RESULTS AND DISCUSSION

Fig. 1 shows the a-spectrum of naturally occurring U and Th radionuclides in a geological sample along with the spike isotopes (\(^{232}\)U and \(^{228}\)Th). Although separated during the radiochemical procedure, it can be seen that the Th fraction also contains \(^{224}\)Ra and progenies. This is due to ingrowth of these short lived nuclides following the half live of \(^{224}\)Ra (\(t_{1/2}\) = 3.6 days) during the long term measurements (which are typically in the range of a few days for natural samples).

INTRODUCTION

Detection of pure \(\alpha\)- and \(\beta\)-emitting radionuclides require careful radiochemical separation procedures preceding radioassay. The radioanalytical group is therefore continuously developing and improving such techniques along with source preparations suitable for high resolution \(\alpha\)-spectrometry. In addition, for chemical yield mass balance calculations or direct sample measurements (air filters, waste waters etc.), precise spectrometer calibration is a prerequisite to minimize any analytical uncertainty.

MATERIALS AND METHODS

In a first step a suite of electrodeposited Uranium sources were prepared using a reference solution (\(^{235}\)U depleted Uranium) of known activity. The U content was determined with an independent method (ICP). These standard sample discs were then used to calibrate an \(\alpha\)-spectrometer system equipped with 8 individual semi-conductive surface barrier detectors. Prepared for quantitative activity determination, the next phase concentrated on development of a purification procedure for U and Th in environmental samples. The method used is based on complete dissolution of the rock materials and separation of U and Th on actinide extractive chromatography using the resin UTEVA produced by EICHROM SA. Two fractions had to be produced, one for the U and the other for the Th radionuclides because of almost identical \(\alpha\)-emission energies for \(^{230}\)Th and \(^{234}\)U. The method was tested using tracer spike solutions (\(^{232}\)U/\(^{228}\)Th multispike). Given the known activity of the spike (\(A_{\text{std}}\)), the detector efficiency (\(\varepsilon\)) and the measured counts (\(I\)) of the standard source in time (\(t\)), the chemical recovery or yield (\(Y\)) resulting from the analytical procedure can be calculated as follows:

\[
Y = \frac{I}{I \cdot \varepsilon \cdot A_{\text{std}}} \quad (1)
\]

The same relation holds for any isotope of the same element in a sample with unknown activity (\(A_{\text{samp}}\)). Combining (1) for sample and spike, any uncertainties in chemical yield cancel out and the sample activity can be simply obtained from the following relation:

\[
A_{\text{samp}} = \frac{I_{\text{samp}}}{I_{\text{std}}} \cdot A_{\text{std}} \quad (2)
\]

REFERENCE