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Tectonic evolution of sedimentary basins of northern Somalia

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Regional seismic reflection profiles tied to lithological and biostratigraphic data from deep exploration wells have been used to determine the structure and evolution of the the Guban, Nogal and Daroor basins of northern Somalia. We recognize six major tectonostratigraphic sequences in the seismic profiles: Middle-Late Jurassic synrift sequences (Adigrat and Bihen Group), ?Cenomanian-Campanian syn-rift sequences (Gumburo Group), Campanian-Maastrichtian synrift sequences (Jesomma Sandstones), Palaeocene post-rift sequences (Auradu Limestones), Early-Middle Eocene post-rift sequences (Taleh Formation) and Oligocene-Miocene (Daban Group) synrift sequences.

Backstripping of well data provides constraints on the age and duration of rifting and the amount of crustal and mantle extension. The tectonic subsidence and uplift history at the wells can be explained by a uniform extension model with three episodes of rifting punctuated by periods of relative tectonic quiescence and thermal subsidence. The first event initiated in the Late Jurassic (~156 Ma) and lasted for ~10 Myr and had a NW-SE trend. We interpret the rift as a late stage event associated with the break-up of Gondwana and the separation of Africa and Madagascar. The second event initiated in the Late Cretaceous (~80 Ma) and lasted for ~20-40 Myr. This event probably correlates with a rapid increase in spreading rate on the ridges separating the African and Indian and African and Antarctica plates and a contemporaneous slowing down of Africa's plate motion. The backstripped tectonic subsidence data can be explained by a multi-rift extensional model with stretching factor, β, of 1.09-1.14 and 1.05-1.28 for the first and second rifting events respectively. The model cannot, however, fully explain the slow subsidence and uplift history of the margin during the Early Cretaceous to Late Cretaceous. We attribute this apparent subsidence to the combined effect of a sea-level fall and regional uplift, which caused a major regional unconformity. The third and most recent rifting event occurred in the Oligocene (~32 Ma) and lasted for ~10 Myr. This rift, which reactivated some of the faults associated with earlier rifting events, is related to the opening of the Gulf of Aden.

The result of these multiple rifting events is that the regionally warped crust that underlies the rim flank uplift of the southern edge of the Gulf of Aden rift has been locally thinned by up to a factor of 2. This has led, in turn, to the development of more than one distinct petroleum system in the Guban, Nogal and Daroor basins. The principal exploration play is for Mesozoic petroleum systems with the syn-rift Oligocene-Miocene taking on a subordinate role owing to low maturity and seal problems. The main seals for the different plays are various shales, some of which are also source rocks, but the Early Eocene evaporites of the Taleh formations also perform a sealing role for Palaeogene or older generated hydrocarbons migrating vertically.