



Climate, human occupation and travertine deposits in Morocco

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Specific calcitic geological formations produced by water (speleothems and travertines) constitute an attractive environment for Humans through recent Quaternary period. The potential contribution of calcite analysis is exceptional because beyond the fact that it is close system for U-series dating, it also registers oxygen stable isotope ($\delta^{18}O$) variations which reveal temperature fluctuations and carbon stable isotopes (^{12}C and ^{13}C) which reveal, different types of vegetation (herbaceous or arboreal) that successively appeared through icehouse and greenhouse periods.

Hydrothermal travertine $\delta^{13}C$ values are displaced to more positive value than the average of meteogene (fluvial) travertines. Growth stages of calcite can be dated using several radiochronological methods, extended from present time until 500 ka with U-series dating method, and using paleomagnetic studies for older Pleistocene period. Geochemical and paleomagnetic data allow constraining human development within the Quaternary chronostratigraphic scale which is compared to the marine isotopic scale as a reference. Meteogene travertines are less suitable for geochemical isotopic studies and radiochronology than hydrothermal travertine due to their numerous impurities.

Here we present the first results obtained by the studies of Moroccan hydrothermal and fluvial travertine in 24 archeological sites distributed on the Moroccan territory. Two main information about growth periods are obtained: (1) travertine precipitation is effective from 1.1 millions years to Holocene, (2) growth periods are observed during both glacial and interglacial stages of the global climatic frame. The travertine prehistoric human occupation is discontinuous during the older periods but becomes more continuous since MIS 9 (350 ka). In the SE Morocco, in the Tafilalet area, flint fragments and Levallois nuclei were found upon travertine. They are probably relevant to Mousterian culture (from 200 to 35 ka.). Human occupation is also evidenced by Neolithic flint fragments (5000-4000 years B.P.) and tumulus (3000-1300 years B.P.) Travertine deposits are numerous in the Oujda area (NE Morocco) with many artefacts'. Until present day, many modern cities are located on travertine sites Fes, Sefrou, El Hajeb, Taza.

The factors which determine human occupation on travertine since Acheulean period are mainly environmental, i.e. (1) *liquid perennial water*, (2) *game hunting*, (3) *mild climatic conditions*.