

Sulfide mineral paragenesis at the Hugo Dummett porphyry Cu-Au deposit, Oyu Tolgoi, South Mongolia

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Mineralogical studies of ore minerals have been conducted for the Hugo Dummett porphyry copper-gold deposit. The Hugo Dummett porphyry Cu–Au deposit is hosted within Late Devonian quartz monzodiorite intrusions, augite basalt and dacitic ash-flow tuff situated in the South Gobi region, Mongolia.

Copper-gold mineralizations at this deposit are centered on a high-grade copper (> 2.5%) and gold (0.5–2 g/t) zone of intense quartz veining. Intense quartz veining (up to 90% by volume) forms a lens up to 100 m wide, hosted by augite basalt and spatially by quartz monzodiorite.

The Hugo Dummett porphyry copper-gold deposit is characterized by three mineralized stages based on textural relationships of ore minerals: (1) early stage (2) middle stage and (3) late stage. The main copper-gold mineralization occurs in the early and middle stages, which is related to the quartz monzodiorite and dacitic ash-flow tuff. Pyrite, chalcopyrite and bornite occur in all stages. The early stage of pyrite, chalcopyrite, bornite, molybdenite and sphalerite were replaced by middle stage of minerals. The middle stage minerals are sphalerite, tennantite, tetrahedrite, chalcocite, covellite, eugenite, galena, electrum, and gold, those are dominantly occur in the quartz monzodiorite. Eugenite is determined in trace amount for the first time in the Hugo Dummett deposit. Additional pyrite, bornite and chalcopyrite were also deposited during this stage. In the late stage, pyrite, chalcopyrite and bornite are dominantly occurs as veins, veinlets and fracture filling in the quartz.

Chemistry of bacterial interfaces: Functional group composition and implications for metal and mineral surface complexation

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Knowledge on the composition of surface functional groups and their reactions is critical in determining the role of bacteria in bacterial mediated biogeochemical reactions. However, bacterial surface chemistry is less well understood, and most of our current understanding comes from the potentiometric titrations of isolated cell wall membranes. Using STXM, and X-ray and infrared spectroscopy we studied the C-, N-, P-, and S-functional group composition of Gram-positive and Gram-negative cells.

Our studies indicate that all identified functional groups and their relative concentrations are similar to both Gram-positive and Gram-negative bacterial surfaces, without any detectable differences. The dominant functional groups are as follows- C: unsaturated C=C (aliphatic and aromatic), C=O of amide and carboxyls, and C-N of amines; N: amine and amides; P: phosphate esters; S: methionine. Several other groups, such as aromatic N and cysteine, are identified at low concentration, but they play an important role in the metal and mineral surface complexation reactions.

Bacterial cell surface functional groups exhibit different affinities with metals based on the functional group type and the Lewis acidity of metal. For example, Hg reactions with bacteria showed that Hg preferentially reacts with cysteine and exhibits different coordination geometries at nanomolar Hg concentration. However, Hg binds to carboxyls at micromolar concentration. A summary of bacterial surface functional groups, and their reactions with selected metals will be discussed.