Depositional environment of late permian karoo beds in the Ruhuhu basin and Mikumi area of Tanzania

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Abstract

The Middle to Upper Permian Karoo sedimentary rocks in the western part of the Ruhuhu Basin have been stratigraphically redefined. They comprise the Mbuyura, Mhukuru, Ruhuhu and Usili Formations hirtherto known as K3, K4, K5 and K6 units respectively. Mbuyura Formation has further been subdivided into the Scarp Sandstone Member, ..Green Beds" and "Red Beds". Three tectonically controlled depositional cycles are recognized in this succession. The first cycle was initiated by fault movements within the NE - SW trending basin which at that time comprised two half grabens with uneven basin floor. Braided river sands of the Scarp Sandstone Member were deposited from the north and southwest of the basin. They pass upwards and laterally into braid plain mudrocks and sandstones of the "Green Beds". The second cycle was initiated by faulting outside the basin margins which led to overstepping of the "Red Beds" on the Precambrian metamorphics (basement), deposition of braided river sands at the basin margin and formation of mud flats and desiccating shallow ponds towards the basin centre. Amelioration of dry conditions accompanied the deposition of the overlying fluvial-lacustrine sandstones and carbonaceous mudrocks of the Mhukuru Formation. At that time the high grounds in the basin were disappearing under the sediment cover and the depositional area was acquiring a uniform easterly to southeasterly gradient. The overlying Ruhuhu Formation with a total thickness of more than 500 m of calcareous and non-calcareous mudrocks with stromatolite and oolite beds represents an establishment of a broad permanent lake with slightly alkaline waters during most of its history, The 13C isotopic values (+3.457 to -18.251 (PDB)) in the calcareous beds suggest that a great part of the carbon in the carbonates was derived from decomposing plant matter. The third cycle is represented by the Usili Formation. It commenced approximately at the Kazanian/Tatarian boundary as the area with Karoo beds was slowly being uplifted. The uplift coupled with lake level fluctuations resulted in the formation of uplands from which rudaceous sediments (lithic arenites) were eroded and deposited in the low lying mudflats and shallow lakes. The sandstones in the lower three formations are dominated by texturally immature arkoses (up to 70% feldspars) and subarkoses which indicate short transport distances from the basement

provenance. Early diagenesis in the sediments as a whole was controlled by climatic conditions and to some extent by depositional environments whereas at the late stages, diagenesis was influenced by temperature, pressure and the type of sediments. A comparison between the Karoo rocks in the Ruhuhu Basin and those in the Mikumi area has been carried out. The available palaeontological data allow a general stratigraphic correlation but are still insufficient for a detailed correlation. A more detailed correlation is nevertheless possible when the palaeontological data are combined with lithostratigraphy. It is concluded that the Karoo succession in the Mikumi area is of the same age as the succession in the Ruhuhu Basin starting from the "Red Beds" to the top of the Usili Formation and both areas were subjected to similar tectonic and climatic patterns, In contrast to the terrestrial depositional environments which prevailed throughout the history of the Ruhuhu Basin. The Mikumi area was for a short period of time within the influence of marginal marine or brackish water conditions.