

Gold Remobilization in the Giant Obuasi Deposit

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The significance of gold remobilization in ore deposits is a contentious issue, largely because we poorly understand the mechanisms for how gold may be extracted from minerals then re-concentrated over short distances. The microstructural and microchemical evolution of arsenopyrite ores from the 62 Moz sediment hosted Obuasi deposit, Ghana, reveal the mechanisms for how such a process may operate. Two co-located economic styles of mineralization occur with gold trapped in the crystal lattice of arsenopyrite and as visible gold in fracture networks. To understand the metallogenic processes involved in the formation of these ores, we used a combination of field work, Scanning electron microscopy (SEM), Electron backscattered diffraction (EBSD), High-resolution X-ray computed tomography, Secondary ion probes (SIMS and NanoSIMS) and quantitative synchrotron X-ray fluorescence microscopy trace element mapping at the Australian Synchrotron.

The arsenopyrite-hosted ore formed first during the main NW-SE shortening direction event (D2_{Ob}) while high grade visible gold mineralisation was controlled by later fracturing and folding of quartz veins during NNW-SSE to N-S shortening (D3_{Ob}). In the arsenopyrite ores the majority of the arsenopyrite crystals are zoned with a gold-poor core and epitaxial rims. The rims are characterized by a micron scale oscillatory zoning and high concentrations of gold (up to 1000 ppm) in the crystal lattice. Commonly, cores and rims are dissected by gold-depleted zones (B-zones) associated with microfractures, grain boundaries and subgrain boundaries formed during recrystallization. B-zones are interpreted as alteration zones with sharp reaction fronts, which formed post-peak metamorphism and deformation during D3_{Ob}. We develop a model whereby grain-scale microfractures and crystal-plastic microstructures facilitate a dissolution-reprecipitation replacement reaction and the release of gold from the arsenopyrite crystal lattice. At Obuasi, this gold appears to have contributed to a significant upgrade in the form of ultrahigh grade ore shoots with visible gold.