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Late Miocene uplift and doming of Madagascar: topographic implications

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Madagascar is an Archean to Neoproterozoic continental crust surrounded by transform, oblique and divergent margins: the oblique Morondava Basin to the west, pounded by the Davie Fracture Zone, and to the north, the divergent Mahajanga (Majunga) Basin connected to the Somali Oceanic Basin. This 1600 km long island is a high axial plateau with elevations from 1200 to 1800m. The top of the plateau corresponds to weathered planation surfaces (etchplains), bounded by more or less high scarps.
We here present geological arguments for the age and the timing of the Madagascar Plateau. This analysis is based on a double, coupled analysis of the onshore geomorphology (stepped planation surfaces) and the offshore margin stratigraphy (seismic stratigraphy and wells).
The geomorphological analysis is based on a characterization, a mapping and dating of stepped planation surfaces (mantled to stripped etchplains, pediments to pediplains). The dating is based on their geometrical relationships with dated magmatic rocks. The difference of elevation between two planation surfaces (corresponding to local base level) provides a proxy of the uplift. The sequence stratigraphic analysis is based on a biostratigraphic reevaluation of 4 industrial wells (foraminifers and nannofossils on cuttings). Uplift periods are characterized by (1) seaward tiltings of the margins overlain by planar reflectors, (2) forced regression wedges and (3) upstream erosions of older sediments recorded by fauna/flora reworking.
(1) During Paleocene to Middle Miocene times (66 to 13 Ma), Madagascar is a quite flat low elevation domain with remnants of an oldest pre-Madagascar Trap (90 Ma) surface. This low relief is highly weathered with growth of numerous lateritic profiles and surrounded by large carbonate platforms with no siliciclastic sands influx.
(2) The Late Miocene is the paroxysm of uplift with (1) a tilting of the margin (Morondova), (2) an increase of the siliciclastic sand flux since middle Miocene and (3) a major stepping of dated planation surfaces.
(3) The end result of this uplift is a convex up shape pattern for the end Cretaceous surface weathered during Eocene times, creating the present-day dome morphology (with a central plateau) of Madagascar.
(4) The amplitude of this uplift can be estimated based on the present-day elevation of Late Eocene lagoonal sediments located 100 km north-east of Toliara and now at an elevation of 900m. If the absolute sea level was around 50 m (Miller et al., 2005) above present-day sea level during Late Eocene times, this means a surface uplift of around 850 m.
(5) The mechanism of this uplift has to explain a very long wavelength deformation (x1000 km) necessary due to mantle dynamics. The relationships with the other East African domes (Ethiopia, East Africa, South Africa) are discussed.
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