Exhumation-Driven Devolatilization as a Fluid Source for Orogenic Gold Mineralization

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Gold mineralization at the Damang deposit, Ghana, is unique among currently known orogenic gold deposits in the region. It comprises gold hosted within metasediments of the Tarkwaian system and contained in a subhorizontal, extensional quartz vein array that formed during regional compression. The Damang region has an extended paragenesis involving numerous structural, metamorphic, igneous and metasomatic events. Orogenic gold mineralization occurred late in the geologic paragenesis at Damang, postdating amphibolite facies regional metamorphism, which peaked at about 2005 ± 26 Ma (U-Th-total Pb dating of monazite). Following peak regional metamorphism, the Damang region underwent a short period of rapid exhumation, as constrained though numerical thermal modelling of existing pressure-temperature-time data, including $^{40}Ar/^{39}Ar$ dating of metamorphic and gold-associated biotite, with gold mineralization occurring between approximately 2005 to 1980 Ma. This exhumation triggered the generation of the subhorizontal fracture array that was fed by fluids released through decompression-driven metamorphic devolatilization reactions such as muscovite and paragonite breakdown. The fluids interacted with the host rocks at Damang to cause precipitation of gold in association with sulfide-carbonate-potassic alteration halos around quartz veins. Such postpeak metamorphic, exhumation-driven devolatilization is unlikely to be a singular occurrence and represents a potentially important source of fluid for orogenic gold deposits elsewhere in Ghana, West Africa, and globally.