MINERALOGIC SPECIATION OF TRACE ELEMENTS IN ENVIRONMENTAL MEDIA: BARIUM NATURAL ATTENUATION AT LANL'S TA-16

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Metal and radionuclide contamination are a significant problem at cleanup sites worldwide. Understanding trace-element mineralogic speciation in the environment is crucial to proposing natural attenuation as a remedial action at such sites.Barium nitrate was a component of explosives that were processed at LANL's Technical Area 16 during the Manhattan Project. Soils, sediments, and alluvial waters at Technical Area 16 are highly contaminated with barium. Soil concentrations range to 40 000 ppm and water concentrations range to 10 mg/L. SEM investigations of barium-contaminated soils and sediments reveal that barium occurs in three mineralogic forms and sorbed on soil particles. Barite is widespread in alluvial sediments. It occurs as overgrowths on quartz grains, on organic particles, and as small (less than 50 micron) isolated grains. Witherite is found in overbank sediments and within barium-contaminated landfills. Witherite particles are typically large (up to 100 micron) grains with pronounced dissolution textures. A barium silicate occurs as overgrowths on magnetite and steel within barium-contaminated landfills.Thermodynamic calculations show that alluvial and spring waters are oversaturated with barite at 0 to ~ 7.5 pH. Witherite is oversaturated at pH greater than ~ 8.8. Barite is confined to the flowing stream channel because sulfate is abundant there (greater than 10 mg/L). Witherite is precipitated due to evaporation of low-sulfate rainwaters in the presence of high-barium sediments. These calculations, which suggest that barium is being sequestered as insoluble barite in the alluvial system, may be used to support monitored natural attenuation as a remedy for barium contamination.