

## SAMARIUM DETERMINATION BY NEUTRON ACTIVATION ANALYSIS IN URANIUM-RICH SAMPLES

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### Introduction

The U fission products interference has been studied over the years, mainly focusing on the influence on the concentration measurement of several elements in uranium-rich samples by Instrumental Neutron Activation Analysis (INAA). The determination of the uranium fission interference factor can be achieved by two ways: 1) experimentally, by simultaneous irradiation of standards with known masses into the same device of irradiation; 2) theoretically, using reported nuclear parameters and determining epithermal-to-thermal neutron flux ratio. The <sup>153</sup>Sm radioisotope used in INAA require special attention because the 103 keV gamma ray presents two interferences due to the U presence: the <sup>153</sup>Sm fission product of <sup>235</sup>U and the X-Ray emitted by <sup>239</sup>Pu, formed from <sup>238</sup>U neutron capture. The aim of this study is to propose a new approach using an effective interference factor correction in the Sm determination in samples rich in U.

### Description of the Work

Twenty standards of U and Sm were irradiated into the same irradiation device for 8 h at the IEA-R1 nuclear research reactor under a  $4.6 \times 10^{12} \text{ cm}^{-2} \text{ s}^{-1}$  neutron flux. The epithermal-to-thermal neutron flux ratio was obtained by the irradiation of an Au-Al alloy for 4 h in the same position. The results obtained experimentally and theoretically were inconsistent, indicating that the interference of the Pu X-Rays is too strong to allow a good theoretical description. It was verified in the certified reference materials (CRMs) analyses, that the best results in the Sm concentration occurred when the experimental interference factor was measured using the same decay time of the CRMs measurements. In this study, aliquots of BCR-677 Estuarine Sediment and IAEA-SL-1 Lake Sediment CRMs were analyzed. Results obtained in these analyses and correction factors used are presented in Table I together with certified values.

Table I: Mean concentrations (in  $\text{mg kg}^{-1}$ ) of Sm obtained in the CRMs analysis, interference factors and certified values.

Reference material	Decay time (d)	Interference factors	Mean concentration	Certified values
BCR-677	7	$0.053 \pm 0.003$	$4.58 \pm 0.07$	$4.66 \pm 0.19$
IAEA-SL-1	8	$0.046 \pm 0.008$	$8.37 \pm 0.26$	$9.25 \pm 0.51$

### Conclusions

The difference between the results of interference factors obtained experimentally and theoretically indicated that the interference is due to mainly <sup>239</sup>Pu X-Ray contribution. The concentrations obtained in the CRMs point out that the proposed methodology is suitable to correct the interference of the U fission product.

**Keywords:** interference factor, uranium fission product, neutron activation analysis, samarium.