

Orogenic Au deposits of the Pohjanmaa Belt, south-western Finland: deposit model and potential Co-source

**SIMON HECTOR, CLIFFORD G. C. PATTEN AND
JOCHEN KOLB**

Institute for Applied Geosciences, KIT

Presenting Author: simon.hector@kit.edu

Gold deposits in Finnish Paleoproterozoic greenstone belts share many characteristics with orogenic Au deposits worldwide. Some deposits, however, known as atypical orogenic Au deposits, have an anomalous enrichment in metals critical to the energy transition (e.g. Cu, Co, Ni) in addition to Au. The mechanisms, however, controlling metal endowment in these orogenic Au deposits remains still poorly understood. We investigate four orogenic Au deposits from the Pohjanmaa Belt in southwest Finland: the Laivakangas and Huhta Au-only and the Jouhineva and Kurula Au-Cu-Co deposits. These deposits are hosted by the same lithologies, show similar structural control and formed under similar PT conditions in the lower amphibolite facies. The differences in metal endowment, hence, are likely controlled by different fluid and metal sources. Detailed petrographic studies show that the Pohjanmaa Belt deposits formed in several mineralizing stages at the metamorphic peak and during retrograde terrane exhumation. The hydrothermal alteration and ore mineralogy vary, but the deposits share a common evolution with an early As-S-(Co-Ni)-rich auriferous stage (Ni-Co-Fe arsenide, arsenopyrite, Au \pm pyrrhotite) followed by a Cu-S-(Au-As) stage (Au, chalcopyrite \pm pyrrhotite, pyrite). Arsenopyrite thermometry yields 430-500°C as minimum temperature for the first hydrothermal stage. The second stage displays a hydrothermal sericite-chlorite-(carbonate) alteration, indicating greenschist facies conditions. We propose identify different fluid-metal source systems representative of the different metal enrichment: (1) As-(Co-Ni)-rich auriferous stage: metamorphic devolatilization of meta-sedimentary/-volcanic rocks with an ultramafic component or magmatic fluids; and (2) Cu-(Au) stage: metamorphic devolatilization of meta-sedimentary rocks or lower crustal-mantle source. Spatial association of Co-rich atypical orogenic Au deposits with mafic/ultramafic meta-volcanic rocks and intrusions, and Cu-rich atypical orogenic Au deposits with meta-sedimentary rocks let us favor a model, where fluids and metals are released by multi-stage metamorphic devolatilization during complex orogenic evolution similar to typical orogenic Au systems. The nature of the wall rocks at a district- to province-scale is critical for the metal endowment, which is useful for targeted exploration. Altogether, the polymetallic enrichment in atypical orogenic Au deposits of Finland improves the economical sustainability of the deposits and represents a potential secure source of critical metals in Europe as by-products of Au.