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Structural inheritance, segmentation, and rift localization in the Gulf of Aden oblique rift

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The structural evolution of the Gulf of Aden passive margins was controlled by its oblique divergence kinematics, inherited structures, and the Afar hot spot. The rifting between Arabia and Somalia started at 35 Ma just before the hot spot paroxysm (at 30Ma) and lasted until 18Ma, when oceanic spreading started.
Fieldwork suggests that rift parallel normal faults initiated in the (future) distal margins, after a first stage of distributed rifting, and witness the rift localization, as confirmed by 4-layer analogue models. These faults arise either from crust or lithosphere scale buoyancy forces that are strongly controlled by the mantle temperature under the influence of the Afar hot spot. This implies a transition from a distributed mode to a localized one, sharper, both in space and time, in the West (close to the hot spot) than in the East (far away from the hot spot).
In this framework, first order transform F.Z. are here (re-) defined by the fact that they deform continental crust. In the Gulf of Aden, as well as in other continental margins, it appears that these F.Z. are often, if not always, located at continental transfer or "transform" fault zones. Our detailed field-study of an offshore transfer fault zone in the southeastern Gulf of Aden (Socotra Island) shows that these structures are long-lived since early rifting until post rift times. During the early rifting, they are inherited structures reactivated as oblique normal faults before accommodating strike-slip motion. During the Ocean-Continent Transition (OCT) formation ("post syn-rift" times), a significant uplift occurred in the transfer fault zone footwall as shown by stratigraphic and LT thermochronology data.
Second order transform F.Z. are defined as deforming only the OCT, thus initiated at the moment of its formation. In the western Gulf of Aden, the hot spot provoked a rift localization strongly oblique to the divergence and, as a consequence, several second order transform F.Z. formed (as well as third order ones that initiated after the onset of oceanic spreading). In the East, the second and third order segmentation is less pronounced as both the OCT and ridge segments are sub-perpendicular to the divergence. During post-rift times, plate reorganization led to oceanic propagator development and second/third transform F.Z. migration along with deformation and vertical movements and normal displacement along the first order transform F.Z. Finally, during Quaternary times, the evolving boundary conditions of the Arabian plate probably also induced vertical movements along the margins.