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Invisible gold: Comparison of Au deposition on pyrite and arsenopyrite

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ABSTRACT

X-ray photoelectron spectroscopy (XPS), field emission scanning electron microscopy (FESEM), and open circuit potentials were used to compare the size, chemical state, and distribution of adsorbed and reduced gold from Au^{3+} chloride solution on pyrite and arsenopyrite. Many small Au^0 particles grow on the arsenopyrite surface, whereas few, much larger, gold particles appear on pyrite. These results mimic the differences in distribution of gold in some coexisting natural pyrites and arsenopyrites. The rate-limiting step in deposition of gold from Au^{3+} chloride solutions is the reduction of Au^{3+} to Au^+, whereas the open-circuit potential for deposition is determined by the reduction of Au^+ to Au^0. The open-circuit potential of pyrite or arsenopyrite is a corrosion potential. Presence of Au^{3+} shifts the corrosion potential to a value that depends on the relative rates of the reduction of Au^{3+} and the oxidation of the mineral. Open-circuit potential measurements indicate that the rate of deposition of gold on pyrite is controlled almost entirely by the rate of reduction of Au^{3+}. By contrast, the rate of reduction of gold on arsenopyrite is controlled significantly by the rate of oxidation of arsenopyrite.