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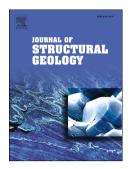
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Structural Analysis and Implicit 3D Modelling of High-Grade Host Rocks to the Venetia Kimberlite Diatremes, Central Zone, Limpopo Belt, South Africa

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Abstract

The Beit Bridge Complex of the Central Zone (CZ) of the Limpopo Belt hosts the 519 ± 6 Ma Venetia kimberlite diatremes. Deformed shelf- or platform-type supracrustal sequences include the Mount Dowe, Malala Drift and Gumbu Groups, comprising quartzofeldspathic units, biotite-bearing gneiss, quartzite, metapelite, metacalcsilicate and ortho- and para-amphibolite. Previous studies define tectonometamorphic events at 3.3-3.1 Ga, 2.7-2.5 Ga and 2.04 Ga. Detailed structural mapping over 10 years highlights four deformation events at Venetia. Rules-based implicit 3D modelling in Leapfrog GeoTM provides an unprecedented insight into CZ ductile deformation and sheath folding. D_1 juxtaposed gneisses against metasediments. D_2 produced a pervasive axial planar foliation (S_2) to isoclinal F_2 folds. Sheared lithological contacts and S_2 were refolded into regional, open, predominantly southward-verging, E-W trending F_3 folds. Intrusion of a hornblendite protolith occurred at high angles to incipient S_2 . Constrictional-prolate D_4 shows moderately NE-plunging azimuths defined by elongated hornblendite lenses, andalusite crystals in metapelite, crenulations in fuchsitic quartzite and sheath folding. D_4 overlaps with a: 1) 2.03-2.01 Ga regional M_3 metamorphic overprint; b) transpressional deformation at 2.2-1.9 Ga and c) 2.03 Ga transpressional, dextral shearing and thrusting around the CZ and d) formation of the Avoca, Bellavue and Baklykraal sheath folds and parallel lineations.

Keywords: Venetia Mine; Limpopo Belt; Central Zone; High Grade; Implicit; 3D modelling

Introduction

Venetia Mine, in production since 1992, is situated 75km west of Messina in the Limpopo Belt of South Africa and is currently in open pit operation with pit base expected at approximately 500m, after which the mine will commence with underground mining. The *ca.* 520 Ma Venetia kimberlite diatremes of the Limpopo Province of South Africa have been the focus of intense research, particularly since the commencement of full-scale mining in the early 1990's (e.g. Allsopp *et al.*, 1995; Phillips *et al.*, 1999; Smith and Barton, 1995; Seggie *et al.*, 1999; Kurszlaukis and Barnett, 2003; Brown *et al.*, 2009; Richardson *et al.*, 2009). Regional geological mapping has established the framework of metamorphic and structural events of the Central Zone of the Limpopo Belt (Brandl, 2000, 2002; Klemd *et al.*, 2003; van Reenen *et al.*, 2004; Rigby *et al.*, 2011) which form the context for mine-based studies (e.g. Barnett, 2003; Doorgapershad *et al.*, 2003; Barton *et al.*, 2003).

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