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A Review of Gold Mineralization Styles in Finland

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Abstract

A wide range of styles of gold mineralization has been recognized in Finland, including orogenic, metamorphosed epithermal, skarn- or epigenetic ironstone-hosted, intrusion-related (nonskarn), massive sulfide-hosted, paleoplacer, and placer deposits. Gold production in the past was principally as a byproduct from the mining of Paleoproterozoic base-metal massive sulfide deposits. This situation has changed during the last decade with the closure of some base metal mines and the commencement of production from recently discovered, gold-only deposits.

Gold mineralization occurred during distinct episodes of crustal evolution in Finland. Several late-Archean greenstone belts in the Karelian craton in eastern and northern Finland contain orogenic gold deposits dated at about 2.75 to 2.70 Ga, suggesting a coherent and pervasive tectonic and metallogenic event. In the Paleoproterozoic, low-grade (<1 ppm) concentration of gold occurred within the Outokumpu Cu-Co-Ni massive sulfide deposits, associated with ophiolites formed during rifting of the Karelian craton at 1.97 to 1.95 Ga. Svecofennian magmatism between 1.91 and 1.87 Ga, attributed to the formation and accretion of a number of volcanic arcs adjacent to the Karelian craton, is associated with syngenetic massive sulfide mineralization, commonly with gold grades between 0.1 and 1.0 ppm. The Tampere schist belt in southern Finland, which formed within this accretionary setting, is host to the Kutemajärvi gold deposit, which appears to be a metamorphosed high-sulfidation epithermal deposit that formed within a subsiding felsic volcaniclastic and subvolcanic sill complex during the transition from calc-alkaline through more alkaline volcanism.

The main accretionary stage of the Svecofennian orogeny in Finland culminated with metamorphism and deformation between 1.89 and 1.86 Ga. During that time, intrusion-related Au-Cu mineralization took place in both syntectonic porphyry stocks and their wall rocks in and close to the Archean-Proterozoic margin. Orogenic gold mineralization took place at or slightly after the metamorphic peak throughout the Svecofennian domain, possibly also overprinting massive-sulfide and intrusion-related occurrences. It is notable that the largest orogenic deposits are located within discrete plutons, rather than hosted by supracrustal sequences. This may be a consequence of the rheological contrasts between plutons and the supracrustal lithologies.

The Paleoproterozoic Lapland domain in the northern part of the country records a protracted and complicated evolution involving multiple episodes of rifting, magmatism, sedimentation, and alteration, culminating at around 1.9 Ga with the collision of the Karelian craton, the Svecofennian fold belt to the south, and the Kola craton to the north. These deformational events led to orogenic gold mineralization throughout the Proterozoic greenstone belts of northern Finland at about 1.89 to 1.86 Ga, during and soon after the peak of metamorphism and deformation. Skarnlike or epigenetic ironstone-hosted deposits were also formed during the orogeny, in the western and southwestern parts of the Lapland domain, probably somewhat later, at around 1.86 Ga. The most favorable sites for mineralization are regionally extensive zones of early albitization that predate gold mineralization. The deposition of molasselike sediments during the terminal stages of the Svecofennian orogeny and weathering of both orogenic and syngenetic sulfide mineralization, also prior to 1.8 Ga, produced placer accumulations (now paleoplacers) in the conglomerates of the uppermost formation of the Central Lapland greenstone belt. Placer deposits of controversial origin and provenance have also been worked for many years in the glaciofluvial sediments of northernmost Finland.

The areas with greatest potential for the discovery of new orogenic gold deposits in Finland are the late Archean and Paleoproterozoic greenstone belts in eastern Finland and Lapland, respectively. Some Fe-Cu-Au skarns or epigenetic ironstone-hosted deposits have been mined in the past, and there may be potential for the discovery of larger iron oxide-copper-gold systems in the western Central Lapland greenstone belt. For intrusion-related (nonskarn) mineralization, the most promising areas are close to the Raahe-Ladoga Suture, and the potential for additional metamorphosed and deformed epithermal mineralization exists in the Tampere schist belt. The significant number of gold occurrences already known in these areas highlights the potential for new discoveries.

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