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Sequential separation of ultra-trace U, Th, Pb, and lanthanides with a single anion-exchange column

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Abundance and isotopic ratios of trace uranium (U), thorium (Th), lead (Pb) and lanthanides in environmental samples play a key role to investigate features of the samples. In the environmental samples such as rocks, soils, and airborne dusts, trace U, Th, Pb, and lanthanides are contained with major elements such as Na, K and Fe. These major elements and the polyatomic ions which originated from the co-existing elements affect accuracy of analytical results measured by ICP-MS. The analytes, therefore, should be separated from the interfering elements. The authors developed the technique for sequential separation of U, Th, Pb, and the lanthanides using a single anion-exchange column and mixed media consisting of hydrochloric acid, nitric acid, acetic acid, and hydrofluoric acid. With a single anion-exchange column, sequential separation of 50 ng each of the elements of interest in an ICP-MS calibration solution was successfully carried out. The recovery yields of these elements were more than 95%. Alkali metals, alkali earth metals, and Fe were eliminated from these elements. This sequential separation technique was applied to the author's own simple automatic system. The system consists of a tiny anion-exchange column, switching valves controlled by a PC, and a gas bottle to pressurize the eluents. The separation of elements of interest was optimized for several parameters including particle size, column length, and flow rate of eluents. The elements of interest were completely separated within 6 hours by use of this system.

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