Tectono-sedimentary development of the (Permian) Karoo sediments in the Kilombero Rift Valley, Tanzania

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Abstract

The Kilombero Rift Valley in Tanzania belongs to the East African Rift System and contains a sedimentary sequence of Karoo age that is more than 6000 m thick. The present Kilombero Rift basin is most likely of Cenozoic origin. Nevertheless, within the present rift, the Karoo sequences were formed in an earlier rift basin characterised by westerly-dipping boundary faults, i.e. with a different polarity than the present one.

The Karoo sequences of Permian age comprise three formations in the Kilombero Rift (Ndeke Beds, Calcareous Beds and Ruhembe Beds). These units are made up of terrigenous, mainly siliciclastic sediments. The succession is well correlated with other East African Karoo units, and displays a rift-controlled sedimentation.

The Ndeke Beds represent debris flow, braided stream and floodplain deposits within an alluvial fan system, building out from well developed, high relief border faults, situated to the east in a westward-facing half-graben. The present results point towards a half-graben of about 80 km length and at least 40 km width. There seems to have been only one major early rifting phase, which triggered the deposition of the Ndeke Beds. Most of the Ndeke Beds and the succeeding Calcareous Beds represent a post-rift filling phase. In this development, the alluvial fans formed the marginal parts of a basin, which, through a succeeding topographic levelling and the development towards a low relief landscape, were dominated by lacustrine sedimentation. The overlying, mainly fluviodeltaic Ruhembe Beds reflect a late Karoo tectonic activity. This event is displayed in well-developed debris flow zones near the top of the Karoo succession in the Kilombero Rift basin.

Our stratigraphical investigation has not discovered any sedimentary units between the Karoo and Quaternary. However, Mesozoic Beds have been described from the western rifts and the coastal areas of Tanzania, and may also be present in the central areas of the Kilombero Rift Basin.

The Cenozoic rift phase is clearly reflected in the present topographic relief, where two synthetic, eastwards facing half-grabens are separated by a well developed, high relief accommodation zone (the Gombati Transfer Zone). The accommodation zone displays a complex tectonic signature due to block faulting and rotation of the strata, between prominent dextral transfer faults. This pattern is in great contrast to the minor tectonic disturbances found in the sediments, both to the north and south of the transfer zone.

The switch in half-graben polarity and tectonic setting from the Karoo to the Cenozoic situation, clearly demonstrate that even if the tectonic lineaments tend to follow the same zones of weakness, their polarity and internal configuration is far from straightforward.