Geophysical Research Abstracts
Vol. 19, EGU2017-9434, 2017
EGU General Assembly 2017

First numerical ages from the northern lake Chapala shoreline, western Mexico, and their importance for palaeontology and archaeology

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Lake Chapala in the central-western Mexican state of Jalisco is the successor of the late-Miocene to early Pleistocene palaeo-lake Jalisco and is situated in an active neotectonic basin at approximately 1500 m above sea level. It presently covers an area of ca. 1100 km^2 and represents Mexico's largest freshwater reservoir. As water depth reaches only a few meters the position of its shorelines has fluctuated substantially throughout the lake's history due to volcanic and tectonic activity as well as climate fluctuations. One of the more recently abandoned shorelines is preserved on the northern shoreline east of Ajijic at San Antonio Tlayacapan (SAT), where sand and silt deposits crop out at the present waterline. The beach sediments at SAT are famous for their fossils of late Wisconsian age (e.g. ground sloths, gomphotheriids), but also host human osteological remains, which are now housed in the Museo de Paleontología de Guadalajara, in the state capital.

Numeric dating of sediments from Lake Chapala has proven to be exceedingly difficult as bones are heavily mineralized by Fe-Mn-oxides. In addition, input of ancient carbon exists from hydrothermal sources deep underneath the lake bottom and its distribution throughout the lake-water body, with currents driven by easterly winds and respective counter-currents, leading to age inversions for 14C-dating (Zárate-del-Valle et al. 2011). As 14C radiometric methods are thus shown to be problematic we here tested the possibility of optical stimulated luminescence (OSL) dating. Diverse tests showed that the samples were not adequate for coarse-grain quartz dating or post infrared stimulated (post-IR) blue-light stimulated (BLSL) dating of polymineral fine grains. The blue emission band of the infrared stimulated luminescence (IRSL) signal of the natural samples has been proven to be quite dim, so that a single aliquot regeneration (SAR) protocol (Murray & Wintle 2000) was not suitable. Finally, we applied a traditional multi-aliquot additive (MAA) IRSL (blue) protocol to polymineral fine grains (4 – 11 μm) extracted from the sediment. This produced late glacial to early Holocene ages for the three SAT samples. Although the ages bear uncertainties, e.g. with respect to the samples‘ a-values and the possible variation of water content of the sediment over the dating period, to our knowledge they represent the first numeric ages for the fossil-bearing deposit. Our positive tests thus encourage us to use the results of the luminescence dating to narrow down the chronological placement of the fossil sites in the Chapala lake shoreface to late glacial to early Holocene times.

Murray, A.S. & Wintle, A.G. (2000): Luminescence dating of quartz using an improved single aliquot regenerative-dose protocol.- Radiation Measurements 32: 57–73.
Zápate-del-Valle, P.F., Ramírez-Sánchez, H.U., Fernex, F., Simoneit, B.R.T., Israde-Alcántara, I. (2011): Radiocarbon age inversions and progression: source and causes in Late Holocene sediments from Lake Chapala, western Mexico.- Environmental Earth Sciences 63:1011–1019.