

5. Varga, Wallenius, Mayer (2025) *Social Science Research Network*, submitted.

Challenges in U and Th isotope ratio analysis and how the Thermo Scientific Neoma MC-ICP-MS helps overcoming those

CLAUDIA BOUMAN¹, GRANT CRAIG², MARKUS PFEIFER¹, HAUKE VOLLSTAEDT¹ AND NICHOLAS S. LLOYD¹

¹Thermo Fisher Scientific (Bremen) GmbH

²Thermo Fisher Scientific

Accurately constraining lowest abundance thorium and uranium isotopes is an important tool in geochronology and for nuclear forensics, e.g., dating geologically young samples or controlling nuclear proliferation. The analysis of these isotopes is challenging due to the large dynamic range posed by the Th and U isotope abundances and limited sample material. Also, due to enrichment, samples often have a wide range of isotopic ratios, a challenge for analysis.

Classically, Thermal Ionization Mass Spectrometry (TIMS) is used to overcome these challenges, offering high efficiency and low abundance sensitivity. Multicollector Inductively Coupled Plasma Mass Spectrometry (MC-ICP-MS) has been used successfully the last decades¹⁻³, primarily due to higher productivity.

The Thermo Scientific™ Neoma™ MC-ICP-MS includes proprietary technologies, such as the Thermo Scientific™ Jet Interface, RPQ and 10¹³ Ohm Amplifier Technology™ which greatly enhance the capabilities of MC-ICP-MS for determining accurate and precise Th and U isotope ratios. It offers full implementation of third-party peripherals such as autosamplers, desolvators and laser ablation, making operation easy for both liquid and solid samples. The Neoma MS/MS MC-ICP-MS, consisting of a patented novel pre-cell mass filter and collision/reaction cell, in combination with the RPQ allows an abundance sensitivity approaching TIMS performance⁵. Filtering of Ar⁺ shortly after extraction, reduces ion-ion interactions along the beam trajectory as the cause for tailing effects.

This contribution discusses MC-ICP-MS for accurate and precise determination of Th and U isotopes in a series of IRMM standard reference materials. A mixture of amplifiers with 10¹³ Ohm resistor, secondary electron multiplier (SEM) with RPQ along with the pre-cell mass filter are used to reduce peak tailing to only a few cps.

1. Yamamoto, Takeshi, Kitamura, Takahashi & Hirata (2024), *Environmental Technology & Innovation*. 36, 103761–103769.
2. Boulyga, Koepf, Konegger-Kappel, Macsik & Stadelmann (2016), *Anal. At. Spectrom.* 31, 2272-2284.
3. Zirakparvar, Manard, Hexel, Dunlap, Metzger, Bostick, Bradley & Ticknor (2023), *J. of Mass Spectrometry* 492, 117114-117123.
4. Craig, Wehrs, Bevan, Pfeifer, Lewis, Coath, Elliott.,