Mesoarchean glacial waters recorded by triple oxygen isotope compositions of the Ivnartivaq ultramafic layered complex, SE Greenland

PETERS, S.T.M.[1], PACK, A.[1] SZILAS, K.[2]

[1]University of Göttingen, Goldschmidstr. 1 37077 Göttingen, Germany; s.peters@geo.uni-goettingen.de
[2]Geological Survey of Denmark and Greenland, Øster Voldgade 10, 1350 Copenhagen, Denmark; ksz@geus.dk

The Ivnartivaq ultramafic layered complex occurs as a large inclusion in the 3.0-2.8 Ga granitoid crust of the Kuummiut terrane, southeast Greenland [1] and possibly consists of metamorphosed cumulates from primitive magmas. The $\delta^{18}O$ values of olivine and orthopyroxene in dunites from this locality, however, are variable and up to 3 ‰ lower than typical values of these minerals in primitive magmas. Similarly low $\delta^{18}O$ values in more recent igneous rocks have been interpreted as the results of interaction between magmas and meteoric waters. In accordance with these interpretations, we suggest that the low $\delta^{18}O$ values of the Ivnartivaq minerals reflect the assimilation of hydrothermally altered rocks by the magmas from which the ultramafic cumulates formed. Using triple oxygen isotope systematics and an approach similar to [2] but with an updated datum for $\Delta'^{17}O_{SMOW}$ in San Carlos olivine [3] and a more extensive dataset for $\Delta'^{17}O$ in mantle-derived rocks, we estimate that the hydrothermally altered rocks that were assimilated by the Ivnartivaq magmas had interacted with meteoric waters that had $\delta^{18}O_{SMOW}$ values between -25 and -40 ‰. At present, such low $\delta^{18}O_{SMOW}$ values are exclusively present in waters of glacial origin. The low $\delta^{18}O$ values of the Ivnartivaq minerals may therefore attest the presence of glacial waters some time between 3.0-2.8 Ga. Notably, this age range overlaps with the age of diamictites from the Pongola Supergroup that were argued, and disputed, to be to oldest evidence for a glacial period on Earth [4]. [1] Kolb 2014 *Precambrian Res* 255, 809-822 [2] Herwartz et al. 2015 *PNAS* [3] Pack et al. *Rapid Comm Mass Spectr* 30 (13), 1495-1504 [4] Young et al. 1998 *J of Geology* 106.5 523-538