



Contribution ID: 20 Contribution code: ATA-8

Type: Oral Presentation

Survey of naturally occurring ^{236}U with direct-AMS

Wednesday, 23 October 2024 11:00 (20 minutes)

From a multi-isotope direct-AMS survey of 310 uranium ore concentrates (UOCs), $^{236}\text{U}/^{238}\text{U}$ ratios from 2×10^{-12} to 2×10^{-7} are measured. However, a range from low- 10^{-12} to mid- 10^{-10} is expected from directly mined natural uranium ore minerals. This upper-end discrepancy would normally be attributed to inputs of spent fuel materials, but the numerous occurrences and the lack of economic reasons to recycle anything in the front stage of UOC production make the abnormally high $^{236}\text{U}/^{238}\text{U}$ ratios rather perplexing. When plotted against the $^{187}\text{Os}/^{188}\text{Os}$ ratios, which were also obtained in the survey, the high $^{236}\text{U}/^{238}\text{U}$ results are seen to occur around the value of $^{187}\text{Os}/^{188}\text{Os} = 10$, a none-random pattern as might be anticipated from unwitting contaminations. The $^{187}\text{Os}/^{188}\text{Os}$ ratios measured reflect mostly the Os impurities contained by the UOCs. They might be affected by the Os impurities contained by the chemicals used for the UOC manufacture, but these chemicals are ultimately derived from Crust materials in which $^{187}\text{Os}/^{188}\text{Os}$ ratios are typically within 0.1 and 1. Thus, the observed correlations between $^{236}\text{U}/^{238}\text{U}$ and $^{187}\text{Os}/^{188}\text{Os}$ favor those measured high $^{236}\text{U}/^{238}\text{U}$ ratios being natural. This work also calls for further studies of naturally occurring $^{236}\text{U}/^{238}\text{U}$ in a wider range of native uranium-bearing minerals. Meanwhile, it is a reminder that any such studies are best done using direct-AMS without chemical sample pretreatment to better avoid anthropogenic ^{236}U that is pervasively present in the environment today. It also calls for efforts combatting the AMS ion source memory effects. To secure unambiguous natural ^{236}U surveys, an approach is described that combines UF₅- production directly from powdered native samples and ion source reconfiguration to minimize background.

Student Submission

No

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Session Classification: Actinide Techniques and Applications

Track Classification: Actinide Techniques and Applications