

Redistribution of Gold within Arsenopyrite and Löllingite during Pro- and Retrograde Metamorphism: Application to Timing of Mineralization

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Abstract

The association of gold and $\text{Fe} + \text{S} \pm \text{As}$ phases in mesothermal gold deposits is ubiquitous. Arsenopyrite-löllingite-pyrrhotite-gold textures in amphibolite to granulite facies host rocks have been used to determine the timing of mineralization relative to peak metamorphism at a number of locations. The relative timing of gold deposition versus metamorphism is critically important to crustal-scale genetic models for the evolution of gold-producing regions. By analysis of experimental and natural samples we investigate the behavior of gold relative to these phases during prograde and retrograde metamorphism. We find that during prograde metamorphism gold is first expelled from arsenopyrite before being partitioned into löllingite. The occurrence of invisible gold in löllingite, therefore, does not unequivocally indicate gold deposition synchronous with peak metamorphism. Diffusional processes control both the partitioning of gold into löllingite during prograde metamorphism, and the exsolution of gold from löllingite during retrograde metamorphism. Experiments show that arsenopyrite produced during retrograde metamorphism is not able to incorporate invisible gold significantly. These results have implications for textural interpretations of the coexisting phases. We show that identical textural associations described at several deposits, elsewhere described as synpeak metamorphic, could have formed by metamorphism of a preexisting gold deposit.