Metal transport in sediments near abandoned Uranium mines in Harding County, South Dakota

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Sediment samples were analyzed as part of ongoing environmental investigations of historical uranium mining impacts within Custer National Forest in Harding County, South Dakota. Correlations between metals content, grain size, and soil mineralogy were determined to identify contaminant fate and transport mechanisms. Soil samples were analyzed near the mining source zone and 50 km downgradient. Samples were homogenized and wet sieved through polymer screens. Each fraction was analyzed for As, Cu, Mo, Se, Pb, Th, U, and V concentrations by ICP-MS. Powder X-ray diffraction analysis identified quartz as the primary mineral for all size fractions, with varying amounts of analcime, indicative of volcanic origin. Selected samples were examined for trace mineral composition using scanning electron microscopy. The presence iron pyrites indicates inheterogeneity in redox potentials on a microscopic scale. Elevated metals concentrations were associated with the trace presence of pyrite indicating an influence on metal transport. U(VI) reduction to U(IV) appears likely facilitated by redox reactions with pyrite at the mineral surface. The pyrite crystal lattice is known to incorporate As, making pyrite weathering a potential source of As. Pyrite weathering may also contribute to increased solubility of metals through pH reduction and by complexation with released sulfate.

Italian carbonatites and the mechanism of Earth CO_2 discharge

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10^{20}kg of solid C is stored in the deep Earth, while the flux of C-O-H at the surface may catastrophically change. Italy emits 2.5-5x10^{11} mol. a^{-1} of CO_2 with Vulture volcano alone producing 3.7x10^{6} mol a^{-1} km^{2}. Additional evidence for CO_2 fluxing at Vulture includes diatremes that contain carbonatite and melilitite shells around mantle nodules. Vulture offers a unique opportunity to investigate localised solid/fluid transfer of C towards the surface. Mantle/core outgassing is considered to have a δ^{13}C of abut -5‰. Italian carbonatites have δ^{13}C‰ between -8 and -4, R/Ra up to 7.33 (plume-type values). Carbonatites from Vulture have δ^{13}C, δ^{18}O and δ^{11}B values of −6.7‰ (-4.8‰ intrusive), +10.2‰ (+10.3‰ intrusive) and −5.9‰, respectively (mantle values). The change from natrocarbonatites to Ca-carbonatite at Oldoinyo Lengai is accompanied by a change in δ^{18}O from +6.5‰ to +25‰, while δ^{13}C remains unchanged. Nyerereite inclusions from Vulture suggest that similar processes contributed to δ^{18}O evolution. Radiogenic mantle end-members, detected in Italian carbonatites, are related to deep alkali-carbonatites and metasomatic reactions with pyrope harzburgite. If the isotopic ratios are unrelated to metamorphism or limestone recycling *via* subduction, then core/mantle degassing may be an effective agent in planetary dynamics.