In situ titanium isotope measurements in meteorites using the collision cell MC-ICPMS, Proteus

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Solar System materials display some significant nucleosynthetic isotope anomalies. An important example is the considerable range in ε^{50}Ti displayed by bulk meteorites [1]. Compilation of available extraterrestrial Ti isotope data revealed a missing component, not present in the investigated refractory inclusions record, required to explain the bulk meteorite Ti isotope systematics [2]. This is presumably a presolar component hidden in the complex meteorite matrix.

So far, investigations of isotopically anomalous platy hibonite crystals or presolar grains have been conducted with SIMS on extensively pre-treated meteorite residues [e.g, 3,4], or by laser ablation MC-ICPMS on 'simpler' mineralogies such as CAIs [5]. Isobaric interferences from Ca and especially Cr isotopes during mass spectrometry of Ti isotopes are limiting in more complex materials.

We present a new analytical approach using a unique collision cell MC-ICPMS. Proteus combines the element specificity of a collision cell quadrupole-ICP-MS with the precision of an MC-ICPMS and importantly has an initial quadrupole mass filter to limit the ions entering the collision cell. Here, we set the quadrupole to a bandpass mode from masses 42 to 54, and use O_2 as a reaction gas to promote Ti^+ ions to TiO^+. This allows accurate Ti isotope measurement in a 'cleaned' area of the mass spectrum with significantly reduced CaO and CrO interferences.

We are now able to measure complex materials by laser ablation at spot sizes of 5µm using a multi-ion counting method for small ion beams. The method is validated by ablating minerals, glasses, and a meteorite powder with a wide range in Ca/Ti and Cr/Ti ratios. Finally, we will present the first results of matrix and refractory inclusion measurements of the CM2 meteorite NWA 8267, including Ti isotope images.

[1] Trinquier et al. (2009) *Science* **324**, 374. [2] Steele & Boehnke (2015) *ApJ* **802**, 80. [3] Nittler et al. (2008) *ApJ* **682**, 1450. [4] Kööp et al. (2016) *GCA* **189**, 70. [5] Williams et al. (2016) *ChemGeol* **436**, 1.