

Grain Size Statistics and Depositional Pattern of the Eccca Group Sandstones, Karoo Supergroup in the Eastern Cape Province, South Africa

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Abstract : Grain size analysis is a vital sedimentological tool used to unravel the hydrodynamic conditions, mode of transportation and deposition of detrital sediments. In this study, detailed grain-size analysis was carried out on thirty-five sandstone samples from the Eccca Group in the Eastern Cape Province of South Africa. Grain-size statistical parameters, bivariate analysis, linear discriminate functions, Passega diagrams and log-probability curves were used to reveal the depositional processes, sedimentation mechanisms, hydrodynamic energy conditions and to discriminate different depositional environments. The grain-size parameters show that most of the sandstones are very fine to fine grained, moderately well sorted, mostly near-symmetrical and mesokurtic in nature. The abundance of very fine to fine grained sandstones indicates the dominance of low energy environment. The bivariate plots that the samples are mostly grouped, except for the Prince Albert samples that show scattered trend, which is due to the either mixture of two modes in equal proportion in bimodal sediments or good sorting in unimodal sediments. The linear discriminant function (LDF) analysis is dominantly indicative of turbidity current deposits under shallow marine environments for samples from the Prince Albert, Collingham and Ripon Formations, while those samples from the Fort Brown Formation are fluvial (deltaic) deposits. The graphic mean value shows the dominance of fine sand-size particles, which point to relatively low energy conditions of deposition. In addition, the LDF results point to low energy conditions during the deposition of the Prince Albert, Collingham and part of the Ripon Formation (Pluto Vale and Wonderfontein Shale Members), whereas the Trumpeters Member of the Ripon Formation and the overlying Fort Brown Formation accumulated under high energy conditions. The CM pattern shows a clustered distribution of sediments in the PQ and QR segments, indicating that the sediments were deposited mostly by suspension and rolling/saltation, and graded suspension. Furthermore, the plots also show that the sediments are mainly deposited by turbidity currents. Visher diagrams show the variability of hydraulic depositional conditions for the Permian Eccca Group sandstones. Saltation is the major process of transportation, although suspension and traction also played some role during deposition of the sediments. The sediments were mainly in saltation and suspension before being deposited.

Keywords : grain size analysis, hydrodynamic condition, depositional environment, Eccca Group, South Africa

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