

Magnetostratigraphy of Upper Permian to Lower Triassic (?) Beaufort Group Strata , Karoo Basin, South Africa: Can we “See Through” the Karoo Large Igneous Province event?

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A multifaceted effort to understand the timing of inferred environmental changes in the Karoo Basin, from Late Permian to possibly Early Triassic (?) time, as recorded in Beaufort Group strata, includes work to establish robust magnetic polarity records for sections previously interpreted to encompass end-Permian extinction events. Demonstrating preservation of early-acquired RM in Karoo strata is challenging, due to thermochemical effects related to the Early Jurassic (ca. 183 Ma) Karoo Large Igneous Province (LIP), the fact that Early Jurassic field directions are similar to those of Late Permian age (and the PDF!), and the NE to SW increase in burial diagenesis attending Cape Fold Belt tectonism. The response of Beaufort strata to such thermal effects bears on extracting meaningful polarity records. We obtain 7-10+ independent samples per individual horizon to assess ChRM uniformity. Eastern Cape Province sections yield a NNW seeking, moderate to steep negative inclination ChRM (normal polarity); NRM intensities are ~1 to 5 mA/m. This ChRM persists in progressive thermal demagnetization to about 580° C, the magnetite maximum laboratory unblocking temperature (T_{lub}). Some beds show unblocking of a normal ChRM by 450°C and then the isolation of a SSE, moderate to steep positive (reverse) ChRM, which is inferred to indicate that any ChRM persisting above T_{lub} of ~425°C is pre-Karoo LIP in origin, and likely primary. If the RM unblocked below about 425°C is thermoviscous, then, based on theoretical relaxation time/magnetization blocking relations, the rocks were heated to ~150-300° C for ca. 1 Ma (+/-) (T estimates vary by relaxation time/RM blocking relations). The Bethulie section, Free State Province, is cut by many <2 m wide Karoo LIP dikes. Strata well-removed from dikes yield both normal and reverse polarity ChRM. BT15 (image) is dominated by a well-defined reverse RM with a normal overprint RM unblocked below 400°C, implying elevated temperatures (i.e., ~ 100 to 250°C+) for ca. 1 Ma (+/-). Contact tests are positive but complicated. Host strata within less than 1-2 dike widths from dikes have been thermally remagnetized and show high NRM intensities (> 50 mA/m). Documentation of a primary RM in these strata, which appears in some areas to be preserved, requires careful laboratory- and field-based assessment.