

Contrasting surface chemistry of adsorbed ions in iron oxyhydroxide coatings on feldspar grains in soils deposited over mineralized and unaltered granite in the Big Creek Mining District, Idaho, USA (ToF-SIMS analysis)

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An existing hypothesis in applied geochemistry suggests that a variety of ions are absorbed on pre-existing iron and manganese oxyhydroxide coatings formed on mineral grains in soils, and that these ions move upward and laterally by vadose zone, vapour transport, electrochemical and biogeochemical processes to these depositional sites. Desorbants are used to selectively extract these ions from the grain coatings and the analytical results are used in conjunction with geospatial techniques to identify areas of potential mineralization. Feldspar grains from both samples were used to eliminate potential effects of confounding variables that may be associated with other minerals and surface coatings on those minerals. Elemental maps created by ToF-SIMS analysis indicate that hydrothermal trace elements associated with mineralization concentrate in iron oxyhydroxide coatings on feldspar grains in b-horizon soil developed over gold-silver mineralized and altered granite. Weathered pyrite is the probable source of iron oxyhydroxide mineral coatings in this soil. Elemental maps of arsenic, antimony, lead, and copper are variably present in coatings along flat grain surfaces, and are strongly enhanced in surface coatings located on grain corners. These elements are below detection in iron oxyhydroxide coatings on feldspar grains in b-horizon soils developed over an unmineralized granite outcrop located several kilometres from known geochemical anomalies or mineralized sites. Iron oxyhydroxide coatings on soil grains at the unmineralized site are related to weathering of biotite. These observations suggest that the depositional chemistry portion of the hypothesis is valid.

Catalytic potential of silicate, oxide and sulfide minerals for the abiotic polymerization of glycine under high pressure and temperature conditions

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Polymerization of amino acids is the essential step for the origin of life. It is still uncertain if minerals had a progressive role for polymerization of amino acids in any ancient geological environments. Polymerization experiments of glycine, catalyzed by minerals, were performed under 150°C and 100 MPa for 8 days, using a test-tube type autoclave. Various sulfides (millerite, troilite, pyrite and sphalerite), magnetite and montmorillonite were mixed with glycine monomers in order to test if these minerals behave as the catalyzer to promote peptide formation. HPLC and LCMS analyses of the products showed that: (1) glycine in all the experimental runs polymerized from 2-mer to 11-mer; (2) the highest yield of oligopeptides was found in the sphalerite experiment; (3) cyclic anhydride was more abundant in the montmorillonite experiment; and (4) other minerals behaved intermediately between sphalerite and montmorillonite.

In order to examine surface processes, adsorption experiments were also performed by NH₃- and CO₂-TPD (temperature-programmed desorption) methods. The TPD analyses indicated that sphalerite has high adsorption capabilities both of NH₃ and CO₂. These results imply that sphalerite has high adsorption capabilities of amino and carboxyl groups affecting the elongation of peptides. On the other hand, montmorillonite only has the capability to adsorb NH₃, thus amino group. This type of adsorption may only result in cyclization of amino acids preventing elongation of oligopeptides.