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

Karolina Gołuchowska (1), Abigail K. Baker (2), Maciej Manecki (1), Jarosław Majka (1,2), Jerzy Czerny (1), Rob Ellam (3), Jakub Bazarnik (4,5)

(1) Department of Mineralogy, Petrography and Geochemistry, AGH University of Science and Technology, Poland, (2) Department of Earth Sciences, Uppsala University, Sweden, (3) Scottish Universities Environmental Research Centre, UK, (4) Polish Geological Institute-National Research Institute, Poland, (5) Institute of Geological Sciences, Polish Academy of Sciences, Poland

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: Werenskiøldbreen area, Orvindalen, Chamberlindalen and Nordenskiøld 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 Wedel Jarlsberg Land have higher content of LREE and LILE and Th, U, Nb, in comparison to rocks from Nordenskiøld 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 Werenskiøldbreen 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 Nordenskiøld 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 Nordenskiøld 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 Werenskiøldbreen 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 $^{87}Sr/^{86}Sr_{(i)}$ (Nordenskiøld Land $^{87}Sr/^{86}Sr_{(i)}$ 0.704177 – 0.710285, Werenskiøldbreen 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 Werenskiøldbreen 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 Nordenskiøld 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 Nordenskiøld 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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