High precision 13C and 18O isotope analysis of small carbonates with Dual Inlet and Kiel IV Carbonate Device

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The measurement of high precision isotope analysis in carbonates has been possible since the development of the dual inlet 50 years ago. The isotope ratios of the CO_2 processed from a sample carbonate and of a CO_2 reference gas are compared using a change over valve as gas inlet to the isotope ratio mass spectrometer. The low CO_2 gas pressures evolved from the sample are equilibrated to the pressure of the standard gas. The analysis of small carbonates in the low microgram range became feasible with the introduction of a small micro volume incorporated into the preparation device.

For climate research the analyst needs a device to be able to measure a large number of samples with stable high precision and without correction of raw data. To minimize the sample preparation and high precision analysis of data records a preparation device and mass spectrometer system is needed which is able to go to 10 micrograms of carbonate sample without loosing isotope ratio precision. The Kiel IV carbonate device has been developed for standard sample amount measurements of greater than 20 microgram and has been optimised to down to 10 microgram samples using a MAT 253 mass spectrometer.

For the CO_2 preparation inside the Kiel IV all physical/chemical properties are process controlled, i.e. acid temperature, CO_2 freeze and release temperatures and evolved pCO_2 from the carbonate. It will be presented what differences in high precision and accuracy of isotope ratios exist within different mass spectrometers and preparation devices (GasBench II, Kiel IV, MAT253, Delta V series). Additionally possible interfering aspects, i.e. content and evolution of water during carbonate-acid reaction, reference gas quality and sample-standard gas decrease, and their influence on data results will be explained.