Fe Isotope Systematics Indicate Magmatic Origin of the Per Geijer Iron Oxide-apatite Deposits in Northern Sweden

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Iron oxide-apatite (IOA) deposits of Kiruna-type are key sources of iron ore in Europe. They are sourced from the northern regions of Sweden (Kiruna – Svappavaara – Malmberget). The Per Geijer IOA deposits near Kiruna display significant exploration targets for the Swedish mining company LKAB and are currently being reassessed for possible future mining. Although studied to a lesser degree compared to the well-known Kiirunavaara deposit, they can provide new insights into the controversially discussed origin of IOA deposits. Ore-forming scenarios span from low-temperature hydrothermal processes to high-temperature origin from magma or magmatic fluids. A set of new iron isotope data of magnetite in Kiruna-type iron ores from Per Geijer and Kiirunavaara, and comparative data from two skarn-type deposits of northern Sweden, Kaunisvaara and Masugnsbyn were obtained and compared with available global reference data from layered intrusions, volcanic provinces, and low-temperature and hydrothermal iron ores. The massive magnetite from the Per Geijer deposits exhibit δ^{56}Fe values of 0.18 to 0.44‰ that overlap with magnetite data from layered intrusions and recent volcanic provinces (≥ 800 °C) and corroborates with previous data from IOA deposits in the Kiruna district. In contrast, sampled magnetite from skarn-type deposits in the region (-0.21 to 0.09‰) correspond dominantly with published reference suites of hydrothermal magnetite formed by hydrothermal fluids at temperatures ≤ 400 °C. Therefore, a magmatic derivation is proposed for magnetite of the Per Geijer deposits. Despite some available literature data, this needs to be further evaluated by corresponding O-isotope information. Analyzed δ^{56}Fe data of hematite from the Per Geijer deposits yield similar values of 0.24 to 0.32‰. Since most of the hematite present in these deposits results from direct replacement of magnetite it is suggested that the Fe isotopic ratio is not significantly affected by oxidation events.