Timing of the Orogenic Jouhineva Au-Cu-Co and Huhta Au Mineralization in the Pohjanmaa Belt, Finland

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Some orogenic Au deposits show variable Cu and Co content, such as the Jouhineva Au-Cu-Co deposit and Huhta Au occurrence from the Pohjanmaa Belt (PoB), Finland. The reason for Co-Cu enrichment is still unclear, although multi-stage hydrothermal mineralization is the main hypothesis. We aim to constrain the timing of hydrothermal Au ± Co, Cu mineralization in Jouhineva and Huhta by combining in situ titanite dating with detailed petrography to link mineralization stages with the tectonic evolution of the Fennoscandian Shield. Jouhineva and Huhta are controlled by the same first-order structure, hosted in the same rocks, and contain similar ore mineral assemblages. Jouhineva and Huhta consist of at least two mineralization stages hosted in quartz veins: (1) auriferous arsenides, Co-bearing arsenopyrite, and chalcopyrite$_1$ with biotite, actinolite and sericite$_1$ on vein selvedges; and (2) chalcopyrite$_2$ and free gold with sericite$_2$ and chlorite alteration halos. Three titanite generations are determined. In Jouhineva, titanite$_{1J}$ is intergrown with arsenopyrite and chalcopyrite$_1$. Titanite$_{2J}$ is associated with sericite alteration halos. Titanite$_{1H}$ is intergrown with arsenopyrite, and titanite$_{2H}$ with chalcopyrite$_2$. Titanite$_{1H}$ and Titanite$_{1J}$ are dated at 1854 ± 15 and 1816 ± 12 Ma, respectively. These ages indicate that the first mineralization stages in Jouhineva and Huhta are not coeval, explaining the Au-Cu-Co and Au-only metal assemblages, respectively. The 1760 ± 14 and 1744 ± 30 Ma ages of titanite$_2$ overlap within error, indicating similar hydrothermal evolution. The first stage in Huhta is coeval with large-scale regional tectonic rearrangement during the formation of the Bothnian Orocline (1870-1850 Ma). The first-order structure was reactivated during continent-continent collision at the margin of the Fennoscandian Shield (1840-1770 Ma). The hydrothermal activity terminated during orogenic collapse and final cooling of the orogen (1760-1744 Ma). The complex tectonic and hydrothermal evolution of the PoB explains the different metal endowment in the two deposits.