Geological record of mid-Archean flake tectonics preserved in the c. 3.3 Ga Kromberg volcanic sequence, Barberton greenstone belt, South Africa

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Geodynamic models for the origin and evolution of the c. 3.3 Ga Kromberg volcanic sequence of rocks, in the Onverwacht Group of the Barberton greenstone belt (South Africa), range from formation in an autochthonous, plume-type plateaux setting [1], to that of an allochthonous, ophiolite thrust sheet emplaced in a modern-style plate-tectonic regime [2]. This study reports new high-resolution field observations, petrological data, drill core logging and secondary ion microprobe U-Pb detrital zircon age constraints across the Kromberg type-section on both the eastern and western sides of the Komati River. The new results and data reveal that the Kromberg type-section represents a ca. 1.6 km thick dismembered, partly silicified mélange of lithons of mostly oceanic supracrustal rocks, with only minor metadunites, that are structurally bound by numerous fuchsite-chlorite-carbonate-quartz shear zones. Deformation fabrics recording transient and repeated brittle-ductile oscillations are preserved in these shear zones. It is proposed herein that the observed geological features are compatible with a mid-Archean oceanic flake tectonic model [3], involving horizontal accretion and imbrication of thin, rigid, silicified slivers of upper Archean oceanic crust, which delaminated from thick, weaker, mid- to lower oceanic crust that was recycled into the Paleoarchean mantle. The role of seawater silicification in heterogeneously changing the rheology of the uppermost Archean oceanic lithosphere is emphasized. The geodynamic model invoked here suggests that although the mafic-ultramafic Kromberg oceanic sequence may share some geological similarities to Phanerozoic ophiolites, it most likely formed in a geodynamic setting unique to a hotter mid-Archean Earth.

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