New Insight into the Links Between Major Porphyry Copper, IOCG, and Magnetite-Apatite Deposits from the Gällivare Area, Northern Sweden

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The Paleoproterozoic rocks of the Fennoscandian Shield host many major mineral deposits. In the Gällivare area of northern Sweden, the deposits include magnetite-apatite (iron oxide-apatite [IOA]) at Malmberget with a resource (in 2012) of 290 Mt at 44% Fe, and porphyry copper at Aitik with 3,472 Mt (mined, mineral reserve, mineral resource), with an average of 0.21% Cu and iron oxide copper-gold (IOCG) at Nautanen. Malmberget and Aitik are large actively producing mines, whereas Nautanen is a past producer and current exploration project. Boliden's work in the area, in collaboration with Luleå University, has led to a new understanding of the relationships between these different ore deposits.

The deposits are hosted by mafic to intermediate intrusions, volcanic rocks, and related volcaniclastic facies that were intruded by layered gabbroic intrusions. At least two major deformation events are recognized: The first resulted in the formation of a strong, penetrative fabric that overprints the IOA and porphyry mineralization but appears to predate the IOCG event. A second event led to the folding of the IOA deposits, deformation of the porphyry, and development of a major NW-SE–striking corridor of intense deformation (the Nautanen deformation zone).

This deformation zone is characterized by intense alteration, deformation, and sulfide mineralization. The Nautanen deformation zone appears to contain a thrust stacked sequence with originally deeper portions (Malmberget) of the system thrust onto higher-level sections (Nautanen). This juxtaposition of deep and shallow portions of IOA and IOCG systems has been observed in other districts (e.g., Sequerinho-Sossego, Carajas district, Brazil). The Aitik porphyry copper deposit is also located along the Nautanen deformation zone, in the south of the district. Both Aitik and Nautanen share a number of alteration characteristics that suggest that the porphyry system was overprinted by a later IOCG event. Better understanding of the possible links between these different mineralization systems is the focus of ongoing research.