Benelux Association of BASIS Stable Isotope Scientists

Annual Meeting 2024

April 25 & 26

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Colofon

Editors

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Samuel Bodé

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Content

Preface

Dear members of BASIS, dear fellow stable isotope enthusiasts,

It's that time of the year again, time for another interesting and exciting stable isotope meeting. This year we have 77 registered participants of which 14 sponsoring participants. We received so many abstracts that we needed to shorten the presentation time a little to fit as many as possible into the schedule. There are contributions from well outside the Benelux boundaries and, of course, plenty from within and even right around the corner in Amsterdam.

We hope to provide you an exciting scientific and social program in Amsterdam, the Netherlands. Keep in mind that we are always looking for people to play a more active role within the BASIS, including help with providing content for the website and possibly other, social, media. Next year in 2025 the JESIUM meeting will be held in Groningen in June, which is great, but we also need to think about how that affects our own BASIS2025 meeting.

The BASIS board would like to thank our industrial partners, ThermoFisher Scientific, Elementar, Sercon, IVA, Campro Scientific, Air Liquide, Interchrom and Aeris Technologies for their support. We wish you all, familiar faces and first-time participants alike, a very pleasant and productive 15th Benelux Association of Stable Isotope Scientists meeting.

I am really looking forward to an interesting and exciting meeting.

Kind regards,

Marcel van der Meer
BASIS chair

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Sercon successfully enable the global scientific community to undertake research by providing innovative, collaborative instrumentation and software manufactured and developed in the UK.

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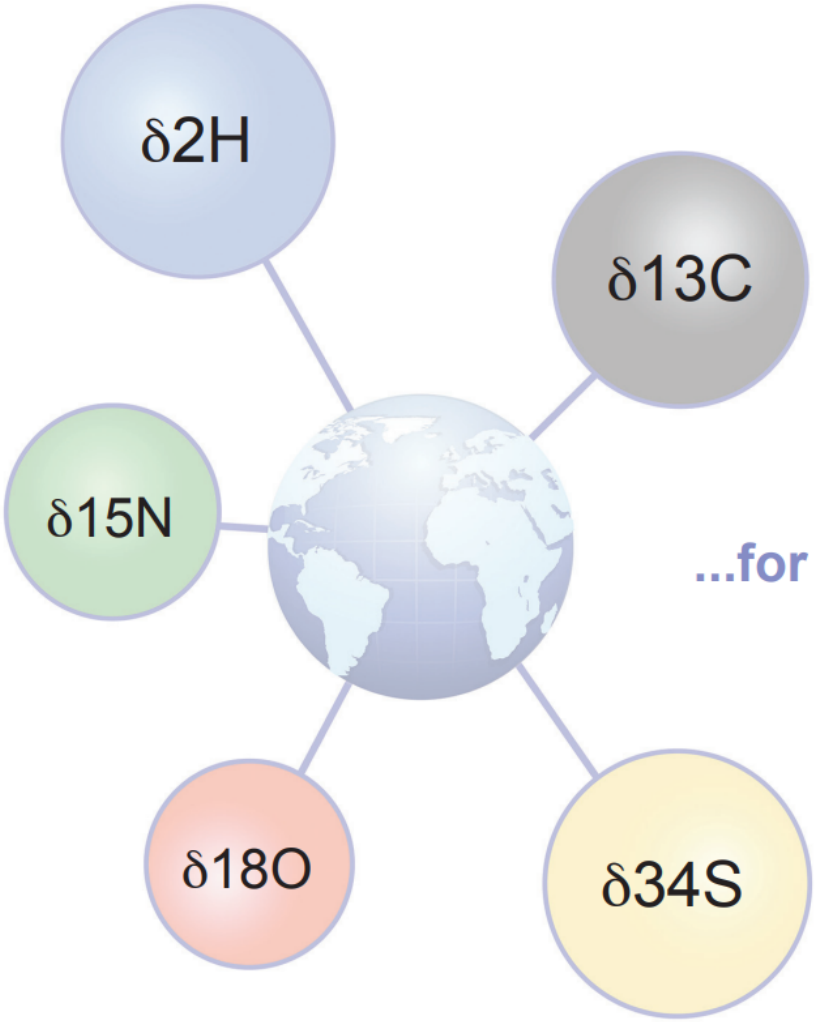

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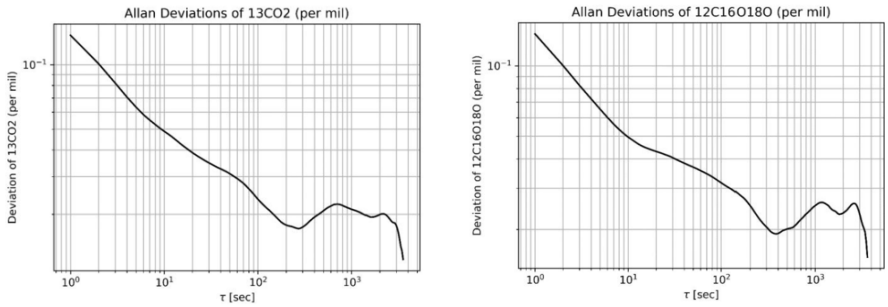

Description

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CO_2 Isotopes/CH_4/C_2H_6/N_2O/CO/CO_2/OCS/CH_2O/EtO/C_3H_8/C_2H_2/C_6H_6

Program

Thursday, April 25 2024

10:00 - 11:30	**Arrival and registration of industrial partners**	
11:30 - 12:00	**Arrival and registration of attendees/members**	
12:00 - 13:00	**Lunch and sponsor trade show**	
13:00 - 13:15	**OPENING BASIS 2023**	
13:15 - 13:30	How to guarantee authenticity and traceability of agri-food and supplements products thanks to the application of isotopic analysis of bioelements. *Matteo Perini*	
13:30 - 13:45	Impact of the site of absorption on the systemic bioavailability of short-chain fatty acids (SCFA)– a study design. *Riet Rosseel*	*Chair: Marcel van der Meer*
13:45 - 14:00	Sea turtle soup? Isotopic clues in archaeological sea turtle remains from the Netherlands *Willemien de Kock*	
14:00 - 14:15	Trophic strategies (C and N isotopic signatures) of three species of Caribbean corals across an extreme environmental gradient in Curaçao *Sarah L Solomon*	
14:15 - 14:30	GC-IRMS: an overview of injection techniques – features and benefits *Maria de Castro*	
14:30 - 15:25	**COFFEE BREAK - TRADE SHOW – POSTER SESSION** *Authors posters 1-10* *be present from 14:30-14:55* *Authors posters 11-20* *be present from 14:55-15:25*	
15:25 - 15:40	Back-to-basics: Can primary references be defined on your IRMS? *Dipayan Paul*	
15:40 - 15:55	Using Isotopic and Chemical Tracers to Investigate Groundwater Residence Time and Recharge Mechanisms in a Semi-Arid Climate: Insights from Northern Morocco *Mohammed Hssaisoune*	
15:55 - 16:10	Paving the way for a new frontier: carbon stable isotope ratio analysis using orbitrap mass spectrometry *Merve Öztoprak Tomečková*	*Chair: Eva de Rijke*
16:10 - 16:25	Development of an LC-IRMS Method for Steroid Analysis in Urine *Lenka Honesova*	
16:25 - 16:40	Investigating whole-body fructose catabolism in vivo using stable isotopes to identify new anti-obesity targets. *Melany Rios-Morales*	
16:40 - 16:55	Shedding (sun)light on animal-microbe interactions using stable isotopes *Michelle Achlatis*	
17:30 - 19:00	**Social event**	
19:00	**Dinner @ Restaurant In de Waag**	

Friday, April 26 2024

9:00 - 9:15	Gross Nitrogen Transformation rates in Four Luxembourg Beech Forests along a pH gradient *Mengru Jia*	
9:15 - 9:30	Radiocarbon and bulk isotope measurements of subglacial carbon dioxide and methane at the western margin of the Greenland ice sheet *Getachew Agmuas Adnew*	
9:30 - 9:45	Evaluating the potential of the ^{13}C-signature of organic aerosols to determine the effect of photochemical ageing reactions. *Ellis de Wit*	*Chair: Loïc Michel*
9:45 - 10:00	A 75-year record of North Sea food web dynamics based on the stable nitrogen isotopic composition of amino acids from harbor porpoise (Phocoena phocoena). *Philip Riekenberg*	
10:00 - 10:15	High precision stable isotope analysis of carbonate and water samples for paleoclimate applications using the Elementar iso DUAL INLET *Mike Seed*	
10:15 - 10:40	**COFFEE BREAK –TRADE SHOW – POSTER SESSION**	
10:40 - 10:55	(Finally) a decision on the ^{13}C isotope scale(s)! *Harro Meijer*	
10:55 - 11:10	Deciphering methane dynamics in the urban ponds of the city of Brussels using carbon stable isotope ratios *Thomas Bauduin*	
11:10 - 11:25	Stable nitrogen and carbon isotope analysis of geoporphyrins in the geological record measured by high-sensitivity EA/IRMS to asses changes in the phototrophic community *Marisa Storm*	*Chair: Dewi Van Harskamp*
11:25 - 11:40	Spatio-temporal distribution of nutrient input and its effect on coral reef food web dynamics along the coast of Curaçao *Nienke C.J. van de Loosdrecht*	
11:40 - 11:55	Pathway specific bulk and clumped isotopic signatures of methane production in a marine lake sediment *Sivan Malavika*	
11:55 - 12:10	Aeris Technologies: CO2 Ratiometer *Hans Helsen*	
12:10 - 12:30	**LEDENVERGADERING – Members meeting 2024**	
12:30 - 13:30	**Lunch and sponsor trade show**	

13:30 - 13:45	Connecting two different isotope worlds through pyrolysis. *Anita Aerts-Bijma*
13:45 - 14:00	Integrating stable isotopes and dietary data to uncover trophic interactions in North Pacific pelagic food webs *Genyffer Troina*
14:00 - 14:15	Compound specific chlorine isotope analysis (CSIA-Cl) using low- and high-resolution GC-EI-MS: Method development and selected applications for chemical warfare agent markers *Adriaan Marais*
14:15 - 14:30	Combining ^{13}C, ^{15}N, and ^{2}H to measure feeding and metabolic activity of marine, shallow-water sponges – a pilot study *Tanja Stratmann*
14:30 - 14:45	Use of principal components analysis to study complex aquifers with scarce data *Azzedine HANI*
14:45 - 15:00	The next generation platform for LC-IRMS analysis *Mario Tuthorn*
15:00 - 15:35	**Young Scientist award - Closing**

Chair Samuel Bodé

Abstracts
Oral Presentations

25/04 -13:15 - 13:30

How to guarantee authenticity and traceability of agri-food and supplements products thanks to the application of isotopic analysis of bioelements

[1] Perini Matteo, [1] Pianezze Silvia

[1] Fondazione Edmund Mach, Via Mach 2, 38098 San Michele all'Adige (TN), Italy

Stable isotope ratio analysis of bio-elements (hydrogen, carbon, nitrogen, oxygen and sulphur) has been used since the 1990s to check food authenticity and traceability of a wide variety of food commodities (Rossmann, 2001). In the last few years, examples of applications also in the pharmaceutical and cosmetic field have been reported (Pellati et al., 2013; Perini et al., 2017, 2021; Perini, Paolini, et al., 2019; Perini, Pianezze, et al., 2019). The use of stable isotope analysis for products authentication purposes is possible thanks to isotopic fractionation occurring in several processes and reactions (biological, biochemical, physical, chemical etc.) which generates unique isotopic signatures. For this reason, the application of this technique on the bulk samples as well as on specific components (e.g. aroma compounds) can be used to detect the origin of an ingredient (synthetic or natural), the substitution of one ingredient for another, as well as the geographical and/or botanical origin of the products.

The widespread and well-known technique based on the coupling between elemental analyzer and mass spectrometer (EA-IRMS) is now flanked by liquid chromatography (LC-IRMS) and gas chromatography (GC-IRMS). Today it is therefore possible to analyze not only the bulk of the matrices but also their individual components.

The $\delta^{13}C$ and $\delta^{2}H$ values of vanillin can determine whether the product is natural (deriving from the expensive CAM plant Vanilla), biotechnologically derived or synthetic (Perini, Pianezze, et al., 2019). Moreover, the $\delta^{13}C$ values of specific components of Rosa damascene mill., one of the most expensive essential oils in the market world, can indicate the fraudulent addition of cheaper oil from a C4 plant (e.g. Cymbopogon martinii, palmarosa) (Pellati et al., 2013).

In pharmaceutical and cosmetic formulations, $\delta^{13}C$ analysis is a suitable tool to discriminate between squalene and squalane from shark (illegal) and from olive oil (expensive) (Camin et al., 2010) as well as between monacolin K (contained in the fermented dietary supplement red yeast rice) and the commercially marketed statin, lovastatin (Perini et al., 2017).The L-theanine extracted from Camellia Sinensis is easily distinguishable from that obtained biosynthetically (Perini et al., 2021).

It is possible to combine different isotopic signatures to guarantee the natural origin of curcumin, caffeine (Ding et al., 2019), tartaric acid and its derivatives.

These examples demonstrate that the isotopic fingerprint represent an effective tool for the authenticity assessment of economically important pharmaceutical, cosmetic and supplement products.

References

Camin, F., Bontempo, L., Ziller, L., Piangiolino, C., & Morchio, G. (2010). Stable isotope ratios of carbon and hydrogen to distinguish olive oil from shark squalene-squalane. Rapid Communications in Mass Spectrometry: RCM, 24(12), 1810–1816.
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25/04 -13:30 - 13:45

Impact of the site of absorption on the systemic bioavailability of short-chain fatty acids (SCFA)– a study design.

Candidate young scientist award

[1] Riet Rosseel, [1] Kristin Verbeke

[1] Translational research in gastrointestinal disorders (TARGID), KU Leuven, Belgium

Short-chain fatty acids (SCFA), comprising mainly acetate, propionate and butyrate, are physiologically produced in the human colon through the fermentation of dietary fibre and potentially play a mediating role in the health benefits associated with high fibre intake. SCFA are readily absorbed by the colonocytes and travel via the portal circulation to the liver after which they end up in the systemic circulation. The fraction of SCFA that reaches the systemic circulation may be a crucial determinant for their effects on organs at a distance such as the pancreas, adipose tissue or the brain. However, since SCFA act as fuel for colonocytes and serve as precursor for the substrate metabolism in the liver, the fraction of SCFA entering the systemic circulation is limited. In contrast, upon consumption of plant-based fermented food products that contain SCFA, produced during food fermentation, SCFA are already absorbed in the small intestine. Because small intestinal epithelial cells preferably use glucose or glutamine rather than SCFA as energy source, we hypothesize that the systemic availability will be higher when orally administered SCFA are absorbed in the small intestine as opposed to the colon. In a crossover, human intervention study with healthy participants, we will investigate the impact of the site of administration on the systemic availability of SCFA. ^{13}C-labelled SCFA will be targeted to either the colon using capsules with a pH-dependent coating that deliver their content only upon arrival in the large intestine, or to the small intestine using standard uncoated capsules. The use of labelled SCFA allows us to selectively quantify the amount of SCFA in the blood that originate from the intestine. Participants will visit the lab on two test days in which they will ingest the capsules during a no fibre breakfast. In addition, ^{2}H-labelled SCFA will be administered intravenously using a primed, continuous infusion to estimate the clearance of SCFA. Blood samples will be collected at regular time points to quantify the ^{13}C- labelled and ^{2}H-labelled SCFA. Insight in the effect of the site of administration on the kinetics of SCFA will empower research into the role of SCFA as health supporting metabolites.

25/04 -13:45 - 14:00

Sea turtle soup? Isotopic clues in archaeological sea turtle remains from the Netherlands

[1,2] Willemien de Kock, [1,3] Youri van den Hurk, [1,4] Merita Dreshaj, [5] Max Ramsøe, [4] Michael Dee, [5] Alberto J. Taurozzi, [6] Per J. Palsbøll, [1] Canan Çakırlar

[1] Groningen Institute of Archaeology, University of Groningen.
[2] Marine Evolution and Conservation, Groningen Institute for Evolutionary Life Sciences, University of Groningen.
[3] Department of Archaeology and Cultural History, NTNU University Museum, Trondheim, Norway.
[4] Centre for Isotope Research, University of Groningen.
[5] The Globe Institute, Faculty of Health and Medical Science, University of Copenhagen.
[6] Center for Coastal Studies, Provincetown. Massachusetts, United States of America.

Sea turtles (Cheloniidae) are scarce in the archaeological findings of Northern Europe, with only occasional discoveries on record. In this investigation, we applied bioarchaeological methodologies to analyse two sea turtle specimens excavated in the Netherlands. The primary objective was to discern whether these specimens had stranded in the Netherlands or had been imported. One specimen, retrieved in Schagen, predates 1500 AD, while the other, recovered in Leeuwarden, Friesland, originated from an early-modern deposit dating between 1650 and 1850 AD. Our analysis incorporated ZooMS (Zooarchaeology by Mass Spectrometry) and stable isotope assessments, focusing on $\delta^{13}C$ and $\delta^{15}N$. The ZooMS results identified the Schagen and Leeuwarden specimens as a loggerhead turtle (Caretta caretta) and a green turtle (Chelonia mydas), respectively. Isotope provenancing using contemporary samples from diverse global regions suggested that the Leeuwarden specimen was likely imported during a period when sea turtle soup, a culinary delicacy associated with high status, was particularly fashionable. This interdisciplinary approach illustrates how the integration of bioarchaeological methods and ecological insights can provide valuable insights into the historical presence and trade of sea turtles. Sea turtles (Cheloniidae) are scarce in the archaeological findings of Northern Europe, with only occasional discoveries on record. In this investigation, we applied bioarchaeological methodologies to analyse two sea turtle specimens excavated in the Netherlands. The primary objective was to discern whether these specimens had stranded in the Netherlands or had been imported. One specimen, retrieved in Schagen, predates 1500 AD, while the other, recovered in Leeuwarden, Friesland, originated from an early-modern deposit dating between 1650 and 1850 AD. Our analysis incorporated ZooMS (Zooarchaeology by Mass Spectrometry) and stable isotope assessments, focusing on $\delta^{13}C$ and $\delta^{15}N$. The ZooMS results identified the Schagen and Leeuwarden specimens as a loggerhead turtle (Caretta caretta) and a green turtle (Chelonia mydas), respectively. Isotope provenancing using contemporary samples from diverse global regions suggested that the Leeuwarden specimen was likely imported during a period when sea turtle soup, a culinary delicacy associated with high status, was particularly fashionable. This interdisciplinary approach illustrates how the integration of bioarchaeological methods and ecological insights can provide valuable insights into the historical presence and trade of sea turtles.

25/04 -14:00 - 14:15

Trophic strategies (C and N isotopic signatures) of three species of Caribbean corals across an extreme environmental gradient in Curaçao

Candidate young scientist award

[1] Sarah L Solomon, [1] Jasper M De Goeij, [1,2] Mark Vermeij, [1] Verena Schoepf

[1] Department of Freshwater and Marine Ecology, Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Amsterdam, the Netherlands
[2] CARMABI Foundation, Piscaderabaai z/n, Willemstad, Curaçao

Tropical reef-building corals are animals with a symbiotic relationship with algal endosymbionts and corals can acquire nutrients from both photosynthetic exchange of sugars from endosymbionts (autotrophy) or from feeding on dissolved and particulate organic matter (heterotrophy). The difference between the coral host and endosymbiont natural abundance of $\delta^{13}C$ and $\delta^{15}N$ (ie $\delta^{13}C_{host\text{-}symbiont}$) and the degree of isotopic niche overlap can indicate if a coral is more autotrophic or heterotrophic. An increase in coral heterotrophy has been hypothesized to be a mechanism of resilience to stressful conditions, such as high seawater temperatures and acidification. Therefore, coral mixotrophy will play a dynamic role in modulating coral health, resilience, and recovery under future (warmer, more acidic) ocean conditions. Corals that already persist in highly variable or extreme environments tend to have naturally increased stress tolerance to both global and local stressors, allowing them to survive in environments that are, for example, warmer and more acidic than surrounding reefs. The inland bays of Curaçao harbor corals that experience local (high turbidity, eutrophication) and global stressors (highly variable and high average seawater temperatures, and low pH compared to surrounding reefs). The physiological traits, such as heterotrophic plasticity, associated with stress tolerance in corals from extreme environments may provide insight into the capacity of corals to acclimatize or adapt to future ocean conditions. We measured the $\delta^{13}C$ and $\delta^{15}N$ of conspecifics (Siderastrea siderea, S. radians, and branching Porites sp.) from two distinct habitats: inland bays with multi-stressor, extreme conditions and environmentally optimal fringing reef habitat. We captured trophic plasticity between seasons (warm, wet seasons versus cooler dry season) in both habitats and we investigate the effects of in situ mild and severe heat stress on heterotrophy between two warm, wet seasons. Utilizing two approaches ($\delta^{13}C_{host\text{-}symbiont}$/$^{15}N_{host\text{-}symbiont}$ and Stable Isotope Bayesian Ellipses in R, or SIBER), we determine that 1) trophic strategy was influenced more by season than by habitat, despite differences in seawater physicochemical conditions being larger between habitats than between seasons, 2) overall, corals were more heterotrophic during the warm season compared to the cooler season and 3) bay S. siderea had the most plastic trophic strategy of all three species.

25/04 -14:15 - 14:30

GC-IRMS: an overview of injection techniques – features and benefits

[1] Maria de Castro, [1] Mario Tuthorn

[1] Thermo Fisher Scientific

The Thermo Scientific™ GC IsoLink™ II IRMS System provides the ultimate level of performance and versatility to meet the analytical challenges of rapidly expanding applications using compound specific isotope ratios. Here we present features and benefits of using the following GC injection techniques: on-column injection, Large Volume Injection (LVI) Programmed Temperature Vaporization (PTV) technique and that Static Headspace Sampling (SHS) injection. We will demonstrate capability of these injection techniques to properly transfer a representative portion of the sample to the analytical column while avoiding discrimination and isotopic effects when used in GC-IRMS.

On-column injection is applied for high accuracy and reproducibility analysis of thermally labile or unstable compounds, as well as for samples with large analyte-boiling-point differences. It can be advantageous in a wide area of applications, including geochemistry, environmental research and paleoclimatology, for investigations of alkenones and alkanes, as well as PLFAs from soils and sediments. We will present an optimized GC-IRMS analytical setup for stable carbon isotope ratios analysis of saturated hydrocarbons.

The LVI PTV is an injection technique which allows the introduction of larger volumes of samples in the gas chromatograph injector. Typically, in the range of tens to hundreds of microliters compared to microliters when using a conventional injection technique. This can be particularly useful for analysis of organic pollutants present in very small quantities in environmental samples. Here we present an optimized methodology for analysis of very small amounts of saturated hydrocarbons.

The SHS injection via split/splitless injector eliminates the need for direct liquid sample injection, reducing column contamination and improving analyte separation and reproducibility of isotope data. A method for SHS GC-IRMS was optimized and applied for carbon isotope analysis of volatile organic compounds, resulting in excellent precision and accuracy for GC-C-IRMS analysis of VOCs, including improved sensitivity and lower detection limits.

25/04 -15:25 - 15:40

Back-to-basics: Can primary references be defined on your IRMS?

[1] Dipayan Paul, [1] Anita Aerts-Bijma, [1] Albert C. van Buuren, [1] Pharahilda M. Steur, [1] Harro A. J. Meijer

[1] Centre for Isotope Research (CIO), Energy and Sustainability Research Institute Groningen (ESRIG), University of Groningen, Nijenborgh 6, 9747 AG, Groningen, the Netherlands.

Isotope Ratio Mass Spectrometry (IRMS) is undeniably the most widely used instrument in the isotope research community. Dual-inlet (DI) and continuous-flow (CF) are the two modes IRMS's operate in. Often times, IRMS's are used in a dedicated operation mode, however, most can be used in both modes if appropriate peripherals are available.

Two new IRMS's (PrecisION, Elementar Germany) were recently procured by the Centre for Isotope Research, University of Groningen to replace the older IRMS's that served the laboratory for about three decades. One operates solely in the CF-mode and is currently being used for aerosol research while the other is switched between the two modes, as research demands. Here we will present our results we have obtained from the IRMS that operates in both modes. Measurements performed in the CF-mode (for $\delta^{13}C$ and $\delta^{15}N$) are very satisfactory, which is expected of these new generation instruments. However, the dual-inlet measurements of CO_2, which we will focus on, show excellent precision but with disappointing accuracy due to scale-contraction originating from an unexplainable source. Scale-contraction can of course be corrected for if one applies a multi-point calibration. This is however not an option when one participates in defining the isotopic composition of primary references. We have been working on such an application recently and were confronted with challenges we did not expect of the new IRMS. This process of evaluating our IRMS, and thus our understanding, for measuring samples that might potentially become a primary reference will be presented here.

25/04 -15:40 - 15:55

Using Isotopic and Chemical Tracers to Investigate Groundwater Residence Time and Recharge Mechanisms in a Semi-Arid Climate: Insights from Northern Morocco

[1] Mohammed Hssaisoune, [2] Lhoussaine Bouchaou, [3] Mohamed Qurtobi, [4] Yassine Ait Brahim

[1] Applied Geology and Geo-Environment Laboratory, Faculty of Sciences, Ibn Zohr University, Agadir 80000, Morocco.
[2] Faculty of Applied Sciences, Ibn Zohr University, Ait Melloul 86150, Morocco.
[3] National Center for Energy, Sciences, and Nuclear Techniques, BP 1382, Rabat 10001, Morocco
[4] Mohammed VI Polytechnic University (UM6P), International Water Research Institute (IWRI),Ben Guerir 43150, Morocco.

Karstic aquifers play a vital role in supplying drinking water and supporting irrigation in Morocco. However, a more comprehensive understanding is essential to enhance their sustainable management in the face of global changes. This study, which involves the chemical and isotopic analysis of 67 groundwater samples from the Rif Mountains' karst aquifer, offers crucial insights into the key factors and processes influencing groundwater recharge and residence time.

Isotopic values of $\delta^{18}O$ and $\delta^{2}H$ suggest that recharge sources vary across the region. For instance, in Lakraa Mountain, North of Lao River, and Haouz and Dersa Mountain aquifers, recharge is predominantly originated from meteoric water at high, intermediate, and low elevations, respectively. Notably, the isotopic signature of the Atlantic Ocean influences all samples except for those from the Lakraa Mountain aquifer, which exhibits Mediterranean Sea influence.

Radiocarbon dating, using the International Atomic Energy Agency (IAEA) model, reveals groundwater ages spanning from modern to 1460 years. The presence of detectable tritium values (>2.7 tritium unit) in groundwater aligns with the tritium levels observed in precipitation at the nearest Global Network of Isotopes in Precipitation (GNIP) stations of Gibraltar and Fez-Saiss, located approximately 100 km north and 250 km south of the study area, respectively. This evidence underscores the contemporary nature of groundwater in the Rif Mountains, with recharge occurring within the past 60 years. This finding highlights the aquifer's renewability and its vulnerability to climate variabilities and human activities.

Furthermore, these results underscore the effectiveness of isotopic tracing in mountainous springs. They offer valuable insights for decision-makers tasked with managing water resources in this karstic region.

25/04 15:55 -16:10

Paving the way for a new frontier: carbon stable isotope ratio analysis using orbitrap mass spectrometry

Candidate young scientist award

[1] Merve Öztoprak Tomečková, [1] Ellen C. Hopmans, [1] Marcel T.J. van der Meer, [1,2] Stefan Schouten, [1,2] Laura Villanueva

[1] Royal Netherlands Institute for Sea Research, Netherlands
[2] Utrecht University, Netherlands

The carbon isotopic composition of a biomolecule is determined by (1) the carbon source(s) utilized by the organism, (2) the enzymatic pathways involved, (3) the degree of conversion of intermediates, and (4) the reaction rate for any given step in the biosynthetic pathway leading to the final product, which is also modulated by substrate availability, temperature and other factors1. The intramolecular distribution of carbon isotopic ratios is therefore expected to be non-homogeneous in biomolecules and holds the potential to give insight into e.g. biological sources and biosynthetic pathways of biomarker molecules. However, intramolecular isotope distributions are rarely reported due to large sample size requirements of nuclear magnetic resonance (NMR) instruments capable of these measurements.

Phytol is considered to be the most abundant acyclic isoprenoid in our biosphere2. It is formed by sequential condensation of isopentenyl diphosphate (IPP) subunits which are synthesized by two distinct, evolutionarily highly conserved biosynthetic pathways. Bacteria almost exclusively synthesize IPP through the methylerythritol phosphate (MEP) pathway, with the notable exception of green sulfur bacteria which utilize the mevalonate (MVA) pathway. Eukaryotes produce IPP via a modified MVA pathway in their cytoplasm, whereas in the plastids, being of prokaryotic endosymbiotic origin, IPP is synthesized via the MEP pathway. Successful recognition of characteristic intramolecular carbon isotopic signatures of phytol may be used to elucidate the biosynthtic origin of phytol or its diagenetic product phytane which can be found in ancient rocks and petroleum as old as is 1.74 Ga3. A preliminary degradation study was able to show different intramolecular isotopic values of the two terminal positions of phytol4, however the signature could not be coupled to a specific biosynthetic pathway origin. Recent advances in Fourier-transform mass spectrometers (FTMS), particularly Orbitrap mass analysers, show the potential to measure intramolecular isotope ratios with sufficient accuracy and precision to elucidate intramolecular isotopic structures of analytes at natural abundance using as little as "10s of nmols of sample material [5–8].

Here we present a novel analytical method for the detection of intramolecular carbon isotopic signatures of phytol using Orbitrap mass spectrometry. Chlorophyll was extracted from various biomass samples as well as a cyanobacterial culture which was grown to exponential and stationary growth phase at 15, 20 and 30°C. Phytol was produced from chlorophyll through hydrolysis and further purified using semi-preparative HPLC. Phytol samples (<4 nmol per analysis) were introduced to the Orbitrap mass spectrometer via direct infusion for ca. 45 minutes and ionized using an Atmospheric Pressure Chemical ionization (APCI) probe. We have optimized measurement parameters such as mass resolution, automatic gain control (AGC) target, higher-energy collisional dissociation (HCD) collision energy, solvent and flow rate to obtain sufficient signal intensities of major fragments of phytol in MS2 mode and have tested for drift and memory effects. Relative standard errors of <2‰ were achieved for 13 major fragments generated from the phytol molecule. We observed distinct, reproducible carbon isotopic patterns for these fragments of phytol from different biosynthetic sources, suggesting large intramolecular isotopic differences. Fragments of

phytol from cultures grown at 15°C show a distinctly depleted carbon isotope ratio signal when compared to fragments of phytol from the same culture grown at 20 and 30°C. The potential for this application for the development of biomarker proxies needs to be explored further.

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25/04 -16:10 - 16:25

Development of an LC-IRMS Method for Steroid Analysis in Urine

Candidate young scientist award

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The determination of the CIR value and the origin of steroids is of paramount importance for anti-doping purposes. Gas Chromatography-Combustion-Isotope Ratio Mass Spectrometry (GC-C-IRMS) has become the standard technique for this purpose. Nevertheless, it is known to be laborious and time-consuming. Therefore, we aim to investigate the feasibility of developing a high-throughput method using Liquid Chromatography Isotope Ratio Mass Spectrometry (LC-IRMS) as a viable alternative.

LC-IRMS converts the analytes to CO_2 through wet oxidation, and for accurate CIR determinations, only water can be utilized as a mobile phase. At ambient temperature, water's elution strength is insufficient for separating steroid compounds. When heated, its elution strength becomes comparable with organic solvent/water mixtures, enabling effective steroid separation. However, the choice of the chromatographic column is critical for successful steroid analysis via LC-IRMS. Most existing steroid separations employ reverse-phase chromatography on silica-based columns, which are inherently unstable under aqueous conditions at elevated temperatures. This necessitates a search for the appropriate column capable of withstanding the rigorous conditions required for LC-IRMS analysis of steroids. Furthermore, explain the complete instrument setup where our previously published multidimensional HPLC cleanup was connected to high-temperature-LC-IRMS. We highlight the difficulties that arise from working with complex systems. Finally, we present the results obtained from the method validation and its application on urine samples.

25/04 -16:25 - 16:40

Investigating whole-body fructose catabolism in vivo using stable isotopes to identify new anti-obesity targets.

Candidate young scientist award

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Background: Dietary fructose consumption has increased tremendously over the last 30 years and epidemiological studies have linked this to increased incidence of obesity, fatty liver disease, diabetes and cardiovascular disease. Fructose is classically described to be catabolized in the liver, where it enters glycolysis bypassing the insulin-dependent regulation that controls glucose catabolism. The fructose-derived metabolites are then processed into fatty acids in an unregulated fashion, which may lead to ectopic fat accumulation in diverse peripheral organs. Although the hepatic biochemical pathway of fructose has been elucidated, how and where fructose is majorly metabolized in the whole-body context has been poorly described. Recently it has been shown in mice, that host and microbial intestinal fructose metabolism plays a key role in the whole-body effect of fructose. Dietary fructose is converted into glucose in the small intestine as a protective clearance mechanism. However, high fructose intake saturates this process leading to fructose catabolism by the liver and the intestinal microbiota. The latter can produce detrimental metabolites that can contribute to fat synthesis. In humans is still not clear whether these processes also take place upon fructose intake, if this is different in health and disease, and most importantly, whether it can be modulated. To achieve this, we relied on the use of ^{13}C label and isotope tracing techniques, to determine the catabolic fate of fructose.

Aim: Here we present an update on ongoing clinical trials that aim to study intestinal and whole-body fructose catabolism in patients with metabolic syndrome and the effect of fecal microbial transplantation and different high-sugar diets on its kinetics.

Methods: Fructose catabolism was measured through a fructose challenge test in patients with metabolic syndrome before and after the different interventions. In short, subjects ingested a high dose of fructose (1gr/kg) followed by a small dose of ^{13}C-Fructose (120 mg) used as a tracer. For up to 6 hours plasma, breath, and urine samples were collected to measure concentrations and ^{13}C incorporation into different metabolites. Different fractional dose contributions were calculated to estimate the changes in fructose catabolism.

Results and conclusions: The data suggest that 1gr/mg of fructose saturates the human small intestine for its absorption leading to its microbial fermentation and its appearance in peripheral circulation. Fructose can also be converted to glucose and/or be oxidized after fasting. This glucose production seems to change location from hepatic to intestinal after fecal microbial transplant. This would state that humans can also activate intestinal gluconeogenesis upon fructose consumption and that this process depends at least in part on the gut microbiota. A high fructose diet increases the small intestine fructose absorption. These results would pinpoint intestinal host/microbial fructose catabolism as an important novel target for treating obesity.

25/04 -16:40 - 16:55

Shedding (sun)light on animal-microbe interactions using stable isotopes

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In recent years, ecologists have been challenged by a new understanding of the natural world, one that recognizes the strong interdependencies that exist between animals or plants and the complex microbiomes that they host. While the "-omics" revolution has tremendously increased our ability to predict metabolic interactions between host and microbes, empirical evidence confirming such metabolic exchanges remains scarce. In a series of experiments, we used stable isotope tracers to demonstrate that marine sponges, ecologically important animals that are celebrated for their heterotrophic feeding capacity, enjoy large portions of autotrophic inputs from the photosynthetic microbes that they host, even when these are in low abundance. We further provide evidence that such energetic supplementation can define the ecological functioning of the host: bioeroding sponges are some of the most aggressive and abundant agents of erosion on coral reefs, often overgrowing and killing live corals, and photosynthetic symbionts fuel this erosion capacity, as we illustrate at the cellular level combining isotope experiments with electron microscopy and nanoscale secondary ion mass spectrometry (NanoSIMS). In particular, NanoSIMS allowed us to track the fate of ^{13}C-bicarbonate, ^{15}N-ammonium as well as enriched dissolved organic matter within the intact symbiosis, separating the metabolic signals of the two partners in a meaningful timeframe and without cross-contamination. All in all, this talk highlights the opportunities that enriched isotope experiments offer in our quest to listen in on the metabolic cross-talk between animal hosts and their microbes, and to deeper understand the multiple levels of their interactions.

26/04 -9:00 - 9:15

Gross Nitrogen Transformation rates in Four Luxembourg Beech Forests along a pH gradient

Candidate young scientist award

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Nitrogen (N) transformations play a pivotal role in regulating N availability, maintaining N retention, and sustaining long-term productivity in forest ecosystems. This study investigated gross N turnover in both the organic layer and mineral topsoil along four distinct Luxembourg beech forests characterized by varying soil types with a pH gradient (acid sandy, acid loamy, calcaric loamy, and limestone). Gross N transformation rates were measured using the ^{15}N pool dilution method and a numerical model. In addition, the abundance of fungi, bacteria, ammonia-oxidizing archaea (AOA), and bacteria (AOB) were assessed through quantitative PCR.

Across the pH gradient, gross mineralization and nitrification rates increased clearly in both layers from acidic to calcareous soils. Moreover, gross immobilization rates of ammonium and nitrate exhibited a marked rise in the mineral layer. Differential patterns between layers could be attributed to variations in carbon (C) content and soil N-status. The shifts in gross transformations resulted in an augmented release of mineral N, indicated by the increased net mineralization and nitrification rates in calcareous ecosystems. These results could be explained by the transition from fungi to bacteria dominance over pH gradients. This was shown by an increase in microbial N-demand and a decrease in relative abundance ratio of fungi to bacteria. The abundances of AOA increased in the organic layer, while the abundances of AOB increased in the mineral layer. These findings indicate a faster N turnover in calcareous soils driven by shifts in microbial communities, and different mechanisms governing N transformations across the soil profile.

26/04 -9:15 - 9:30

Radiocarbon and bulk isotope measurements of subglacial carbon dioxide and methane at the western margin of the Greenland ice sheet

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Subglacial meltwater from the western margin of the Greenland Ice Sheet (GrIS) is a net source of carbon dioxide (CO_2) and methane (CH_4). To estimate the CO_2 and CH_4 emission from the GrIS meltwater and its relevance to the global carbon budget, it is essential to understand the sources and its controlling mechanisms. In this study we measured the radiocarbon content of CO_2 and CH_4, bulk isotopic composition of CO_2 and CH_4 and the Bernard ratio for the samples extracted from the subglacial meltwater and air samples collected from an ice cave at the edge of Isunnguata Sermia glacier (ISG) located at the western margin of the GrIS. For comparison, the bulk isotopic composition of CO_2 and CH_4 and the Bernard ratio was measured for samples extracted from the subglacial meltwater of Russel glacier and nearby lakes and ponds.

In June 2022, the concentration of CH_4 in the supraglacial meltwater at ISG was less than [1] % of the CH_4 concentration in the subglacial meltwater. Due to a strong microbial methane oxidation, determining the source of subglacial CH_4 at ISG using isotopes is challenging. Subglacial CH_4 at ISG is most likely produced microbially via acetoclastic methanogenesis pathway. However, to determine the source of subglacial CH_4 at ISG with higher confidence, conducting incubation experiments with sediments collected from beneath the ice sheet is necessary. The age of subglacial CH_4 at the ISG is about 2000 yrs BP, in good agreement with Neoglacial ice sheet advancement. The dynamics of CH_4 in the subglacial meltwater is controlled by microbial oxidation and hydrology. In early melt season, the bulk isotope composition of methane is depleted compared to peak melt season most likely due to enhanced microbial methane oxidation. In June 2022, the concentration of CO_2 in the supraglacial meltwater was about 50 % of the CO_2 concentration in the subglacial meltwater at ISG. CO_2 is relatively older than CH_4 (about 6000 yrs BP) indicating CO_2 and CH_4 have different sources.

26/04 -9:30 - 9:45

Evaluating the potential of the ^{13}C-signature of organic aerosols to determine the effect of photochemical ageing reactions.

Candidate young scientist award

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Organic aerosols are an important component of atmospheric particulate matter and are associated with adverse health effects. Their chemical composition, consisting of 1000's of different organic compounds, makes their chemical characterisation challenging. One of their main sources are combustion processes, but during their lifetime in the atmosphere, their chemical properties are altered by complex photochemical reactions, so-called ageing reactions. Currently, there are no conclusive chemical markers to diagnose specific ageing processes and the extent of ageing. In this work, we investigate whether we can use stable carbon isotopic signatures in different volatility fractions of the organic aerosol as tracers for photochemical ageing, kinetic isotope effects.

This is done in a laboratory study, where we produce organic aerosols by the combustion of biomass and coal and expose them to atmospheric ageing in a photochemical reactor. The reactor uses high concentrations of oxidants and UV light to simulate an atmospheric age of several days. We collect organic aerosols on two filters, the first collected directly after the combustion chamber and the second collected after the ageing reactor. For stable carbon isotope analysis, we thermally desorb the organic material from the filters in three distinct temperature steps to separate more volatile (= more easily evaporated) from less volatile compounds.

Our results show that the ^{13}C signature as well as the volatility distribution of the organic aerosol are strongly altered by the ageing process. Before ageing in the reactor, the ^{13}C signature is similar for all three volatility fractions. After ageing in the reactor, the ^{13}C signature differs strongly between the volatility fractions and is generally more similar to what is commonly observed in the atmosphere. We can qualitatively explain the change in δ^{13}C with volatility in terms of different ageing processes. These specific ageing processes will be investigated more closely in a specially constructed reactor, where we can expose the filter pieces to isolated ageing mechanisms.

26/04 -9:45 - 10:00

A 75-year record of North Sea food web dynamics based on the stable nitrogen isotopic composition of amino acids from harbor porpoise (Phocoena phocoena).

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Animal tissues incorporate the stable nitrogen isotopic composition from underlying resources into their biomass, but with an additional fractionation effect. The stable isotopic composition of nitrogen within these tissues therefore reflects both the baseline isotope values supporting primary producers and the animal's position within the food web, reflecting trophic structure. Within a long-lived tissue such as bone, collagen remains well preserved after death, allowing investigating long term ecosystem states through collection and analysis of bones of known provenance. Here, collagen from 170 stranded harbor porpoise was sourced from a museum archive and the tissue bank of the Dutch Stranding Network. The samples from both archives were analyzed for stable nitrogen isotope ratios of bulk material and amino acids across historical (1950-2001) and recent (2009-2021) time periods. These results allow for: 1) identification of the modern trophic position of harbor porpoise in the North Sea food web, 2) comparison between the modern and historical trophic position of harbor porpoise, and 3) to infer ecosystem impacts that have led to changes in baseline N and trophic structure in the North Sea. Previously, Christensen et al. (2008) identified lowered $\delta^{15}N$ values starting in the 1960's from analysis of bulk collagen but were unable to conclusively tie this change to a shift in baseline N isotopic composition supporting primary producers or a shift in food web trophic structure or feeding status of porpoise in the North Sea. Baseline integrated analysis of trophic position using source and trophic amino acids will provide further context for this historical data set and provide a valuable multi-decadal baseline for comparison against the more recent archive (2009-2021). The long history of industrial overfishing in the North Sea confounds interpretation of the multi decadal impacts from climate change. We anticipate that the increased resolution and integration of baseline changes across the 75-year period will provide an opportunity to resolve the multiple anthropogenic impacts changing the harbor porpoise's place in the food web structure in the North Sea.

26/04 -10:00 - 10:15

Simultaneous NCS isotope ratio analysis pioneered by Elementar and IsoPrime

[1] Mike Seed, [1] Sam Barker, [1] Rob Berstan, [2] Marian de Reus, [2] Kathrin Rosenthal

[1] Elementar UK Ltd.
[2] Elementar Analysensysteme GmbH

For over 15 years, Elementar has led the way in EA-IRMS analysis, utilizing the unique purge and trap chromatography and ramped heating to deliver high sensitivity, high throughput N, C & S isotope analysis on a broad range of sample applications. . Here, we briefly review the working principle of Elementar's CNS isotope analysis setup and present example data using this technique.

Samples enter the elemental analyser (EA) inlet via an autosampler and a He-purged ball valve, which guarantees blank-free sample introduction. Subsequently, organic sample components are quantitatively converted to a homogenous gas mixture of CO_2, N_2, and SO_2 within a high temperature furnace. CO_2 and SO_2 gases are retained by dedicated adsorption columns, while N_2 passes through without interaction. The retained gases can be released individually and sequentially by heating up the respective adsorption column at a time which is determined by the onboard thermal conductivity detector (TCD). This technology guarantees complete baseline separation of C, N and S peaks even for extreme elemental ratios without isotopic fractionation and is capable of handling high elemental concentrations (up to 20mg C). Furthermore, the sample peaks are significantly narrower and therefore taller compared to isothermal GC-based systems for equivalent sample concentrations. Accordingly, we observe an excellent signal to noise ratio and exceptional instrument sensitivities.

For the analysis of substances with a very low S or N content, the sample weight can easily be increased. When the sample weight is increased, the major carbon isotope will reach very high concentrations. To avoid amplifier saturation, our instruments feature a 100V amplifier and a fully automated sample gas dilution system.

This EA-IRMS system has been used to determine $\delta^{13}C$, $\delta^{15}N$, and $\delta^{34}S$ values of bone collagen [1], which can assist in the dietary reconstruction of prehistoric man. In this field of research, it is essential that as much information as possible is derived from extremely limited sample amounts. Similarly, ecologists have analysed CNS isotope signatures in single tissue samples via this EA-IRMS system in order to improve their understanding of marine dietary inputs [2].

[1] Elementar Analysensysteme GmbH, 2017, Technical Note
[2] Higgs et al., 2016, Current Biology 26, 3393–3398

26/04 -10:40 - 10:55

(Finally) a decision on the ^{13}C isotope scale(s)!

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Although from a principal point of view, the representation of isotope scales only needs one reference material, in practice laboratory intercomparisons improve tremendously when a consensus secondary reference material is defined in terms of its ‰ deviation from the other, primary reference material. Finding and defining such a second reference material has always been based on consensus between laboratories participating in the establishment. In this fashion, the $\delta^{2}H$ and $\delta^{18}O$ scales have been defined based on two reference waters: VSMOW and SLAP, and have successfully been used throughout the community for decades. Although the reference waters themselves have been succeeded by new ones (VMWO2 and SLAP2), the VSMOW-SLAP scale remains in use.

For $\delta^{13}C$, the situation was much less clear for a long time. The so-called VPDB scale was represented by just one reference material, the CO_2 evolved from the calcite NBS-19, by a reaction with phosphoric acid under precisely described circumstances. Only in 2006, a second reference material was proposed, the Lithium Carbonate LSVEC, to which a consensus $\delta^{13}C$ value was attributed of -46.6‰ (Coplen et al., 2006). Along with this proposal, $\delta^{13}C$ values for a series of reference materials, both organic and inorganic, were published on this VPDB-LSVEC scale. The proposal was accepted by the two bodies that (formally and in practice) define isotope scales, namely the IAEA stable isotopes consultancy group, and the IUPAC Commission on Isotopic Abundances and Atomic Weights (CIAAW). Many laboratories, mostly using continuous flow IRMS, have since then adopted this VPDB-LSVEC scale. Others, mostly the groups using DI IRMS in the field of atmospheric CO_2 and CH_4, sticked to the one point VPDB scale. Specially for very negative $d^{13}C$ values, there is a significant difference between the scales.

However, in the years 2015-2017 it gradually became clear that the material LSVEC was isotopically unstable, and that it had been attributed a too negative value. Therefore, the CIAAW advised that LSVEC is not to be used anymore. Nevertheless, the VPDB-LSVEC scale continued to be used, represented by the list of materials from 2006 and others established since then (such as in Schimmelmann et al., 2016).

This situation, with two $\delta^{13}C$ scales, was unfavorable. Many CIAAW and IAEA meetings were spent on resolving the issue. Finally, last January 2024, at the IAEA it was decided to announce that both scales will remain in use. The representation of the VPDB scale is now aided by, but not defined by, a set of other calcite reference materials (IAEA 610, 611, 612, Assonov et al). The VPDB-LSVEC scale can be represented by using a variety of reference materials from the Coplen and Schimmelmann papers, and others defined using that scale.

A conversion function between the scales will be made available. Probably, new and existing reference materials will be attributed $\delta^{13}C$ values (plus uncertainties) on both scales.

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Assonov, S. et al. Characterisation of new reference materials IAEA-610, IAEA-611 and IAEA-612 aimed at the VPDB δ13C scale realisation with small uncertainty. Rapid Comm. Mass Spectrometry 35, (2021).

26/04 -10:55 - 11:10

Deciphering methane dynamics in the urban ponds of the city of Brussels using carbon stable isotope ratios

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Candidate young scientist award

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Methane (CH_4) emissions from lakes contribute significantly to atmospheric CH_4 concentrations. However, there is a notable lack of understanding regarding the dynamics that regulate the sources and sinks of CH_4 in freshwater aquatic environments, especially in urban freshwater environments. Methanotrophy is described as a major sink for CH_4 in freshwater and it is important to better understand the mechanisms that regulate it. The dynamics of CH_4 can be studied by examining the stable carbon isotopic ratios. The carbon stable isotopic composition of CH_4 ($\delta^{13}C\text{-}CH_4$) produced by methanogenesis in sediments is typically more negative than the usual values for organic matter because methanogens prefer to produce CH_4 with lighter isotopes. In the water column, CH_4 undergoes methanotrophy, leading to an increase in $\delta^{13}C\text{-}CH_4$ values because methanotrophs preferentially oxidise the lighter CH_4 pool and the heavier isotopes remain in the water. By comparing the $\delta^{13}C\text{-}CH_4$ of methanogenesis with the values measured in the water column, it is possible to quantify the methanotrophy. Four urban ponds in Brussels were monitored 48 times at regular intervals from June 2021 to December 2023 to assess dissolved CH_4 concentrations, $\delta^{13}C\text{-}CH_4$, and other environmental variables. $\delta^{13}C\text{-}CH_4$ was measured by headspace equilibration using a Picarro G2201-i $^{13}C/^{12}C$ CO_2 and CH_4 analyzer. The study, conducted within the Woluwe Basin in Brussels, included two clear ponds dominated by macrophytes and two turbid ponds dominated by phytoplankton. Concentrations of CH_4 and $\delta^{13}C\text{-}CH_4$ in surface waters ranged from 194 to 48380 nmol L-1 and from -64.59 to -1.55 ‰ respectively. CH_4 concentrations was not significantly different between turbid ponds (2719 ± 1668 nmol L-1) and clear ponds (3264 ± 3004 nmol L^{-1}). The $\delta^{13}C\text{-}CH_4$ showed a significant difference between turbid ponds (-36.4 ‰ ± 14.1 ‰) and clear ponds (-55.2 ‰ ± 12.2 ‰), indicating that oxidation was higher in turbid ponds. Our study found that the oxidizing fraction of methane was positively correlated with both total suspended matter (TSM) concentration and the light extinction coefficient in the water column. This suggests that higher TSM concentrations could enhance methanotrophy by mitigating light inhibition and providing a fixation substrate for methanotrophic bacteria in the water column. As a result, turbid ponds exhibit higher methanotrophic activity.

26/04 -11:10 - 11:25

Stable nitrogen and carbon isotope analysis of geoporphyrins in the geological record measured by high-sensitivity EA/IRMS to asses changes in the phototrophic community

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The stable isotopic compositions of carbon and nitrogen in geoporphyrins, a degradation products of chlorophylls, are key to deciphering changes in the marine phototrophic community from the geological record. The isotope analysis of geoporphyrins is, however, complicated by the availability of only miniscule quantities of individual compounds and by the molecular weight and polarity of the molecules that impede compound-specific isotope analysis by conventional GC/C/IRMS. Instead, a modified EA/IRMS system with improved sensitivity enables the isotope analysis with high analytical precision after isolation and purification of target geoporphyrin compounds by reversed- and normal-phase high-performance liquid chromatography. Here, we utilize the stable carbon and nitrogen isotope ratios recorded in C32 Ni deoxophylloerythroetioporphyrin (DPEP) to decipher changes in the phototrophic community across the Early Jurassic Sinemurian–Pliensbachian transition (~195 Ma) in the Lusitanian Basin, Portugal. We test whether biotic changes that appear in concert with redox shifts entail deviations in the isotope fractionation during photosynthetic carbon uptake. This fractionation is crucial in reconstructions of atmospheric carbon dioxide levels that are based on the isotopic signature of the biomarker phytane, also a degradational product of chlorophylls. We combine bulk C and N isotope data, biomarker analysis and trace-metal concentrations to assess coupled isotopic, biotic and paleoenvironmental (redox) changes.

We find that the Lusitanian Basin was shifting from euxinic to anoxic and finally oxygenated conditions across the study interval. A distinct shift from cyanobacterial- to eukaryotic chlorophyll is detected, coinciding with an abrupt shift from hydrographically restricted conditions to a more open, possibly upwelling-type system. The isotopic signature of phytane and resulting carbon dioxide level reconstructions do record the overall background values as recorded in coeval strata of other locations. Resolving carbon dioxide levels across such intervals of distinct ecosystem change more precisely does, however, require adjustments.

26/04 -11:25 - 11:40

Spatio-temporal distribution of nutrient input and its effect on coral reef food web dynamics along the coast of Curaçao

Candidate young scientist award

[1] Nienke C.J. van de Loosdrecht, [1] Petra M. Visser, [1,2] Mark J.A. Vermeij, [1,2] Jasper M. de Goeij

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In coastal waters, water quality is affected by nutrients and other substances of oceanic, terrestrial, and even aerial origin. Tropical coral reefs are residing in oligotrophic (i.e., nutrient-poor) waters, often fringing coasts of islands and therefore directly influenced by relatively small changes in nutrient input from both sea- and land-based sources. However, surprisingly little is known on the actual fluxes of terrestrial versus oceanic inputs and its effect on coral reef benthic communities. To link the terrestrial processes to the coral reef functioning, the spatial and temporal variability in nutrient input was quantified by ^{13}C- and ^{15}N-stable-isotope signatures of different benthic reef communities (i.e., sponges and macroalgae) at 18 reef sites along a depth gradient on the fringing reefs of Curaçao (Caribbean). Enriched ^{15}N-stable-isotope signatures of macroalgae (Dictyota spp.) during the wet season in the shallow reefs that were located in close proximity to high population density, likely indicating anthropogenic nitrogen input through surface runoff. Along the depth gradient, used as a measure of distance from coast, this enrichment in the shallow waters (5-8 m) rapidly disappeared at depth (> 10 m). This seasonal and local enrichment was less pronounced, in the sponges (Scopalina ruetzleri, primary consumer) compared to the macroalgae (Dictyota spp., primary producer). This lead to the question of how nutrients, from different sources, move through the food web and subsequently how the food web dynamics are affected. Therefore we examined the food web using stable isotopic signatures at two of the reef sites, the most depleted and most enriched stable-isotope signatures. The enrichment of $\delta^{13}C$- and $\delta^{15}N$-stable-isotope signatures was species-specific, with the highest enrichment found at base of the food web. Through additional analysis of stable-isotopic signatures of sources (i.e., $DO^{13}C$ and $DO^{15}N$), isotopic models can be applied to examine the contribution of nutrient sources to different trophic levels and improve our understanding of the influence of the use of different nutrient sources on the nutrient fluxes and trophodynamics of tropical coral reefs.

26/04 -11:40 - 11:55

Pathway specific bulk and clumped isotopic signatures of methane production in a marine lake sediment

Candidate young scientist award

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Biogenic methane, the largest contributor of atmospheric methane, can be produced by acetoclastic, hydrogenotrophic and methylotrophic methanogenic pathways depending on the substrates and type of methanogens. Given the significance of biogenic methane emissions in the context of climate change, it is important to elucidate the different pathways involved to precisely model and mitigate methane fluxes.

Stable carbon and hydrogen isotope measurements ($\delta^{13}C$ and δD) and the clumped isotopologues ($\Delta^{13}CDH_3$ and $\Delta^{12}CD_2H_2$) of methane have emerged as an important diagnostic tool, providing insights into methane sources and reaction pathways. So far, most of such studies have been conducted on pure microbial cultures and not in natural environments. Here we investigated, for the first time, the methane production pathways of the microbial community in sediments from a marine coastal system (Lake Grevelingen, the Netherlands). Sediments were incubated with a range of methanogenic substrates (acetate, carbon dioxide-hydrogen, methanol, and methanol-hydrogen), to study the isotopic differences in the methane formed via the corresponding pathways. The bulk and clumped isotopic composition of methane was measured using the Thermo Ultra High-Resolution mass spectrometer at Utrecht University.

Our results show that the four different methanogenic pathways studied produce isotopically distinct methane in the sediments. The 16S rRNA gene analysis of the sediments used in the incubations confirms the presence of microbial communities capable of the conversion of the respective substrates to methane. The results of this study using natural sediments are in general agreement with previous pure culture studies, indicating that clumped isotope analysis can be a useful method to unravel methane production pathways in natural environments.

26/04 -11:55 - 12:10

Aeris Technologies : CO2 Ratiometer

[1] Hans Helsen

[1] Aeris Technologies, 26252 Eden Landing Rd, Hayward, California 94545, US

Aeris Technologies utilizes a Direct absorption in Mid-Infrared in a compact Multipass-cell. Due to the nature of mid-infrared in combination with a compact cell, we generate ppt-ppb level accuracy typically for most gases. Recent developments allowed us to develop a lower cost but robust and compact, temperature stabilized ratiometer to measure $^{13}C\text{-}CO_2$, $^{17}O\text{-}CO_2$ and $^{18}O\text{-}CO_2$ isotopes at a very sensitive level effectively.

26/04 -13:30 - 13:45

Connecting two different isotope worlds through pyrolysis.

[1] Anita Th Aerts-Bijma, [1] Dipayan Paul, [1] Albert C. van Buuren, [1] Vivian R. Kroon, [1] Harro A. J. Meijer

[1] Centre of Isotope Research, University of Groningen

Geochemists express ^{18}O compositions of carbonate minerals on the $\delta^{18}O$ VPDB scale, based on the production of CO_2 from calcite reference materials, under well-specified conditions. On the other hand, $\delta^{18}O$ values of waters, oxides and silicates are normally expressed on the $\delta^{18}O$ VSMOW scale, based on the well-controlled establishment of CO_2-water equilibrium. The relationship between these two separate $\delta^{18}O$ scales, or rather the CO_2 that evolves from them, is poorly defined. Through isotopic measurements of the CO_2 gas, either from the reaction or the equilibration process, both $\delta^{18}O$ scales are linked to each other. However, as both processes involve isotopic fractionation, this linkage is rather indirect. The figure illustrates the situation. From a metrological point of view this indirect comparison is therefore not preferable. Pyrolysis of the primary reference materials of both $\delta^{18}O$ scales will allow us to link the materials, and thus these two scales, directly. The idea seems straightforward, but many challenging obstacles appear on the road.

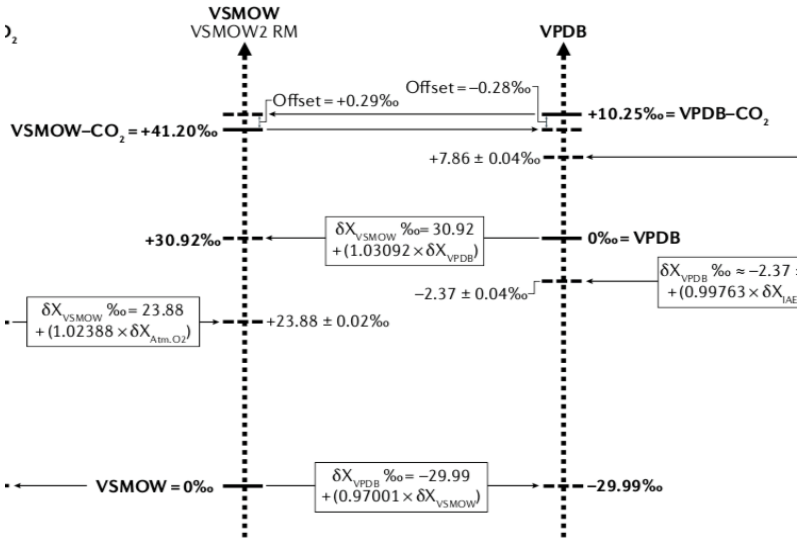

Figure. The $\delta^{18}O$ isotope scales based on water-CO_2 equilibration (VSMOW, left) and based on the calcite-phosphoric acid reaction (VPDB, right). Of all the numbers indicated, the two "0 ‰" are per definition, the fractionations VSMOW to VSMOW-CO_2 and VPDB to VPDB-CO_2 (41.20‰ and 10.25‰) have been measured long ago. The offsets can in principle be directly measured. Finally, the numbers -29.99‰ for VPDB on the VSMOW scale, and inversely the +30.92‰ of VSMOW on the VPDB scale, have been merely computed from the other numbers. (Picture from Hillaire-Marcel et al., "A stable Isotope Toolbox...", Nature Reviews Earth & Environment 2021).

26/04 -13:45 - 14:00

Integrating stable isotopes and dietary data to uncover trophic interactions in North Pacific pelagic food webs

[1] Genyffer C. Troina, [2] Philip Riekenberg, [2] Marcel Van Der Meer, [1,3,4] Evgeny Pakhomov, [1,3,4] Brian P.V. Hunt

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Knowledge of how sympatric species use available resources helps to identify interspecific competition and its potential effects when food is limited or competitor abundance increases. This is particularly relevant under current scenarios of climate changes and shifting species distributions. Resolving competitive interactions requires knowledge of species' trophic level and prey consumption. The 2022 International Year of the Salmon (IYS) Pan-Pacific expeditions provided a unique opportunity to obtain samples of meso-predator species in the eastern North Pacific Ocean, including salmon and other nektonic and micronekton species (e.g., squids, myctophids). Here, we combine dietary analysis from stomach content data, bulk-tissue, and compound-specific stable isotopes to empirically resolve interspecific trophic interactions among North Pacific meso-predators. By combining these different methods, we aim to 1) describe the feeding habits of North Pacific meso-predators (Pacific salmon, myctophids, cephalopods) in the high seas; 2) assess whether there is interspecific competition for food; and 3) assess if these competitions vary spatially and depending on local oceanographic conditions. Our results will help the development of food web models to investigate how interspecific interactions may be affected by climate-driven shifts in prey availability and species distribution

26/04 -14:00 - 14:15

Compound specific chlorine isotope analysis (CSIA-Cl) using low- and high-resolution GC-EI-MS: Method development and selected applications for chemical warfare agent markers

[1] Adriaan Marais

[1] Organisation for the Prohibition of Chemical Weapons (OPCW)

Introduction: Chlorine gas, which has been used frequently as chemical warfare agent in past and recent armed conflicts, does not have a large body of research data for attribution purposes. Limited direct detection options in the environment exist due to rapid reactivity, decomposition and dissipation of chlorine, which is further complicated due to chlorinated end-products being fairly ubiquitous and possibly originating from common chlorinating agents such as bleach. Compound specific isotope analysis (CSIA) may address some of these limitations by accurate measurement of small differences in the abundances of isotopes. Due to the high natural abundance of chlorine stable isotopes ($^{35}Cl/^{37}Cl$), CSIA-Cl presents an attractive option for organochlorine isotope studies due to routine gas chromatography (GC) instrumentation coupled to either low-resolution quadrupole mass spectrometry (qMS) or high-resolution mass spectrometry (HRMS) platforms can be utilised, where dedicated Isotope Ratio Mass Spectrometry (IRMS) instruments are not available or configured for organochlorine measurement. Some intrinsic limitations of GC-EI-MS need to be addressed before and during method development for successful measurements. GC-EI-MS methods for CSIA-Cl were developed and validated with simulated scenarios for source relation effects in organochlorine marker formation related to chlorine gas to indicate reaction/kinetic and source related differences.

Materials and Methods: Phenol was reacted with commercial bleach and laboratory NaOCl under various pH controlled aqueous conditions, as well as chlorine gas under native conditions, to yield 2-chlorophenol (2-CP), 4-chlorophenol (4-CP), 2,4-dichlorophenol (2,4-DCP), 2,6-dichlorophenol (2,6-DCP) and 2,4,6-trichlorophenol (2,4,6-TCP). Subsequent $^{37}Cl/^{35}Cl$ ratios ($\delta^{37}Cl$) were measured by qMS and HRMS, expressed relative to $\delta^{37}Cl$ values of commercially obtained standards.

Results: Environmental organochlorine markers originating from chlorine gas exposure may be differentiated from bleach as chlorinating agent based on $\delta^{37}Cl$. Future work will expand on this application through isotopic measurement in different matrices (e.g.concrete, human hair, plant material), method transfer and interlaboratory evaluation for robustness, and further exploring the viability of organochlorine isotope ratio measurements on different instrument

26/04 -14:15 - 14:30

Combining ^{13}C, ^{15}N, and ^{2}H to measure feeding and metabolic activity of marine, shallow-water sponges – a pilot study

[1] Tanja Stratmann, [2] Marcel T.J. van der Meer

[1] NIOZ - Royal Netherlands Institute for Sea Research, Department of Ocean Systems

[2] NIOZ - Royal Netherlands Institute for Sea Research, Department of Marine Microbiology & Biogeochemistry

In this study, we performed a triple (^{13}C, ^{15}N, ^{2}H) labelled ex-situ pulse-chase experiment with shallow-water sponges (Halichondria panicea) that were incubated in 1% $^{2}H_2O$ for 12h and fed with ^{13}C and ^{15}N enriched bacteria substrate. We determined ^{13}C, ^{15}N, and ^{2}H uptake in sponge bulk tissue and ^{13}C and ^{2}H in phospholipid-derived fatty acids in the sponges. Furthermore, we measured fluxes of ^{13}C-DIC and inorganic nutrients over time and recorded oxygen consumption during the closed incubations. Dead sponges preserved in 4% formaldehyde were incubated in 1% $^{2}H_2O$ and served as control for ^{2}H-isotope exchange in active tissue.

26/04 -14:30 - 14:45

Use of principal components analysis to study complex aquifers with scarce data

[1] Azzedine Hani, [1] Samir Hani, [1] Nabil Boughrira, [2] Noureddine Guezgouz

[1] Badji Mokhtar Annaba University, Algeria
[2] Souk Ahras University, Algeria

A methodology was developed and applied to the Tindouf (southwestern Algeria) in order to understand better the hydrogeology of the complex aquifers despite the scarcity of the available data. Graphical representation of deuterium versus oxygen-18 and principal components analysis (PCA) are statistical techniques used to combine various disciplinary data in order to identify chemical and isotopic groups, which are in turn used to define groundwater flow paths. The results of this study agree with the generally accepted hydrogeological conceptual model of the aquifers. In addition, we obtained new results using the PCA method: (1) a description of the complex flow system by grouping various qualitative and quantitative parameters; (2) the definition and characterization of the main groundwater flow paths from their sources to the discharge zones. These flow paths are defined by their water categories, which are represented by salinity and origin of groundwater. This approach is useful for analysing aquifers despite the lack of important database and may be helpful for studying other complex groundwater basins.

26/04 -14:45 - 15:00

The next generation platform for LC-IRMS analysis

[1] Mario Tuthorn, [1] Qiong Li, [1] Daniel Felsmann, [1] Nils Stöbener, [1] Kasun Gayantha

[1] Thermo Fisher Scientific

The new Thermo Scientific™ LC IsoLink™ II IRMS System is designed to streamline LC-IRMS analysis and offer a reliable, robust tool for compound specific isotope analysis of polar compounds. The next generation LC-IRMS platform features unique, patented technology including the backflush function that simplifies routine maintenance, minimizing flow path blockage and significantly maximizing system uptime and productivity.

The Thermo Scientific™ LC IsoLink™ II Conversion Interface is now fully integrated in the innovative Vanquish™ LC platform. The modular pull-out design is saving space and allows easy accessibility of all system parts, including a new cartridge-based oxidation reactor, without de-stacking for routine maintenance. Full LC IsoLink II IRMS System operation is driven by the Thermo Scientific™ Qtegra™ ISDS Software that features complete integration with Chromeleon™ Chromatography Data System Software capabilities. Single software platform setup simplifies workflows, saves time and minimizes errors.

To assess the long-term stability, data quality and system robustness, the LC IsoLink II IRMS System has been operated in analytical labs for over 2 years, allowing thorough system evaluation and optimization. Here we present exhaustive data set to demonstrate excellent precision and reproducibility of the new system and provide for an outlook of diverse LC-IRMS applications.

Abstracts
Poster presentations

P1 High precision stable isotope analysis of carbonate and water samples for paleoclimate applications using the Elementar iso DUAL INLET

[1] Calum Preece, [1] Mike Seed , [1] Sam Barker, [1] Will Price, [1] Rob Berstan

[1] Elementar UK Ltd

Paleoclimate research is important for understanding past, current and future climate, providing the data needed to model and predict current and future climate change scenarios. Stable isotope analysis provides an essential tool for gathering past climate information from natural archives such as waters including ice-cores, ground waters, and biological waters; and carbonate materials such as foraminifera and other fossilized carbonates. Due to the often limited and small sample sizes available for stable isotope analysis it is vital that highly precise and accurate analysis can be carried out on the smallest of sample sizes.

Dual inlet technology remains the most precise, accurate and sensitive technique for pure gas, carbonate and water analysis. The Elementar iso DUAL INLET is a valuable tool for paleoclimate applications, enabling the analysis of pure gas samples within an incredibly compact footprint via our powerful lyticOS software suite. The 14-ultra low dead volume valves with bodies machined from a single block of high purity stainless steel and dedicated turbomolecular pump for the changeover valve guarantees zero residual memory effects between reference and sample gas.

The iso DUAL inlet can be optionally enhanced for the automated analysis of carbonate and water samples. With the iso AQUA PREP enhancement, up to 180 water samples can be analysed achieving $\delta^{18}O$ precision better than 0.05‰ (1σ, n=10) and δD precision better than 1‰ (1σ, n=10), for any environmental water sample. The iso CARB PREP enhancement enables automated analysis of up to ^{180} micro-fossil samples for ^{13}C and ^{18}O down to 20µg sample size. For the highest productivity, both carbonate and water analysis can be performed with the iso MULTI PREP enhancement with switching between modes needing simply a change of needle. The IRMS collector configuration can also be upgraded for “clumped isotope analysis” of carbonate materials.

We will highlight the performance of the iso DUAL INLET with carbonate and water functionality across a range of sample types for paleoclimate applications, supporting researchers building a detailed understanding of the past to better inform policy makers for the future

P2 Using stable isotopes ratios to decipher changes in benthic food webs characteristics along the rapidly warming West Antarctic Peninsula

[1,2] Martin DOGNIEZ, [3] Camille MOREAU, [3] Léa KATZ, [3] Bruno DANIS, [4] Axelle BRUSSELMAN, [4] Bruno DELILLE, [5] Loïc N. MICHEL, [2] Isa SCHÖN, [1] Gilles LEPOINT

[1] Laboratory of Trophic and Isotope Ecology , R.U. FOCUS, Université de Liège (ULiège)
[2] Freshwater Biology Unit, OD Nature, Institut Royal des Sciences Naturelles de Belgique (IRSNB)
[3] Marine Biology Laboratory, Université Libre de Belgique (ULB)
[4] Chemical Oceanography Unit, R.U. FOCUS, Université de Liège (ULiège)
[5] Animal Systematics & Diversity Laboratory, R.U. FOCUS, Université de Liège (ULiège)

The Western Antarctic Peninsula (WAP) is one of the most rapidly warming region of the marine realm. In this context, it is crucial to improve our understanding of the consequences of the upcoming changes in the biotic and abiotic environments on ecosystem functioning. Here, we focused on food web structure of shallow-water benthic communities. In February 2023, the first TANGO expedition, using a sailboat, brought nine scientists from the Belgian Universities of Liège, Ghent and Brussels to WAP. To assess the importance of environmental changes on local food web dynamics, five benthic communities were investigated along the WAP, with a focus on macroalgae forests (n=2 sites) and sedimentary soft bottoms (n=3 sites). These stations were split between two contrasted environments, Dodman Island (Grandidier Channel, 66°S) & Blaiklock Island (Bigourdan Fjord, 67.5°S). More precisely, these two locations differed markedly in terms of sea-ice coverage throughout the year, and in terms of general hydrography (small island exposed to the Grandidier channel's currents VS fjord system surrounded by active glaciers).

In each station, basal food sources (i.e. sediment-associated POM, water-column POM, macroalgae, microphytobenthos) as well as benthic invertebrates (n-individuals = 435, n-morphospecies = 64) were sampled quantitatively to assess their biomass in-situ, and to gather biological material for stable isotope analysis (SIA). Using stable isotope ratios of carbon, nitrogen and sulphur, we aim to formally represent the different communities in the isotopic space, and to compare their topologies along the environmental gradient studied. These representations will then be used to test whether differences in food web structure echo the general characteristics of the communities, such as the higher organism biomass measured in the macroalgal forests, which are also more diverse in terms of number of sampled species. In the near future, these preliminary data will be supplemented by samples collected around the Gerlache Strait (n-stations=6, 64.3°S – 65°S) during the TANGO 2024 campaign. By broadening the environmental conditions studied, this should enable us to better understand the evolution of trophic dynamics in these shallow Antarctic benthic ecosystems subject to rapid environmental change.

P3 Nitrate source apportionment in river Kagera, Lake Victoria catchment using isotopic techniques

[1,4] Catherine Mathenge, [2] Benjamin Nyilitya, [1] Stephen Mureithi, [3] Cargele Masso, [4] Pascal Boeckx

[1] Department of Land Resource Management and Agricultural Technology, University of Nairobi, Kenya
[2] National Water Resources Department, Ministry of Water & Sanitation and Irrigation, Kenya
[3] One CGIAR, International Livestock Research Institute, Nairobi, Kenya
[4] Isotope Bioscience Laboratory - ISOFYS, Department of Green Chemistry and Technology, Faculty of Bioscience Engineering, Ghent University

Nitrate contamination poses a significant environmental threat globally, impacting water quality in both surface and groundwater systems. This creates problems for aquatic ecosystems and poses risks to human health. Eutrophication, a common result of nitrate contamination, is characterized by the rapid growth of aquatic vegetation that reduces water quality and ecosystem services. Despite its considerable impact, there remains a lack of comprehensive understanding of nitrate sources and discharge patterns, especially in the Lake Victoria basin of East Africa. To address this gap, a study was conducted in the River Kagera basin, responsible for 33 % of Lake Victoria's inflow. The study utilized $\delta^{15}N$ and $\delta^{18}O$ isotope analysis in nitrate, hydrochemistry, and a Bayesian mixing model (MixSIAR) to identify and quantify nitrate sources. Over April to December 2022, spatial monitoring data were collected across three seasons: long rains, dry season, and short rains, in areas with diverse land uses including mixed farming, sugarcane production, urban and industrial zones, and forested areas. Isotopic analysis was performed using the bacterial denitrification process, with statistical analysis conducted using R software on both physiochemical and isotopic parameters. Nitrate isotopic data from water and potential sources were integrated into a Bayesian mixing model to determine the relative contributions of various nitrate sources. Notable spatial variations were observed at sampling sites with concentrations ranging from 0.004 to 3.31 mg N L^{-1}. Spatially and temporally $\delta^{15}N\text{-}NO_3$- values ranged from +6.0 to +10.2‰, whereas $\delta^{18}O\text{-}NO_3$- displayed significant spatial differences with mean ranges from -1 to +7‰. MixSIAR analysis revealed important contributions from manure and sewage sources. These study results offer valuable insights into the origin of nitrate in the River Kagera, enabling informed policy decisions to enhance nitrogen management strategies in riparian East Africa. Addressing nitrate contamination is crucial to safeguarding the region's water resources and ecosystems.

P4 Innovations in Stable Isotope Analysis: Ensuring the Authenticity of Fruit-Based Products

[1] Botoran Oana Romina, [1] Costinel Diana, [1] Mathiu Teodora, [1] Miricioiu Marius Gheorghe, [1] Ionete Roxana Elena

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Food authenticity is an ever-evolving multi-disciplinary field, increasingly reliant on sophisticated analytical methods for rapid and reliable verification and expansion of knowledge in plant and animal metabolism. Central to this field is the stable isotope ratio analysis of key bio-elements (hydrogen, carbon, nitrogen, oxygen, and sulphur), which has become an essential and effective tool in distinguishing between authentic food products and fraudulent ones. This study focuses on exploring how different production practices, both legitimate and illicit, impact the $\delta^{18}O$, $\delta^{13}C$, and D/H isotopic values in fruit-based products. By employing stable isotopes as natural markers for the origin of food or beverages, we leverage their unique isotopic ratio signatures, which are indicative of the processes they undergo, such as photosynthesis, environmental changes (like evaporation), or human interventions (such as adulteration). We specifically evaluated the impact of adding various sugar syrups (from corn, cane, and beet) at different concentrations (0.1-16%) to apple juice, aiming to identify the isotopic adulteration threshold for such mixtures. This involved analyzing the isotopic profiles of experimental samples, measuring concentrations of ^{13}C, ^{18}O, and ^{2}H before and after fermentation. Our findings reveal that apple juices with sugar syrup additions ranging from 2% to 30% can be distinctly identified. However, detecting adulteration becomes more challenging at extremely low syrup concentrations (0.1%, 0.5%, 1%), necessitating further analysis, possibly including compositional profiling. Additionally, the study developed simpler models for mixture differentiation. Post-fermentation, ^{18}O demonstrated a higher correlation coefficient, whereas pre-fermentation measurements of ^{2}H showed better correlation. These results underscore the potential impact of any level of adulteration on a product's isotopic composition, a critical factor in determining product authenticity, given known original raw materials. This research contributes to developing effective linear mixture models, supporting food quality assurance and public health protection.

P5 Linking CO_2-in-air and pure CO_2 isotope scales with a closed loop experiment

[1] Sander Hoekzema, [1] Pharahilda M. Steur, [1] Dipayan Paul, [1] Hubertus A. Scheeren, [1] Harro A. J. Meijer

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Stable isotope composition measurements of atmospheric CO_2 can now be conducted directly on dry air samples using laser-based techniques. The conventional IRMS method requires extraction of the CO_2 from the air, as pure CO_2 gas is required. Linking isotope measurements of CO_2-in-air to a primary reference scale (VPDB or VSMOW) is complex, but a direct link is required to ensure compatibility of results between labs, and/or derived from both measurement methods. The Jena Reference Air Set ($JRAS^{06}$), maintained by the Max Planck Institute for Biogeochemistry at Jena, is at this moment the best way to link isotope measurements of CO_2-in-air to the VPDB scale. It is, however, limited to the $\delta^{13}C$ and $\delta^{18}O$ values, while laser-based systems also provide the opportunity to measure the $\delta^{17}O$ of atmospheric CO_2. Also, $\delta^{18}O$ values of CO_2 derived from calcites, the primary reference material of the VPDB scale, produced at different labs continue to show discrepancies. Linking our CO_2-in-air isotope measurements to the $JRAS^{06}$ scale gives us therefore a direct link to the VPDB scale as maintained in Jena, but does not give us a direct link to the VPDB scale as maintained at our own lab.

We present first attempts to directly link the isotope scale of our pure CO_2 to our CO_2-in-air isotope scale by doing a closed loop experiment. In a closed loop experiment we aim for making CO_2-in-air samples from a pure CO_2 material by dilution with a matrix gas and successively extract the CO_2 from the dilution without altering the isotope composition of the CO_2. This requires extensive testing of every step in this process, making sure no fractionation or contamination occurs. As we have both Dual Inlet IRMS and laser-based instrumentation available, we are in the unique position to couple the results of both techniques, and check the isotopic composition both at the pure CO_2, and the CO_2-in-air stage.

P6 Thermo Scientific™ Orbitrap Exploris™ Isotope Solutions: tools for comprehensive characterization of polyisotopocules

[1] Mario Tuthorn, [1] Issaku E. Kohl, [1] Nils Kuhlbusch, [1] Dieter Juchelka, [1] Andreas Hilkert

[1] Thermo Fisher Scientific

Orbitrap Isotope Ratio MS, both electrospray and gas source, is becoming increasingly accepted in the community as a unique and complimentary approach to classical IRMS techniques for measuring relative abundances of isotopically substituted species. Electrospray ionization offers the specific advantage of performing “soft” ionization, which produces intact molecular ions and provides unique insight into the molecular anatomy of polar compounds in aqueous solutions. In contrast to classical approaches, no chemical manipulation or gas conversion reactions are required and as a result, no intramolecular information is lost from sample to analysis. Similar to classical approaches, the principles of identical treatment and rigorous sample standard bracketing have been retained and are the key to achieving precise and accurate relative abundance measurements.

Currently, this approach is being applied to oxyanions and small organic molecules. Utilizing the HRAM capabilities of the Thermo Scientific™ Orbitrap Exploris™ MS platform, resolving singly and doubly substituted polyisotopocule molecular ions is achieved in routine measurements. Methods have been developed for nitrate ($\delta^{15}N$,$\delta^{18}O$, $\delta^{17}O$, $\Delta^{17}O$, $\Delta^{15}N^{18}O$, $\Delta^{15}N^{17}O$, $\Delta^{18}O^{18}O$), sulfate ($\delta^{33}S$, $\delta^{34}S$, $\delta^{36}S$, $\delta^{17}O$,$\delta^{18}O$, $\Delta^{17}O$, $\Delta^{33}S$, $\Delta^{36}S$, $\Delta^{34}S^{17}O$, $\Delta^{33}S^{18}O$, $\Delta^{34}S^{18}O$, $\Delta^{17}O^{18}O$, $\Delta^{18}O^{18}O$), phosphate ($\delta^{18}O$, $\delta^{17}O$, $\Delta^{17}O$, $\Delta^{17}O^{18}O$, $\Delta^{18}O^{18}O$), which achieve sub-‰ precision for isotope ratios of singly substituted isotopologues. We are actively developing methods for small organic molecules such as MSA, caffeine, vanillin and amino acids. Here we will present progress in method development including sample introduction, methods and measurement approaches.

P7 Stable carbon isotope analysis of Imidacloprid with simultaneous high resolution mass spectrometry: method development and applications

Candidate young scientist award

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[1] Instrumental Analytical Chemistry, University of Duisburg-Essen, Germany

Compound-specific isotope analysis (CSIA) enables determination of stable carbon isotope ratios of individual compounds in complex samples. While numerous volatile organic analytes are amenable to investigation, the development of methodologies for the analysis of polar and thermally labile compounds remains challenging. Imidacloprid is a neonicotinoid insecticide and commonly used for crop protection and veterinary flea control. It is also a consistently identified environmental contaminant in soils, groundwater, and surface waters around the world. With a suitable CSIA method environmental degradation processes such as hydrolysis and photolysis can be studied by determining possible process-specific isotope fractionation factors. Another application would be the determination of an isotopic fingerprint of commercial products manufactured by different producers, synthesis routes or raw materials.

This study introduces a liquid-chromatography isotope ratio mass spectrometry (LC-IRMS) method for analyzing the stable carbon isotope ratio of imidacloprid in complex samples containing transformation products or other matrix compounds. It is based on a temperature stable reversed phase column and uses pure water as an eluent. A recently introduced post-column splitter for a simultaneous analysis of analytes by high-resolution Orbitrap mass spectrometry could be employed. Structural information that gets lost by the combustion of analytes to CO_2 in the LC-IRMS oxidation interface can be retrieved by high resolution mass spectrometry. Unknown peaks in the chromatogram can be further investigated by means of their mass to charge ratio and fragmentation data from MS^n spectra. Another advantage of this coupling is an improved identification of coeluting species that possibly alter isotopic data. The applicability of the newly developed method is demonstrated using hydrolytically and photolytically degraded imidacloprid as an example. Furthermore, the stable carbon isotope ratio of imidacloprid in two commercial veterinary flea control products was successfully analyzed using the developed method.

P8 Holocene variability of the Southern Hemisphere Westerly

Winds on Amsterdam Island (37°S) from peat records

Candidate young scientist award

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[3] Department of Marine Organic Biogeochemistry, NIOZ Royal Netherlands Institute for Sea Research, Den Burg, The Netherlands.
[4] Laboratoire des Sciences du Climat et de l'Environnement (LSCE), Gif-sur-Yvette, France.

This project aims to reconstruct the Holocene changes in intensification and/or latitudinal shifts of the Southern Hemisphere Westerly winds (SHW) combining peat archives on a latitudinal transect on a series of sub-Antarctic islands: Kerguelen Islands (49°S), the Crozet archipelago (46°S), and Amsterdam Island (37°S). We will assess past SHW dynamics through wind intensity, humidity/precipitation and temperature reconstructions. Here we focus on the effective precipitation (precipitation minus evaporation) reconstruction of Amsterdam Island, located at the current northern edge of the SHW wind belt. We present preliminary result of two bog surface wetness (BSW) proxies: (i) stable hydrogen isotope analysis of plant derived n-alkanes (δ^2H of n-alkanes) and (ii) plant macrofossils analysis along with a temperature record based on the relative abundance of branched glycerol dialkyl glycerol tetraethers (brGDGTs), bacterial membrane lipids.

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P9 Exploring complexity in sediment fingerprinting: harnessing the combined potential of stable isotopes and environmental DNA for enhanced insights

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Soil erosion, along with the export of fine particles and associated chemicals, presents substantial challenges, resulting in the loss of soil nutrients and compromised water quality. In this context, sediment fingerprinting is extensively employed to clarify the influence of human activities and climate change on sediment export, achieved through the assessment of sediment provenance in water bodies.

As a response to these challenges, sediment fingerprinting has gained widespread acceptance, driven by advancements in analytical techniques that integrate various tracers, including elemental composition and Compound-Specific Stable Isotopes (CSSIs), to enhance source discrimination. CSSIs are associated with vegetation covers, while elemental composition is related to sources with different mineral compositions. However, obtaining more detailed information about specific crops or forests necessitates additional data.

In this study, we explore the potential of environmental DNA (eDNA) to complement CSSI tracers, providing insights into plant species and representing a possible next-generation fingerprint. We conduct analyses on CSSI and eDNA in a small core collected at the outlet of the Sarrón catchment (115 km^2, Central Spanish Pyrenees), which drains into the southeastern part of the Joaquin Costa reservoir. Additionally, composite samples were collected in the Sarrón catchment, encompassing the three main land covers—cropland, forest, and scrubland—as well as two geomorphic elements: highly disturbed areas and channel banks.

The selection of the study area was driven by its distinctive behaviour within the larger river catchment flowing into the reservoir, coupled with its lithological homogeneity, characterised by sandstones, claystones, and conglomerates of the Graus Formation. This specific composition aids in better identifying the contributing factors to variations. The primary objective of this approach is to offer a comprehensive understanding of sediment sources within the catchment. The catchment features seasonal streams and a history of land use changes, transitioning from rangelands to croplands for increased agricultural production and later reverting to natural revegetation due to mid-^{20}th-century land abandonment. Effective source discrimination in such intricate landscapes is challenging, emphasising the need for diverse tracer integration.

In light of these challenges and thanks to the growing availability and quality of vegetation maps and eDNA reference libraries, the integration of CSSI sediment source fingerprinting with eDNA information could emerge as a valuable method for identifying soil erosion hotspots. This integration would assist stakeholders in prioritizing areas or crops that require targeted prevention measures.

P10 Time-space evolution of synkinematic clay minerals in the Carboneras fault zone traced by X-ray diffraction, H and O isotopes, and K-Ar dating

Candidate young scientist award

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Multiple occurrences of fluid-assisted brittle deformation events typically lead to an increase of the structural complexity of the fault zones, with the development of various Brittle Structural Facies (BSF) formed at different times, depths, temperatures, and with complex cross-cutting relations. As a result, BSFs are characterized by an uneven distribution of detrital, syn-kinematic, and post-kinematic minerals, whose study offers valuable insights into their temperature conditions of (de)formation, and the origin of fluids circulating in the fault zone. We combined X-ray diffraction (XRD) analyses of whole-rock, illite-polytype determinations of several grain-size fractions (6-10 µm, 2-6 µm, 0.4-2 µm, 0.1-0.4 µm, and <0.1 µm), H and O isotopes, and K-Ar dating of synkinematic illite from 8 fault gouges from three outcrops of the Carboneras strike-slip fault zone (Betic Cordilleras, SE Spain). Mineralogical and geochemical data enabled us to reconstruct the distributions of synkinematic clay minerals within the BSFs, constrain their formation temperature, and unravel the origin of fluids involved during faulting. Geochronological data allowed us to constrain the time-progressive development of synkinematic illite during fault slip. XRD results document a syn-kinematic assemblage formed at different temperature and depths of deformation mainly composed of mixed layers chlorite-smectite and illite-smectite (1Md polytype), and occasionally 2M1 illite. Whole-rock and grain size fractions display variable H and O signatures, depending on the synkinematic/detrital minerals content ratio within different grain-size fractions. The clear variation in isotopic signature between the coarsest (where inherited minerals prevail) and finest fraction (where synkinematic clay minerals are dominant) testifying for the different origin of the mineralizing fluids. Eventually, K-Ar dating of synkinematic illite crystals indicated that they formed as result of distinct thermotectonic events, during the Oligocene, middle-late Miocene, and Pliocene-Pleistocene. In conclusion, the data portray a complex history of multiple brittle thermotectonic events occurring under different temperature conditions and depths, where parental fluids infiltrated into the fault zone and interacted with host rocks at various degree.

P11 Geochemial analysis of feedstock samples to improve supply chain transparency for biodiesel production

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Biodiesel and renewable diesel are renewable fuels and an essential element of the energy mix to help transition the heavy-duty transport sector to net-zero CO_2 emissions. They are compatible with the existing distribution infrastructure and can be conveniently blended with fossil fuels to run unmodified compression ignition engines, making them a practical solution for reducing emissions today. Bio- and renewable diesel can be produced via transesterification or hydrocracking and hydrogenation, respectively, of a va y of feedstocks including used cooking oils, tallow, and vegetable oils. To ensure sustainable sourcing of such feedstocks, it is imperative to know their biological and geographical origin. At present, this origin is only recorded through audits and certification, which are more sensitive to fraud.

Verifying the origin of produce by means of its molecular composition as well as the isotopic composition of its molecular constituents is a method developed, and at present actively deployed, in the food industry, e.g., for honey, olive oil, wine etc. (e.g., Laursen et al. 2016). This study seeks to modify such methods for use with biofuel feedstocks by answering outstanding questions such as (i) defining the best analytical approach (clean-up procedure, target compounds, derivatization methods), (ii) the effect of heating of vegetable oil on its molecular and isotopic composition, and (iii) determining if hydrogen isotopes (using isoscapes) are feasible approaches to reconstruct the geographical origin of these feedstocks. First results will be presented from the analysis of a suite of ca 30 feedstock samples obtained from different biological sources and different geographies. The paper will provide initial answers to the questions posed above and will discuss the differences and difficulties encountered when compared to analysis of fresh produce in food forensics. When successful, our results will provide the much-needed hard data to support claims of origin of feedstocks used for biofuel production and as such help deliver renewable energy in a sustainable way.

Laursen, K.H., Bontempo, L., Camin, F., Rossman, A. 2016. Advances in Isotopic Analysis for Food Authenticity Testing. In: Advances in Food Authenticity Testing. Editor: G. Downey, Elsevier – Woodhead Publishing, ISBN 9780081002209, p. 227-252.

P12 Life in the cradle of Civilization: preliminary results from an isotopic study on human and animal remains to explore mobility at Abu Tbeirah (Iraq)

Candidate young scientist award

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Abu Tbeirah is an Early Dynastic Sumerian site dated to the second half of III Millennium BC, located about 15 Km NE of Ur (Nasiriya, Dhi Qar province, Southern Iraq).

As suggested by cuneiform tablets, Southern Mesopotamia was characterised by an exchange of goods both within and outside the alluvial plain. The archaeological evidence suggests that mobility was not only a lower-class prerogative but it also involved higher-class individuals.

Since 2012, Abu Tbeirah has been subject to excavation by an Iraqi-Italian archaeological mission, the first foreign mission allowed to enter Iraq after the Gulf War. The soil in this region exhibits high salinity, and archaeological layers feature bituminous surfacings, typical of the Fertile Crescent. For these reasons, bones are prone to taphonomical phenomena bringing the alteration of collagen. Enamel, being substantially less prone to diagenesis, emerges as a reliable source for isotopic analysis.

Despite indirect evidence depicting human mobility in Southern Mesopotamia, systematic direct investigations, such as isotope analysis, have been limited. Only one study applied $^{87}Sr/^{86}Sr$ isotope to analyse two individuals from the royal cemetery of Ur but with low resolution, another study employing $^{87}Sr/^{86}Sr$ and $^{18}O/^{16}O$ (δ ‰) focused on cattle from the same cemetery.

In light of these challenges, we employ a multi-isotopic approach, including isotopic proxies such as $^{18}O/^{16}O$ (δ ‰) and $^{87}Sr/^{86}Sr$ to investigate potential non locality phenomena and different types of herd and animal management using tooth enamel. These represent the first multi-isotopic approach inquiring about human mobility in an archaeological site from southern Mesopotamia. Results show a great homogeneity in the values of humans and a greater variability in animal data.

P13 Fluctuations in the marine nitrogen cycle of the Benguela Upwelling System over the last 140 ka

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Reconstructing marine nitrogen (N) cycling through palaeoceanographic proxies provides important insights into regional primary productivity, the ocean redox state, and ocean-atmosphere dynamics. Determining past fluctuations in the importing and removal of bioavailable nitrogen (N) has traditionally involved the nitrogen isotope ratio ($^{15}N/^{14}N = \delta^{15}N$) of bulk sediment. Thanks to recent analytical advances, we can measure organic N bound within the calcite tests of foraminifera. Formed during an organism's lifetime, the isotopic composition of foraminifer-bound (FB) $\delta^{15}N$ is retained upon deposition for up to millions of years (Ren et al., 2009). FB-$\delta^{15}N$ can therefore be considered to be a reflection of the source nitrate, as well as any additional N-cycling processes (e.g., nitrogen fixation, denitrification), all of which discriminate against ^{14}N by varying degrees (Ren et al., 2009; Smart et al., 2018, 2020). However, disentangling the contributions of each N-cycling process to FB-$\delta^{15}N$ requires detailed knowledge about modern local biogeochemical cycling, as well as an understanding of species-specific preferences (e.g., habitat, diet, and photosymbiosis). This is especially pertinent in the Benguela Upwelling System, a region which hosts denitrification, anammox, and potentially nitrogen fixation (Kuypers et al., 2005; Sohm et al., 2011; Flynn et al., 2020). One valuable tool for assessing the effect of anammox on FB-$\delta^{15}N$ is the novel BHT-x lipid biomarker. The ratio of BHT-x (a stereoisomer of bacteriohopanetetrol uniquely synthesized by anaerobic ammonium oxidising (anammox) bacteria) relative to total bacteriohopanetetrol (ubiquitously produced by bacteria), can potentially be used to infer past changes in water column oxygenation (Rush et al., 2014, 2019, Schwartz-Narbonne et al., 2020; Van Kemenade et al., 2022).

Our project is focused on using these two palaeoproxy methods to reconstruct late Quaternary (0 – 140,000 years BP) biogeochemical variability within the oxygen minimum zone located close to the Walvis Ridge in the northern Benguela Upwelling System (BUS). In addition to being one of the most productive regions in the global ocean, the BUS is sensitive to larger-scale ocean and atmospheric variability, and changes observed in our sedimentary record therefore have the potential to reflect hemispheric-scale climate changes

P14 Innovations in Stable Isotope Analysis: Ensuring the Authenticity of Fruit-Based Products

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Food authenticity is an ever-evolving multi-disciplinary field, increasingly reliant on sophisticated analytical methods for rapid and reliable verification and expansion of knowledge in plant and animal metabolism. Central to this field is the stable isotope ratio analysis of key bio-elements (hydrogen, carbon, nitrogen, oxygen, and sulphur), which has become an essential and effective tool in distinguishing between authentic food products and fraudulent ones. This study focuses on exploring how different production practices, both legitimate and illicit, impact the $\delta^{18}O$, $\delta^{13}C$, and D/H isotopic values in fruit-based products. By employing stable isotopes as natural markers for the origin of food or beverages, we leverage their unique isotopic ratio signatures, which are indicative of the processes they undergo, such as photosynthesis, environmental changes (like evaporation), or human interventions (such as adulteration). We specifically evaluated the impact of adding various sugar syrups (from corn, cane, and beet) at different concentrations (0.1-16%) to apple juice, aiming to identify the isotopic adulteration threshold for such mixtures. This involved analyzing the isotopic profiles of experimental samples, measuring concentrations of ^{13}C, ^{18}O, and ^{2}H before and after fermentation. Our findings reveal that apple juices with sugar syrup additions ranging from 2% to 30% can be distinctly identified. However, detecting adulteration becomes more challenging at extremely low syrup concentrations (0.1%, 0.5%, 1%), necessitating further analysis, possibly including compositional profiling. Additionally, the study developed simpler models for mixture differentiation. Post-fermentation, ^{18}O demonstrated a higher correlation coefficient, whereas pre-fermentation measurements of ^{2}H showed better correlation. These results underscore the potential impact of any level of adulteration on a product's isotopic composition, a critical factor in determining product authenticity, given known original raw materials. This research contributes to developing effective linear mixture models, supporting food quality assurance and public health protection.

P15 Carbon uptake by microorganisms and transfer to higher trophic levels in slow sand filters: a ^{13}C tracer study

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[1] Utrecht University
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In Dutch drinking water production, the final purification step involves slow sand filtration to ensure the water is bacteriologically safe. The effectiveness of these filters is attributed to both physical processes and biological actions within the filter. Historically, the uppermost layer of slow sand filters (~0-2cm), known as Schmutzdecke, has been presumed as the main (primary) site of concentrated microbial activity which is responsible for pathogen and organic material removal. This understanding has greatly influenced the design and operational strategies of slow sand filters over the years. This study challenges this longstanding perception by showing that at least the 2 to 10 cm below the Schmutzdecke may also play a significant role in removing organic materials. Stable carbon isotope labeling experiments conducted using intact sediment cores harvested from Dutch drinking water production site to trace the fate and transfer of enriched Glucose with ^{13}C within the slow sand filters. By analyzing the stable carbon isotope ratios of fatty acids and faunal community within the microbial loop of slow sand filter, this research revealed active microbial communities in both the upper Schmutzdecke and the layer directly below it (2 to 10 cm), challenging the traditional idea that activity mainly located in the top layer.

Lipid analysis demonstrated distinctive label dynamics within prokaryotic communities in 0 to 10cm depth of the sand bed. label was rapidly incorporated into fatty acids, with reaching their maximum label incorporation after 24 hours, some fatty acid, however, are hardly labeled or incorporated the label much later, highlighting their significant roles in organic material degradation. Enumeration and bulk carbon isotope analysis of meiofauna unveiled the comparable efficiency of the upper and lower sand layers. ^{13}C tracer dynamics modelled to reveal possible feeding strategies of the various faunal taxa in slow sand filter. The results of the modelling showed that ±20-25% of the diet of oligochaetes and nematodes is made up of bacteria, highlighting the tropic relationship between bacteria and meiofauna in the slow sand filter.

Keywords: slow sand filter, microbial community, fatty acids, meiofauna, stable carbon isotope

O16 Million years evolution of seawater isotopes

Candidate young scientist award

[1] Katrin Haettig, [1,2] Stefan Schouten, [1] Marcel van der Meer

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The salt content of the sea is one of the most important oceanographic parameters which cannot be reconstructed with reasonable accuracy based on sedimentary records yet. Since salinity correlates with the isotopic composition of seawater ($\delta^{18}O_{sw}$ & $\delta^{2}H_{sw}$), reconstructions have focused on using fossils which record seawater isotopic compositions.

Long-chain alkenones are produced by Haptophyte algae (e.g. Emiliana huxleyi), living in the sea surface. Schouten et al. (2006) showed that in cultures, hydrogen isotopes of alkenones trace the hydrogen isotopic composition ($\delta^{2}H$-H_2O) as well as the salinity of the growth water. Subsequently, several environmental and paleoceanography studies demonstrated the application of hydrogen isotopic composition of the C37:2 and C37:3 alkenones as a proxy for seawater salinity (e.g. van der Meer et al., 2007; Pahnke et al., 2007; Kasper et al., 2014; Weiss et al., 2019).

We applied this method on marine sediment cores from the Atlantic and Pacific Ocean and Tasmanian Sea spanning different time scales from last 20.000 years up to 37 Million years. We showed that $\delta^{2}HC37$ sedimentary records are reproducible, but indicate different and larger changes than expected and reflected by $\delta^{18}O$ records of calcite shells .

Minutes 14th general BASIS member meeting

21 April 2023

Ghent, Belgium

1. Welcome, opening and attendances

There were 49 members present during the general BASIS meeting.

2. Minutes 13th general meeting

The minutes of the 13th meeting have been approved.

3. Financial report (01-01-2021 to 31-12-2022)

The financial report was approved and signed by the financial committee Jack DJ De Jong and S Warmerdam this approval discharges the treasurer.

4. Board members and renewals

4.1 The board is composed of:

President:	Marcel van der Meer:	mandate:2020-2023
Secretary:	Katja Van Nieuland:	mandate 2020-2023
Treasurer:	Jort Ossebaar:	mandate 2020-2023
Scientific committee:	Henk Schierbeek:	mandate 2020-2023
	Eva de Rijke:	mandate 2020-2023
	Loïc Michel:	mandate 2020-2023

4.2. Replacement and re-election of the board

- Katja and Henk are not candidate for a new mandate.
- Samuel Bodé proposed to replace Henk Schierbeek in the Scientific committee.
- Loïc proposed to replace Katja as secretary.
- No new candidates came forward
- Marcel, Jort, Eva, Loïc, Samuel are elected for a mandate till 2025

Michiel Kienhuis continues to be webmaster of BASIS.

5. Meeting 2023 Feedback

The venue was considered highly professional with a good sponsor room and presentation room, nice lunches.

Downside this was an expensive edition of our BASIS meeting.

Due to the increase in prices for the venues, dinner and catering, the board will recalculate the participant fee.

6. Meeting 2024 and 2025

The next meeting will be in The Netherlands, Amsterdam.

Eva de Rijke will coordinate this meeting.

7. Some practical questions:

The majority of the members would still appreciate a printed booklet and keep the meeting in the current format.

Some people are interested in a technical session, if there will be one in Amsterdam will be decided later by the board members.

8. Varia

During the assembly, the members took a moment to recognize the retirement of Huub van Cruchten, the Manager Advanced Products Thermo Fisher Scientific BeNeLux. He has been a pivotal figure in our sponsor's organization, contributing significantly to our collaborative efforts and fostering strong relationships between our organizations.

Jesium will be held in Groningen, the Netherlands, June 16-20,2025, with Harro A.J. Meijer, as Chair of the local organizing committee

Agenda 15th general BASIS member meeting

26 April 2025

Amsterdam, the Netherlands

1. Welcome, opening and attendances

2. Minutes 14th general meeting

3. Financial report (01-01-2023 to 31-12-2023)

4. Board members and renewals

President:	Marcel van der Meer:	mandate: 2020-2025
Secretary:	Loïc Michel:	mandate 2023-2025
Treasurer:	Jort Ossebaar:	mandate 2020-2025
Scientific committee:	Samuel Bodé:	mandate 2023-2025
	Eva de Rijke:	mandate 2020-2025
Webmaster:	Michiel Kienhuis	mandate 2020-2025

No re-election needed

Call for candidates to join the BASIS board.

5. Meeting 2024

Feedback

6. Meeting 2025 and 2026

Where and when?

Technical sessions?

Conference Booklet?

Other approach?

Participant fee?

7. Varia

Basis Fund

Aims of BASIS fund

The BASIS fund will support pre- and postdoctoral researchers for active oral contributions to large conferences with an international audience. In addition, the BASIS fund will support technical staff to visit other stable isotope laboratories to receive training on a specific analytical stable isotope tool.

Each person can request for funding only once during his/her pre- or post-doctoral career. Technical staff can apply twice during their professional career.

Application procedure

Who can apply?

All pre- and post-doctoral researchers and technical staff that are member of BASIS can apply. BASIS membership starts after participation in an annual BASIS meeting and is valid for one year.

What can be requested?

Financial support is limited to 750 Euro.

Reimbursement is always based on effective costs.

When to apply?

Submissions are open any time of the year. Hence, there is no deadline.

Note that the BASIS fund budget is limited, and the funding system can be closed anytime. The BASIS board will decide the latter.

How to apply?

The applicant fills in the above application form and sends it with annexes to

bestuur@basis-online.be and the BASIS board will assess each application.

Reimbursement will be carried out upon receipt of original proofs of expenses by BASIS treasurer (Jort Ossebaar).

List of Participants BASIS 2024

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Practical information

Venue

Amsterdam Science Park
WCW conference halls
Science Park 125
Tel. +31 20 592 6012
website: www.wcw.nl
Open free Wifi network: Amsterdam Science Park

Other links:

Amsterdam Science Park (http://www.amsterdamsciencepark.nl)
How to get to Amsterdam Science Park?

http://www.amsterdamsciencepark.nl/location-facilities/route-description/directions-by-car/
Online route planner http://route.anwb.nl/routeplanner

Parking Instructions

On the A10 highway (ring Amsterdam) take exit S113 (Diemen/Watergraafsmeer). Follow Middenweg to Kruislaan (traffic lights). Take a right. Follow Kruislaan, underneath railway station Science Park, straight at traffic lights onto Science Park. Park at P1 on your LEFT-hand side, almost at the end of Science Park.

If the organizers provided you with a parking ticket at P1, please keep the original ticket you received when entering P1. You will need both tickets upon exiting.

Please find the map attached that shows the location of the P1 parking area.

Directions by public transport

By train

Four times an hour a train leaves from Amsterdam Central station or Almere/Zwolle station to station Amsterdam Science Park.

- http://www.ns.nl/reizigers/reisinformatie/stationsvoorzieningen/stations/a/amsterdam-science-park#vertrekstaten
- http://www.ns.nl/

By subway

Amsterdam Amstel, bus 40 or 240

By tram

From Amsterdam CS tram 9 direction Diemen

Change at stop Kruislaan to bus 40

By Bus

40 from stations Amsterdam Muiderpoort and Amsterdam Amstel
Spitsbus 240 only from Amsterdam Amstel
Timetables of bus 40 and 240 can be found on the website of GVB:
http://www.gvb.nl/reisinformatie/Pages/Vertrektijden.aspx

OV-Bike

At Amsterdam Amstel station and Muiderpoort station an OV-bike (public transport bike) can be rented. It's takes about 15 minutes to bike to Amsterdam Science Park from both stations.

A large part of Amsterdam, Diemen and Duivendrecht lies within a 7-kilometre radius (20-30 minutes by bike) from Amsterdam Science Park.

To plan your journey by bike, travel to the website of Routecraft for the best directions to Amsterdam Science Park. Note: use Kruislaan 300 instead of Science Park at the adress field! You can plan your route also by using Google Maps.

Directions by Car

Amsterdam Science Park is accessible by car. You can park at the civic amenity and plan your route to us by using Google Maps.

- Ring road Amsterdam (A10)
- Exit 'Watergraafsmeer/s113'
- Follow signs 'Science Park'
- On Middenweg at Kruislaan turn right
- Follow road through train tunnel
- You have arrived at Amsterdam Science Park
- Now use the map of Amsterdam Science Park (see below)

Trucks/busses higher than 3,35 m

- Ring road Amsterdam (A10)
- Exit 'Zeeburg/s114'
- Follow Zuiderzeeweg, Flevoweg, Insulindeweg
- Molukkenstraat, Mac Gillavrylaan

Navigation system

Using a navigation system? The street name "Science Park" is not always implemented in navigation systems. You can use "Kruislaan 300" instead.

Symposium dinner Thursday 25 April 2024

IN restaurant DE café WAAG

Restaurant-Café In de Waag
Nieuwmarkt 4
1012 CR Amsterdam
+31 (0)20-4227772
www.indewaag.nl

By public transport

Take the sprinter train from Amsterdam Science Park Station to Amsterdam Central Station
From Amsterdam Central Station it is a 10-min walk

It is not recommended to travel by car to de Waag because parking is expensive (more than €10/hr: https://indewaag.nl/route-parkeren) and roads in the center are very busy on Thursday evening, as all shops are open.