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VCOF-CRDS as a versatile, high-precision method for cap-delta measurements in water, carbonates and CO_2

JUSTIN CHAILLOT[1], SAMIR KASSI[2], MATHIEU CASADO[3], AMAELLE LANDAIS[4] AND MATHIEU DAËRON[1]

[1]Laboratoire des Sciences du Climat et de l'Environnement (LSCE/IPSL)
[2]LIPhy
[3]LSCE
[4]LSCE - Institut Pierre Simon Laplace, France

The past year saw the publication of two articles documenting the application of VCOF-CRDS (V-Cavity Optical Feedback Cavity Ring-Down Spectroscopy, a spectroscopic technique borne from a crossing between high-performance optical spectroscopy and optical clock methods) to geochemical measurements. VCOF-CRDS is now operational for measuring water isotopes (δ^2H, $\delta^{18}O$) at very low humidity (10 ppmv) with an accuracy suitable for applications to glaciology. Furthermore, by self-referencing the laser source relative to high-resolution spectroscopic features of the water molecule, we will soon be able to deploy VCOF-CRDS instrument in the field, in extreme environmental conditions (Concordia station, Antarctica) [1]. Furthermore, we demonstrated the ability to directly measure $\Delta^{17}O$ in CO_2 with <10 ppm accuracy and essentially perfect (≈1 ppm) metrological linearity, enabling high-precision $\Delta^{17}O$ measurements on carbonates (30-40 µmol per analysis) and water (150-300 µL per analysis) [2].

VCOF-CRDS is also a versatile approach applicable to other analytes, as illustrated by measurements of $\Delta^{33}S$ in H2S [3] and ongoing attempts to target CO and CH_4 isotopologues.

[1] Casado et al. 2024 10.5194/amt-17-4599-2024
[2] Chaillot et al. 2025 10.1016/j.chemgeo.2024.122450
[3] Chaillot et al. 2023 10.1039/D2VA00104G