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Archaean tectonics in the Paamiut region, South-West Greenland

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In the summer of 2010 the inland area southeast of Paamiut, Greenland was visited for the first time since the area was mapped geologically in the 1960's. This area contains deformed Meso-Archaean TTG-gneisses and dispersed supracrustal rocks over a distance of more than 100 km along the Inland ice. The visited outcrops are of exceptional quality and offer a rare opportunity to understand the formation of Archaean supracrustal rocks, their alteration and interaction with the intruding magmas. The field work resulted in a wealth of new data and rock samples that are currently being processed for thin section (microscopy) and geochemical analysis. Here, we present some preliminary results of these investigations.

The supracrustral rocks in the Paamiut area include unusually well-preserved meta-volcanic sequences that comprise former lavas and volcano-clastic protoliths with recognisable primary volcanic features. A ca. 560 m thick profile was studied in detail at Nigerlikasik showing a compositional transition from ultramafic rocks at the base, to felsic meta-volcanics in the upper part of the section (see Klausen et al., this conference for details). The occurrence of felsic volcanic rocks in Archaean supracrustal rocks worldwide is rare, and their presence may further constrain processes that actually played a key role in the formation of the Earth crust during the Mesoarchaean.

Similar supracrustal rocks situated south-east of the Paamiut area, near the inland ice, form dispersed fragments in the TTG-type basement and contain metamorphic rocks interpreted as metamorphosed clastic sediments. However, our field observations raise questions about the origin of these rocks. An origin as felsic volcanic rocks that were altered by circulating fluids in the ocean floor seems in some cases more likely than a sedimentary precursor. This process could have played a role in other presumed metamorphosed sediments in Archaean areas as well. In order to test for potential mass transfer during metamorphism of the different meta-supracrustal rocks, we plan detailed analytical work including geochemistry, geochronology, and mineral chemistry investigations.

The TTG gneisses form ca. 90% of the current outcrops of this level of the crust, thus the amount of plutonic material is significant. It is commonly proposed that all TTG rocks within specific terranes formed at the same time. So far, three tectonic blocks (Paamiut, Neria, Sermiligaarsuk blocks) have been proposed in the studied area (McGregor & Friend 1997; Friend & Nutman, 2001). However, our fieldwork has not been able to confirm the presence of major tectonic boundaries; for example the boundaries proposed for the Neria block were sought, but not located. Our working hypothesis envisages a tectono-magmatic situation characterised by repeated emplacement of magma into the upper crust of a single, long-lived subduction system. Deformation and temperature evolution is related to the emplacement tectonics of the large volumes of plutonic rocks. The locus of magmatism may have shifted position relative to the leading edge over time. Such a scenario would likely result in a wider range and a more random distribution of magma emplacement ages within a restricted area, compared to the clearly differentiated events inside terranes divided by relative sharp tectonic boundaries, as predicted by a terrane model. To test this hypothesis, a structural framework that includes a geological cross-section of the area will be worked out in more detail. The understanding of the tectonometamorphic evolution includes a discussion of the structural boundaries, but also the time-temperatures evolution of the supracrustal rocks. The required metamorphic temperature calculations, as well as measurements of the ages of the TTG-gneiss will be integrated into the structural framework.

McGregor V.R. & Friend C.R.L. (1997) Precambrian Research 86, p 59-70
Friend C.R.L. & Nutman A.P. (2001) Precambrian Research 150, p 143-164