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The sedimentology of the Paleoproterozoic Duitschland Formation (Transvaal Supergroup, South Africa): new insights from Langbaken 340KS

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Sulfur isotope studies [1] from the Duitschland Formation (Transvaal Supergroup) show that the deposition of this succession on the Kaapvaal craton is coeval with the Paleoproterozoic Great Oxidation Event (GOE). The transition from a pre-GOE to a post-GOE world occurs across an unconformity in the middle of the succession. This mid-Duitschland (MD) unconformity has been proposed as a regional and global correlation surface on the assumption that: (i) it represents a pan-glacial lowstand, and (ii) the GOE is a single, irreversible, global event [2].

We present the first detailed sedimentological and petrographic data from the Duitschland Formation on the farm Langbaken 340KS, where the angular MD unconformity is well exposed. Field mapping and four new correlated logs have revealed significant differences between the facies types and thicknesses seen at Langbaken and those noted at the type locality of Duitschland 90KS and in core studies [3].

Slumped carbonates in the lower Duitschland overlie the basal conglomerate, diamictite and shales and contain infrequent cm thick beds of angular chert granules. Moving stratigraphically up through the lower carbonates: (i) granule chert beds become more frequent, thicker and coarsen to contain rounded chert pebbles, (ii) discrete non-continuous beds of chert pebble conglomerate 1-10 m wide and 0.2-2 m thick incise into the carbonates, and (iii) carbonates are succeeded by red-cream weathering, massive, clast-supported, rounded, chert-pebble to chert-boulder conglomerates. These conglomerates attain a maximum thickness of ~125 m; this is an order of magnitude thicker than previously noted [3]. The conglomerates occur both beneath and overlying the angular unconformity surface and fine and thin out laterally over 200-300 m to sublitharenites. No direct evidence for ice movement (e.g. striated pavements) is seen associated with the MD unconformity.

These conglomerate deposits are interpreted as mass flow deposits (or possibly Gilbert-delta style deposits) which are being shed onto the outer portion of a southward-dipping carbonate ramp. These observations suggest - previously unnoted - lateral heterogeneity within the Duitschland basin with relation to sediment supply, modes of sedimentation, and the generation of accommodation space over scales of ~50 km.

We propose that sedimentation was fault-controlled in the Duitschland basin. Relative differences in hanging-wall subsidence could create areas of greater accommodation space in which conglomerates could accumulate. Periodic tectonic instability may have shed conglomerates into the basin. Further, some currently unknown tectonic event, possibly compressional [3] and roughly coeval with the GOE, must have tilted the lower Duitschland prior to the development of the MD unconformity. The MD unconformity might thus be produced by local tectonic uplift, exposure and erosion and not a pan-glacial event. These results highlight the importance of considering local factors in reconstructing Paleoproterozoic Earth history, and of integrating geochemical data with a robust stratigraphic and sedimentological context.

References

[1] Guo et al., 2009. *Geology,* **37**, 399-402

[2] Hoffman, 2013. *Chemical Geology*, **362**, 143-156

[3] Coetzee, 2001. M.Sc thesis (unpublished), University of Johannesburg, 220 pp.