Goy Tepe,[289] where they are dated to the Neolithic. This similarity between the two periods contributes to the discussion on the heritage of Neolithic populations to Chalcolithic ones in our area.

The main raw material used is bone. Quite often people extracted this material from domesticated animals (ovi-caprines) at hand, but large ruminants, wild or domesticated, were also used. The selections, probably oriented by technical advantages, are quite systematic: metapods of small ruminants for awls, scapulae of big mammals for shovels.

The main characteristics of the tools demonstrate a will to produce in a quick but efficient way: quite often tools are made on plain bones only lightly shaped, while rapid techniques are frequently used (percussion, abrasion). Part of the blanks obtained by percussion are probably the result of a proper, well controlled *débitage*: the blanks are fairly long and regular. We cannot exclude that others, with more random shapes, were collected from kitchen wastes.

As has been observed on grinding materials[290] and in several areas of the site, ochre is quite often attested on bone tools. It would be useful to analyse this red material found on stones and bones and to determine, through a joint study by specialists, its possible uses and the links between two industries. Similarly, the discovery of bone shovels that were possibly used to work the earth needs further cross studies and experimentations.

Part IV:

Studies concerning the three areas of the Middle Kura Valley

Bertille Lyonnet and Barbara Helwing

With this section of our work we enter into the studies dealing with the three geographic areas of the Middle Kura Valley. In this part of the project, our specialists study and compare the material culture, or the landscape and geomorphology of the three places in order to detect differences and similarities and the chronological development. This phase of our research is just at its very beginning, and most of the time it was possible to work on only two areas and not yet on all the collections. Nevertheless, the project gives a hint at the potential of such studies, which will aid in a better determination of the local cultures, of their local development, and of their relations between themselves and/or with other regions further away. We will first present the results concerning the general landscape and environmental conditions, and then comparative studies on the material culture.

Holocene landscape and human modes of occupation in the Kura Valley (Azerbaijan)

Vincent Ollivier and Michel Fontugne

Introduction

Current geomorphological studies raised the question about the Caspian eustatic influence on the Kura Valley landscape mutations since the last glacial maximum.[291] The Caspian Basin is a vast endorheic system (371 000 km^2), particularly responsive to the flows of its contributors, to climatic oscillations (from regional to extra regional scales) and to solar insolation. For these reasons, its levels have changed dramatically both erratically and cyclically over various time scales,[292] causing vast modifications in both the volume and the area of the water body. In numerous examples around the world, hydrosystems have reacted to eustatic variations along the geological time scale by regressive incisions during lowstands and important rapid valley infilling during high sea levels. Considering this important parameter for landscape mutation throughout the Quaternary period, modes of human occupation must have either reacted to or been strongly influenced during the Holocene in the entire area under study, which concerns the Mil Steppe in the Lower Qarabagh and the Tovuz region **(Fig. 159)**. The question here is to identify and quantify the real impact of eustatism in the various hydrosystems of this study area and its effect on the human mode of occupation during the Holocene.

Geomorphological research in the Tovuz Region

The Tovuz region is from the point of view of geoarchaeology actually the area investigated in most detail of the three study regions. The geomorphological research concerns the morphosedimentary organization of the terraces levels of the Agstafa, Hesensu, Tovuz, Arenji, Zeyem and Şamkir çayi or riverlets, along which archaeological sites are located.

Environmental components

The area of study, which is oriented northwest to southeast on the right bank of the Kura River and

289 F. Guliyev, personal comm.
290 Hamon, in this article.
291 Ollivier *et al.* 2011.
292 Kazancı *et al.* 2004.

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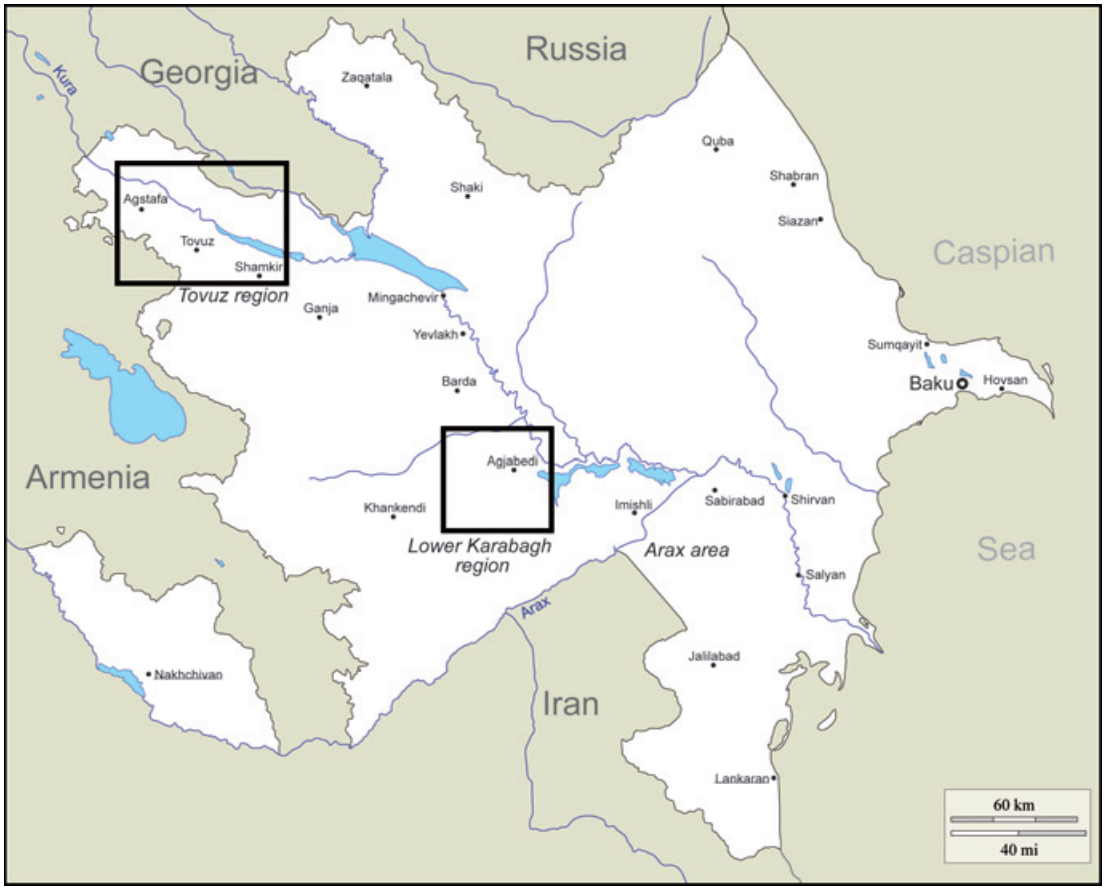

Fig. 159
South Caucasia: map and location of the study regions

bounded between the cities of Agstafa and Şamkir, is composed of mountain-, hill-, foothill- and plain-landscapes. The climate of the mountainous part is considered as sub-Mediterranean and semi-humid at lower altitudes (with beech, oak, and pine forests) and thermo-moderate and humid in the higher parts (alpine meadows). On the other hand, the plain and foothill ecosystems are associated with dry-hot semi-deserts and dry steppes with mild winters. On the right bank of the Kura River, the main lithology and outcrops are Jurassic, cretaceous, volcanic, metamorphic and sedimentary rocks. On the left bank, the geology is constituted by Miocene transgressive deposits and Pliocene tectonized formations, rich in pebbles, silts and gypsum. Quaternary deposits predominate in both parts of the Kura Valley. With a minimum estimated thickness of 80 meters, they belong mostly to alluvial fans and terraces from the torrential rivers of the Lesser Caucasus foothills and to the Kura River. Morphoclimatic and climato-eustatic variations have shaped these formations since the end of the last climatic cycle.

Hydrosystem characteristics

The torrential units studied are part of the Kura hydrosystem. This hydrosystem has been directly connected to the Caspian Sea since at least the Upper Pleistocene. The Agstafa, Hesensu, Tovuz, Arenji, Zeyem and Şamkir çayi hydrologic systems have a mature equilibrium profile and share quite the same basin morphometric characteristics. Their watershed area encompasses ca. 2400 to 2650 km^2, their length measures between 133 to 120 km, and their mean discharge varies between 0.91 m^3/s (Tovuz çayi) and 13.6 m^3/s (Agstafa çayi). Globally, their annual water supply derives 45% from groundwater, 35% from the snowmelt and 20% from rain precipitation. The actual physiography of the Azerbaijan Kura Basin, with an average declivity of 0.17% from the Georgian border to the Caspian shore, presents a large and relatively flat valley, in which the eustatic variations can be expressed on a wide spatial scale. The Tovuz region, located in the upstream part of this geomorphological environment, has significant tectonic activity with an average uplifting of 4 to

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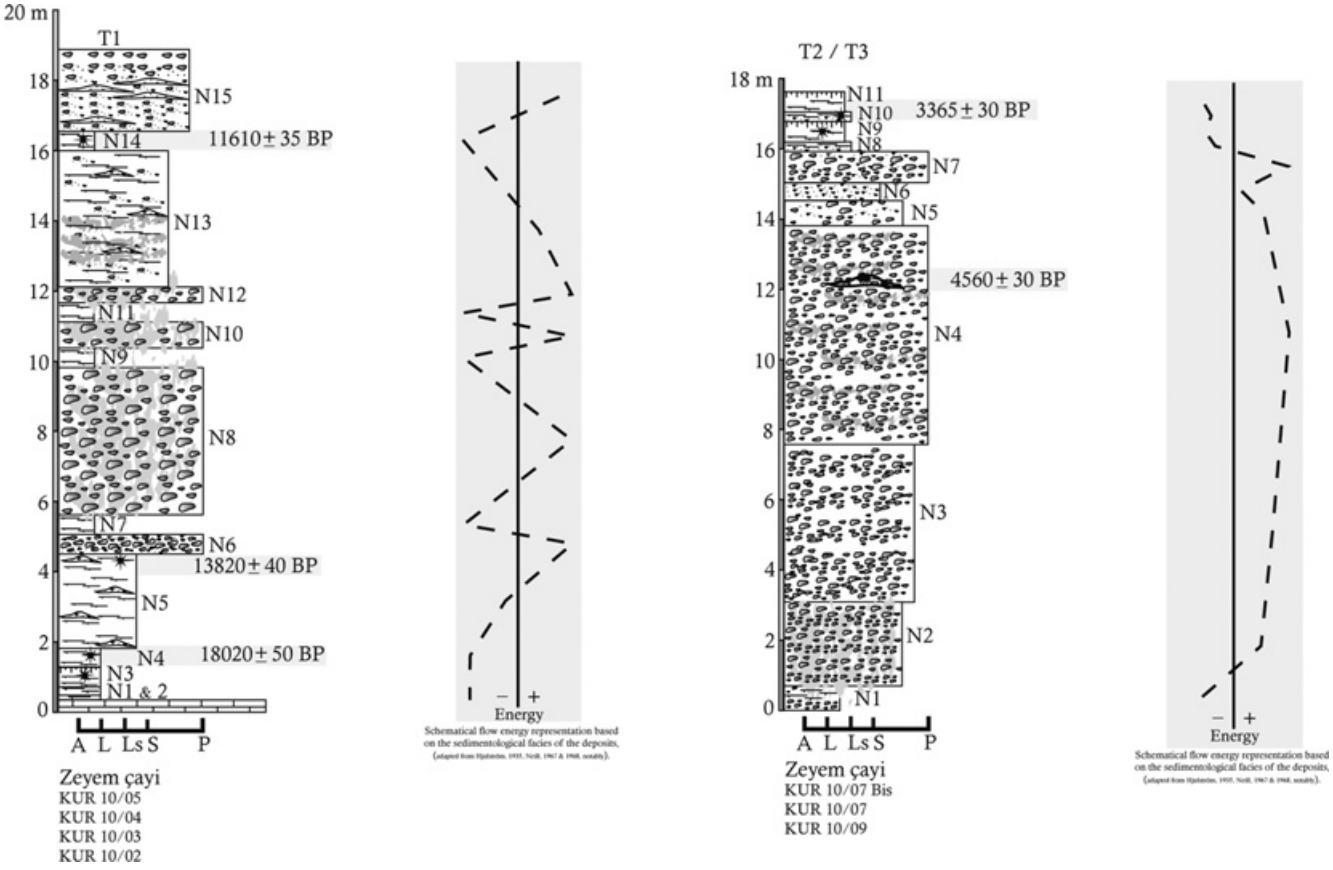

Fig. 160
Mentesh Tepe area. Zeyem çay, preliminarily studied stratigraphy

6 mm/year. This geodynamic contributes to the maturity of the longitudinal river profiles and to the amplification of the eustatic signatures in the terrace morphosedimentary expressions. Five terrace levels were identified during the geomorphological field work analysis, and their organization seems to follow relative level oscillations of the Caspian Sea since the last glacial maximum.

Geomorphology and geoarchaeology: preliminary result

The geomorphological and geoarchaeological studies were focused on two main strategies. The first one was to define precisely the landscape components and driving forces of the system. Each of the tributaries of the Kura River was analyzed in this regard. A total of 26 stratigraphical sections were decrypted and 21 radiocarbon analyses are in process. The estimation of palaeohydrodynamism in the respective stratigraphy studied is based on macrofacies sedimentological analysis.[293] The eustatic inertial impact time on the upstream hydrosystem morphogenical trend and the palaeo-shoreline localizations over time are based on the interpolation of radiochronological data and topographic altimetry of the Azerbaijan territory.[294] The second strategy was to focus on the archaeological sites discovered during field work in the course of the previous French Foreign Affair Ministry mission directed by Bertille Lyonnet. Around 60 sites were visited, including visible mounds and scatters of sherds on the surface. Despite the diachronic aspect of the sites observed, we have noticed that in this study area the major settlements from Neolithic to Bronze Age period (notably: Göy Tepe, Mentesh Tepe and Soyuq Bulaq) concerns primarily the higher terrace levels of the Kura River and its tributaries.

These high terrace formations started to settle during the Upper Pleistocene at 18 020 ± 50 BP (19 788–19 291 cal. BCE), a period of major Caspian Sea transgression **(Fig. 160)**. This dynamism, characterized by high energy deposits (pebbles and sands), continued until 11 610 ± 35 BP (11 661–

[293] Adapted from Hjulström 1935; Neill 1967; Neill 1968; Miall 1988; Wu *et al.* 1973 notably.

[294] SRTM NASA, cp. Farr *et al.* 2007.

Fig. 161 Mentesh Tepe area. Holocene flood area and silt deposit (Zeyem çayi and Hesensu çayi)

11 369 cal. BCE) during the late glacial period. A major regressive incision, which means a very important deepening of the downstream to upstream river valley, started between the late glacial era and the beginning of the Holocene (radiocarbon dating in progress). This event could be linked to the context of the Mangyshlak marine regression. This morphogenic trend was immediately followed by an intensive period of sedimentation, which continued until 3365 ± 30 BP (1742–1606 cal. BCE, **Fig. 160**). During this period, the hydrography and sedimentation were potentially connected to the dynamics of the Caspian Holocene transgression, and settlements were located on the periphery of river banks. Gradually, the next phases of marine regression disconnected the sites from the river proximity by the return to incision morphogenic trends.

Field work and investigations on the upper terrace levels enabled us to identify a specific area with a longitudinal transition of the outcrop facies. The soils in the upstream part are composed of silty deposits, while the downstream ones, in the direction of the Kura, consist of pebbles and sands. The Neolithic, Chalcolithic and Bronze Age occupations are mainly located in this silty deposit area. The stratigraphy of the right bank Kura tributaries clearly shows a fitting with erosion contact between silty and pebbly deposits. This is particularly visible in the natural cutting of the Zeyem and Hesensu rivers **(Fig. 161)**. A radiocarbon dating at 4495 ± 35 BP (3352–3090 cal. BCE) in the silty levels close to Mentesh Tepe confirms the chronology of the event **(Fig. 161)**. During the high relative level of the Holocene Caspian Sea, the flood from the Lesser Caucasus and its foothills covered the high terraces and caused the deposition of silt sediments. This dynamic of overflow over the Pleistocene/late glacial alluvial fan, where the settlements were located, provided thin sediments that are favorable for agriculture. The development of a humid zone with thalwegs, in which runoffs were more or less concentrated, at least until the Chalcolithic period, contributed to a relatively effective *in situ* water supply. The geological setting also played an important role in water availability in the area of archaeological sites. Lithology and faults control the proximity of aquifers and spring re-emergence. Yet, the eustatic movement can be considered here as the main parameter that controlled the hydrosystem morphogenical adjustment over time.[295] Subsequent to the Bronze Age, the thalwegs were significantly deeper due to the lowstand of the Caspian Sea. In this context, the human occupation seems to have decreased progressively, probably because the Neolithic and Chalcolithic settlement areas were 30 meters above the riverbeds within these new environmental conditions. Nowadays, the main parts of the higher terraces are relatively arid areas, colonized by a steppe cover of Artemisia. The main argument for this aridity is the very deep position of the groundwater due to morphostructural conditions

[295] Newson 2002.

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(*graben* and cretaceous limestone syncline). In addition, the landscape morphosedimentary expression and the sedimentological feature of the Quaternary formations outside the silty area, which are dominated by sands and quasi open-work pebbles deposits, support the water infiltration, which is observable at the sole infilling by seeps and spring re-emergence. Work is in progress in this area and needs to be further developed in order to complete the fluvio-eustatic model and its relation to human occupations. Nonetheless, the first environmental answers can be proposed.

Geomorphological research in the Mil Steppe area of the Lower Qarabağ

The second area of study is situated in the middle of the Mil Steppe in the Lower Qarabağ, in the Ağcabedi Rayon. As in the Tovuz region, archaeological sites dating to the Neolithic period are under excavation by a German-Azerbaijan team within the French-German ANR-DFG project "Ancient Kura" and the Academy of Science of Azerbaijan. Four Kura tributaries are under study in this open landscape: the Afşar, Gargar and Qarasu streams and – largest of all – the Araxes River. The tributaries of the Kura River are precious testimonies of the inland impact of Holocene eustatic variations on an archaeologically rich, yet poorly known region of Azerbaijan. Because they are closer to the Caspian hydrosystem than the Tovuz region, their study will provide us with clues for quantifying chronologically and spatially the landscape changes and their long term impact on ancient societies. In addition, the geomorphological analysis of the Araxes will supply valuable comparative data connected to the Armenian upstream area, where the Neolithic archaeological sites of Aratashen and Aknashen are located.

Environmental components

The Lower Qarabagh Mil Steppe is an open landscape with xerophytic vegetation that has developed in a plain punctuated only by small hills in direction of the Lesser Caucasus foothills. The climate is mildly subtropical, warm and dry. The calcareous substratum of the Jurassic and Cretaceous periods is covered by a very thick Neogenic sedimentation (around 200 m thickness), in which marine and fluvial Quaternary sandy-clayey deposits are significant. Limnic gray/brown and halomorphic/salsodic soils are prevalent. Closer to the Kura River and to the Kura-Araxes convergence are well developed swampy areas and riparian vegetation. As in the Tovuz region, a significant tectonic activity exists. Close to the Ağcabedi area, the uplifting process is greater with rates around 4–6 mm/year in the proximal Lesser Caucasus foothills. Downstream the uplifting values are negative with subsidence rates around −4 mm/year, decreasing in the estuarine area direction.

Hydrosystem characteristics

Few developed hydrosystems prevail in the Lower Qarabağ plain. This is due to the specific climatic conditions (mainly subtropical and semi-arid) and the geomorphological/lithological context predominated by low declivity and sandy-silty sedimentary cover. The precipitation, with an annual average rainfall under 400 mm/year, is absorbed by the high permeability of upstream soils, and the river drainage is uncertain. Downstream the underground water re-emerges and contributes to the Kura water table. It is also important to note that more than 70% of the river supply from the foothills is provided by this groundwater. The fluvial morphology of the Afşar, Gargar and Qarasu çayi is characterized by more winding riverbed with less cached thalwegs in comparison with the Tovuz region hydrosystems. The mean discharge of the Qarasu and Gargar çayi, one of the biggest unsustainable torrential rivers in our study area, is around 4.2 m^3/s with a reduced watershed inferior to 2500 km^2. Finally, one of our key rivers is the Araxes River. With a length of 1072 km (cp. the Kura River with 1514 km), a watershed of 102 000 km^2 (218 906 km^2 for the Kura) and a mean discharge of 285 m^3/s it is the major Kura tributary with important geomorphological implications beyond Azerbaijan and Armenia.

Geomorphology and geoarchaeology: preliminary results

Initially the palaeo-landscapes of the Ağcabedi rayon are difficult to determine without serious field work. The soft morphology of the plain and hills encountered there requires rather a micro-topographic analysis than a determination of the large landforms. However, gradually the Quaternary heritage and the forms and superficial formations that make up the actual landscape architecture become recognizable. We used the same strategies as in the Tovuz region, that is, an analysis of upstream – downstream systematics of the Afşar, Gargar and Qarasu rivers, and a focus on the archaeological sites which are frequently represented there by mounds or *tepe* containing abundant data about occupations during the 6th to 4th mill. BCE. As in the Tovuz region, we observed five alluvial terrace levels along these Kura tributaries, with the same morphosedimentary organisation **(Fig. 162)**. A total of 19 radiocarbon samples was made on seven key stratigraphies in determinant locations in order to understand each

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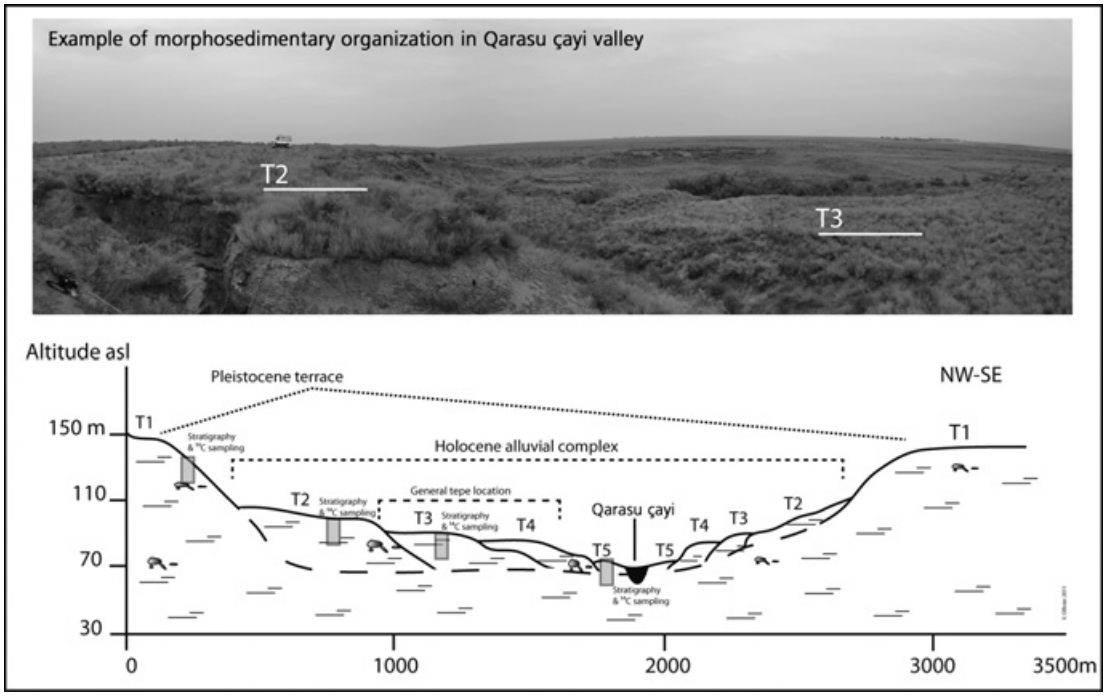

Fig. 162
Kamiltepe region. Morphosedimentary organization

river's evolution and their link with the major forcing. The geomorphological landscape is structured by hills, which are in fact the inheritance from the Upper Pleistocene and late glacial marine transgression. The micro plateau surfaces, separated by small slope failures (3 to 4 m), represent the Holocene terrace complex **(Fig. 162)**.

According to the curve in relative sea level,[296] during the Pleistocene-late glacial highstand, the shoreline was at 3 or 4 km from the Kamiltepe area and ca. 50 meters a.s.l. Then, during the late glacial-Holocene transition, the sea level fell, and the coastline receded ca. 120 km from this site area. Today, some Holocene soils are still saturated with salt in a few areas (for example, the downstream part of the Gargar River). The hydrosystem must have followed the landscape mutations imposed by variations in the sea level, but the lack of relief inferred by the low piedmont declivity hinders the visibility of the terrace fittings. However, we could determine that the sites are located on the terraces number 3 and 4 **(Fig. 162)**. The first observations show that the younger sites are above the flood plain, while the older ones, like MPS 4 (dated to the first 150 years of the 6th mill. BCE), are positioned in the middle of it and present flood levels in the top part of their stratigraphy. Opposite conventional morphogenetic events and characterizing a high base level for the hydrosystems, this could be interpreted as a first indication of the eustatic impact on the landscape and the human occupations.

Discussion and conclusion

Rises in the marine sea level can be very fast on a global scale,[297] but in the case of the Caspian Sea, its endorheic character make them even more rapid and reactive to the climatic and tectonic settings. Based on this, the hydrosystem and human occupations of the Caspian Basin should be even more sensitive to regional eustatic changes. Alluvial valleys provide the link between processes that control sediment flux to the continental margin and processes that control dispersal into the basin. The volume of sediment delivered to the margin reflects hinterland drainage areas and large-scale relief.[298] The valley incision probably characterizes the lowest of lowstands.[299]

Pleistocene and late glacial regressive or transgressive variations are of large amplitudes (+/−150 m) and are likely to affect significantly the fluvial morphology and the morphogenic dynamic

[296] Mamedov 1997; Rychagov 1997, Kroonenberg *et al.* 1997; Mikhailov *et al.* 2003; Hoogendoorn *et al.* 2005.

[297] Melt Water Pulse-1A: Deschamps *et al.* 2012.
[298] Blum 2003.
[299] Posamentier 2001.

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of the Kura River and its tributaries. The relative mobility of the Holocene curve of the Caspian Sea does not exceed the −21 m/−20 m of altitude in the transgressive phases, i.e. about 6 m higher than the current level. However, the modest Holocene variations, around 6 m in range, also seem significant enough to have caused the crossing of a geomorphic threshold for the Middle Kura Valley hydrosystems.

This positive feedback of the Kura tributaries to the eustatic movements is expressed through valley infilling during the highstand by the multiplicity of sediment inputs available from upstream. The regressive incisions during lowstands back up far into the inland (700 km) and spread to mountain torrential units. Favourable climatic conditions are necessary to promote each kind of development of morphogenic trends. In view of the important slopes encountered, the foothills hydrosystems can be considered as sensitive units reacting strongly to medium/high amplitude, but also to the long-term changes in the relative level of the Caspian Sea. The on-going work must be reinforced within this perspective, but important correlation between the Kura hydrosystem evolution and the Holocene eustatism seems to be confirmed.

In the Mentesh Tepe area, we noticed that modern villages and cultivated areas are located on the silty deposits that were generally occupied during the Neolithic period. Obviously, agricultural activities require the same approach to the past morphogenic evolution. Water for irrigation is artificially diverted to terraces areas in the high dry steppe. During the mid-Holocene, irrigation was natural (marine transgression and high torrential levels) and active through the overflow floods.

The Chalcolithic sites are seldom present on the surface, and the majority is buried beneath a sedimentary cover, as has been demonstrated by the survey mentioned above and BTC pipeline investigations.[300] Sometimes associated with Neolithic sites, they are also often located downstream from the piedmont, in the Kura floodplain. In the lowering phase of the sea level, this area became particularly exposed to gully erosion in the context of the 5500 cal. BP regression.[301] This could explain the low outcrop representation of the Chalcolithic sites in the Tovuz region.

In the Lower Qarabağ plain, two main geomorphologic phenomena can be distinguished in the human modes of occupation context: the river groundwater upwelling following the marine transgressions, on the one hand, and the Lesser Caucasus upstream watershed "flashflood" inferred to climatic conditions on the other. In each case, ancient societies had to occupy the most appropriate level of fluvial terraces. More investigations are necessary in order to build a precise pattern, but the multiplicity of the sites, of the identified palaeochannels and of the on-going radiocarbon dating concerning this area will certainly lead to the discovery of some determinant indications.

These preliminary results and interpretations inspire further research work, while giving some details about the main morphogenical driving forces that possibly influenced the Holocene human occupations in the Kura-Araxes Lowlands. The need for further cross analyses between archaeology and geomorphology is obvious.

Archaeological landscape studies: The Mil-Qarabağ Plain and the Kvemo Kartli Survey Projects: a preliminary account of the first two field seasons (2010–2011)

Andrea Ricci

Landscape archaeology plays a critical role in addressing the core research questions of the Ancient Kura Project. Intensive survey and geoarchaeological investigations are conducted to understand early settlement developments and human-environmental dynamics in the studied regions. So far detailed archaeological surface investigations have been conducted both in Azerbaijan and Georgia. In the former, during the summer of 2010 and 2011, for a total of seven weeks, a small team carried out initial archaeological landscape explorations along the Qaraçay and Qarasu river basins, in the southwestern part of the Ağcabədi Rayon, south of the Kura River **(Fig. 1)**. The results of the first year of investigation of the so-called Mil Plain Survey (MPS) have been recently discussed with an emphasis on the Neolithic presence.[302] In the second year, field work was conducted in collaboration with Vincent Ollivier. In September 2011, a two-week period of preliminary research was completed in the region of the Kvemo Kartli (KKS), along the Mašavera river basin, in southeastern Georgia **(Fig. 1)**. The third region to be investigated within the Ancient Kura Project is located around Mentesh Tepe and scheduled for 2012. Because of the brevity of these first two seasons, this account cannot be dealt with here in detail or thoroughly; instead, by presenting some preliminary results of this pilot research, we intend to provide a basis for discussion and a foundation for future work in the region.

[300] Maynard 2011.
[301] Hoogendoorn *et al.* 2005.
[302] Helwing *et al.* 2012.

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