Os-Pb isotope constraints for the timing of sulphide remobilization in orogenic gold systems

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Precambrian metamorphic belts host a significant proportion of the world's gold. Many of the largest gold deposits were reworked during successive orogenic events. The Meliadine gold district, Nunavut, represents one of Canada's largest emerging orogenic BIF-hosted gold districts and is situated at a reworked Archean cratonic margin. Gold is paragenetically late and occurs as clusters of inclusions within variably recrystallized arsenopyrite crystals and/or concentrated within low-strain micro-textural sites (e.g., sulphide grain boundaries and fractures) along with remobilized sulphide and hydrothermal phosphate minerals. Previously reported Re-Os arsenopyrite and U-Pb xenotime ages bracket the timing of gold introduction and subsequent remobilization to 2.27–1.85 Ga. New MC-ICP-MS and *in situ* LA-ICP-MS Pb isotope data for these dated arsenopyrite samples, together with undated remobilized sulphide phases (e.g., pyrrhotite), plot along an inferred mixing line that parallels the evolution of the bulk-earth between 2.3–1.8 Ga. Our Os-Pb results show that the isotopic composition of remobilized sulphide minerals provides a unique record for tracing the auriferous hydrothermal history and tectono-thermal processes from reworked and metamorphosed deposits. For these environments, the present micro-textural setting of gold can provide very little information on how gold was initially introduced. Establishing the timing of gold introduction and its subsequent remobilization is particularly important for mineral exploration efforts in complexly deformed and metamorphosed settings that are favourable for orogenic gold systems.