The role of crustal contamination in Neoproterozoic metaigneous rocks from SW coast of Svalbard

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This study focuses on the late Neoproterozoic metaigneous rocks that occur along the SW coast of Svalbard to investigate magma evolution, especially magma-crust interaction, and to assess the potential sources of contamination. To achieve these goals, trace element geochemistry, as well as Sr and Nd isotope geochemistry have been applied. Samples have been collected from four regions from South to North of SW Svalbard: Wedenskiöldbreen area, Orvindalen, Chamberlindalen and Nordenskiöld Land. The metaigneous rocks are metamorphosed under a minimum of greenschist facies conditions.

The LILE are much more scattered than HFSE and REE, which present visible and very often separate trends for each region. The trace element profiles reveal that rocks that occur in Wedenskiöldbreen area have higher content of LREE and LILE and Th, U, Nb, in comparison to rocks from Nordenskiöld Land, which show less enrichment in these elements and are relatively more enriched in Sr. Incompatible element ratios, used to trace crustal contamination, like Th/La, (Th/Nb)_PM, (La/Nb)_PM, Th/Yb and Nb/Yb decrease from South to North. The samples from Wedenskiöldbreen area are usually the most scattered and have elevated trace element ratios (Th/La 0.12 to 0.59, (Th/Nb)_PM 2.37 to 8.38, (La/Nb)_PM 1.61 to 5.02, Th/Yb 1.29 to 5.06, Nb/Yb 2.79 to 10.09) and have the lowest ratio of Sm/La (0.11 to 0.31), in contrast to samples from Nordenskiöld Land, which usually show a very narrow group and are depleted in trace element ratios (Th/La 0.06 to 0.096, (Th/Nb)_PM 0.40 to 0.71, (La/Nb)_PM 0.71 to 1.04, Th/Yb 0.2 to 0.31, Nb/Yb 2.9 to 4.4) and have an elevated ratio of Sm/La (0.41 to 0.64). Isotope geochemistry reveals that metaigneous rocks from Nordenskiöld Land have the highest ratio of $^{143}$Nd/$^{144}$Nd$_{(i)}$ 0.512164 – 0.512392, whereas rocks from Orvindalen have the lowest ratio of $^{143}$Nd/$^{144}$Nd$_{(i)}$ 0.511422 – 0.511811. Metaigneous rocks from Chamberlindalen area and Wedenskiöldbreen area have intermediate ratios of $^{143}$Nd/$^{144}$Nd$_{(i)}$. Orvindalen shows the highest ratios of $^{87}$Sr/$^{86}$Sr$_{(i)}$ 0.700937 – 0.733005, whereas the rest of the samples have similar ratios of $^{87}$Sr/$^{86}$Sr$_{(i)}$ (Nordenskiöld Land $^{87}$Sr/$^{86}$Sr$_{(i)}$ 0.704177 – 0.710285, Wedenskiöldbreen area $^{87}$Sr/$^{86}$Sr$_{(i)}$ 0.700864 – 0.713204, Chamberlindalen area $^{87}$Sr/$^{86}$Sr$_{(i)}$ 0.703876 – 0.706138 ). The EC-AFC model used to explain $^{143}$Nd/$^{144}$Nd$_{(i)}$ and $^{87}$Sr/$^{86}$Sr$_{(i)}$ trends for Wedenskiöldbreen area and Orvindalen area, indicate contamination by assimilation and fractional crystallization processes, where the potential contaminant was metapelite, however this model does not explain the trend for samples from Nordenskiöld Land, which imply that a different, Sr-rich, contaminant influenced on these rocks.

Based on the trace elements geochemistry, as well as Sr and Nd isotope geochemistry, we show that the rocks from the coast of SW Svalbard have been contaminated, where the highest contamination is observed in the South of the Wedel Jarlsberg Land and decreases towards the North. Samples from Nordenskiöld Land are the less affected by contamination, however based on the $^{87}$Sr/$^{86}$Sr$_{(i)}$ ratios and patterns of elevated trace elements, as well as on the EC-AFC model, the potential contaminant was different in different regions.

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