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Remnants of Mesoarchaean oceanic crust in the Tartoq Group, North Atlantic Craton, SW Greenland

Kristoffer Szilas (1), Vincent J. van Hinsberg (2), Alexander F.M. Kisters (3), Thomas F. Kokfelt (1), Anders Scherstén (4), and Brian F. Windley (5)

(1) Geological Survey of Denmark and Greenland - GEUS, Øster Voldgade 10, 1350, Copenhagen, Denmark (ksz@geus.dk), (2) Department of Earth Sciences, University of Oxford, South Parks Road, Oxford, United Kingdom, (3) Department of Earth Sciences, Stellenbosch University, Matieland 7602, South Africa, (4) Deptartment of Earth and Ecosystem Sciences Division of Geology, Lund University Sölvegatan 12, 223 62 Lund, Sweden, (5) University of Leicester, Department of Geology, University Road, Leicester, LE1 7RH, UK

The Tartoq Group comprises supracrustal rocks of dominantly volcanic origin in several discrete fault-bounded blocks, up to 20 km long and 10 km wide, hosted by Archaean orthogneisses of tonalitic composition adjacent to the fjord of Sermiligaarsuk in the Archaean craton of South West Greenland (∼61.5°N). These supracrustal blocks cover an area of approximately 20x50 km. The main lithological units in the metavolcanic blocks include: pillow lava, dykes with a semi-ophitic texture, gabbro, and serpentinite. Peak metamorphic conditions range from sub-greenschist facies to upper amphibolite and lower granulite facies, which generally correlate with the different lithological units, such that pillow lavas and shallow dykes are at lower metamorphic grade and gabbros and serpentinites are at higher grade.

The Tartoq Group is thrusted (top to the SE) with imbrication of the supracrustal rocks and younger orthogneisses. Kilometre-scale nappe structures, low-angle shear zones, and younger cataclasites formed as a result of the accretion and progressive exhumation of these rocks. Deformation was associated with hydrothermal alteration (with Au-mineralisation) that overprinted regional metamorphic parageneses and intense carbonation in high strain zones.

LA-ICP-MS U-Pb zircon age dating of an orthogneiss sheet that was intrusive into the supracrustal rocks yield a minimum age of 2.996 +/- 0.006 Ga for the Tartoq Group.

The mafic metavolcanic rocks are dominated by tholeiitic basaltic compositions (MgO = 6-10 wt.% and FeOT = 12-14 wt.%) and no co-genetic calc-alkaline rocks have been found. The tholeiites possess negative primitive mantle-normalised Nb-anomalies (NbN/LaN = 0.5-0.8). In tectonic discrimination diagrams, the tholeiitic rocks plot in the MORB or IAT fields. Mafic flows, dykes and gabbros have similar flat chondrite-normalised trace element patterns (LaN/SmN = 0.8-1.0) and show fractional crystallisation trends (ol + cpx +/- plag), which together with the serpentinites, indicate that they form a co-magmatic assemblage resembling that of an ophiolitic ocean floor sequence.

La, Y, and Nb values are similar to those of modern back-arc basalts. Absence of komatiites argues against an oceanic plateau setting, as is often called for to explain Archaean tholeiites. Other authors (Herzberg et al. 2010; Rollinson 2010) have suggested that the differences between modern MORB and Archaean non-arc tholeiites simply reflect a higher Archaean mantle temperature and we support this view.

The structural relations combined with geochemical, metamorphic and isotopic data suggest that the Tartoq Group is a slab of Archaean oceanic crust, which after shallow subduction, was emplaced in an exhumation wedge, retrogressed by fluid input commonly to greenschist facies, imbricated with marginal orthogneisses, and folded and thrust into several tectonic slices and slabs with the orthogneisses. Overall we interpret the Tartoq Group to represent a structurally dismembered section of Archaean oceanic crust.

References:

Herzberg, C., Condie, K. and Korenaga, J. 2010. Thermal history of the Earth and its petrological expression. EPSL 292, p. 79-88.

Rollinson, H. 2010. Coupled evolution of Archean continental crust and subcontinental lithospheric mantle. Geology, v. 38, no. 12, p. 1083-1086.