

Determination of carbon ($\delta^{13}\text{C}$) and oxygen ($\delta^{18}\text{O}$) isotopic composition from carbonate and DIC samples by using new Isotope Ratio Infrared Spectrometer

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Precise and accurate determination of isotopic composition of carbon (^{13}C) and oxygen (^{18}O) from carbonate or DIC sample with proper referencing and data evaluation algorithm presents a challenge for scientists. Mass spectrometry was the only widely used technique for this kind of analysis, but recent advances make laser based isotope ratio infrared spectroscopy (IRIS) a viable alternative. It is now possible to perform this analysis reliably with IRIS with sample amounts as low as 200 μg . We present measurements of three international reference materials, and one of them treated as an unknown. Five samples each of approximately 1mg each were acidified using a few droplets of 100% H_3PO_4 and left for equilibration overnight at 25°C. The standard deviation was less than 0.15‰ $\delta^{13}\text{C}$ and 0.2‰ $\delta^{18}\text{O}$, respectively.

To achieve these kind of results, the Universal Reference Interface (URI) Connect was developed. CO_2 free synthetic air is used to flush out the contents of a sample container into a variable volume. If necessary, the sample is further diluted before entering the analysis chamber. Reference gas measurements are automatically performed at the same concentration as sample measurements to compensate for instrument drifts and non linearity. In a test experiment with 1% CO_2 in 12 ml vials, we achieved an internal precision of better than 0.07‰ and 0.1‰ for $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$, respectively.

The URI Connect can handle about 100 samples per day from an autosampler, or samples can be injected one at a time through a septum on the front of the instrument. Gas samples collected in flasks, bags, syringes, or vials can be analyzed. The system only needs the equivalent of about 80 μg - or 40 μL - of pure CO_2 gas to complete an analysis. Due to it's small weight and robustness, sample analysis can be performed in the field, e.g. aboard a research vessel.