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LANL / ER / FRAMEWORK

APPLICATIONS OF GEOCHEMISTRY IN CONTROLLING ELEMENTAL DISTRIBUTIONS IN BACKGROUND SOILS AND SEDIMENTS, LOS ALAMOS, NEW MEXICO

by

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ABSTRACT

Approximately 250 background soil samples (mainly mesa top) and 18 canyon-bottom (Ancho and Indio Canyons) sediment samples have been collected adjacent and within the Laboratory boundary (Longmire et al., 1995). Prior to chemical analyses, soil and sediment samples are partially digested primarily using HNO_3 at pH 1, which provides element concentrations in acid-soluble solid phases such as calcium carbonate, solid organic matter, clay minerals, and ferric hydroxides. Aliquots of the same soil and sediment samples are also completely digested using HF, providing total element concentrations. These digestion procedures provide a comparison of elements incorporated within the primary silicate minerals (total digestion) with those elements concentrated in surface coatings formed during soil genesis (partial digestion). Analytical methods for 24 analytes consisted of inductively coupled plasma spectroscopy, atomic absorption, and ion chromatography.

Well-developed soils have higher concentrations of trace elements than weakly developed soils and sediments found on the Pajarito Plateau. The B horizons in background soils generally contain higher concentrations of iron hydroxides, clay minerals, and trace elements relative to A and C horizons and sediments. These minerals and solid compounds control distributions of trace elements (As, Be, Cd, Cr, Co, Mn, Ni, Pb, Se, Th, U, V, and Zn) in soils through adsorption and coprecipitation processes. The B horizons are highly variable in their trace-element content, which is reflective of the types and distributions of geochemically reactive solid phases. Background sediments have trace-element distributions similar to the A and C soil horizons. Understanding geochemical processes occurring in soils and sediments is critical for developing technically defensible programs for site assessment, understanding contaminant transport, evaluating viable remediation options, and performing meaningful risk analysis.

No additional Laboratory background data are needed for B horizons (134 samples) present on mesa tops; however, we recommend additional characterization of A and C horizons because a small number of samples (<25) are present in the data set for mesa top soils. We recommend that additional samples be collected and characterized from A, B, and C horizons for slope and canyon-bottom soils and sediments.

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RECOMMENDATIONS

Characterize LANL and site background for soils, sediments, and Bandelier Tuff using a multi-disciplinary approach involving the Decision Support Council, Earth Sciences Council, and Field Units.

Use consistent sample digestion (HNO_3) procedures prior to chemical analyses to compare background soil samples to site samples.

Standardize field sampling procedures and require better field descriptions of sampling sites.

Enlarge background data sets for mesa top soils (A and C horizons), slope soils (all horizons), canyon-bottom soils (all horizons), and canyon-bottom sediments.

Additional background analyses are required for soils and sediments if:
a) background screening values are exceeded AND SALs are exceeded, or
b) Al, As, Be, or Mn are known (or suspected) to have been released at the PRS.

Utilize results of background and site characterization to the fullest extent to enhance maximal success and benefits of remediation strategies.