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Sr and Nd Sources for Epigenetic Cu ± Au and IOCG Deposits in the Kiruna Mining District Based on Rb-Sr and Sm-Nd Isotope Data

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The Kiruna Mining District is host to a variety of ore deposit types including the giant Kiirunavaara iron oxide-apatite (IOA) deposit, smaller-scale syngenetic to epigenetic Cu±Au deposits (e.g., Pahtohavare), and iron oxide-copper-gold (IOCG) deposits (e.g., Rakkurijärvi). A recent structural investigation in the Kiruna area has highlighted that a significant brittle overprint is associated to Cu mineralization and can be correlated with a tectonic period ca. 80 m.y. after the Kiirunavaara IOA emplacement (Andersson et al., 2021, in press), bringing into question the time frame for Cu±Au precipitation/remobilization with respect to regional tectonic processes. Utilizing a mineral systems perspective, new whole-rock Rb-Sr and Sm-Nd isotope data from the Pahtohavare and Rakkurijärvi ore deposits in the southern Kiruna Mining District (Fig. 1) are compared to fluid and metal source candidates cropping out directly in the district.

The Pahtohavare Cu±Au mineralization is accompanied by pervasive albite-rich alteration especially in graphitic schist horizons (hosted in the Kiruna Greenstone Group (KGG)). The sample analyzed represents an albitized graphite schist and has an $^{87}Sr/^{86}Sr_{1.88\ Ma}$ value of 0.7205 and an $\varepsilon Nd_{1.88\ Ma}$ value of -5.3. The early Rakkurijärvi IOCG Na-Ca-(Fe) alteration was sampled from a weakly mineralized (chalcopyrite and pyrite, ±Au) outcrop of Kurravaara Conglomerate and has an $^{87}Sr/^{86}Sr_{1.86\ Ma}$ value of 0.7040 and an $\varepsilon Nd_{1.86\ Ma}$ value of -5.3. The data for the deposit samples were calculated using an estimated age of mineralization/alteration. Mixing trends from 1/Sr versus initial $^{87}Sr/^{86}Sr$ values for all isotopically preserved samples indicate distinct patterns for the two ore-altered samples. The Pahtohavare albitized graphite schist shows a Sr mixing trend between the KGG source candidates and a ca. 1.88 Ga granite. The Rakkurijärvi Na-Ca-(Fe)-altered conglomerate shows a mixing trend with a magnetite-gabbro and a KGG gabbroic sill. The different trends suggest the fluid pathways and Sr sources for each deposit were distinct but that the bimodal ca. 1.88 Ga magmatism contributed Sr in the ore-bearing fluid for both deposits, suggesting the ore deposits to have formed simultaneously or after the emplacement of these intrusions. While a later Rb-Sr isotope reset prevents the direct comparison of some felsic ca. 1.88 Ga intrusions in the district, the Sm-Nd system was preserved. Epsilon Nd values show a partial overlap of the ore-altered samples with the felsic igneous intrusions and a complete overlap with previously published εNd values from Perthite Monzonite Suite intrusions regionally. The significance of the different crustal lithologies and the ca. 1.88 Ga intrusive activity as possible Sr-Nd-metal sources is an important finding in this study and has implications on the regional behavior of ore forming systems in northern Norrbotten.

Fig. 1. The southern Kiruna Mining District showing sample locations and lithologies (modifed after Offerberg, 1967).

References

Andersson, J.B.H., Bauer, T.E., and Martinsson, O., 2021, Structural evolution of the central Kiruna area, northern Norrbotten, Sweden: implications on the geological setting generating iron oxide-apatite and epigenetic iron and copper sulfides: Economic Geology, in press.

Offerberg, J., 1967, Berggrundsgeologiska och flygmagnetiska kartbladen, Kiruna NV, NO, SV, SO: 29J.