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Project Vienna – Prospects for a novel pre-cell mass filter for MC-ICP-MS/MS using the example of mass-shifted titanium

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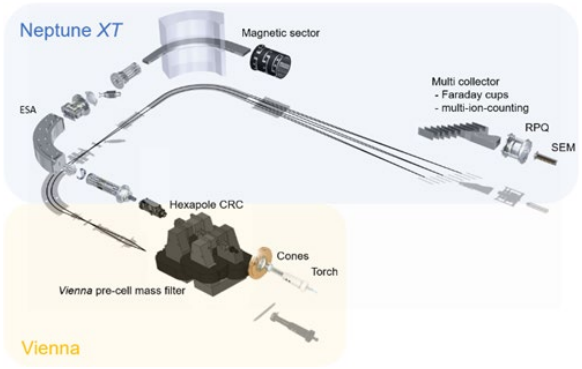

In recent years the field of ICP-MS/MS has evolved considerably, leading to increased interest in an instrument combining the excellent precision of isotope ratio measurements from multicollector (MC-)ICP-MS with the full analytical versatility of established single-collector ICP-MS/MS instruments. Here, we present preliminary data from *Project Vienna.* In *Project Vienna* we created the prototype Thermo Scientific™ *Vienna* MC-ICP-MS/MS, building upon the experiences collected from the preceding Thermo Scientific *Proteus*, a one-of-a-kind quadrupole-collision cell-MC-ICP-MS borne from a cooperation between the University of Bristol and Thermo Fisher Scientific™ [1,2].

Proteus, although a considerable success, had two disadvantages compared to a conventional MC-ICP-MS: lower sensitivity due to the lower energy extraction of ions from the plasma and the non-exponential mass bias imprinted on the transmitted ions by the quadrupole pre-cell mass filter. In contrast, *Vienna* retains high sensitivity by using an established MC-ICP-MS interface. The most groundbreaking new feature is the pre-cell mass-filter, which uses combined magnetic and electric fields to select discrete mass ranges in front of the collision and reaction cell. Unlike the quadrupole in *Proteus*, this technology generates steady and correctable exponential mass fractionation behavior.

Titanium isotope measurements are valuable tools in geo- and cosmochemistry. However, isobaric interferences from abundant Ca and Cr make *in situ* applications challenging. Reaction of Ti^+ with O_2 proved to be a successful way in moving Ti away from interferents [3,4]. The pre-cell mass filter is crucial in this application to clean the mass range (Ni-Zn) of mass-shifted TiO and, additionally, cuts ^{40}Ca, ^{40}Ar and $^{40}Ar^{16}O$ ion beams, which else induce unwanted secondary reactions. The data collected with *Vienna* can be accurately corrected for mass bias at lower concentrations compared to *Proteus*, demonstrating the ongoing evolution in MC-ICP-MS/MS. Looking ahead, the collected experience from *Project Vienna* is being integrated into the MS/MS module for the recently launched Thermo Scientific *Neoma* MC-ICP-MS [5].

References: [1] Elliott *et al.* (2015) *Goldschmidt* **2015**, 824. [2] Schwieters, J. *et al.* (2016) *Goldschmidt* **2016**, 2783. [3] Pfeifer *et al.* (2019) *Goldschmidt* **2019**, 2647. [4] Shaw *et al.* (2020) *Goldschmidt* **2020**, 2352. [5] Thermo Fisher Scientific (2020) BR30600-EN 0520C: Neoma Multicollector ICP-MS.