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Modal Composition and Tectonic Provenance of the Sandstones of Ecca Group, Karoo Supergroup in the Eastern Cape Province, South Africa

Authors : Christopher Baiyegunhi, Kuiwu Liu, Oswald Gwavava

Abstract : Petrography of the sandstones of Ecca Group, Karoo Supergroup in the Eastern Cape Province of South Africa have been investigated on composition, provenance and influence of weathering conditions. Petrographic studies based on quantitative analysis of the detrital minerals revealed that the sandstones are composed mostly of quartz, feldspar and lithic fragments of metamorphic and sedimentary rocks. The sandstones have an average framework composition of 24.3% quartz, 19.3% feldspar, 26.1% rock fragments, and 81.33% of the quartz grains are monocrystalline. These sandstones are generally very fine to fine grained, moderate to well sorted, and subangular to subrounded in shape. In addition, they are compositionally immature and can be classified as feldspathic wacke and lithic wacke. The absence of major petrographically distinctive compositional variations in the sandstones perhaps indicate homogeneity of their source. As a result of this, it is inferred that the transportation distance from the source area was quite short and the main mechanism of transportation was by river systems to the basin. The QFL ternary diagrams revealed dissected and transitional arc provenance pointing to an active margin and uplifted basement preserving the signature of a recycled provenance. This is an indication that the sandstones were derived from a magmatic arc provenance. Since magmatic provenance includes transitional arc and dissected arc, it also shows that the source area of the Ecca sediments had a secondary sedimentary and metasedimentary rocks from a marginal belt that developed as a result of rifting. The weathering diagrams and semi-quantitative weathering index indicate that the Ecca sandstones are mostly from a plutonic source area, with climatic conditions ranging from arid to humid. The compositional immaturity of the sandstones is suggested to be due to weathering or recycling and low relief or short transport from the source area. The detrital modal compositions of these sandstones are related to back arc to island and continental margin arc. The origin and deposition of the Ecca sandstones are due to low-moderate weathering, recycling of pre-existing rocks, erosion and transportation of debris from the orogeny of the Cape Fold Belt.

Keywords : petrography, tectonic setting, provenance, Ecca Group, Karoo Basin
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