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First proofs of preservation of a Mesozoic paleorelief in Southeast Africa: Insights from the (U-Th)/He dating of iron oxides from Malawian duricrusts

Maximilien Mathian[1], Guillaume Baby[2], Jean-Noël Ferry[3], François Guillocheau[4], Thierry Allard[5], Patrick Rafiki N Chindandali[6], Gilles Ruffet[4], Cécile Quantin[1], Rosella Pinna-Jamme[1], and Cécile Gautheron[1]

[1]GEOPS, Université Paris Saclay, UMR CNRS 8148, 91405, Orsay, France (maximilien.mathian@u-psud.fr)
[2]IPGP, Université Paris Cité, UMR CNRS 7154, 75005, Paris, France (baby@ipgp.fr)
[3]Total R&D, Total Scientific and Technical Center Jean Fréger, 64000, Pau, France (jean-noel.ferry@total.com)
[4]Géosciences Rennes, Université de Rennes 1, UMR CNRS 6118, 35000, Rennes, France (francois.guillocheau@univ-rennes1.fr)
[5]IMPMC, Sorbonne Université, UMR CNRS 7590, 75005, Paris, France (thierry.allard@upmc.fr)
[6]Malawi Geological Survey Department, M3, Zomba, Malawi (rafikiwanga@gmail.com)

Approximately 70% of the emerged relief on the Earth is characterized by erosional low-gradient topography also known as planation surfaces (PS). Many geomorphologists defend the idea that some of these surfaces could be relics of old reliefs uplifted and preserved from erosion for tens of millions years. Some of the highest PS of Southeast Africa (> 2000 m) were considered by King (1962) as remnants of an ante-Cretaceous paleorelief called “Gondwana Surface”. Specifically, the Nyika Plateau (Northern Malawi, 2200 m) is one of the largest potential relics of the “Gondwana Surface” in Southeastern Africa. This PS overlooks the stripped etchplain of the Malawian Plateau, a potential Late Cretaceous PS about 1200 m of elevation.

However, the preservation of such ancient reliefs is controversial, particularly under a tropical wet-dry climate. Doubts about the ages of these PS exist mainly due to the lack of a precise chronology of these objects on a continental scale. In detail, African PS are often covered by preserved or partly eroded tropical weathering covers such as unconsolidated laterites and/or duricrusts. Under these climatic conditions, lateritic duricrusts can be preserved for millions of years and thus contain several generations of iron oxides witnesses of past local paleoenvironment and geodynamic evolution. In order to understand the formation and preservation of the Southeast African highest PS and date them, we decided to apply (U-Th)/He dating of iron oxides on selected duricrust samples. The exploration of the Nyika Plateau allowed the discovery of an outcropping duricrust and a depositional area of eroded duricrust blocks from different origins. We study duricrust samples from these two areas in order to find some clues about the plateau antiquity and to improve our knowledge about the local paleoclimatic and geodynamic history.

Samples from the in situ duricrust levels, outcropping on the plateau, are polygenic and are

formed by three main types of zones: preserved and degraded hematite-rich zones, that are considered to correspond to the initial generation of iron oxides, and a goethitic matrix. The preserved hematites have a Mesozoic (U-Th)/He ages, whereas the goethite-rich matrix of this duricrust formed during the Quaternary. The degraded hematite-rich parts, also rich in quartz, have more dispersed ages ranging from the Mesozoic to the Tertiary. In the detrital accumulation zone, blocks from a similar duricrust were found as well as blocks of another type of duricrusts: a pisolithic one rich in goethite. This last type of duricrust was eroded from a more recent duricrust level, as their iron oxides have Late Tertiary/Quaternary ages. These dating proved the Nyika Plateau relative stability since the Mesozoic period, confirming that duricrusting of reliefs in tropical area can also protect old emerged landscapes from total erosion.

King L.C. (1962) Morphology of Earth, Oliver and Boyld, Edinburg.