Global distribution of Pu isotopes and 237Np.

Inventories and compositions of Pu isotopes and 237Np in archived soil samples collected in the 1970s from 54 locations around the world were determined to provide regional baselines for recognizing possible future environmental inputs of non-fallout Pu and Np. As sample sizes used in this work were small (typically 1 g), inhomogeneities in Pu and Np concentrations were easily recognizable and, as a result, we were able to determine that atypical debris in South America, from French testing in the South Pacific, is more widely and uniformly distributed than previously supposed. From our results we conclude that fallout 237Np/239Pu atom ratios are generally lower in the Southern Hemisphere (approximately 0.35) than in the Northern Hemisphere (approximately 0.47.) Moreover, 237Np/239Pu atom ratios are more device-dependent, hence more variable, than counterpart 240Pu/239Pu atom ratios. Given predictable trends caused by sample inhomogeneities, with only two exceptions, the Pu results of this work are entirely consistent with (and in several instances improve on) results previously reported for these same samples. However, unlike earlier interpretations used to explain these results, we recommend that fallout isotopic signatures be represented by mixing lines, rather than averages, to better reflect regional variations of stratospheric fallout inventories relative to tropospheric fallout inventories, and provide the theoretical basis for doing so. Finally, the Np results of this work constitute one of the largest single compilations of such data reported to date.