

**LITHOSTRATIGRAPHY, SEDIMENTOLOGY AND PROVENANCE
OF THE BALFOUR FORMATION (BEAUFORT GROUP) IN THE
FORT BEAUFORT-ALICE AREA, EASTERN CAPE PROVINCE,
SOUTH AFRICA**

BY DAVID KATEMAUNZANGA

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Department of Geology

Faculty of Science and Agriculture

University of Fort Hare

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ABSTRACT

A traverse through the Balfour Formation was chosen in the area around the towns of Fort Beaufort and Alice in the Eastern Cape Province. The main objectives of the study were to map the lithological variations within the Balfour Formation and to distinguish it from the underlying Middleton Formation and the overlying Katberg Formation.

A combined desktop, field and laboratory approach was used in this study. Aerial photographs, satellite images and digital topographical maps formed the basis of the desktop work. After desktop mapping, a number of field traverses were measured through the study area. Sedimentary structures were observed, photomosaics were done, stratigraphic sections were measured and samples were collected for thin sectioning, heavy mineral separation and major, trace and REE analysis.

Sedimentological development of the Balfour Formation has been outlined in relation to its provenance during the Late Permian. Lithological variation of the Balfour Formation is characterised by alternating sandstone-dominated and mudstone-dominated members. Arenaceous Oudeberg and Barberskrans Members are contain facies ranging from intraformational conglomerates (Gmm), massive sandstones (Sm & Ss), horizontally laminated sandstones (Sh), planar and trough cross-bedded sandstones (Sp, Sl & St), trough cross-laminated sandstones (Sr) and fine-grained sediments (Fm & Fl), whereas the mudstone dominated members are characterised by the facies Fm and Fl. Lithofacies together with bedforms observed in the Balfour Formation were used in architectural-element analysis. Sandstone-rich members are dominated by channel fill elements such as LS, DA, SB, LA and CH, whereas the fine-grained component consists of mainly, FF

element. The mudstone-dominated members contain FF, CS and LV elements, with LA, SB and CH in the subordinate sandstones.

Petrography, geochemistry and palaeocurrent analysis indicated that the source of the Balfour Formation was to the south-east and the rocks had a transitional/dissected magmatic arc signature. This led to the postulation of the Karoo Basin to have developed in a retro-arc foreland basin where there was supralithospheric loading in the Cape Fold Belt due to a compressional regime initiated by the subduction of Palaeo-Pacific plate underneath the Gondwana plate. The tectonic loading was episodic with eight major paroxysms affecting the Karoo Supergroup. The Balfour Formation coincides with the fourth paroxysm, this paroxysm in turn consists of two third-order paroxysms that initiated the deposition of the Oudeberg and Barberskrans Members in low sinuosity streams. Each paroxysm was followed by a period of quiescence and these resulted in the deposition of the Daggaboersnek, Elandsberg and Palingkloof Members in meandering streams.

Depositional environments were determined mainly from the sedimentary structures and 3D architecture of the rock types. Sandstone rich members were formed by seasonal and ephemeral high energy low sinuous streams whereas the fine-grained rich members were formed by ephemeral meandering streams. Palaeoclimates have been equated to the present temperate climates; they were semi-arid becoming arid towards the top of the Balfour Formation. This has been determined geochemistry (CIA), sedimentary structures and other rock properties like colour.

DECLARATION

I declare this dissertation to be my own unaided work. It is being submitted for the Master of Science Degree in Geology at the University of Fort Hare, Alice. It has not been submitted before for any degree at any other University.

.....

David Katemaunzanga

July 2009

DEDICATION

To my mother and father, this is the path that you set me on,

and,

To wife and daughter, your love and support have been my strength.

ACKNOWLEDGEMENTS

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