



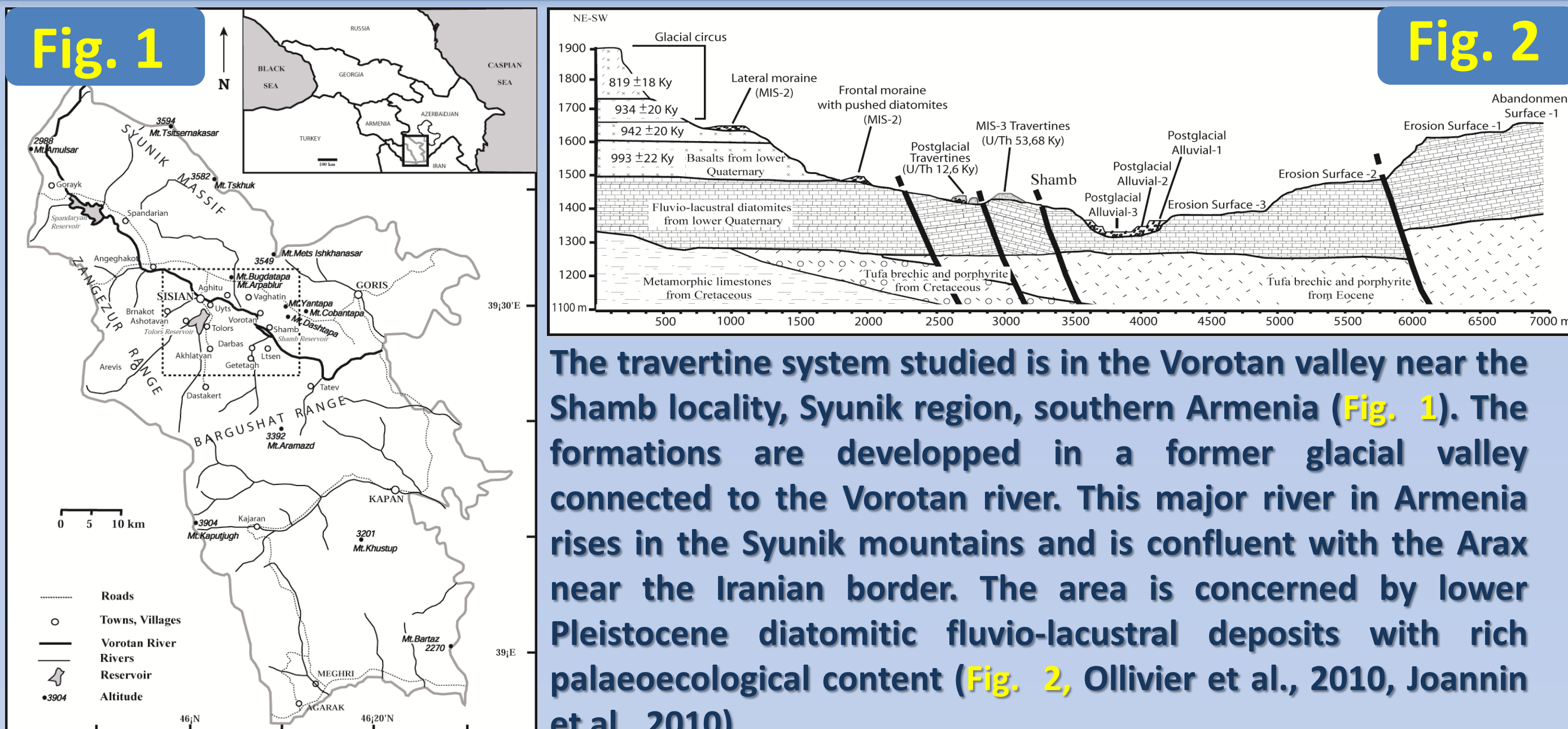
## Shamb travertine, southern Armenia : evidence of rapid climatic and morphogenic changes around 9500 cal. BP in the Lesser Caucasus

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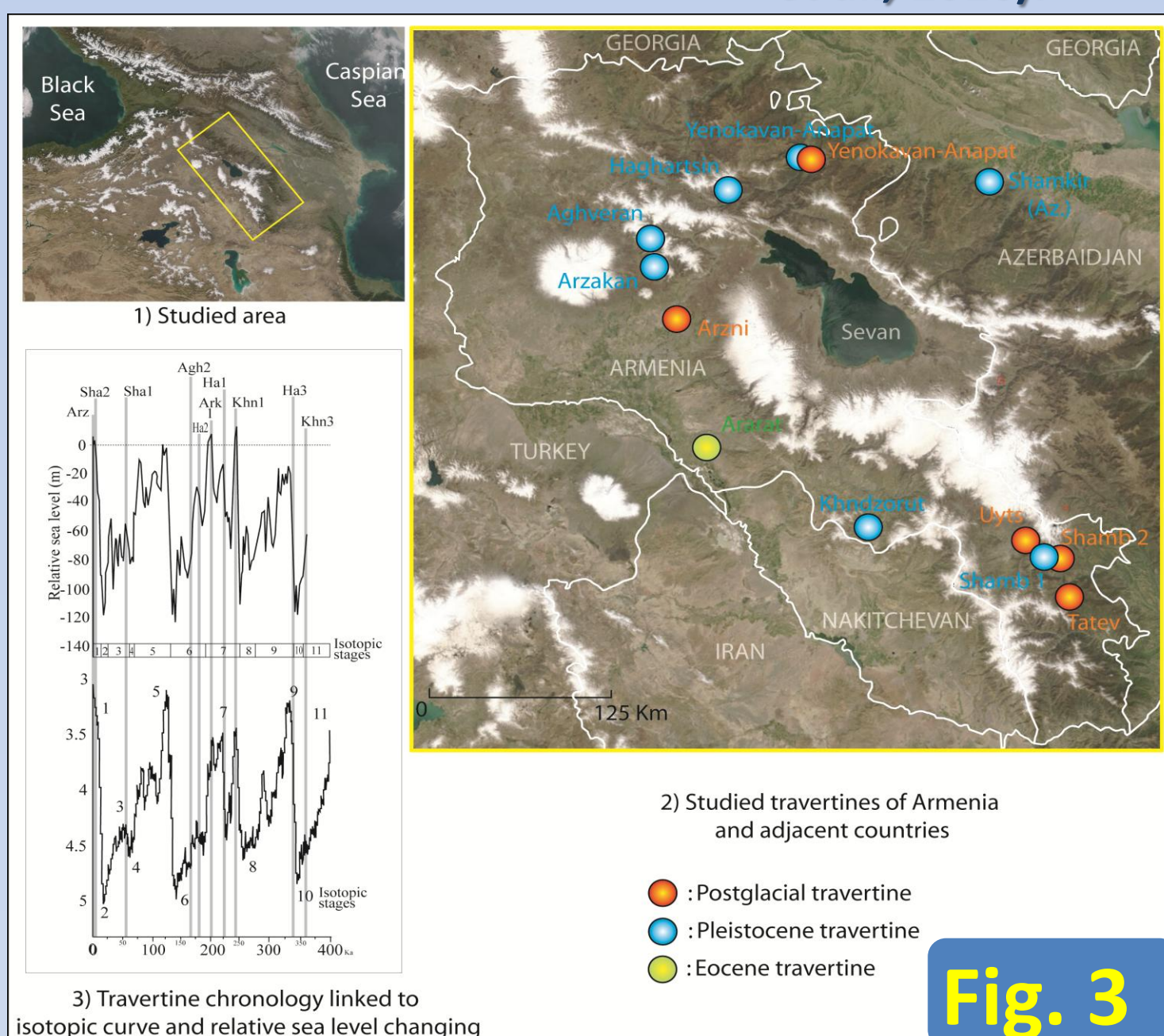
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### General context



The travertine system studied is in the Vorotan valley near the Shamb locality, Syunik region, southern Armenia (Fig. 1). The formations are developed in a former glacial valley connected to the Vorotan river. This major river in Armenia rises in the Syunik mountains and is confluent with the Arax near the Iranian border. The area is concerned by lower Pleistocene diatomitic fluvio-lacustral deposits with rich palaeoecological content (Fig. 2, Ollivier et al., 2010, Joannin et al., 2010).



The Shamb travertine consist of various facies from alluvial thin detrital sedimentary units to chalky carbonated layers and sharp travertine deposits with grass imprints, gastropods, pollens and charcoal.

The study of this formation is integrated into the "Caucasus Mission" Program (CNRS, MAE). One of the objectives of this research program is to define and identify the rapid climate changes and their impact on the landscape mutations and societies in the Lesser Caucasus through the morphosedimentary analysis of the Quaternary travertine system development (Fig. 3).

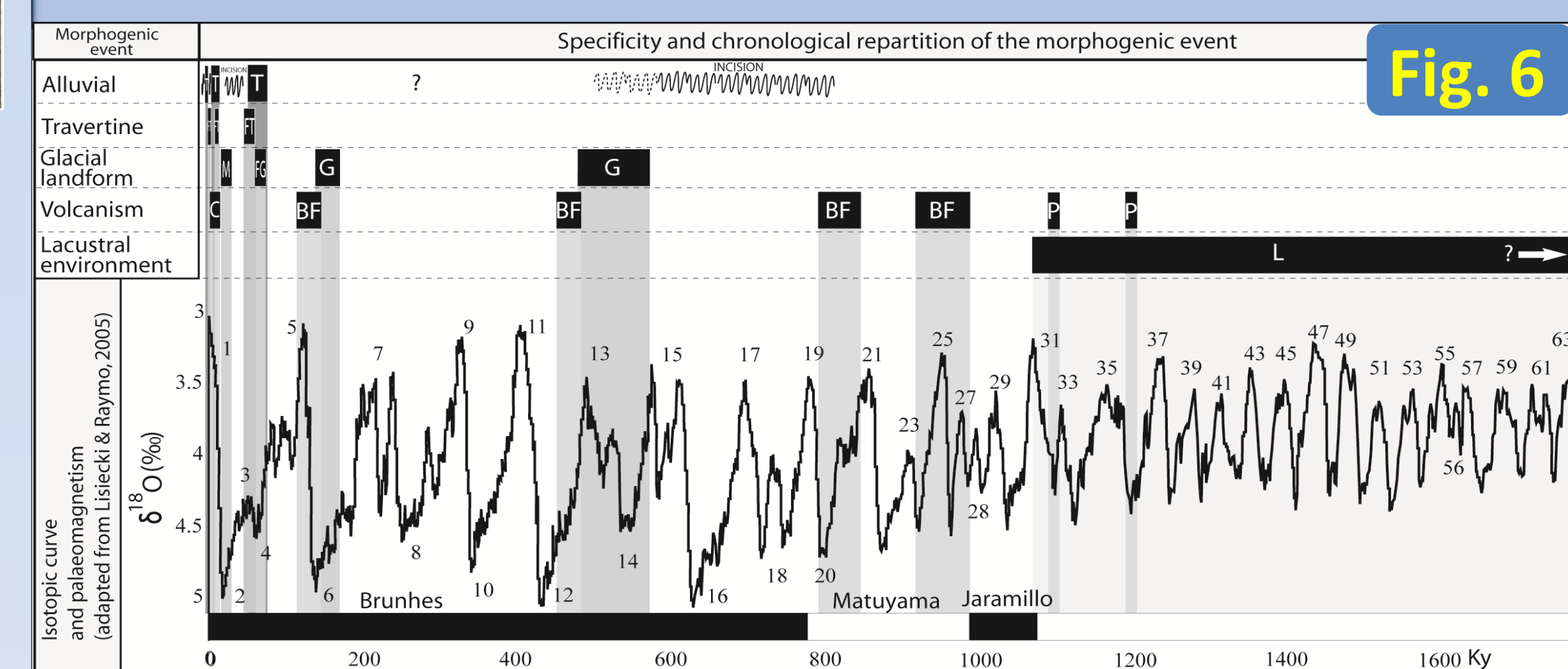
### Methodology and results



The geomorphological methodology used is a high-resolution morphosedimentary sequential analysis including palaeoecological data. The chronology is constrained by  $^{14}\text{C}$  dating (Fig. 4). In terms of sedimentary facies, our results clearly show the progression of temperate and humid conditions since the Last Glacial Maximum with an optimum ranked around 9000-9500 cal. BP. These conditions are expressed through the progressive development of various travertine facies, from chalky units to sharp carbonated deposits that underline the growth of hydrodynamic conditions in the valley (Fig. 5). A major phase of accumulation is also highlighted at this time. The pollen analysis almost completed will define more precisely these results. The presence of thin steppic fire levels in some subjacent Lateglacial travertine facies probably underline a short period of drier climate around 12900 cal. BP (Younger Dryas ?). The Shamb travertine can be characterized as a real composite stratigraphic sequence for the definition of the Rapid Postglacial Climate Changes in Lesser Caucasus.

Layers	Age BP	Age cal. BC	Age cal. BP
Shamb2-N17	8255 $\pm$ 45 BP	7455-7085 cal BC	9089-9406 cal BP
Shamb2-N15a	8200 $\pm$ 50 BP	7351-7065 cal. BC	9014-9300 cal BP
Shamb2-N15	8360 $\pm$ 50 BP	7542-7305 cal. BC	9254-9491 cal BP
Shamb2-N11	8780 $\pm$ 50 BP	7992-7632 cal. BC	9941-9581 cal BP
Shamb2-N9	8860 $\pm$ 50 BP	8223-7811 cal. BC	9760-10172 cal BP
Shamb 1-3	11080 $\pm$ 140 BP	11289-10716 cal. BC	12665-13238 cal. BP

### Conclusions



Then, the steppic and dry conditions occurs before a new reversal of morphogenic tendencies oriented towards the thalweg linear incision. This study sets the first step to the knowledge of landscape mutations in connection with climate changes and human occupations since the end of the last climatic cycle in this region. It takes part of the Quaternary morphogenic and palaeoenvironmental pattern already proposed for the 1.6 Ma to Holocene period in this region (Fig. 6, Ollivier et al., 2010 ; Joannin et al., 2010)

During the Lateglacial humid conditions begin to rise in the southern Armenia valleys. Around 9500 cal. BP temperatures and humidity seems to increase at the same time and causes the filling of the valleys by the travertine formations development. This climatic event is generally recorded between Caucasus, Iran and Anatolia (Morteza, 2008 ; Wick et al., 2003 ; Turner et al., 2008 ; Wasylikawa et al., 2008 ; Kvadadze et Connor, 2005, notably).