Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.10051

Rapid measurement of carbonate clumped isotopes using tunable infra-red laser spectroscopy

NITZAN YANAY[1], ZHENNAN WANG[1], DAVID DETTMAN[1], JAY QUADE[1], KATHARINE HUNTINGTON[2], ANDREW SCHAUER[2], DAVID D NELSON[3], J. MCMANUS[3], KAUSTUBH THIRUMALAI[1], MATHIEU DAËRON[4] AND SABURO SAKAI[5]

[1]University of Arizona
[2]University of Washington
[3]Aerodyne Research, Inc.
[4]Laboratoire des Sciences du Climat et de l'Environnement
[5]Japan Agency for Marine-Earth Science and Technology

Presenting Author: nitzanyanay@email.arizona.edu

Clumped isotope abundance in carbonates is an important paleothermometer, but measurement is difficult, slow, and subject to common-mass (m/z) interferences using isotope ratio mass spectrometry (IRMS). We present a fast method of clumped isotope measurement by laser spectroscopy that directly measures CO_2 isotopologue abundances rather than m/z ratios. We have adapted a tunable infrared laser differential absorption spectrometer (TILDAS) system to optically measure the abundances of four specific CO_2 isotopologues ($^{16}O^{12}C^{16}O$, $^{16}O^{13}C^{16}O$,$^{16}O^{12}C^{18}O$, and $^{16}O^{13}C^{18}O$) used for clumped isotope thermometry. TILDAS achieves the same precision (0.01‰ S.E.) more rapidly (~50 minutes/ analysis) and on smaller samples (<2 mg calcite) compared to most widely used IRMS systems, without making assumptions about ^{17}O abundance in the sample to correct for common-mass interference. A temperature calibration based on 406 analyses of CO_2 produced by acid digestion of 51 synthetic carbonates equilibrated at 6 °C to 1100 °C is consistent with results for natural carbonates and other published calibrations (Fig. 1), demonstrating the operational equivalence to IRMS systems. In addition, our TILDAS system results were indistinguishable from top performing IRMS systems after replicating the recent InterCarb interlaboratory calibration effort (Fig. 2). Finally, we demonstrate recent applications of the TILDAS system to geologic investigations. Measurement by TILDAS holds the potential to change the landscape for clumped isotope analysis.

Figure 1

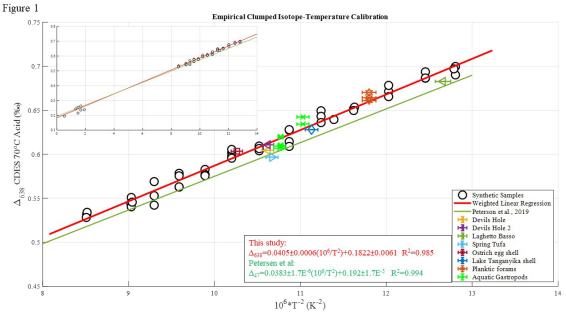

Figure 2