

# **Sources of orogenic gold ore fluids in the Ilomantsi greenstone belt (Finland): insight from fluid inclusion LA-ICPMS analysis**

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Fluid and metal sources in orogenic-type gold deposits remain controversial, and a key question is whether input of magmatic-hydrothermal fluids into metamorphic fluid systems is essential for high gold endowment. Magmatic fluids are often invoked as gold sources based on largely circumstantial or equivocal evidence such as association of gold mineralisation with granitic intrusions, or patterns of radiogenic and stable isotope data. By contrast, virtually no multi-element fluid composition data, which could provide direct constraints on fluid sources, are currently available. We present new LA-ICPMS fluid inclusion data for orogenic gold fluids from the Late Archean Pampalo orogenic gold deposit (Ilomantsi greenstone belt, eastern Finland), which shed light on the nature and origin of gold transporting fluids. The belt is composed of metamorphosed epiclastic and mafic to felsic volcanic rocks and intruded by contemporaneous tonalites, granodiorites and leucogranites. Gold mineralisation at Pampalo is hosted by a second order shear zone and present as disseminations in felsic porphyry dikes and intermediate volcanoclastic rocks, and as gold-bearing quartz veins. Low-strain sites in boudin necks of the felsic dike host euhedral quartz with early stage fluid inclusions related to gold mineralisation, while later generations of quartz veins contain later fluid inclusions. All studied fluids carry the typical features of orogenic gold fluids: low salinity, presence of CO<sub>2</sub> or N<sub>2</sub>, high sulphur contents and low base metal concentrations. Gold concentrations vary significantly between the early (ca. 300 ppb) and late fluid types (< 50 ppb). Because the compositional features of magmatic-hydrothermal fluids are well established, fluid mixing calculations using metal concentrations and halogen ratios demonstrate that the early gold-rich fluids at Pampalo have a metamorphogenic origin and contributions of magmatic-hydrothermal fluids were insignificant.