
Low-Temperature Acid Weathering in Newhaven, Sussex, United Kingdom, and Its Application to Theoretical Modeling in Radioactive Waste-Disposal Sites

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Abstract: Tertiary weathered sediments located immediately to the west of the harbor at Newhaven, Sussex, UK, were investigated by examination of major and trace elements by scanning electron microscope (SEM), microprobe, and inductively coupled plasma mass spectrometer (ICP-MS), and the mineralogy was studied by optical petrography, X-ray diffraction (XRD), transmission electron microscope (TEM), selective leaching, and thermodynamic modeling. Studied outcrops experienced acid leaching by sulfuric acid percolating downward through Tertiary sediments overlying Cretaceous chalk. The progressive neutralization of the percolating acid fluids resulted in "sequentially" layered neoformation of minerals: jarosite, iron oxides, aluminous minerals (sulfates, oxyhydroxides), gypsum, and Fe-Mn oxides. Substantial agreement was found between field observations and mineral assemblages obtained by modeling with the program CHILLER. These results suggest that the initial assumptions on the weathering process and mechanisms are correct. The relevance and implications of this study in the modeling of future denudation and weathering processes of radioactive waste-disposal sites (both deeply buried sites for high-level waste and surface sites for low-level waste) are discussed. Neoformed phases, such as jarosite, aluminous minerals, and silico-aluminous gels may play a significant role in the efficient trapping of mobilized pollutant radionuclides.

Key Words: Acid Weathering • Aluminous Minerals • Jarosite • Radioactive-Waste Sites • Silico-Aluminous Gels • Thermodynamic Modeling

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