Is gold an immigrant or a neighbor: Remobilization in the giant Obuasi gold deposit, Ghana?*

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Many of the world’s largest gold deposits contain evidence of multiple mineralizing events. Whether or not gold is remobilized or derived from separate, overprinting hydrothermal systems is a matter of some controversy. The 60 Moz Obuasi deposit, Ghana, has two contrasting styles of mineralization with 50% of the resource contained in disseminated arsenopyrites in sedimentary rocks and 50% as high-grade native gold, occupying fracture networks in previously deformed quartz veins. We constrained the microstructural and microchemical evolution of the arsenopyrite ore during metamorphism and deformation, using a combination of scanning electron microscopy (SEM), electron backscattered diffraction (EBSD), secondary ion mass spectrometry (SIMS), and quantitative synchrotron X-ray fluorescence microscopy trace element mapping with the Maia large solid-angle detector array at the Australian Synchrotron. EBSD reveals gold-bearing arsenopyrites deformed via crystal-plasticity, which led to the development of subgrain boundaries and a small number of new grains. The recrystallized areas became focal points for subsequent brittle microfracturing. In these deformed regions, gold concentrations are significantly lower and selected grain boundaries of the arsenopyrites have undergone significant dissolution. Coeval with the microfracturing and dissolution, a generation of pyrites precipitated with native gold inclusions. The results indicate that significant quantities of gold were remobilized from gold-rich growth zones within arsenopyrite and potentially reconcentrated at much higher grades within the fracture networks in adjacent quartz veins. Crystal-plasticity, microfracturing, dissolution, and nanoscale dissolution-reprecipitation replacement reactions were likely all important mechanisms in releasing gold from the arsenopyrite crystal structure. Field relationships and petrography reveal that low-strain deformation and incipient recrystallization of arsenopyrite as well as embrittlement and gold remobilization occurred during late folding of the host rocks postdating the main phase of arsenopyrite crystallization.