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CROSSROADS IN EARTH AND PLANETARY MATERIALS

Microelectronic junctions in arsenian pyrite due to impurity and mixed sulfide heterogeneity

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Abstract

Impurities and crystal defects within the semiconducting bulk of a metal sulfide introduce energy levels within the forbidden bandgap. These levels in turn control semiconducting type and local electrical properties within single and multi-phased sulfide assemblages. Heterogeneity in sulfide semiconductivity linked to these impurities can lead to *p-n* micro-junction formation and potential distributions near the surface that may alter redox reactivity. Secondary gold ore genesis via a micro-galvanic effect related to heterogeneity has in the past been hypothetically linked to such micro-junctions. Understanding these regions and their interaction with weathering fluids in the regolith for example requires large-scale imaging of potential distributions associated with near-surface micro-junctions and correlation with the responsible elemental distributions. Here we investigate the existence of micro-electronic junctions in a mixed sulfide assemblage using scanning laser beam induced current (LBIC) and correlate them with pyrite-chalcopyrite interfaces mapped using combined energy-dispersive spectroscopy (EDS) and wavelength-dispersive spectroscopy (WDS) on an electron hyper-probe. Junctions in a natural assemblage are positively identified for the first time.

Keywords: Pyrite, heterogeneity, semiconductors, electrical properties, micro-junction, heterojunction, chalcopyrite, mixed sulfides, laser beam induced current, elemental mapping, metal ore genesis, electrochemical