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Continuous Flow - Cavity RingDown Spectroscopy Using a Novel Universal Interface for High-Precision Bulk 13C Analysis

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We have developed the world's first optical spectroscopy-based system for bulk stable isotope analysis of 13C. The system is based on a novel universal interface, named LIAISON, capable of coupling to almost any CO2-generating sample preparation front-end ranging from an elemental analyzer to any dissolved carbon analysis module, which are of significant use in geochemical, ecological and food authentication studies. In one specific application, we have coupled LIAISON to an elemental analyzer (EA) and to a cavity ring-down spectrometer (CRDS) for 13C isotopic analysis of adulterated honey samples. Another application was developed to analyze dissolved inorganic carbon in water samples. LIAISON is suited for handling a high-throughput sample analysis process by running three different gas handling operations in parallel: Admitting combustion gas from the EA into a first gas bellows, analyzing the previous sample collected into a second gas bellows with CRDS, and flushing and purging a third gas bellows in preparation for the upcoming sample collection operation. The sample-to-sample analysis time is 10 minutes and the operation is completely automated for the whole front-end auto-sampler tray capacity, requiring no operator intervention. The CRDS data are collected, tabulated and saved into an output text file. The memory effect between the USGS L-Glutamic acid standard at natural abundance and the moderately enriched USGS L-Glutamic acid standard is excluded by the selection of the adequate number and duration of flush and purge cycles of the gas sample bags. The system's proven accuracy was cross-checked with EA-IRMS and its achieved precision was typically less than 0.2 permil, including the 13C-enriched tested samples. The LIAISON-CRDS system presented here provides a fully automated solution for 13C bulk stable isotope analysis with unprecedented ease-of-use and possible field portability and application with the availability of a compact front-end. In addition, LIAISON's universality enables CRDS to supplant IRMS in many continuous flow 13C isotopic analysis applications employing sample preparation modules in tandem with IRMS.