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Coupling gold compositional variations with hydrothermal vein parageneses as exploration tool in orogenic settings - the Loch Tay area (Scotland)

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Mechanisms responsible of the genesis of gold mineralisation in orogenic belts have long been debated due to potential of gold to be derived from metamorphic fluids, magmatic-related fluids or possible remobilization of one by the other. Although the process is structurally controlled to a certain degree, characterisation of the deposits can be hindered by poor exposure of the in situ (vein-hosted) gold occurrences. However, this issue may be mitigated by particulate gold, which is frequently recovered in stream sediments. We propose an interdisciplinary approach which combines detailed compositional characterisation of gold particles with paragenetic analysis of sulphide-rich veins; this information is thus assessed against lithological and structural constraints in the study area. The area is bounded by the regional Highland Boundary Fault and Loch Tay Fault, and gold is locally widespread as detrital particles in rivers and streams; in-situ evidence of gold-bearing veins is rare, but gold-sulphide veins have been documented in literature [2]. Historic mine activities have also identified gold in quartz ± baryte veins in association with arsenopyrite, galena and sphalerite. The definition of compositional signature of a gold particle is achieved by combining their alloy compositions with their mineral inclusion contents [1]. Au alloy and inclusion suites of the samples, mainly recovered in sediments, were investigated using EPMA and SEM. Mineral assemblages and crosscutting relationships in hydrothermal quartz veins, to establish their paragenesis, were identified using SEM-CL. Results achieved so far indicate variability in gold compositional signatures that suggests at least two different fluid sources and mineralising episodes. The paragenetic analysis of veins shows several generations of quartz, with variable mineral content, supporting the hypothesis of multiple fluid pulses. This holistic methodology allows an interpretation of the spatial variations in gold mineralisation styles and can bring to the identification of potential ore-related fluid pathways at different scales. This PhD project can ultimately generate a new, transferable approach to interpreting gold metallogeny in complex orogenic terranes.

[1] Chapman RJ et al. (2000) Econ Geol 95 1753-1773

[2] Corkhill C et al. (2010) Scottish Journ of Geol 46 (1) 23-30