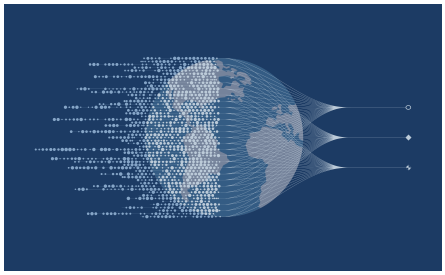

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Isotopic Ratio Analysis at Ultra-Trace Concentration Levels for CTBT Applications

Each anthropogenic emission possesses a unique radionuclide composition, serving as a 'fingerprint' that enables the identification of radionuclide contamination sources. This report presents a cutting-edge and rapid technique for radionuclide detection and source identification, focusing on ultra-trace concentration levels critical for detecting small-scale nuclear tests. Radionuclide isotopic ratios were measured using a high-resolution sector field mass spectrometer paired with a high-sensitivity APEX sample introduction system, complemented by the state-of-the-art 'Ortec' alpha spectrometer. Gamma spectra were recorded using the SILENA gamma-spectrometric system. Elevated isotopic ratio values, such as 137Cs/239,240Pu, 238Pu/239,240Pu and 240Pu/239Pu, provide reliable evidence of nuclear events and allow for source attribution when integrated with atmospheric transport modeling. The report also examines the occurrence of uneven 'hot' particle deposition and the formation of extensive 'hot' spots, emphasizing their significance in understanding radionuclide distribution and contamination patterns.

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