matrix, located under a phase of collapse of the wall of the shelter. Smaller density of faunal and lithic finds; no pottery was found.
- Niv. 4: Mesolithic layer, dated to ca 9100-8600 BCE, that has only been identified in the northern part of the site.

- Niv. 5: No traces of material culture have been recovered in this layer to date over an opened area of only 4m^2. Radiocarbon dates on Equid tooth (*Equus* sp.) indicate a date ca 10400-9800 BCE, during the Younger Dryas. The geological substratum has not been reached yet.

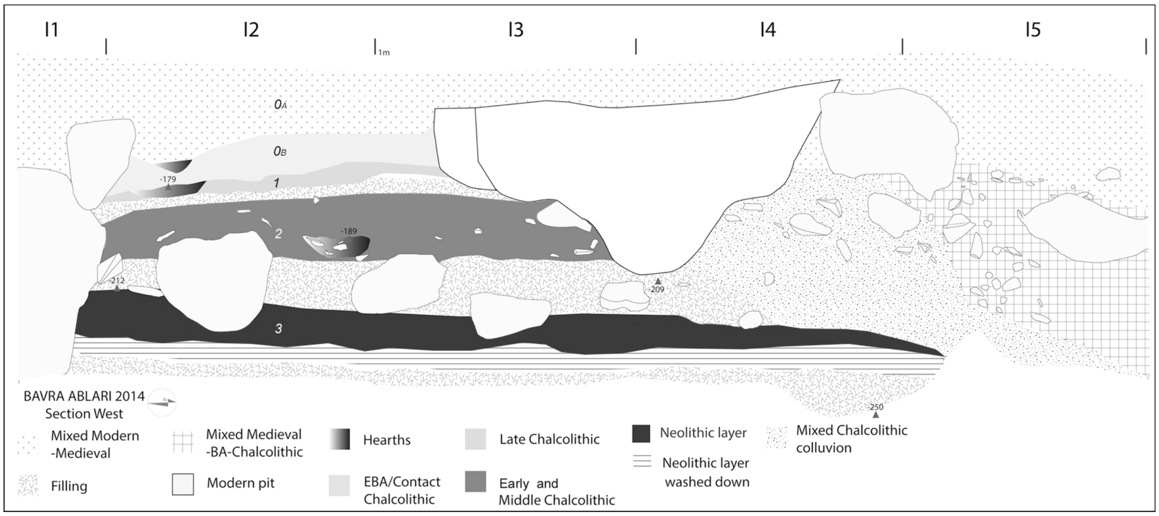


Figure 34: *Stratigraphy at Bavra-Ablari, line I1-I5 West showing the two Chalcolithic layers and the Neolithic layer.*

6.4.1.1. Mesolithic (Layer 4)

Layer 4 was only identified in the northern part of the site. The sediment is a humid black clay with a high degree of organic preservation and a lot of micro-charcoals. C14 dates have placed this layer between the 9th-8th millennium BCE.

The excavations of the Mesolithic layer are in progress, and only 37 faunal remains have been studied so far (Dr. J. Chahoud). The Mesolithic spectrum comprises mainly large wild ungulate remains (31 NISP), including deer (*Cervus elaphus*), aurochs or bison (*Bos* sp./*Bison* sp.), and six remains of unidentified small-sized ungulates (cf. wild *Caprinae*).

6.4.1.2. Neolithic (Layer 3)

Layer 3 is an accumulation of brown silty sediment with several large blocks. This layer contains far fewer organic inclusions than layer 4, although several charcoal lenses and a single hearth have been identified. The layer is dated to the late 7th/early 6th millennium BCE.

The faunal assemblage of the Neolithic layer is under study by Dr. Jwana Chahoud (American University in Beirut) and comprises 533 remains. Of this assemblage, 268 identified specimens are attributed to mammals. Preliminary results indicate a spectrum largely dominated by ungulates (91%). Caprinae (*Capra* sp. and *Ovis* sp.) make up 87% of the total mammal NISP, completed by bovines (*Bos* sp. 4%), and one molar of swine (*Sus* sp.). The remains of these four taxa are very fragmented and can possibly be attributed to domesticated species but more analyses need to be carried out. The wild fauna is represented by equids (3%) and cervids (3%) in equal proportion, followed by carnivores (3% of NISP: bears, and *mustelidae*). Considering the small faunal assemblage, overall it seems that the Late Neolithic population at Bavra Ablari had an economy based on husbandry practices, supplemented by occasional hunting activities (Varoutsikos et al. *in press*)

6.4.1.3. Chalcolithic (Layers 2 and 1)

The two layers are separated on the basis of slight changes in sediments. The brown-grey clay matrix of layer 2 transitions into dark brown-black sediment in its upper portion. However, both layers have produced fairly similar assemblages that can be presented together.

Although the abundance of boulders in the stratigraphy strongly limits our ability to delimit structures, several areas of activity have been identified in the Chalcolithic layers. Areas of consumption are located close to the wall of the shelter. These consumption areas consist of a concentration of burnt faunal remains and lithic debitage, and are associated with a series of superposed hearths. At least four Chalcolithic hearths have been identified, along with several lenses. Several types of hearth are represented: a hole dug in the ground; a hole covered by a sill plate of small rocks on top of which the wood is placed; and a structure composed of several stones vertically attached to each other.

The density of charcoal and ashes, the superposition of lenses and hearths, and the amount of faunal and lithic remains are all surprisingly high for a settlement type that would generally be associated with short-term occupations. Several hypotheses can be suggested. It is possible that Bavra-Ablari was a short term-settlement, and the density of remains represents repeated occupations over a short period of time. This situation could potentially explain the lack of structure and postholes. Alternatively, the rock-shelter may have served as a longer-term settlement, possibly in the context of semi-nomadic transhumances. The existence of such a settlement would raise important considerations about the evolution of settlement patterns during the Chalcolithic period.

Pottery sherds (N=53) were recovered only in the Chalcolithic layers. These sherds are of a dark-brown/black ware, mainly mineral tempered. Characteristic features are notched rims and perforations under the lip (Figure 34). This type of ceramic, defined as "Sioni" (Kiguradze and Sagona 2003; Kiguradze and Menadbe 2004:359.), is found at sites throughout the Caucasus with layers dating from the course of the Chalcolithic, such as Mentesh Tepe in Azerbaijan, Aknashen-Khaturnakh in Armenia, or Damtsvari Gora in

Georgia (Lyonnet et al. 2012; Badalyan et al. 2010; Varazashvili 1992) Finally, let us note the identification of what could possibly be a fragment of *tuyère.*

Figure 34: *Sioni pottery sherd from Chalcolithic layer*

The faunal assemblage is more abundant in the Chalcolithic layers, with around 3448 mammal remains with 2015 speciment identified to family and species levels. (Varoutsikos et al. *in press*). The spectrum is largely dominated by domestic species, which make up 93% of the assemblage (NISP), with caprinae (54%) and cattle (39%). Four remains attest to the presence of swine, but the identification of their domestic or wild nature remains difficult to assess. Along with the livestock, dogs were present on site (1% of NISP). The wild fauna is in great majority represented by equids (3%). The faunal assemblage is more abundant in the Chalcolithic layers, with around 3448 mammal remains. Only 2015 specimen are identified to family and species levels. The spectrum is plainly dominated by domestic species, which make up 93% of the assemblage (NISP), including caprinae (54%) and cattle (39%). Four remains attest to the presence of swine, but the identification of their domestic or wild nature remains difficult to assess. Along with the livestock, dogs were present on site (1% of NISP). The wild fauna is in great majority represented by equids (3%) and red deer (2%), while three remains of aurochs (*Bos primigenius*) have also been identified. Other carnivores, including mustelid and foxes, are attested to in minor quantities (1%). There was thus a clear exploitation of the plateau for pastoral activities, along with the hunting of cervids and equids. In addition to the exploitation of mammals, there is also evidence for the use of river resources, like fish and crabs (56 remains), and for bird hunting (37 remains). These faunal remains thus emphasize a pastoral economy that also had features of rare hunting activity and opportunistic fishing.

Archaeobotanical analysis carried out by L. Martin (Université de Genève) provides first insights into the plant economy of Bavra-Ablari. A total of 187 litres of sediment has been sampled from secured contexts. Preliminary study shows that domesticated species such as barley (*Hordeum* sp.) and einkorn wheat (*Triticum monococcum*) are attested in the Chalcolithic layers. These two rustic species are well adapted to mountain environments. Wild plant remains like nuts (*Corylus avellana*), elderberry (*Sambucus* sp.), and hackberry (*Celtis* sp.) were also recovered, and might be related to gathering activities

6.4.2. Discussion

As of yet, Bavra-Ablari's Mesolithic layer (layer 4) has only been excavated on 4m^2, and its lithic assemblage is, at present, too small to be properly characterized. Besides backed bladelets, none of the tools can yet be connected to any other Mesolithic assemblages identified in the area at sites like Bavra or Edzani (Gabunia and Tsereteli

2003). No microliths—geometric or scrapers—are present; however, the assemblage clearly supports a production of bladelet blanks. The next seasons of excavation should allow us to better understand the place of Bavra-Ablari in the cultural landscape of the South Caucasus Mesolithic.

After a hiatus identified in the stratigraphy and the chronology, the rock shelter was occupied at the end of the 7th-early 6th millennium BCE. This layer is attributed to the Neolithic, with a probable assemblage of domestic fauna that presents similarities to Chalcolithic domestic species in frequency, age groups and animal sizes. Furthermore, the lithic industry shows some degree of continuity with local Mesolithic assemblage, even though several typologically Neolithic traits are present.

Bavra-Ablari would seem to confirm the absence of a progressive domestication process in the South Caucasus. Several fully developed agricultural societies appear suddenly ca 6000 BCE in the Kura and Araxes Valleys and on the northern slopes of the Great Caucasus and everywhere at the same time. The origin of this secondary Neolithization has yet to be determined.

The Chalcolithic is by far the most represented period at Bavra-Ablari. There is, during this period, a change in settlement pattern: a decrease in tell-type sites from the plain and an increase of cave sites and rockshelter occupations. (Kohl 1993) This change persisted to such an extent that by the beginning of the 4th millennium, then, mountainous areas were intensely occupied (Kiguradze 2001). Indeed, the density of finds and hearths supports either regular, short-term occupations of the rock-shelter, or the persistence of single, longer-term settlement. This evolution is necessarily connected with a change in subsistence pattern. Data provided by Bavra-Ablari shows the presence of an economy based on a full exploitation of the plateau, which involved livestock herding supplemented by occasional hunting as well as the possible cultivation of species more adapted to high altitudes such as einkorn. This hypothesis also finds support in the contents of the lithic assemblages. Based on local raw material, these assemblages were intended for the production of butchering elements, as well as the creation a few hunting implements used to acquire fishes, birds, or small mammals.

6.4.3. Overview of the lithic assemblage (Appendix 2.6)

6.4.3.1 Raw Material

The Neolithic assemblage of Bavra Ablari provided 660 pieces, all made of dacite (N=136) obsidian (N=522), and two other materials in small quantity: white flint (N=2), and quartz (N=2), for which origin points could not be identified.

Two different types of dacite have been identified. On one hand, a dark, coarse-grained dacite most likely originated from the mio-pliocene outcrop of Amiranis-Gora, east of Akhalkalaki and 6 to 7km from the shelter (Gabunia 2000; Varoutsikos et al. 2012). This same dacite is found in large quantity in the Chalcolithic layer. It has very limited clastic potential and, as with most coarse-grained material, can be difficult to analyze. I have carried out several experiments in order to determine the behavior of the material and to improve the identification of features (striking platform, retouch) in the archaeological assemblage. In the course of these experiments, several characteristics of the material have been noted:

- Dacite fractures easily during the knapping process. It is possible that up to 50% of the flakes identified were broken during their detachment.

- It is, in many situations, very difficult to identify the usual features that constitute a flake, such as a bulb or a butt.

The main implication of these studies is that the assessment of the number of flakes versus debris must be approached with caution. In this study, we considered as flakes elements showing at least one of the features required. Overall, it seems the coarse-grained dacite was imported in two different forms: pebbles and small plaque, each of which was exploited differently.

A second type of dacite was identified in the Neolithic layer and on a dozen pieces only. It is a finer-grained dacite, grey-green, of better clastic properties. Its origin is thus far unknown, and there is only very little debitage. All the final products found in this raw material are manufactured on long flakes and are finely retouched.

Only two samples of obsidian from the Neolithic layer have been characterized by ICP-MS (Gratuze, IRAMAT, comm. pers.). They both have produced the same result, and come from the Chikiani outcrop, located on the Javakheti plateau, 32km away from the site. The characterization was carried out on two pieces that were typologically associated with the "Shulaveri-Shomu" type in the hope that they would demonstrate presence of obsidian sources in the assemblage. Chikiani obsidian is one of the best in the South Caucasus and has been largely exploited since the Lower Paleolithic (Varoutsikos et al. 2013).

There is a clear inversion in terms of raw material management between the Neolithic and the Chalcolithic layers (Figure 35). In the latter, dacite is the main raw material, representing up to 65% of the assemblage. A few pieces of quartz and flint have also been found. The dacite used here is also different than the Neolithic layer; it is coarse-grained and darker, most likely coming from a local source.

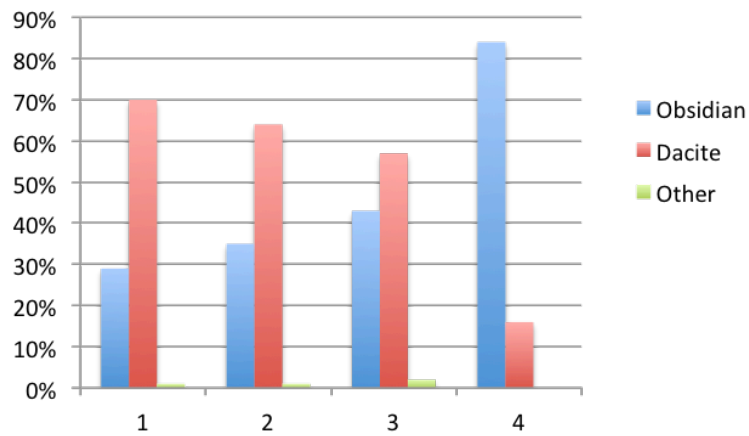


Figure 35: *Raw material proportion from Chalcolithic (1) to Mesolithic (4).*

6.4.3.2 Main characteristics of the assemblage

Assemblages from the two Chalcolithic layers (N=3380) are typo-technologically similar. The industry on dacite is characterized by three different *chaînes opératoires* based on the debitage of small pebbles (Appendix 2.1). After opening a striking platform a large flake is obtained through direct percussion. This thick blade-like flake is then retouched bifacially to obtain rapidly large bifacial implements. Another sequence uses the same core to produce expedient smaller blade-like flakes, removed in the volume, that are then transformed into sidescrapers. Finally, the last *chaîne opératoire* removes long flakes on the side of the core in order to produce ridges that will drive a longer removal. This final product does not necessarily show any retouching, but may provide evidence of use-retouches. We found only very rare occurrence of striking platform preparation and only very few technical pieces. Very little investment is put into the shaping of the core and the dacite production is clearly expedient, dedicated largely to the manufacture of large butchering tools, bifacial pieces, and side-scrapers.

Obsidian production was largely aimed towards creating microliths and especially small armatures such as trapezes or *tranchants*. This typological category is seen in most sites around the South Caucasus, from the Late Neolithic to the Late Chalcolithic. The *chaîne opératoire* of this production is only partially represented on-site, as few technical pieces, including an overshot blade and striking platform fragment, were found. The limited presence of cortex and of sub-products generally associated with the production of bladelets supports the idea that production occurred mostly outside of the site. This is also noticed in the case of the roundscrapers and endscrapers identified in the Chalcolithic layers (Figure 36).

For the Neolithic (Layer 3) assemblage, several general tendencies can be distinguished. The collection has produced several obsidian scrapers (rounds, on blades, thumbnail, n=19). We also see obsidian bladelets that are completely or partially backed (n= 10), and four microliths (trapezoid) (Figure 37:5). The industry is based on the production of bladelets, although several fragments of long prismatic blades were found within the layer, but no associated blade cores or technical by-products could be identified.

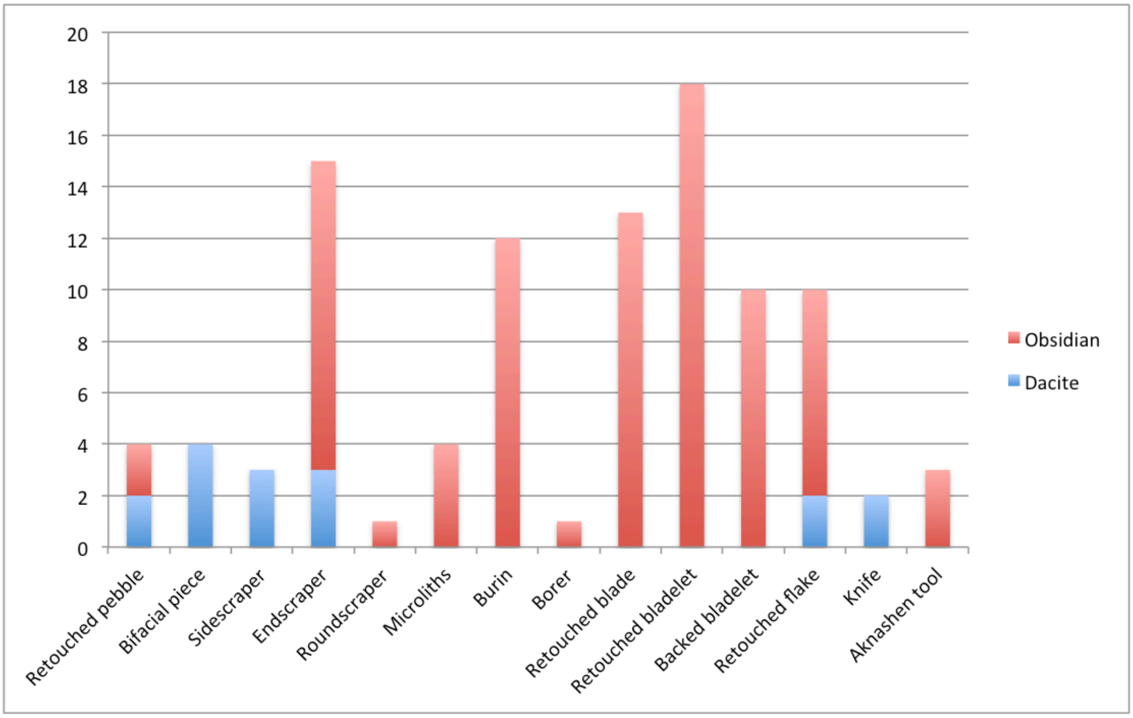


Figure 36: *Lithic category by raw material: obsidian (red) and dacite (blue)*

Most of the dacite production is expedient, although there is evidence of the production of some retouched tools, namely knives and sidescrapers, made in finer grain dacite that are significantly longer and more carefully retouched. This is especially seen in the instance of a large dacite tanged point or spearhead with bifacial retouch (Figure 37:6). Finally, the Neolithic assemblage also includes flat river pebbles with crested retouch, a behaviour unseen in previous or following layers, but that has been identified as Anaseuli II (Meshveliani 2013).

Overall, the Neolithic assemblage of Bavra-Ablari offers a new and interesting perspective on late 7th to early 6th millennium BCE assemblages. First, it provides documentation of the use of local coarse-grained dacite in the manufacture of expedient

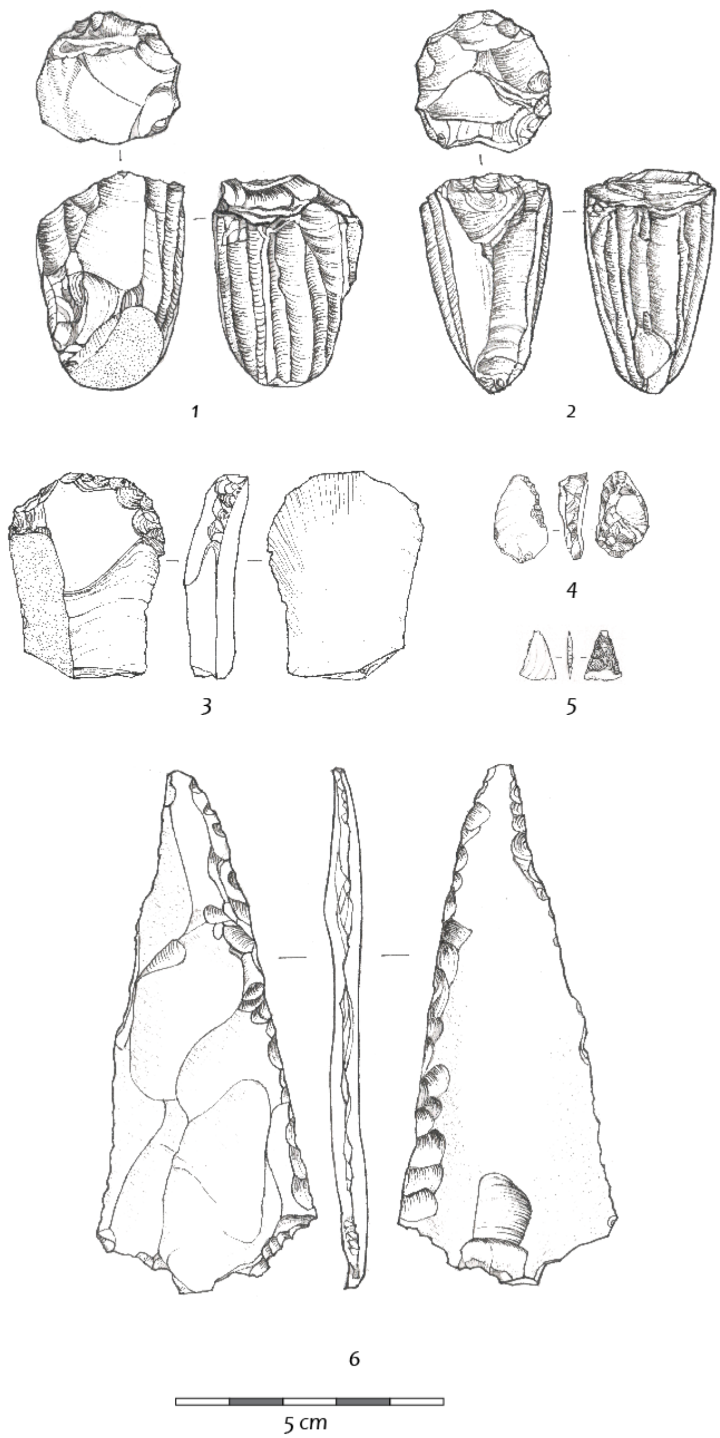


Figure 37: *Neolithic assemblage from Bavra-Ablari. Obsidian: 1-2: D-shaped bladelet core; 3: endscraper; 4: CTE; 5: tranchant. Dacite: 6: tanged point.*

butchering elements. It also provides information about the specific management of a finer-grained type of dacite, the origin of which is unknown, used in the production of tools that required a higher time-investment and were more likely connected to hunting activity. On the other hand, the obsidian assemblage shows a well-developed on-site production sequence for medium sized bladelets and the reduction of the bladelet core to exhaustion. This process involves careful management of the striking platform, the flaking surface, and the convexity and the carinated profile of the core. This *chaîne opératoire*, along with backed bladelet manufacture, assimilates the assemblage into a Mesolithic-type production. However, the presence of large blade fragments associated with a different production sequence not represented on the site is particularly interesting. This type of production has not been witnessed in Mesolithic sites around the South Caucasus. Furthermore, the large proportion of retouched blades in terms of the total number of blanks shows a different type of management, focused on the optimization of use of such blanks, especially in the context of scraper manufacture. Along with the identification of three "Aknashen tool", these elements could constitute evidence for contact between hunter-gatherer group with Mesolithic stone tool assemblages and Shulaveri-Shomu groups with Neolithic subsistence patterns and blade-based assemblages.

6.5. Lithic assemblages and sites presentation.

6.5.1. Kmlo 2

6.5.1.1. Site Background

The site of Kmlo-2 is a rock shelter originally identified in the Aragats region in 2002 during a survey led by the Mission Caucase and the Armenian Institute of Archaeology and Ethnography. Originally known as Apnagyugh-8, it is located east of the Aragats mountains in the mid-Kasakh river valley, near a stream that passes the Tsakhkunyats massif and its obsidian outcrops (Chataigner et al. 2012). The valley is dug through thick basaltic flow, and eventually connects the Armenian highlands to the Ararat plain. On the steep slops of the valley, at an altitude of approximately 1700m ASL, the rockshelter covers an area of 9m x 3m, and a height of 3m to 8m. Repeated earthquakes and erosion have led to the collapse of the entrance of the cave, and disturbed parts of the archaeological layers.

The test sounding carried out in 2002 has revealed large amounts of obsidian material, typologically associated with pre-Neolithic cultures (Arimura et al. 2009). Three seasons of excavation (2003-2006) and a supplemental one in 2009 in the northeastern area of the cave, under the direction of B. Gasparyan and C. Chataigner, have allowed archaeologists to identify the first early Holocene human occupations in Armenia. The complex sedimentation of the site, and the numerous post-depositional processes that occurred in this seismic area have created a challenging stratigraphy. The new squares opened in the northeast part of the cave in 2009, along with a series of 24 radiocarbon dates and preliminary lithic analysis, have allowed a complete review of the

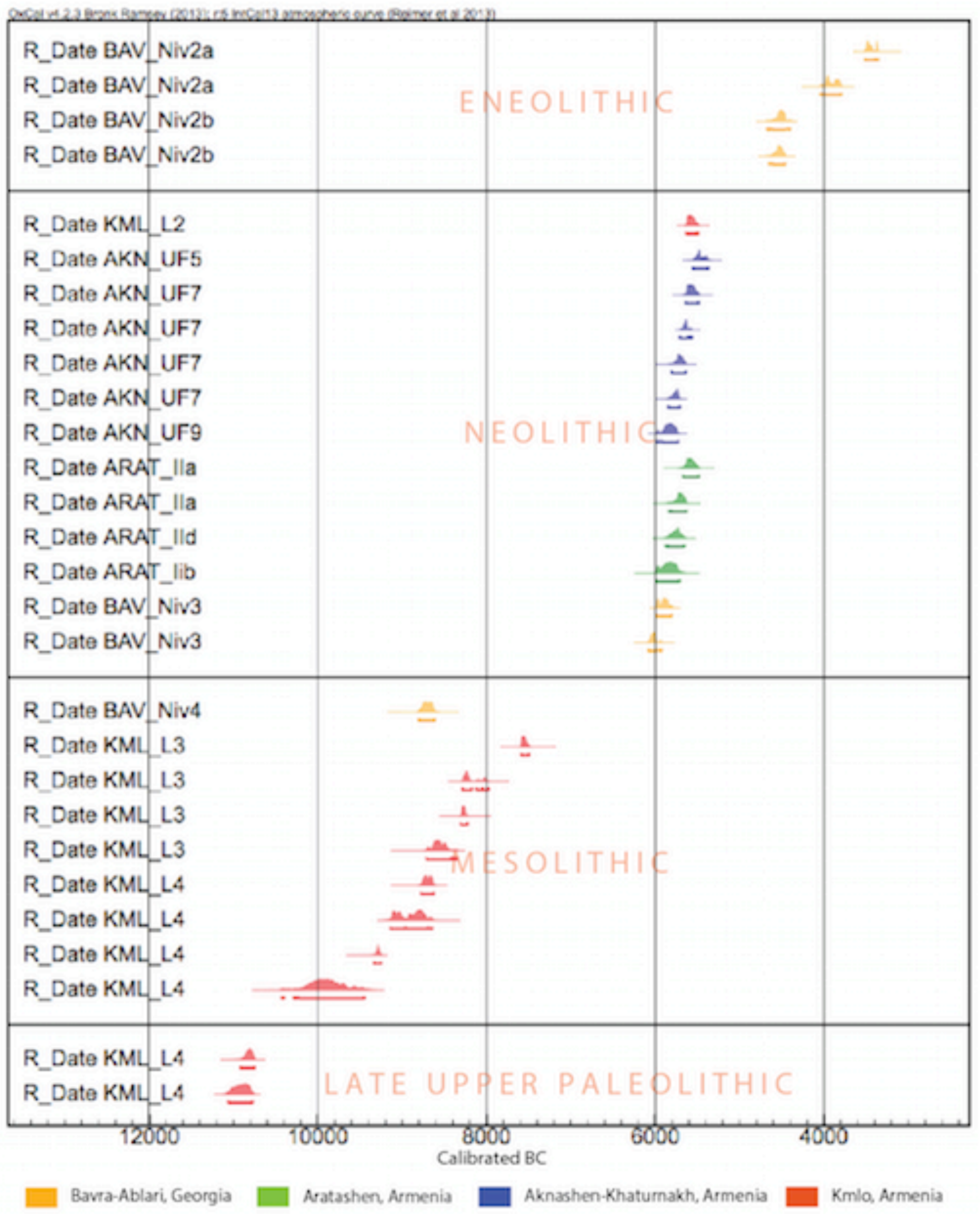


Figure 38: *Calibrated date for the assemblages studied in this work.*

sequence. The first phase corresponds to layers 1 through 4 in the southwest part of the cave and to horizon I in the northeast part. This phase (12-15cm thick) is associated with a series of medieval occupations, dated from the 10th-11th century AD, that have highly perturbed underlying deposits (Arimura et al. 2009). The layer originally defined as 5 in the southwest part of the cave corresponds to horizons II through V in the northast part (about 60 cm thick). For the whole cave, we can determine the following sequence : Phase II, a Chalcolithic occupation dated to late 6th-early 5th millennium BCE; Phase III, an early Holocene occupation from the mid-9th to mid-8th millennium BCE; Phase IV, also connected to early Holocene with radiocarbon dating given a 10th to mid-9th millennium BCE date; and Phase 5, belonging to the late Pleistocene (12th-11th mill. BCE). However, issues of both mixing and sample contamination must be taken into account. The mineral and organic fractions of a bone sample were analyzed, providing two dates with 1700 years difference, a situation the authors attribute to isotope exchange between bioapatite and contaminated carbons (Cherkinsky and Chataigner 2010). More information revealed by the lithic traditions allows the authors to suggest two possible cultural stages within the late Pleistocene/early Holocene occupations: one earlier phase (horizons V-IV), in which the assemblage is dominated by scalines and backed bladelets, and another one (horizon III) characterized by the appearance of "Kmlo tools", the presence of which slowly increases from the end of phase IV well into phase II (Chataigner et al. 2014). These categories have been suggested as the possible representations of the Early Neolithic dating from 9th-7th millennium BCE, matching Darkveti IV or Kotias Klde A2 along with Mesolithic periods (Chataigner et al. 2014).

Besides some Chalcolithic potsherds, the totality of the material culture in the Prehistoric layers is represented by the lithic industry. The assemblage is mostly composed of obsidian, with dacite (basalt) and several types of flints being a minority. The obsidian comes from several neighboring sources that are a two to three day walk away, such as Gutansar, Tsaghnunyats—although obsidian from here might be river pebbles carried by the Kasakh—Arteni, Kars, and Geghasar. The main characteristics of these assemblages are productions of small blades or bladelets, the abundance of microliths (trapezes, lunettes), the use of microburin technique, and the presence of Kmlo tools (Arimura et al. 2009).

The faunal and botanical assemblages from the rock shelter are difficult to interpret. Without access to supplementary information, the botanical samples identified on the site have all been characterized as "wild" (Chataigner et al. 2014). Several animal species were identified, including large bovines in layer V to III—possibly aurochs or bison—as well as mountain caprids (wild goat and sheep) (Chataigner et al. 2014). In the lower layer, there is an undetermined proportion of equids that Chataigner described as "important" (Chataigner et al. 2014). This Equid was possibly *Equus hemionus Pall*. which has been connected to some of the rock art representing horses identified at Geghamavan-1 (Kechoyan et al. 2014). The high fragmentation of the faunal assemblage poses issues regarding the identification of the wild vs. domestic status of some of the species represented on the site. However, the possible presence of domestic sheep has been suggested in the Early Holocene horizons, but could also be connected to an intrusion from the Chalcolithic layer (Arimura et al. 2012).

The rock shelter of Kmlo-2 is a challenging but unique site in the Armenian territory. Several horizons have been identified representing Late Pleistocene, Early Holocene, Chalcolithic, and Medieval occupations. The gap represented at Kmlo-2 between the first Shulaveri-Shomu cultural expression and the latest Early Holocene non-agricultural group is thus about 1500 years. Kmlo-2 was a small rock shelter used for short-term occupation, possibly as a hunting camp as well as a small workshop. The at times opposing chronological attributions of bone and charcoal dating call for caution in the interpretation of the cultural layers. However the rich lithic industry provides opportunity for inter-site analysis.

Kmlo-2 is so far the only early Holocene site in Armenia that has provided ^{14}C dates and a challenging yet useful stratigraphy.

6.5.1.2. Raw material (see Appendix 3.1)

The entire assemblage from Horizon II is in obsidian. LA-ICP-MS characterizations have identified 10 different sources (Figure 38): Gutansar (50%), Tsaghkunyats (20%), Arteni (15%), Hatis, Sarikamis South, and Geghasar (Chataigner and Gratuze 2014:59-60). The nature of the cortex identified in some pieces, as well as assumptions about current nodule size, supports the idea that part of the raw material was brought to site in the form of river pebbles: the Kasakh River carries blocks from neighboring sources, most likely the Tsaghkunyats outcrops. However, for the sources located further (Arteni, Spitakasar, Geghasar), GIS least-cost analysis suggested a 3-day walk from the site (Arimura et al. 2010), all the way from the western slopes of the Aragats Mountain to the southwestern area of the Sevan Lake. If some of these distances can potentially be reduced due to the lack of knowledge regarding secondary obsidian sources (especially the roles of river in carrying obsidian pebble), this distribution supports the mobile nature of the groups occupying the Kmlo-2 rockshelter during the early Holocene.

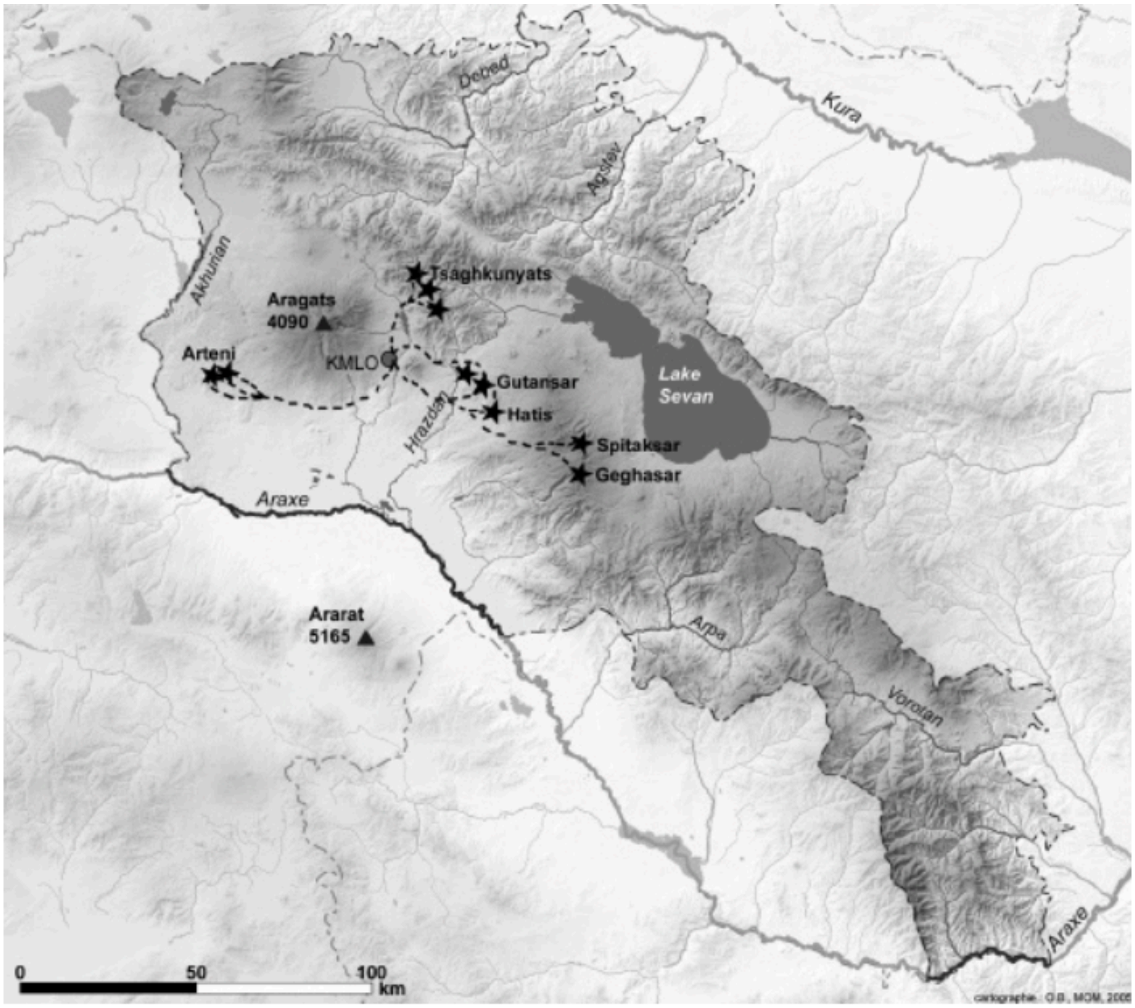


Figure 38: *Polysource model of obsidian acquisition at Kmlo-2.*

6.5.1.3 Main characteristics of the assemblage (see Appendix 3.1)

The local industry is largely oriented towards the production of small blades and, mostly, bladelets (Figure 39). A large portion of the production sequence took place on the site as shown by the large number of cortical flake and casson, as well as finished, and rejuvenated products. Tools are manufactured largely on bladelets, except for the specific Kmlo tools that were generally realized with small blades or flakes. The retouched bladelet category, along with backed bladelet and microliths, also carried out in majority on obsidian. The non-cortical flakes and non-casson debris were excluded from this chart in order to optimize the visibility of the proportions. Flakes and debris amount to 431 and 855 pieces, respectively. The total assemblage studied equals 1566 pieces.

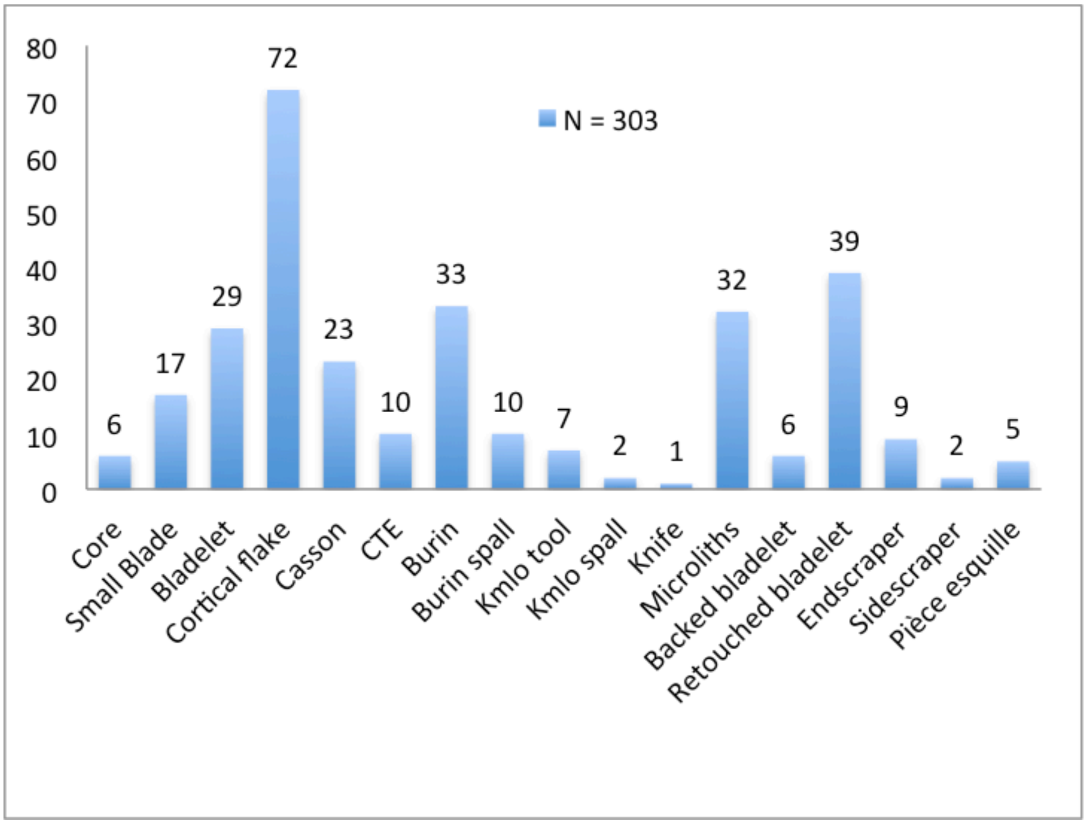


Figure 39: *Count of the obsidian assemblage categories at Kmlo-2 Horizon III*

Overall, only one *chaîne opératoire* was identified in the layer III of Kmlo-2. It is based on the exploitation of small obsidian pebbles, mainly in order to produce of bladelets that measure, on average, 35 x 12 x 6mm and require only minimal initial preparation of the core. The first stages of exploitation led to the creation of larger products—small blades and blade-like flakes—that were used in the production of Kmlo tools. The bladelet production constituted the focus of the manufacture sequence and involved pressure flaking technique, requiring more careful management of the core convexity and preparation of the striking platform.

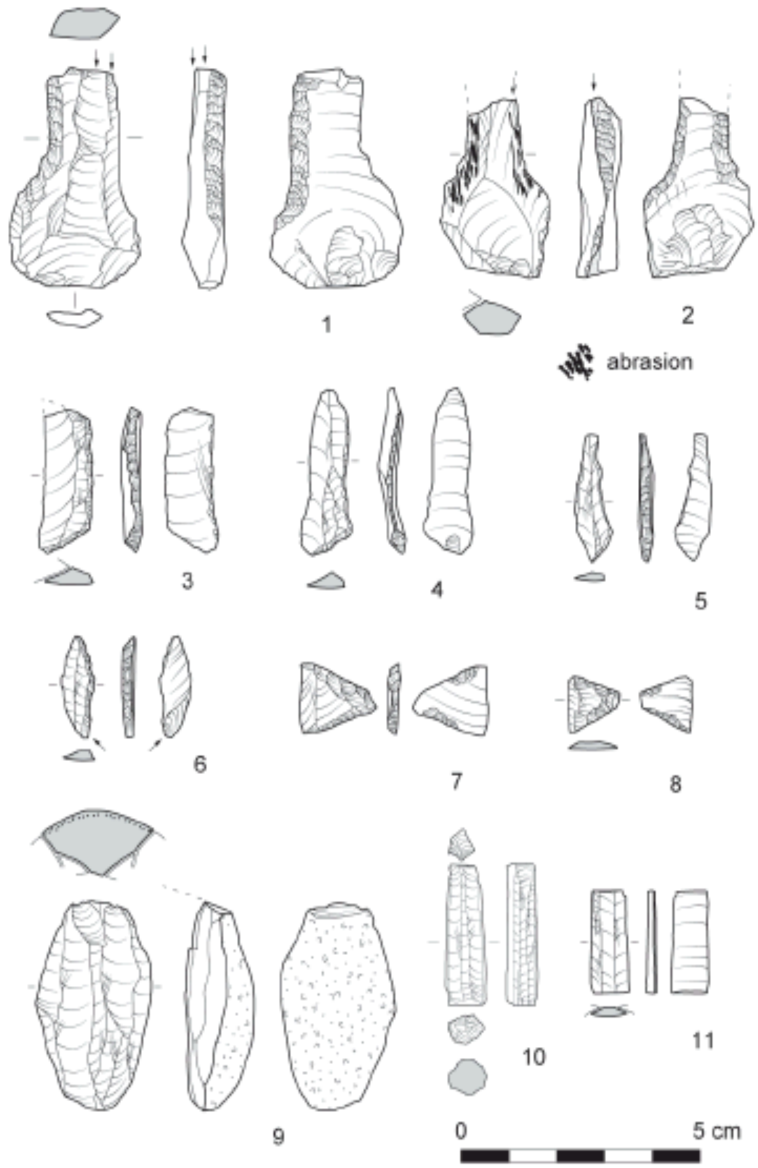


Figure 40: *Horizon III assemblage in obsidian:1-2: Kmlo tool; 3-4: backed bladelet; 5-6: microliths; 7-8:tranchants; 9: bladelet core; 10: bullet core; 11: bladelet fragment (after Arimura et al. 2010)*

6.5.2. Aknashen-Khaturnakh V, VI, VII

6.5.2.1. Site Background

6.5.2.1.1. Stratigraphic context and chronocultural sequence

The site of Aknashen is located only 6km southeast of Aratashen, on the Aratat plain in the Armavir province. The tell itself, at an altitude of 838 ASL, has a diameter of 100m that covers a surface of approximately 0.8ha (Badalyan et al. 2010). Torosyan first identified and excavated the site as Verin Khatunarkh in 1969-1972, 1974-1977, and 1980-1982. The first work focused on 400m^2 of the western part of the blur and remained mostly unpublished (see Torosyan et al. 1970). The excavations resumed from 2004 until 2009, and took place again in 2011. Directed by R. Badalyan, the more recent excavations focused on the Eastern sector of the site.

Trench A was opened on the north side of the sector so that archaeologists could assess the cultural potential of the areal and find the geological substratum. After 415cm of cultural layer, excavators reached the water table level, but the archaeological layer continued. Trench B is located on the southern part of the sector is and comprises 10 squares of 2m x 2m, which together cover a total area of 313m^2 (Badalyan et al. 2010). As of 2013, 46 radiocarbon samples have dated the site between the mid-6th millennium BCE and the 3rd millennium BCE. The oldest dates are found in the Neolithic layer, at 5980-5840 BCE. Overall, the stratigraphic sequence was divided into 15 stratigraphic units (UF), seven Horizons and five sub-horizons. The Chalcolithic layer (I), identified by its characteristic pottery, is highly disturbed by LBA and medieval activities like pits and burials. The following layers (II to V) belong to the Neolithic (or Late Neolithic, first half of the 6th millennium BCE).

Table 2: *Stratigraphic table of Aknashen-Khaturnakh*[3].

Hor.	Tr. 1	Tr.	Tr. 3	Tr. 4	Tr. 5	Tr. 6	Tr. 7	Tr. 8	Sondage A
V	UF 9	UF 9	UF 9	UF 9	UF 9	UF 9	UF 8	UF 8	UF 9
	UF 10	UF 10	UF 10	UF 10	UF 10	UF 10			UF 10
		UF 11			UF 11				
VI	UF 11	UF 12		UF 11	UF 12				UF 11
VII	UF 12	UF 13		UF 12	UF 13				UF 12
	UF 13								UF 13
	UF 14								UF 14
									UF 15

Aknashen's architecture and material culture is from Horizon II to V, and is fairly homogeneous. The structures are circular, 4m to 5m of in diameter, and are made mostly of pisé or "bauge" (Sadozai 2013). This technique involves the use of monolithic packs

[3] All three horizons (V to VII) yielded dates ranging from 5980 to 5730 BCE (R. Badalyan, comm. pers.)

of plastic clay with vegetal inclusions in order to build a wall, one layer after the other.

According to this method, walls are built using formwork, but are progressively casted on by successive layers. This technique may have been used in parallel with mud bricks, although it remains at Aknashen much more uncommon than at Aratashen or Arukhlo. Remains of Neolithic burials have been identified in Horizon IV and V, and, in one case, they were associated with obsidian artifacts (Badalyan et al. 2010).

Figure 41: *Trenches at Aknashen-Khaturnakh*

(Badalyan et al. 2013)

6.5.2.1.2. Material culture

The material culture shows several variations throughout the layers, but remains homogeneous overall. As of 2010, 7196 pottery sherds were found. Of these sherds, 6340 belong to Neolithic or Chalcolithic layers, and 9 sherds are, most likely, imports. Three main types of ceramics that make up the assemblage of Aknashen: organic tempered-chadd-tempered (46%, including chopped straw, cereal residue, animal excrement); mineral temper-grit-tempered (42% using the coil technique); and organic and mintral temper-grit-tempered (12%). The proportion of chaff-tempered ceramic decreases in the lower levels. Some of the pottery types and wares have shown similarities with the Shulaveri-Shomu sphere, as well as with pottery from Kultepe-1 in Nakhichevan (Chataigner et al. 2014). Several interesting sherds have been identified as imports due to their high quality (pure clay, painted in black with geometric decoration) and their iconography, which may show parallels with Samarran pottery from the northern Near East (Shimshara, Hakemi Use, Sabi Abyad) (Badalyan et al. 2010). The overall quantity of sherds in the lowest layers remains low. In Horizons VII and VII, less sherds appear, and these findings are mostly grit-tempered, although they are described as "atypical" (Badalyan et al. 2014). Most importantly, the majority of this layer's ceramic assemblage is composed of imported ceramic, although no cultural attribution is complete thus far (Badalyan et al. 2014) (Figure 42). In Horizon VII, we must also note the presence of cone-shaped ceramic tokens (one token and two token fragments) made of pure clay (ibid.), which were also found at Khramis Didi Gora and the Mil Steppe sites.

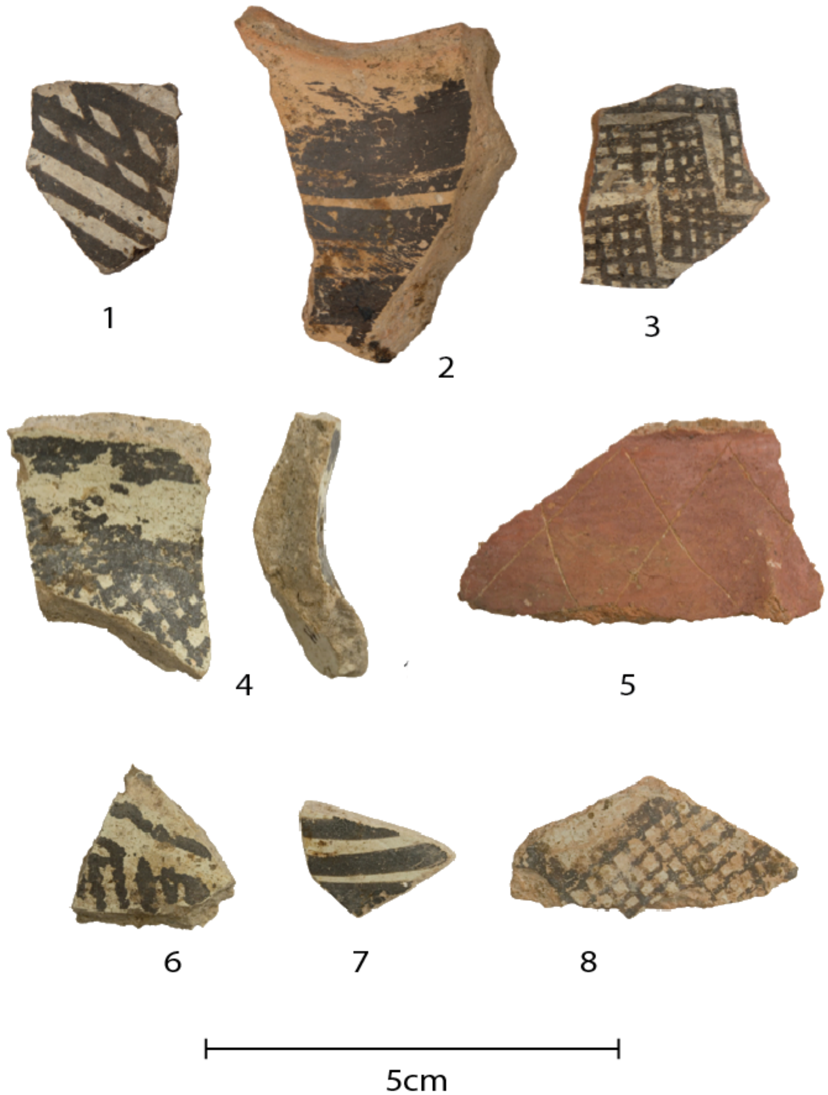


Figure 42: *Imported pottery sherds from Aknashen-Khaturnak. 1-4,6-8: painted; 5: incised (Badalyan et al. 2013)*

Between 2004 and 2013, 267 grinding tools were collected (Figure 43). Although the site has produced only a limited amount of percussion tools (Badalyan et al. 2010), the assemblage is heterogeneous, showing an important diversity in food preparation technique (Hamon 2013). The tools are made of volcanic (basalt, lava, tuff) and metamorphic material (sandstone, limestone, granite). While some of the tools used—saddle-shaped querns, flat querns, perforated celts, trapezoidal axes, and abraders—are found in other Shulaveri-Shomu sites, Aknashen also produced unique types—hand abraser, polished tools—that could be exogenous (Hamon 2013). Some of these tools, such as the perforated celts, seem to exist in some sites in Northern Iraq, as well as Yarim Tepe.

Figure 43: *3-4, Metate, 1-2, incised pebbles (Hamon 2013)*

Aknashen's bone industry comprises 378 objects in bone, antler, and horns. Many different types are represented, such as awls (80%), punches, "tablettes," and spoons (Christidou 2013) (Figure 44). Both the quantity and the variety of bone tool decreases in layer VI-VII (N=27). Several diamond-shaped bone beads have also been found in Horizon V and have been placed in parallel with the ones found in Yarim Tepe (Badalyan et al. 2014). Other finds include small copper ornaments (token copper ring found by the skull, also found at Khramis Didi Gora, Gargalar Tepesi, and Aratashen) (Chataigner et al. 2014), small antigorite beads, an obsidian discoid pebble with a groove in the center, and several perforated or grooved animal teeth, vertebrae, and marine shells (Badalyan

2014). Several fragments of malachite and azurite have been found, possibly connected to metallurgical activity, although it is unlikely that such activities would have taken place on the site. Finally, in Horizon VII, one exceptional find has yet to be properly interpreted: a green-stone stamp of plank-convex section with a polished surface and beautifully incised tracery decoration, possibly connected to Halaf culture.

Figure 44: *Neolithic bon tool assemblage: 1-2: spoon; 3-5: perforated plate (Badalyan et al. 2014)*

6.5.2.1.3 Environment and subsistence pattern

Geomorphological and environmental studies (Chataigner et al. 2014; Ollivier 2013) have shown that during the 6th millennium BCE, Aknashen's direct environment comprised "wetlands (*Cyperus sp., Carex sp.*), gallery forests along the rivers (*Salix*, *Populus, Tamarix*) and mixed oak forests (*Quercus, Acer, Amygdalus, Celtis*) in the surrounding foothills" (Chataigner et al. 2014; Ollivier, 2013). This environment was inhabited by wild animals such as aurochs (*Bos primigenius*), red deer (*Cerus elapses*), roe deer (*Capreolus capreolus*), gazelles (*Gazella sp.*), and moufflons or ibex (*Ovis orientalis*, *Capra aegarus*) (Badalyan et al. 2007, 2010, Balasescu et al. 2010; Chataigner et al. 2014).

Mezhlumyan carried out the first partial faunal analysis of the assemblage in 1972. The great majority of the faunal assemblage of the Neolithic Horizons is composed of domesticates. As of 2010, 13,000 remains have been studied, among which 5900 have been identified to taxonomic level (Badalyan et al. 2010). Domestic species are mainly represented by sheep *(Ovis aries*) and goat (*Capra hircus),* as well as cattle (Bos taurus). There are also rare occurrences of pigs (Sus domestics) and dogs (*Canis familiaris).* Caprinae dominate the assemblage, although frequency of their remains decreases over time in favor of cattle. The slaughtering age profile shows a good representation of younger age group (although lambing did not occur at the site) and a selection of younger animals for meat consumption (Badalyan et al. 2010). This contrasts sharply with the mixed exploitation represented at Aratashen (Balasescu 2010). The inter-site difference can also be seen in hunting patterns. While both sites shows evidence supporting an increase in hunting activity from the lower to the upper layers, hunting at Aknashen does not appear to have been as selective as at Aratashen (focusing on the deer). A large spectrum of species is represented, including aurochs (*Bos primigenius*), wild boars (*Sus scrofa),* horses (*Equus ferus*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), gazelles (*Gazella sp*.), bears (*Ursus arctos*), wolf (*Canis lupus*), foxes (*Vulpes vulpes*), wild cats (*Felis sylvestris*), small mustelids (*Mustela sp.),* hares *(Lepus sp*.), beavers (Castor sp.), hedgehogs (*Erinaceus sp.*) and wild Caprinae, i.e. mouflon (*Ovis cf. orientalis)* or wild goats (*Capra aegagrus*) (Badalyan et al. 2010:24). Fishing is also attested to at Aknashen (carp, tench, catfish) and at least one bird species was hunted (*Otis tarda*).

Both sites involved economies primarily of sheep herding, but the lack of very young and older breeding animals at Aknashen and the rarity of charcoal ash have been interpreted as evidence of a seasonal occupation. Conversely, Aratashen, with its varied slaughtering age profile, and presence at the site of domestic pigs, demonstrates the possibility of a year-round occupation (Balasescu et al. 2010; Brochier 2008, Chataigner et al. 2015). Furthermore, at Aknashen, geoarchaeological studies suggest that the amount of mineralized dung identified at the site highlights the lack of interest of inhabitants in using it as a fertilizer (Badalyan et al. 2010). These differences between Aknashen and Aratashen could be interpreted in terms of site function, seasonality, and the status of its inhabitants.

The botanical remains of Aknashen include 42 flowering plants identified through flotation or plant impression pisé. Several species of cereal were cultivated: free-threshing wheat (*Triticum aestivum/turgidum),* emmer (*T. turgidum ssp. dicoccum*), naked barley (*Hordeum vulgare var. nudum*), and hulled barley (*H. vulgare*), with naked wheat and barley being predominant (Hovsepyan 2014). Two additional cultivated pulses, small-seeded lentils and biter vetch, are also present. The predominant species cultivated are also found in the Near Eastern crop assemblage, although not systematically (Zohary and Hopf 2000 in Hovsepyan and Willcox 2008). Seed and chaff would have been separated by winnowing (using a tribulum) and the chaff would have been used in the making of the pisé. Several cruciferous plants were also used at the site, possibly for oil production, as is suggested by the systematic foraging (and possible cultivation) of *Alyssum* and *Camelina* plants. Overall, the wild plants assemblage shows a great ecological diversity (Hovsepyan 2014).

Aknashen was a seasonal stockbreeding and agricultural settlement dating from the first half of the 6th millennium BCE. Its rich botanical assemblage shows the use of more than 20 species, among which is the hexaploid naked wheat, which did not originate in the Near East. It has been suggested that hybridization took place at some point during the 7th or even 8th millennium BCE (Hovsepyan and Willcox 2008), possibly in the southeast area of the Circumcaspian. The new Horizon VII remains undated but shows a material culture that is significantly different. That layer seems to have been built on the geological substratum (manifested by a layer of lake deposit dating to the post-Wurm) and could possibly be connected to the first occupation of the area.

6.5.2.2. Presentation of the assemblage (see Appendix 5.1)

As of 2014, the assemblage is made of 45,496 artifacts (172kg), 99.6% of which are in obsidian. The rest of the assemblage includes flint, dacite, quartz and jasper artifacts.

The assemblages studied in this project originate from Horizon V, VI, and VII, which are each made of several stratigraphic units. Horizon VII was, at the time of the 2013 the assemblage study, only exposed on $2m^2$. All three horizons have been dated between 6005-5837BCE and 5815-5730 BCE. The small surface of Horizon VII yielded only 79 pieces; however, those found involve many technical pieces and tools. Informal data regarding subsistence patterns has not provided evidence for a significant change in subsistence pattern. Horizons V and VI produced 1177 and 278 lithic artifacts, respectively. Horizon VI is generally considered a cultural hiatus. However, the presence of a plateau in the calibration curve during the first centuries of the 6th millennium does not allow us to distinguish clear chronological differences between layer V and VII. However, the material culture found before and after Horizon VI is clearly different. Even when estimating the maximum chronological gap between Horizon VII and V, the processes that resulted in such changes must have happened over the course of 150 to 200 years—a fast pace, considering the phenomenon studied.

6.5.2.2.1. Raw Material

The material from layer V through VII is almost exclusively obsidian. Several other raw materials have been identified, including quartz (VI:1), ponce (V:2, VII:2), jasper (V:1), flint (V:5, VI:3, VII:1), and dacite (V:11, VI:1, VII:0). The decrease in dacite from Horizon IV onward seems to be confirmed by the absence of this raw material in layer VII, although the limited sample size limits the interpretation of this phenomenon.

Obsidian is found in several colors: transparent grey, grey, transparent black, black, orange-black, orange, brown-black, and brown. No particular distribution has been noticed, and macro-visual sourcing based on color and texture has been shown to be particularly ineffective in this area (Chataigner, comm. pers.). Therefore, ICP-MS analysis has been carried out on 40 samples (Badalyan et al. 2010)(Figure 45). The data from this analysis suggests that 86% of the raw material comes from three sources: Arteni (48%, 55km NW), Gutansar (32%, 50km NE), Hatis (6%, 45km). The last 7 sources (of 10 total) are represented by a few samples. Overall, this polysource model of procurement is also seen at Aratashen, although here it involves different outcrops. Groups typically had two to three obsidian procurement strategies, with procurement occurring either in the context of semi-nomadism or within a small group. The smaller proportions of obsidian could be the result of contact with other, possibly more mobile groups or may simply signify leftovers from previous trip. The absence of large sources such as Tsaghkunyats (which is also the case at Aratashen) is interesting, however, and could be connected to territorial questions. These outcrops are indeed further into the highlands and might have been out of range for these agricultural communities.

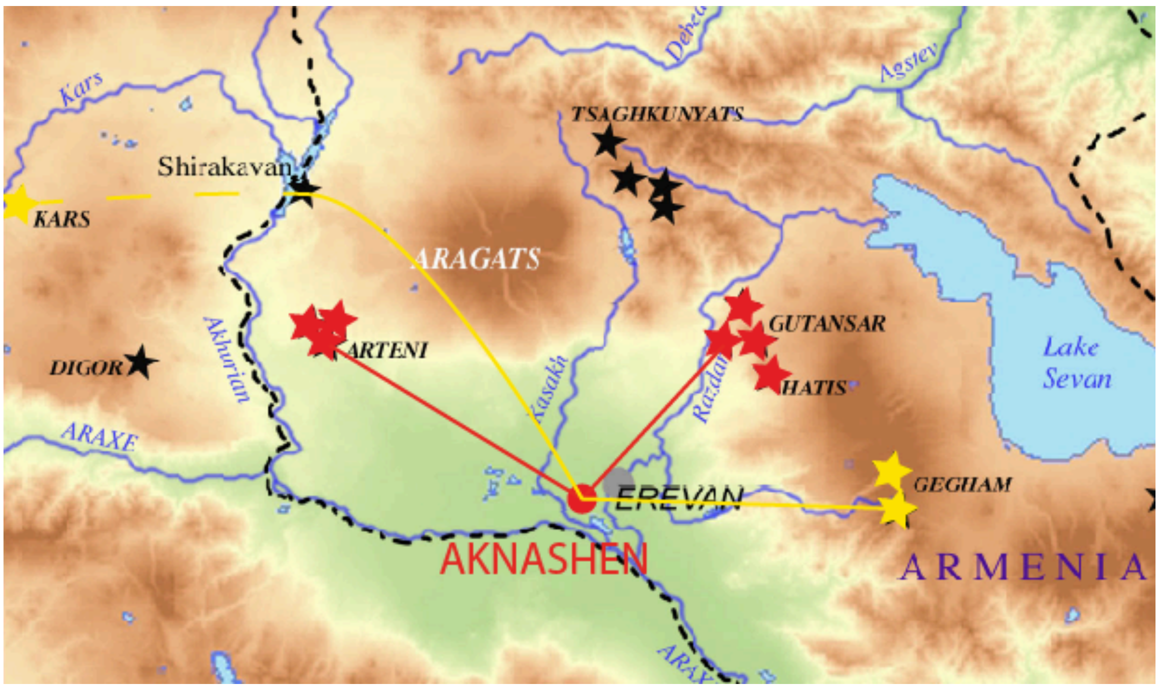


Figure 45: *Polysource model of obsidian acquisition at Aknashen*

Overview of the assemblage

The total studied collection from Aknashen amounts to 1534 pieces. This collection consisted of the material accumulated during the 2013 excavation season from Horizon V through VII. It is only a small portion of the total lithic assemblage gathered since the beginning of the excavation, a collection that comprises 45,000 obsidian artefacts (492 units in other raw material). However, the actual weight of the accumulated assemblage only amounts to 172,864kg, an important consideration when addressing questions of raw material distribution. Therefore, the total amount of the material studied in this project is only 5.9kg.

Table 3: *Distribution of the assemblage/Horizon*

Horizon V	Horizon VI	Horizon VII
1177 pieces	278 pieces	79 pieces

Overall, the general assemblage is still largely dedicated to the production of blades and bladelets. The format of the bladelet at this site is stylistically different, and about 20% larger, than the one used in the context of Bavra-Ablari or Kmlo-2 sites. Some degree of consistency is found between the three layers, but differences also exist. While the small size of Horizon VII's collection calls for caution in interpreting its meaning, several technological differences with the previous horizons seem to support the hypothesis of an apparent switch of focus from blade to bladelet production, or an overall reduction of the blanks. A larger sample size should allow us to better substantiate this hypothesis. Comparatively, there is a small amount of technical pieces and cores (Figure 46). Furthermore, specific blade production techniques are known for their optimization of raw material exploitation as well as the overall production of very little by-products. Thus the low representation of by-products related to earlier stages of the *chaîne opératoire* suggests that cores were already brought to the site preformed or even already exploited. As it is generally the case with collections from agricultural sites, we see a decrease in tool type and retouch type accompanied by an increased focus on the manufacture of standardized blanks, generally used for plant processing activities. Some of the blanks show irregular retouch, while others have been used without retouching, as is seen through micro-denticulation and micro-wear on one or two edges of the blade.

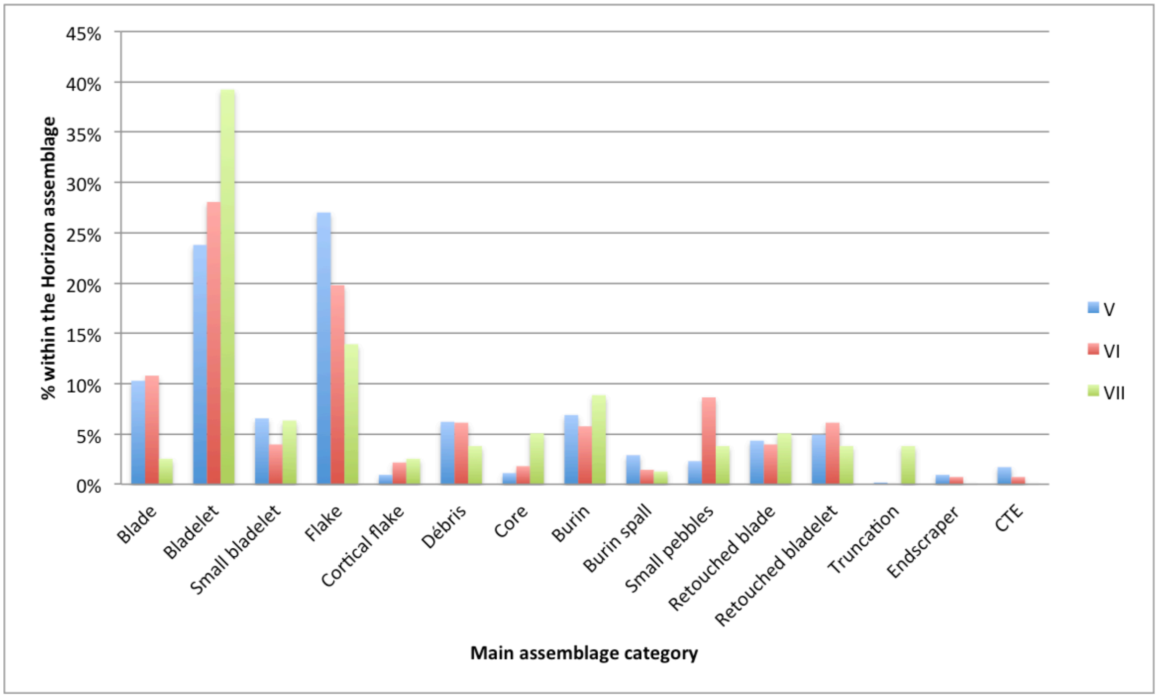


Figure 46: *Horizon V-VII, distribution of the main assemblage categories*

Overall, several aspects of the Aknashen V-VI-VII assemblage are particularly relevant for our approach.

The majority of the production is dedicated to the manufacture of long, standardized blade blanks through indirect percussion, and pressure flaking (using long crutch and lever) (Figure 47). This blade making *chaîne opératoire* produces an important amount of blanks. In some cases, we have found concentrations of bulbar flakes or esquilles, along with fragments, that might point towards a focused activity. It is thus possible that blank production occurred in very limited time and space, and the retouching and toolmaking were more spread-out processes. Considering the techniques involved in the blank production, this could support hypothesis that put forth involvement of one or two

Figure 47: *Lithic assemblage from layer V-VI (1-13), and VII (14-16).1: blade core (mode 4-5); 2-5: blades; 6-11: tranchants; 12-13: Aknashen roundscrapers; 14: bullet core; 15-16 bladelet cores*

specialists detaching a series of blade through different technique (lever, crutch, indirect percussion) in one or two days of activity. These blanks might then have been spread throughout the families within the community, who then operated the retouch themselves. This diffusion of tools among separate families for retouch could explain the difficulties in creating a typology of retouched tools. This fragmentation, both spatial and chronological, of the *chaîne opératoire* is particularly interesting when connected to the question of technology transfer and group interaction.

6.5.3. Aratashen II

6.5.3.1. Site Background

The site of Aratashen is located by the river Kasakh on the Ararat basin, about 25km west of the city of Yerevan. Sardaryan first explored the site in the 1970s, and Aslanyan investigated the area between 1988 and 1990, but no publications are available for these projects. These research resumed with six seasons of excavations directed by R. Badalyan and P. Lombard from 1999 to 2004 (Badalyan, et al., 2004a, 2004b, 2005, 2007).

Aratashen is an ovoid tell (or blur), approximately 6m in diameter and located at 852m ASL. The fluctuations of the Kasakh River bed have exposed the northern section of the site to the elements, and modern terracing work damaged the upper layers of the sequence. The site is an accumulation of thin sandy river sediment and pebbles, and destruction/occupation layers. The first series of excavations had divided the stratigraphy into four “horizons” (0 to III), from Chalcolithic to Neolithic, determined on the basis of architectural characteristic. Several radiocarbon dates and a re-assessment of the data excavated have re-arranged the Neolithic sequence into two main levels divided into subphases (IIa, IIb, IIc, IId) ranging from 5663-5481 to 5905-5711. The first level (I) was opened on 215m^2, the second (II) on 120m^2 and resting immediately on the virgin soils, thus representing the first occupation stage at Aratashen (Table 4).

Table 4: *Chronostratigraphic table with newly calibrated dates*

2002-2003	2005 (final)	C14	Cal. BP	BCE
Horizon I	Level 1	-	-	-
Horizon II	Level 1a	Lys-2269 Lys-2268	6669±60 6820±55	5701-5486 5834-5627
Horizon III	Level IIb	AA-64175	6948±73	
-	Level IIc	-	-	-
-	Level IId	AA-64176 AA-64178 AA-64177	6821±46 6866±49 6913±49	5794 -5631 5875 -5658 5967 -5711

There is an apparent break between levels I and II in terms of industry, construction, and faunal assemblage (Badalyan et al. 2007). Level I produced five fairly large and simple circular structures, made of rectangular mud bricks and with clayed floors. Besides a few possible silos, archaeologists also uncovered a few dug hearths filled with pebbles (Figure 48).That level also produced a significant amount of ceramics associated with Shulaveri-Shomu culture, along with two basalt querns found *in situ* along the wall of one of the structures. Level II, on the other hand, is architecturally much more dense and complex, with an intricate network of different types of domestic structures. Dwellings are generally 3.5m of diameter, with very limited clayed floors. The construction technique seems to have involved both pisé and mud brick, and was used in the construction of silos, work platforms, and possibly ovens (ibid.), sometimes associated with concentration of river pebbles. Layers IIb to IId are also extremely abundant in faunal and lithic remains. Besides a few Shulaveri-Shomu sherds appearing in IIb, and five painted ceramics correlated to late Halaf period, these layers remains poor in pottery (Palumbi 2007, Badalyan et al. 2007).

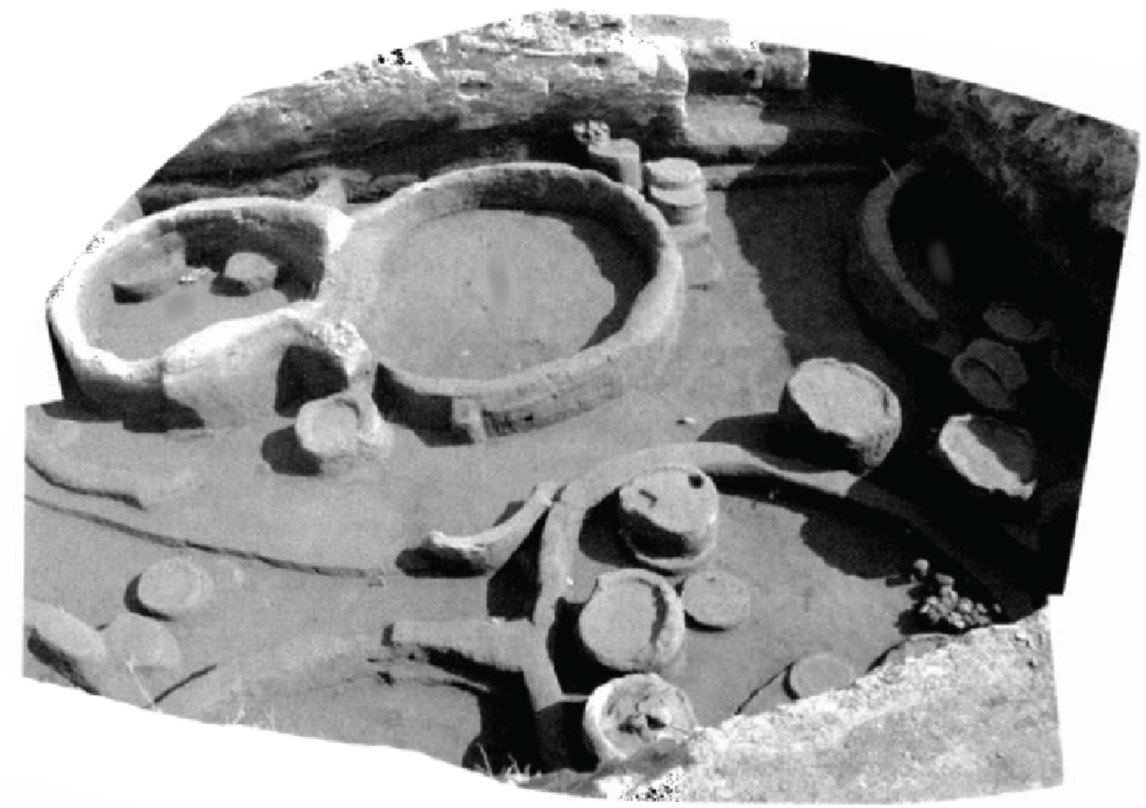


Figure 48: *Photo of Horizon III, round houses and domestic structures (Badalyan et al. 2007)*

The bone, horn, and antler industry includes more than 500 objects, with a high concentration in the IIb horizon. The industry is composed large majority of tools dedicated to hide-working or basket making, such as awls, spatulas, hoes, arrowheads, and one sickle handle (Christidou 2009), (Badalyan et al. 2007). The tools were realized on sheep/goat and sometimes bird bones, and the most elaborate versions were manufactured on metacarpi or metatarsi of caprinates (Christidou 2009). Other types of domestic instruments were uncovered, such as several palettes realized on shoulder blades, a "toothed" artifact also found in other Shulaveri-Shomu sites, and antlers. While the industry found at the site bears strong resemblance to behaviors widespread in the northern Near East (Christidou 2009), it also has some clear South Caucasian features (Figure 49).

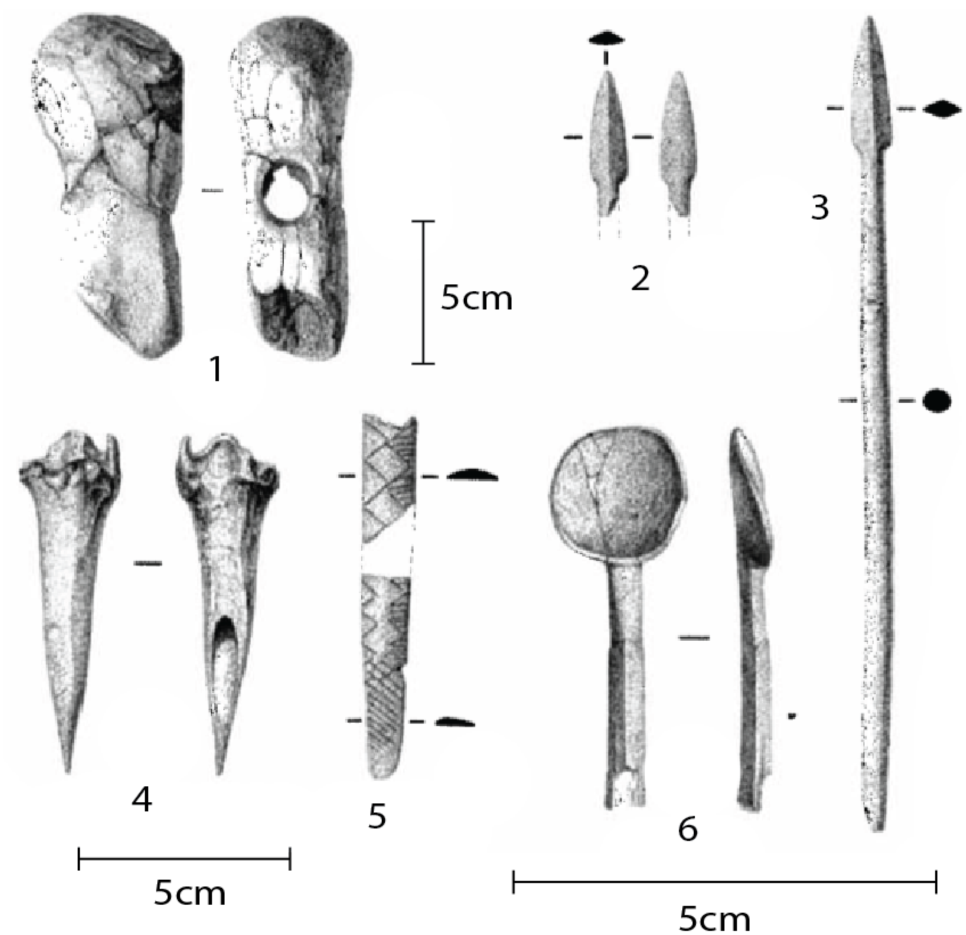


Figure 49: *Bone tool industry from Horizon II-III. 1: hammer ; 2-3: arrows; 4: awl; 5: incised bone; 6:spoon (Badalyan et al. 2007)*

Let us note the total absence of metal (besides possible evidence of iron ore, encasing rock, in IId) until the layer IIb, in which a copper bracelet made out of 57 beads made of metal leaf was found (Badalyan et al. 2004, 2007). This particular technique is known in northeast Mesopotamia at the sites of Yarim Tepe and Chaga Bazar, and indicates different behaviors than those noticed in the mid-Kura Valley sites (Chabot and Pelegrin 2012).

Aratashen's subsistence economy is based, in large majority, on herding of small domestic ruminants. Layers IIa and IIb have produced the largest amount of material, and sheep (*Ovis aries*) and goats (*Capra circus)* make up 80% of the faunal remains of these layers. The rest of the domestic species represented in the assemblage are oxen (*Bos taurus)* (8%), dogs (*Canid familiaris)* (1%), and pigs that may have been domesticated (*Sus domesticus*) (1%) (Balasescu et al. 2010). Wild fauna is uncommon, and amounts to slightly above 10% of the total assemblage. Of the wild fauna, there is a clear surrepresentation of cervids (*Cervus elaphus*) (10%), which would have been used for their meat and antlers, and more anecdotical identifications of wild pig (*Sus scrofa*), wild goats (*Capra aegagrus*), muflon (*Ovis cf. orientalis*), bear (*Ursus cf. arctos*), birds, beavers, and others (Balasescu et al. 2010). The assemblage also attests to fishing, with bones suggesting the consumption of carp (*Cyprinus carpio*), tench (*Tinca tinca),* and catfish (*Silurus glanis*).

Throughout the layers, there is an evolution of the proportions of sheep remains and goat remains. While sheep remained predominant, the ratio of sheep to goat lessened from 4:1 to 2:1 between IId and IIc (Badalyan et al. 2007), The slaughtering of the caprinate is almost equally distributed among age categories, with a slight increase in slaughtering of caprinates between 6 months to 2 years, an age preference that is characteristic of meat consumption. However, both the presence of juveniles under 6 months and the kill-off pattern suggests the presence on the site of all age categories (Balasescu et al. 2010). This pattern could be explained by a year-long occupation of Aratashen. It also may be related to a specific function of the site where lambing might have taken place. This can be supported by local nature of the hunted fauna except for bear and wild goat, animal types that would have originated from the highlands.

This animal activity was coupled with the cultivation of several domesticated crops such as *Tr. spelta*, *Tr. diccoccum*, *Hordeum vulgare*, *var. nudum*, and lentils (*Lens culinaris*). The hexaploid barley (*Hordeum vulgare*) is the most common on the site. The grains were used for combustion, while the chaff was utilized as temper for mud bricks and pisé. In addition with other wild species, the charcoals identified suggest an environment of plains and hills, with forest corridors running along the water axis.

The site was first occupied at 5905-5711BCE by a fully developed agricultural group with already domesticated crops and animals. The origin of some of these crops is not yet identified but could be located in the Caspian plains such as with the hexaploid wheat (*Tr. Aestivum*). The group may have lived on the site the entire year, which would have involved a specific inter-site organization at the territory level of off-site lithic production, the use of wild animals from the highlands, and the presence of Halaf potsherds. While several of Aratashen's cultural features can be connected to Near Eastern influences of Halaf and Hassuna, the site also shows parallels with the Shulaveri-Shomu culture, as well as with some elements that are characteristic of Araxes River valley sites like Kultepe.

6.5.3.2. Presentation of the assemblage

The overall lithic assemblage is composed of 18,000 pieces (90kg). The collection is comprised largely of obsidian, with 26 pieces in flint, quartz, quartzite, silicified limestone, mudstone or serpentine. The assemblage selected for this study comes from the layers IIb-IIc-IId. Horizon II is characterized as typically Neolithic, with a high density of structures and material culture. It is sub-divided into 4 stages from II-a to II-d. Level IId is especially targeted by this study, for it has provided radiocarbon dates ranging from 6821 +-46 to 6913 +- 49 and is thus close in date to the Horizon VI-VII studied in Aknashen-Khaturnkah. The material found in this layer is generally associated with structures (31, 53, 28, 8, X, 317, wall K01 B) found on house floors, sometimes grouped together (UF291).

6.5.3.2.1. Raw Material

Aside from some elements in dacite, flint, and quartz, the overwhelming majority of Aratashen IIc-IId material is obsidian. This study focused only on the obsidian assemblage, as the other material was exploited only through expedient *ad hoc* strategies.

Obsidian at Aratashen is characterized by a multitude of colors. Characterization carried out on 69 samples (Badalyan et al. 2007) highlights a polysource mode of exploitation, with a large focus on one particular source. Indeed, Arteni obsidian seems to be the most represented during the Neolithic period at Aratashen (62%). The source is located at a 10-hour walk from the settlement. The second most important source is the large complex of Gutansar (19%), also located in a neighboring area and represented at Aknashen. Other sources are represented in smaller proportion and generally located more than a 20-hour walk from the site. This is the case for Geghasar (4%) as well as some Anatolian sources such as Kars (7%) and the Lake Van sources of Meydan and Tendurek (3%).

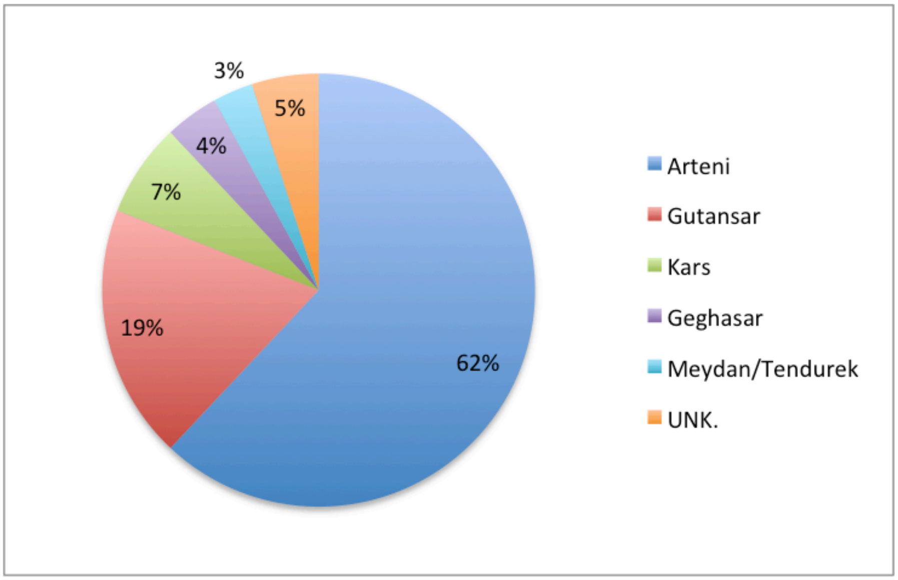


Figure 50: *Polysource model of obsidian acquisition*

This pattern is interesting in several ways (Figure 50). The polysource model remains largely dominated by the obsidian from the Arteni source. While this obsidian is also seen in large quantities at Aknashen (48%), it represents 69 percent—a great majority—of the assemblage at Aratashen. This could be connected to a sample bias, but may also underline different approvisioning patterns for neighboring sites. The variability in obsidian-gathering methods can also be witnessed in the seemingly complete absence of Hatis obsidian in Aratashen, although the outcrop is located close to the site and is located in between Gutansar and Geghasar, two sources that *are* represented at Aratashen. Such differences may highlight different networks between groups or paths that allowed for easier travel between certain places on the landscape.

6.5.3.2.2. Overview of the assemblage

Initial analysis of the material carried out by Chabot (Badalyan et al. 2007) shows that the industry was largely aimed at producing tools on long blades, as only 2.3% of the tools were made on flakes. A majority of the tools were realized on the proximal and medial part of the blades, which allowed for the production of denticulates, burins, pointed tools, sickle blades and tribulum elements. Most of the blanks were obtained by indirect percussion, pressure with crutch, and lever, even though there are very few indications of *in situ* debitage. While there are no microliths present, there is a rich ground stone tool industry of querns, mortar and pestles, and hand-stones, realized mostly in basalt, but also in lava and tuff. Hamon (2008) identifies several clingstones of 4 to 9cm in diameter. The site also produced 8 polished stone axes (from IId and IIb layers) of oval or trapezoidal shape, ranging from 6 to 12cm of length (Badalyan et al. 2007). In addition, archaeologists found grooved stones manufactured in stone rocks, which show two to three transversal grooves, a feature also found in contemporaneous Zagros groups.

The amount of obsidian artifacts studied from Aratashen Horizon II amounts to 1530 pieces. In Aratashen as in Aknashen, the assemblage is largely dominated by blade and bladelet fragments, as well as by flakes and retouched blades. The assemblage is characterized by the low production of debitage, cores, and technical pieces, especially when compared to the proportion of blanks represented.

Overall, the assemblage composition is typical of a Shulaveri-Shomu settlement that utilizes standardized blade blanks with minimal retouch for agricultural activities (Figure 51). Low representation in cores, by-products, and microliths show that most of the production sequence took place off-site, and suggests also that the little *in situ* production was punctual and focused. The presence of microliths, associated with small proportions of wild fauna in the assemblage, support the small role played by hunting activities in the subsistence patterns of the site.

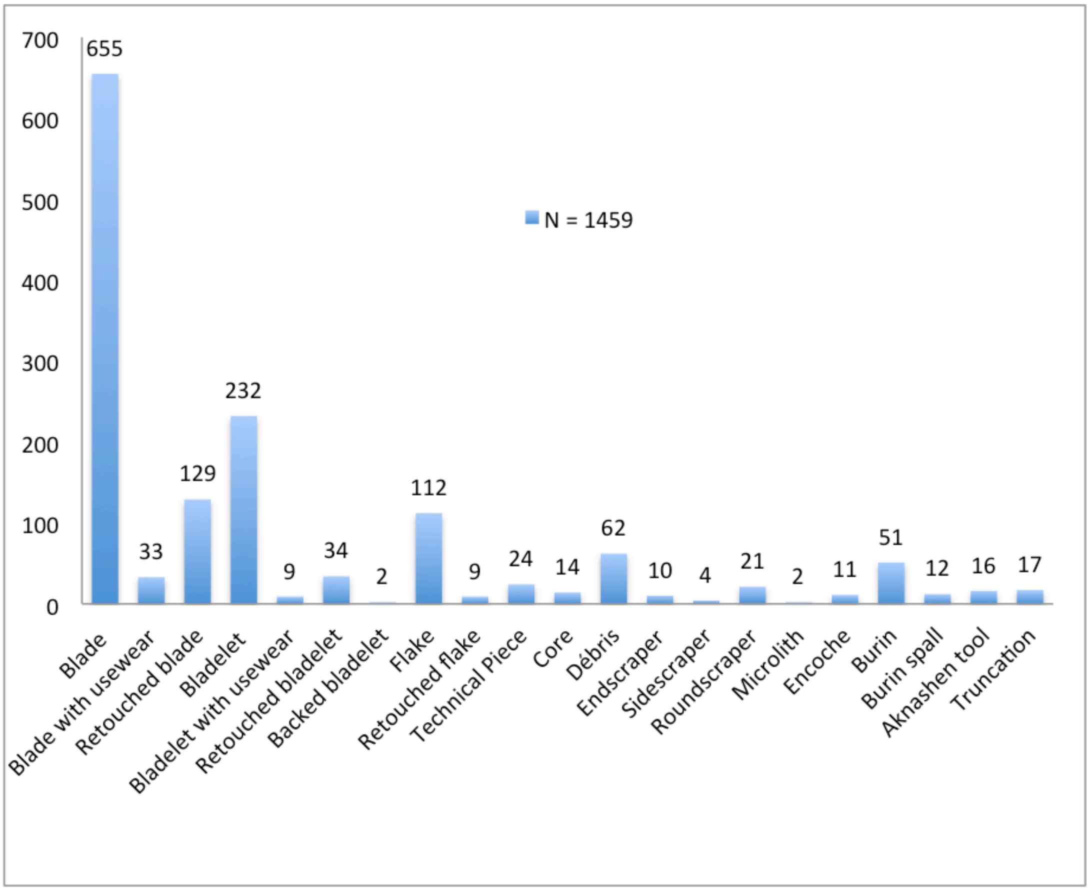


Figure 51: *Count of the main assemblage categories*

As in the assemblages from the earliest layers of Aknashen, Aratashen's collection is blade-based and relies heavily on the use of a combination of different pressure-flaking techniques and direct and indirect percussion. This production mostly results in the manufacture of standardized blanks for agricultural activities.

Three main different *chaînes opératoires* were identified on the site. The first was for flake production, carried out opportunistically on byproducts of the other sequences. A second *chaînes opératoire* was for general blade production that relied on indirect percussion and pressure flaking. It seems that cores were brought to the site at the beginning of their exploitation, which was then initiated with removals of large and irregular blades using indirect percussion. At this stage, several CTEs were obtained and the *plein débitage* was carried out with a mix of crutch and lever pressure flaking, along with indirect percussion again. By-products of these first stages have been used in the manufacture of large roundscrapers, tools made and heavily used on the site. As the size of the core decreased, it was sometimes (although not systematically) quickly re-organized to produce smaller blades. The third *chaîne opératoire* identified for the production of smaller blanks quickly organized a striking platform on smaller cortical flakes to obtain regular to irregular bladelets. This sequence is also seen in Horizon VII at Aknashen and differs from most of the Shulaveri-Shomu assemblages post-5800BCE.

A particularly interesting aspect of the lithic industry at Aratashen is its spatial distribution and possible implication for specialized production, a point already noted at the neighboring site of Aknashen. Indeed, it has been suggested that the blank production was extremely standardized throughout the site. Very few by-products of this production could be found, and those that were uncovered were generally focused in one particular location. This focused, standardized production is opposed to the high diversity of tool and retouch type. One explanation could be the existence of short events of blank production, occurring at one place and one time and leading to the distribution of these blanks throughout the site. Once this distribution occurred, the retouch might have taken place independently in each household. This dispersive retouch may explain he diversity of retouch as well as the higher frequency of specific retouch types in specific areas of the site (Figure 52).

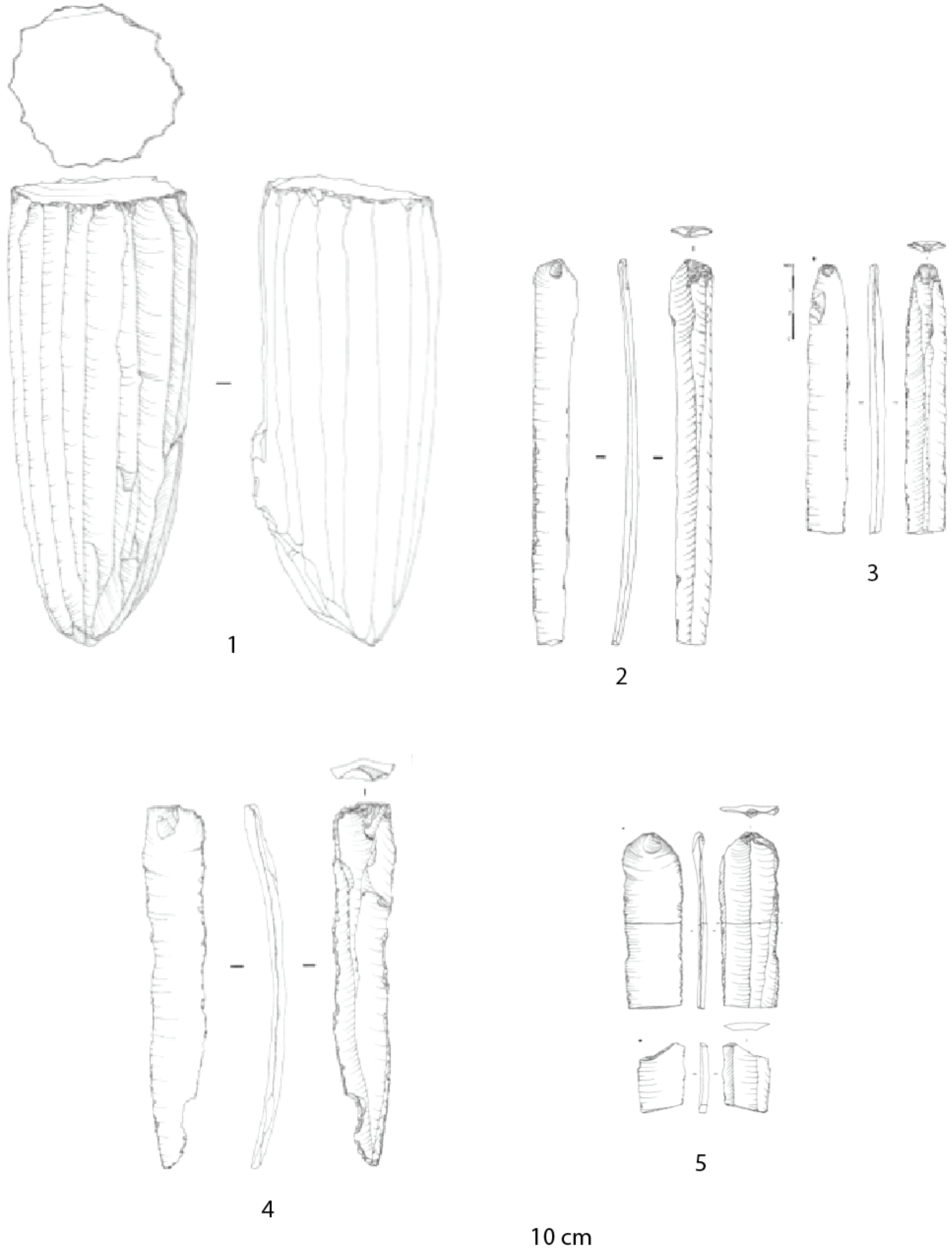


Figure 52: *Aratashen assemblage:1: long blade core; 2-3,5: Pressure flaking blade; 4: Indirect percussion blade (drawing J. Leclerc)*

6.6. Model of expectation: identification of chaînes opératoire, techniques and tool types.

We have argued in chapter 3 that lithic assemblages could be used to infer specific type of group interactions, which may themselves be interpreted in the context of the Mesolithic-Neolithic transition in the South Caucasus.

We have suggested also that several aspects of assemblages are behaviorally significant in terms of access to the enculturating environment such as *chaîne opératoire* (for blank production), techniques used in the context of the production sequence, and specific tool type. Therefore, we first need to present a protocol for the identification of techniques, and suggest a list of typology that will be used consistently in the assemblages studied.

6.6.1. Techniques

The identification of the techniques used for the production of stone tools in these various assemblages is based on several experiments carried out by flintknappers and lithic analysts over the past century. These flintknappers—Tixier, Crabtree, Inizan, Titmus, Pelegrin, and Hirth, among many others—have contributed to the constitution of a solid set of data. While H. Harrock of Qatar Museum has questioned some of these results and doubted the validity of these features, the lack of quantitative data supporting this critique allows us, for now, to continue to use them in the determination of pressure-related technique. Considering the size of the blanks considered, we focus here on the identification of three possible pressure-flaking techniques for bladelet and blade production (Modes 3 to 5 in Pelegrin 2012:467-470) as well as indirect percussion. Some of the characteristics generally associated with use of crutch or lever involve significant presence of a lip, variations in bulbar scars and bulbar morphology (with a higher representation of diffused bulbs), parallel and rectilinear ridges, straight blade profiles (at least until the mesial/distal connection), constant thickness, and lower occurrences of ripples on the ventral surface of the product. However, the impact of the type and position of the core-holding device on these characteristics is not properly understood (Pelegrin 2012). Evidence for such devices can be small abrasions or bidirectional removals on the distal of the core. The width of the blade may also be seen as a possible indication, as longer products will generally need to be wider. Most of the following techniques will create these similar characteristics, but differences can be identified in the morphometry of the product and in its specific features, connected to the use of copper point or an antler punch.

6.6.1.1. Indirect percussion (Figure 53)

Indirect percussion is mostly used for core preparation and blade detachment. This technique involves a hammer and a punch (antler or antler and copper). Indirect percussion generally involves larger but less regular blades with sub-parallel edges and a wavy mesial segment, and using this technique requires less overhang preparation. Chabot (2014) suggest that it is not possible to detach entire series of blades using only indirect percussion. This would involve the use of indirect percussion at particular, strategic moment of the production sequence.

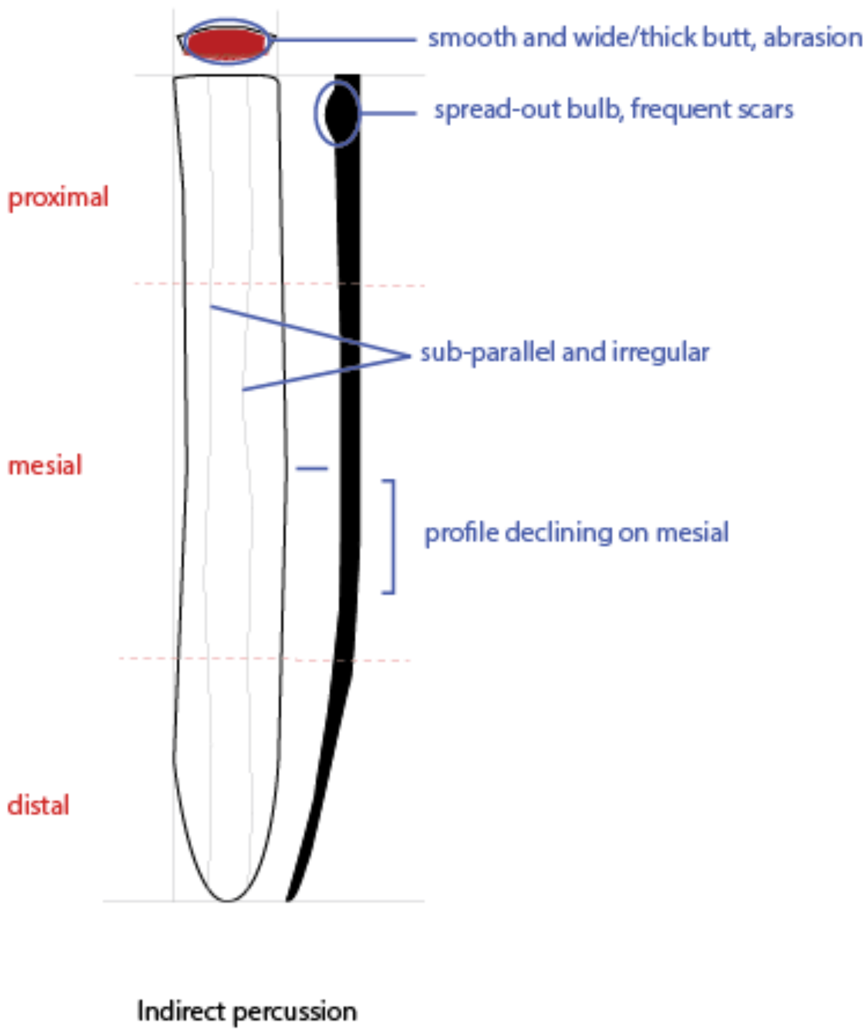


Figure 53: *Blade with features associated with indirect percussion*

6.6.1.2. Mode 3 (short crutch)

This technique relies on the use of a short shoulder crutch and stabilization of the core on the ground. Using this technique, Pelegrin (2012) was able to produce obsidian blades that were 12-15cm long and up to 1.8cm wide.

6.6.1.3. Mode 4 (long crutch)

This technique involves the use of a long, possibly abdominal crutch from a standing position. Even though Pelegrin describes this technique as inefficient, it will produce blades up to 20cm long and 21mm wide on flint, and up to 30cm long and 26-28mm wide on obsidian,

6.6.1.4. Mode 5 (lever) (Figure 54)

This technique relies on a long lever for blade production. Pelegrin estimates that the lever technique allows for applying a pressure of up to 300kg. Its reconstruction is based on the assumption that the principle of the lever itself was well known by early Neolithic groups, who erected megaliths at sites like Gobekli Tepe. This technique would allow the detachment of a blade up to 30cm long and 3-4cm wide, but doing so requires a complete immobilization of the core (Pelegrin 2012:467). This technique generally involves simple platform preparation at an angle of ca 90'. The core preparation for modes 4 and 5 can be divided into two options. First, the flintknapper will select nodules with large tabular shapes and thin cortices, which limits the performing process to the regularization of the flaking surface. Alternatively, irregular nodules require a more complex preforming involving direct and indirect percussion preparation, as well as the creation of up to four axial crests, to prepare the volume of the core, the open striking platforms, and the flaking surfaces. With mode 4 and 5, overhangs are carefully prepared and lips are more likely to be preserved, while the butt itself does not show marks of impact. However, in case of the use of a copper point, the butt will show concentrate cracks or micro-crushing.

The use of such techniques is attested to as early as the Pre-Pottery Neolithic in the Near East (Chabot and Pelegrin 2012; Inizan 2012). The full exploitation of a core for long laminar production generally involves a sequential use of these techniques to meet the need of specific sections of the *chaîne opératoire* (preforming, core shaping, blade exploitation, retouching).

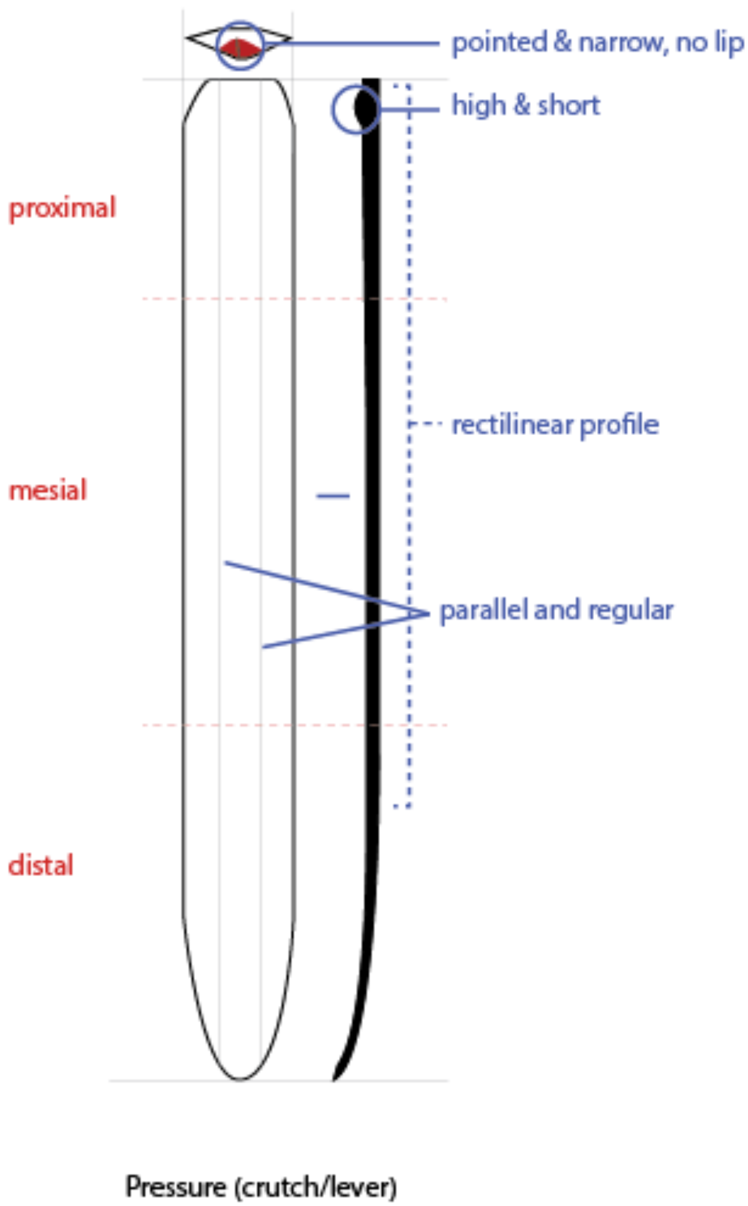


Figure 54: *Blade with features associated with pressure technique (mode 4 or 5)*

6.6.1.5. Microburin technique (Figure 55)

Microburins show a very specific retouch generally used to produce edge *en biseau* that are particularly suitable for the production of microliths (Figure 55). Generally, for this reason, the microburin technique is more identified in hunter-gatherer context.

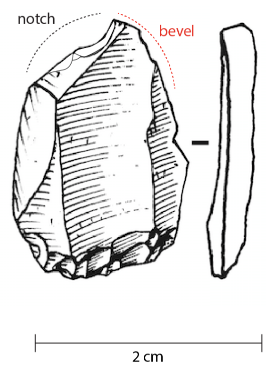


Figure 55: *microburin with notch and bevel*

6.6.2. Typology

6.6.2.1. Blade typology (Figure 56)

Considering the large amount of retouched blades at sites such as Aknashen and Aratashen, we attempted to create a typology of these tools. This typology was based on the location and direction of retouch carried out on the blades. Some sub-variations had to be ignored (especially in the sub-types of retouch):

- Type 1 is the so-called X-retouch, which is characterized by an alternation of the retouch on both sides of the blank.
- Type 2 is opposite parallel retouch carried out on one half of the blank.
- Type 3 is inverse retouch carried out on one half of the blank.
- Type 4 is direct-inverse retouch carried out on one half of the blank.

- Type 5 is a direct retouch on one edge carried out on one half of the blank.
- Type 6 is a direct retouch on two edges on the distal side, and inverse on two edges on the proximal side, while
- Type 7 is the opposite.
- Types 8 is an inverted type 4

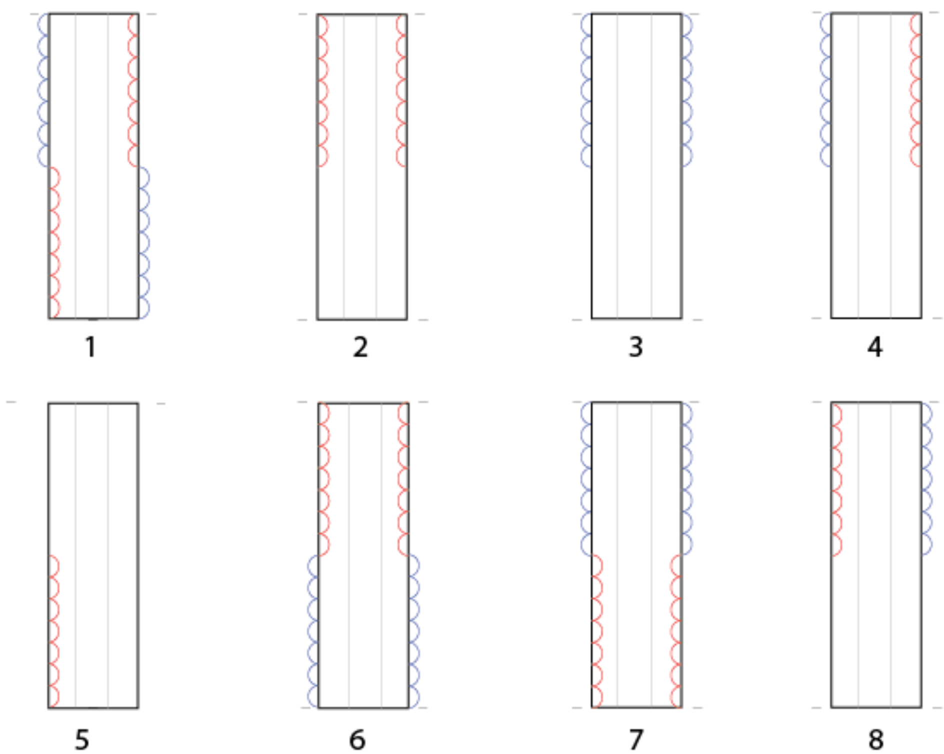


Figure 56: *Retouched blade typology with direct retouch, inverted retouch*

One particular type of tool on blades is the so-called Aknashen tool (Figure 57). As presented above, it is a blade dragment that is backed through an overshot burin technique with a retouched or used opposite edge. Twenty-one Aknashen tools were found in the Aratashen assemblage.

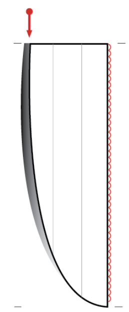


Figure 57: *Aknashen tool: blade fragment, overshot angle burin and direct retouch on opposite edge*

6.6.2.2. Other tool types

The typology developed is broad enough to remain inclusive and allow for inter-assemblage comparison, but it is also focused on the specific type of production taking place in the area:

- *Retouched pebble*: small flat pebbles found only associated with the Neolithic layers. They show several traces of bifacial retouch on one of their edges.
- *Endscraper*: covering retouch on the distal end of the blank. At Bavra-Ablari, this is usually carried out on blade fragments.
- *Roundscraper*: blank fragment with circular shape and retouch on 50% or above of its circumference.
- *Burin*: many types of different burins are found at Bavra Ablari, including *burin d'axe, dièdre, dièdre dejeté, burin d'angle,* and *recoupe de burin.* Most of the burins are carried out on butts and fracture. In the case of *burin d'angle* they often reach the opposite edge and form a back. They are also often associated with retouching of the tool on the edge opposite to the back.
- *Borer:* only one example of borer was found. It was manufacture on a bladelet using steep retouch in both sides.

- *Retouched blade (1 side):* blade fragments showing retouch on one side only. There is a large variety of retouch including type (covering, steep, short…), location (bilateral, bifacial, mesial, dorsal, etc…), and nature (regular vs. irregular, continuous vs. discontinuous). If no patterns have been identified, all blade fragment show intense retouching.
- *Retouched blade (2edges):* a larger quantity of blades show retouch on both edges, although with the same variation in nature, type and location.
- *Retouched bladelet (1 edge):* same as Retouched blade 1, on bladelet blank
- *Retouched bladelet (2 edges):* same as Retouched blade 2, on bladelet blank
- *Backed bladelet:* bladelet with more than 75% of one of their edges backed with abrupt to semi-abrupt retouch.
- *Retouched flake:* flakes with no particular pattern in the retouch
- *Denticulate:* tool showing regular denticulated retouch
- *Truncation:* blade or bladelet willingly fractured through different means
- *Kmlo tool* (Figure 58)*:* hooked tools with continuous parallel pressure flaked retouch on one side, carried out on irregular blades or blade-like flakes

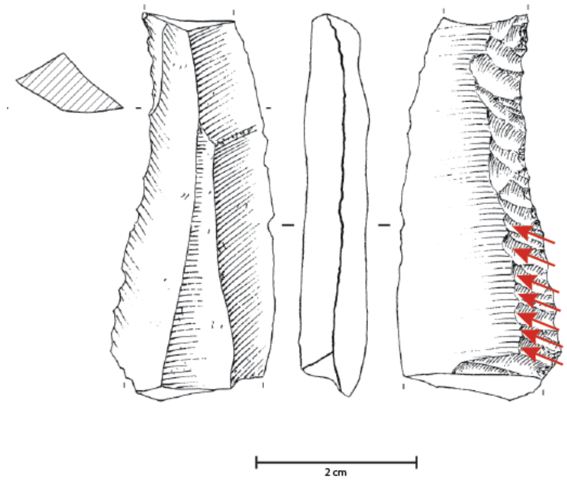


Figure 58: *Kmlo tool on blade-like flake with parallel kmlo retouch on one side*

6.6.3.3. Microliths

The microliths category is carried out on bladelet and involves six different types of tools:

- *Backed bladelet*: bladelet with a steep retouch all along one edge, sometimes accompanied by a microburin
- *Lunate*: crescent-shaped back created with a steep retouch (sometimes bidirectional, although not at Kmlo-2).
- *Scalene*: backed bladelets that are obliquely truncated (a few times, just obliquely snapped).
- *Trapeze*: trapeze-shaped microliths with one back and two oblique truncations.
- *Retouched microburin*: flake demonstrating evidence of microburin technique with several unorganized attempts at retouch.
- *tranchant*, triangular geometric microliths carried out both on flakes and

bladelet fragments, showing a long, covering retouch on the dorsal surface. In one occurrence, the flake is formed by creating the edge of the triangle with an steep retouch. In the two other microliths, it appears to be only broken

6.7. Conclusion

The standardization of the elements we have defined as behaviorally significant for our model can now support an inter-assemblage comparison. Details of the typo-technological analysis of the collections from Kmlo-2, Bavra-Ablari, Aknashen-Khaturnakh and Aratashen can be found in the appendix.

For each assemblage we have identified the different production sequence, the blanks and types of tool manufactured, and the techniques and methods involved in the *chaîne opératoire* (Figure 59).

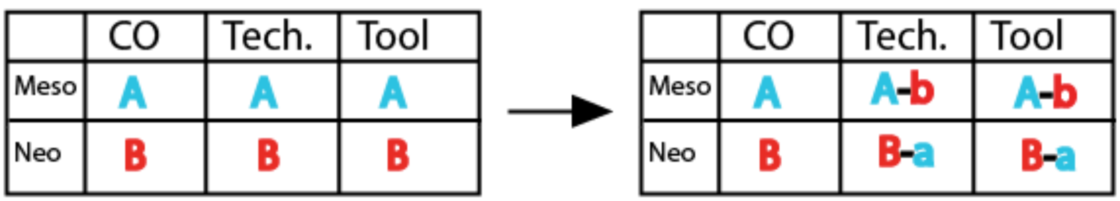


Figure 59: *Expectations of evolution of Mesolithic and Neolithic assemblages in the case of symbiotic open frontier.*

This information can now be integrated into our expectation model to identify interactions between Mesolithic and Neolithic assemblages. Each site has been defined by its subsistence pattern. We can now address possible exchanges of technology between the sites qualified as “Mesolithic” and the ones “Neolithic”. Depending on the locus where parallels are identified (*chaîne opératoire*, techniques, or tools) and the degree (uppercase vs. lowercase) and direction of this exchange, we can define the type of contact that occurred—full access to enculturating environment or short-term interactions on the pathways of the landscape. From this point, we may suggest models of group interaction that we can then interpret in the framework of Mesolithic-Neolithic transition.

Chapter 7

Results and Discussion

7.1. Inter-site comparison of behaviorally significant technological features.

7.1.1. Raw material exploitation.

The study of raw material exploitation can allow us to identify similar patterns as well as possible location of group interactions. Three main types of raw materials were identified in this study: obsidian and two types of dacite.

Dacite was found at Bavra-Ablari III, Aknashen V-VI, and Aratashen II. At Bavra-Ablari III, it is sub-divided into two groups, a local coarse-grained dacite, and a finer-grained dacite, the origin of which could not be identified. The dacite from both Aknashen V-VI and Aratashen II is more similar to the coarse-grained dacite found at Bavra, which is a type of raw material that is fairly ubiquitous in highly volcanic regions such as the South Caucasus.

Obsidian is the most commonly used material in all assemblages, and is therefore the most likely to provide interesting information (Figure 60). In terms of raw material acquisition, Bavra-Ablari may be disconnected from the other three sites as it is the only site that provided Chikiani obsidian (although only 1 sample could be characterized). The comparison between Kmlo-2, Aratashen, and Aknashen, however, is helpful as more information is available for raw material exploitation. Within the site of Aknashen itself, the obsidian provenience is fairly consistent, with a high representation of Arteni and Gutansar across the layers. Additional analyses carried out by Gratuze and Chataigner (comm. Pers.) have allowed the identification of new sources (Sarikamis North and South, and Yaglica for instance). The nature of the pieces characterized from the layer VI (i.e., small pebbles) might explain the overrepresentation of the Tsaghkunyats outcrop in comparison with the obsidian in layers V and VII as the pebbles would have been carried by the Kasakh river.

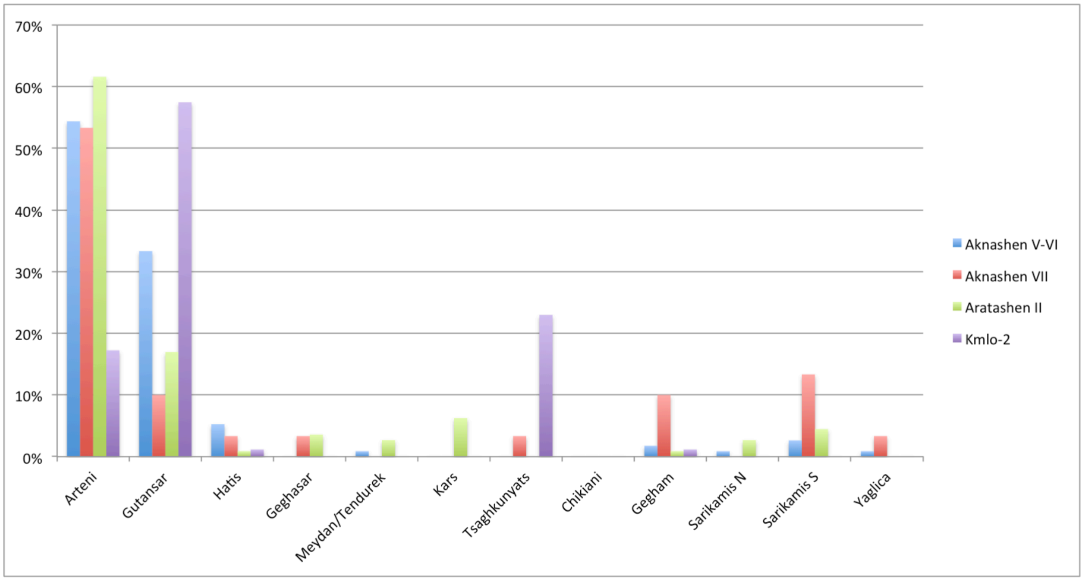


Figure 60: *Comparison of percentage for obsidian acquisition patter from the Armenian sites (Aknashen, Aratashen, and Kmlo-2)*

Overall, there does not seem to be an evolution in approvisionement pattern from V through VII. However, when considering Aknashen V-VI, Aknashen VII, and Aratashen II together, it is interesting to notice that the Gegham and Sarikamis sources are significantly better represented in the earliest layers at Aknashen (VII), than in the two slightly later layers. The exploitation of Sarikamis obsidian, also represented at Kmlo-2, has been suggested to be correlated with the exploitation of the salt mountain of Tuzluca, near the confluence of the Akhurian and the Araxes Rivers (Chataigner and Gratuze 2014: 67)(Figure 61).

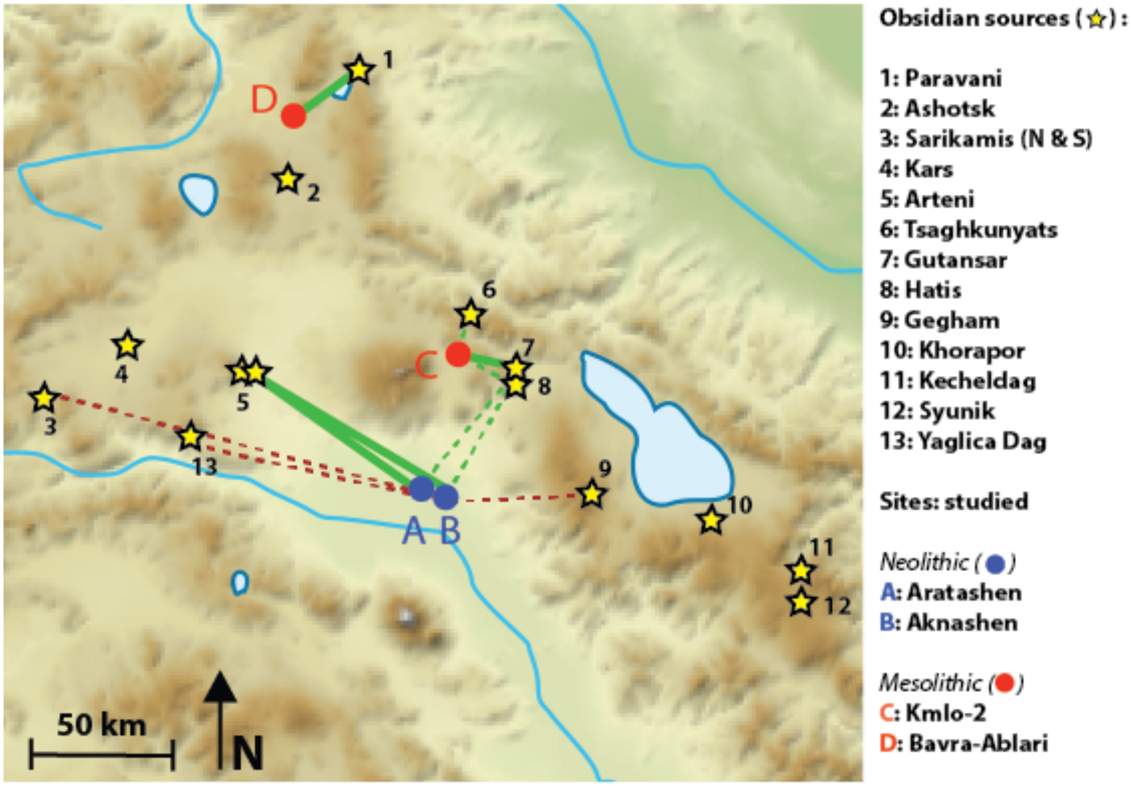


Figure 61: *Obsidian acquisition. Thick green lines are primary sources, dotted green lines are secondary sources, dotted red lines are secondary sources for Aknashen VII.*

However, these patterns remained coherent with a specific type of landscape occupation. When compared with the composition of the obsidian assemblage at Kmlo-2, several points can be highlighted. First is the use of similar sources such as Arteni, Gutansar, Tsaghkunyats, and Hatis, also found at Aknashen and Aratashen. These sources, however, have several outcrops and secondary sources, and it remains to identify the exact point of origin of any given artifact within the group itself. However, there is pattern of exploitation of sources located on the edges of the Araxes basin.

7.1.2. Preform

Different types of preform management have been identified for the obsidian assemblage of these four sites. The chart below describes the earliest *chaîne opératoire* stages seen on the site for the main blank productions. At Kmlo-2, bladelet cores are made *in situ* and small pebbles with cortex are carried from the river valleys to the settlement. At Bavra-Ablari horizon III, two types of productions can be seen. In one case, bladelet production was carried out on small bladelet cores. These cores were brought to the site already formed but not fully exploited. In the second instance, a particular tool production on blades occurred, but its sequence production is absent from the assemblage and only the final products have been found. At Aknashen VII, tool production is mostly carried out on long blades, but a small production of bladelets has also been identified. Long conical blade cores were preformed off-site, and seem to have been brought to the settlement during *plein débitage*. On the other hand, the three-bladelet cores identified all have traces of cortex (>50% of the surface), and were brought to the site at a fairly early stage of exploitation.

The assemblages from Aknashen V-VI and Aratashen II are both dedicated to the production of long blades using mode 3, 4, and 5. However, Aknashen V-VI blade cores were brought on the settlement in their *plein débitage*, while cores from Aratashen may have been transported at a slightly earlier stage (Figure 62).

Despite the impossibility to compare preforms from all sites, several conclusions can be made. First, the earliest stage of the *chaîne opératoire* varies from one site to the other. This is most likely connected to the status of the site (short-term hunting camp, semi-sedentary settlement), its distance from the raw material sources (Kmlo-2 being the

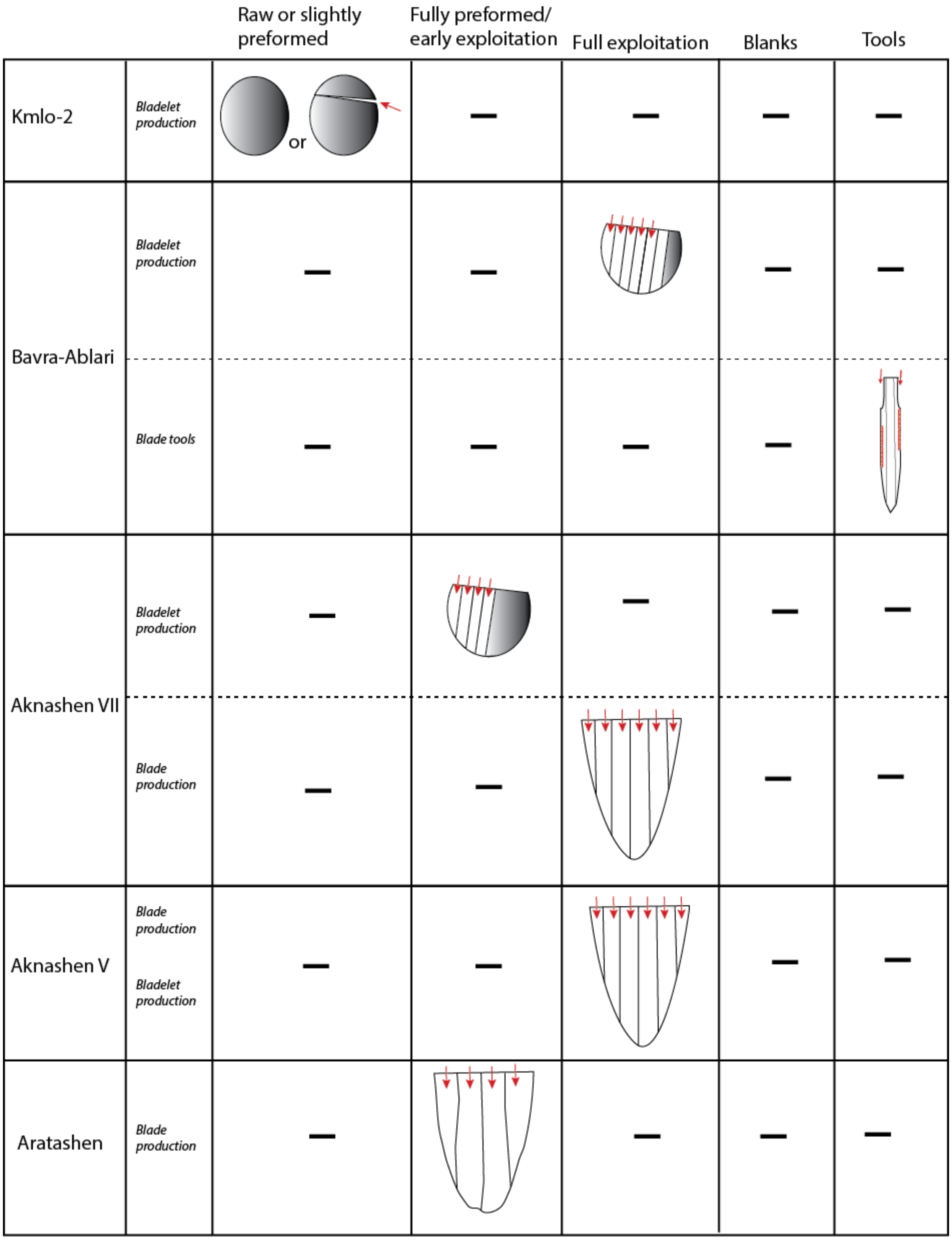


Figure 62: *Earliest stage of the production sequence present in each assemblage for a given type of production (blade and bladelet)*

closest of the three sites to its primary source), and the type of products ultimately manufactured. The separation of the production sequence (Figure 63) thus may involve several actors from different group and different locations. In the case of semi-sedentary occupation, differences in the earliest stage of the *chaîne opératoire* found in the assemblage could even suggest a sequence of settlements within the pattern of territorial occupation of a group.

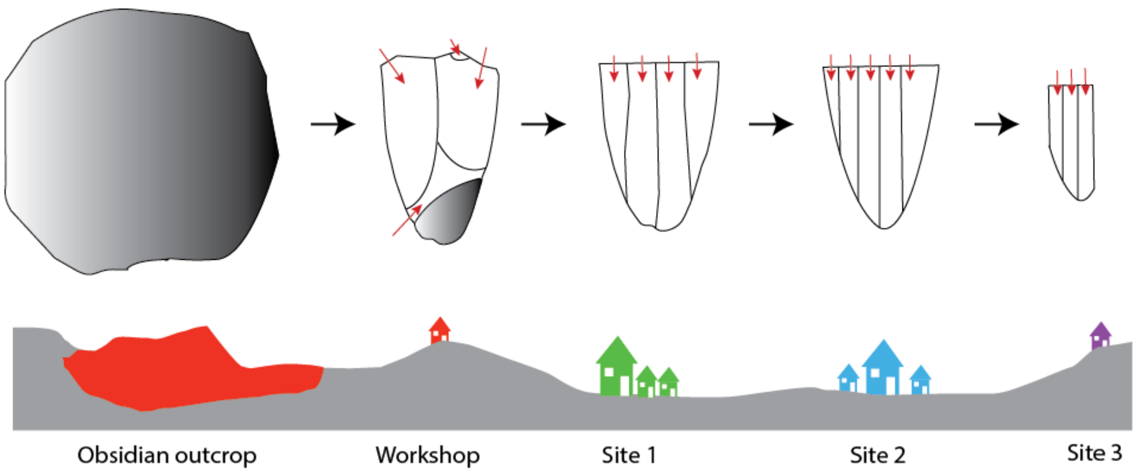


Figure 63: *Possible explanations for differences in production sequence represented* between Neolithic sites in the valley. Blade cores would actually travel from one site to the other, either with the group, or with craftman producing blades at several locations.

7.1.3. Chaînes Opératoires of blank production.

The identification of parallels in *chaînes opératoires* also involves recognizing similarities in blank production and techniques used. This type of knowledge is generally performed within the enculturating environment. Indeed, in the third chapter of this work, I demonstrated the close connections between a given technology and its social environment. Therefore, the production of similar blanks can be performed very differently depending on one's cultural background. Furthermore, the acquisition of a given techniques involves not only technological pre-requirements but also long-term practice of the said technique (Figure 64).

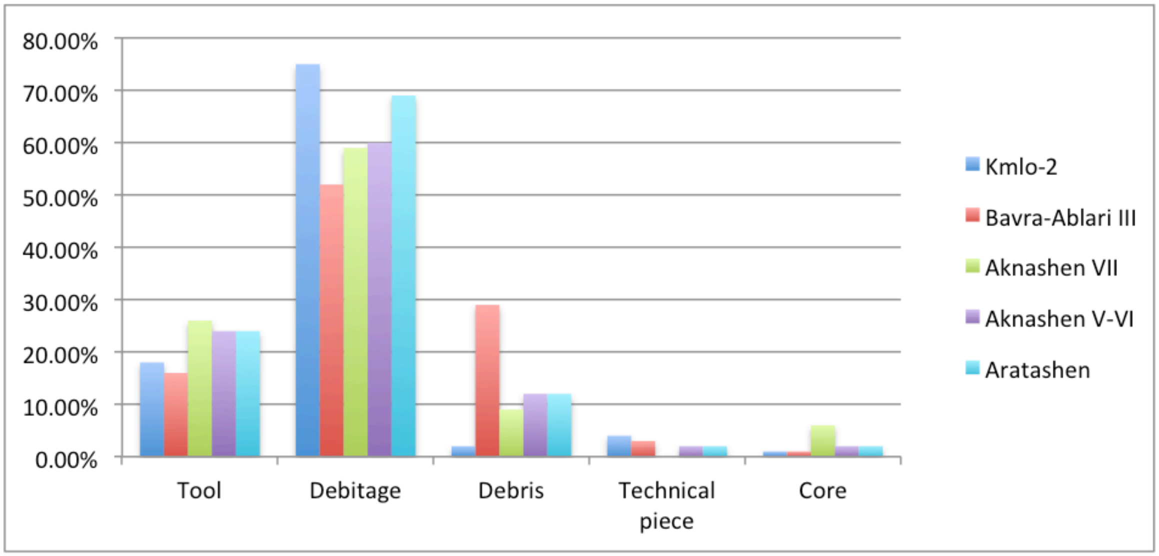


Figure 64: *Inter-site assemblage proportions*

Differences can be connected to site function, and chaîne opératoire. At Kmlo-2, there is a preponderance of bladelets and small blades produced from the same type of cores. The cortical pebbles were brought on site and quickly prepared for small blade/bladelet production. Large flakes are removed to open the flaking surface and the striking platform, and the natural scars and edges of the pebbles were used to direct the first blade-like removals. The first stages were carried out through direct percussion. As the core reached its *plein débitage*, slightly more care is seen in the preparation of the overhang which, along with more regular bladelet production, suggests the use of pressure-flaking, possibly using a small shoulder crutch. The larger blanks were retouched into scrapers and Kmlo tools, while smaller blanks were retouched into microliths using microburin techniques (Figure 65).

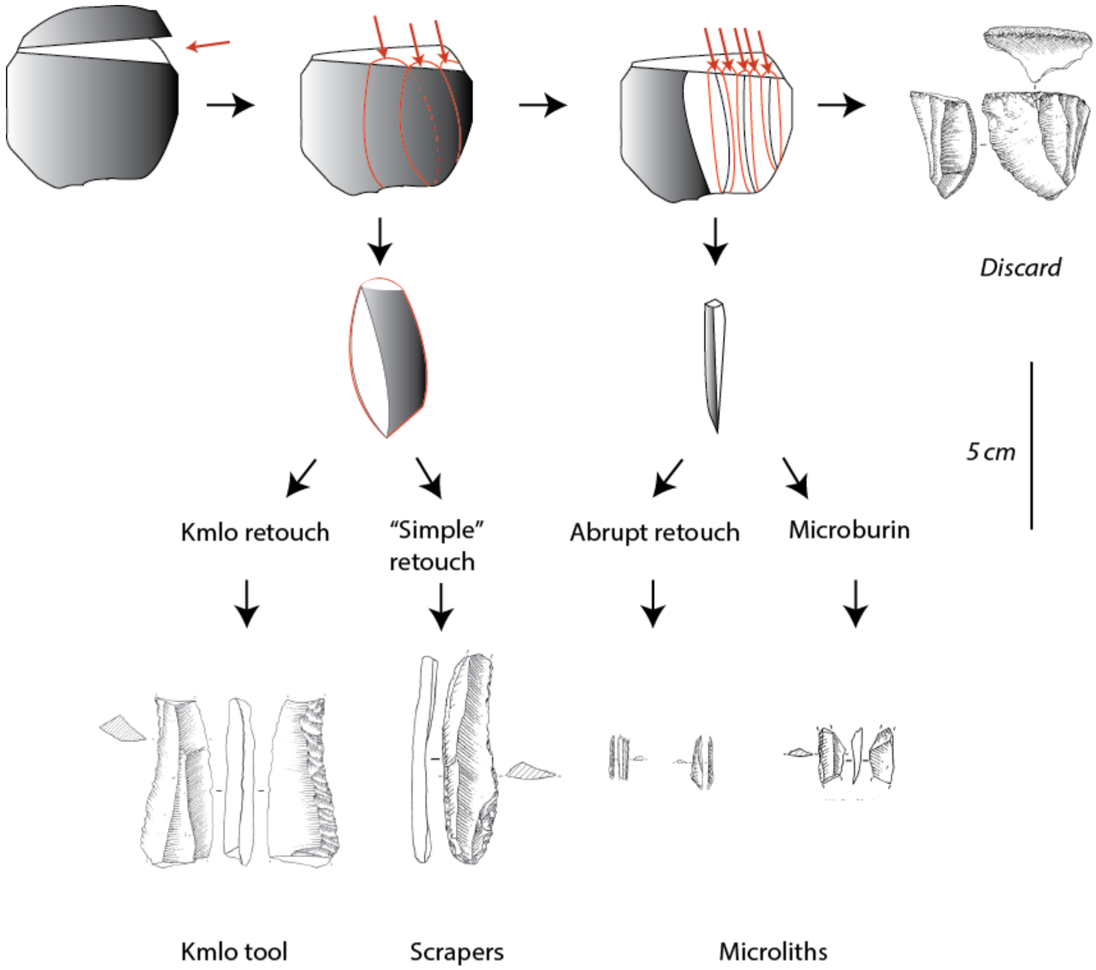


Figure 65: *Kmlo-2 chaîne opératoire for the production of Kmlo tools, scrapers and microliths*

At Bavra-Ablari III, we have identified a single *chaîne opératoire* for bladelet production (Figure 66). Cores were brought to the site already exploited as D-shaped bladelet cores. The production first occurred on 50% of the flaking surface and was progressively enlarged to 100% of the circumference, as the size of the product decreased. The unipolar exploitation thus is transformed from semi-turning to fully circular, with a generally low involvement in the preparation of the striking platform. Any accident was repaired through lateral blows and almost systematic creation of neo-crested blades. Part of the

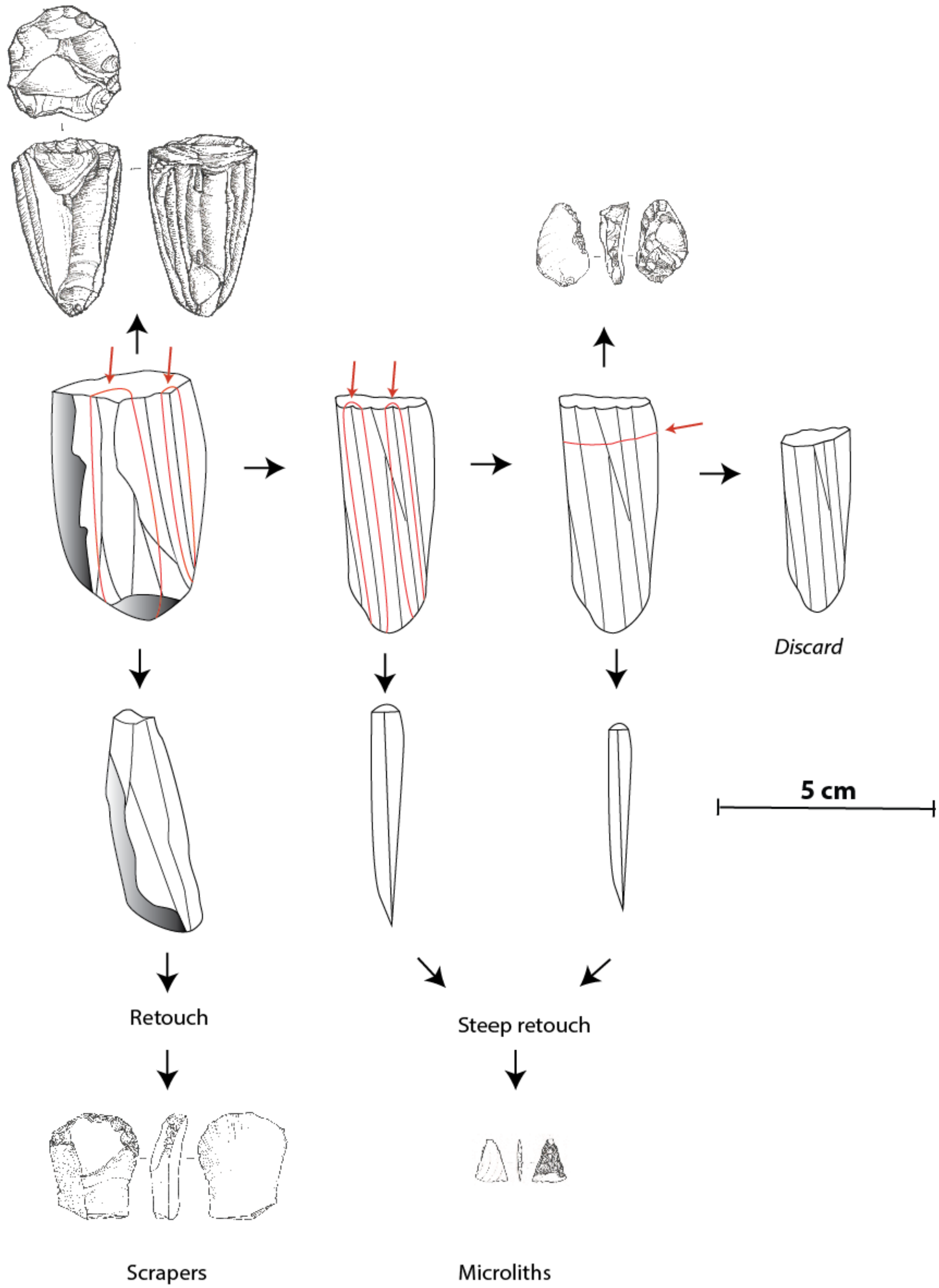


Figure 66: *Bavra-Ablari chaîne opératoire*

production was carried out through direct percussion while some elements of pressure flaking are seen in the context of bladelet *plein débitage*. The blade making sequence did not take place on the site, but it led to the production of elements with morphometric features that are close to the ones seen in Aratashen and Aknashen assemblages. However, their butt and bulb are significantly larger and more marked, and the low amount of proximal fragments and complete blades do not allow us to assess the type of technique used for their debitage.

At Aknashen V-VI, cores were brought at the beginning of plein débitage. Low quantities of cortex and *chaîne opératoire* by-product limit our understanding of the processes that occurred on the site, but several features of this assemblage can be identified. The sequence was dedicated to the production of long blades through an alternation of indirect percussion and pressure flaking with crutch or lever. The blades' overhang preparation varied from low to high involvement, the latter being illustrated by a careful abrasion to create a small "nose". In the course of the plein débitage, the core was managed mostly through distal removals and overshot blades (generally every 4-5 blades). This production took place at very specific locations in the site, and at very specific moment.

At Aknashen VII, no convincing evidence for the use of levers for blade production has yet been found, although Chabot suggests the use of crutch (Chabot 2013) for pressure flaking. This is seen in the bullet cores and other bladelet cores found in this layer. Two types of *chaîne opératoire* were only partially identified for bladelet production. The first one required a complete circular exploitation of pyramidal core, possibly resulting in the exploitation of bullet-cores through pressure flaking towards the end of their production sequence. The other ones relied on a more informal bladelet production on cortical flake with little preparation (Figure 67).

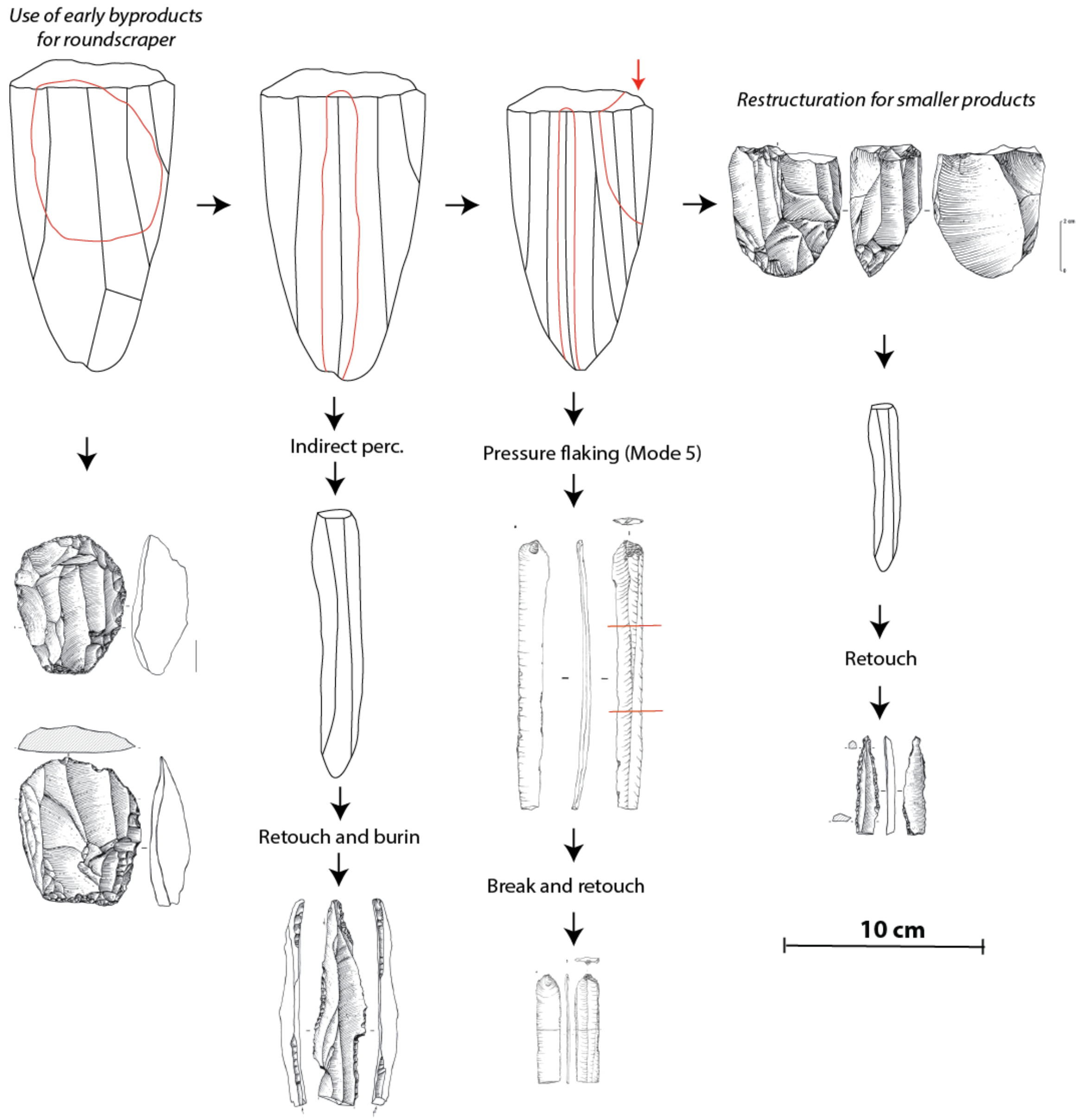


Figure 67: *Aknashen-Aratashen chaînes opératoires*

Finally, at Aratashen II, the same general framework of production as the one witnessed at Aknashen V-VI was identified. However, the presence of large flat blade showing evidence of indirect percussion, as well as an overall higher percentage of cortical pieces (and higher amount of cortex on these pieces) suggest that cores were brought to the site at a slightly earlier stage of *the chaîne opératoire* than at Aknashen.

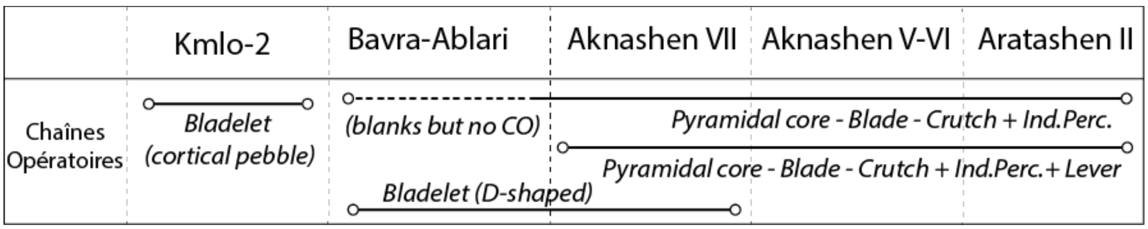


Figure 68: *Assemblage comparison for chaînes opératoires*

Overall, very specific and different *chaînes opératoires* were identified between the Mesolithic and the Neolithic sites (Figure 68). Bladelet production is found at Kmlo-2, Bavra-Ablari, Aknashen VII and, to some extent, at Aknashen V-VI and Aratashen II. However, this production was carried out through different strategies (expedient on cortical pebble, D-shaped core, bullet core). Blade production was only witnessed in the context of Neolithic sites, making the presence of retouched blade at Bavra-Ablari particularly interesting.

7.1.4. Techniques

Several techniques have been identified in the assemblages of these sites: direct percussion (soft or hard hammer), indirect percussion, pressure flaking (retouching, hand, crutch, lever), and the specific microburin technique (Table 5). Techniques of direct percussion constitute the very basis of flintknapping, and indirect percussion was widespread by the end of the Upper Paleolithic. However, the specificity of techniques seen in lever pressure flaking or microburin involves a high degree of practice and has been presented as evidence for group interaction since the late Pleistocene (Desrosiers 2012). The spread of lever technique in the Near East during the Late Neolithic has also been associated with phenomenon of group expansion or cultural contact (Chabot and Pellegrin 2012). The full application of a technique and its complete integration within the *chaîne opératoire* of different group is seen in this work as evidence of either full access toan acculturating environment or common origin of said groups.

Table 5: *Assemblage comparison for techniques: SP (Soft Percussion), HP (Hard Percussion), IP (Indirect percussion), M3 (Mode 3), M4 (Mode 4), M5 (Mode 5), MB (Microburin).*

	SP	HP	IP	PFR	M3	M4	M5	MB
Kmlo-2	X	X	-	X	X	-	-	X
Bavra-Ablari III	X	X	-	X	X	-	-	-
Aknashen VII	X	X	X	-	-	X	/	-
Aknashen V-VI	X	X	X	-	-	X	X	-
Aratashen II	X	X	X	-	-	X	X	-

Therefore, while the presence of soft and hard percussion in all assemblages is expected due to the nature of flintknapping activities, other techniques might be more behaviorally significant. Indirect percussion could not be identified in any of the pre-Shulaveri-Shomu assemblages in this study. Although the number of thorough lithic analyses in the South Caucasus remains low, no mention of this technique in any other

Upper Paleolithic, Epipaleolithic, or Mesolithic assemblages has been found. Instead, the technique only appears in the context of large blade production and in association with pressure flaking technique. Although it is possible that this issue is connected solely to the lack of identification of the behavior, it may also be entirely absent from the technological kit of Caucasus groups up until the early 6th millennium BCE (Figure 69).

Pressure flaking was first found in the context of tool retouching in Kmlo-2 and Bavra-Ablari for Kmlo tool production. While this particular technique disappeared in Shulaveri-Shomu assemblages, it was particularly well-operated in earlier hunter-gatherer contexts. This Kmlo-type retouch in particular involved careful and thorough preparation of micro-striking platforms along the edge of the blank. The tools found at both sites showing this retouch are helpful examples of the difficulty of the technique.

It is also in the pre-Shulaveri-Shomu context that archaeologists located pressure flaking techniques that utilized a crutch for bladelet production (most likely Mode 3). Although the same technique is suggested for blade production at Aknashen and Aratashen, differences in format, cores, and striking platform preparation likely represent a different variant that is not yet identifiable. Bladelet production through pressure flaking is suggested for several Mesolithic sites around the South Caucasus, but this technique has not been found in earlier, epipaleolithic sites such as Kalavan. It is generally accepted that this techniques originates from further east, possibly as far as eastern Siberia (Desrosiers 2012) and is first seen in the South Caucasus through contact with the Zagros area (Kozlowski 2009).

Pressure flaking with a crutch has been found for blade production in association with indirect percussion, in addition to lever technique, exclusively at Aknashen and

Aratashen. Considering the close association of pressure flaking with the lever techniques, and its absence from any earlier assemblages, it is possible that both techniques were introduced in the South Caucasus simultaneously, in association with long blade production. From a chronological standpoint, it seems that the first evidence of these two techniques comes from the late 7th millennium BCE, in Mesopotamian sites such as Sabi Abyad (Chabot and Pelegrin 2012). Considering the difficulties involved in operating the techniques, the presence of crutch or lever pressure flaking in a new territory would support either a case of technology transfer involving long-term inter-communal interactions or movement of the group itself.

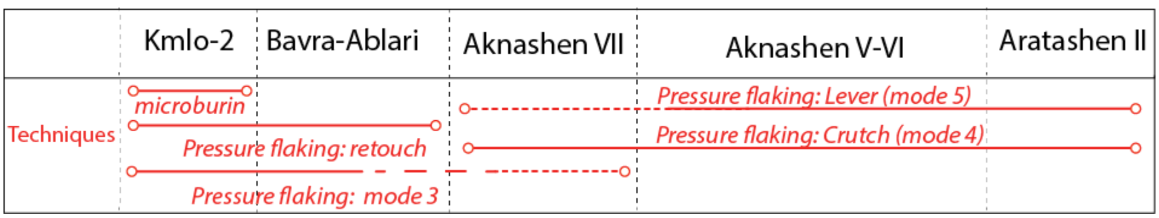


Figure 69: *Assemblage comparison for techniques*

Several specific techniques involved in the *chaînes opératoires* of the 5 assemblages are exclusive to specific context. Microburin technique is, for instance, only at Kmlo-2, while pressure flaking with a lever only appears connected to long blade production at Aknashen and Aratashen. On the other hand, techniques such as pressure flaking retouch known as “Kmlo retouch” are only identified in the pre-Neolithic context (Kmlo-2 and Bavra-Ablari). The absence of similar techniques between the different sites suggests that there was not sufficient enough degree of interaction to allow full access to enculturating environments.

7.1.5. Tool assemblage

Despite the limitations of a purely typological approach, the analysis of the composition of tool assemblages and consideration of specific tool types can shed light on possible interactions when examined alongside previous results on *chaînes opératoires*.

7.1.5.1. Tool composition

An inclusive typology allowed the integration of all of the tool types found in the four sites. The similarities noticed here can be connected to site function and, to some extent, to cultural parallels.

I will first note that, despite existing differences in proportions, the sites of Aknashen and Aratashen are fairly similar to each other both in terms of tool representation and tool type present. The *chaînes opératoires* at both sites were targeted at the production of long blades that systematically (85% at Aknashen and 83% at Aratashen) make up the large majority of burin supports, and retouched blanks in general (93% at Aknashen and 95% at Aratashen). As previously stated, while the production of these blanks is extremely standardized (at least for horizons V and VI at Aknashen, and IIb-d at Aratashen), it was difficult to notice any kind of specific pattern in the retouching process, which leads me to suggest a specialized production of long blade followed by a distribution of the blanks throughout the site, with retouch taking place at the household level.

Furthermore, there is a small degree of coherence between productions at Bavra-Ablari and Aknashen. I have demonstrated that, while the production in the former was aimed at the manufacture of bladelets and the latter is dedicated to blade-making, there are some parallels in terms of proportions of retouched bladelets and retouched flakes. However, these similarities have been shown to decrease when one considers more thoroughly retouch types and tool sub-types.

Finally, there are interesting similarities between Kmlo-2 and Bavra-Ablari assemblages (Figure 70), especially when they are contrasted with the Shulaveri-Shomu collections. In both sites, retouched bladelets make up the major portion of the assemblage, supporting our description of a production sequence dedicated to the manufacture of small regular blanks. The proportion of backed bladelets and microliths also shows the resolutely microlithic character of these industries. However, the greater presence of blades at Bavra is connected to the presence of these long, highly retouched, regular blanks for which no production sequence is seen *in situ*. There is also a higher proportion of scrapers at Bavra, possibly connected to the status of the site as a butchering camp, a usage supported by the faunal analysis. On the other hand, a higher proportion of microliths at Kmlo-2, as well as the presence of wild ovicaprids in the faunal assemblage, supports the status of the rock shelter as a hunting camp.

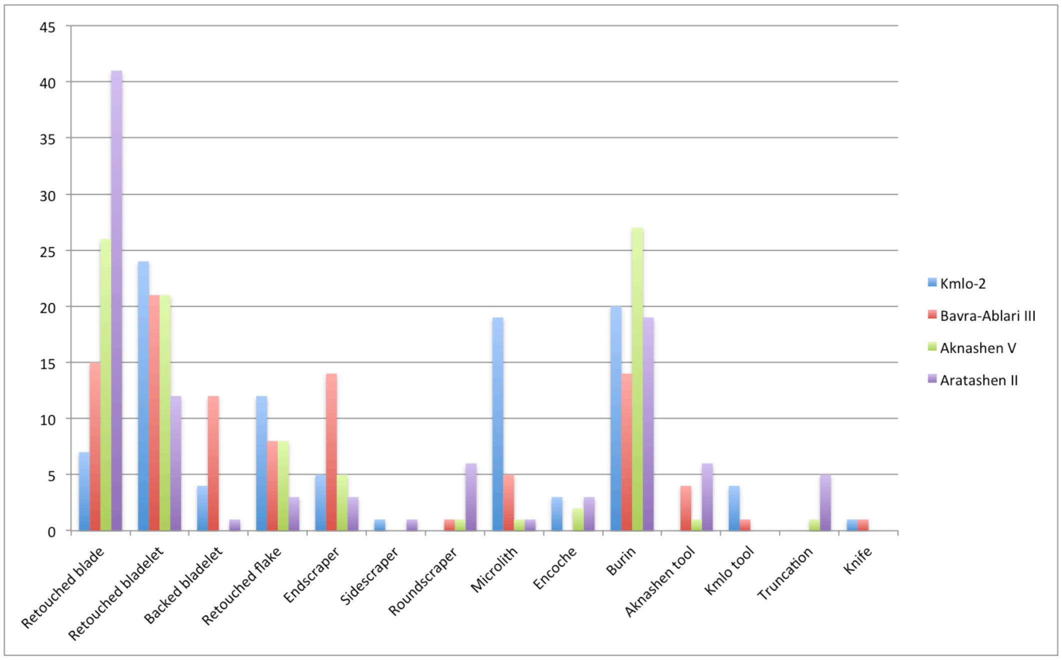


Figure 70: *Tool composition for all 5 assemblages*

7.1.5.2. Tool type

Setting aside technological composition, tool types that are specific enough to require specific techniques (microburin microliths, Kmlo tools, Aknashen round scrapers, and Aknashen tools) can also be significant in the context of stimulus diffusion as defined earlier in this study.

Kmlo tools are found in two sites exclusively, Kmlo-2 and Bavra-Ablari. At Kmlo-2, they appeared during the very first Mesolithic (10th millennium calBC) and their proportions increased until the 8th millennium BCE. Some Kmlo tools were found in later Chalcolithic layers, but these might represent intrusive elements from lower layers. At Bavra-Ablari, there is a single Kmlo tool associated with the late 7th-early 6th millennium layer (III). Despite the large Chalcolithic collection found at the site, no Kmlo tools or uses of Kmlo retouch were identified, which suggests that this technique disappeared during or right after the Shulaveri-Shomu period. Some mentions of such tools have been made in Chalcolithic context in Armenia (Gasparyan comm. pers.) but these finds have radiocarbon dates associated to them. Therefore, the Kmlo tool phenomenon remains strongly connected to the early Holocene period, as is the Çayönü tool in southeast Anatolia, which is found exclusively in PPN contexts.

In our study, only Kmlo-2 has produced a large amount of microburins, although there are three possible microburins, on fragmented flakes, from Bavra-Ablari III. The absence of such techniques in Aknashen and Aratashen is also witnessed in other Shulaveri-Shomu sites. This phenomenon is not necessarily connected to the decrease of microlith production, as sites like Aknashen do have trapezes and *tranchants* that are more associated with shifts in technical behaviors. Microburin is a culturally specific technique, and microliths at Mesolithic sites are made differently than at Shulaveri-Shomu sites.

The tool defined as the "Aknashen tool" in the context of this work is a burin, realized on a retouched prismatic blade medial fragment that has been snapped or truncated. The burin shot is an angle burin on a fracture or truncation, which is systematically overshot so as to create a back on one side of the blade. The opposite edge is either continuously retouched, or showing usewear (as opposed to other burin type that are not systematically retouched). The tool is found in large majority at Aknashen and Aratashen, but it also appears in other Shulaveri-Shomu sites in Georgia (T. Agapishvili, comm. pers.). Its technological requirement (large blade blanks), and function (most likely sickle blade) make it a typical Shulaveri-Shomu tool type. Its identification at Bavra-Ablari, within an assemblage that is bladelet-based, makes it a potential evidence for interaction with agricultural groups from the river valleys (Figure 71).

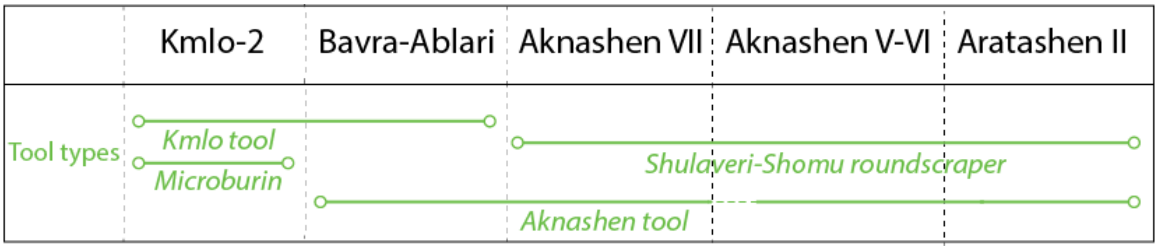


Figure 71: *Assemblage comparison for tool types*

We have already mentioned the limitation of a typological approach and justified the use of this approach in the context of this study. When focused on very particular types of tools, both from a typological and technological perspective, I believe that, when re-integrated into a broader dataset, it is possible to interpret possible parallels in behavioral terms. The presence of Kmlo tool at Bavra Ablari and Kmlo-2 challenge the idea that this particular tool can only be associated with hunter-gatherers in the South Caucasus. On the other hand, tools such as sickle blades, Shulaveri-Shomu roundscrapers, and Aknashen tools (Figure 72) constitute the bulk of the lithic assemblages from agricultural settlements. The presence of Aknashen tools at Bavra-Ablari provides evidence supporting some contact between contemporaneous agricultural and hunter-gatherer groups.

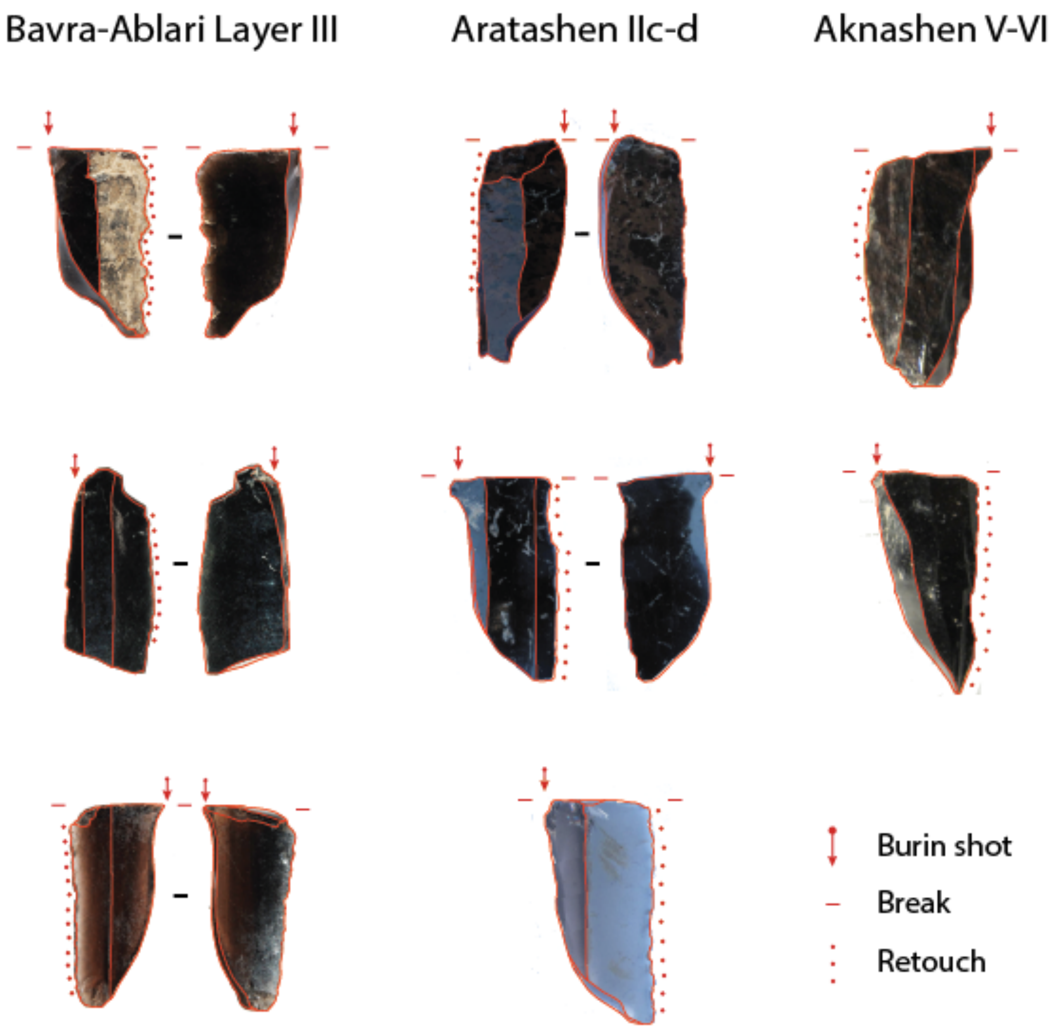


Figure 72: *Aknashen tools from Bavra-Ablari, Aratashen, and Aknashen.*

7.2. Testing the data against the model of expectation

7.2.1. General comments

Several parallels and distinctions have been identified among the *chaînes opératoires* and the tool types of the four sites discussed in this chapter. Overall, there is a clear distinction between the earliest site, Kmlo-2, and the latest assemblages at Aknashen V-VI and Aratashen II. There are no parallels in *chaînes opératoires*, techniques or tool types. On the other hand, the status of Bavra-Ablari shows elements from both Kmlo-2 and Aknashen-Aratashen. Bavra-Ablari exhibits a very specific *chaîne opératoire*, a possible version of which may be found in early Aknashen VII. Pressure flaking (mode 3) and Kmlo-type retouch connects Bavra-Ablari with Mesolithic Kmlo-2, suggesting a typical Mesolithic *chaîne opératoire* and blank production at the site. However, we also find in the assemblage long blades presenting characteristics of Aknashen-Aratashen blanks. Considering the lack of by-products associated with their productions, their high degree of retouch, and the identification of Aknashen tool, we suggest that the presence of retouched long blades at Bavra-Ablari results either from a tool exchange or stimulus diffusion process. Without evidence of the production sequence, it is impossible to differentiate between the two possibilities. However, both suggest short-term contact away from the enculturating environment, between Bavra-Ablari and a Neolithic group.

Discussion

We have identified three behaviorally meaningful aspects in Mesolithic and Neolithic assemblages. The possible parallels found between *chaînes opératoire*, techniques, and tool types in these assemblages can be integrated into the model laid out earlier in this work. This model assumes that different aspects of a production sequence (from raw material acquisition to retooling process) take place at different social and geographic locations. Therefore, the transfer of a given aspects of this sequence from one group to the other is determined by access to their respective enculturating environments. Therefore, sharing tool shape is expected to require less access to this environment than sharing an entire *chaîne opératoire* of blank production. These assumptions have been operationalized into models of expectations of lithic assemblages in order to identify specific types of interactions between Mesolithic and Neolithic groups in the South Caucasus. The identifications of such interactions, in addition to other chronological, geographic and cultural data, can help us suggest mechanisms of interactions within the framework of Dennell's agricultural frontiers that led to the Neolithization of the South Caucasus.

In order to integrate the data into our expectation model, we examine two sites, a Mesolithic (Kmlo-2 or Bavra) and a Neolithic (Aknashen and Aratashen), defined on the basis of their chronology and subsistence pattern.

7.2.2. Kmlo-2 vs. Aknashen-Aratashen

The comparison of Kmlo-2 and Aknashen-Aratashen (Figure 73) did not yield parallels at any level in respect to the lithic assemblages at each site. Although the groups at each site exploited the same obsidian sources, they do not seem to have interacted in any way. This can be interpreted as a lack of contact due to a closed static border (H2.A.1), or as a migration process, in which arriving farmers would have chased the Mesolithic groups away (H2.B.2.1).

The Kmlo-2 assemblage that I have studied here and the first Shulaveri-Shomu sites in the Araxes basin are chronologically separated by 1000 to 1500 years. Although only partial faunal analysis could be conducted on this layer, the typo-technological characteristics and the evidence of subsistence patterns associate this layer with a local Mesolithic tradition. In this context, the lack of similarities between these assemblages can be best interpreted as a lack of continuity. This would suggest the exogenous nature of the groups arriving to the Araxes Valley during the early 7th millennium BCE, and then settling at Aratashen and Aknashen.

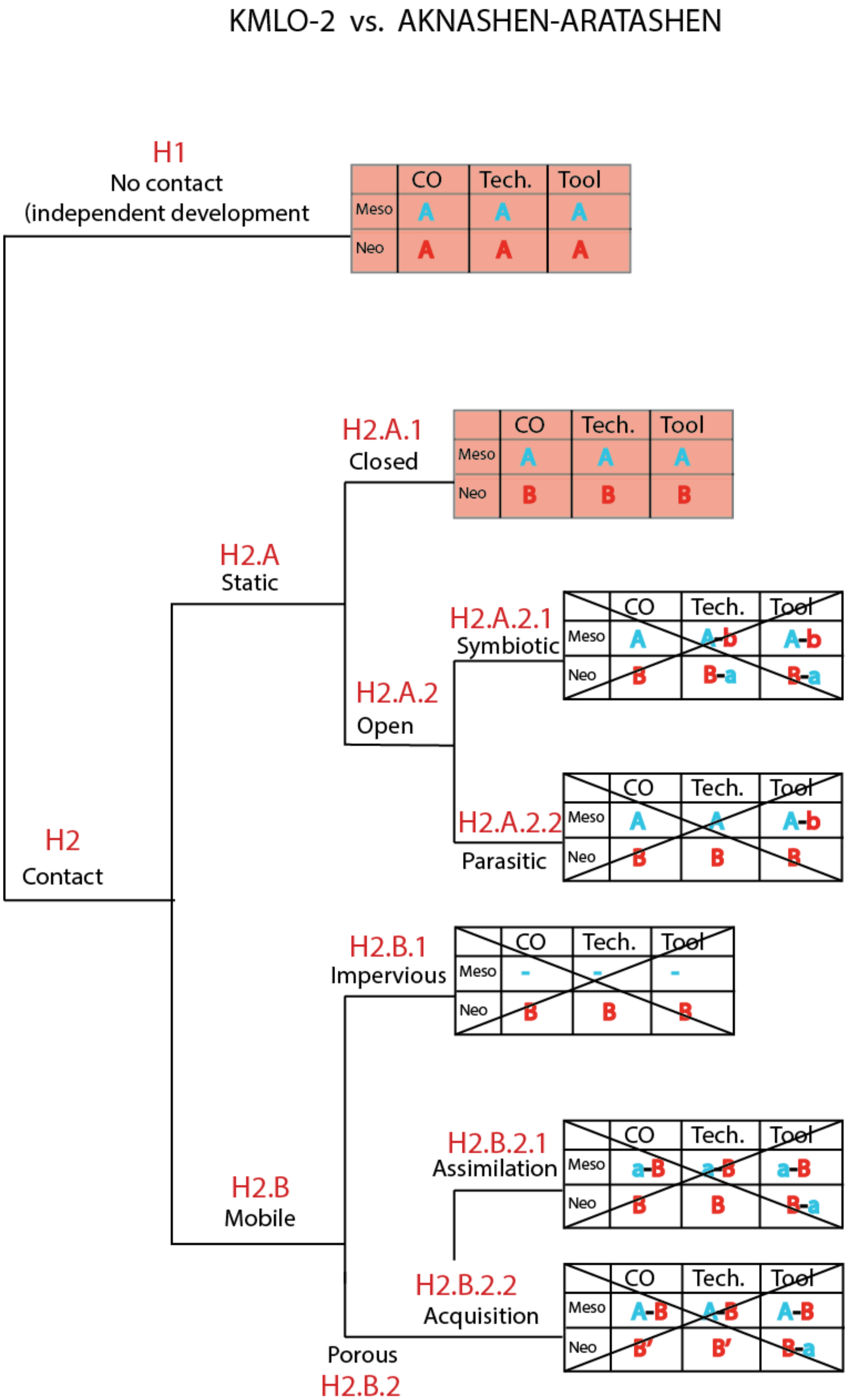


Figure 73: *Expectation model suitable for H.1, H2.A.1., and H2.B.2.1*

7.2.3. Bavra-Ablari vs. Aknashen-Aratashen

The horizon III at Bavra-Ablari is contemporaneous with the Araxes Valley settlements, which date to 6000 to 5700 BCE. Despite several remaining questions regarding the exact nature of the faunal assemblage, the majority of the evidence points toward defining Bavra-Ablari as a Mesolithic rock-shelter occupied by hunter-gatherers.

Indeed, both the *chaîne opératoire* and the techniques used at the site remain resolutely Mesolithic (Figure 74). The sequence produced bladelets on D-shaped cores, which were progressively reduced in a bullet-core type. The larger blanks were used to make scrapers and Kmlo tools, while the smaller products were retouched into microliths. However, we also identified long retouched blades, the production of which requires techniques not seen at Bavra-Ablari. Most likely, the blades were brought to the site as final products. This situation may be interpreted as a case of parasitic open frontier (H.2.A.2.2). In this scenario, Mesolithic and Neolithic groups occupied different ecological niches within the same territory. Therefore, the frontier was static as the two groups remained in their niches. At the same time, however, this model suggests that the frontier remained open as the two groups interacted across it. Dennell's model characterizes this as a parasitic relationship, in which hunter-gatherers stole agricultural goods. While it is difficult to use this evidence to make a claim to this kind of behavior, the archaeological evidence of this period does demonstrate a unilateral movement of artefacts (Aknashen tools, retouched blades) from agricultural settlements to hunter-gatherer groups. This configuration (Figure 74) involved limited contact, possibly on the pathways of the landscape, in the course of population movements around outcrops of raw material such as obsidian or salt.

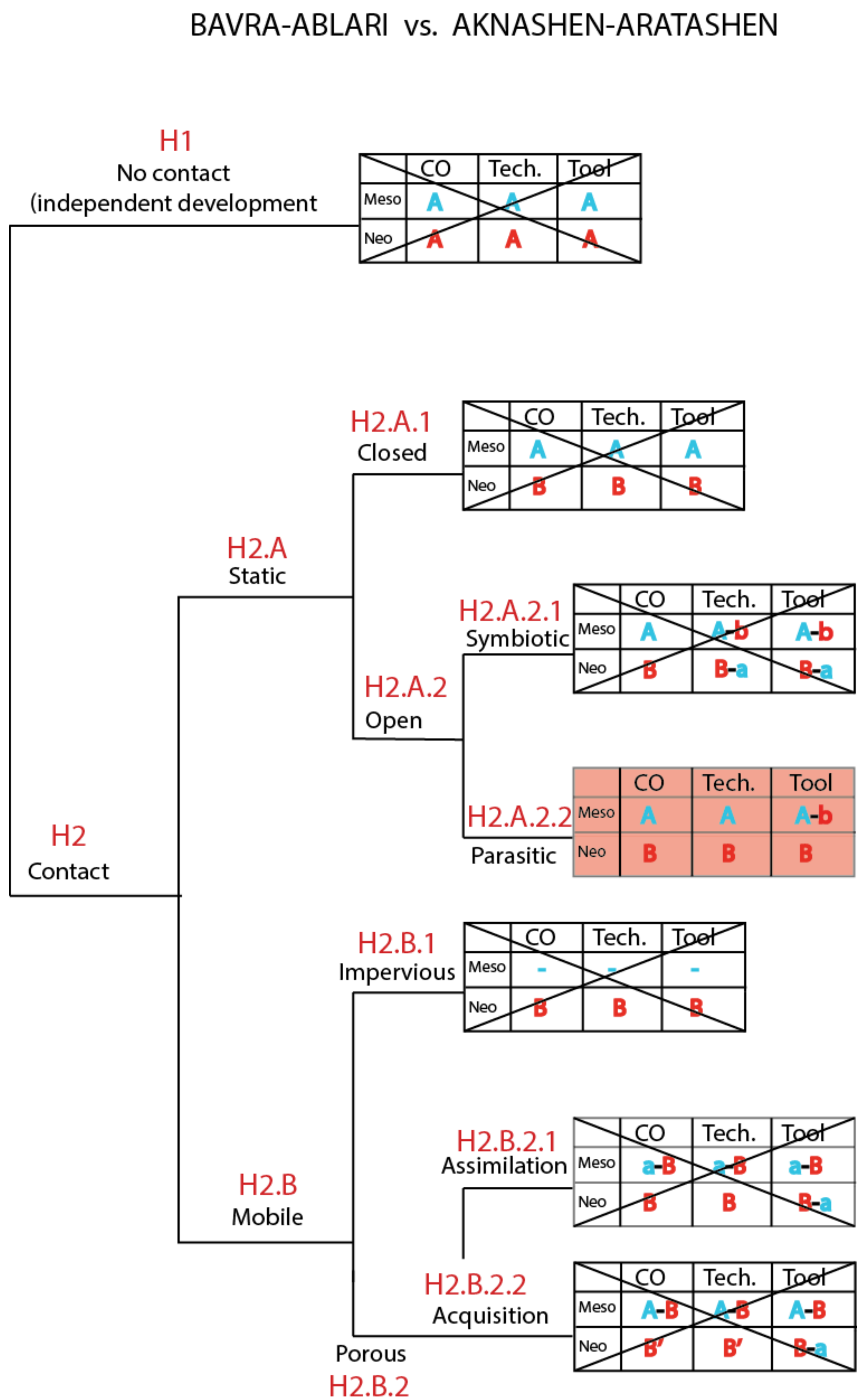


Figure 74: *Expectation model suitable for H.1, H2.A.2.2.*

The only possible parallel at this level of the production is bladelet production: at Bavra-Ablari, bladelets were produced on a slightly different version of D-shaped cores and bullet cores found in the Horizon VII at Aknashen, but the lack of *chaîne opératoire* by-products calls for caution. However, parallels in *chaînes opératoires* between Mesolithic and Neolithic assemblages during the earliest Shulaveri-Shomu phase would support claims for the occurrence of intense interactions as the new agricultural communities entered occupied territory.

Bavra-Ablari and the Aknashen-Aratashen sites are located about 160km away from each other, and do not share any obsidian types. Furthermore, the location of Bavra-Ablari suggest that interaction with agricultural settlements was more likely connected to the Shulaver-Shomu groups located in the Upper Kura valley in southern Georgia and in northwestern Azerbaijan, like Gadadrchili Gora or Shulaveri Gora. At these sites, archaeologists have also identified typology and *chaînes opératoires* that match those found at Aratashen and Aknashen.

7.2.4. Lithic Analysis - conclusion

The assemblages studied in the context of this dissertation come from sites that come from the mid-8th millennium BCE to mid-6th millennium BCE, the period generally seen as the transition from Mesolithic to Neolithic in the South Caucasus.

Several *chaînes opératoires* were used to produce blades and bladelets in the assemblages under study, and flake production remain largely expedient. These production sequences involved particular techniques that led to the production of specific blanks and tools. These differences and similarities can now be studied in the framework of group interaction, which will allow me to identify evidence of technology transfer or stimulus diffusion. For instance, this is the case for the use of microburin technique, the presence of Kmlo tools, and the spread of pressure flaking with lever from the Near Eastern world. These data, interpreted in alongside the other chrono-cultural data acquired in the context of this work, shed light on some of the cultural and demographic processes that occurred during the development of Shulaveri-Shomu group in the South Caucasus, and provide partial answers to questions about the origin of agriculture in this region.

7.3 – The Neolithic: a problematic identification.

The processes that I am interested in here address questions of socio-economic evolution and movement of groups within large territories during long periods of time. Only a holistic approach to the issue—combining both technological and diffusion aspects of lithic analysis and reintegrating them within a broader interpretative framework that involves geographic, economic, and chronological data—can properly support the hypothesis of the existence of an open static frontier in the early 6th millennium BCE.

I addressed issues connected to the identification of Neolithic in archaeological assemblages early in this work. The evidence that we search in order to assess whether or it shows a "Neolithic" status of any given group is directly connected to our understanding of what Neolithic is. Such biases in the collections that we consider exist also in the South Caucasus. I have argued that some of these biases were connected to two aspects of Soviet archaeology: first, archaeological material uncovered during the Soviet period suffers from the lack of dating and difficulties in assessment of stratigraphic sequence. Secondly, the Marxist-Leninist approach to social development favored local evolution to external influences, and this way of thinking discounted theories that put forth the role of outside actors. However, this approach was not accepted by all archaeologists involved in the region. Several academics contributed to local traditions of research outside of set Soviet narratives while also providing a great amount of information about Late Holocene cultural development in the region. However, as most interpretations of archaeological evidence revolved around an *indigenist* explanation, the first chronological sequence supported slow transition from Mesolithic to Neolithic through a developmental stage identified at sites such as Darkveti (Georgia) and Chokh (Dagestan). This hypothesis was supported by a “natural habitat” approach after the identification of the Caucasus as the “center of origin” of several species that would be integrated in the primary group of cultivated crops during later periods (Vavilov 1926; Lisitsina and Prischipenko 1976). However, we have presented issues related to these approaches, in particular how the understanding of the “early Neolithic” or “aceramic Neolithic” nature of these assemblages may be connected to the lack of radiocarbon dates or the insufficient data regarding the assessment of domesticated nature of the faunal collections.

We have defined of Neolithic as a lifestyle relying on adaptive strategies that eventually resulted in domestication of crops and animals. This approach allows some degree of flexibility in the identification of the phenomenon in an archaeological assemblage. The Neolithic could therefore be defined a period within which foragers, hunters, farmers, and all other groups with specific subsistence strategies in between, interacted and exchanged. The use of Neolithic as a chronological component would avoid only the biases connected to our current understanding of the process, one that is, still, mostly understood through a large demic. However, a purely chronological approach is problematic, as it forces us to start analyzing inter-regional interactions. Furthermore, a chronological approach creates a unilineal evolutionist perspective on this phenomenon. If one only considers an ecological approach--which would take into account a group of adaptive subsistence patterns that have a higher impact on their environment than others—the it nature of Neolithic as a particular historical process is erased. For both ecological and historical perspectives to be taken into account, we might adopt the concept of Neolithic to limited geographic areas—that is, to the regions involved in primary development, the Near East, and in diffusion, Europe and the South Caucasus. Doing so would mirror the work of Kozlowski (2009) in suggesting the regional particularity of the Mesolithic concept.

7.4 New data from the South Caucasus

7.4.1. New evidence against Old models

A re-assessment of the data provided by more than one hundred years of archaeology in the South Caucasus has produced a rich number of hypotheses regarding the development of Neolithic societies in the region. As such, the area has been used to illustrate all of the competing approaches found in the study of origins of food production. All three main explanatory frameworks have been suggested, from indigenism (Lisitsyna et Prischepenko 1977; Nebieridze 1986; Amirkhanov 1987) and migrationism (Munchaev 1975) to adoptionism (Kiguradze 2001; Kushnareva 1997). However, the major issue in the study of this region has been the attempt to force a corpus of data to fit these existing frameworks. As the development of modern excavation techniques in the region dramatically improved the resolution of archaeological data, we suggested a bottom-up approach that focuses on the identification of the mechanisms underlying each of those models.

The creation of a new dataset over the past 20 years also sheds light on existing results. Several phenomena have been identified and some hypotheses can already be disregarded. First among them is the adoption in the Caucasus of an Early or Aceramic Neolithic phases. Based on a strict application of a Near Eastern chrono-cultural sequence in this region, there is no evidence for subsistence pattern evolution preceding the arrival of the fully agricultural societies of the Shulaveri-Shomu culture during the early 6th millennium BCE. Review of the stratigraphy, chronology, and socio-economic data available in this work and previous studies (*see* Courcier 2014, Meshveliani 2013) has shown the lack of critical information—at Chokh, Anaseuli, Darkveti, or Kmlo-2—to support this hypothesis.

New projects on Mesolithic sites show a large variety of behaviors with some degree of consistency in lithic production. While Mesolithic groups were extremely mobile, they may have settled for longer periods of time in forest refugium during the cold Younger Dryas. Studies have demonstrated the lasting effect of the Younger Dryas in some mountainous area such as the Javakethi plateau. However, its effects did not prevent groups from exploiting the local resources at sites like Paravani 1 or Bavra-Ablari. Evidence for subsistence change is scarce. Data from Kotias Klde and Bavra-Ablari show exploitation of wild ovicaprins, carnivores (wolves, bears, foxes), fishes, and birds. However, none of these assemblages relate to what has been qualified as Early

Neolithic. How, then, are we to address the documented changes that occurred in lithic assemblages during the early Holocene?

In this work, I have argued against the reliance on typological categories to identify cultural identities. However, I have also supported the case of the Çayönü-Kmlo2-Paluri tool as an example of stimulus diffusion, in which the shape of the tool itself required specific sequences of techniques that produced specific results. Different groups utilized varying sets of techniques to achieve similar results. This could support the possible contact between South Caucasus group and southeast Anatolian Pre-Pottery Neolithic societies in the course of the 10th-8th millennium BCE. For instance, Kmlo-2 obsidian distribution showed the presence of obsidian from Sarikamis. However, there is no available evidence for a parallel evolution of subsistence patterns like intensification of herding, cultivation of crops, or even the presence of morphologically and genetically domesticated species.

The first behaviors associated with the Neolithic were found as fully agricultural societies entering the South Caucasus at the very beginning of the 7th millennium BCE. We have identified three regions, each of which shares broad cultural similarities while showing some regionally specific traits: the mid-Kura Valey, the Mil Steppe, and the Araxes River valley. In the mid-Kura Valley, a high density of structures and ground stone tools characterize large mud-brick settlements like Shulaveris Gora, Shomutepe, or Khramis Didi Gora. In southern Azerbaijan, on Mil Steppe extension of the Iranian Mughan Steppe, where at the site of Kamiltepe a monumental mud-brick platform was excavated in the 2000s. This architecture, along with the site's regional settlement pattern and most aspects of its material culture do not have many parallels with the Shulaveri-

Shomu groups found in the mid-Kura Valley. The last region is the Araxes River valley, where sites such as Aratashen, Aknashen, or Masis Blur have yielded evidence of a culture relatively similar to Shulaveri-Shomu. However, some differences with the mid-Kura sites have been found in material culture and subsistence patterns. These three groups share several features: the exploitation of fully domesticated species, a small proportion of hunting in the subsistence economy, long blade production, and a developed bone industry. However, each site also shows some interesting regional variation, which might be connected to different movement of Neolithization.

7.4.2. Continuity or hiatus? Pace of the Neolithization process.

Whatever the nature of the Shulaveri-Shomu phenomenon, it occurred quickly. There is currently no evidence for pre-Shulaveri-Shomu agriculture in the South Caucasus. As I mentioned earlier, there is a clear hiatus between the latest evidence of pre-Neolithic societies, around the mid-8th millennium BCE at Kmlo-2, and the first agricultural layers, around 5900 BCE at Arukhlo. This 1500-year gap might be an artifact of research and site preservation, but it may also reflect the low density of outside settlements during this period. The environmental evidence for this particular time is also difficult to comprehend. One on hand, globally, this period took place during the Holocene Climatic Optimum. Cores from the mountainous zone have shown the delay in the improvement of post-YD climatic conditions, but the status of this switch is unclear in the river valleys. The first important climatic signal is associated with the 8.2k event, a phenomenon that is generally correlated with the pejoration of the climate and a degradation in the environment. However, it does mark the beginning of an afforestation process in the highlands. Therefore, we witness a situation that contradicts our expectation of an occupation of the river valleys right after the YD, and re-occupation of the mountainous area at about 6200 BCE. Indeed, sites such as Kmlo-2 show that hunter-gatherer groups were using partially the river valley area. The density of wild crops and animals found here could have been particularly attractive. However, no hunter-gatherer sites have been found in the valley itself, and only one has been located in the neighboring piedmont.

If one assumes the existence of an empty territory during the entire millennia preceding the arrival of Shulaveri-Shomu group, we might suggest that the Neolithization of the South Caucasus took place without any resistance. However, the new data provided by Bavra-Ablari seem to suggest a new picture of this process.

7.4.3. Questions from Bavra-Ablari

The excavation of Bavra-Ablari resulted from several surveys carried out in the Armenian and Georgian highlands, in an effort to identify farming settlements in these particular ecological niches. The rock shelter, located at an altitude of 1660m ASL produced a stratigraphic sequence with multiple layers ranging in date from the Late Pleistocene to the Bronze Age.

First, the site provides evidence of an occupation during the mid-9th millennium BCE. Despite the small sample size, several elements of a bladelet *chaîne opératoire* and typology, as well as the use of tools in hunting of deer and aurochs, show some coherence with the assemblages from neighboring sites (Edzani, Bavra, etc…). The Neolithic layer was especially interesting, as it dates to the beginning of the 6th millennium BCE, when the traces of first agricultural societies appeared in the valleys. While the domesticated nature of the small-sized ungulates remains to be clarified, the majority of the species found in the assemblage indicate a subsistence pattern oriented towards pastoral economy and exploitation of the plateau resources. On the other hand, the lithic assemblage shows a mixture of Mesolithic technological substratum that integrates specific typological elements generally associated with Shulaveri-Shomu culture, such as long blade fragments and specific retouch.

The site of Bavra-Ablari raises a number of important questions. If the groups settling at the rock shelter during the very late 7th-early 7th millennium BCE were indeed hunter-gatherers, why did they not appear between the mid-8th and the late 7th millennium BCE? The refugium hypothesis could explain a process by which most Mesolithic sites remained centered around specific geographic locations, like coastal plains, a move that may have been accompanied by a population retraction. This event was followed by an expansion and colonization of new areas by hunter-gatherer groups in association with an 8.2k event that, in the South Caucasus highlands, triggered afforestation processes. The site also provides evidence supporting interactions between highland hunter-gatherers and Shulaveri-Shomu groups from the river valleys. Indeed, it has been suggested that some of the Neolithic groups living at sites such as Aknashen were semi-sedentary. It is possible that some of the herd management strategies involved highland pastures and triggered phenomena of transhumance and vertical movement. Examples of farmer/hunter-gatherer interactions in this particular context have been suggested in the Near East and are coherent with our flexible definition of Neolithic strategies.

7.5 Group interaction and stone tools

The identification of group interaction in lithic assemblages follows the model developed earlier in this work. Through typo-technological studies, we have highlighted parallels between assemblages at the four different sites of Bavra-Ablari, Aratashen, Aknashen, and Kmlo-2 ranging from the Mesolithic to the Late Neolithic. The interpretation of the continuity of specific techniques, or similar tool types, between sites calls for caution. However, when considered in with the context other archaeological data, these comparisons can provide useful information.

The chart below highlights some of these parallels, as the sites have been organized chronologically. It suggests first and foremost an actual disruption between the so-called "Early Neolithic" layer of Kmlo-2 and the Late Neolithic collections of Aknashen and Aratashen. It also emphasizes the intermediary place of Bavra-Ablari in this process, as the site contains elements connected to both Mesolithic and Late Neolithic traditions. The status of the Horizon VII at Aknashen can also potentially illustrate interaction phenomena. At Bavra-Ablari, blanks and tools were the only elements connected to the Shulaveri-Shomu culture. On the other hand, at Aknashen Horizon VII, D-shaped cores have been found in association with large pyramidal blade cores, but no tools were manufactured on these small blanks. No evidence exists for pressure flaking with levers or large crutches (mode 4 or 5) at Bavra, and no Mesolithic-type tools were found at Aknashen or Aratashen. Finally, Kmlo tools are present exclusively at pre-Shulaveri-Shomu sites.

Considering the information highlighted here, several suggestions can be made to interpret the implications of this configuration.

7.5.1 Kmlo tool, a case for stimulus diffusion?

The case of the Kmlo tool is particularly interesting. In this work, I suggest that it is directly related to the phenomenon of stimulus diffusion (Figure 75). Already used in archaeological context by Tostevin (2012), this approach underlies most of the assumptions regarding inter-assemblage comparison that are eventually extended into the problematic "pot equals people" equation. However, in the context of this work, it is used to address very specifically shaped tools within a geographic space, within which scales remain limited (i.e. the Near East and South Caucasus).

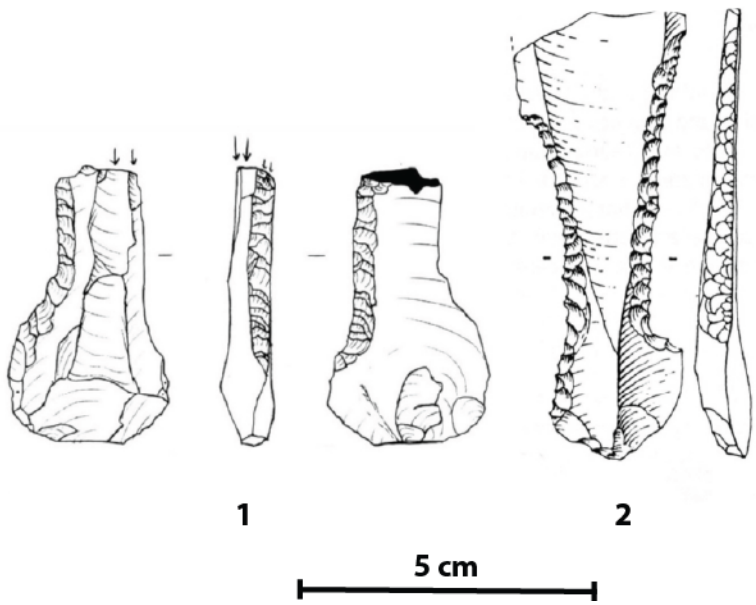


Figure 75: *1: Kmlo tool; 2: Çayonu tool*

The Kmlo tool is indeed a particular type of artifact that involved the deployment of specific techniques of controlled, thorough, parallel pressure-flaking retouch on an elongated blank in order to create a hooked shape. As mentioned earlier, several examples have been found in the neighboring countries of Armenia (Kmlo tool), Georgia

(Paluri tool), and Turkey (Çayönü), spanning a period that ranges from Early Holocene to 6000-5000 BCE. Neither the TPQ nor the TAQ have been clearly identified for the technique of the type of tool, but it has not been found in Epipaleolithic assemblages nor in Shulaveri-Shomu collections.

We suggest in this work that, despite differences in manufacturing sequences (flake blank vs. blade blanks for instance), the hooked design of the artifacts and their technical requirements (parallel pressure flaking) are specific enough to support early contact between hunter-gatherers of the South Caucasus and PPN Anatolian groups. This contact likely occurred between the 10th to 7th millennium BCE. The reasons behind the transmission of such tools are unclear, considering that they were employed for different uses in southeast Anatolia and the South Caucasus (Arimura et al. 2010). Overall, this assumption implies contact between hunter-gatherer and and farming societies that did not lead to development of agriculture in the South Caucasus. Mesolithic populations were extremely mobile, and PPN groups were heavily involved in transhumant movements throughout the landscape. These interactions could have taken place around salt mines, river valleys, or high plateau. The lack of archaeological data from northeastern Anatolia limits our ability to support this hypothesis, but it provides interesting implications for considering possible resistance to the introduction of agricultural practices in the South Caucasus.

7.5.2 Pressure techniques and the enculturating environment

Among the several types of pressure techniques, we have emphasized in particular the role of the lever and long crutch (modes 4 and 5)(Pelegrin 2012) in the identification of group interaction. If the case of independent invention of pressure flaking with a lever remains a possibility, it is unlikely that Mesolithic groups in the South Caucasus during the Holocene developed this technique.

The absence of these modes at Kmlo-2 and Bavra-Ablari, and their sudden appearance in the technological landscape of the South Caucasus early in the 6th millennium BCE, is significant in many respects. First and foremost, this particular technique has also been identified in Late Neolithic assemblages from northern Mesopotamia, such as Sabi Abyad, during the second half of the 7th millennium BCE (Akkermans, 2000). In the case of such a particular mode, the technological parallels between northern Mesopotamia and the South Caucasus (Chabot and Pelegrin 2012) could involve some degree of affiliation between the two techniques. Second, the advantage of the technique is the systematic production of standardized long blades. The presence of such products in a Mesolithic assemblage at Bavra-Ablari is here interpreted as "parasitic" contact between two contemporaneous groups. .

7.5.3 Results: hunter-gatherer and farmer interactions?

The first evidence of agriculture in the South Caucasus is associated with the Aratashen-Shulaveri-Shomutepe in the Araxes and Kura Valleys at the very beginning of the 6th millennium BCE. In the valley, these groups, identified at sites such as Aratashen and Aknashen, settled in environments that seemed to be unoccupied at the time. Mesolithic sites are unknown in this particular environment, and the latest hunter-gatherer groups are thought to have existed 500 years before the arrival of this community. The identification and excavation of Bavra-Ablari identified the first hunter-gatherer settlement of Mesolithic tradition contemporaneous with the Shulaveri-Shomu groups following an Open Parasitic frontier model.

The two groups occupied different ecological niches—thus they largely occupied a static frontier—but interacted nonetheless, creating an open frontier. However, it seems that such interactions remained unilateral, as no Mesolithic tools were found within Neolithic assemblages. Following Dennell's model, this configuration is interpreted as a parasitic relationship in which resources Mesolithic communities stole resources from their neighbors. This type of relationships was short-term, and took place on the pathways of the landscape, away from the enculturating environment. This distance did not permit interactions that led to transmission of knowledge, and thus they did not spread techniques, or blank *chaînes opératoires*. The contacts may have also occurred on specific retooling sites, like hunting camps, and only tools along with some blanks found their way from Neolithic groups into Mesolithic assemblages. While more evidence is necessary for a full description of the nature and outcomes of such contacts, this model suggests that Mesolithic-Neolithic interactions remained brief and outside of the enculturating environment, and thus were not likely to lead to a context conducive to the exchange of agricultural technologies.

The full context of this contact remains unclear. First of all, only heavily retouched blades have been identified in Mesolithic contexts. We have suggested that the organization of the production of these blades involved a blank production that occurred during very short periods of time—over only a few days—and possibly rested in the hands of a few specialists. Once this sequence was achieved, the blanks were distributed to the members of the community, who then retouched the blades to fit their needs. It is likely that the large majority of persons living in the village had access to such blanks.

Second, I have noted that settlements such as Aknashen and Aratashen were semi-sedentary. It is unclear if this patter involved the entire community or just a group of people within it. If the groups living at Aknashen settled at another location, possibly in the context of summer pasture, these highlands settlements are unknown. However, it is likely that interactions with hunter-gatherer from the highlands took place during these movements across the landscape.

7.6 Origins of South Caucasus agricultural societies

In this work, I have made two key suggestions: first, agricultural groups identified in the Kura and Araxes River valleys during the early 6th millennium BCE had no affiliation with local Mesolithic traditions. Second, Neolithic and Mesolithic groups interacted in the context of semi-sedentary patterns, but that exchange of goods remained limited. I have also proposed possible early contact between Pre-Pottery Neolithic group from Anatolia and Mesolithic groups from Armenia and Georgia during the early Holocene. While the material culture identified at sites such as Aknashen and Aratashen does suggest some degree of affinity with Near Eastern traditions (blade technology, soft stone stamps, imported pottery), several problematic elements remains (crop genetic, chronology, architecture) about the origins of such groups. Integrating linguistic, genetic information, and chronological data provides some elements of answer.

7.6.1 Language, genetic, and the Near East

Researchers have already addressed the existence of parallels between the early spread of farming technology and dermic diffusion through linguistic and genetic data (Bellwood 1984, 1991, Cavalli-Sforza and Cavalli-Sforza 1995, Diamond 1997, Higham 1996, Renfrew 1987). The main premise of these assumptions is that if the "Neolithic revolution" is considered an important unconformity in the genetic, linguistic, and cultural landscape that it traversed, we should find markers of this phenomenon in our modern linguistic and genetic landscape.

The area that comprises the modern Caucasus is known to be one of the most genetically and linguistically diverse area in the world (Comrie 2008, Greppin 2004). Several explanations have been provided for this variance: chiefly, the geographic location and topographic characteristics of the region imbue it with the physical characteristics of a "buffer zone" between diverse cultural and geographic areas; the poorly connections across these lands; and the relationships between the varied physical environment and diverse human ecology within complex and long-term historical processes. Topographic and social factors have recently been used to explain this configuration. In the Daghestanian branch of Eastern Caucasian language family, some small language groups have even been positively correlated with geographic locations close to sources of several streams (Korjakov 2006). The shortage of agricultural land in mountainous areas has also been used to explain the frequency of endogamy, a practice strongly connected to the persistence of internal changes against external linguistic influences (Comrie 20080. The territory of the Caucasus is best described under the term of "accretion zone" (Nichols 1997), which casts it as an area with important genealogical and linguistic diversity.

In a particularly relevant case study, Nichols (2013) analyzed the structure and origins of speakers of the three main languages of Nakh-Dagestanian, spoken by groups living their lives on the southeastern foothills of the mountain range. Nichols, looking at the semi-regular rate of vocabulary loss per 1000 years, suggested the appearance of the

Nakh-Dagestanian language at around 6000BCE, a date that also marks the appearance in the agricultural record of the first agricultural sites in the South Caucasus. Furthermore, Nichols also identifies that, of the words that have the strongest popular resistance to modification, many are connected to farming activities, including the words for barley (mud), bull (stu), or wool (tkha), as the modern forms finds close relative in the earliest branches of Dagestanian. She interprets the existence of such words in proto-Nakh-Dagestanian as supporting the existence of farming communities, which would have originated from the Fertile Crescent, in the Eastern Caucasus and by the Caspian Sea (Nichols 2013).

The main result of recent genetic studies is the finding that most groups in the Caucasus are more closely related to their geographic neighbors than their linguistic neighbors (Nasidze et al. 2002). The results of mtDNA analyses suggest that Indo-European speaking-Armenians, Caucasian-speaking Georgians, and Turkic-speaking Azerbaijanis are more closely related to other Caucasus population (and to each other) than other Indo-European or Turkic groups (Nasidze et al. 2002, Schonberg et al. 2011), although the latter share more genetic similarities with groups from modern Turkey, a situation possibly connected to a common Central Asian ancestry (Schonberg et al. 2011).

The mtDNA results are particularly interesting when compared to the Y-chromosome genetic landscape of the region. This dataset is characterized by higher diversity values, which along with other evidence (low frequency R1a1 haplogroup, common F and J2 haplogroups) support the idea that the Caucasus represents a "break-zone in the genetic landscape of Eurasia" (Nasidze et al. 2002:261). One of the interpretations and implications put forth by geneticists is that the Caucasus population is more closely related to Near Eastern populations than European populations, possibly connected to repeated introduction of Near Eastern populations—with a male majority—in the region (such as, for instance, the repeated Arab-Muslim invasions from the 7th to the 17th century A.D.) (Comrie 2008). However, some degree of affinity between European and Caucasian groups (first, the existing degree of mtDNA parallels, and the Alu insertion polymorphism) could point towards a common ancestry dating back to the Paleolithic (Renfrew 1992), or may indicate the passage of Near Eastern farmers to Europe via the Caucasus (Nasidze et al. 2002).

The linguistic and genetic information is limited in nature. While the interaction of Caucasian peoples with Near Eastern groups can be documented in genetic data, the actual timing of these interactions remains unknown, having occurred intermittently from the time of the Upper Paleolithic movement of hunter-gatherer groups to the period when Medieval incursions of Arab-Muslim armies occurred across Greater Caucasus. However, Nichols's work narrows down this range, suggesting that agricultural groups from the southwest Caspian area of the Near East arrived into the South Caucasus around 6000 BCE.

7.6.2. Review of Near Eastern components in South Caucasus traditions

Several types of data support the South Caucasus-Near Eastern connection in the context of agricultural development.

First is the material culture found in the earliest layers of the Shulaveri-Shomu sites. Besides the parallels found between Northern Mesopotamia and South Caucasus blade-making techniques, which feature levers, several imported so-called Halaf sherds have been found commonly in Shulaveri-Shomu sites from the Kura and the Araxes Valley. Particular types of incised soft stone stamps are also associated with these early layers at sites such as Aknashen and Shulaveris Gora.

Crop genetics also show that specific types of naked hexaploid wheat (*Triticum aestivum*) found in sites of the Araxes and Kura River originated from a hybridization of *Aegilops tasuchii* and a tetraploid wheat (Zohary and Hopf 2004; Petersen et al. 2006). Large population of *Ae. tauschii* are native to Armenia as well as to the southwestern Caspian Sea belt, and the genome of the *Ae. tauschii* near the sea belt is the closest to the one in hexaploid wheat, evidence to support this theory of origin . (Chataigner et al. 2014; Dvorak et al. 1998; Kilian et al. 2009).

The chronological, genetic, linguistic, and material data studied and reviewed in the context of this work allows us to suggest a scenario that explains the origin of farming settlements in the South Caucasus along with the mechanisms underlying the establishment of these groups in the region.

7.6.3 Between Anatolia and the Caspian sea: Chronology of contacts.

7.6.3.1 Early stimulus Diffusion (10^{th}-8^{th} millennium BCE)

The earliest contact between the South Caucasus and the Neolithic sphere of the Near East took place as early as the 10th-8th millennium BCE (Figure 76). A change of paradigm in the description of the Neolithic phenomenon has emphasized the density of exchange networks in the Near East as early as the PPNA. Long-distance contact during this period in the Near-East are already seen with movement of Red Sea shell beads to the Middle Euphrates. Therefore, the possibility of even short-term contact between the South Caucasus and southeastern Anatolia is possible.

Figure 76: *Early contact between the Neolithic Near East and the Mesolithic South Caucasus taking place after the Younger Dryas, and highlighted by stimulus diffusion process of Kmlo-Çayönü tool*

These contacts thus would have remained scarce and, from a lithic perspective, can be categorized as resulting from "stimulus diffusion," witnessed through the Çayönü-Kmlo tool distribution. Such contacts, which occurred on pathways throughout the landscape, would likely have occurred around obsidian sources such as Meydan or Sarikamis, or at salt mines like Tuzluca. These interactions occurred away from each group's enculturating environment (i.e., village/home), and thus did not lead to any exchange of lithic technology, domestic species, or any type of agriculture-related knowledge. The South Caucasus sphere remains very much supported by a hunting /foraging-based subsistence pattern.

7.6.3.2 Movements of Late Neolithic groups towards the Caspian sea belt (7th millennium BCE)

The Near-Eastern Late Neolithic is generally considered to have started during the first half of the 7th millennium BCE. This period most likely was accompanied by a change in settlement patterns, with settlements becoming smaller and size and possibly more associated with more mobile groups (Akkermans 2000).

Following linguistic and crop genetic lines of evidence, I have suggested that the groups settling in the Kura and Araxes River valleys originated from the southwest Caspian Sea belt, where they domesticated local crop species (Figure 77). There is currently very little evidence of agricultural settlement in this area, and the typological sequence remains undated. Therefore, the timing of this phenomenon is unclear, but it seems that it must have occurred at a fast pace. The arrival of the first groups in the South Caucasus by 5900 BCE would necessitate that the southwest Caspian area was settled by agriculturalists during the second half of the 7th millennium BCE at the latest. Environmentally, this period corresponds with a sudden decrease in temperature, which lasted in the Near East for about 400 to 600 years, known as the 8.2ky event (Van der Plicht et al. 2010). While some studies, including one of Sabi Abyad, suggest that this climatic phenomenon had no systematic impact all settlements (Akkermans 2010), other examples show that it triggered a reorganization of settlements and the adaptation and subsistence patterns followed by the groups living there (Biehl et al. 2010; Ryan and Rosen 2010). Furthermore, it is generally associated with the expansion of farming towards western Turkey. Therefore, these environmental changes may have resulted in adaptive strategies that caused some Late Neolithic groups, most likely those that were associated with Samarra or Hassuna cultures, to resettle in the Caspian Sea, an area that was not as strongly impacted by this climatic change (GRID-Arendal 2013).

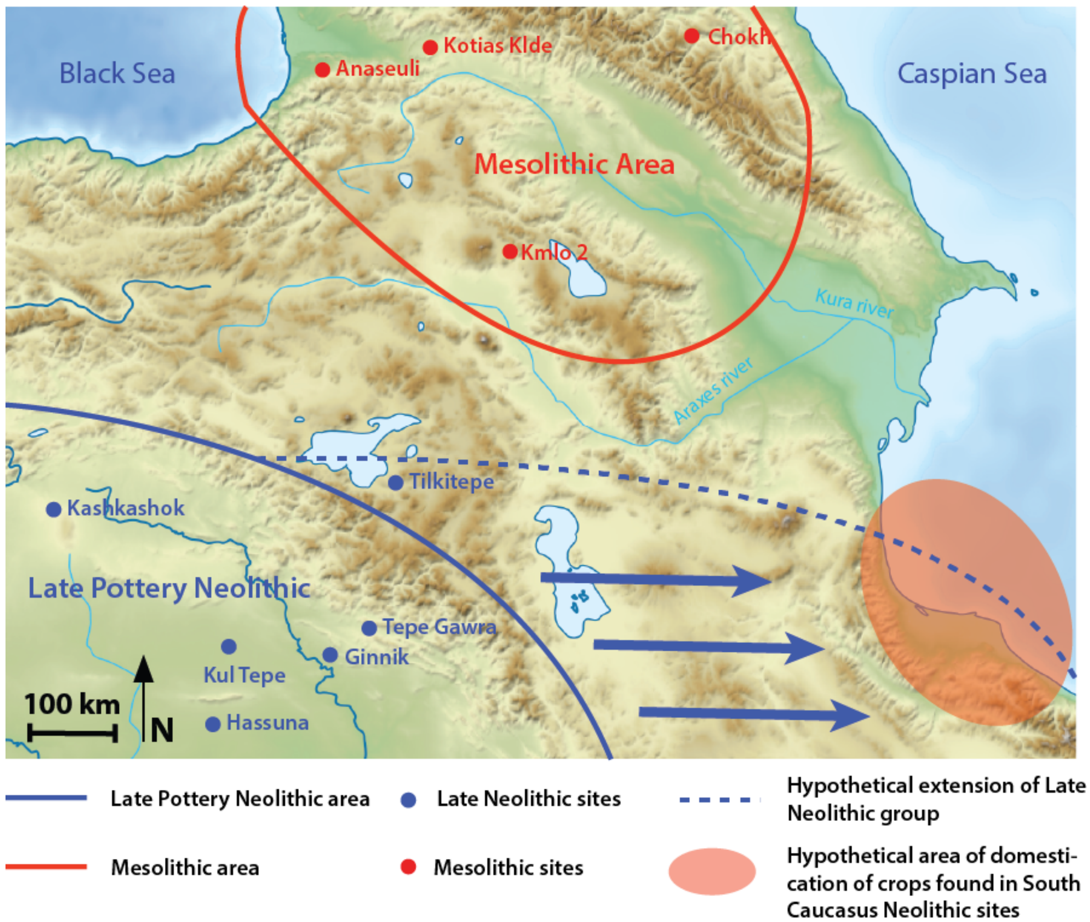


Figure 77: *Hypothetical movement of Hassuna-Samarra groups towards the Caspian SW sea belt as an adaptation to the 8.2ky event. This area is suggested as the zone of origin and domestication of crops later found in Shulaveri-Shomu sites such as Aknashen.*

7.6.3.3 Near Eastern groups entering the Caucasus (6100-5900 BCE).

Because of an existing plateau in the calibration curve, it is difficult to pinpoint when the first agricultural groups entered the South Caucasus. We suggest that, from the Caspian coastal areas, these groups followed the fertile plains of the Araxes and Kura River valleys, and even crossed the mountain range through the Derbent pass to settle in the North Caucasus. This scenario could explain the fact that, despite a seemingly unique cultural "background" of these groups, some variations are found in terms of the material culture of pottery, architecture, and stone tools. As these groups arrived in the valleys, they encountered Mesolithic communities in the context of horizontal movement in the landscape between the lowlands and the highlands. It does not seem that such contact led to an adoption of agriculture by local Mesolithic groups or to an assimilation of these groups in the Neolithic communities, as the lithic assemblage of Aratashen and Aknashen remains remarkably consistent up until the late 5th millennium BCE. It is thus possible to picture a sustainable cohabitation of farmers and hunter-gatherers, who occupied different ecological niches. This cohabitation did not lead to a transfer of technology. Towards the end of the 5th millennium BCE, we witness a re-occupation of the highlands by agricultural communities (Varoutsikos et al. *in press*). The groups show an affiliation with Shulaveri-Shomu communities in their material culture, but have also developed their own subsistence patterns, which relied on domestic species and were fully adapted to their environment in terms of altitude. At this point in time, Neolithic groups were fully settled throughout the Caucasus, and no traces subsist from this period of the Mesolithic communities (Figure 78).

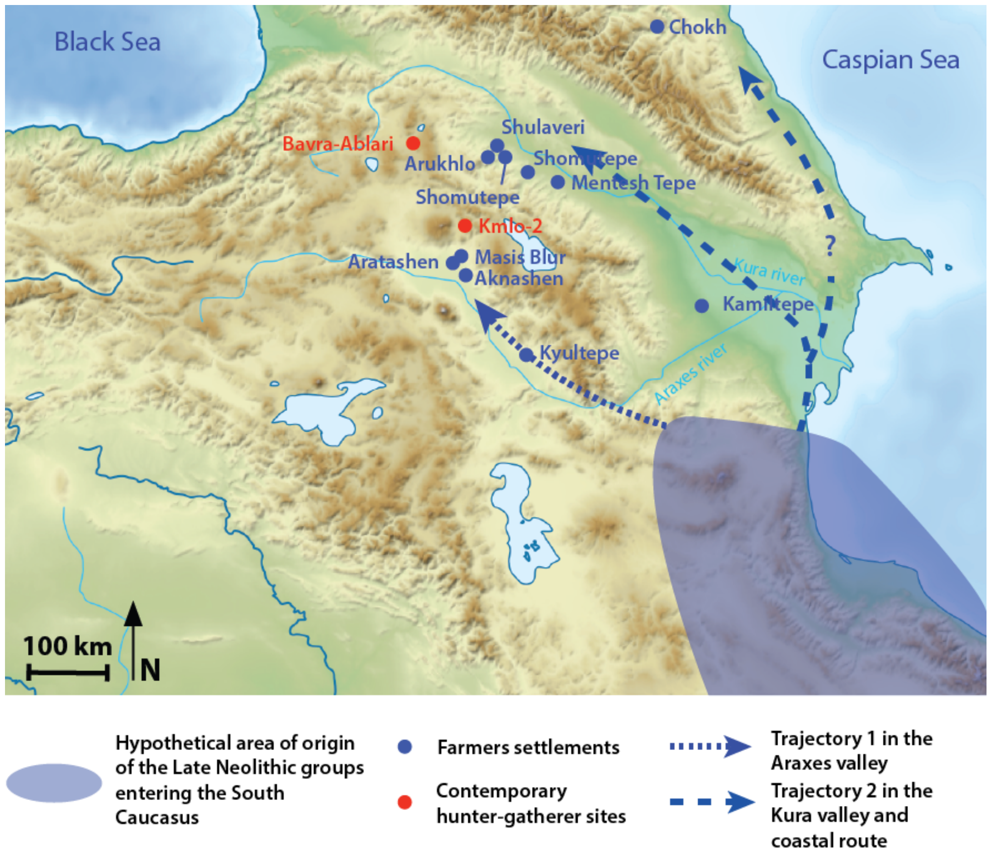


Figure 78: *Movements of Late Neolithic groups in the South Caucasus following river valleys (Kura and Araxes) and coastal lines (Caspian sea shore and Derbent pass)*

Conclusion

How did the Neolithic way of life come into being in the South Caucasus? Answering this question requires first that we rethink our understanding of what constitutes the “Neolithic way of life.”

Initial descriptions of the Neolithic focused on the role of the period as a marker of progress in a unilinear perspective on social evolution. The Neolithic, according to this understanding, triggered village life, sedentism, surplus production, and social organization, ultimately leading to our modern societies. However, the accumulation of data over the past century has radically changed this conception of the period. Other independent episodes of crop and animal domestication have been witnessed at different periods and different locations throughout the world. In fact, the Neolithic “way of life” involved other adaptive strategies than sedentary farming. There was no one single core of innovation; rather, there existed a large sphere of innovation connected by a dense network of communication. This network involved actors from different cultural backgrounds and varying subsistence economies. Within this sphere, different episodes of domestication occurred, and the same species were domesticated multiple times. These interactions involved the participation of hunter-gatherer relying on wild species, pastoral nomads, and fully sedentary agriculturalists, participating in the construction of a Neolithic sphere.

Therefore, the study of the Neolithic must prioritize not only identifying the forces that triggered this adaptive change, but also the mechanisms that allowed this change to become sustainable and spread throughout the entire region. The Neolithization process was supported by a large-scale territorial organization, a dense network of interactions, spreading goods and knowledge fast, across land and sea.

Therefore, to understand Neolithic spread, we must focus on group interaction. This work developed a methodological framework to address different types of group interaction through lithic assemblages, and applied it to the Neolithization of the South Caucasus. We carried out identification of behaviorally significant elements in lithic assemblages based on several assumptions: first, that stone tool production sequences are culturally specific and can fully be shared only through complete access to the place of teaching, the enculturating environment; and secondly, that different parts of the production sequence occur at different places on a landscape. In the context of the Neolithic, stone tool shapes were shared on the pathways across the landscape, while techniques transfer necessitated long-term contact within the enculturating area. Therefore, by identifying where the parallels between two assemblages belong on the spectrum shape versus technology transfer, we can suggest the type of interactions that occurred between groups. To some extent, this study also assumes that, if famers and hunter-gatherers interact to an extent that they have access to each other's enculturating environment, there will be an automatic transfer of technology.

I utilized this model in examining the Neolithization of the South Caucasus, where few studies have been carried out on the topic. My question required the identification of a site in the highland contemporaneous with the Neolithic settlements located in the valley in addition to a comparison of typo-technological characteristics from Mesolithic and Neolithic sites. After several surveys, the team with which I worked identified and excavated the rockshelter of Bavra-Ablari. The site yielded two Mesolithic layers, one dated to the mid-9th millenum BCE, and another one contemporaneous with the first Neolithic occupations at Aknashen and Aratashen (6000-5800 BCE).

In parallel with the assemblage from the Kmlo-2 Mesolithic site, the assemblages from Bavra-Ablari, Aratashen, and Aknashen yielded useful results regarding Mesolithic-Neolithic group interactions. According to my analysis, taken together this evidence supports the hypothesis that groups that settled at Aknashen and Aratashen were not connected to local Mesolithic traditions. The farming groups most likely originated from the southwest Caspian belt, where they settled quickly after moving outside of the Mesopotamian plain, possibly as a response to the 8.2ky event. The study suggests that the Mesolithic and Neolithic groups interacted following an "open static parasitic frontier" model. The two groups interacted in the highlands in the context of semi-nomadic movement, or around sources of raw material such as salt or obsidian. This contact led to the integration within the Mesolithic assemblage of several typologically Neolithic tools. There are, however, no traces of Mesolithic features in Neolithic assemblages, which indicates the likelihood that these groups vacated the highlands towards the end of the 6th millennium BCE.

Strict definitions of Neolithic have greatly limited our ability to identify and understand the phenomenon. Addressing the Neolithic from the perspective presented in this work relies on our ability to identify the role of group interactions. These processes involved actors who were sometimes hardly identifiable in archaeological record—mobile groups leaving little traces, but who played a foundational role in creating the Neolithic. However, this situation also forces us to develop new methodological frameworks that allow us to extract social meanings and behaviors from archaeological material. By doing so, we can work to address the question at the core of anthropology, of how human interactions shape society.

Appendix

Appendix 1.1 – NW Iranian Obsidian Geological Survey (Figure S1)

(dir. B. Varoutsikos, H. Nazari, and M. Khalabtari Jafari)

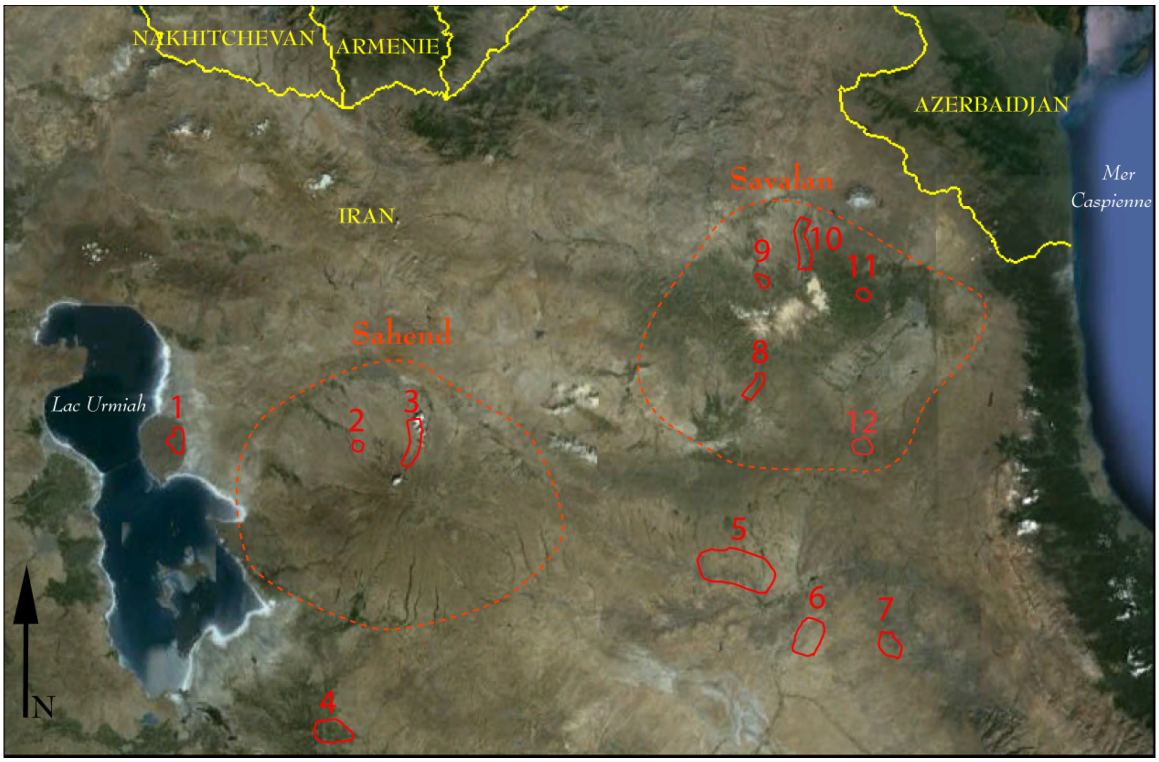


Figure S1: *Areas visited. 1, Urmiah lake, 2-3, Sahend Mountain, 4, Leylan, 5-7 , Bozqush, 9-12, Savalan Mountain*

The Savalan Mountain

Mt. Savalan is a Oligo-Quaternary volcano that culminates at 4811m asl. The slopes of the volcano are covered by lava dome and pyroclastic material from the fractures at the margin of the caldera. These rocks are generally extremely acidic (>65% SiO_2) to mildly acidic (52-65%). The survey in this region was targeted at confirming or reconsidering the suggestions of Didon and Germain (1976) and Niknami (et al. 2010) that several obsidian outcrops had been found in the area.

In the Meshin Shahr (N38°17.931' - E 047°42.074') and in the surrounding areas of Saheb Divan, silicified rocks are found in an acidic environment. We identified an outcrop of fluidal rhyolite, but no obsidian. The "black rocks" mentioned in Niknami's article have been identified in the Garesu River basin, but they were not obsidian (perlite). In the Warjaneh area (N 38°24.086' - E 047°52.058'), a type of volcanic glass was found. It was a glassy rhyolite, with inclusions of alcalines, quartz, and feldspaths that render it unknappable.

In the Qotur Suyu valley (N 38°20.848' - E 047°51.971') white and black tuff formations featured inclusions of halophytique rocks, identified by Didon and Germain (1976) as obsidian but with inclusions of phenocrystals. Finally, we targeted other small areas around the Gonag Giran village, including a Neogene andesitic formation identified by Niknami et al. (2010) as an obsidian outcrop. This area produced small fine-grain perlite pebbles that resembles obsidian but that has different clastic properties.

The Sahend mountain

The Sahend Mountain is a massive Plio-Quaternary stratovolcano on the oriental banks of the Urmiah Lake. The volcanic dome reaches 3707m (Kamal pic) and was recovered by more than 3000 tons of Miocene deposits. The survey was focused on the north and northwestern slopes of the volcano. We visited first the Oligo-Quaternary andesitic deposit of the Ligvan Valley (N 37°46.434' - E 046°24.342'), but we could not identify obsidian, despite the presence of fine-grained dacite.

In the Mianeh region, we targeted several areas. Aqkand-Tvin (N 37°15.661' - E 048°11.651') is an Oligocene volcanic complex that produced a lot of glassy rhyolite with important inclusions of quartz and feldspaths phenocrystals that represent more than

40% of the total mass. The same situation was noticed at Tora Daghi (N 37°14.479’ - E 048°03.577’), and Shirinbulag (N 37°29.861’ - E 047°37.122’).

Leylan region

Figure S2: *left, obsidian bloc from Leylan, right, perlite from Sahend*

The Leylan region was the most promising (Niknami et al. 2010). The obsidian block exhibited at the Azerbaijan Museum in Tabriz mentions Leylan as the outcrop. This village is located on a Quaternary fluvial terrasse, between two massive volcanic formations. Intense prospections on both these formations and in the fields surroundings the village has not led to the identification of any obsidian. However, one of the villagers brought a block of obsidian weighing 4kg and measuring 17x10x10cm, with no cortex but with presence of neo-cortex on 30 to 40% of its surface (Figure S2). His family had found the obsidian more than 20 years, in the village, as they were digging to build a bread oven. We were allowed to sample this block, which we sent to MURR (Missouri University Research Reactor) for ICP-MS analysis carried out by M. Glascock. The analysis revealed two interesting results. First, the sample’s composition is very close to the Geghasar range located in northern Armenia. Second, it is also very similar to the composition of a sample provided by an Iranian student to M. Glascock that was taken from the museum block. There were no elements that differed enough between the Geghasar and the Leylan sample to say that the samples were not the same. Therefore, either the sources are nearly identical, or the Leylan sample originated at Geghasar.

Appendix 1.2 – Gegham survey project

The Azat valley (Figure S3)

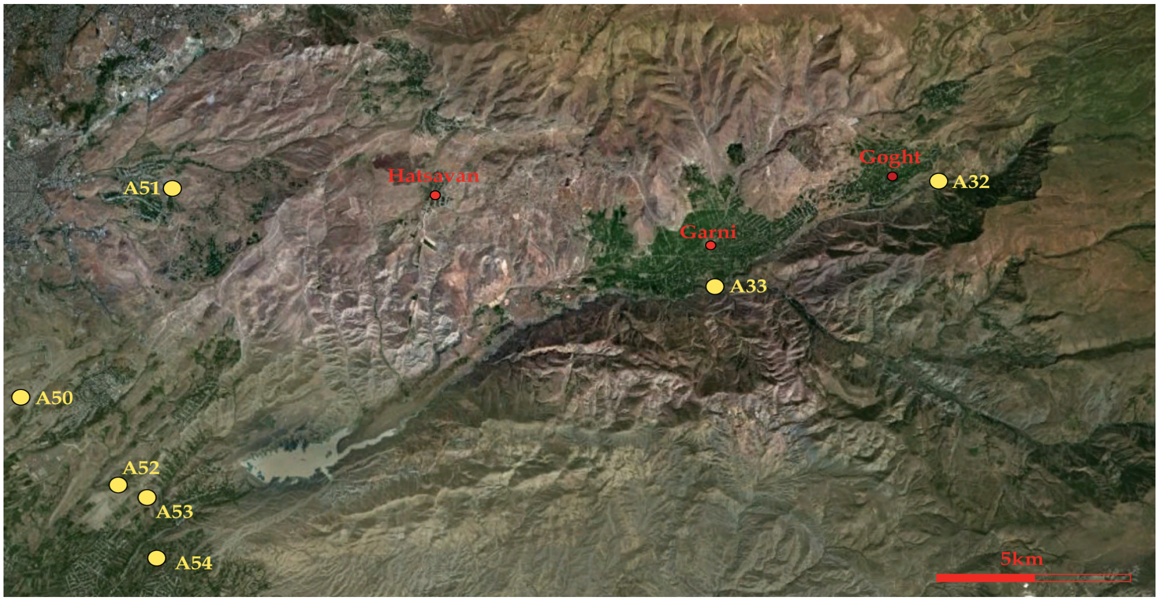


Figure S3: *GPS point in the Azat valley (artifact concentration)*

The Azat hydrographic system is one of the most important in Armenia, with its source directly in the Gegham massif. This valley is known to shelter some of the most famous historical sites of the region, such as the monastery of Geghard and the Roman temple at Garni. The survey in this region focused on the identification of rock shelters and caves in its upper part, and, on its lower part, field transects on the different plateau along the river. Only three caves and one rock shelter have been identified, with no artifacts associated to them.

In the lower part of the Azat Valley, mostly between the villages of Bardzachen and Lanzajat, systematic field transects did not produce any artifacts. However, in the area of Verin-Jrashen, a bladelet fragment in obsidian was found. (GPS A51 : 40° 8'14.38"N 44°34'33.63"E). This bladelet has a few retouch but is not chronologically diagnostic. No other artifacts were found.

The Narek valley (Figure S4)

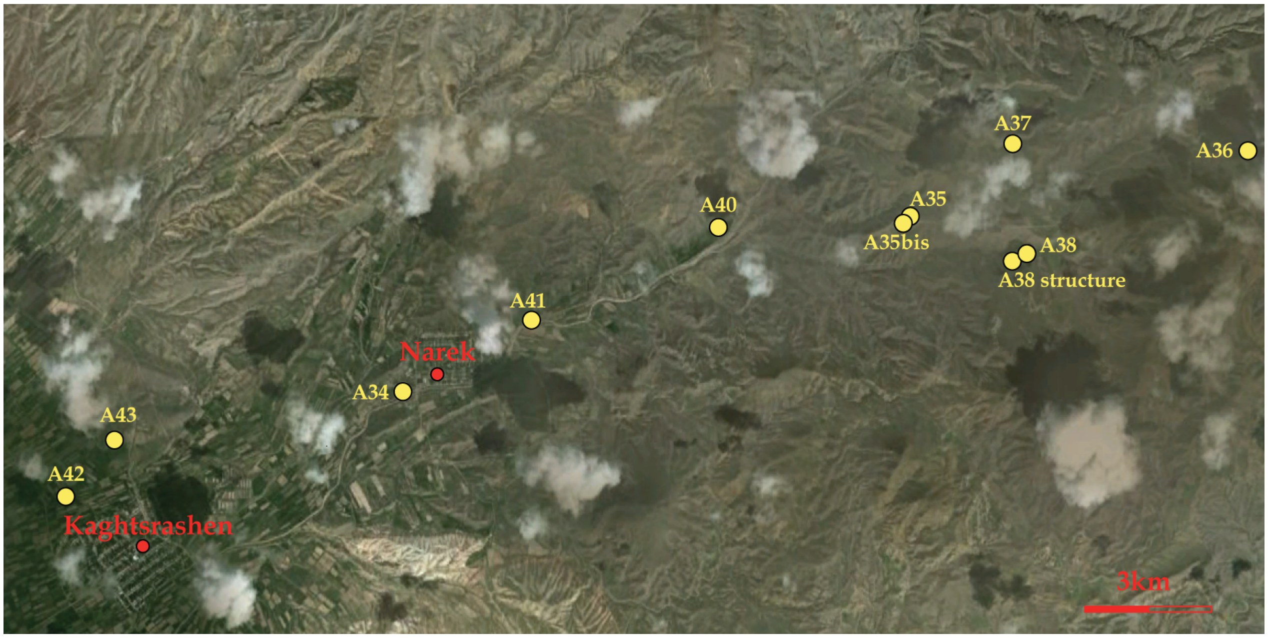


Figure S4: *GPS point in the Narek valley (artifact concentration)*

The source of the Narek River is in the Yerakh Mountain. The survey in its upper course reached the Khosrov State Reserve, where several sites were identified. First, a group of 4 structures was found (GPS A38 : 40° 0'25.49"N 44°44'25.12"E). It is located at 6km E-NE from Nareak, on a plateau above one of the affluents of the river and is made of:

- 1 rectangular structure, with the wall preserved up to 1m, and partially surrounded by another 8m long wall.

- 2 pseudo-rectangular structures

- 1 circular structure on the top of a small hill.

Systematic field survey on this site (around 400m2) led to the identification of 13 ceramic sherds from the early medieval period.

Upper Narek Valley

Another site, in the upper valley, was identified. In this region, the valley connects to an affluent of the Azat River. Two areas were visited (GPS 285 and 286), each showing presence of artifacts. On GPS 286, an important concentration of structures and aligned stones was identified along with a mortar. The pottery sherds were identified as belonging to the historical period (from Urartu to Medieval periods) but were not diagnostic.

The Vedi River (Figure S5) also originates in the Gegham massif. Several areas of this hydrographic systems were surveyed, including the Shaghap Valley, the Urtz and Tasanord area, the Khosrov River, and the main affluents of the Vedi. In the Khosrov Valley, a rock shelter was located (GPS A46) but no material was found on the surface. However, a structure was associated to it, most likely sub-modern. Several kilometers to the east, in the upper part of the valley, a few aligned stones were identified (GPS A7 : 39°57'23.16"N 44°55'2.07"E), but again, no material could be associated to them.

At the confluence of the Khosrov and the Vedi rivers, at about 5km from the Urtsadzor village, several terraces produced a few archaeological artifacts. In A4 (39°56'5.80"N 44°51'24.87"E), several obsidian fragments as well as 9 pottery sherds (Antique, medieval and sub-modern) were found. North to this location, at point A45 (39°57'15.88"N 44°52'23.79"E), on a tell-like formation, another medieval structure was identified, along with a dozen pottery sherds (3 with rims) from the same period.

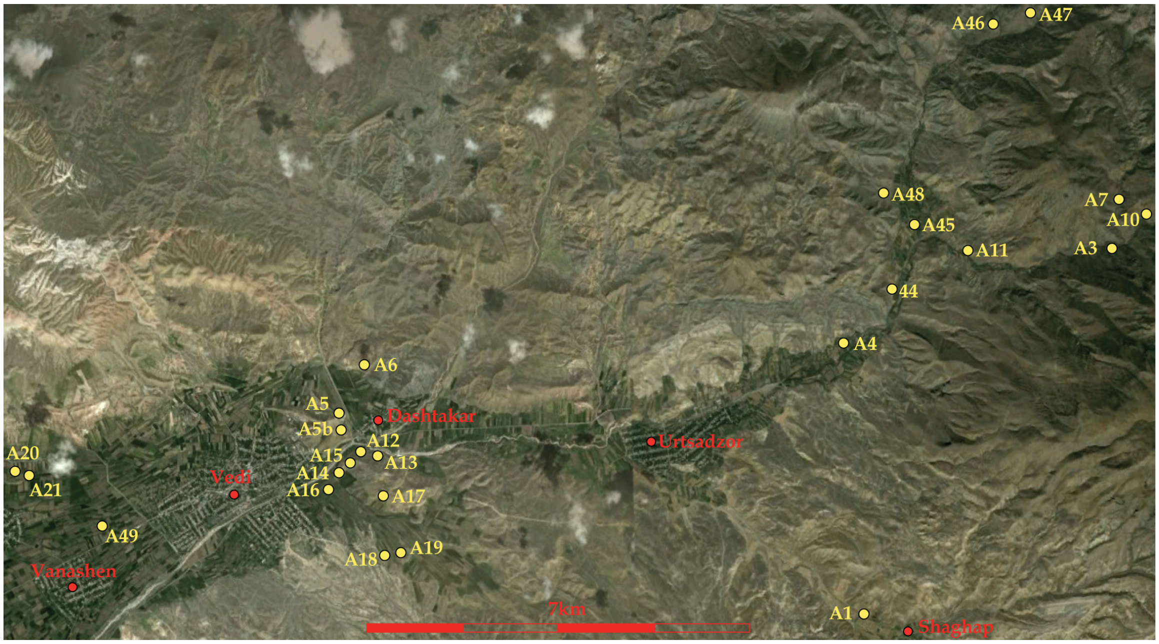


Figure S5: *GPS point in the Vedi valley (artifact concentration)*

in the upper part of the valley, a few aligned stones were identified (GPS A7 : 39°57'23.16"N 44°55'2.07"E), but there again, no material associated to them.

At the confluence of the Khosrov and the Vedi rivers, at about 5km from the Urtsadzor village, several terraces have produced a few archaeological artifacts. In A4 (39°56'5.80"N 44°51'24.87"E), several obsidian fragments as well as 9 pottery sherds (Antique, medieval and sub-modern) were found. North to this location, at point A45 (39°57'15.88"N 44°52'23.79"E), on a tell-like formation, another medieval structure was identified, along with a dozen pottery sherds (3 rims) from the same period.

Shaghap area - This region is located between the villages of Urtsadzor and Shaghap. Field transects retrieved a few sherds, mostly from the Antiquity. At GPS 244 and 245b, two rock shelters were located. In the first one (GPS244), a test pitled to the identification of a well-preserved stratigraphy, along with a lot of material, mostly bones and ceramic.

The pottery belongs to the Iron Age period. In the second rock shelter, although a rectangular structure was found, no material was associated with it (Figure S6).

Figure S6: *Rock shelter in the Shaghap surroundings that yielded iron age ceramic.*

Lower part - An important archaeological potential was found in the lower part of the Vedi Valley. The village of Dashtakar is located at the exit of the town of Vedi, at the confluence of the Vedi, Kotuts and Barakaghbyur Rivers. The main landscape features here are the two cliffs marking the limit between the middle and the lower part of the river. The Vedi area is already known for hosting a few archaeological sites. Some of the locations were identified during the 2012 season, and test pits were carried out during the 2013 summer, along with the survey of new areas in this region. While the surface collection confirmed the archaeological potential of the area, the test pits highlighted the lack of sedimentation. Overall, this area can be divided into three parts.

First is the northern section. Three sites found in 2012 were tested in 2013. Dashtakar 1 is a rock shelter that is ideally located but that did not produce any archaeological artifacts. Dashtakar 2 is located on top of the cliffs above the town of Vedi. Even though a significant quantity of surface material was found (mostly Bronze

Age pottery sherds, as well as several obsidian flakes and 1 obsidian striking platform) (Figure S7), the lack of sedimentation did not allow preservation of archaeological material. However, another area of the site, surveyed in 2013, led to the identification of more Bronze Age pottery, along with Iron Age and possibly Urartu artifacts. There again, there was a limited amount of sediment on top of the bedrock. At the other end of this geological formation, we identified a concentration of pottery sherds (Vedi 1), two of them having been attributed to the Chalcolithic period. Finally, the site of Dashtakar 3, which produced a lot of surface material associated with the Bronze Age in 2012, was tested but there was too little sediment left.

Figure S7: *Pottery material from Vedi area, bronze age (A14_2/3 ;A14b_2_ and medieval period (A16)*

The second part is located north of Sisavan. Several fields transects reconstructed several concentrations of artifacts yet unidentified. A test pit was dug on top of a tell-like concentration (Sisavan 1 or tell Sisavan GPS A21 : 39°54'54.43"N 44°40'27.86"E). This place is locally know as Vedii Blur and is a 300x100m tell. Three holes were dug on top of the tell, which the locals attribute to looters looking for gold. On the surface, several artifacts as well as aligned stones were found. An interesting sedimentation was identified (at least 1.5m) with at least two layers, one medieval, and another that only produced faunal remains along with a red flint flake with use wear. On the S/SE part of the tell, systematic transects gathered several medieval pottery sherds, 6 obsidian flakes (possibly 3 ecofacts), and 1 striking platform fragment.

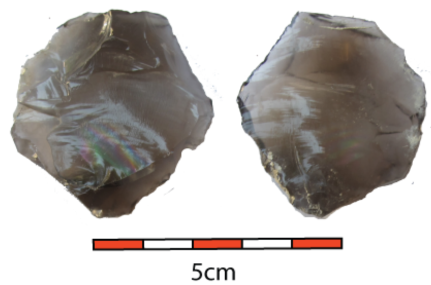


Figure S8: *Striking platform from Dashtakar 2*

On the other side of the Vedi River, another cliff connected to the Urtz Mountain produced a lot of artifacts, leaving no doubts about the presence of an archaeological site at GPS points 14 and 15 (39°55'1.68"N 44°44'55.97"E and 39°54'53.89"N 44°44'45.68"E, respectively). A preliminary surface collection, focusing solely on diagnostic elements, led to the identification of 8 Bronze Age pottery sherds, 1 Iron age sherd, and 1 obsidian flake. No structures were associated to this concentration. However, 2 small-scale test pits carried out in 2013 did not allow the identification of archaeological layers.

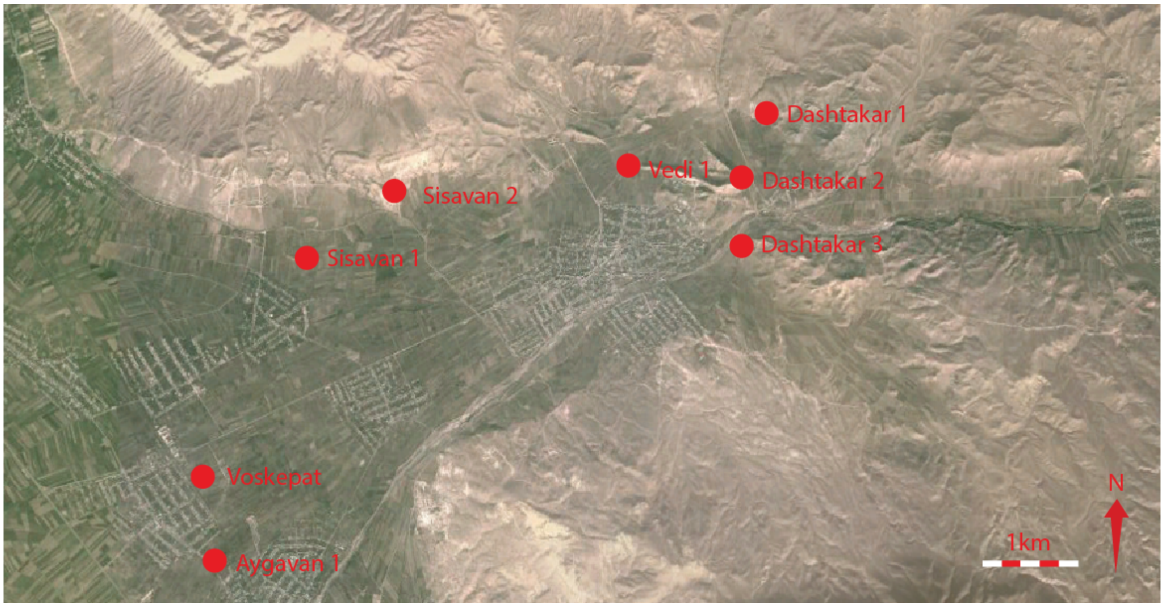


Figure S9: *Potential stratified sites from the Vedi area*

In the northern part of the cliff (GPS 13 0- 39°55'4.07"N 44°45'13.83"E) (Figure S9), systematic field transects were carried out and a small obsidian scraper was found. In general, all the surrounding fields produced medieval ceramics (GPS 16 : 39°54'44.75"N 44°44'37.73"E). Finally, to the southeast of Goravan, a small flake core in flint, as well as a obsidian flake fragment were found at GPS 18 (39°54'4.25"N 44°45'17.80"E).

Figure S10: *Top, medieval rim, bottom large mammal proximal rib*

Figure S11: *Point A21 "Tell Sisavan"*

Ararat village area - A series of survey as well as test pits were carried out in the area of the village of Ararat. On the flanks of the Urts Mountains, we identified several concentrations. First at the GPS points (39°49'36.81"N 44°44'25.70"E) and 56 (39°49'41.17"N 44°44'31.02"E) were identified 1 large obsidian blade fragment, as well as a small exhausted bladelet core. Several non diagnostic obsidian flakes were also gathered along with 3 pottery sherds.

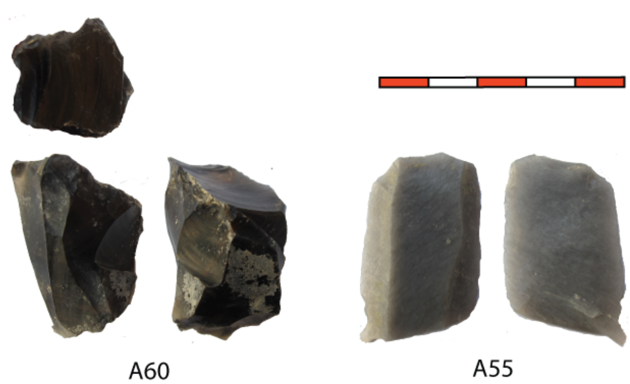


Figure S12: *A60, bladelet core, A55, blade fragment*

Figure S13: *A23b, Antique pottery sherd*

Less than 1km NE from this area, 7 circular structures were identified. These are dry-stoned structures with a diameter of 5 to 8 meters. While the superstructure was not preserved, we found that another layer of stones, possibly the base of a wall, was associated to the structure (Figures S14, S15). However, almost no artifacts were found associated with those structures. Only a few flakes were collected on the surface.

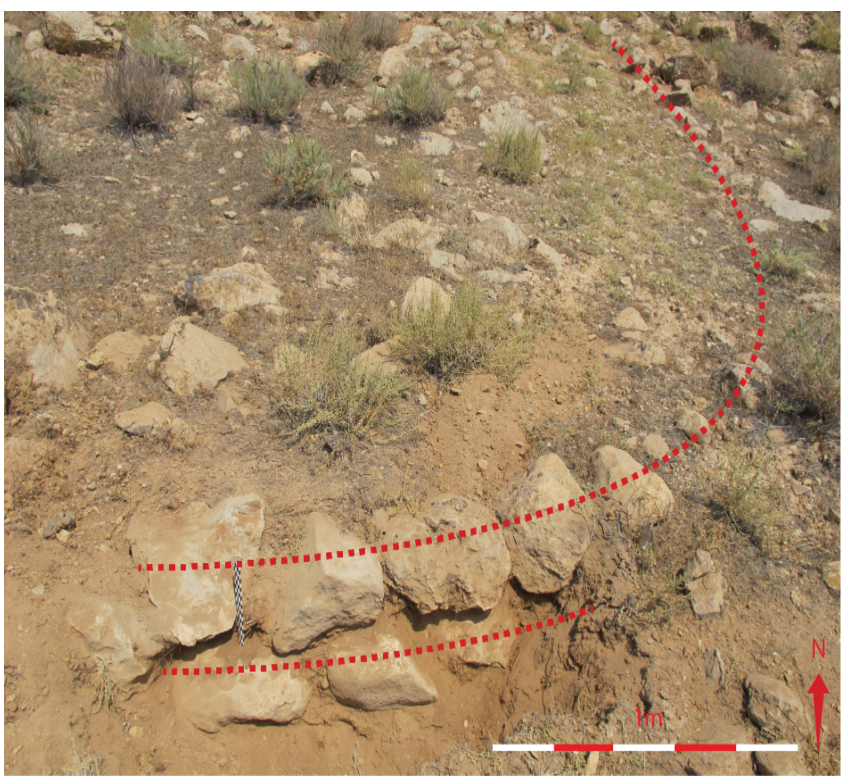


Figure S14: *Round structure in the Ararat area (A59)*

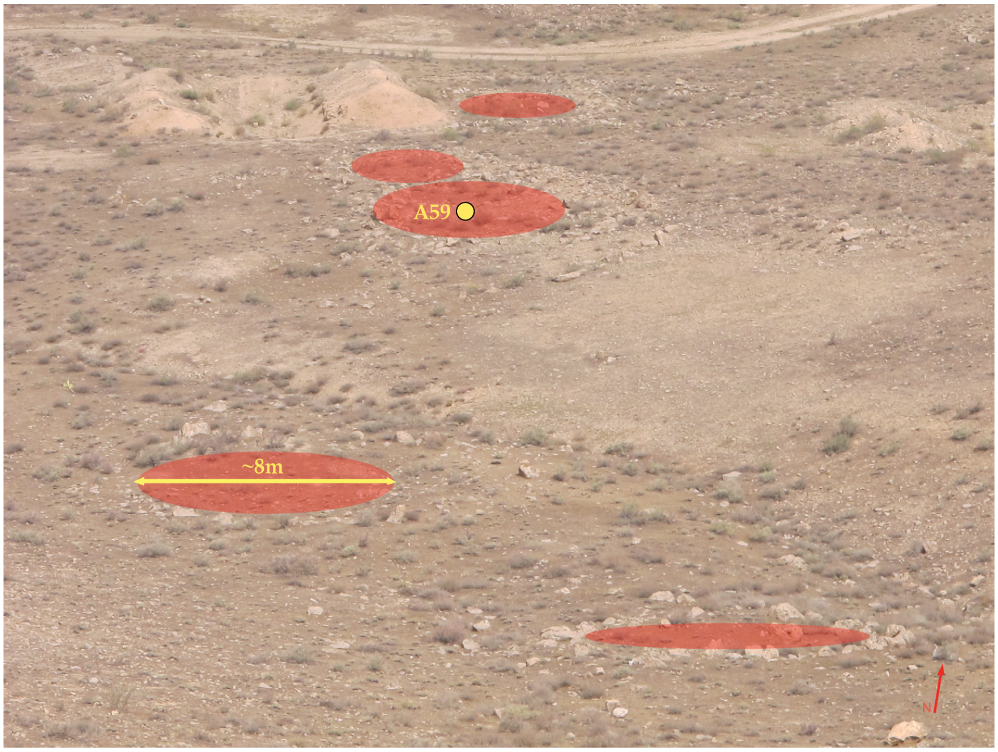


Figure S15: *GPS poin A59, groups of round structure*

Dvin - Several fields were surveyed in the area of Dvin, and Verin Dvin. Two kilometers north of the latter, in the piedmont of the Urtz Mountains, 12 pottery sherds (among which one included a rim and one was painted) were found at GPS A23 (40° 2'10.64"N 44°36'52.71"E), associated to the Antiquity.

To the southeast of this village, we also visited a tell, at GPS A24 (40° 1'1.89"N 44°36'11.17"E), where several rectangular structures, as well as two unidentified pottery sherds, were found.

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The Lanjar area

The Lanjar River is one of the tributaries of the Aratsoget, which meets the Aras River in Nakhichevan. This axis creates the southeastern end of the Urtz Mountains and hosts many valleys, which are sometimes difficult to access. Part of this region has been surveyed in order to identify caves and rock shelters, but several field transects were also carried out.

Figure S16: *Iron Age pottery burned potsherds*

Figure S17: GPS point A250, cave with stratified deposit

In one of the valleys, located between Zangakatun and Urtsalanj, two caves were found and visited. One of them (GPS 250) showed a good amount of sediment and a 1x1m test pit was dug (Figures 16, 17). In about 50cm of sediment, we identified two LBA/EIA pottery sherds, a bovid tooth and several long bone fragments. Furthermore, the entire valley hosts small terraces with structures (most likely pens). This area should be more systematically surveyed, as sedimentation and organic preservation seem better than in the regions previously visited.

Appendix 2.1 – Bavra-Ablari radiocarbon dates

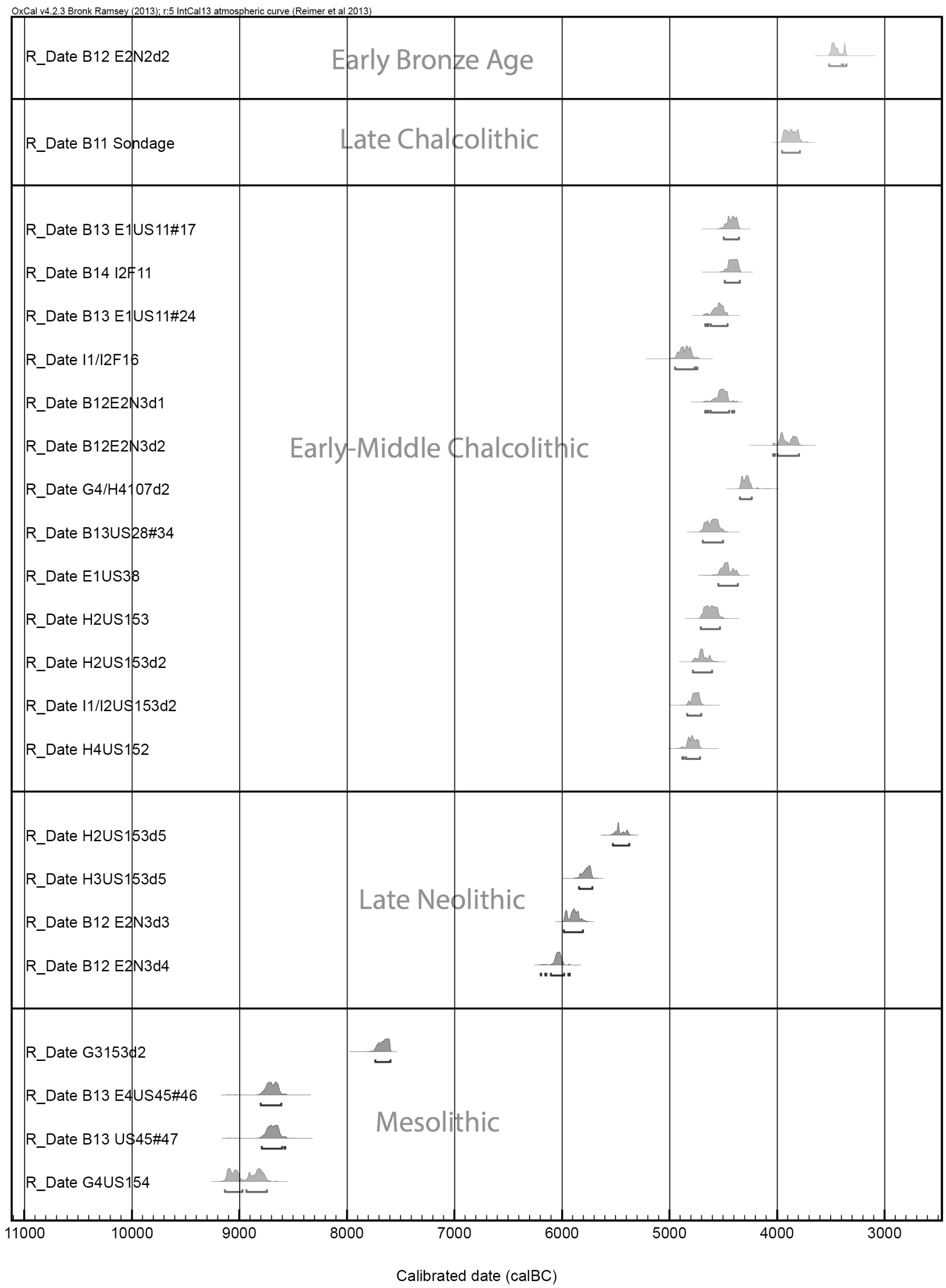

Figure S18: *Bavra-Ablari radiocarbon dates*

Appendix 2.2 – Bavra-Ablari Stratigraphic matrix

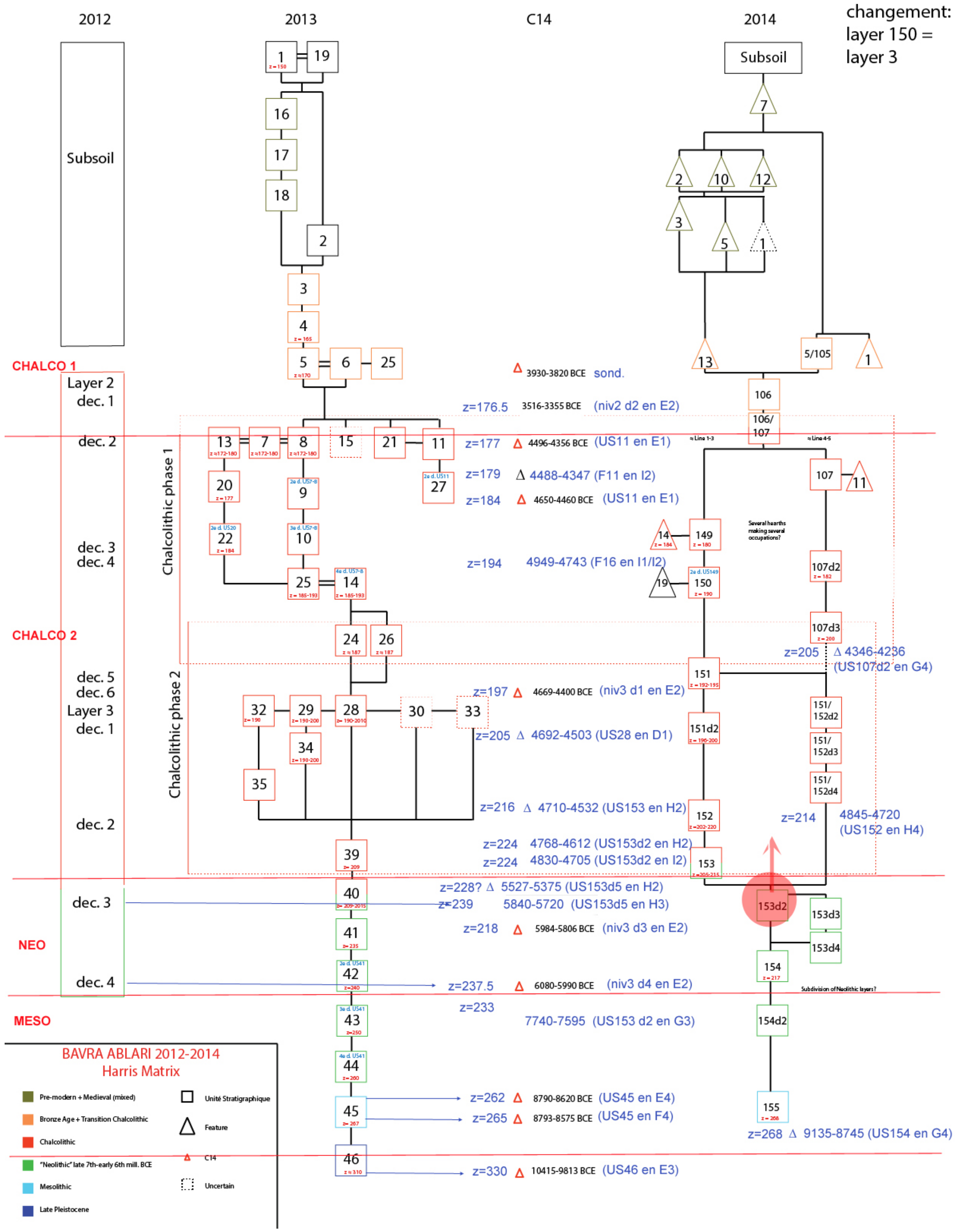

Figure S19: *Bavra-Ablari's Harris matrix*

Appendix 2.3 – Bavra-Ablari. Artefact distribution of the Chalcolithic layer

(Dacite, Obsidienne, Bone)

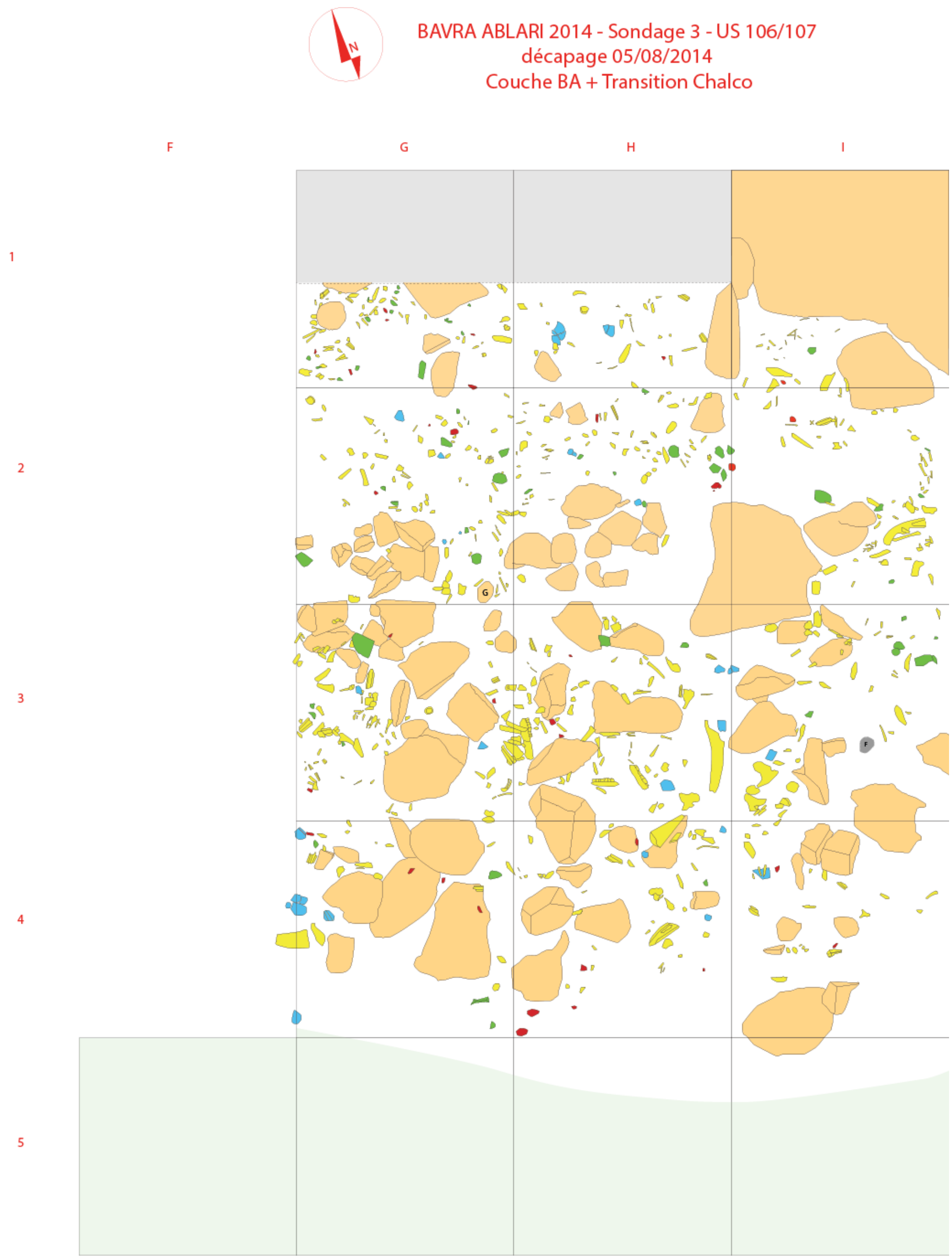

Figure S20: *Chalcolithic layer, artifact distribution*

Appendix 2.4: Bavra-Ablari, Mesolithic and Chalcolithic tools

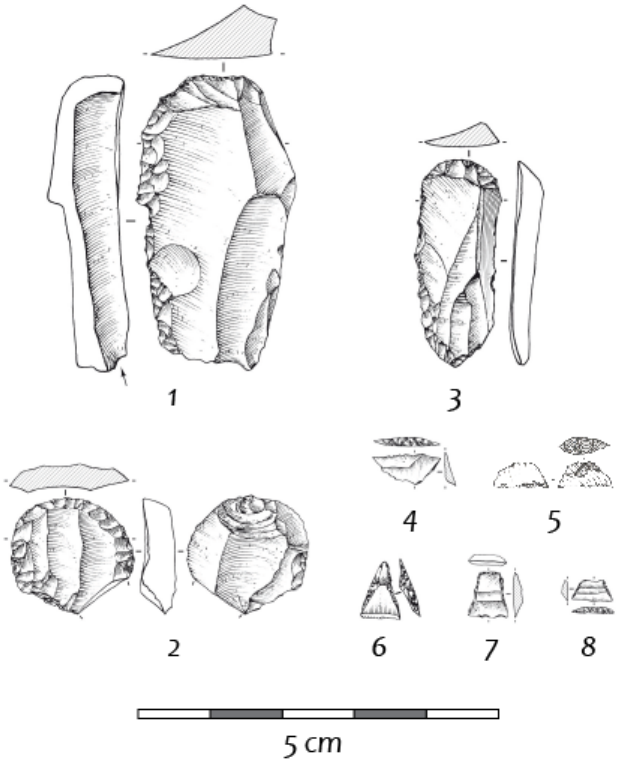

Figure S21: Chalcolithic layer: 1-3: scrapers, 4-8: microliths

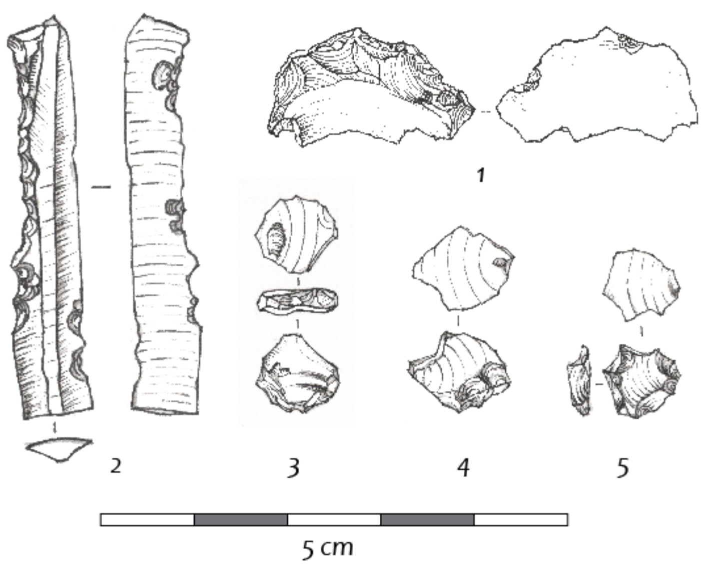

Figure S22: *Mesolithic assemblage: 1, 2-5: bladelet core CTEs (D-shaped and Bullet); 2: partially backed prismatic bladelet (drawings: G. Devilder)*

Appendix 2.5: Bavra-Ablari, Chalcolithic Dacite chaînes opératoires

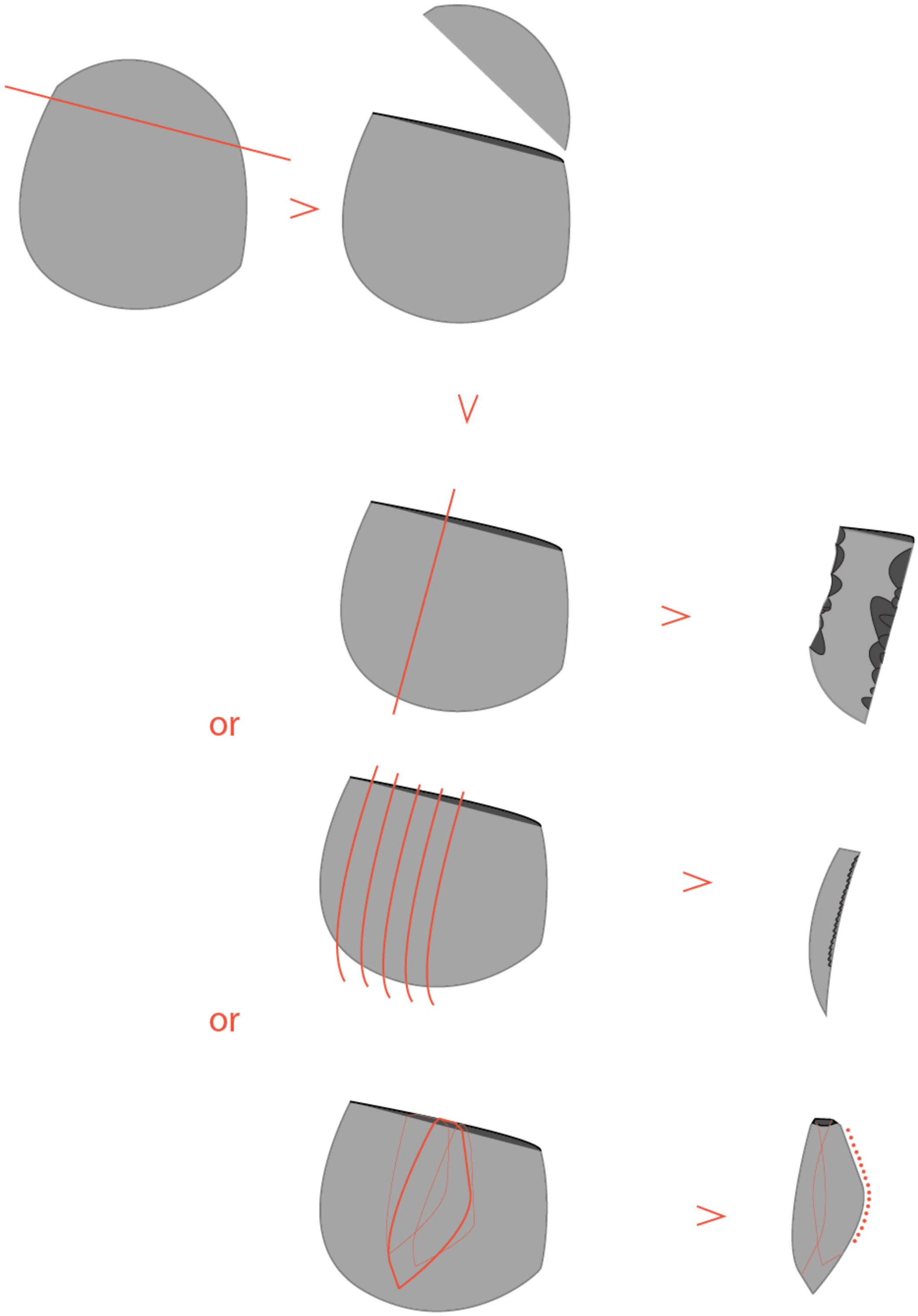

Figure S23: *Bavra-Ablari, Chalcolithic layer, Dacite chaîne opératoire*

Appendix 2.6: Bavra-Ablari: Lithic analysis

Dacite assemblage

The Neolithic dacite industry at Bavra-Ablari seems more curated than the Chalcolithic one. It aims at the production of large implements (bifacial pieces, endscrapers, sidescrapers) (Figure S24). There does not seem to be a preference for one material or the other, except for the manufacture of one long spearhead. However, there is always a higher degree of involvement in the tools made in finer-grain dacite, both in terms of retouch and of the preparation for the removal.

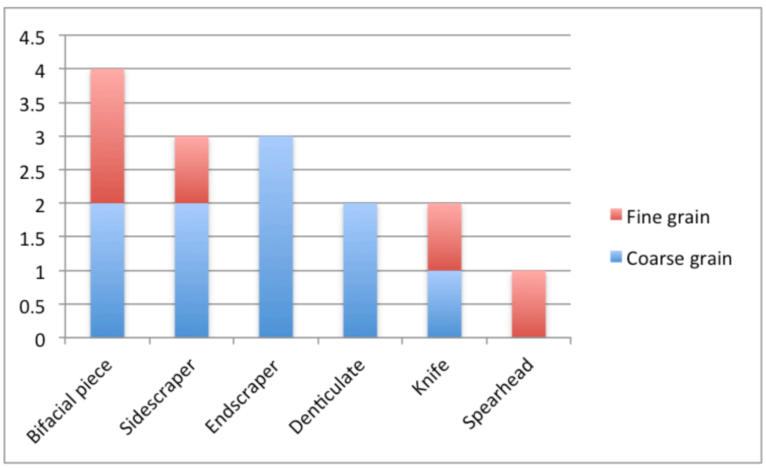

Figure S24: *Dacite use in tools*

Taking into consideration the limitations created by the raw material in terms of creating specific technological features, we have only characterized the use of direct percussion throughout the *chaîne opératoire*. However, we cannot identify differences in soft or hard hammer percussion, but we have found two soft hammerstones associated with this layer that may have been utilized in the retouching stage of the finer-grain dacite tools (Figure S25).

Figure S25: *Fine-grained Dacite tanged point from Bavra Ablari Horizon III*

Technological composition

The coarse-grained pebbles and pebble fragments identified are the same as in the Chalcolithic layers. The cortex does not show any traces of wear, and it seems unlikely these were carried by the Paravanistkali River.

Overall, the assemblage is characterized by a low representation of technical pieces and is characterized by a high proportion of flakes (Figure S26). Tools represent 8% of the overall dacite collection, but finer-grained dacite tools represent close to 50% of the same raw material's assemblage. There are no cores, and only very few core-trimming elements, or pieces associated with management of the core, could be identified. One blade-like flake showed the very rudimentary organization of a crest. There is also one CTE from a pseudo-laminar context, with three negatives of parallel removal on its dorsal surface. It is also possible that some of the large cortical flakes are the result of the opening of the striking platform of the debitage table. Another type of flake has been noticed fairly consistently. The "axe-shaped" flake is generally wider than it is long, and systematically has a broad and high butt with a thin distal end. This flake can either represent the result of a missed direct strike located too deep in the striking platform, the lack of convexity of the core's table, or a conscious choice to reinforce the same convexity in order to drive a longer flake during the next blow.

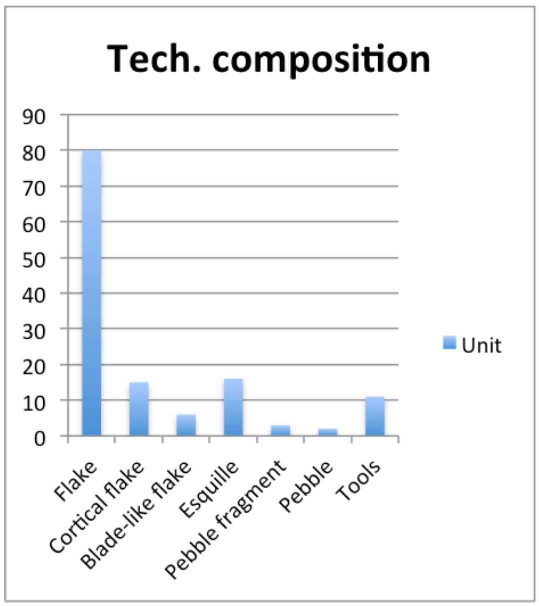

Figure S26: *Technological composition of the dacite assemblage*

Chaîne Opératoire.

The absence of cores and the minimal representation of any elements connected to the *chaîne opératoire* could suggest an off-site production (a scenario that is not supported by the amount of debitage), or a more expedient nature of the process. However, the products are, for the Neolithic, in average, 36% longer than the Chalcolithic assemblage, a difference in length that suggests their creation required a different strategy.

There is particular criteria in the selection in the blocks used. Two different type of nodule are found: round pebbles and rectangular plaques. Both are used in very opportunistic, although mostly unipolar, strategies, following natural angles, scars, and reliefs of the core. There are two ways to manage the convexity of the core. Either some of the existing angles are retouched to produce a pseudo-crest, or a hard blow well inside the striking platform will create concavity that can be exploited for the next flake removal. In some very rare cases (N=4), flakes show traces of preparation (grinding the overhang).

The finer-grain dacite production does not seem to have taken place *in situ*. No byproducts have been found, and the small amount of debitage would support the reconstitution of retouching activities only.

Blank Production

The objective of production for the dacite assemblage is difficult to identify due to the low frequency of tools. There seems to be an effort towards the acquisition of fairly standardized flakes, but only a very small proportion of those actually show traces of retouch. This situation can be explained in multiple ways:

- The inherent characteristic of the dacite does not allow for the identification of use retouch on most of these flakes. Dacite also represents expedient production to supplement the obsidian assemblage, as obsidian is not considered as being practical in butchering activities.

- The clastic properties of the material rarely allows for the production of larger implements, apart from the shaping of a larger flake.

Tool Production

Typologically speaking, the entire tool production is carried out on flakes. The small size of the sample prevents us from implementing a statistical approach, but several observations can be made. The finer-grained dacite uses large flakes to retouch bifacially. The tools are the largest implements of the assemblage, and support a shaping rather than a knapping of this material. It is likely that only these large flakes were brought onto the site. These tools (spearhead, knife, and sidescraper) may have a natural back. They are finely retouched using precise direct percussion, possibly with the smaller hammerstone found associated with this layer.

Tools on the darker dacite feature less retouch and are less standardized. Medium-sized flakes are retouched with direct percussion to produce irregular scrapers. One exception should be mentioned: a large carinated scraper on a cortical flake. The blank here resulted from an opening cortical flake that was shaped through abrupt retouch to create an overall circular shape, with an active edge covering about 50% of the tool. This type of tool has been identified in Shulaveri-Shomu context, but the presence of a single instance here does not warrant any typological parallel for now.

Obsidian assemblage

The Neolithic obsidian assemblage is composed of 522 pieces, largely revolving around the production of bladelet blanks and retouching of bladelets and blade fragment. The tool category makes up 16% of the collection, and only very little cortex is found despite the presence of the Chikiani source only 30km away from the rock shelter.

Assemblage overview

Considering both the side of the bladelet products and the type of material used (obsidian being, by definition, a brittle material), several options have been identified based on the morphological features suggested above. The distribution of butts within the assemblage is fairly widespread. Four types have been identified (punctiform, smooth, linear, and faceted) (Table S1). A punctiform butt is generally one of the features associated with pressure flaking in the context of bladelet production (Pelegrin 2012) but can also be found in other *chaînes opératoires*. However, a large majority of the bladelets also displayed a majority of 2 to 3 parallel scars from previous bladelet removal.

Table S1: *Obsidian bladelet butts*

Facetted	Punctiform	Linear	Smooth
12%	36%	24%	28%

Furthermore, the majority of the bladelets show parallel ridges and straight profiles, generally associated with an indication of pressure flaking (Inizan *et al.* 1995, Tixier 2012). However, I note the lack of particular tendencies noticed in the nature of the bulb, as there is no significant distribution in bulb morphology (see above chart). I would suggest the possible use of pressure flaking technique for parts of the bladelet production *chaîne opératoire*.

No evidence for indirect percussion has been identified. However, soft direct percussion is likely to have been used, as two soft hammerstones have been found, along with a significant amount of linear butts with heavily abraded overhang.

The production *chaîne* is unipolar. However, a few cleaning flakes show evidence of a bidirectional management of the core, generally through a small removal on the distal end of the core that reshape the convexity of the flaking surface.

Technological composition

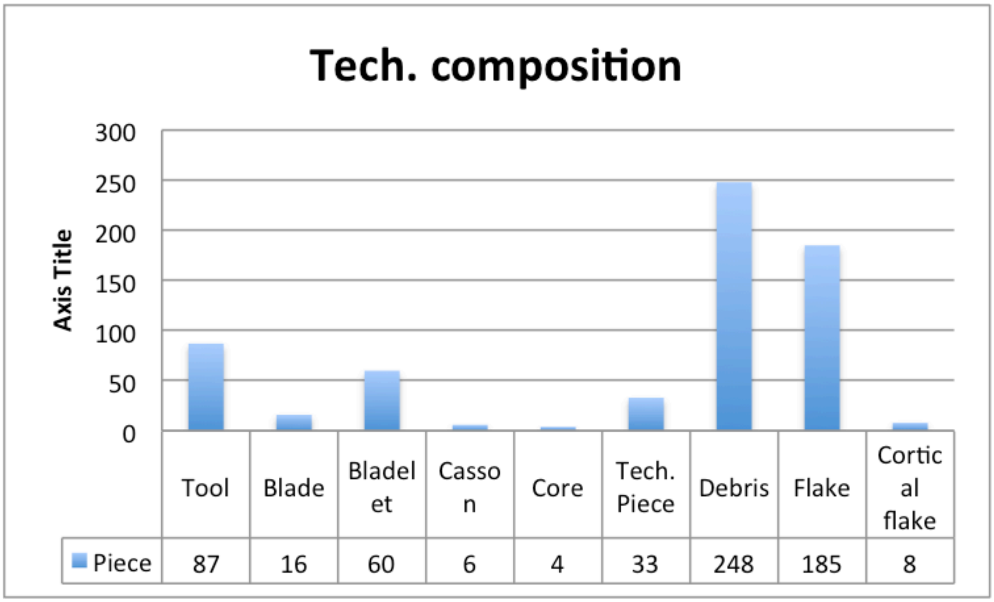

Figure S27: *Technological composition of the obsidian assemblage*

The technological composition (Figure S27) of the Neolithic obsidian assemblage shows a high proportion of tools and a low proportion of cortical pieces. Blades are only represented by blade fragments (see definition above). Evidence of local *chaînes opératoires* is found in the identification of 4 bladelet cores along with 33 technical pieces. These are mostly made of crested bladelet (and neo-crest), CTE (striking platform fragments), side bladelets, cleaning flakes, all connected to the bladelet production *chaîne*.

Chaîne opératoire and blank production

The production on obsidian taking place at Bavra-Ablari was aimed at creating a single kind of product. The main blank is a bladelet ranging from 67x8x3mm to 8x8x5mm, and of 24.7mm length, 10,1mm width, and a mean thickness of 3.7mm. Fragments of blade blanks are present on the site, while cores and by-products related to the production of *chaîne* of this element remain absent. This fact, along with a clear separation in the morphometric features of bladelet and blade manufacture, show that blade and bladelet production were completely separated and that no blade production

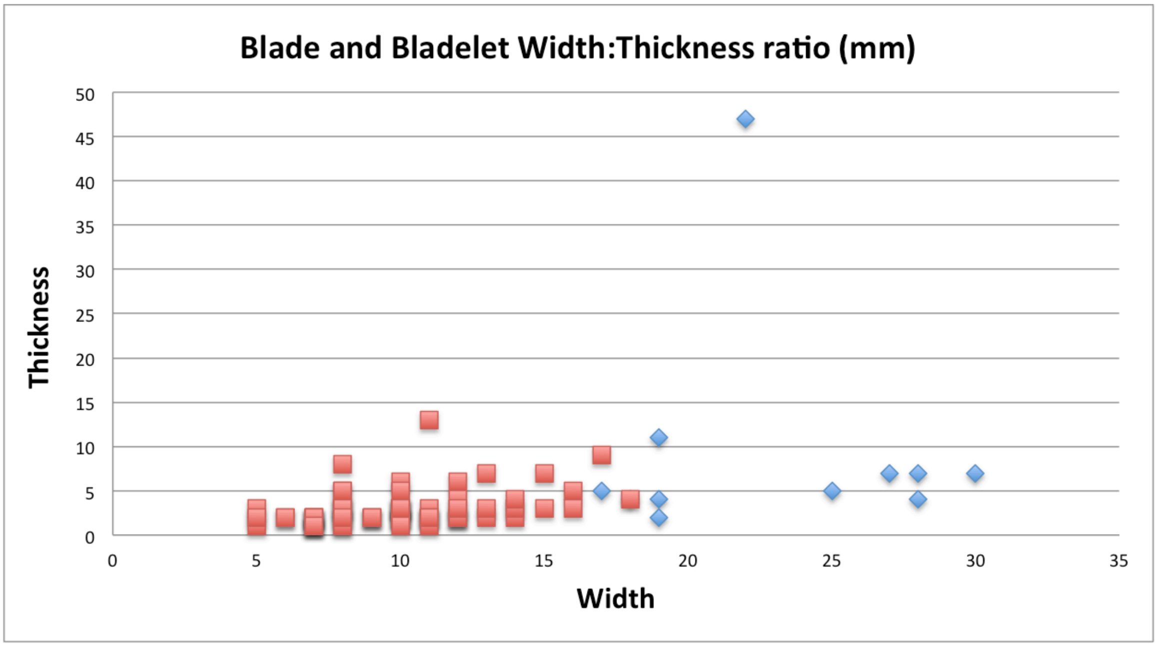

Figure S28: *Blade/bladelet width:thickness ratio (in mm)*

took place on the site (Figure S28). Considering the degree of blank fragmentation, we decided to assess blade/bladelet distribution through width/thickness ratio. The distribution shows two distinct groups and a large, although coherent, range of variation within the bladelet group. This variation illustrates the continuum of the exploitation of an increasingly small bladelet core. One *chaîne opératoire* has been identified for the bladelet debitage. The low number of corteces and large flakes associated with early stages of the production *chaîne* would suggest the on-site exploitation of cores that were already preformed and partially exploited (70 x 30 x 40 mm) (Figure S29).

The early stage of the production required a D-shaped core with an exploitation on 50% of the circumference. The back of the core shows cortex on one occurrence, and several corner-bladelets, which enlarge the flaking surface, show lateral cortex. The progressive reduction of the volume was managed by different strategies. In case of accident, the striking platform was renewed with a thick removal. Accidents occuring on the flaking surface itself were managed through lateral blows leading to creation of a new crest. This way, a knapped could also manage the convexity of the core. Two other strategies could be used to readjust the distal end: either striking bi-directionally, through a distal blow opposite to the main striking platform, or through the removal of a longer, slightly overshot bladelet.

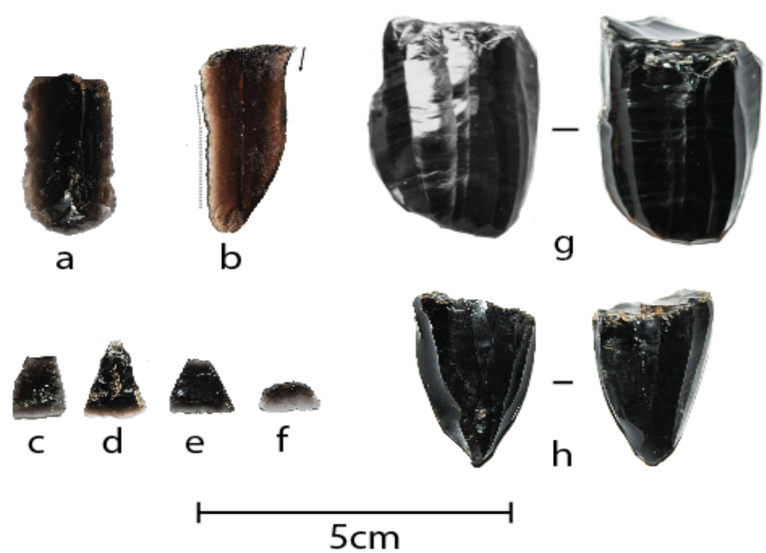

Figure S29: *a, endscrapers, b, aknashen tool, c-f, microliths, g-h, core*

These management strategies led to the reduction of the core and associated products, and were supported by a regular decrease in size of tablets. The exploitation seems to have progressively shifted from semi-turning to circular, possibly finishing in small bullet-core types (as shown by some tablets). However, more technical sub-products must be found and assessed to support this statement.

Among the blanks identified as blades, four fall into the high end of the bladelet range. The other seven show a variation in size, but this can be connected to the origin of the fragment (upper vs. lower mesial, distal, proximal). In any case, all of these fragments are heavily retouched, and no sub-products of the sequence have been identified in the assemblage. They show a range of 1 to 5 very parallel to sub-parallel scars on the dorsal surface from previous blade removals, with a significant majority of the fragments showing two scars (Figure S30). Finally, let's note that the large majority of blade butts are smooth and tend to be nicely prepared with either small removal of the overhang, or sometimes removal of small esquille on the striking platform itself.

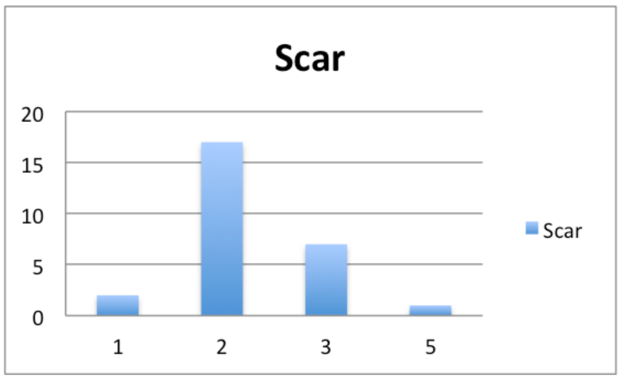

Figure S30: *Scar (n) on blade*

Therefore, none of the operations related to blade production are represented on the site (cores, CTEs, flake size). While it is possible that some of these blades were retouched at Bavra-Ablari, it seems that, primarily, production occurred in another location.

Tool production (Figures S31, S32)

Tool production at Bavra-Ablari occurs on blade, bladelets, and flakes. There is a larger proportion of tools made on blade vis-a-vis the total number of blade blanks than on any other blank category. This is consistent with the degree of retouching identified on the blades.

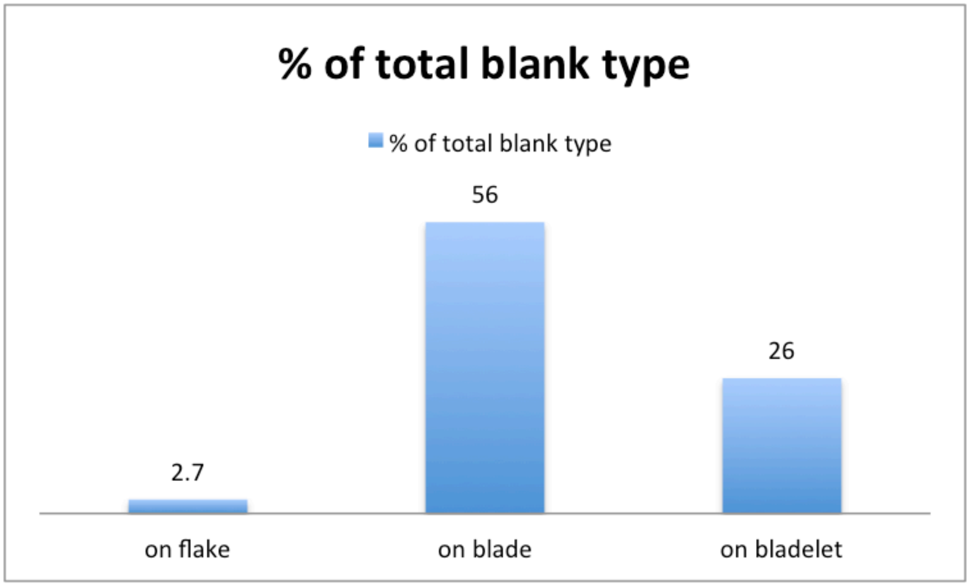

Figure S31: *percentage of tools/blank*

The typology developed is broad enough to remain inclusive and allow inter-assemblage comparison, but it is also focused on the specific type of production taking place in the area:

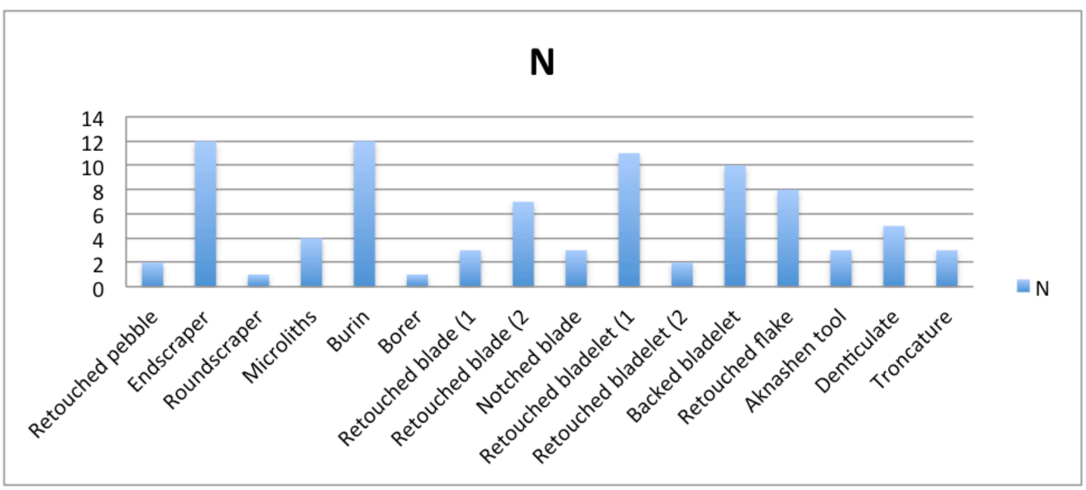

Figure S32: *Tool distribution (n)*

The sample of tools remains limited. However, some tendencies can be suggested. The tool categories most represented at Bavra-Ablari are scrapers, burin, and backed and retouched bladelets. The high quantity of burins is a feature of both Mesolithic and Neolithic assemblages in the region, although they are much more rare in Chalcolithic collections (as is the case at Bavra-Ablari). The low amount of microliths in the assemblage is unusual for a Mesolithic site, contrary to the dominance of straight-backed bladelets in most Mesolithic assemblages. These backed bladelets sometimes show bidirectional abrupt retouch, and in three occurrences, a classic abrupt retouch was carried out on micro-bladelet. These techniques and tools are identified for Epipaleolithic and Mesolithic sites in the South Caucasus, and appear more rarely in Shulaveri-Shomu collections. Finally, I note here the presence of a very typical Kmlo tool in obsidian.

Notes on the Mesolithic assemblage

The Mesolithic chipped-stone assemblage contains only 123 pieces, as layer 4 has only been opened on four squares so far. It is mainly in obsidian (92%), along with some pieces in dacite. As the crow flies, the site is located about 32km away from the only known obsidian source in Georgia (Chikiani), an outcrop that produces excellent raw material and that has been in use since the Lower Paleolithic, as evidenced by the bifaces found in the vicinity of the source

The typo-technological characteristics show an assemblage based on a production of bladelets and small blades. It is most likely that this production took place on-site, as demonstrated by the proportion of by-products and technical pieces that show a careful management of small bladelet pyramidal cores. The element most characteristic of on-site production is the backed bladelet sometimes showing a burin strike in the continuity of the steep retouch. However, while the industry is coherent with a Mesolithic production, thus far there are no clearly diagnostic elements like geometric microliths or micro-burin techniques.

2.7 Bavra-Ablari lithic figures

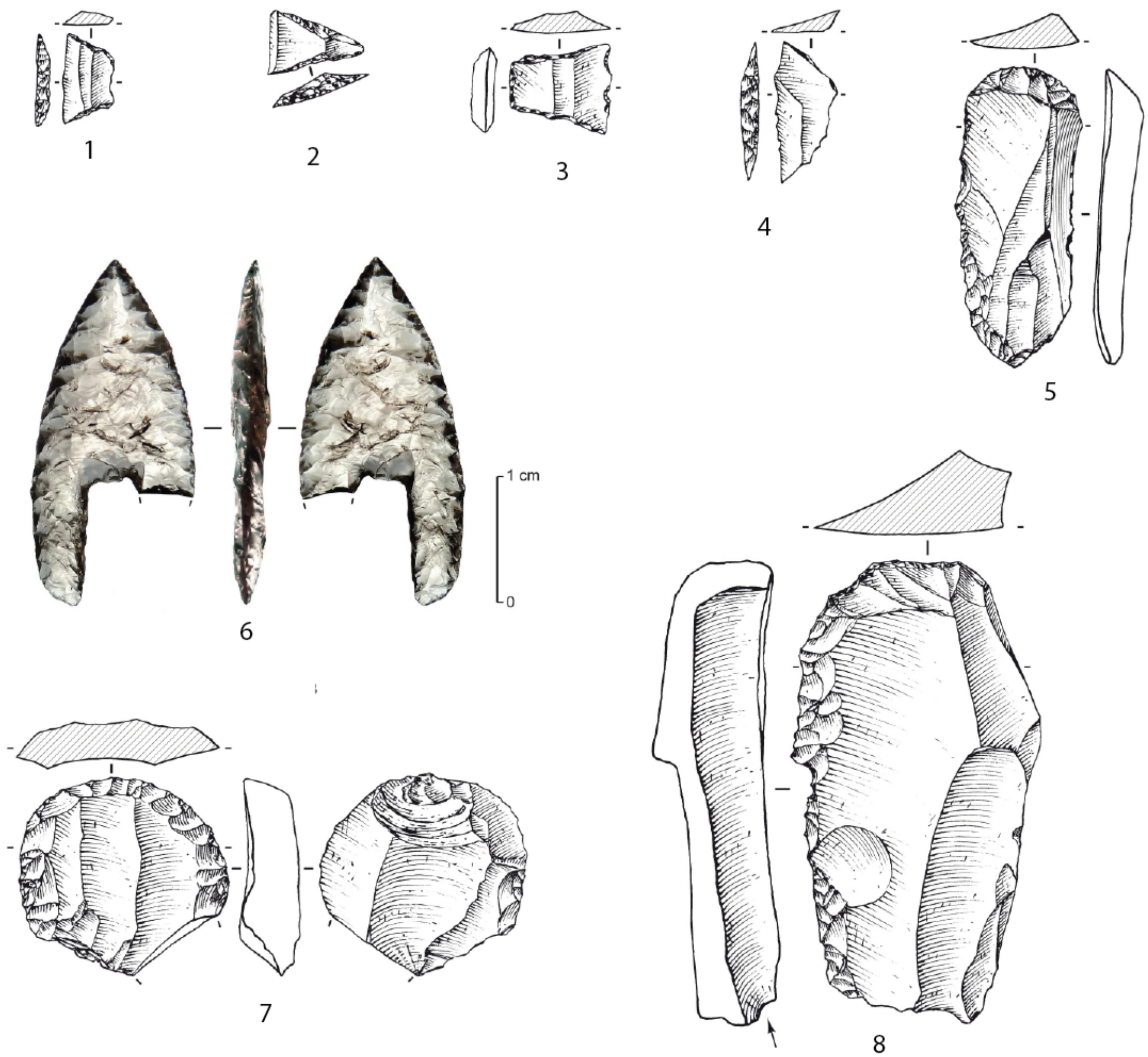

Figure S33: *Bronze Age and Chalcolithic layer assemblage: 1-4, microliths (tranchants); 5,7,8; scrapers on blade and blade-like flake; 6 Bedeni point.*

Appendix 3.1 – Kmlo Lithic analysis

Overview of the assemblage (Figure S34)

The local industry is largely oriented towards the production of small blades and, mostly, bladelets. A large portion of the production sequence took place on the site, as shown by the large number of cortical flake and casson, along with the presence of finished and rejuvenated products. Tools were manufactured largely on bladelets, except for the specific Kmlo tools, which were generally realized on small blades or flakes. The retouched bladelet category, along with backed bladelet and microliths, made up the majority of tools. The non-cortical flakes and non-casson debris were not included in this chart in order to optimize the visibility of the proportions. Flakes and debris amount to 431 and 855 pieces, respectively. The total assemblage equals 1566 pieces.

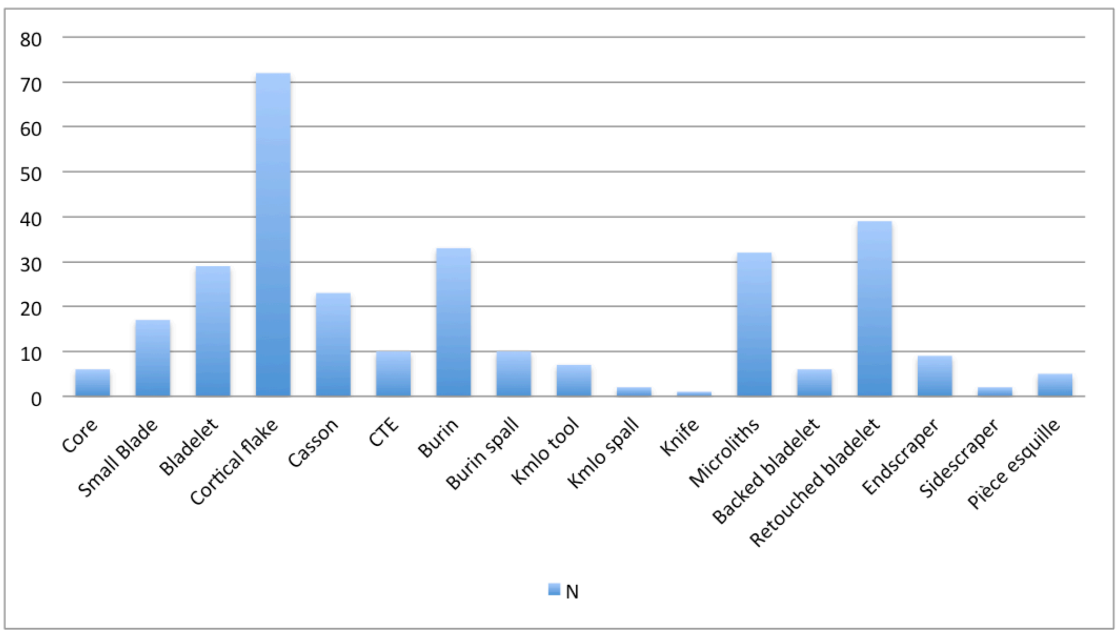

Figure S34: *Kmlo-2 Assemblage distribution*

Techniques identified

The *microburin* is a particular technique that permits the controlled fracturation of a blade, bladelet or flake. It results in a pointed, beveled fracture that is particularly suitable to the manufacture of microliths. Identified as early as the late 19th century (Chierici 1875), the use of this technique has since been identified in many assemblages, mostly Epipaleolithic, in the Old World (Rozoy 1968, 1971). There are some problematic aspects connected to its identification in archaeological assemblages, as it appears similar to a Krukowski microburin, which represents an accident that generally takes place in the course of the backing of a blade or bladelet. Distinguishing the two thus requires the identification of the several steps of the microburin sequence that show an effort from the knapper to obtain this type of product: first, an archaeologist must account for a significant frequency of these microburins within the assemblage (Henry 1974:189). Then, he or she should assess how the blank thus created, used, or retouched. Finally, he or she must identify the original notch as well as the proper beveled fracture.

Following these criteria, 21 microburins (and 2 possible microburins) have been identified in the Aceramic Neolithic assemblage of Kmlo-2. All of the microburins were retouched to produce microliths, and they amount to 65% of the microlith blanks. However, we have not found any significant difference in the length/width or width/thickness ratios of the microliths manufactured using microburin technique or through other techniques.

Several small, soft hammerstones were found throughout the layer. Considering the clastic properties of obsidian, these small implements would have been very appropriate to exploit small cores. The pressure flaking technique is already illustrated by the Kmlo tools (Figure S35). In this tool, that particular type of long, regular, parallel retouch can only be achieved through the use of this technique. However, looking at several possible characteristics that define pressure flaking for bladelet production, the identification of this technique is unclear. There is no significant distribution in types of bulbs. These are characterized by volume (1: low, medium 1, medium 2, marked) but are equally distributed for both bladelet and small blades. However, analysis of the bladelet butts shows a majority of punctiform butts generally associated with pressure flaking (Figure S36). The overall degree of preparation of the overhang and the striking platform is high. Furthermore, smaller bladelets demonstrate a lower degree of regularity both in terms of the shape and parallelism of the edges. This situation could be explained by the flintknapper's switch from pressure flaking, used during the main exploitation of the core, to soft direct percussion towards the end, as the immobilization of the core for pressure flaking became more problematic.

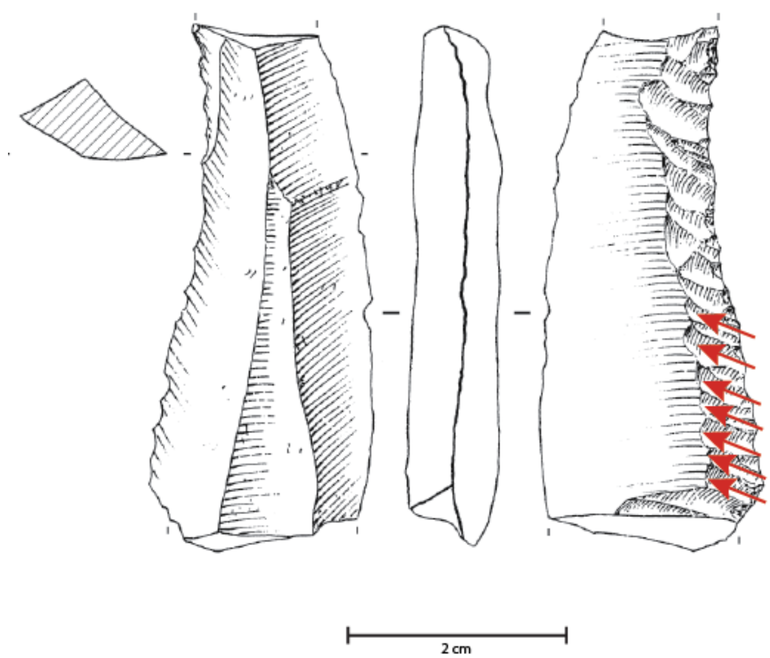

Figure S35: *Parallel pressure flaking on Kmlo tool (Kmlo-2)*

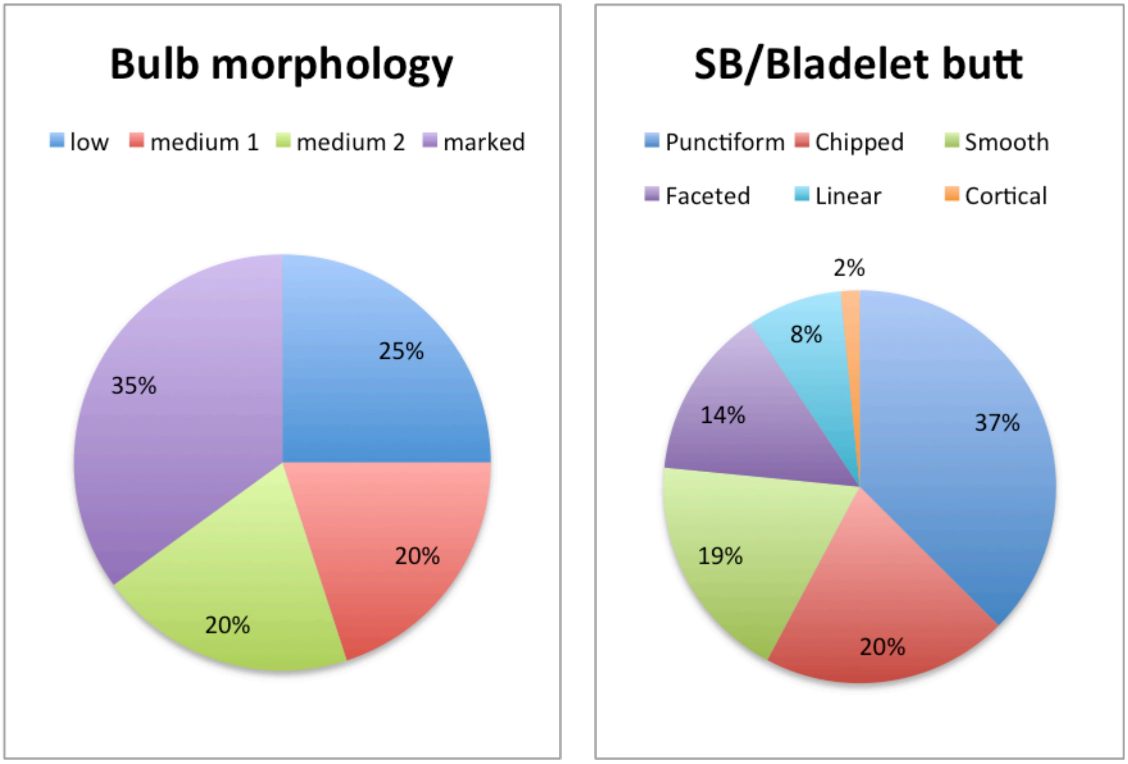

Figure S36: *Bladelet bulb and butt morphology*

Technological Composition (Figure S37).

The technological composition of the Horizon III collection shows a standard representation of the different elements involved in the *chaîne opératoire*. In this collection, there is significant proportion of tools (18%), cortical flakes and bladelets (10%). The tool category involves products realized on blades, bladelets, and flake blanks. The debris, characteristically high for obsidian production sequence, was not taken into consideration in this chart, but the non-retouched flakes amount to 60% of the collection and emphasize an important flintknapping activity taking place on the site. This is supported by the presence of technical pieces (N=27). While not present in great quantities, these pieces represent most steps of the production sequence, except possibly the final stages of rejuvenation and discard.

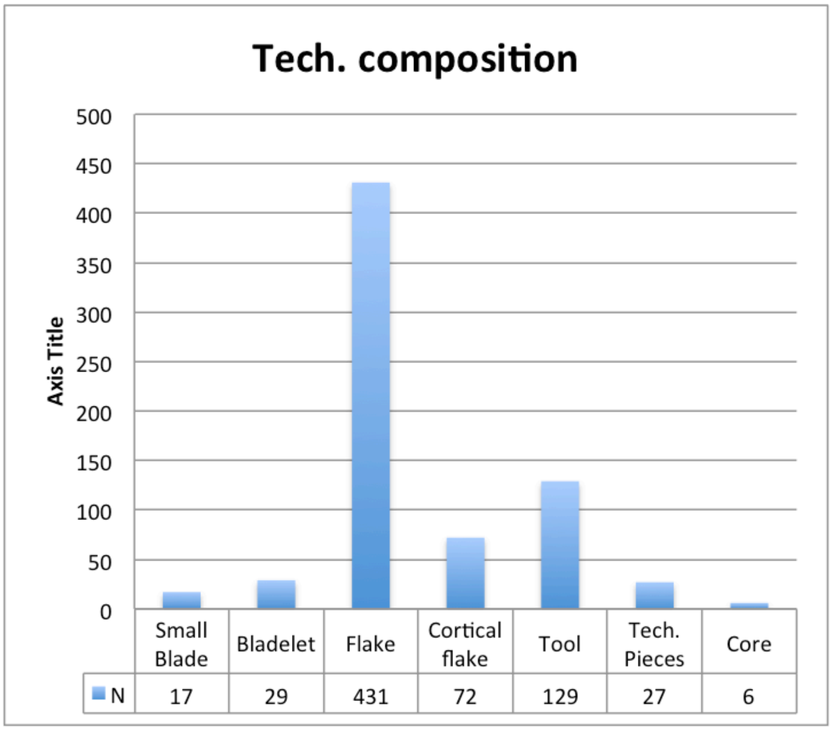

Figure S37: *Technological composition*

None of these propositions are unexpected, considering the location and nature of the site. Kmlo-2 is a temporary rock shelter located close to primary or secondary sources of obsidian. There is an abundance of obsidian by the site, and more sources are integrated in the itinerary of these mobile groups. In a *chaîne opératoire* involving specific knowledge and know-how, raw material is managed as an abundant resource. Therefore, despite evidence for on-site production, the relatively small proportion of technical pieces, accident repairs, or rejuvenation could support the idea of a medium to low investment in the technical process.

Chaîne opératoire and blank production.

The layer III industry at Kmlo-2 is organized around the production of bladelets through the unipolar knapping of single-platform cores (although bidirectional knapping is also occasionally encountered). The raw material is, as mentioned earlier, brought to the site as pebbles or as a final product, depending on its origin. The maximum size for a product (all categories) is 59 x 15 x 4mm. Core measurements are generally found between 32 x 23mm and 31x34mm, and cortical flakes are kept under 40 x 30mm, so the pebbles themselves are expected to be less than 10cm long and 5-8cm wide (Figure S38). Furthermore, cortical flakes make up 36% of the total flake assemblage, and 21% of this category are fully cortical. In addition, as 70% of the obsidian comes from neighboring sources, we expect that the large majority of the material was brought on site in the form of these pebbles.

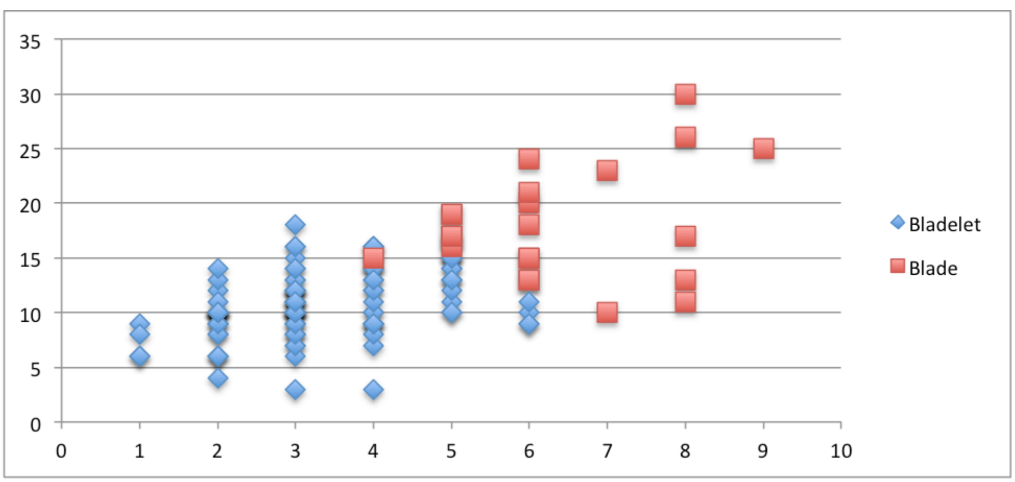

Figure S38: *Blade/bladelet width:thickness ratio (in mm)*

For complete bladelets, length varies between 24mm to 52mm, width from 7mm to 21mm, and thickness from 3mm to 12mm, with means of 34.8mm, 12.5mm, and 5.6mm, respectively. The means collected for width and thickness on complete bladelet are respectively 20% and 40% higher than those originally collected on broken elements.

The results are biased by the origin of the fragment (proximal, medial, distal). Our results show that measurement taken on proximal fragments of bladelet were closer to the ones on complete bladelets, and the assessment of the width ratio for all the assemblage has thus been based on this type of fragment. The width ratio scatter for both small blades and bladelets supports the existence of one single sequence of production for both products, where morphometric difference would then be the result of the decreasing size of the core. Bladelets have an average of 2.4 parallel scars, blades an average of 2.9 scars. For the blade, the number of scars ranges from 1 to 6, and 64% of the blade have 3 parallel scars. For the bladelet, the number of scars ranges from 1 to 4. In this group, 55% of bladelets have 2 scars, while 35% have 3 scars. However, several elements, including core and bladelet morphology and morphometry, core management strategies, striking platform preparation, and proportion of blanks used for tool manufacturing, suggest a particular focus on this bladelet production.

Six cores were identified in Layer III, including 4 bladelet cores and two flake cores. The four bladelet cores are broadly D-shaped and show a semi-turning exploitation. One of the cores is exhausted but, as with the 3 others, still has some cortex on one of its surface. Besides the exhausted core, there is a remarkable similarity in the morphometry of the 3 other cores. The exhausted core shows evidence of bidirectional management of the core, although there is a principal striking platform from which all the products are detached. The negatives of previous removals are less similar than those of the other bladelet cores, an observation we have already made on the smaller category of bladelets themselves.

This focus on bladelet production is also implied by the amount and nature of technical pieces associated with this stage of the production sequence. Three neo-crested blades (secondary crested blades) fit the mean bladelet size and were created to resculpt the convexity of the flaking surface. Five twisted bladelets were found in the assemblage. In some situations, these bladelets can be transformed for different uses, as seen with Dufour bladelets (Lucas 1999), but in this instance they seem to fall within the normal variation of bladelet production.

There is variation in the overhang treatment and preparation of the striking platform. While the involvement in this behavior seems to remain low, there is evidence for specific care in a dozen bladelets. The preparation generally consists of an abraded overhang, or even the removal of small flakes and facetting of the butt. This preparation also largely takes place on parallel bladelets, which suggests a correlation with the use of pressure flaking technique for their procurement.

Tool production.

Despite the large number of retouched blades in layer III, the majority of blanks used for tool productions are bladelets. Blades are generally used for Kmlo tool production, or for simple retouch (direct or inverse, but generally irregular and discontinued). Retouched bladelets identified are generally mesial fragments, while retouched blades tend to be mesial and distal fragments. Another aspect in support of a more expedient blade production, as a necessary early step of a *chaîne opératoire* dedicated to the production of bladelet, is the width/thickiness distribution of non-retouched blades, retouched blades, and bladelets from both categories. The chart shows that blanks generally selected for retouching are located on the lower morphometric side of the blade ensemble. These blanks act as a transition towards the bladelet format. Indeed, aside from their use for Kmlo tool manufacture, some of the tool categories, including burins, are equally shared between blade and bladelet blanks (Figure S39).

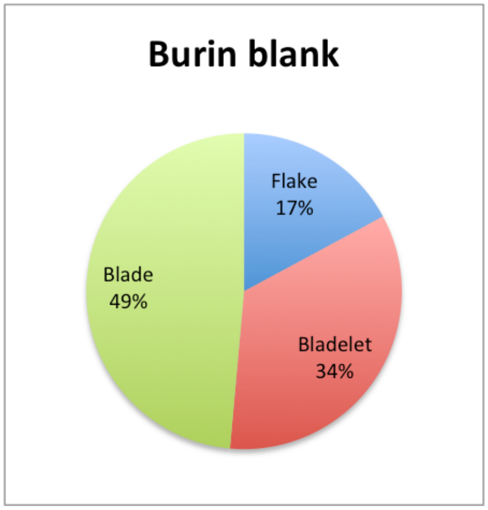

Figure S39: *types of blank on which burins are carried out*

The tool distribution (Figure S40) shows a relatively low importance of scrapers compared to the microlithic tool categories. Endscrapers are carried out on the distal end of the fragment blade or bladelet, except for one proximal example. Sometimes, the retouch extends onto one or two edges of the flake. The two sidescrapers each involve one large cortical flake with a natural back that could possibly fit in the knife category, showing a regular abrupt retouch. Burins make up the largest tool category at the site. The largest proportion of burins is realized on small blades, and the entire production is a straight angle burin, with the exception of two examples of *dièdre d'axe.* Eight burins are made on a retouched blank, upon which the retouch took place before the burin strike.

Among the most interesting tools is the Kmlo tool (N=7). Kmlo tools are realized on blanks that are slightly thicker than the average (7.2mm vs. 6.3mm) and are often truncated or snapped. The retouch, coined "Kmlo-2 retouch" (Arimura comm. pers.) is straight and long, and may be direct or inverse. However, it is always regular and continuous, with an average of 7 retouch/cm of edge on one or two sides of the blanks. This level of definition requires the controlled application of pressure flaking and a systematic preparation of the small striking platform (i.e., the edge). Microwear analysis carried out by L. Astruc (ArScan) suggested the presence of heavy abrasion on the tools, possibly connected to their use on wooden material. Their Turkish counterpart, the Cayonu tools, generally have been applied to the making of stone-bowl objects or bracelets (Astruc et al. 2011). Some of these tools show traces of rejuvenation by the removal of one of the retouched edges with a burin strike, creating "Kmlo spalls."

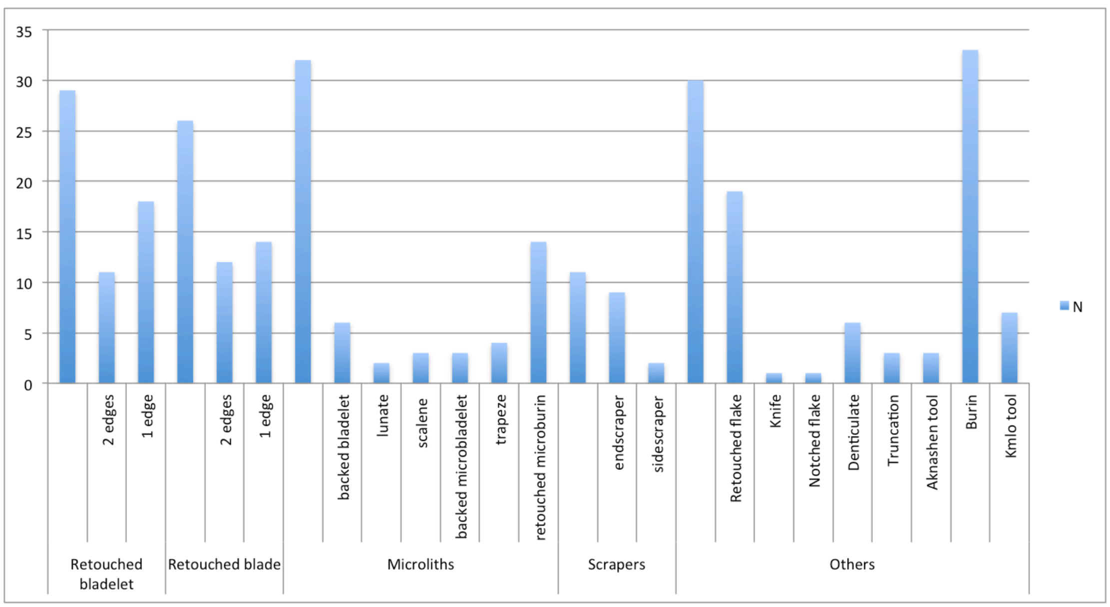

Figure S40: *Retouched edge/tool type (n)*

Discussion

Only one *chaîne opératoire* was identified in the layer III of Kmlo-2. It is based on the exploitation of small obsidian pebbles, and is largely for the purpose of the production of bladelets measuring, on average, 35 x 12 x 6mm. This *chaîne opératoire* requires only minimal initial preparation of the core. The first stages of exploitation lead to the production of larger products, small blades, and blade-like flakes, all of which are used in the production of Kmlo tools. The bladelet production constitutes the focus of the manufacture sequence and involves pressure flaking technique, requiring more careful management of the core convexity and preparation of the striking platform.

3.2 Kmlo lithic figure

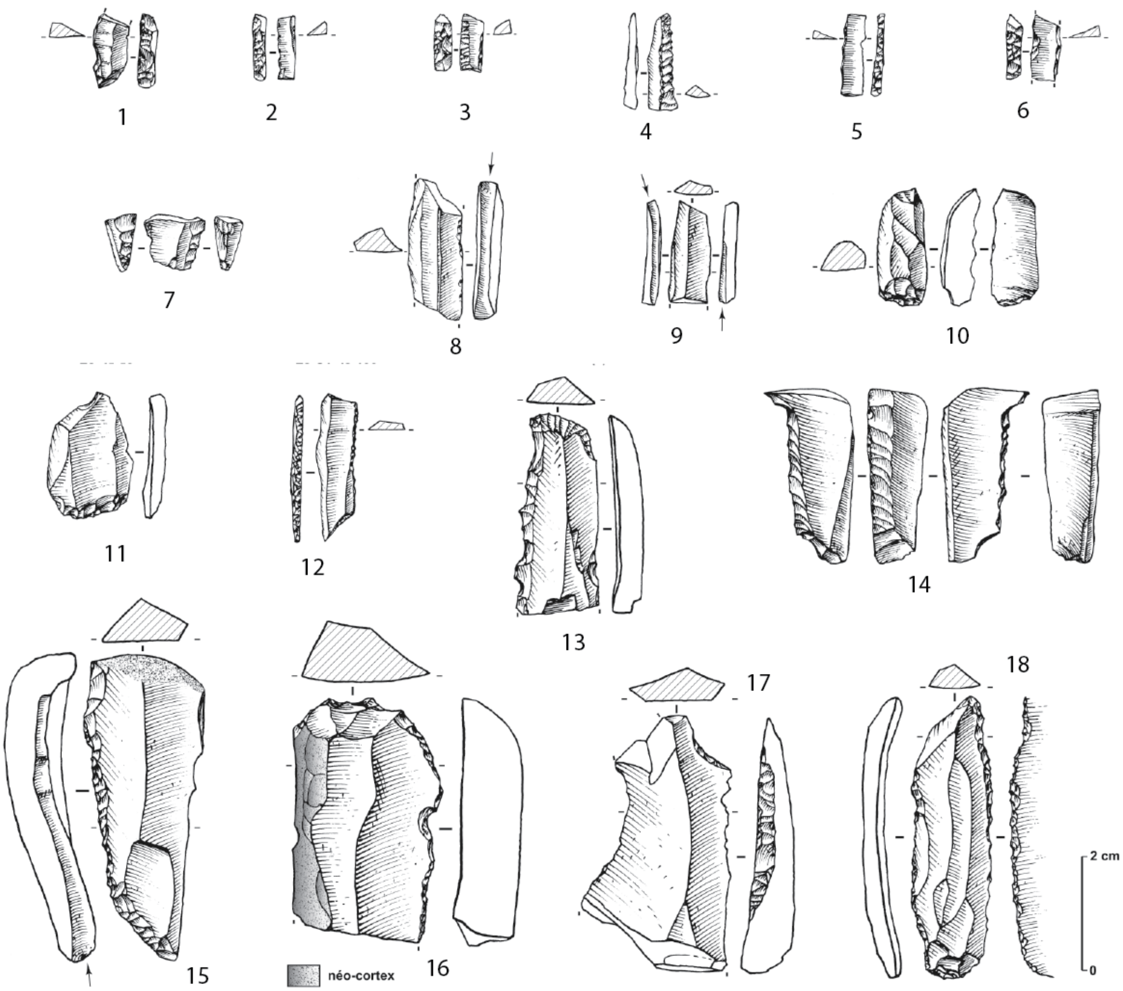

Figure S41: *Kmlo-2 assemblage: 1-7, microliths; 8-9, burin; 10-11, micro-burin; 12, backed bladelet; 13, endscraper; 14, Kmlo tool; 15-18, retouched blade-like flake*

Appendix 4.1 – Aknashen-Khaturnakh lithic analysis

The range and complexity of techniques identified at Aknashen requires some clarification about the features used to characterize them as an archaeological assemblage. The identification is based on several experiments carried out by flintknappers and lithic analysts over the past century, all of whom have contributed to the constitution of a solid set of data (Tixier, Crabtree, Inizan, Titmus, Pelegrin, Hirth, among many others). Considering the size of the blanks considered, we focus here on the identification of three possible pressure flaking techniques for bladelet and blade production (Modes 3 to 5 in Pelegrin 2012:467-470) as well as indirect percussion. Some of the characteristics generally associated with use of crutch or lever involve significant presence of a lip, variations in bulbar scars and bulbar morphology (with a higher representation of diffused bulbs), parallel and rectilinear ridges, straight blade profile (at least until the mesial/distal connection), constant thickness, and lower occurrence of ripples on the ventral surface of the product. However, the impact of the type and position of the core-holding device on these characteristics is still not properly understood (Pelegrin 2012). Evidence for such devices can be small abrasions or bidirectional removals on the distal of the core. The width of the blade can also be seen as a possible indication of their use, as longer products will generally need to be wider. Most of the following techniques will create these similar characteristics, but differences can be identified in the morphometry of the product and in specific features connected to the use of copper point or an antler punch.

The quantitative identification of technique could be carried out solely on layer V, which provided a sample large enough for such approach. Only qualitative suggestions can be made for the layers VI and VII. Indeed, the blades selected for the identification of technique must be complete, or may be proximal fragment of at least 5cm length. We have defined four levels of bulb morphology (diffused, diffused +, marked, marked +) (Figure S42), and four levels of edge parallelism (unpar., sub-parallel, parallel, parallel +). For Horizon V, 24 blades met these criteria. For the complete blades, the average measurement is 106mm long, 23mm wide, and 4mm thick. The longest blade is 151mm in length, the largest is has a width of 39mm, and the thickest measures 11mm. The average size of the butt is 7.3 x 2.5mm (Figure S43). There is a large majority of smooth butt, and overhang preparation ranges from lightly abraded to small retouch. The average flaking surface/striking platform angle is 88'.

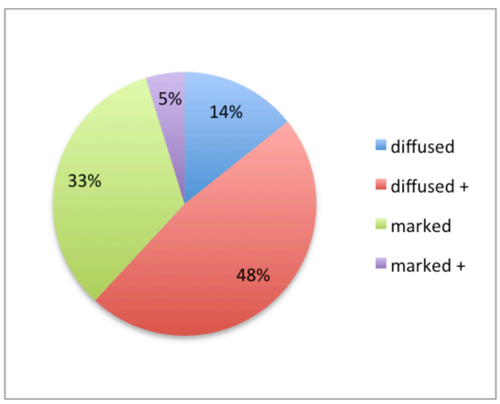

Figure S42: *blade bulb morphology*

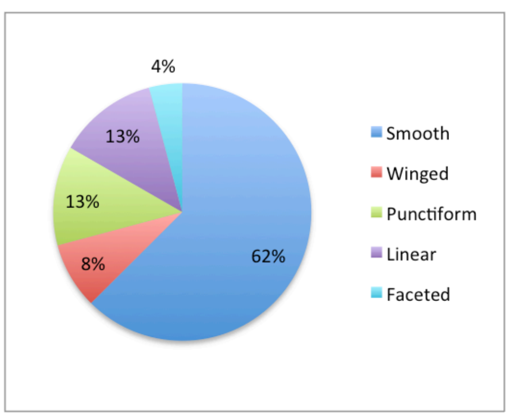

Figure S43: *blade butt morphology*

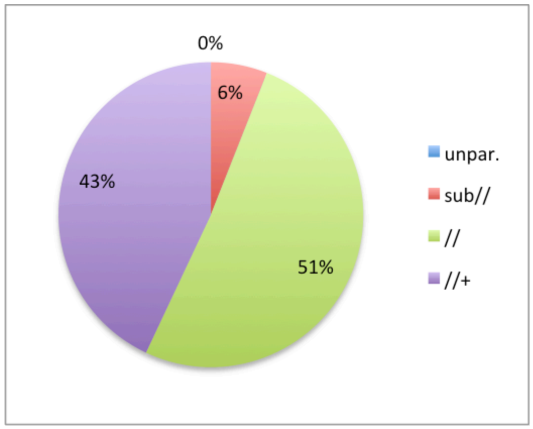

Figure S44: *scar number on blade*

There are also several occurrences of a specific type of preparation that creates two breaks, which preserve the angle and "force" the inclusion of two ridges within the blade. These blades are also less regular, which could be connected to specific platform preparation for indirect percussion activity (N=3). Finally, the majority of the blades (complete or mesial plus distal fragment) are rectilinear or slightly curved in their distal end. Overall, 3-5 blades seems to show traces of pressure with possible lever usage. Between 16 to 18 blades show evidence for pressure debitage. Considering the width and length of the product, as well as several other features, these may be of the type mode 4 with a crutch.

The lack of complete blades in Horizon VI does not allow the calculation of an average length. However, the average width (23mm) and thickness (4.6mm) is consistent with the measurements inform Horizon V. Eight out of 10 butts identified are smooth, and the large majority (90%) of the fragments above 5cm long show extremely parallel edges (//+). All the blades are either rectilinear or slightly curved in their distal end. The use of a lever can be suggested for 2 blades, and the finds shows use of a crutch for 7 blades and up to 40% of the bladelets.

As of yet, Horizon VII does not show any evidence of Mode 5, although J. Chabot suggests that one blade can be identified as the result of lever technique. There is, however, supporting evidence for the use of crutch (Mode 4) for the manufacture of bladelet blanks, which are represented in this layer along with soft hammer direct percussion.

Several techniques were in use at Aknashen, ranging from direct percussion with a soft hammerstone to the complicated development of the lever technique. Several traces of indirect percussion, both on blades and on flakes, are also present. All of these techniques were used at different steps of the production sequence, and may also reflect specific technological idiosyncrasies of the flinknappers present on the site.

Technological Composition. (Figure S45).

The compared technological composition of the assemblages from horizons V, VI, and VII shows some significant consistence in the representation of the different elements. The average proportion of tools is 23% whereas the combined core and technical piece average up to 4%. In this chart, blade and bladelets have been included in the blank category. However, they represent 59% of the category in horizon V, 66% in horizon VI, and 75% in horizon VII. This evolution could be connected to the switch towards smaller blank production operated in horizon VII.

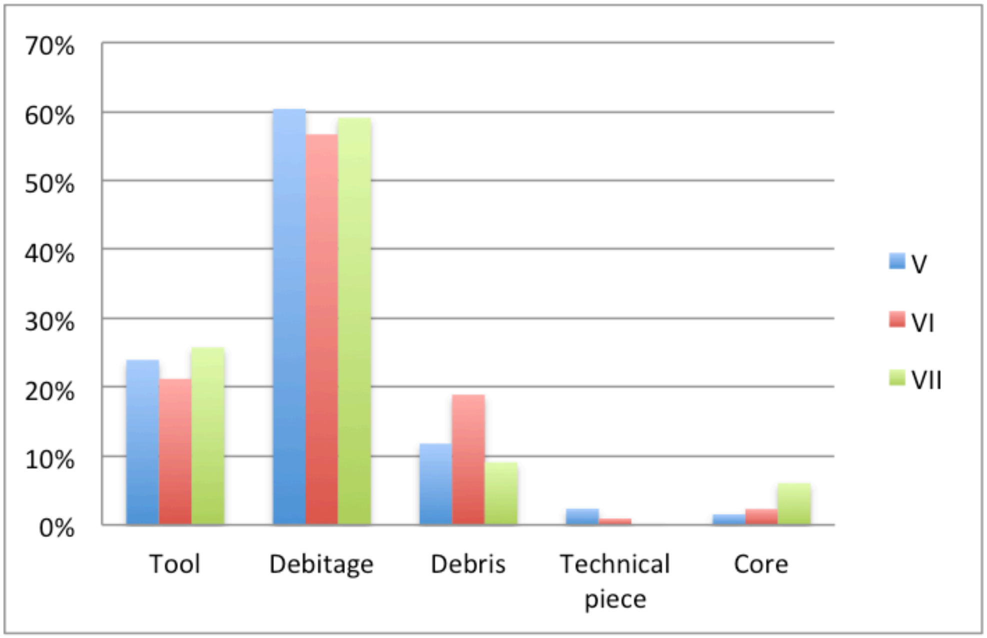

Figure S45: *Assemblage technological distribution*

The surrepresentation of blanks in comparison to the debitage is, to some extent, characteristic of a laminar production that optimizes the use of raw material, a scenario supported by the overall small number of cores found throughout the layers. However, in addition to the low representation of technical pieces (tablets, flaking surface rejuvenation, core-shaping flakes) and cortical flakes, a technological assessment of these pieces shows a lack of overall core preparation and core management activities on the site. In his studies of assemblages originating from previous layers, J. Cabot noticed the same pattern. This layer and the layers studied by Chabot show a structure of the *chaîne opératoire* that is spatially separated and the movements of core ready to be exploited or even already partially knapped.

Chaînes opératoires and blank production

There is overall little evidence of core preparation on the site. However, it has been pointed out that, in the case of a properly executed systematic blade-making sequence, the by-products are few in number. While long blades are for now absent from the Horizon VII, all the three layers show consistencies in the production of smaller blanks as shown by the width/thickness ratio of the bladelets.

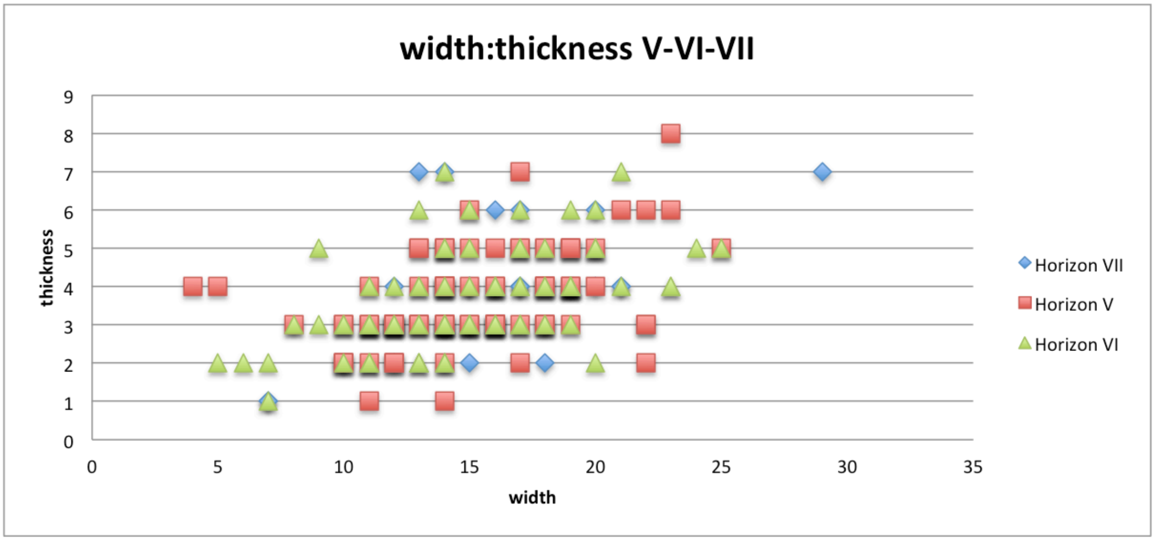

Figure S46: *thickness/width ratio of bladelet for Horizon V-VI-VII*

However, the absence of longer products in Horizon VII is particularly striking, especially since longer products are associated with new types of cores. Some differences exist in terms of core management. Besides one bullet core, almost nonexistent at Aknashen and rare in the Shulaveri-Shomu context, the production focused on smaller implements, through the exploitation of semi-turning bladelet cores on pebbles (with a cortical dorsal surface). This situation is the result of a consistent decrease in core length and size from horizon VI to VII. The bullet cores have been exploited and managed through several episodes of CTE flaking, using the pressure technique with a crutch. The absence of blades takes on even more importance, as there does not seem to be different blade-or bladelet-producing *chaîne opératoire* in Horizon V and VII.

The projection of width/thickness ratio of both blades and bladelets for the

Horizon V assemblage did not show any significant morphometric gap in the production. However, while no specific evidence for separated *chaînes opératoires* was found, several flakes seem to show a re-amenagement of the core as production switches from blade to bladelet. Indeed, there is no evidence of a bladelet production sequence starting on pebbles. It seems that the transition takes place when the products reach around 7cm length and 2.6cm in width. Level VII's bladelets are carried out on small cores, turning or semi-turning and mostly regular. One type of proaction on semi-turning may have used direct percussion, but the bullet core shows evidence of a pressure technique as well. Three flakes also have features suggesting a possible *ad hoc* bipolarity, not representing a systematic removal pattern, but still aiming at the production of blanks, as opposed to evidence of bidirectional management of the core, for instance. The situation in V is not as clear. Some scars, along with features on overshot bladelet, may suggest the presence of bullet cores in the layer. The use of bidirectional management of the core is more pronounced in the bladelet sequence than the in blade production of this Horizon.

The blade production is carried out on large, long cores with a turning exploitation mode. There is little evidence of the initiation of the exploitation of the core itself, which, as we said, tends to support the hypothesis that most of them were brought on site in the early stages of the blank production, or at the end of the core preforming sequence. Large, flat, and irregular blades, axially removed, are more likely associated with these stages. Five of those blades also show scars of large, transferal removals on the dorsal surface, connected with the preparation of the flaking surface (for instance in T4 UF11). It seems that the main production sequence, that is, of the long blades, is reached fairly quickly. Whether for mode 4 or 5, preparation of the striking platform remains minimal.

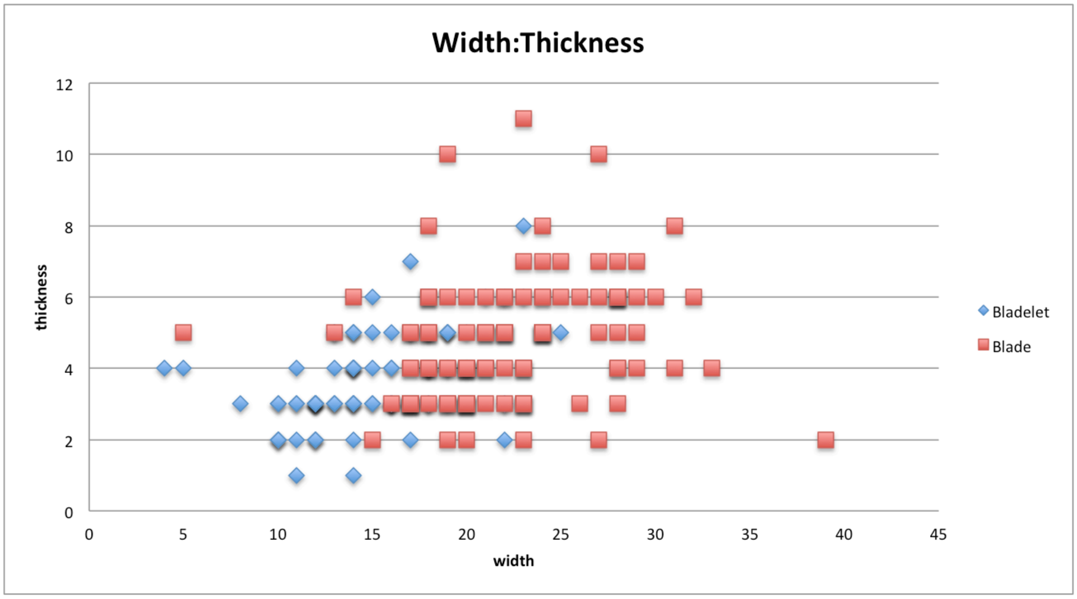

Figure S47: *Width:Thickness ratio of blade vs. bladelet*

Long blades are unidirectionally removed following a diacritical scheme largely based on 2-1-2' although some occurrence of 1-2-3 are also found. Whether this is controlled or not, there appears to be a regularity in the removal of longer, slightly overshot blades every 4-5 blades, which could be a strategy to preserve, during the blank production, an appropriate convexity of the volume without having to engage in more complex core management operations. There are 12 flakes, core fragments, or overshot blades showing traces of abrasion on the distal part of the core connected to the core immobilisation device, necessary for any pressure flaking technique.

The most common type of accident is a failed removal of the blade, which creates a step on the flaking surface. This mistake is generally corrected either by the removal of a larger blade through direct percussion, or through the removal of transferal flakes to create a rough neo-crest. Overall, tools on the site demonstrate the knapper's ability to deal with accident taking place during the main exploitation to sequence, and to select and apply appropriate strategies.

Overall, the mesial fragment of the blade is the most represented, and blades have an average of 3.2 scars. Thirteen blades show evidence of snapping.

Tool production

In all layers (Figures S48, S49), the main tool types are burin and retouched blade/bladelet. Besides endscrapers and sickle blades, there are no clear patterns in the type, direction, and location of retouch on bladelets and blades. Only one type of retouch, named X-retouched, seems to be repeated and has been identified both at Aknashen and Aratashen.

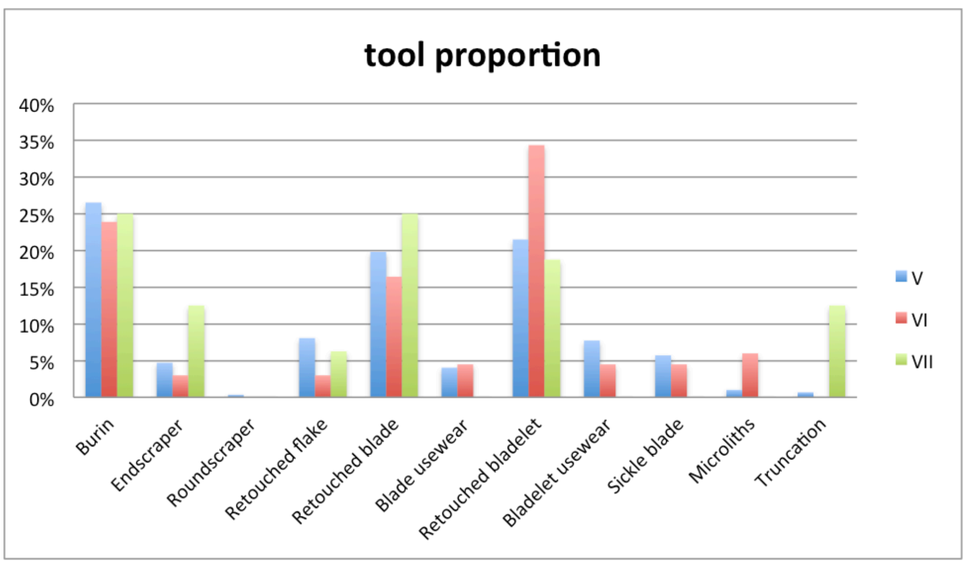

Figure S48: *Aknashen comparative tool proportions*

The majority of retouched blades and bladelets are mesial fragments, and it does not seem to be any particular selection of the said fragment in terms of width, length, or thickness. A large majority of bladelets (72%) are retouched on two edges, while the proportions are close to equal for blade retouch (51% vs 41%). The particular type of retouch known as x-retouch is characterized by an alternation of the retouch on both sides of the blank. Typically, the proximal part will show direct retouch on one side, and inverse on the other. The pattern is then reversed for the distal part. This particular retouch organization could be connected with specific hafting technique, and may also explain the higher proportion of 2-edge retouch on bladelet (as opposed to the normal distribution in blades, which can more easily be used and kept in hand).

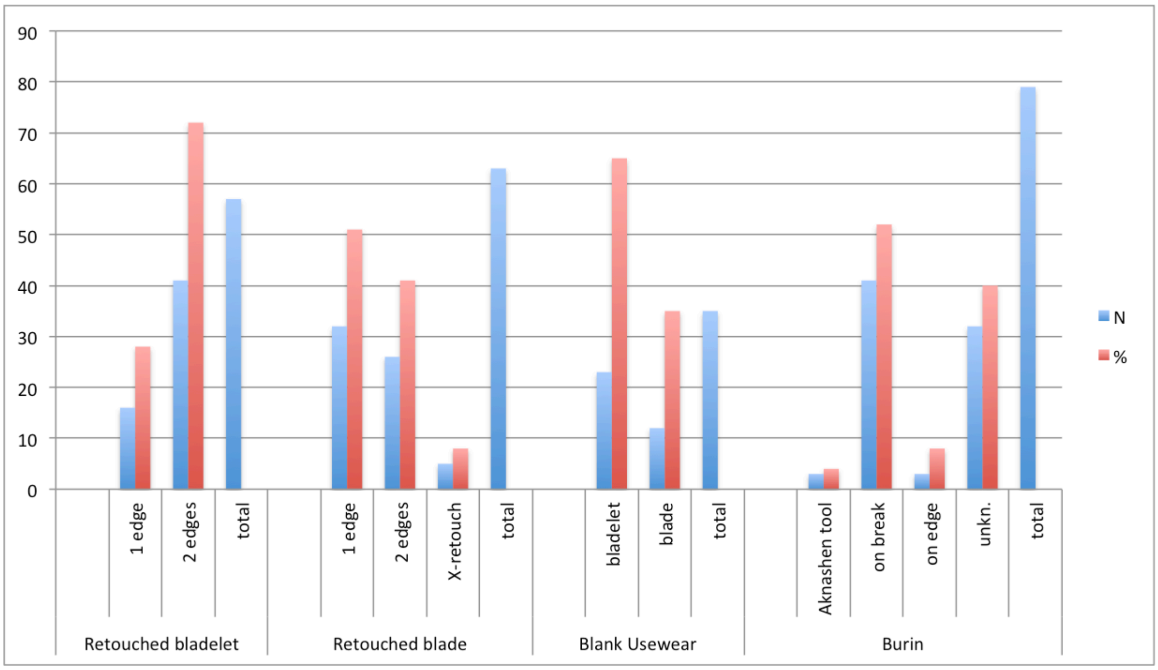

Figure S49: *Retouched blanks proportion (% and n)*

One of the typical tool types at Shulaveri-Shomu sites is the large carinated roundscraper, which can range in size from 59x64x19mm to 82x71x18mm (although some examples in other layers could be as long as 120mm). It is manufactured on large blanks, generally recycled flaking surfaces, CTEs, or distal parts of cores. There is a notable correlation between the size of the striking platform found on cores and the size and volume of these scrapers. They show several episodes of refection, and an important investment in the retouch. Smaller versions of this type are found on small pebbles.

There, a pebble fractured in half, and long axial removal carinates the volume. Eventually, smaller semi-abrupt removal creates the active edge of the scraper.

Another well-represented tool type is the burin. The burin strike is made largely on a break or truncate of the blade. There seems to be a tendency to overshot the burin inorder to create a back. Burins are retouched on the opposing edge 82% of the time. We should also note the presence of retouched burin spall, which could indicate retouch to “drive” the burin, although proper experiments need to be carried out.

Finally, the “tranchant” category involves triangular or trapezoidal microliths made on blades and bladelets. The quantity and proportions of these microliths decrease dramatically in layer VI and VII, and there also seems to be a slight change in typology.

4.2 Aknashen lithic figures

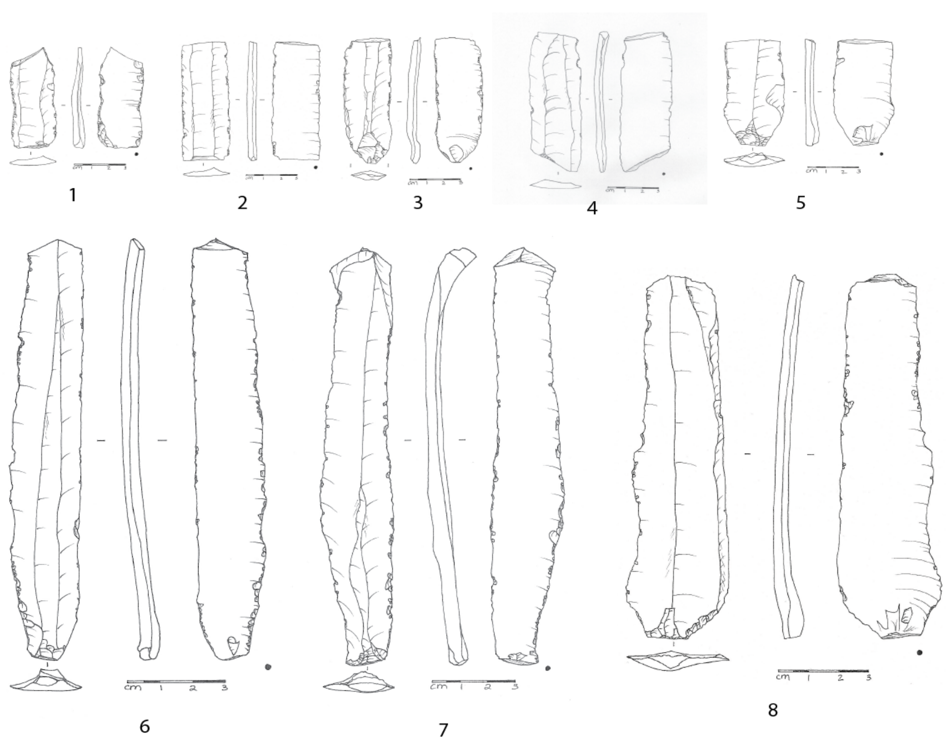

Figure S50: *Aknashen blade production: 1-3; retouched blade fragment; 4-5, blade fragment; 6-8, blade*

Appendix 5.1 – Aratashen lithic analysis

The criteria used to identify the techniques in use in the different *chaînes opératoires* at Aratashen II are the same as those defined in Aknashen. The morpho-technological features include butt, bulb, preparation of the overhang, parallel edges and rectilinearity of the profile. Several techniques have been considered: direct percussion (hard and soft hammer), indirect percussion, and modes 3, 4, and 5 (Pelegrin 2012), listed earlier in this work. This site is also similar to Aknashen in terms of bulb morphology (diffused, diffused +, marked, marked +), and of edge parallelism (unparallel, sub-parallel, parallel, parallel +).

For the blade assemblage, the average length, width and thickness are consistent with the use of pressure flaking with a crutch. The great majority—a larger number than at Aknashen—of butts are smooth. The overhang preparation varies from lightly to strongly abraded and the majority (74%) of bulbs are marked (from marked to marked +). Finally, 95% of blades have parallel scars. The average angle is 85' and the average butt is 10 mm x 3.5 mm. All the blades are rectilinear or slightly curved in their distal ends. Only 23 complete blades were identified, with three of them showing all the features generally associated with lever pressure.

The talon angle is slightly (although not significantly) smaller than at Aknashen (86'), but there seems to be a more systematic preparation of the overhang than at the neighboring site, where there is a higher proportion of marked bulb. This particularity is generally associated with less regular blades, a lower proportion of highly parallel scars, and butts that are significantly bigger than those at Aknashen. Taken together, these characteristics seem to result from indirect percussion technique. Indeed, as is apparent in the chart below, the average dimension of the products also is also bigger than at Aknashen. One assumption would be that we are dealing in this assemble with an earlier stage of the *chaîne opératoire* that is possibly only associated with indirect percussion. The *plein debitage* is thus largely associated with lever or crutch pressure flaking, and at least 8 blades show all the features associated with this technique.

Along with lever and crutch pressure flaking and indirect percussion, direct percussion is also witnessed (Figures S51, S52, S53). As we suggested, different techniques are used throughout the *chaîne opératoire*. Based on personal experience, I suggest that it is likely for several techniques to be used within the *plein debitage* itself to correct a mistake or adapt to specific core and striking platform morphologies.

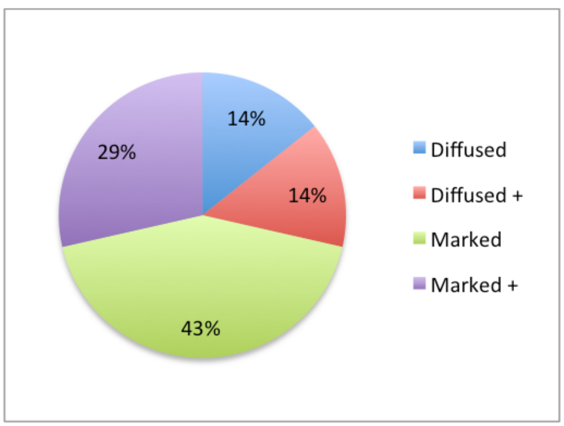

Figure S51: *Bulb morphology*

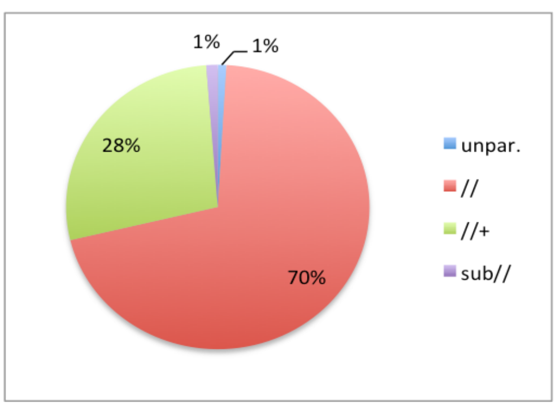

Figure S52: *Scar parallelism*

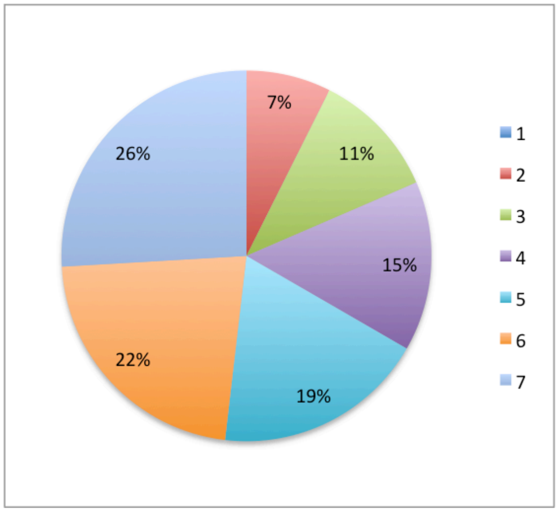

Figure S53: *Scar number on blade*

*Technological composition (*Figure S54)

Overall, the distribution tools and debitage at Aratashen is very similar to that of Aknashen, with tools making up 24% of the collection and debitage, 69%. There is a small amount of debris, technical pieces, and cores (4%, 2%, and 1%, respectively), and only two of the pieces (all categories) have any cortex.

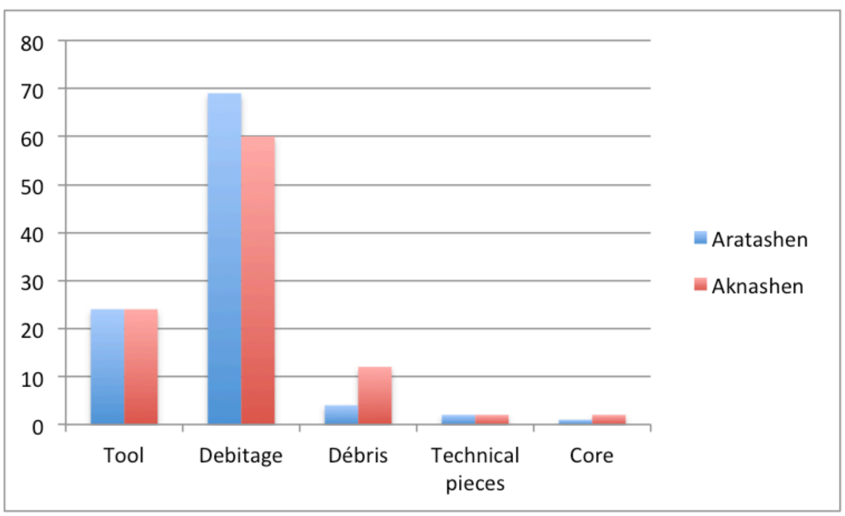

Figure S54: *Aratashen and Aknashen's assemblage technological distribution*

The implication of the small amounts of debris, technical pieces, and cores is that, similar to the case of Aknashen, only parts of the *chaîne opératoire* are represented on site. While, as we noted, the underrepresentation of the debris is characteristic of a laminar production using a controlled pressure flaking technique, we are also missing the presence of shaping elements that would be used to preform the core. Similarly, we did not find abandoned or reused cores. Therefore, the majority of the debitage at Aratashen was dedicated to the *plein debitage* of blades progressively transitioning towards bladelet categories.

Chaînes opératoires and blank production

While the usual blade production on long cores can be seen at Aratashen, there are some elements that diverge from the neighboring assemblage of Aknashen. The identification of the number and type of *chaînes opératoires* within the Aratashen II assemblage includes an analysis of cores, technical pieces and blanks. This reveals the possible existence of a re-organization of the core after a segment of blade production, with the purpose of producing smaller blanks (i.e. bladelet). Another possible sequence can be connected to the production of Shulvarei-Shomu round scrapers.

One long pseudo-conical core with 23 blade removals, which range from parallel to sub-parallel, has been found. This core is particularly instructive, as one side of it shows features of exploitation associated with pressure—very parallel scars and small bulb negatives—while the other side seems to show the use of either indirect percussion—sub-parallel scars and pronounced counter-bulbs. This provides further support to the notion of alternating techniques, a scenario that we have already suggested.

Excavators at Aratashen also found four D-shaped bladelet cores, exploited on 50% of their circumference, with 9 to 13 bladelet removals. In three cases, it seems as if the core was exploited all around before it was transformed through large perpendicular removals into a smaller core for bladelet production. Several parallels and larger removals can be found on the back of the core, although they are oriented diagonally compared to the axis of the core. One core, on the other hand, still shows cortex on its back, suggesting the possibility of a *chaîne opératoire* specifically dedicated to bladelet production.

Two flake cores were also found. Flakes are obtained in a very opportunistic way using direct percussion, although there seems to have been a choice in elongated blanks. This format is achieved through the selection of existing scars on the core. The flake cores themselves are usually fairly small (with maximum dimensions of 5cm x 5cm), and are obtained on larger flakes. Considering the small amount of debris and technical pieces, the existence of such flakes could originate from two processes: a conscious choice in the procurement sequence to bring to the site such pieces, or the re-use (recycling) of pieces coming from exceptional operations carried out on the other types of core. The small number and proportion of these cores may support the existence of the latter case.

Blade production and bladelet production.

Only 23 complete blades were identified in the assemblage. The longest is 190mm, the widest is 35mm, and the thickest is 8mm. The average length of the blades is 112mm, the mean width is 22mm, and the average thickness is 5.6mm. As we have stated previously, there is a large majority of smooth butts in the assemblage, moreso than at Aknashen, and the overhang preparation varies from lightly to strongly abraded.

At Aratashen, twelve complete bladelets were found. The longest is 8.2mm, the widest is 20mm, and the thickest is 5mm, with average proportions of 56mm, 22mm width, and 3.8 mm (Figure S55). Again, there is a large majority of smooth butts and of parallel scars, with an average angle of 85'.

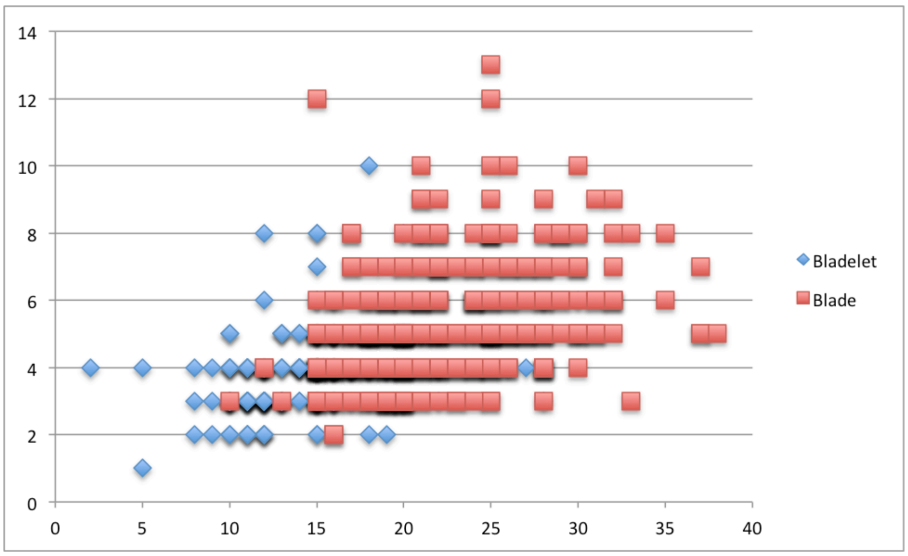

Figure S55: *width/thickness ratio of blade vs. bladelet (in mm)*

The width/thickness ratio of both blades and bladelets does not reveal any large differences between the two datasets. This continuation would suggest one *chaîne opératoire*, for which product size slowly decreased. However, several elements seem to point towards one global *chaîne opératoire* that was divided into two sub-*chaînes opératoires* for blade and bladelet production. Additionally, one other bladelet *chaîne opératoire* on cortical flake was identified.

Blade production is carried out on the same type of cores found at other Shulaveri-Shomutepe sites. The longest blade core is 10cm, shorter than the longest blades found at the site. As opposed to Aknashen, the cores seem to have been brought on-site either before, or at the very beginning, of the *plein debitage* sequence. This is supported by two main pieces of evidence: first, the presence of broad blades associated with earlier stages of the sequences; and second, the type of blanks used to make round scrapers. In two occurrences, these scrapers were manufactured on large striking platforms (CTEs). In another case, a scraper was made on the large transversal flake of a blade flaking surface. Most of the surface seems to have been exploited following a 2-1-2', and a majority of the management of the convexity was operated through a distal blow.

The transition towards blank production occured either naturally (small blades) or required a short reorganization of the core itself. Several technical pieces suggest a reorientation of the axis of debitage associated with the creation of a new striking platform, through a large blow on the original flaking surface. The reason for such re-arrangement is unclear. It may be related to a previous accident on the blade core that required a large repair in order for the flintknapper to keep exploiting the core.

As suggested above, these operations seem to have been extremely localized both in time and in place: most of the byproducts associated with these activities were found concentrated at several locations, while the blanks and retouched blanks were spread out throughout the layers and the site.

Tool production

The tool production is dominated by retouched blades, bladelets, and burins. There is no significant difference in proportion of tools between Aratashen and Aknashen, although there is a slight over-representation of burin and a lower representation of roundscrapers in the latter site. Microliths are not well-represented and the higher proportion of truncation is connected, admittedly, to identification biases during the first analysis of the Aknashen V-VI-VII assemblages.

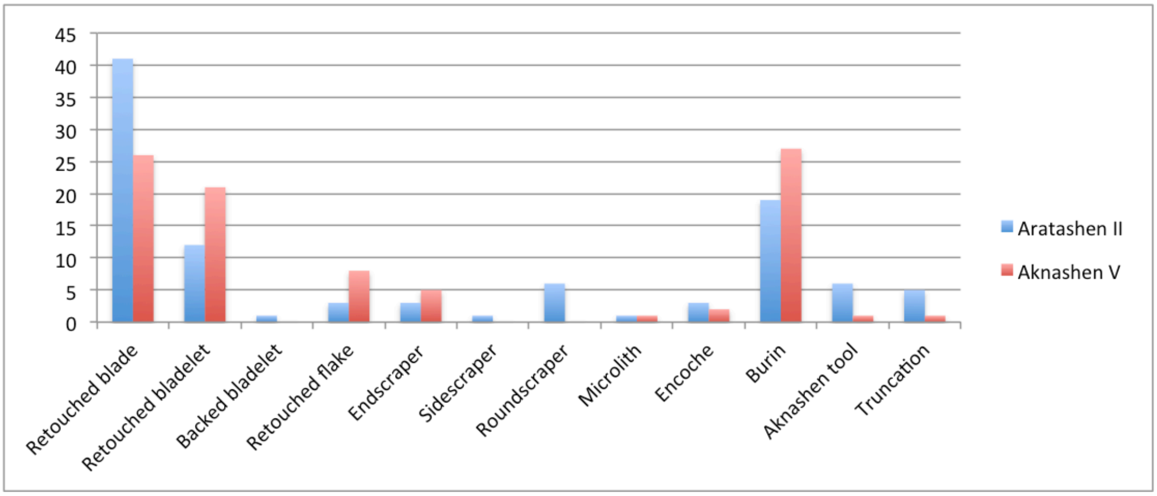

Figure S56*: Tool distribution*

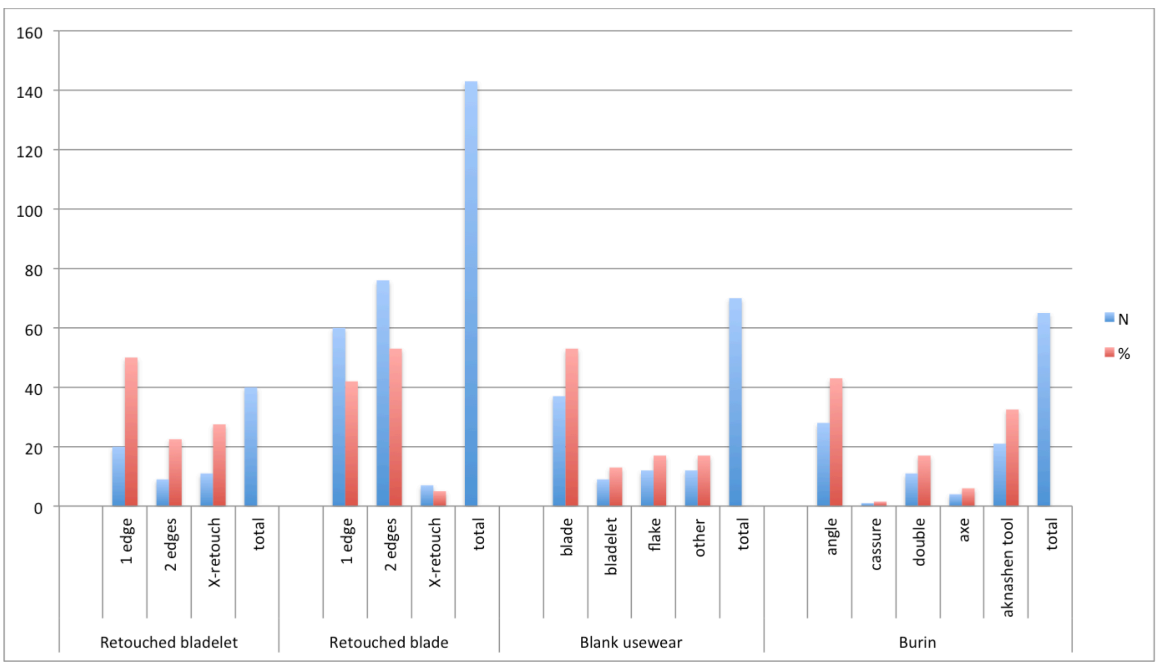

Figure S57: *Retouch pattern/blank*

As opposed to Aknashen, most bladelets (50%) are retouched only on one edge, while 22.5% are retouched on two edges. Blades are retouched on 1 edge (42%), and 2 edges (53%). The same X-retouch is seen both on blades (5%) and bladelets (27.5%).

This particular type of retouch is connected to hafting implements, and would thus suggest a use of larger blades without any handle. This scenario is supported by the larger proportion of blades with usewear, but with no other retouch (53%).

The projection of retouch types presented in our work did not allow for the identification of any specific pattern. However, there seems to be a correlation between a blade's location within the site and the type of retouch carried out. Retouch type 2 occurs more frequently in context 290-290C, while retouch 4 and 8 are more frequently found in structure 317'. Retouch 5 and 3, on the other hand, were best represented in wall K01B. This pattern can have two implications. Either it is connected to task-specific areas requiring different retouches for different purposes (or hafting techniques). Alternatively, we could assume for the most part, an equal functionality for these retouch types. In this case, the diversity could result from the retouch occurring in different households as a stochastic variation.

One particular type of tool on blades is the so-called Aknashen tool. As presented above, it is a blade fragment backed through an overshot burin technique, with an retouched or used opposite edge. Twenty-one Aknashen tools were found in the Aratashen assemblage.

The same type of round scrapers found at Aknashen and Masis Blur is found at Aratashen. These are carried out on large flakes, sometimes with core-trimming elements (striking platform) showing still the scars of previous blade-like parallel removals. In other cases, the scrapers are manufactured on by-products of early *chaîne opératoire* sequences, right before the *plein debitage*. The flake is then carinated on 80% and above of its diameter through long, direct retouch. All of these scrapers show a high degree of re-tooling and much care in the management of the shape of the active front of the tool. One of the structures (str. 31UF 239) shows not only 4 round scrapers, but also some by-products of their manufacture.

5.2 Aratashen lithic figures

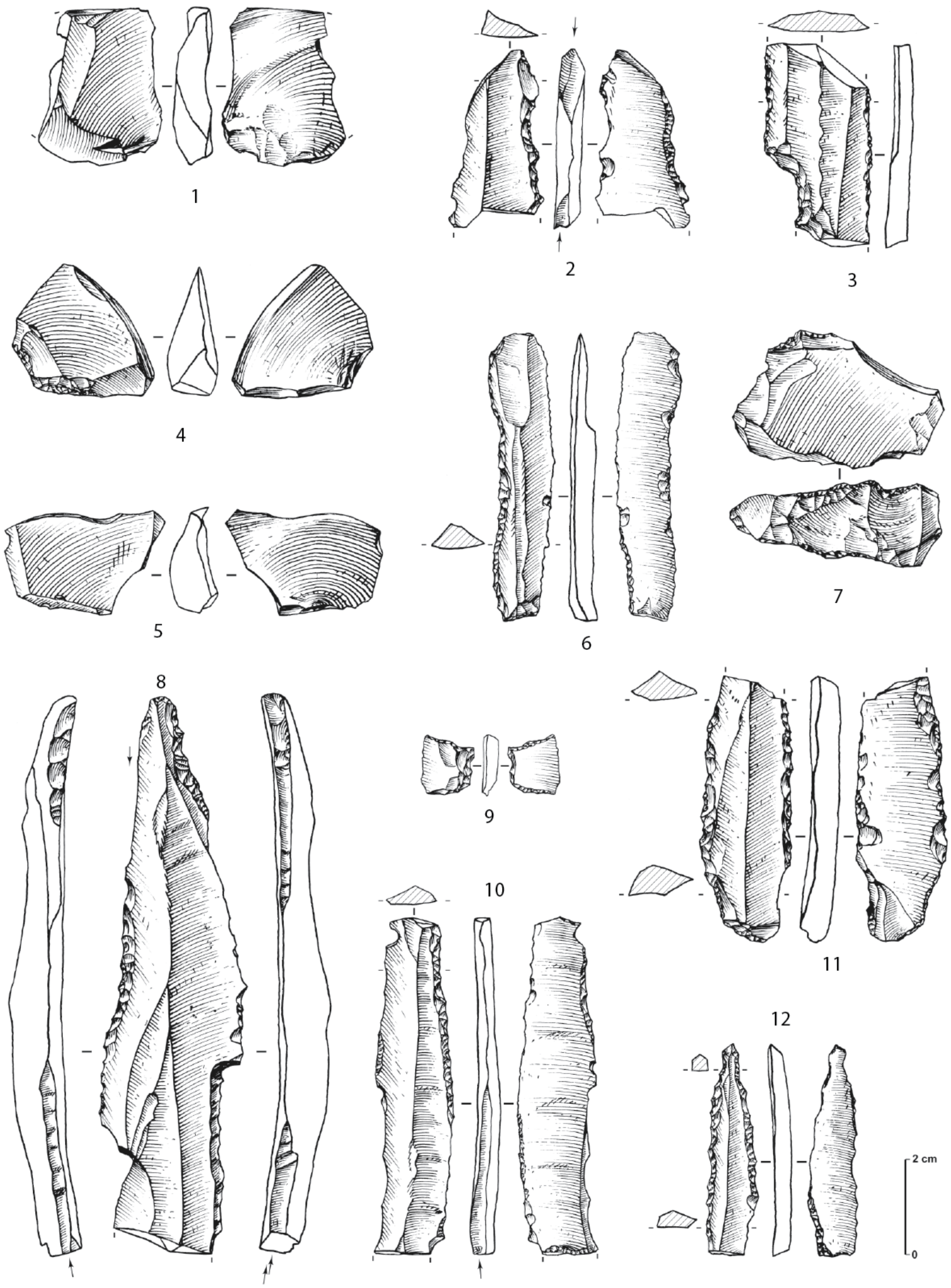

Figure S58: Aratashen lithic assemblage : 1,4,5,7: CTEs fragment; 2,3,6, 10, 11, 12, retouched blade fragment; 8, burin on retouched blade; 9, microliths (G. Devilder)

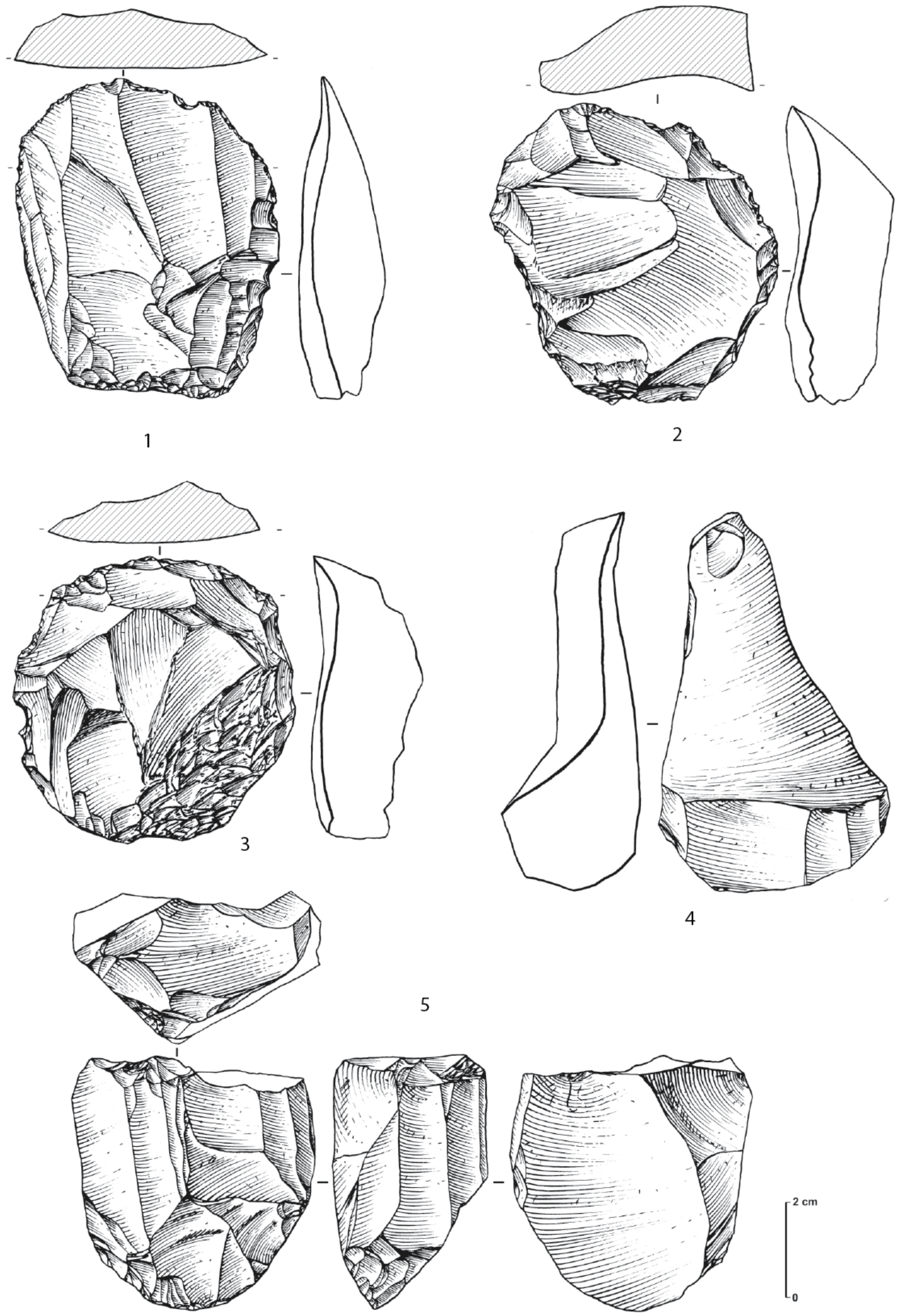

Figure S59: Aratashen lithic assemblage: 1, scraper on debitage surface; 2, scraper; 3, scraper on CTE; 4, overshot blade; 5, core fragment shaped to produce smaller blanks. (G. Devilder)

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