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Characterizing magnetite reference material for secondary ion mass spectroscopy (SIMS)

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Sweden is responsible for over 90% of the iron ore production in the European Union, the bulk of which originates from the Kiruna-Malmberget region in northern Sweden, the type locality for Kiruna-type apatite-iron oxide ores. Despite thorough investigations of these long known deposits, their origin is still debated. Currently, two main formation theories are discussed: formation by orthomagmatic processes (Nyström & Henriquez 1994; Troll et al. 2019), versus hydrothermal processes (Hitzman et al. 1992; Smith et al. 2013).

Secondary ion mass spectrometry (SIMS) analysis allows gathering of more detailed information regarding intra-crystal variations, such as core to rim growth zonations, than bulk analysis do. Measurements of δ^{56}Fe and δ^{18}O in Kiruna-type magnetites by SIMS would therefore aid in the determination of their main formation process. However, there are conflicting studies regarding crystallographic orientation effects of δ^{56}Fe and δ^{18}O in magnetite, and while some authors found that the isotope ratios varied depending on how the crystal was oriented (e.g. Huberty et al. 2010), others found no such effects (e.g. Marin-Carbonne et al. 2011). This research project thus aims to further examine any effects of crystal orientation on Fe and O isotope signatures and identify a suitable magnetite reference material for SIMS analysis. To enable comparison between isotope ratios and crystal orientations, the sample orientations will therefore be determined by electron backscatter diffraction (EBSD) prior to SIMS analysis. SIMS analysis require reference material mounted next to the sample for continuous corrections during analysis. Different magnetite samples will now be tested for usage as reference materials. If a homogeneous reference material is found, future studies can utilise it for further investigations of the formation of Kiruna-type magnetite, as well as any other research concerning δ^{56}Fe or δ^{18}O in magnetite.

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