Advances in instrumentation based on cavity enhanced laser absorption spectroscopy

DOUGLAS BAER, MANISH GUPTA, FENG DONG, ELENA BERMAN, TOM OWANO AND ROBERT PROVENCAL

Los Gatos Research, Mountain View, CA, USA

Novel instrumentation based on high-resolution laser absorption spectroscopy now allows high precision measurements of gas concentration and isotopic ratios continuously, in real time, and without preconcentration. These analyzers employ tunable lasers that operate in the near-infrared and mid-infrared spectral regions and employ an optical cavity as a measurement cell. The simple operation of these instruments allows measurements almost anywhere. The laser wavelength is continuously and repetitively scanned over selected absorption features of target isotopologues to record high-resolution absorption lineshapes at data rates of 1 Hz or faster. The integrated areas of the measured lineshapes enable determination of the respective isotope-specific concentrations directly. No longer constrained to operate in a laboratory, these analyzers offer opportunities to record measurements in remote sites in less-developed areas. This presentation will summarize recent developments at LGR in both hardware and software analysis that enable measurements of isotopic ratios in carbon dioxide (δ13C, δ18O, CO2), methane (δ13C, CH4), nitrous oxide (δ15Nα, δ15Nβ, δ18O, N2O) and water (liquid and vapor; δ2H, δ17O, δ18O, H2O) in ambient air and in complex gas samples. An overview of the current performance of LGR instruments and perspectives on future developments will be presented.

Ca isotope fractionation in a permafrost-dominated boreal ecosystem (Kulingdakan watershed, Central Siberia)

M.-L. BAGARD[1]*, A.-D. SCHMITT[12], F. CHABAUX[1], O.S. POKROVSKY[3], J. VIERS[3], P. STILLE[1], F. LABOLLE[1] AND A.S. PROKUSHKIN[4]

[1]Université de Strasbourg-CNRS LHyGeS, 1 rue Blessig, 67084 Strasbourg Cedex, France (*correspondence: mbagard@unistra.fr)

[2]Université de Franche-Comté-CNRS, 16 route de Gray, 25030 Besançon Cedex, France

[3]Université Paul Sabatier-CNRS, 14 Avenue Edouard Belin, 31400 Toulouse, France

[4]V.N. Sukachev Institute of Forest, Krasnoyarsk, Russia

Ca isotope compositions were measured in different compartments (stream water, soil solutions, rocks, soils and soil leachates and vegetation) of a small permafrost-dominated forested watershed in the Central Siberian Plateau. Our results show that only the processes related to vegetation activity significantly fractionate Ca isotopes within the watershed. These fractionations occur during Ca uptake by roots and along the transpiration stream within the larch trees. Biomass degradation then significantly influences the Ca isotopic compositions of soil solutions and soil leachates via the release of light Ca. Furthermore, organic and organo-mineral colloids originated from organic matter degradation are thought to affect the Ca isotopic composition of soil solutions by preferential scavenging of ^{40}Ca. This imprint of organic matter degradation on the $\delta^{44/40}Ca$ of soil solutions is much more significant for the warmer south-facing slope of the watershed than for the shallow and cold soil active layer of the north-facing slope, indicating that the available stock of biomass and the decomposition rates are critical parameters that regulate the impact of vegetation on the soil-water system. Moreover, the obtained $\delta^{44/40}Ca$ patterns contrast with those described for permafrost-free environments with a much lower $\delta^{44/40}Ca$ fractionation factor between soils and plants, suggesting particular processes related either to the presence of permafrost or to the specific features of organic matter degradation in permafrost environments. Finally, biologically induced Ca fractionation observed at the soil profile scale is not visible in stream and river waters, whose isotopic variability in the course of the year is likely controlled by the lithological heterogeneity of the sources. As such, we suggest a negligible influence of biologically related fractionation on the long-term Ca isotopic signatures of riverine fluxes carried to the ocean.

DOI:10.1180/minmag.2013.077.5.2
www.minersoc.org