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Developing a continuous-flow method for triple oxygen isotope analysis by laser absorption spectroscopy

Content

Water isotope measurements from ice cores provide important information about regional and global climate. High-resolution measurements of δ18O, δD, and deuterium excess are routinely made by continuous-flow analysis (CFA) methods that make use of laser spectroscopy instruments. Recent advances in instrumentation also allow for simultaneous measurements of δ17O and 17O excess (Δ17O). Here, we describe a measurement methodology for all stable water isotopes using a CFA system coupled to a cavity ring-down laser spectroscopy (CRDS) instrument. We present replicate measurements of an ice core sample taken from Summit, Greenland, using our CFA-CRDS configuration. Our data demonstrate that the CFA-CRDS method can make high-precision measurements of Δ17O (<5 per meg) with high resolution (a few cm) in ice core samples; calibration errors generate most of the variability among the replicate datasets. We highlight ongoing development progress to further reduce calibration errors and to streamline our method for routine measurements. Our work shows that this method can detect seasonal variability in Δ17O in Greenland ice, and it suggests that the measurement resolution of CFA-CRDS is largely defined by the melt and measurement rate. CFA-CRDS has the potential to increase measurement resolution of δ17O and Δ17O in ice cores and it can produce measurements with very low error (<5 per meg) when calibration strategies are well developed.

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