An Alternative Formation Environment for Kiruna-Type Iron Deposits: An Example from the Per Geijer IOA Deposit, Northern Sweden

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The Per Geijer iron oxide-apatite-REE deposit lies ~4 km northeast of the world-class Kiirunavaara orebody, northern Sweden. The >800-m-thick porphyritic Luossavaara Formation separates the Kiirunavaara orebody below from the Per Geijer ores above. Whereas wall-rock brecciation is commonly observed at the contact between the magmatic and/or hydrothermal Kiirunavaara ores and the Luossavaara hanging wall, we suggest the contact between the Luossavaara Formation and the overlying Per Geijer orebody displays a stratigraphic erosive relationship.

In this contribution, core logging observations are combined with lithogeochemistry and in situ mineralogy from thin sections across a 12-m transition zone from the Luossavaara Formation below into magnetite-apatite ore. Alongside QEMSCAN analysis, we aim to provide insight into the environment of formation at the onset of the Per Geijer ores.

The immediate footwall rock to Per Geijer ore comprises a sandy deposit with broken phenocrysts and other angular detritus derived directly from the underlying Luossavaara Formation. QEMSCAN imagery reveals a matrix of albite-quartz-K-feldspar containing angular albite phenocrysts partly overprinted by K-feldspar. This correlates with an Na-rich lithogeochemical anomaly at the base of the orebody that corresponds to the erosive contact. The footwall unit becomes K-rich downhole, reflecting K-feldspar alteration. Above the erosive contact, the magnetite-apatite shows planar lamination parallel to stratigraphy and localised graded bedding of magnetite and apatite clasts, reflecting suspension sedimentation and clastic mass-flow sedimentation, respectively, of magnetite and apatite, in a subaqueous environment.

Reworking of the Luossavaara Formation marks the subsidence and transgression from a subaerial to a deep-water subaqueous environment, thus assigning the Per Geijer ores to the Matojärvi Formation. We interpret the basal ores as hydrothermal magnetite-apatite precipitates or water-settled pyroclastic magnetite-apatite ash. These findings should influence exploration in northern Sweden as we consider magmatic and/or hydrothermal products reached the paleosurface and basin processes influenced the lateral extent of Fe ore.