

**AN IMPROVED METHOD FOR THE DETERMINATION OF Ra-226 IN ENVIRONMENTAL SAMPLES  
BY ALPHA SPECTROMETRY BASED ON SULFATE SALTS PRECIPITATION KINETICS**

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Radium-226 is a naturally occurring isotope from the  $^{238}\text{U}$  decay series with a radioactive half-life of  $1600 \pm 7$  years. It is a very toxic radionuclide mainly because it deposits into bones. A chronic exposure to significant activities of  $^{226}\text{Ra}$  can cause some types of cancers and chronic ingestion can lead to several diseases. Numerous analytical methods have been developed to routinely measure  $^{226}\text{Ra}$  in various environmental samples; however, routine monitoring of  $^{226}\text{Ra}$  in a large amount of environmental samples is often tedious, labour intensive, time consuming, and expensive. New methods, which are robust, sensitive, and rapid, need to be developed to facilitate the measurement of  $^{226}\text{Ra}$  in environmental samples.

Alpha spectrometry is one of the preferred techniques to measure trace activities of  $^{226}\text{Ra}$  in environmental samples because it is very sensitive. The thin layer source needed for the measurement can be rapidly prepared with a  $\text{BaSO}_4$  micro-precipitation, but this technique is not selective: other elements such as Ca, Sr, and Th interfere and need to be removed.

A very simple and rapid method to purify Ra from potential interferences, after sample dissolution, consists in co-precipitating Ra with  $\text{PbSO}_4$ , dissolving the  $\text{Pb}(\text{Ra})\text{SO}_4$  precipitate with EDTA and then performing a  $\text{BaSO}_4$  micro-precipitation at pH 4-5. EDTA complexes most of the potential interferences and prevents them from precipitating without the need for separation resin. This is a very effective method, but Sr is not adequately removed, several oxides such as  $\text{Fe}_2\text{O}_3$  are not dissolved by EDTA, and Ca precipitates with sulfate when its concentration is too high.

The  $\text{PbSO}_4/\text{EDTA}$  method was significantly improved by studying the precipitation kinetics of selected sulfate salts. After combustion, fusion, dissolution, and filtration, Ra was effectively co-precipitated with  $\text{PbSO}_4$  in a 50 ml centrifuge tube and filtered after just one minute. In this short lapse of time, Ca and Sr were not significantly precipitated even if relatively large concentrations were present ( $\sim 8$  and  $0.5$  g/L for Ca and Sr, respectively). Then, the  $\text{BaSO}_4$  micro-precipitation was performed in the presence of EDTA, which effectively prevented the potential radioactive interferences from precipitating. A low MDA of approximately  $0.3$  mBq/sample was obtained using trace metal grade reagents. The method was validated with reference materials and successfully applied to several types of environmental samples such as mice, sediments, and foods. The developed separation method was rapid, robust, and cost effective.