Current Neolithic Research in Armenia

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If the cultures that developed in the centre of the Southern Caucasus, of which Armenia is part, are compared to those of the northern Near East or the neighbouring regions bordering the Black Sea and the Caspian Sea, it is clear that there is a large gap in our knowledge of the beginnings of Neolithisation. Indeed, in the basin of the Kura, in Georgia and Azerbaijan, it is only at the beginning of the 6th millennium calBC that a culture appeared (the Shulaveri-Shomutepe culture) that possessed an advanced mastery of the domestication of plants and animals (Kushnareva 1997; Kiguradze and Menadbe 2004), whereas in the basin of the Arax the culture of Kültepe of Nakhichevan developed from the 2nd half of the 6th millennium cal. BC (Munchaev 1982; Narimanov 1987) (Fig. 1).

In Armenia, where ten years ago the Neolithic period remained very poorly known, the collaboration between the Institute of Archaeology of Yerevan and the French "Caucasus" mission enabled the discovery of two different cultures: a Mesolithic/ Early Neolithic culture on the eastern flank of the Aragats mountains (Kmlo-2 rock shelter) and a local variant of the Shulaveri-Shomutepe culture in the Ararat plain (Aratashen and Aknashen-Khatunarkh)[1].

Fig. 1 Main Neolitic sites mentioned in the text.

The Mesolithic / Early Neolithic of Kmlo-2

The Kmlo-2 rock shelter (Arimura *et al.* 2010), cut into the basaltic flows of the Aragats mountain carved by the Kasakh River (Fig. 2), was occupied during the prehistoric period by small human groups that hunted ibex, mouflons and deer. Remains of Caprinae have been found in the upper horizons of the prehistoric layer, but the wild or domestic status of the highly fragmented bones is difficult to determine. Only wild plant remains were found in this layer. The dating of Kmlo-2 is a difficult issue (Arimura *et al.* 2010), but excavations in 2009 and additional ^{14}C dating indicate that the site was occupied in three different phases, 11th-10th millennia, 9th-8th millennia and 6th-5th millennia calBC.

The inhabitants of Kmlo-2 produced their tools from obsidian pebbles washed down by the Kasakh River from outcrops situated near its source (Tsaghkunyats range), as well as from larger blocks which they brought from deposits that were one to three days distant by foot (Gutansar, Hatis, Arteni, Geghasar) (Fig. 3). The numerous debitage products, which represent 90% of the lithics, provide evidence for making tools on the spot. There is a large number of microliths (30%), including geometric pieces such as lunates and

trapeze-rectangles that probably served as barbs for arrows.

The most interesting objects for the study of relations with the neighbouring regions are obsidian tools with continuous and parallel retouch on one or both lateral edges, clearly executed by pressure flaking technique. These artefacts, original for Armenia and called "Kmlo tools", are similar to obsidian tools found on sites of the 8th-7th millennia calBC in southeastern Anatolia and northern Mesopotamia (Çayönü, Cafer Höyük, Shimshara, etc) and called "Çayönü tools" or "Çayönü rods" or "Beaked blades" (Redman 1982; Fuji 1988; Caneva *et al.* 1994; Mortensen 1970) (Fig. 4).

A use-wear analysis, carried out by L. Astruc (Arimura *et al.* 2006) on "Çayönü tools" and "Kmlo tools", shows some differences between the two groups of artefacts. Although the retouch seems to be similar, the blanks on which they are made, the retouching technique, the wear traces, and the methods of rejuvenation are different. According to the use-wear analysis, no direct relationship can be established between "Kmlo tools" and "Çayönü tools". Moreover, the geochemical analysis of 20 "Kmlo tools" has confirmed that all were made locally on obsidian from Armenian deposits (Tsaghkunyats, Arteni, Gutansar, Hatis, Geghasar) and that there was no import of artefacts or raw material from the northern Near East.

In Georgia, similar tools, called "hooked tools", characterise a culture attributed to the early Neolithic, the Paluri-Nagutnyj culture, that developed on the southwestern slopes of the Greater Caucasus (Grigolija 1977). Similar tools are also found on the high plateaus of southern Georgia ("Paravani group"), where the large obsidian deposit of Chikiani was exploited (Kiguradze and Menadbe 2004: 353-357). Most of these Georgian Early Neolithic sites are found at altitude, several are rock shelters, and all have produced only one level of occupation; unfortunately, none has yet been dated by 14C.

The chronological attribution of the "Kmlo culture", characterized by the presence of "Kmlo tools", has been recently clarified by 14C dating. The horizon in which the "Kmlo tools" appear has been dated to the first half of the 9th millennium calBC; these artefacts are numerous in the overlying horizons dated to the end of the 9th and to the 8th millennium calBC. They seem to have continued in the upper strata of the 6th-5th millennia calBC. This late date for the use of "Kmlo tools" is confirmed by the discovery of similar artefacts on other sites of the region, including the hunter's camp at

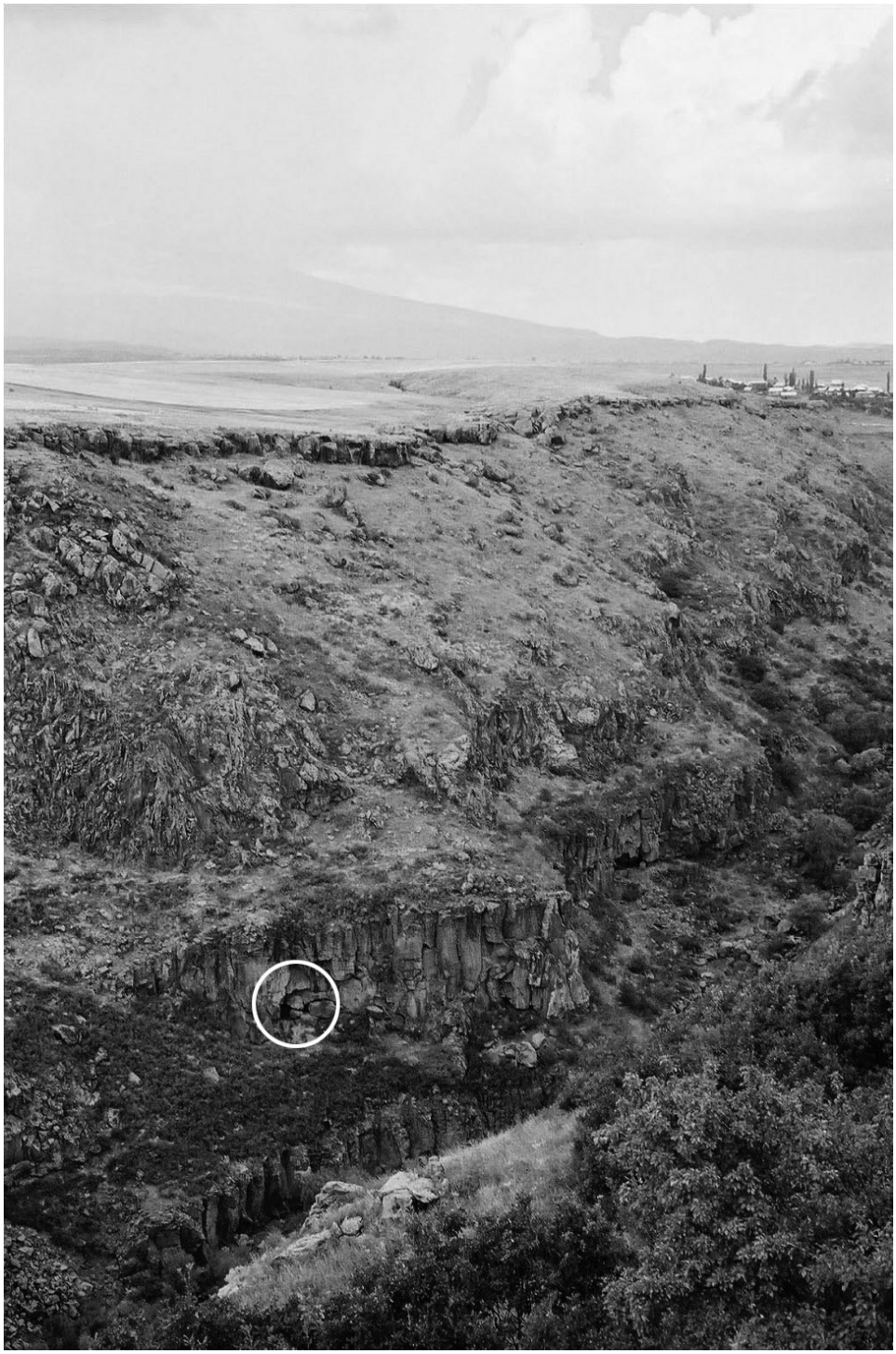

Fig. 2 Kmlo-2 rock shelter in the canyon of the Kasakh river.

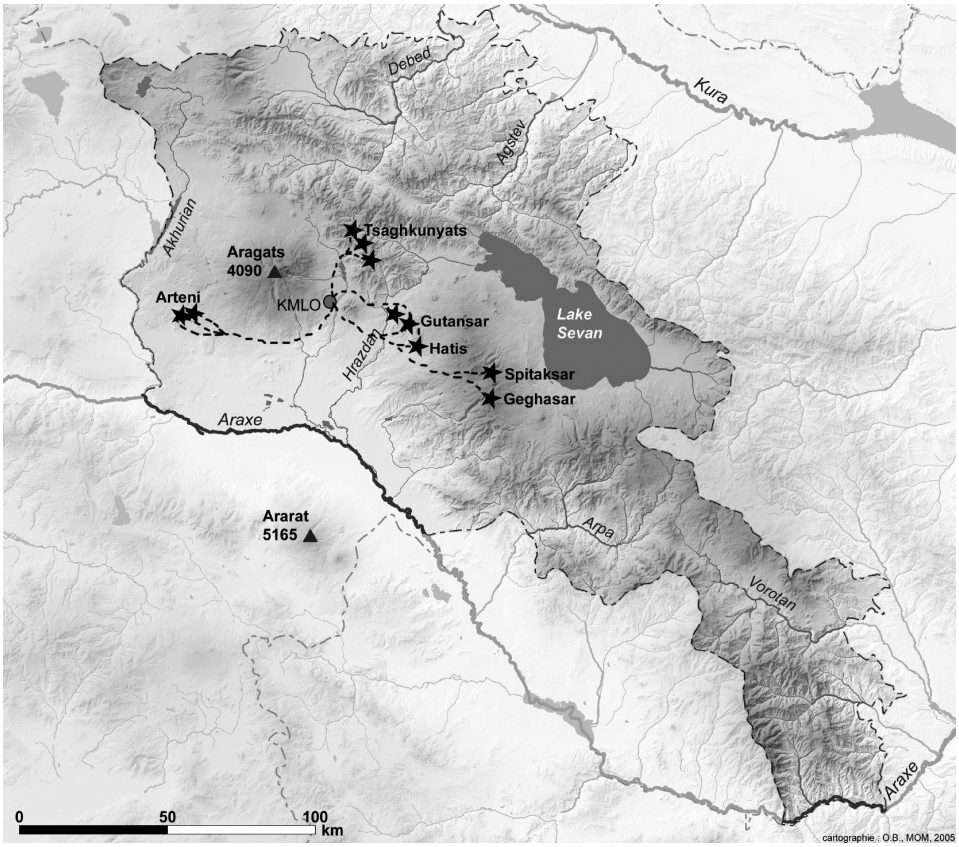

Fig. 3 Obsidian procurement of the Kmlo-2 inhabitants

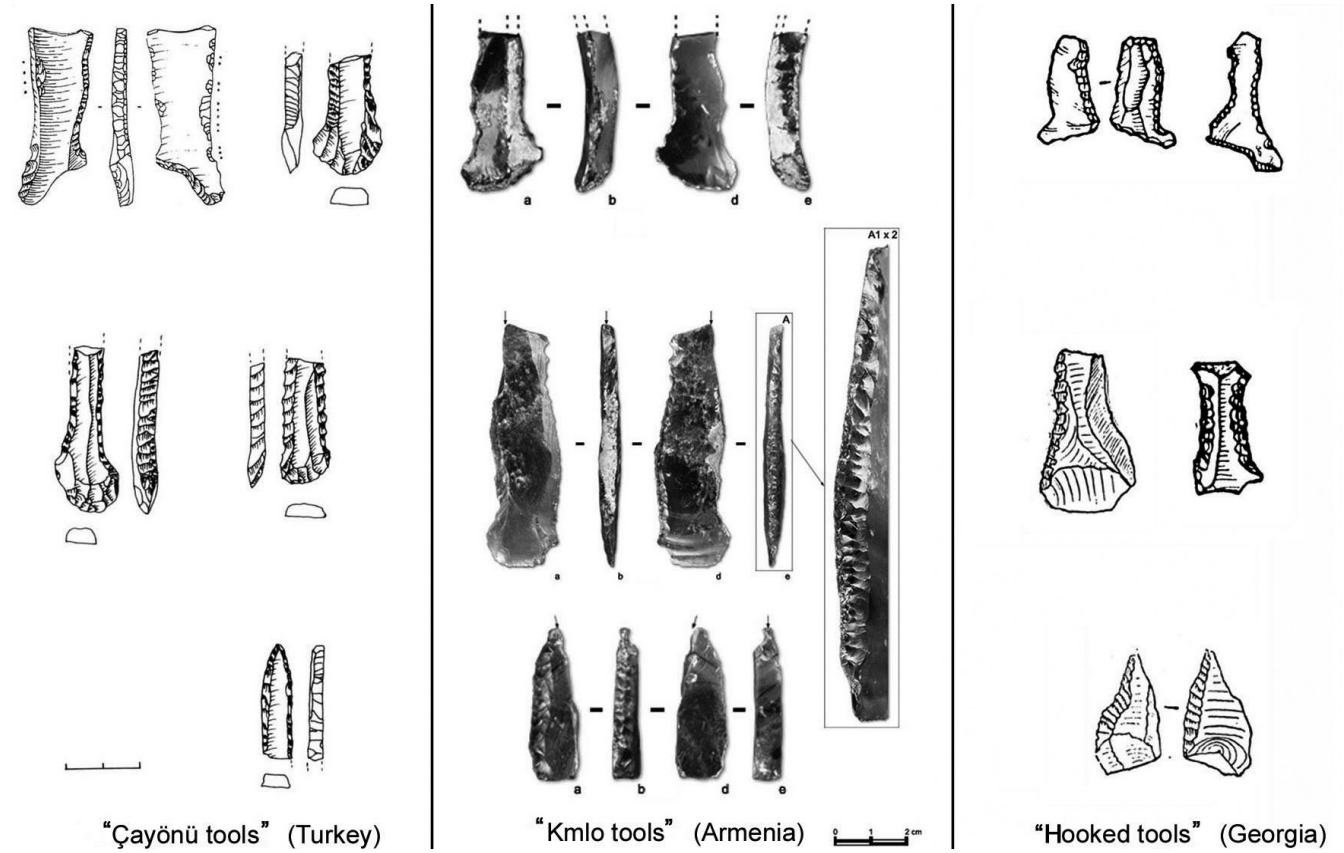

Fig. 4 Tools with an abrupt, regular, sub-parallel retouch.

Tsaghkahovit established on the northern flank of the Aragats in the 2nd half of the 5th millennium calBC (Arimura *et al.* n.d.).

The "Kmlo tools" thus appear to be one of the indicators of a culture established in the 9th millennium calBC on the high plateaus of western Armenia. It is possible that this culture developed locally and continued at least until the 6th-5th millennia calBC. At this time, a quite different culture appeared in the Ararat plain.

The Late Neolithic of the Ararat Plain

The Late Neolithic sites of Aratashen and Aknashen-Khatunarkh are located in the lower valley of the Kasakh River, which meanders in the Ararat plain before flowing into the Arax River. Aratashen, which has been excavated from 1999 to 2004, is a small elliptical elevation of about 60 m in diameter consisting of two Neolithic levels lying on the sandy virgin soil. At the periphery of the elevation, unstratified material has been found; this material, which consists mainly of Chalcolithic pottery and obsidian artifacts, comes probably from the upper part of the mound, destroyed by erosion over millennia and by modern levelling works (Badalyan *et al.* 2004a; 2007). As the stratigraphy of Aratashen revealed a gap between the Neolithic and Chalcolithic levels, it was decided to excavate another site, in order to fill this gap.

Fig. 5 Architecture of the lowest levels of Aratashen.

The site of Aknashen-Khatunarkh, located 6 km southeast of Aratashen, was partly excavated by R. Torosyan in the 1970s and 1980s; but the results of his work, carried out in the west sector of the hill, were not published. The new excavations by the Armeno-French mission began in 2004 and are still in progress (Badalyan *et al.* n.d.). The site of Aknashen-Khatunarkh is a mound circular in plan (about 100 m in diameter), with a flat top rising 3.5 m above the surrounding plain. So far the most complete stratigraphic sequence has been found in trench A. There, the cultural layer is more than 4 m thick and continues farther down, but the high level of the water table did not permit further excavation. The preliminary typological analysis of the material, mainly pottery, has enabled attribution of the lower horizons (V-II) to the Late Neolithic and the upper horizon (I) to the Early Chalcolithic. It seems that at the present stage of investigations there is no significant hiatus in this stratigraphic sequence.

The corpus of 14C dates shows overall concordance between Aknashen-Khatunarkh and Aratashen: the earliest levels (lowest strata of horizon V at Aknashen-Khatunarkh and horizon IId at Aratashen) belong to the very beginning of the 6th millennium calBC. At Aknashen-Khatunarkh, the upper Neolithic level (horizon II) covers the last centuries of the 6th millennium calBC; therefore the Chalcolithic level (horizon I), disturbed by medieval and modern intrusions, would belong to the first half of the 5th millennium calBC.

The inhabitants of these settlements were farmers (naked wheat, emmer, six-row barley, and lentil) and herders (sheep, goats, cattle and rare pigs). Constructions, circular in plan with diameters from 3 to 5 m, were built in pisé or, more rarely, in mud bricks. There is a high concentration of small structures within or outside the constructions; they were generally used as silos (to stock grain or sometimes tools) or as ovens (Fig. 5).

The obsidian tools are quite different from those of Kmlo-2; they are mainly on blades, produced by indirect percussion or by pressure flaking technique with crutch as well as with levers (Chabot and Pelegrin n.d.), a technique that appeared in the northern Near East at about the end of the 8th millennium cal. BC (Çayönü, late Pre-Pottery Neolithic) (Altinbelek *et al.* n.d.).

The lower Neolithic levels at Aratashen and Aknashen-Khatunarkh have produced an abundance of objects made of bone, horn and deer antler. The main types consist of awls, spatulas, "hoes", arrowheads, spoons, wide palettes and tubular casings. In the upper levels, a sharp decline in the quantity and variety of the bone industry can be observed: more than 80% of the bone artifacts are awls.

Some bone arrowheads have been found close to stones which present on their rounded upper part 1 to 3 wide transverse grooves in a U-shape section. Grooved stones are known in the Near East from the 11th millennium calBC onward, and two regional variants can be distinguished: in the Levant and western Mesopotamia, the groove follows generally the longitudinal axis of the tool, whereas in northeastern Mesopotamia and the Zagros (Zawi Che-

mi, Karim Shahir, Jarmo, *etc.*), they follow more often the transverse axis (Solecki 1981; Howe 1983; Moholy-Nagy 1983). The grooved stones of Armenia could be compared to this latter variant (Fig. 6).

Pottery is totally missing from the lowest levels of both sites; at present it is clear that the earliest sedentary communities in the Ararat plain did not use pottery. Later, coarse wares with mineral or mixed temper appear; chaff-tempered ware develops then, but remains rare in the Neolithic horizons. These potteries show reddish-brown to gray-black color; in some cases, they are decorated with applied elements such as simple knobs. There are in addition some rare sherds of fine painted ware, probably imported from northern Mesopotamia. Sherds similar to Samarran or Early Halaf wares were found at Aknashen-Khatunarkh in horizon V (Badalyan *et al.* n.d.), others with motifs characteristic of Middle/Late Halaf pottery were found at Aratashen in horizon IIb (Palumbi 2007).

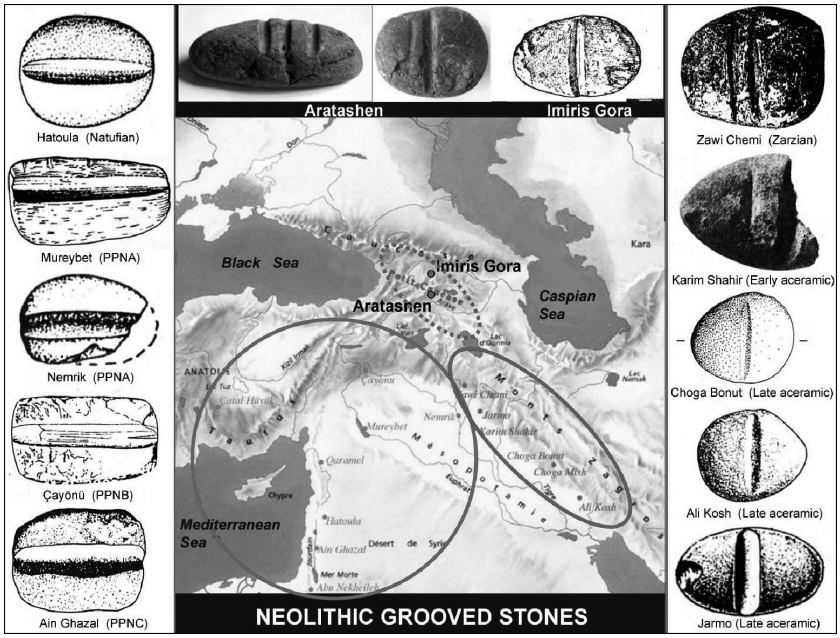

Fig. 6 Distribution of sites yielding grooved stones with longitudinal and transversal grooves.

At Aknashen-Khatunarkh, in the Chalcolithic horizon, chaff-tempered ware makes up the bulk of the pottery and is characterized by a combed treatment of the surface (a haphazardly executed series of incised lines over the body of the vessel) and by new decorations: a horizontal row of perforations below the rim, undulated rim, and notches on the rim. These features are characteristic of the pottery of the Early Sioni culture, which developed in the Kura Basin after the disappearance of the Shulaveri-Shomutepe culture (Kiguradze and Sagona 2003).

The Late Neolithic culture represented on these two sites in the plain of Ararat is closely related to the Shulaveri-Shomutepe culture that developed in the same period (6th millennium calBC) farther north in the Kura Basin. Both cultures have many points in common: in architecture, in lithic and bone industries, and in pottery.

At the site of Aknashen-Khatunarkh, which presents a stratigraphic sequence covering the phases of the Late Neolithic and the Early Chalcolithic, two factors stand out: a) change is completely progressive; b) there are important differences between the earliest and latest levels, indicating an evolution in the way of life. The first phase, with architecture in pisé and objects characteristic of the Shulaveri-Shomutepe culture, indicates a sedentary economy. The last phase is characterized by abandonment of constructed architecture, the rarity of groundstone tools, and the decline of bone and lithic industries. All these features, which are characteristic of the Sioni culture in Georgia, suggest a change in the economy towards more mobility.

Discussion

In order to better understand the Neolithisation process in Armenia, two topics are discussed here: a) the hypothesis that the search for obsidian, which is abundant in this country, led to the establishment of trade networks between this region and Mesopotamia; b) the role of the southern Caucasus in the emergence of hexaploid wheat culture in the Near East.

Obsidian Procurement

More than 20 sources of obsidian are scattered across the southern Caucasus, mainly in Armenia, but also in southern Georgia and southwestern Azerbaijan. The systematic characterization of the Caucasian sources was achieved through geochemical analyses and fission-track dating and this geological data served as a base for determining the origins of an important corpus of artefacts from sites dating to between the 6th to the 1st millennia calBC (Blackman *et al.* 1998; Badalyan *et al.* 2001, 2004b). These results were compared with the database for obsidian in the Near East.

These analyses have shown (Fig. 7) that the obsidian from the southern Caucasus was widely used in the basins of the Kura and the Arax Rivers, up to the shores of the Black Sea and the Caspian Sea. But it hardly circulated beyond the mountain ranges that border this region in the north (Greater Caucasus) and in the south (Anti-Taurus). Only a group of sources located in the upper basin of the Vorotan River (Satanakar, Sevkar, Bazenk) was exploited beginning in the 6th millennium calBC by populations settled in the basin of Lake Urmiah (northwestern Iran).

On the other hand, the Anti-Taurus possesses several deposits of obsidian that were largely exploited

during the Neolithic and Chalcolithic periods: a) the Bingöl and Nemrut Dag sources, which spread widely throughout the Fertile Crescent, but not to the north; b) the Meydan Dag deposit north of Lake Van, which had a broad diffusion in Northern Mesopotamia and is represented in the southern Caucasus only occasionally; c) the Erzurum region, whose populations exploited only the local obsidian. In fact, the obsidian sources located in the Lake Van and Erzurum regions represent less than 1% of the provenances of all the southern Caucasian archaeological samples analysed (Badalyan *et al.* 2004b). The near-absence of diffusion of obsidian from the northern Near East towards the southern Caucasus and from this region towards the south is noticeable and suggests that the obsidian exchange networks elaborated by the Mesopotamian populations did not play an important role in the process of Neolithisation of the southern Caucasus.

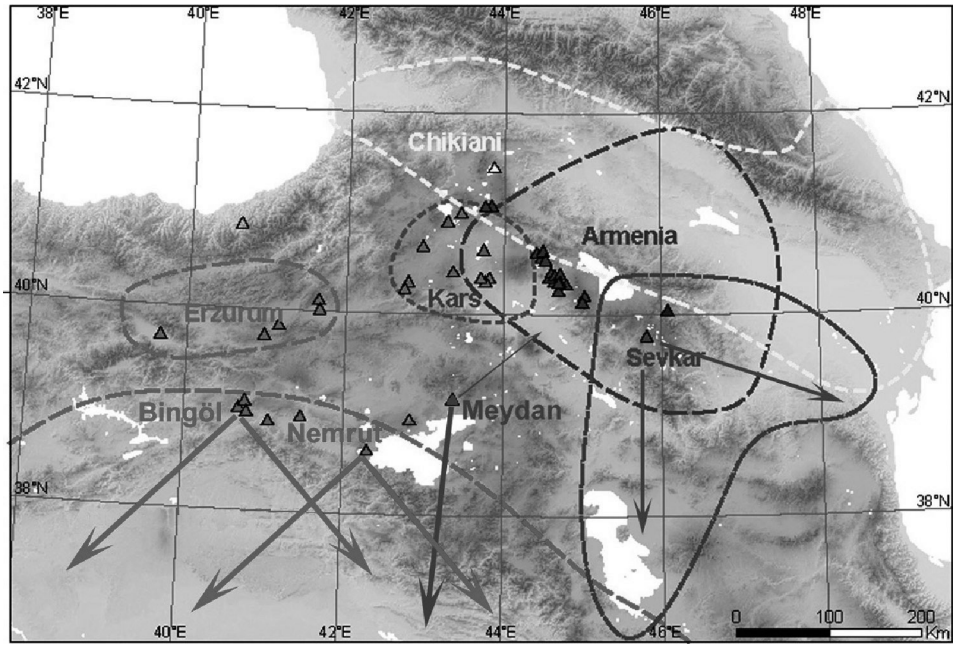

Fig. 7 Obsidian procurement in the northern Near East and the southern Caucasus.

Emergence of Exaploid Wheats

The assortment of cereals found on the Armenian sites of the 6th millennium calBC (Aratashen and Aknashen-Khatunarkh) is characterized by the abundance of naked wheat, whose species, Triticum turgidum (tetraploid) or Triticum aestivum (hexaploid), is difficult to determine (Badalyan *et al.* 2007; Hovsepyan and Willcox 2008; Badalyan *et al.* n.d.). Such a predominance of naked wheat is attested in the Kura basin in the Shulaveri-Shomutepe culture, where spelt wheat (Tr. spelta), a hulled hexaploid species, is also present (Lisitsyna and Priscepenko 1977; Janushevich 1984; Wasylikova *et al.* 1991; Zohary and Hopf 2004). The first hexaploid wheats were hulled products (Tr. spelta), but the naked derivatives (Tr. aestivum) could have appeared shortly after the formation of spelt, because the shift between hulled and naked hexaploid wheat was apparently produced by only two mutations (Zohary and Hopf 2004).

In the regions situated northwest of the Black Sea, in the Bug-Dniestr culture, the spread of spelt is dated to the end of the 7th and the beginning of the 6th millennium calBC (Janushevich 1984 ; Kotova 2009). However, genetic analyses show that the spelt wheat of Europe (Moldavia, northern Black Sea) and those of Asia (Caucasus, Iran, Afghanistan) do not have the same origin: European spelt wheat originated from hybridization between cultivated emmer (Tr. dicoccum) and club wheat (Tr. compactum), whereas Asian spelt wheat originated from hybridisation of tetraploid wheat (Tr. turgidum) with the diploid wild grass Aegilops tauschii (= squarrosa) (Dvorak *et al.* 1998; Yan *et al.* 2003; Dedkova *et al.* 2004).

In particular, molecular studies have revealed that populations of Aegilops tauschii native to Armenia and the southwestern part of the Caspian Sea belt are closest to genome D found in the hexaploid wheat (Dvorak *et al.* 1998). Thus, a hypothesis defined in the nineties (Nesbitt and Samuel 1996; Zohary and Hopf 2004) was largely confirmed by genetic studies (Lelley *et al.* 2000; Giles and Brown 2006; Kilian 2009): the most likely origin of the hexaploid bread wheat is the southwestern corner of the Caspian belt and the adjacent southern Caucasus. The hybridisation is generally considered to have taken place between 6000 and 5000 BC; however, as the recent excavations at Aknashen-Khatunarkh have shown that hexaploid naked wheat was already present as main cultivated crop at the very beginning of the 6th millennium calBC (Badalyan *et al.* n.d.), we must consider now that the hybridisation may have taken place earlier, in the 7th or even the 8th millennium calBC.

This domestication must be distinguished from the appearance of hexaploid naked wheat in the Middle PPNB (first half of the 8th millennium calBC) in southeastern Anatolia and northern Syria (Abu Hureyra 2B, Cafer Höyük, Halula, *etc.*) (Nesbitt 2002). A recent genetic analysis suggests that, in the Near East, there were at least two Aegilops tauschii sources that contributed germplasm to the D genome of Triticum aestivum (Giles *et al.* 2006), one giving rise to the lineage possessing the TAE1 allele and its derivatives, and the other giving rise to the lineage with TAE2 allele. The first hybridisation probably occurred at the beginning

of the 8th millennium calBC in southeastern Turkey and northern Syria, where local Aegilops tauschii has a high frequency in TAE2 allele; the second, more recent, hybridisation occurred in the southern Caucasus and in the southwest corner of the Caspian belt, where TAE1 is common (Giles *et al.* 2006).

This second domestication could have occurred among small population groups that came from the eastern Near East at a point in time when pottery was still unknown (until the beginning of the 7th millennium calBC), which would explain the absence of pottery in the earliest phase of the Shulaveri-Shomutepe culture. Then these groups could have evolved locally or become mixed with local populations. Such a "cultural diffusion model" would explain too the spread of agriculture in Europe during the Neolithic period (Morelli *et al.* 2010).

Conclusion

Current Neolithic research in Armenia has brought to light two different cultures: a) a Mesolithic/Early Neolithic culture with a microlithic industry (Kmlo-2 rock shelter) on the high plateaus of western Armenia; this culture evolved locally until the 5th millennium calBC (persistence of the "Kmlo tools" in this region); b) a Late Neolithic culture (Aratashen and Aknashen-Khatunarkh) in the Ararat plain, which constitutes a southern variant of the Shulaveri-Shomutepe culture, widespread in the Kura basin during the 6th millennium calBC.

From several cultural elements (farming, herding, debitage by pressure flaking with lever, imported Mesopotamian pottery, *etc.*), we can infer links between the Shulaveri-Shomutepe culture and the Near Eastern Neolithic cultures. However, other elements of the Shulaveri-Shomutepe culture (circular architecture, absence of pottery in the lowest levels, abundance of naked wheat, *etc.*) indicate its originality. Therefore, the origin of this culture could be due to contacts between Near Eastern farmers and local populations in the southwestern area of the Caspian Sea at the end of the 8th or beginning of the 7th millennia calBC.

Whatever the theory on the advent of agriculture in the southern Caucasus, the sites of this region where cereal crops such as spelt and bread wheat developed, remain to be discovered. Thus research must continue in order to discover sites prior to Aratashen and Aknashen-Khatunarkh and to better understand the populations of Armenia in the early Holocene.

Notes

1 The excavations at Kmlo (resp. M. Arimura) and at Aratashen and Aknashen-Khatunarkh (resp. R. Badalyan) were funded by the French Ministry of Foreign Affairs, the National Center for Scientific Research (C.N.R.S.) and the National Academy of Sciences of Armenia.

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