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Environments and societies of small Caucasus (Armenia) in the light of the Quaternary climatic changes and landscape mutations

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Pluridisciplinary studies about quaternary and actual geomorphological, climatical evolution and archaeology (relationship between Man and Biosphere) are very poor in Eurasia (Armenia, Georgia and Azerbaijan notably, fig. 1), a crossroad area of cultural exchange and environmental changes. Actual or paleo-climate modelling, in connection with impacts on the societal and landscape modifications needs to include knowledge of the past climates (glacial or warming phases, aridification or fluctuant precipitation regimes episodes), landscapes (erosion and flood problems, threats to populations and natural resources) and societal modifications (adaptations and changes on human occupations, migration of the populations) from this part of the world to be much more efficient and generate scenario's proposals for the future hazards, risks and environmental modifications that are in action today.



Fig. 1, location of the studied area

The main goal of our study is to evaluate the respective influence of Quaternary climate oscillations (glacial and interglacial alternations) and paroxysmal events (seism and volcanism : those parameters are attractive and/or repulsive vectors for human populations that are playing a major influence in occupation mode, landscape evolution and climatic oscillations as a “global forcing”) on the morphogenic / palaeoenvironmental dynamics (landscape evolution rhythms) and human occupations from a long time period (1My to Holocene) in Eurasia.

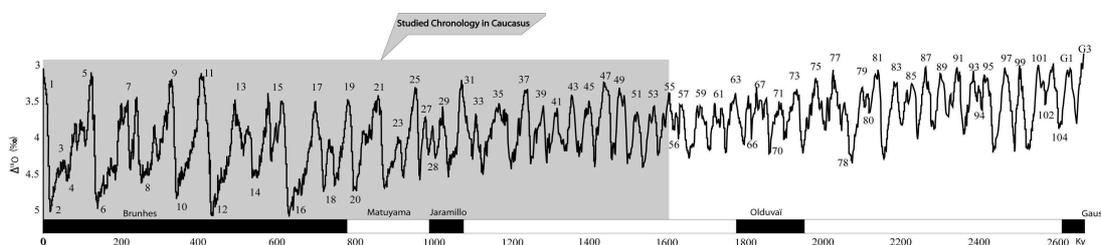


Fig. 2, Quaternary isotopic chronology covered by the study (adapted from Lisiecki and Raymo, Paleoclimatology, 2005, Vol. 20, pp. 1-17)

During the Quaternary period, the Small Caucasus range was marked by an intense volcanic activity. From northern to southern Armenia (Aragatsotn and Syunik region notably), bulky lava flows and tectonogenic movements closed the main valleys during the Pleistocene and allowed the establishment of several lacustrine areas with volcanogenic and/or diatomaceous deposits between 1.6 My and 700 Ky. Some of these deposits contain leaf impressions and pollens enabling local palaeoclimatic reconstructions, others are surrounded by Palaeolithic human occupations.

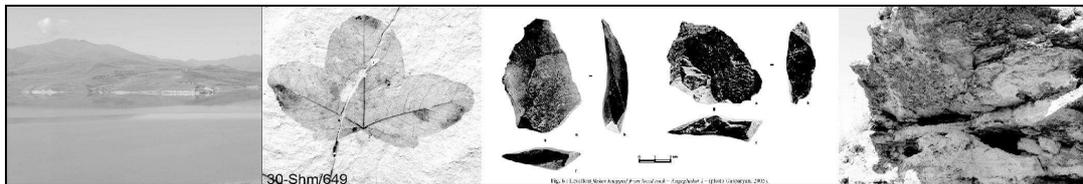


Fig. 3, examples of diatomitic lacustrine environments, leaves imprints, Paleolithic tools and travertine studied for the morphogenic and paleoenvironmental reconstruction

Several field-trips in Armenia since 2002 highlight the variability of the Quaternary morphogenesis in relation with volcanism, fluvio-lacustrine deposits, glacial inheritance, travertine formations and human occupations (fig. 3). Geomorphological maps and geological transects were performed. Preliminary events chronology is determined by numerous K/Ar, Ar/Ar, U/Th and radiocarbon dating (on basalt, volcanic pumice travertine samples and charcoals) and magnetostratigraphy.

Magnetostratigraphic analyses were carried out on the major fluvio-lacustrine section of the Syunik area (Shamb locality, southern Armenia) from which most of the palaeoecological data were extracted. According to the paleomagnetic results, the K/Ar age of the basalt flow in the upper part of the main section studied (993 ± 22 ka), and the Ar/Ar age of a pumice in a lower level ($1,21 \text{ Ma} \pm 40 \text{ kyr}$), the whole stratigraphy must have been deposited during the Matuyama period of reversed polarity, between Olduvai and Jaramillo events. The combined palynological and macroremains analysis of the same section highlights the alternation of relatively forested and steppic phases related to climatic variations moved from the obliquity periodicity (41 kyr). During the Lower Pleistocene, this area underwent major climatic fluctuations, going from a warm-temperate climate to a drier and temperate climate, and then to a cold climate during the glacial periods.

Evidence for several glaciations from Marine Isotopic Stage 11 to MIS 2 described at relatively modest altitudes (bottom of the Vorotan valley) underline the important role of the quaternary cold episodes in the Pleistocene morphogenic dynamic of southern Armenia. From northern to southern Armenia, major travertine formations with leaf imprints were developed on the slopes and valleys at 340 Ky, 250 Ky, 160 Kyr, 53 Kyr, 12 Ky, 10 Ky and 4 Ky to 1,5 Ky confirming the establishment of the interglacial or interstadial warming and their potential influences on the human occupations during the middle to the upper Quaternary. Then, the main valley alluvial incisions occurred between the Last Pleniglacial and the Postglacial period and the volcanic activity seemed to decrease during the Holocene.

This multi-proxy study reveals the major and rapid morphogenetic changes of the studied regions from the predominance of lacustrine environments at the beginning of the Pleistocene to the present river and canyon landscapes, in relation to tecto-volcanic events and the quaternary climate variability. Then from the recent archeological discovery of the different team of our programs, the effect of the evolution of the Quaternary climates and landscapes on the settlement of the Caucasian societies will be approached in the light of the numerous chronological data and palaeoenvironmental reconstructions. This work is based on the crossed research in archaeology, geomorphology and paleoecology of the "Caucase Mission", ECLIPSE, "Quaternary environments of the Lesser Caucasus: forcing of volcanism, glaciations and man", ECONET, "Palaeoeconomy and paleoenvironment in the European Neolithic context between Black Sea and Caspian Sea" programs and the French-Armenian collaborations (Departments of Geography, Archaeology/Ethnography, and Botany of the Yerevan State University).