



Stratigraphy and sediment provenance of the Karoo Supergroup in Southern Botswana using geochemical indicators

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The Karoo Supergroup of Botswana unconformably overlies Archaean and Proterozoic rocks. They are however, poorly exposed being in turn overlain by up to 200m of Kalahari Beds. This Carboniferous - Jurassic succession comprises sequences of sedimentary and volcanic rocks which are spread across southern Africa. In Botswana, rock complexes have been correlated between widely spaced boreholes based on macroscopically similar appearance and similar position in the succession. In neighbouring South Africa and Namibia these rocks are well exposed and the lithostratigraphy is well constrained by the fossil record. The Karoo units of Botswana have been correlated with these more precisely defined successions on the basis of lithostratigraphy only and are unsupported by other criteria and as such are limited; especially considering the different depositional settings between Botswana and South Africa.

Here we present the results of a study of the heavy whole rock geochemistry in an attempt to provide additional, chemostratigraphic criteria for the lower and middle part of the Karoo suite, the Dwyka and Ecca Groups. Analysis of 60 samples for major and trace (including REE) element composition shows a close relation between the geochemical characteristics and stratigraphy. Major elements show that the deltaic material of the Kweneng Formation and Boritse Formation was sourced from recycled continental crust. The basinal mudstone and siltstone below and above fall into an intermediate-mafic igneous field. Most samples have distinct negative europium anomalies ($\text{Eu/Eu}^* = 0.49-1.27$; av. = 0.75) and most values are characteristic of sediments of cratonic derivation. A clear shift in $(\text{Gd/Yb})\text{N}$ in the basinal pro-delta shales (the Bori Formation) is generally 2.0 or greater, which is typical of an Archean signature, whereas post-Archean rocks usually have $(\text{Gd/Yb})\text{N}$ 1.0 – 2.0 as seen for the strata above the delta mouth bars and channels (average 1.6). In a diagram in which $(\text{La/Yb})\text{N}$ plotted against CeN shows a relationship between REE fractionation and provenance, the samples from the Ecca's lacustrine Kwetla Formation and Bori Formation fall into the Intermediate Igneous Provenance Field along with data from the Dwyka, whereas the deltaic Kweneng and Boritse Formation belong to the quartzose provenance field. This agrees with indicators from the major element discriminators.