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Session 5a) Novel Methodology 1: Application of Isotopologue Measurement

Two years of triple oxygen isotope measurements in carbonates using laser spectroscopy: challenges, achievements, and future directions

David Bajnai[1] & Andreas Pack*

[1] Department of Geochemistry and Isotope Geology, Geoscience Center Göttingen, University of Göttingen, Göttingen, Germany

*Presenting Author Email: david.bajnai@uni-goettingen.de

The measurement of all three stable oxygen isotopes (^{16}O, ^{17}O, ^{18}O) adds a new dimension to the traditional $\delta^{18}O$ scale, offering insights into the formation and alteration history of carbonates. For example, triple oxygen isotopes can help identify whether carbonates were formed in equilibrium or through kinetic processes, and they can also be used to detect diagenesis. However, measuring all three oxygen isotopes via mass spectrometry on a CO_2 analyte is challenging, requiring either labor-intensive methods or costly equipment. In recent years, laser spectroscopy has emerged as a promising alternative for triple oxygen isotope analysis of CO_2. At Göttingen, we use an Aerodyne TILDAS laser spectrometer. This report highlights progress in method development and datasets generated over the past two years.

Key challenges included developing a custom inlet system to dilute analyte CO_2 with collision gas and maintaining consistent analytical conditions between replicates [1]. Currently, we achieve a long-term precision of ±8 ppm. So far, we have analyzed high-pH laboratory precipitates to study isotope fractionation from CO_2 hydroxylation kinetics [2], modern corals to investigate vital effects [3], and have explored the formation processes of amethyst geodes [4]. We will also present data from Neoproterozoic carbonates aimed at reconstructing climate conditions.

References

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