Evolution of High-Altitude Passive Margins: Morphology, Uplift Processes and Source-to-Sink Dynamics in the Eastern Red Sea Rifted Margin

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Résumé

This presentation explores the formation and evolution of high-altitude passive margins, focusing on the morphology and uplift processes of the eastern Red Sea region and its relationship to the stratigraphy of the Red Sea (Source to Sink approach). The main objective is to address gaps in our understanding of the origins and persistence of erosional escarpments along rifted margins and their connection to continental rifting. To achieve this, the research combines geological observations, mapping, and reconstructions of past topography to calculate erosion rates and compare them to sedimentation volumes. The study presents a landform map of the Eastern Red Sea Margin (ERSM) and an age model of landscape evolution in eastern Arabia. It discusses different phases of erosion and their timing, focusing on two distinct domains: an old planation surface that was exhumed and rejuvenated during the Oligocene on the plateau, and a young ($<$ 15 Ma) coastal plain formed by the eastward retreat of the escarpment. Furthermore, we identified three different settings controlling the escarpment evolution and coastal plain morphology along the margin from north to south. Subsequently, we discuss the relationship between the morphology of the escarpment and the segmented structure of the ERSRM. These observations allowed us to propose post-rift erosion volumes and rates. Immediately after the end of rifting in the Red Sea, erosion rates are high and remain relatively high (although decreasing) up to 5 Ma. A dramatic drop in erosion rates during the Pliocene is observed and we discuss whether this is due to margin equilibrium or climate changes. Analyzing the source-to-sink budget, we show that while eroded and sedimented volumes are in the same range, an overall deficit in eroded volumes is observed. The conclusion emphasizes the need for further modeling and investigation to better understand the flexural response to denudation and to refine our understanding of erosion and scarp retreat processes in relation to climate. By bridging the gap between onshore geomorphic evolution and coastal basin stratigraphy, this study contributes to a comprehensive understanding of the long-term evolution of rifted margins.

Mots-Clés: Red Sea, Geomorphology, Escarpment, Source to Sink, Landforms evolution

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