

A 20-ka reconstruction of a Sahelo-Sudanian paleoenvironment using multi-method dating on pedogenic carbonate

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Soils can be precious environmental archives as they are open systems resulting from external persistent disturbance, or forcing (Jenny, 1941). Pedogenic carbonate nodules associated with clay-rich soils have been investigated in the Far North region of Cameroon in non-carbonate watersheds (Chad Basin). Nodule bearing soils have mima-like mound morphologies, within stream networks. Such settings raise questions on the processes leading to carbonate precipitation as well as landscape genesis.

The mima-like mounds have been identified as degraded Vertisols, resulting from differential erosion induced by a former gilgai micro-relief (Diaz et al., 2016). Non-degraded Vertisols occur in waterlogged areas, located downstream from mima-like mound locations (Brabant and Gavaud, 1985). Therefore during a former wetter period Vertisols may have been extended to the mima-like mound areas, followed by a shift toward drier conditions and erosion (Diaz et al., 2016). Consequently, mima-like mounds and associated carbonate nodules are inherited from climatic changes during the Late Pleistocene-Holocene period.

The aim of this study is to validate the scenario above using the carbonate nodules collected in a mima-like mound as time archives. Optically stimulated luminescence (OSL) dating of K-feldspars trapped within the nodules is used to assess the deposition time of the soil parent material, composing the mima-like mounds. The carbonate and organic nodule parts have been radiocarbon dated with the aim of assessing the carbonate precipitation age and the age range of soil formation, respectively.

Results show that the soil parent material was deposited between 18 ka and 12 ka BP and that the nodules precipitated between 7 ka and 5 ka BP. These results suggest that the deposition occurred during the arid climatic period of the Bossoumian (20 ka to 15 ka BP; Hervieu, 1970) and during the first drier part of the African Humid Period (14.8 ka to 11.5 ka BP; deMenocal et al., 2000; Armitage et al., 2015). It is thus likely that the onset of Vertisol genesis at the mima-like mound areas occurred during the main humid period (since 11.5 ka BP; Armitage et al., 2015). The carbonate nodules seem to be related to the third lacustrine transgression at the end of the African Humid Period (7 ka to 5 ka). The ages provided by radiocarbon dating on the trapped organic matter are expected to range between the OSL ages and the carbonate nodules ages.

These results strengthen the scenario proposed for mima-like mounds genesis and validate their potential as palaeoclimatic archives within the Chad Basin.

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