Lower crustal Archaean rocks in South-East Greenland

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The Skjoldungen region in South-East Greenland is characterised by felsic gneisses and granites that often contain abundant mafic and ultramafic inclusions (agmatitic) with only minor amounts of mainly mafic but also ultramafic gneisses occurring in narrow belts. The gneisses are commonly migmatitic and mafic gneisses often contain abundant intrusive felsic sheets. The gneissic basement is intruded by a ca. 2.7 Ga alkaline complex and preliminary age data suggest that regional migmatisation occurred during a period from 2.8 to 2.7 Ga [1].

The mafic gneisses group into calc-alkaline and tholeiitic suites, suggesting a heterogeneous mantle source. The felsic gneisses divide into a group with a adakite-like composition and a group characterised by large positive Eu anomalies and often depleted and fractionated HREE. Felsic gneisses formed during at least two stages: 1) an early phase of crustal differentiation of a mafic proto-crust possibly starting at ca. 2.86 Ga and, 2) a late stage related to crustal thickening and remelting which seems to relate to a prolonged stage of high grade metamorphism at ca. 2.8-2.7 Ga [1]. The regional crust is dominated by granites formed during the second stage. The early felsic gneisses have adakitic chemistry and aparrantly formed in the presence of residual garnet whereas the later felsic gneisses formed from an already differentiated lower crust with accumulated plagioclase. The tectonic setting during the early crust forming episode is envisaged to range from a magmatic-arc to the mid-ocean ridge setting. The later stage probably occurred during crustal thickening in a collision orogen involving the root zone of a magmatic arc at the base of the crust (Fig. 1).

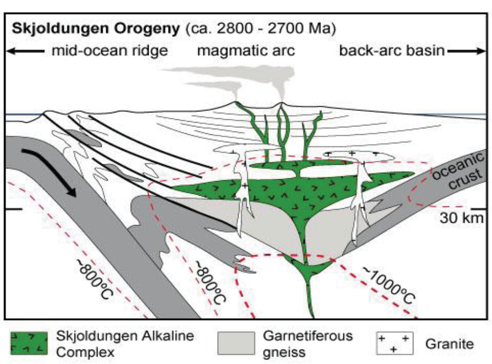

Figure 1: Model for the formation of the protoliths for gneisses in southeastern Greenland

[1] Kolb, J., Thane, K., Bagas, L., in review. Tectonometamorphic and magnetic evolution of high-grade Neo- to Mesoarcharan rocks of South-East Greenland. Gondwana Research.

Bacterial communities in drainage from waste-rock test piles

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Sulfide mineral oxidation is catalysed by microorganisms, increasing oxidation rates by orders of magnitude, releasing SO_4, Fe and H^+ [1]. Sulfide mineral oxidation rates decrease with decreasing temperature. Seasonal temperature fluctuations influence the rate of release of sulfide oxidation products from waste rock stockpiles over time [2]. Iron and sulfur oxidizing bacteria contribute to the oxidation of mine tailings in Arctic environments at temperatures as low as -11°C [2,3]. Yet, limited information exists on the importance of bacterially-catalysed oxidation of sulfide minerals in waste-rock stockpiles and their role in the generation of acid mine drainage in Arctic conditions.

Two large-scale waste-rock test piles, one with 0.035 wt. % S (Type I test pile) and another with 0.058 wt. % S (Type III test pile), located in the continuous permafrost region at the Diavik Diamond Mine were studied to examine the role of microoganisms in the biochemical evolution of test-pile drainage. Three groups of bacteria in test pile drainage were quantified using most probable number techniques [4] for neutrophilic and acidophilic sulfur oxidizers (SOBn and SOBa, respectively), and iron oxidizers (IOB). The media compositions, incubation conditions, and enumeration procedure are described in detail by Hulshof et al. [5]. The monitoring of populations present in test-pile drainage began in 2007 and a microbial succession was observed over time.

Drainage from the Type I test pile maintained a near neutral pH with low concentrations of SO_4 and Fe for the duration of this study. A population of SOBn was present from 2009 through 2010, with the exception of one sample in September 2010. Acidophilic sulfur oxidizers were only detected at very low numbers ($< 10^2$ bacteria/mL). IOB were detected in June 2009 and late 2010, but at low numbers ($< 10^3$ bacteria/mL).

Every year, the pH of the drainage from the Type III test pile decreased from near neutral in May to acidic conditions by October. Concentrations of SO_4 increased with decreasing pH. A population of SOBn were observed in the Type III test-pile drainage in 2008, however, population numbers decreased in late 2009 as the pH decreased. Acidophilic S oxidizers were only detected in 2009 after the drainage pH had decreased. In addition, the population of IOB increased with decreasing pH.

These results suggest bacteria populations evolved with changes in the drainage chemistry. Continued monitoring with more detailed analysis is required to better understand the biogeochemical evolution of these waste-rock test piles.

[1] Kirby et al. (1999) *Applied Geochemistry* **14**, 511-530.
[2] Elberling et al. (2000) *J. Contam. Hydrology* **41**, 225-238.
[3] Leduc et al. (1993) *FEMS Microbiology Letters* **108**, 189-194
[4] Cochran (1950) *Biometrics* **6**, 105-116.
[5] Hulshof (2006) *Water Research* **40**, 1816-1826.