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Constraining the geotectonic setting for the Archaean Tartoq Group (SW Greenland) from its metamorphic and structural history

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Archaean greenstone belts are a main source of information on the geotectonic regime that operated on the Early Earth. Rock compositions, deformation structures and P-T conditions of the lithosphere tightly constrain conditions of the Archaean mantle, which in turn places constraints on mantle dynamics and, hence, the plate-tectonic style during the earliest history of our planet. However, in order to do so, the geotectonic setting for these belts needs to be established and this is not always straightforward.

In this study we combine geochronology, geochemistry and metamorphic petrology with a detailed structural survey to understand the Archaean Tartoq Group, and use it to constrain the conditions of its tectonic setting. The Tartoq Group presents an ideal opportunity for this research, comprising of a series of exceptionally preserved >3 Ga supracrustal blocks exposed along the Sermiligaarsuk Fjord in SW Greenland. Our work on rock textures and geochemistry indicates that the rocks of the Tartoq Group represent a cross-section through oceanic lithosphere, from deep gabbros and ultramafic bodies, to intermediate sills and dikes, to submarine flows, volcanoclastics and limited chemical sediments (e.g. BIF). This sequence was subsequently intruded by TTG melts and subjected to a sequence of tectonic episodes to arrive at its present configuration as a series of thrust bounded inliers in the TTG-dominated Greenland craton.

Metamorphic grades in the Tartoq Group, constrained from mineral thermometry and pseudo-section calculations, range from lower greenschist facies conditions (380°C at 2 kbar) to upper amphibolite facies conditions (650°C at 6-7 kbar), with one locality recording partial melting of metabasalt at >6 kbar and 800°C. Large-scale structures and deformation textures indicate a co-axial burial and exhumation history, which, together with an ocean-crust protolith suggests a subduction-style setting for these rocks. However, intermediate pressures and the lack of high-P mineral relicts indicate that the Tartoq was not subjected to the high-P, low-T conditions characteristic for such a setting. We reconcile these contrasting data in a model where the Tartoq Group represents a wedge of the overriding oceanic plate that is dragged along with the slab at the initiation of subduction, at a shallow angle. It is thereby subjected to subduction-style tectonics, but at a much steeper dT/dP gradient than observed in the subducting slab. Here we will discuss these results and their implications for the geodynamics of the Early Earth.