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Sediment-hosted gold deposits in the Golden Triangle of SW China: Current understanding and future trends

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Large areas of the Golden Triangle in SW China contain 30-40 sediment-hosted gold deposits with a total gold endowment in excess of 800 tons. These deposits have been considered analogous to Carlin-type gold in Nevada, but may also be classified as epizonal orogenic gold deposits. Gold mineralization is mostly hosted in Permian and early Triassic marine carbonate rocks and calcareous siltstones, with some deposits contained in Permian basaltic rocks. Ore bodies are localized in fracture zones and brittle faults generally several hundreds to >2000 m along strike and 300 to >1000 m down dip. Gold ores have an average grade of 3-7 g/t, but high-grade ores containing 100-200 g/t Au are locally present in several major gold deposits. Ore-related alteration is pervasive and consists of early jasperoid and late drusy quartz, ferrous calcite, clay minerals (illite ± dickite ± kaolinite), fluorite, realgar and opiment, which are associated with fine-grained pyrite and arsenopyrite disseminations and stibnite veinlets. Bitumen is well developed in many deposits, and field and textural relations indicate its coeval precipitation with gold. Pyrite typically displays textural and compositional zoning, consisting of As-Au-poor cores and Au-As-rich rims. Gold is principally hosted in arsenian pyrite overgrowths and arsenopyrite as structurally bound gold or gold nanoparticles, but free gold grains (<20 micron) are also locally present. Alteration gangue minerals contain abundant aqueous fluid inclusions and, less significantly, carbonic varieties (CO_2, CH_4 and additional hydrocarbons). These inclusions have homogenization temperatures ranging from 300 to 210 ºC and calculated salinities of 3-12 wt.% NaCl equiv.. Stable isotope data (S, H, O, C, Pb) do not support a simple source model either for individual deposits or district-wide gold genesis. For example, hydrogen and oxygen isotopes range across magmatic, metamorphic, and meteoric fields, and sulfur isotopes indicate marine sulfate, deep-seated magmatic, and metamorphic signatures. Recent studies of noble gas isotopes and halogen systematics of the fluid inclusions extracted from the ore minerals appear more definitive and allow a mixture of deep-seated magmatic component and meteoric waters.

Radiometric dating yieds ages of 260-40 Ma for the ore or gangue minerals, posing problems in precisely understanding the timing, processes, and tectonic environments of gold mineralization. Furthermore, illite Rb-Sr, pyrite and bitumen Re-Os, and hydrothermal carbonate Sm-Nd dating, yield ages of 220-195 Ma and 145-130 Ma. This suggests two separate gold events presumably driven by postcollisional extension associated with Indosinian orogeny involving collision between the Indochina and South China blocks and the far-field extension due to roll-back of the subducting paleo-Pacific slab. Despite significant advances, sources of gold and fluids for the district-wide gold ore formation remain enigmatic and need further study.