Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18044

Re-Os geochronology of the Duitschland Formation: Implications for Paleoproterozoic glaciation and oxygenation

ALEXIE E.G. MILLIKIN[1], BENJAMIN T UVEGES[2], GARETH IZON[2] AND ALAN ROONEY[1]

[1]Yale University

[2]Massachusetts Institute of Technology

Presenting Author: alexie.millikin@yale.edu

One of the most intriguing associations during the early Paleoproterozoic (ca. 2.5-2.2 Ga) is that between atmospheric oxygenation and widespread glaciation. Early Paleoproterozoic strata record glacial units from at least five cratons and the disappearance of mass-independent sulfur isotope fractionation (S-MIF), a widely accepted proxy for atmospheric oxygenation and marker for the Great Oxidation Event (GOE). Due to a paucity of radiometric ages, however, regional and global correlations of early Paleoproterozoic stratigraphy recording the loss(es) of S-MIF are tenuous, leading workers to argue for both unidirectional and oscillatory trajectories of oxygenation. The lack of a robust stratigraphic framework also precludes an understanding of the extent and number of glaciations and their relationship, if any, with atmospheric oxygenation.

The Transvaal Supergroup, preserved in the Griqualand West and Transvaal sub-basins of the Kaapvaal Craton (South Africa), is one of the most important archives of early Paleoproterozoic Earth history. One outstanding debate with major implications for the nature of the GOE and the number of glaciations is the proposed correlation of the Duitschland (northeastern Transvaal sub-basin) and Rooihoogte formations (southwestern Transvaal sub-basin). Both units record the disappearance of S-MIF[1-5] and at least one glacial diamictite, but only the Rooihoogte Formation is constrained temporally with an age of 2316 ± 7 Ma[6]. Here we present new preliminary Re-Os geochronology data from core ADL-1, drilled in the Duitschland area, which reveals that the Duitschland Formation may be >100 Myr older than the Rooihoogte Formation. With this stratigraphic revision at least two distinct losses of S-MIF would occur within the Transvaal sub-basin, supporting a model of oscillatory oxygenation. This work permits correlation of the Duitschland Formation with the Makganyene Formation[7], which contains a low-latitude glacial diamictite, and either the underlying Koegas Subgroup or overlying Postmasburg Group in the Griqualand West sub-basin.

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

[2]Bekker et al. (2004), *Nature*, 427: 117-120.

[3]Luo et al. (2016), *Science Advances*, 2: e1600134.

[4]Poulton et al. (2021), *Nature*, 592: 232-236.

[5]Izon et al. (2022), *PNAS*, 199: e2025606119.

[6]Hannah et al. (2004), *EPSL*, 225: 43-52.

[7]Gumsley et al. (2017), PNAS, 114: 1811-1816.