Polyphase Cobalt Mineralisation in the Rajapalot Au-Co Deposit, Finland

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The Paleoproterozoic greenstone belts of northern Finland host orogenic gold deposits with 'atypical metal associations' [1]. This group includes Rajapalot, situated in the Peräpohja Belt, which is enriched in cobalt [2]. The timing and processes of cobalt mineralisation, and potential genetic link to the Au mineralisation, at Rajapalot (and other Au-Co deposits in northern Finland) has been explored [3] but remains only partially understood.

In this study, detailed optical and scanning electron microscopy, has formed the basis of a paragenetic interpretation [4], elucidating multiple stages of cobalt mineralisation associated with different p-T conditions, deformation and alteration phases. Major and trace element geochemistry for Co and Fe sulphides and sulpharsenides from EPMA and LA-ICP-MS respectively further characterises the different stages of cobalt mineralisation.

Cobaltite (Cbt; CoAsS) solid solution (ss; where Co substitutes for Ni and Fe) minerals form across four paragenetic phases at Rajapalot, identified by distinct textures, associations and chemistries. Glaucodot, a Fe-rich cobaltite ss mineral, forms early in the paragenesis and is associated with pyrite, which shows fluctuation in cobalt and arsenic activity through its growth zoning. Cbt1 and Cbt2 record compositions between alloclasite and cobaltite ss members. They are both fine grained and inclusionless but have different nickel concentrations. These stages have experienced ductile deformation, resulting in an alignment with the foliation of the host rock, and dynamic recrystallisation, evidencing prolonged mineralisation over changing p-T conditions. The fourth cobaltite ss phase, Cbt3, is coarse grained, Co-rich, and commonly hosts gold inclusions, indicating coeval mineralisation. Finally, the mobilisation of trace elements and their signatures in different sulphide/sulpharsenide generations from LA-ICP-MS point and map analyses are also discussed.

[1] Hector et al. (2023). OGR, 154.
[2] Rantala et al. (2021) NI43-101 Report, AFRY.
[3] Sayab et al. (2025) MinDep, 60, 213-231.
[4] Webb et al. (2024) GSL, 541, 273-297.