Geophysical Research Abstracts
Vol. 20, EGU2018-12624, 2018
EGU General Assembly 2018

Successful combination of electron spin resonance, luminescence and palaeomagnetic dating methods allows reliable reconstruction of the Pleistocene evolution of the lower Moulouya river (NE Morocco)

Melanie Bartz (1), Mathieu Duval (2), Lee J. Arnold (3), Martina Demuro (3), Georgina E. King (4), Gilles Rixhon (5), Claudia Álvarez Posada (6), Josep Parés (6), and Helmut Brückner (1)

(1) University of Cologne, Institute of Geography, Köln, Germany (m.bartz@uni-koeln.de), (2) Australian Research Centre for Human Evolution (ARCHE), Environmental Futures Research Institute (EFRI), Griffith University, 170 Kessels Road, Nathan, QLD 4111/Australia, (3) School of Physical Sciences, Environment Institute, and Institute for Photonics and Advanced Sensing (IPAS), University of Adelaide, North Terrace Campus, Adelaide, SA, 5005/Australia, (4) Institute of Geological Sciences, University of Bern, Baltzerstr. 1-3, 3012 Bern/Switzerland, (5) Laboratoire Image, Ville, Environnement (LIVE), UMR 7362 - CNRS, University of Strasbourg-ENGEES, 3 rue de l'Argonne, 67083 Strasbourg Cedex/France, (6) Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Paseo de Atapuerca, s/n, 09002 Burgos/Spain

The lower Moulouya river (NE Morocco) is the largest catchment in Morocco and drains a tectonically active area due to the NW-SE convergence of the African and Eurasian plates. The Quaternary evolution of the basin has been very little studied so far and establishing reliable numerical chronologies has thus been quite challenging, in particular because of their expected antiquity (Calabrian to Middle Pleistocene). This study presents the first chronostratigraphic framework of the lower Moulouya fluvial deposits based on an unprecedented combination of numerical dating methods, namely electron spin resonance (ESR), optically stimulated luminescence (OSL), single-grain thermally transferred-OSL (TT-OSL) dating of quartz, as well as post-infrared infrared (pIRIR) stimulated luminescence dating of K-feldspar. Moreover, an additional independent chronological constraint was obtained through the systematic palaeomagnetic study of these fluvial deposits.

OSL and pIRIR dating yielded natural signals that lay at or close to dose saturation. However, the minimum ages calculated using these luminescence datasets constrain the accumulation of the lower Moulouya deposits to at least the Middle Pleistocene, or earlier (>0.3-0.8 Ma). Given these dose saturation limitations, ESR and single-grain TT-OSL dating were utilised as an innovative way to gain further chronological insights into the ancient Pleistocene fluvial deposits. With the multiple centres (MC) approach in ESR dating, equivalent dose values of the Al and Ti centres were found to be in general agreement within 1σ, suggesting complete bleaching of the ESR signals during fluvial transport. The ESR dating results yield finite Calabrian depositional ages for all river sections from $\sim$1.1 to $\sim$1.5 Ma, which are in good agreement with the final single-grain TT-OSL results. After undertaking grain-specific assessments of TT-OSL signal variability and applying an additional quality assurance criterion based on a Fast Ratio acceptance threshold of $\geq$2, we obtained TT-OSL ages of between $\sim$1.1 and $\sim$1.2 Ma for one of the fluvial sequences. These TT-OSL and ESR age results are consistent with the independent age control obtained using palaeomagnetism, where the occurrence of mostly reversed polarity in the deposits points to the Matuyama Chron (>0.78 Ma).

In conclusion, this study shows the high potential of the MC approach in ESR dating, especially when dealing with samples beyond the dating range of conventional luminescence techniques. The consistency between single-grain TT-OSL, ESR and palaeomagnetism provides a robust chronostratigraphic framework for the deposits. It indicates that massive fluvial deposition occurred in the lower Moulouya towards the end of the Calabrian. While low incision rates (0.025$\pm$0.003 mm/a) related to thrusting activity during the Calabrian could be inferred, the fluvial record points to an acyclic and discontinuous sedimentation pattern over the last $\sim$1.3 Ma. Our chronological datasets therefore probably rules out climate as the main driver for fluvial aggradation in the lowermost sedimentary basin. As a response to tectonic uplift, we suggest that a major capture event occurred during the first half of the Quaternary.