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国立大学法人
島根大学 エスチュアリー研究センター

EsReC
Shimane University Estuary Research Center

162nd Estuaries Open Seminar 第162 回 汽水域懇談会

Laser absorption measurement of carbonate clumped isotope ratios, a new tool for paleotemperature measurement in aquatic and terrestrial systems

参加希望者は以下に登録をお願いします。(2/22 (水)正午締切)
https://www.leaf2.shimane-u.ac.jp/enquete/no/kisui162-2

日時:2023年 2月24日(金) 17:00−18:30, 24th February (Fri), 2023

場所:ハイブリッド開催(16:30からzoomを開設)
(センター 2階セミナー室とzoomを併用)
Seminar Room 2F, EsReC, & Zoom online

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Clumped isotope ratios in carbonates are a powerful paleothermometer, and the use of this measurement is increasing in geology and paleoclimate work. However, the analysis tends to be time consuming and expensive when measured with traditional isotope ratio mass spectrometry (IRMS). By turning to laser absorption techniques, the high precision analysis of isotope ratios of many different isotopologues of carbon dioxide can be performed quickly and without the problem of common mass interferences that are seen in IRMS measurements. I will describe a fully automated Tunable Infrared Laser instrument that extracts CO_2 from carbonate samples, cryogenically removes water and non-condensables, and then measures the four isotope species of CO_2 that are required for a clumped isotope measurement ($^{16}O^{12}C^{16}O$, $^{16}O^{13}C^{16}O$, $^{16}O^{12}C^{18}O$, and $^{16}O^{13}C^{18}O$). This system achieves precision equivalent to high quality IRMS data (0.01‰, 1 S.E.), and it surpasses typical IRMS measurements in several features: rapid measurement (50 minutes per carbonate sample); small sample size (<20 µmol of CO_2, or <2 mg equivalent calcite); and no need for an assumed ^{17}O abundance in the sample to correct for common-mass interference. An empirical calibration, using synthetic calcites grown or equilibrated across a temperature range of 6° C to 1100° C is consistent with other published calibrations.

The advantages and limitations of clumped isotope thermometry will be discussed based on preliminary data from current research projects. Regional fluvial temperatures and the oxygen isotope ratio of local rainfall can be reconstructed using modern unionid bivalve shells from across North America. A pilot study of Lake Turkana bivalves reveals information about seasonal runoff and temperature in a river delta as well as a possible way to study the thermal structure of shallow water in this lake. Finally, seasonal variation in local relative humidity is investigated using sequential samples in a pair of land snail (*Achatina*) shells using both clumped and conventional ($^{18}O/^{16}O$) isotope ratios.

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