ASITA 2026

Presentation Program and Abstracts

Advances in Stable Isotope Techniques and Applications

June 7th-10th, 2026
University of Saskatchewan
Saskatoon, SK

POSTER PRESENTATIONS

Greenhouse gas fluxes from residues of different canola lines during early-stage Decomposition

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Plants are the major source of soil organic matter (SOM), yet the extent to which genetic variation within crop varieties influence SOM formation and carbon stabilization remains unclear. In canola (*Brassica napus L.*), breeding has mainly focused on aboveground traits, with less explicit consideration of how root traits affect soil carbon dynamics and greenhouse gas emissions. Previous work in our lab has shown that canola lines differ in the amount of carbon they release as rhizodeposits, suggesting potential variation in belowground carbon inputs. The persistence of this carbon in soil and the relative contributions of root and shoot residues to stable SOM formation ultimately determines the line-specific potential to alter soil carbon storage.

This study examines the effects of residues from three *B. napus* lines; short-rooted NAM 1, long-rooted line NAM 39, and a commercial canola hybrid (CL) on soil carbon turnover. Plants were pulse labelled with $^{13}CO_2$, and their shoot, shallow root (0–15 cm), and deep root (15–60 cm) residues were added to soils that contained either labelled or unlabelled rhizodeposits. Soil microcosms were incubated under controlled conditions and total and $^{13}CO_2$ concentrations were determined to quantify differences in rhizodeposit, root, shoot and soil-derived CO2 respiration. Isotopic and soil fractionation analyses are ongoing to track residue-derived carbon in particulate organic matter (POM), MAOM, and microbial phospholipid and amino sugar pools.

Preliminary results show emission patterns differed among lines, soil depth, and residue treatments, indicating that residue composition influences decomposition dynamics. Further analysis of fluxes and isotopic data will help clarify how different residue inputs contribute to carbon turnover and stabilization. These results will improve our understanding of how canola root traits influence soil carbon processes and greenhouse gas emissions, and may help guide crop breeding strategies aimed at improving soil carbon storage.

Evaluating the effectiveness of lipid extraction techniques on the elemental and isotopic composition of modern bone collagen

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When isolating bone collagen for stable isotope analysis, the presence of adhering lipids can distort the observed elemental and isotopic data. Lipids are depleted in ^{13}C and have little to no nitrogen, resulting in low δ^{13}C values and high $C{:}N_{atomic}$ ratios. Different pretreatment methods have been used to remove lipids, but the relative efficacy and potential impacts of these pretreatments have not been tested. This study used a factorial design to independently adjust bone fragment size, solvent type, and dissolution time on 41 modern marine and terrestrial mammal bones. We tested chemical treatments using 2:1 v/v chloroform:methanol or 2:1 v/v dichloromethane:methanol over five different time intervals and on two different sized fractions of bone for a total of 22 treatments. We analyzed how different preparation and lipid removal techniques impact the elemental and isotopic values obtained from bone collagen. There was a significant increase in the δ^{13}C values following lipid extraction treatments on the smaller fraction of crushed bone relative to the non-lipid-extracted control of the same size. All tested lipid-extracted collagen samples perform better for the $C{:}N_{atomic}$ quality control metric than non-lipid extracted collagen. This research will inform recommendations for optimizing the removal of lipids from bones and further the understanding of sample preparation for carbon, nitrogen, and sulfur stable isotope analysis on EA-IRMS.

Tracing nitrogen use efficiency for specialty crops on the prairies

Autumn Collins, Olivia Otchere, Paige Fehr, Jamie Taylor, and Kate Congreves

Department of Plant Sciences, University of Saskatchewan

Understanding nitrogen use efficiency (NUE) can improve nitrogen fertilizer management for crop production, lowering fertilizer costs and reducing greenhouse gas (GHG) emissions. In agriculture, the application of nitrogen (N) fertilizer to soil is a major source of nitrous oxide (N_2O) emissions, a potent GHG. Implementing improved N fertilizer management via the "nitrous oxide reduction protocol" (NERP) is a promising strategy for improving NUE and reducing N_2O; however, most research has focused on major crops, little is known for how effective this may be for diverse specialty crops. To address this gap, our multi-site experiment is testing if improved N strategies (informed by NERP) lead to improved NUE for the specialty crops carinata (*Brassica carinata*), camelina (*Camelina sativa*), brown mustard (*Brassica juncea*), sunflower (*Helianthus annuus L.*), flax (*Linum usitatissimum*) and spring wheat (*Triticum aestivum L.*) as a reference crop. This research aims to quantify NUE by using the stable isotope ^{15}N technique. After seeding, a solution of 30% atom ^{15}N will be applied to each of the six crops under four N management practices (representing NERP's basic, intermediate, and advanced N management, plus an unfertilized control). The ^{15}N will be traced into the crop grain and straw at harvest. We hypothesize that the more advanced N fertilizer strategies will increase ^{15}N recovery, indicating improved NUE. This research will provide insight for how best to support improving NUE and reducing N_2O for specialty crops on the Canadian prairies.

Into the ISOVERSE open-source data tools for efficient, transparent, and reproducible processing of stable isotope data

Sebastian Kopf, Rohan Jain, Simran Jadhav

Department of Geologic Sciences, University of Colorado, Boulder

Reproducible data processing is a key prerequisite for efficient data exchange, methodological progress, consistent training of new users, and productive discourse in stable isotope research. However, producing a faithful record of every step of the data reduction process from raw data to final results in a reproducible manner can currently be prohibitively time-consuming. All too often data processing that is both transparent and easy to communicate thus falls victim to the enormous effort required to design experiments well, run complex analytical procedures, and interpret the results in the proper geochemical/geologic/ecological context. While this is understandable, insufficiently documented data processing workflows create a high risk for errors to go undetected and become propagated. Additionally, they create barriers to sharing and discussing one's approach to data reduction effectively. These drawbacks limit opportunities for exchange of ideas, methodological progress, and large-scale data repository efforts aimed at extracting maximum benefit from stable isotope data across the many disciplines that make us of it.

The goal of the ISOVERSE (www.isoverse.org) is to fill this gap by creating a comprehensive software ecosystem of free, open-source tools for efficient, transparent, and reproducible processing of stable isotope data from raw analytical measurements all the way to fully processed stable isotope data ready for publication and repository deposition. By building on best practices in modern data science and software engineering, the ISOVERSE seeks to empower scientists at all career stages and programming levels to share their work more easily and contribute fully reproducible data sets to data repository efforts. In this presentation, I will introduce some of the existing key capabilities of the ISOVERSE and discuss implementation plans for next stage of development with the goal of stimulating discussion and eliciting constructive feedback from the community of stable isotope experts at ASITA.

ORAL PRESENTATIONS

Monday, June 8th

A brief history of ASITA, Isomass and Radom

Peter Stow

Isomass Scientific Inc.

This talk will briefly explore the history of the ASITA conference from its beginning to present day. It will discuss the role Isomass played in the early days of the conference, where Isomass is now and how the Radom microwave source fits into the future of isotope analysis.

Effects of Pretreatment on Bulk Organic Carbon and Related Measurements by Elemental Analysis-Isotope Ratio Mass Spectrometry

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The bulk elemental and stable isotopic composition of carbon and nitrogen in organic matrices, including biomass, soils, and sediments, is a common and often critical measurement used for characterizing the measured material. Combined, ‘online’ measurement of natural materials is typically and conveniently accomplished by coupling an elemental analyzer to an isotope ratio mass spectrometer (EA-IRMS). Soils and sediments often contain some amount of inorganic carbon typically in the form of carbonates. When measured by EA-IRMS, the resulting ‘total carbon’ as well as the stable isotope ‘delta’ measurement reflect the combination of organic as well as inorganic forms of carbon within a sample. Commonly, acid pre-treatments are used to eliminate carbonates to enable a solely ‘total organic carbon’ measurement. These treatments, in turn, may impact the resulting nitrogen measurements and complicate the desired online ‘dual analysis’ of both carbon and nitrogen.

Here, we compare two common acid pre-treatment techniques – direct acidification followed by rinsing and acid fumigation – on a range of natural samples prior to analysis by EA-IRMS. Additionally, we independently measured the inorganic carbon content via direct acidification and measurement of evolved carbon dioxide by online coulometry. Four distinct locations in the United States were chosen – Lake Harris in Florida, seagrass beds off the western coast of Florida, wetland sediments from south Florida, and permafrost soils from interior Alaska – with each site contributing four samples representing the internal variability of samples from that site. We find significant effects of acid pretreatment on all measured variables. Complete removal of inorganic carbon results in confident stable isotope measurement of organic carbon, whereas acid pre-treatment impacts both the elemental abundance and stable isotope measurements of nitrogen. Direct acidification followed by rinsing can liberate material and cause biases for all measurements. The different dynamic ranges of carbon and nitrogen measurements complicate these difficulties.

Isotope Ratio Measurements to Support Sustainable Wild Rice Production in Northern Saskatchewan Indigenous Communities

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Wild rice is an economically and culturally significant crop for Indigenous communities in Canada. More than 70% of Canada's wild rice is cultivated in northern Saskatchewan, where it plays a vital role in supporting local economies. In collaboration with Indigenous communities, the National Research Council of Canada (NRC) has developed portable monitoring technologies to collect essential data to enhance crop yields and optimize growing conditions while preserving local biodiversity and cultural heritage. By integrating traditional knowledge with scientific approaches, this initiative aims to minimize the environmental footprint of agricultural practices and promote sustainable and responsible environmental management and land stewardship.

Despite the importance of wild rice, limited scientific data exists on Canadian varieties. NRC Metrology's role in this collaboration focuses on providing trace element and isotope ratio measurements to better understand local growing conditions and monitor their evolution over time as influenced by climate change. As part of this effort, the NRC scientists measured carbon and nitrogen isotope delta values in wild rice samples collected from multiple sites across northern Saskatchewan. The results indicated minimal variation in carbon isotope delta values, whereas nitrogen isotope delta values varied significantly, likely reflecting differences in local growing environments. Future studies will include oxygen isotope ratio analyses to help determine the geographic origin of wild rice samples. This research, believed to be the first of its kind for Canadian wild rice, provides a scientific foundation to support traditional indigenous environmental practices and protect the integrity of the local food supply chain.

Compound-Specific Carbon Isotope Measurements of Fecal Steroids: A Potential Proxy for Herbivore Dietary Shifts

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Fecal steroids (i.e., Δ^5-sterols, 5α-stanols, 5β-stanols, epi-5β-stanols, and bile acids produced by microbes within animal digestive systems) in sedimentary archives are increasingly used as herbivore tracers in environmental, paleoecological, and archeological studies. The distribution and relative concentrations of these compounds in dung from contemporary herbivores have been used to calibrate sedimentary proxies for past herbivore abundance and species composition. Another major dimension of herbivore ecology is dietary guild (i.e., grazers and browsers). Because C_4 grasses and C_3 trees have distinct $\delta^{13}C$ signatures, compound-specific isotope measurements of herbivore steroids in sediments may provide additional insights into temporal changes in herbivore community diets. However, insufficient chromatographic resolution between co-eluting sterol/stanol isomers has limited the ability to make these measurements on individual source-specific stanols. Here, we present an optimized GC-C-IRMS method that improves chromatographic separation of fecal steroids, enabling $\delta^{13}C$ measurements of individual phytosterols and their corresponding 5β-stanol transformation products, extracted from mammalian herbivore dung collected from Kruger National Park, South Africa. Method development involved systematically evaluating key GC-C-IRMS parameters. Preliminary results demonstrate sufficient chromatographic separation between 5β-stigmastanol, epistigmastanol, and epistigmastenol (compounds that commonly co-elute with each other and with campesterol) in dung samples representing thirteen herbivore species. Previous bulk dung $\delta^{13}C$ measurements exhibited a ~16‰ isotopic spread and informed sample selection for GC-C-IRMS analysis. The fecal steroids measured here exhibited a similar ~15–18‰ isotopic range, with $\delta^{13}C$ values clearly reflecting C_3-, C_4-, and mixed-feeding dietary inputs. Analytical standard deviations for all target compounds were ≤0.7‰, comparable to previously reported $\delta^{13}C$ measurements of TMS-derivatized alcohols. Future work will focus on improving instrument sensitivity and refining sample purification methods to target additional steroids of

interest. Overall, the enhanced chromatographic resolution achieved by our method enables the isotopic characterization of these compounds and their biosynthetic and diagenetic pathways—thereby advancing the development of an isotope-based proxy for paleo-herbivore diets.

Cold Traps & Clean Peaks: Cryogenic Approaches to Atmospheric Methane Analysis with GC-IRMS

James Ravenhill, Andrew Kingston, Fereshteh Meshkani,

Molecular and Isotopic Geochemistry Lab - AGAT Laboratories Calgary, AB Canada

Co-elution of gas species remains a persistent challenge in GC-IRMS analyses of atmospheric and natural gas samples, particularly for methane measurements where air components (O_2 and N_2) overlap with methane on hydrocarbon separation columns such as HP Plot-Q. One technique to mitigate these challenges is to use on-column cryogenic trapping systems, like the Gerstel CTS 2, which retains gases and volatile compounds at the head of the GC column prior to separation. In addition to enhancing chromatographic performance through analyte focusing and sharper peak formation, cryogenic trapping can reduce the introduction of contaminants and oxidants such as atmospheric oxygen, thereby minimizing source exposure during analysis of air-rich samples. Here, we present our experience using on-column cryogenic trapping for the separation of various gas species and evaluate its potential for measuring ambient atmospheric methane isotope ratios without the need for additional specialized inlet systems.

A new separation strategy for LC-IRMS $\delta^{13}C$ measurement of underivatized amino sugars from soil

Jesse Reimer and Bobbi Helgason

Soil Microbiology Lab, Department of Soil Science, University of Saskatchewan

Amino sugars are used to assess bacterial and fungal necromass contributions to mineral-associated organic carbon, a comparatively stable soil organic carbon pool. Isotope tracer studies using ^{13}C can help determine the dynamics of these microbially-derived soil organic carbon pools. However, $\delta^{13}C$ measurement of low isotope enrichment levels can be uncertain following derivatization for GC-C-IRMS analysis due to derivatization reagent adding 2-3x the number of carbon atoms to the analyte of interest, and isotopic fractionation. Separation of underivatized compounds via LC-O-IRMS can provide a solution; however, column technologies are limited for LC-O-IRMS analysis because organic mobile phases comprised of exogenous C (e.g., methanol) cannot be used. Separation via anion exchange can be technically challenging due to contamination of atmospheric CO_2 into hydroxide-based mobile phases, increasing CO_2 backgrounds and creating carbonate breakthroughs alongside strongly bound acidic amino sugars, collectively interfering with $\delta^{13}C$ measurements. We developed an alternative LC-O-IRMS separation strategy of amino sugars, using an isocratic mobile phase that is compatible with wet oxidation in a gas/liquid IRMS interface. Amino sugars were separated on a Ca-form ligand exchange/ion exclusion column at 85 °C using 10 mM $CaNO_3$ eluent adjusted to pH 3.4. Separated analytes flowed to an Elementar LiquiFace to be oxidized with 20% w/v sodium persulfate and 10% v/v phosphoric acid at 100 °C before CO_2 separation in a liquid/gas exchanger and measurement on an Elementar Isoprime precisION IRMS. This separation method offered improved acidic amino sugar elution and basic amino sugar separation. No degradation to column performance was observed. A lack of hydroxide-based eluents means this separation strategy does not require custom modifications to prevent CO_2 contamination into HPLC system components, or more costly CO_2-tight ion chromatography systems with in-line eluent generators. Good sample linearity was achieved, with no amount-dependent correction of $\delta^{13}C$ required within sample ranges.

Developing sulfur isoscapes for mobility studies using modern plants

Damon Tarrant, Michael Richards

Stable sulfur isotope analysis of archaeological human and animal bone collagen is increasingly used as a dietary indicator. In addition, collagen sulfur isotopes can serve as mobility indicators when compared to regional baseline sulfur isotope distribution maps (isoscapes). Here, we present results from the use of modern plant sulfur isotope measurements to produce isoscapes for British Columbia and Denmark. We discuss our sample treatment and analytical process for producing simultaneous carbon, nitrogen and sulfur stable isotope measurements and subsequently the statistical and machine-learning analyses used to develop these isoscapes.

Creating a haystack from a needle: Trials and tribulations with SIMS and bulk sulfur isotope analysis in complex diagenetic settings

Andrew Kingston, Omid Ardakani

Analyzing the sulfur isotope composition of minerals like pyrite and sulfate is a powerful method for untangling paragenetic histories in complex diagenetic systems. Traditionally, this relies on bulk sampling and the chemical extraction of distinct sulfur species, such as elemental sulfur, sulfides and sulfates. However, because bulk analysis requires pulverizing the rock, it physically mixes distinct sulfur-bearing phases. This homogenization can obscure the very textural and paragenetic relationships needed to accurately reconstruct diagenetic histories. Secondary Ion Mass Spectrometry (SIMS) bypasses this limitation by enabling *in situ*, high-resolution multiple sulfur isotope analysis of individual grains while preserving their spatial context. However, micro-scale analysis introduces its own complexities. Analytical artifacts inherent to high-resolution techniques can severely skew geochemical interpretations. For example, the formation of hydrides in organic-rich grains, which can artificially overprint true ^{33}S signatures. To illustrate these analytical challenges, we present integrated SIMS, bulk rock sulfur isotope data, and laser Raman spectroscopy to highlight the limitations and necessary caveats of resolving these complex systems.

Cooking up New In-House Organic Sulfur Calibration Materials

Anic Imfeld

An overview of the process for developing internal solid organic calibration materials for $\delta^{34}S$ analyses, for the purpose of matrix-matching with a variety of low-S solid organic samples. While many calibration materials are available for purchase, the larger amounts of material required for $\delta^{34}S$ analyses of low-S samples in particular make using these commercial standards for day-to-day analyses prohibitively expensive. Furthermore, the precision of and uncertainties associated with purchased calibration material vary significantly. A selection of common materials such as garlic and onion powders have been found that are shelf-stable and span a wide enough isotopic range to allow for their use as daily calibration materials.

Replacing Carbon Monoxide in the IRMS Lab

Paul Eby

Carbon monoxide is used as a monitoring gas in IRMS labs that measure oxygen isotopes by carbon reduction (such as the TC/EA) but is an obvious safety hazard.

But can CO be replaced? It can be demonstrated that isobaric compounds (molecules or chemical species that have the exact same nominal molecular mass but different chemical structures or atomic compositions) can, in some instances, be used to replace a monitoring gas for IRMS applications.

Three potential replacements for CO (mass 28, 29, 30) have been explored and will be presented here:

1) Pure N_2 (mass 28 and 29)
2) N_2 and 0.2% NO (mass 28, 29, 30)
3) The CO fragment of CO_2

Offline preparation of carbonates for $\delta^{13}C$ and $\delta^{18}O$ analysis vial Gasbench-IRMS

Andrea Prentice

Stable isotope analysis of carbonate materials is routine in many laboratories, but sample preparation methodologies can vary. Most commonly, users either flush vials with helium online and manually add acid or perform a variation of this method offline. Here, a third methodology was tested whereby vials were evacuated under vacuum and gently filled with helium. To determine the best way to utilise the vacuum system, a set of test standards was prepared using one of five preparation techniques: multi-vial evacuation/fill, single vial evacuation/fill, heated multi-vial evacuation/fill, heated singly vial evacuation/fill, and online flushing. The $\delta^{13}C$ values of the check standard NBS-18 did not differ among preparation methods. The $\delta^{18}O$ values of the internal check standard C-132 did not fall within the acceptable range when using the multi-vial evacuation/fill technique, although applying heat improved the results. Benefits of the vacuum evacuation method included improved laboratory safety and reduced helium consumption. However, long-term monitoring of check standards revealed an eventual deterioration in precision, for both $\delta^{13}C$ and $\delta^{18}O$, when using the vacuum evacuation method compared to online preparation that was likely the result of leaks developing in the manifold.

Freezing prevents ^{60}Co-γ irradiation artefacts in DOM concentration, composition and $\delta^{13}C$

Mitchell Lo[a]
With permission to publish from:
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Gamma (γ)-irradiation is often used to sterilise environmental water samples for international transport and biosecurity compliance. However, its impact on the isotopic integrity of dissolved organic carbon (DOC) remains poorly understood. I will present the effects of γ-irradiation (50 kGy), a commonly used sterilisation technique for water samples arriving into Australia, on DOC concentration and stable isotopic signatures ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$, $\delta^{2}H$) in natural waters and Milli-Q water mixed with organic matter standards, comparing frozen-irradiated and unfrozen-irradiated samples. Irradiation, when applied to unfrozen water, led to significant ($p < 0.05$) DOC loss and significant ($p < 0.05$) $\delta^{13}C$ enrichment of residual DOC, and increased ^{13}C values in dissolved inorganic carbon, consistent with preferential ^{12}C oxidation. Frozen samples exhibited no significant changes in DOC concentration or $\delta^{13}C$, indicating that immobilisation of DOM in ice suppresses its oxidation. $\delta^{15}N$ and $\delta^{18}O$ of NO_3 demonstrated considerable changes, however, inconsistent changes across both treatment and replicates, resulted in a non-significant result. Interestingly, no change was observed in the $\delta^{18}O$, $\delta^{2}H$ values for frozen or unfrozen irradiated samples compared to unirradiated samples ($p > 0.05$). These results demonstrate that $\delta^{18}O$ $\delta^{2}H$ are robust to γ-irradiation impacts, whilst for DOC, freezing samples prior to γ-irradiation effectively preserves both the isotopic integrity and concentrations of DOC.

ORAL PRESENTATIONS

Tuesday, June 9th

^{13}C tracing reveals microbial drivers of root-zone carbon dynamics among prominent field crops

Bobbi Helgason

Department of Soil Science, University of Saskatchewan

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Novel developments in Laser Ablation IRMS and carbonate preparation systems from Nu Instruments Ltd.

Dr. Michael T. Colucci[1], Martin Moore[1], Dr. Ciaran O’Connor[2], Dr. Joe Ready[2]

[1] Nu Instruments Ltd.

[2] Elemental Scientific Lasers

Nu Instruments Ltd. presents two new developments in light stable isotope measurements of carbonate samples: 1) a fast and accurate Carbon and Oxygen Isotope technique using a CO_2 laser interfaced with a simplistic preparation system to the Horizon2 IRMS instrument, and 2) a next generation carbonate sample preparation device, the NuREACT, that allows for temperature controlled acid-carbonate reactions up to 120°C within agitated individual sample vials. For the first development, we present the capability for in-situ $\delta^{13}C$ and $\delta^{18}O$ by interfacing the Elemental Scientific Lasers $MIR10^2$ IR CO_2 laser system to the Horizon2 Isotope Ratio Mass Spectrometer in continuous flow mode (He carrier gas) with a simplified sample prep system that includes a cryoloop, nafion water trap, and GC column. Precision of <0.11‰ and <0.30‰ for carbon and oxygen respectively were achieved for the measurement of well characterized Carrara Marble with analysis times as short as 180 seconds and spot sizes as small as 180 µm. We also present highly precise measurements for the ETH carbonate standards. For the second development, we present the next generation carbonate preparation system, the NuREACT, that allows for acid-carbonate reactions up to 120°C within magnet-driven, agitated individual sample vials. The higher reaction temperatures combined with agitation allows for faster carbonate digestions of 5 minutes for pure calcite, 30 minutes for dolomite, and 1-2 hours for magnesite. Low percent carbonate samples are more efficiently digested with this device. Sample weights ranging from <10ug to 8mg are possible with NuREACT. We present highly precise and accurate data for the ETH carbonate standards.

Fully integrated TOC and TNb analysis of estuarine and sea water samples with the Elementar iso TOC cube®

Kyle W. R. Taylor[1], Calum Preece[2], Toby Boocock[2], Mike Seed[2], Marian de Reus[3]

[1] *Elementar Americas, Inc.*

[2] *Elementar UK Ltd*

[3] *Elementar Analysensysteme GmbH*

Identifying and quantifying the processes that control the carbon and nitrogen cycling in aquatic systems is important for mitigating urban and agricultural pollution, optimizing environmental policy and understanding global nutrient cycles. The isotopic analysis of dissolved organic carbon (TOC) and total bound nitrogen (TNb) are particularly important to elucidate the different sources, track nutrient cycling processes and help contamination identification.

Here, we present the δ^{13}C performance of the Elementar iso TOC® cube for <5 mg/L carbon TOC concentrations in estuarine river water samples, highlighting a salinity gradient from 2g/L to 25g/L. We also present determination of TOC concentration and δ^{13}C TOC in seawater, demonstrating the performance of the iso TOC® cube for the analysis of seawater samples.

The iso TOC cube® elemental analyser has been developed for fully integrated TOC/TNb isotope ratio analysis. Optimised for precise measurements of TC, TOC, TIC and TNb isotope ratios covering a wide range of applications areas. All types of liquids from drinking water, industrial wastewater, soil leachates, or marine samples are determined reliably and with the highest isotopic precision.

High-Precision Discrete N_2O Isotopic Analysis with the new Picarro PI5131-i Cavity Ring Down Spectroscopy Analyzer and Sage Gas Autosampler as an alternative to conventional mass spectrometry analytical techniques

Russell Chedgy[1*], Richard Farrell[2], Sarah Demers[2], Joyeeta Bhattacharya[1]

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Nitrous oxide (N_2O) is a potent greenhouse gas that contributes to global warming and ozone depletion. Precise measurements of its stable isotopes are essential for understanding nitrogen cycling across soil, ocean, atmospheric, and wastewater systems. In response to the growing demand for high-precision N_2O isotope analysis, Picarro has recently introduced the PI5131-i isotopic and gas concentration analyzer. This instrument enables simultaneous measurements of site-specific isotopic signatures ($\delta^{15}N_\alpha$, $\delta^{15}N_\beta$) along with bulk δ^{15}N and δ^{18}O, as well as continuous N_2O concentration measurements. Built on Picarro's robust mid-infrared, laser-based cavity ring-down spectrometry (CRDS) platform, the PI5131-i incorporates significant hardware and software enhancements from its predecessor G5131-i and ensures a reliable, robust and stable measurement foundation. When coupled with the Sage gas autosampler as its front-end peripheral, the system delivers IRMS-level performance for discrete N_2O isotopic measurements. Sage automates and streamlines sample workflows, increases throughput, and provides an intuitive software environment for advanced calibration and ready-to-use processed data. Here, we evaluate the PI5131-i's measurement performance for discrete N_2O isotopic analysis using a suite of gas calibration standards and soil incubation samples. We quantify achievable precision for bulk and site-specific isotope parameters and assess the PI5131-i's viability as an alternative to conventional IRMS methods.

A novel dual inlet large radius IRMS for isotopologue measurement

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The challenges with the measurement of the isotopologues of carbon dioxide using IRMS are well documented. In particular, achieving the required measurement precision for the heavier isotopologues (m/z 48 and 49) has proved difficult.

Measurement precision can be improved by using a much larger radius IRMS instrument. Several such instruments are commercially available, although they can be expensive to buy and difficult to operate.

Sercon and Isotopx have co-developed a dual inlet large radius IRMS that is based on the ion geometry of the Isotopx Phoenix TIMS. This offers very wide flat top peaks and excellent stability, as well as being very easy to use.

The proven, automated Sercon dual inlet system ensures low ppm precision for most of the CO2 isotopologues. Baselines are clean, and the Isotopx ATONA Faraday system offers ultra-low background noise coupled with excellent gain stability. ATONA also allows extremely large beam sizes where there is sufficient sample.

We present isotope ratio data for CO2 standards and samples, highlighting the analytical possibilities of this new platform.