Evaluation of measurement precision of $^{87}Sr/^{86}Sr$ ratio in various environmental samples for nuclear forensics purpose by using high resolution ICP-MS

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A number of nuclear forensic methods have been developed to verify the declared origin of uranium ore concentrates. In addition, they can be applied to identify the origin of unknown uranium ore concentrates intercepted from illicit trafficking. Among them, isotopic analysis of $^{87}Sr/^{86}Sr$ ratio can also provide clues to the location of the uranium concentrates. In general, Rb and Sr coexist in natural soils and rocks, and the natural radioactive Rb-87 isotope collapses into ^{87}Sr through β decay. Since the distribution of ^{87}Sr may be different depending on the region and rock type, the ratio of $^{87}Sr/^{86}Sr$ enable to estimate the collection location of uranium concentrates. In order to measure $^{87}Sr/^{86}Sr$ ratio, Sr should be purely separated from rock components including ^{87}Rb which is one of main isobaric species. The measurement of $^{87}Sr/^{86}Sr$ ratio is carried out with high resolution Sector field ICPMS (SF-ICPMS) instead of Quadropole ICPMS (Q-ICPMS) for analyzing slight changes in the measured values of the ratios in the samples of interest.

In this study, sample solutions of three rock samples and two standard soil samples were prepared by total dissolution method and the strontium chemical separation of the prepared solutions was carried out using Sr resin after thorough optimization using the reference solution. After separation, the ratio of $^{87}Sr/^{86}Sr$ was measured using SF-ICPMS and the concentration of Sr was calculated in the sample solution. In the similar way, the concentration of Rb in the sample solution was also obtained. It was confirmed that the measured values of Rb/Sr and $^{87}Sr/^{86}Sr$ were similar to those of the standard soil material, and that the measurement precision of $^{87}Sr/^{86}Sr$ was less than 0.5% at the concentration of 1 ng/mL of Sr. The precise measurement of $^{87}Sr/^{86}Sr$ ratio in the sample, which is performed in this study, can be used as a basic data for nuclear forensic technique that can reveal the regional relation to the uranium raw material in the future.