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Individual radiological particle population analysis of soil and hunt for discrete global fallout particles

Content

Soils, sediments and powders were analyzed to detect individual radiological particles, assess differences between the samples, and to discriminate natural minerals from global fallout or other contributions. The samples consisted of soil from a residential area overlying the Aquia Formation in Anne Arundel County, MD, USA; soil from a residential area overlying the New Oxford Formation Triassic red bed in Montgomery County, MD, USA; soil from a light industrial area overlying glacial loess deposits in Monroe County, NY, USA; NIST SRM 4357 Ocean Sediment; NIST SRM 2710 Arizona Road Dust; SRM 4353A Rocky Flats Soil Number 2; SRM 4350b River Sediment; SRM 4355 Peruvian Soil; several commercial heavy mineral sands; and as controls, nonradiological silicon carbide powder; and nonradiological alumina powder. Although heavy mineral separation techniques can readily separate out grains of zircon, monazite, rutile and others that are known to potentially host uranium and/or thorium, density-based separations alone do not address cases where agglomeration of particles of interest with lighter materials might occur. Density separation also cannot address the separation of very fine particulate matter adequately. Autoradiography can be used down to about 30 microBq per particle identified. It preserves discrete particle information and offers a means to efficiently process many tens of grams of soil without throwing away any fraction, therefore not biasing against very fine or agglomerated material. It can be used to quickly characterize the individual activity levels of hundreds of grains per sample. Quantitation depends on appropriate reference materials, calibration and protocols specific to individual particle microanalysis. Identified particles can be analyzed from the same sample mount or removed for other microanalytical methods. Other methods applied were optical crystallography, confocal laser scanning microscopy, Raman spectroscopy, SEM, tXRF and alpha spectrometry. Individual particle activity was determined and plotted against particle size, morphology and chemistry revealing population differences and characteristics useful for the discrimination of natural from unnatural sources.

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