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Austral and East African Uplifts and Relief Growths, Paleoclimate Changes: A Tool for Predicting Offshore Sediments Location and Nature

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Summary

The topography of Austral and Eastern Africa (including Madagascar) is characterized by very long wavelength (several thousands of kilometers) plateaus and domes related to mantle dynamics: the Southern (Kalahari) Plateau, the Eastern (Kenyan) African and Ethiopian Domes and Madagascar Plateau.
Our objective here is to discuss the relationships between the plateaus and domes growth since Early Cretaceous times, the climate (and mainly the precipitation) changes and the sediment supply along the passive margins.

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Our objective here is to discuss the relationships between the plateaus and domes growth since Early Cretaceous times, the climate (and mainly the precipitation) changes and the sediment supply along the passive margins (research project PAMELA - Passive Margin Exploration Laboratories - founded by TOTAL and IFREMER).

The reconstruction of the paleoprecipitation record (paleobotanical data) suggests humid to very humid conditions required for chemical weathering from Valanginian to Early Aptian, from Coniacian to Middle Eocene, Late Oligocene, Tortonian and Zanclean.

Uplifts (onshore geomorphology and offshore stratigraphiy) occurred (1) during Late Cretaceous times (90 Ma and 70 Ma) with the growth of the South African Plateau, (2) around the Oligocene – Eocene transition with the early stages of the East-African and Ethiopian domes and of the Madagascar Plateau, with a paroxysm during Late Miocene times (main uplift of Madagascar. The 30-15 Ma period is the second phase of uplift of the South African Plateau which reached its present-day elevation.

Both these uplifts and climate changes control at the first order the erosion processes, the topography and then the sediment supply.

1. The Late Cretaceous uplift of the South African Plateau fed two major sedimentary systems, the Orange and proto-Zambezi system, mainly supplied from the Bushveld area. These systems are not fed by a single point source, but by several rivers with coalescent deltas. The sediments are mainly made up of silts with few sands, probably coming from the erosion of the Early Cretaceous (Valanginian-Early Aptian) weathering profiles.
2. The Paleocene-Eocene time interval is characterized by an intense period of weathering (starting around 80 Ma on the South African and Madagascar Plateaus) with formation of thick laterites surrounded by carbonate platforms (chemical solutes). Little mechanical erosion occurred on the Indian Ocean side (proto-Tugela, proto-Zambezi, proto-Rovuma deltas) mainly during Paleocene times.
3. The Eocene-Oligocene uplift initiated the present-day drainage system with several point-source deltas. The Late Miocene uplift led to a major stripping of old weathering products or newly formed ones (during the humid periods of the Late Oligocene and the Late Miocene) that are transported offshore as silts (dominant lithology) and clays (smectites-dominant), transformation along the coastal plain of kaolinites.