Tales of chasing tails: Pushing the limits of abundance sensitivty using the collision cell MC-ICPMS, Proteus

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Recent developments in Thermal Ionisation Mass Spectrometry (TIMS) and (Multi Collector)-Inductively Coupled Plasma Mass Spectrometry (MC-ICPMS) have greatly improved the ability of analysts to detect and accurately quantify minor and trace isotope abundances. Accurate detection of such isotopes contributes to a wide range of disciplines, from geochronology (^{230}Th, ^{234}U), magmatic processes (^{226}Ra, ^{210}Pb), nuclear fuel processing and safeguards (^{90}Sr, ^{236}U) to nuclear waste and remediation monitoring (^{129}I, ^{137}Cs).

Yet current instrumentation remains limited in its detection of ultra-trace abundance, short-lived radio-nuclides which are typically detected by decay counting methods or Accelerator Mass Spectrometry. TIMS is limited by the efficiency of activator solutions for the large sample loads required for measurements of low abundance isotopes and (MC)-ICPMS by reduced abundance sensitivity caused by the energy loss of ions scattered in the flight tube.

Here we report on the recent abundance sensitivity characterisations on the prototype collision cell MC-ICPMS, Proteus. We document standard measures of abundance sensitivity for U and Th isotopes in the low parts per billion range. We assess the potential for static and novel tandem mass spectrometry, the latter utilising the quadrupole mass analyser located before the magnetic sector of Proteus with application to the measurement of ^{210}Pb. This approach further improves abundance sensitivity by several orders of magnitude.