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Discovery, Geology and Timing of the Nautanen North Cu-Au-Ag-(Mo) Deposit, Norrbotten, Sweden

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Nautanen North is a newly discovered iron oxide-copper-gold deposit located in the northern Norrbotten ore province of Sweden that contains a resource of 21 Mt at 1.46% Cu, 0.78 g/t Au, 6 g/t Ag, and 99 g/t Mo. The deposit was discovered in 2012 by Boliden Mines AB while targeting ground EM and magnetic anomalies within the regional-scale Nautanen Deformation Zone (NDZ). Alteration facies at the deposit include sodic and high-temperature calcic-iron (HT Ca-Fe), high-temperature potassic-iron (HT K-Fe), and low-temperature potassic-iron facies at the core of the deposit, both of which host the highest grades of copper. Chalcopyrite and magnetite dominate the mineralization assemblage with pyrite, pyrrhotite, and molybdenite. Sulfides and magnetite occur within discrete zones of breccia and veining as well as along shears and as disseminations adjacent to structures. Re-Os dating of sulfides from the various mineralization styles highlights a protracted formation history of the deposit, which can be related to regional deformation and magmatic events. Early HT Ca-Fe veining with sulfides occurred at 1825 ± 8 Ma (molybdenite) and correlates with regional metasomatic alteration and metamorphism within the NDZ. Stockwork-style sulfide mineralization hosted within HT K-Fe altered rocks is dated to 1785 ± 8 Ma (molybdenite), and high-grade breccia formation is dated to 1747 to 1766 Ma (molybdenite/chalcopyrite-pyrite); these dates correspond to a period of regional metamorphism and deformation and emplacement of the large batholiths of the Lina granite within northern Norrbotten. Vein-hosted sulfide mineralization adjacent to the main ore zone is dated to 1720 ± 8 Ma (chalcopyrite-pyrite). Magnetite geothermometry suggests magnetite at Nautanen North precipitated under conditions typical of hydrothermal systems. Temperatures derived from magnetite display a good correlation with the temperature ranges proposed for host rock alteration assemblages within the hydrothermal iron oxide and alkali-calcic alteration systems (IOAA).