253 Plus with the Kiel IV Carbonate device – New features to improve resolution of clumped carbonate isotope datasets

JENS RADKE*[1], NILS STOEBENER[1], MICHAEL KRUMMEN[1] JOHANNES SCHWIETERS[1]

[1]Thermo Fisher Scientific, Hannah-Kunath-Str.11, 28199 Bremen, Germany.
(*correspondence: Jens.Radke@thermofisher.com)

Temperature reconstructions using clumped isotope data are mainly limited in precision and temporal resolution by the availability of carbonate that can be extracted per sampling interval. In the best case the measured isotope ratio results are limited by counting statistics, which are derived from a combination of the efficiency of the mass spectrometer and the amount of CO_2 gas that can be extracted from the sample and introduced to the mass spectrometer [1]. The requirement for replicate measurements increases the amount of sample required [2]. Thus, the sampling resolution of clumped isotope datasets can be improved by efficiency in sample preparation and isotope ratio mass spectrometry.

The Thermo Scientific™ 253 Plus™ 10kV IRMS with Kiel IV™ carbonate device efficiently produces robust clumped isotope data from smaller samples. A new inlet capillary design with a special coating and a proprietary production process avoids scrambling of the clumped isotope signature. Ion energy shielding and baseline monitoring ensure accuracy of measurements without influence of baselines, and smaller ion beams can be measured with precisions at the limits of counting statistics using 10^{13} ohm amplifier technology. Using this setup we obtained results that are in consistent agreement with the Δ_{47} values of isotopically different δ^{47} gases and heated gases. Significant improvements to sample utilization are made through the LIDI (Long Integration time Dual Inlet) methodology [3].

In combination with a sample clean up device, a wide range of natural carbonaceous samples were measured using an enhanced LIDI methodology. The new LIDI batch processing further improves quality of small-sample clumped isotope datasets. The combination of new features is pushing the boundaries of clumped isotope ratio measurements towards the goal of the total sample consumption, which is known from standard bulk isotope analysis.

[1] Huntington, Eiler, Affek, Guo, Bonifacie, Yeung, Thiagarajan, Passey, Tripati, Daëron & Came (2009), *RCMS* **44**, 1318-1329. [2] Fernandez, Müller, Rodriguez-Sanz, van Dijk, Looser & Bernasconi (2017), *G3* **18**, 4375-4386. [3] Müller, Fernandez, Radke, van Dijk, Bowen, Schwieters & Bernasconi (2017), *RCMS* **31**, 1057-1066.