Electrical Processes in Charge of Ore Formation

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Electrical phenomena may play a more fundamental role in geological processes than previously recognised. Previous work has revealed that gold can precipitate within quartz veins during seismic events via quartz's piezoelectric properties—where mechanical stress generates localized electric fields that facilitate ore-forming reactions, a process known as piezocatalysis. This mechanism introduces a new perspective on metal transport and concentration, with implications extending beyond gold mineralisation.

This presentation explores the intersection of mineral electrical properties, electrochemical reaction pathways, and piezoelectricity in ore-forming environments. We examine how mineralisation processes such as galvanic redox reactions at conductive mineral junctions, and factors governing metal nanoparticle stability (i.e. zeta potential, electrostatic attraction, and surface potential) are affected by the presence of piezoelectric potentials.

Experimental results demonstrate that electric fields generated by stressed quartz can significantly enhance metal deposition onto conductive minerals, particularly sulphides. We propose that quartz piezoelectricity promotes electrochemical deposition (i.e., 'electroplating') over spontaneous galvanic reactions and drives nanoparticle movement via electrophoresis rather than electrostatic attraction. We hypothesize that the directionality of applied voltages may govern the galvanic corrosion or protection of sulphides, influencing ore preservation or remobilisation during deposit formation.