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LA IRMS (and LA CRDS) – the minimally destructive alternative for *in-situ* single/repeat/sequential stable isotope analyses of solid or liquid matrices

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Laser ablation (LA) was first coupled to an isotope ratio mass spectrometer (IRMS) ca. 3 decades ago, offering minimal to no sample preparation, allowing for minimally destructive measurements, repeat measurements on minute sample amounts, even in situ sequential sampling. Although initial results were promising, the method failed to gain followers and the early results were largely forgotten.

In this contribution we explore the design limitations of the early systems, as well as present new data on an optimized, purposefully designed ablation chamber for high accuracy, high precision, spatially resolved LA IRMS measurements. We extensively tested LA IRMS on a variety of organic (pollen, wood, bone collagen, tooth, chitin (hair, fingernail, and horn), sugars and sweeteners, vegetable oils, bee honey and wax, airborne particulate matter, whole blood, pine needles, milk, bivalve) and inorganic (carbonate, phosphate) materials, both solid and liquid. For some of these we also present ^{13}C data from an EA, to show method equivalency.

Depending on matrix, we carried out these tests using two instrumental set-ups. The front end was either an LSX 213 G2+ laser or a Fusions CO_2 laser (Teledyne Photon Machines, MT USA). The back end in all testing was an HS2022 IRMS via a CryoFlex sample preparation module (Sercon UK). An isoScell Δ100 (Terra Analitic, Romania) sample chamber, specifically designed for LA IRMS and commercially available, was utilized for all analyses. The setup was successfully tested with equivalent Thermo and Elementar cryo-focusing units and mass spectrometers as well. A method for measuring 18O via the same instrumental setup was recently developed [1].

We also analyzed ^{13}C in carbonates (organic and inorganic) by coupling LA, isoScell and Cavity Ring Down Spectroscope (Picarro G2201-i), a double laser-approach.

Samples where spatial resolution is crucial (e.g., wood, hair, fingernail, tooth, speleothem) can be ablated sequentially at intervals of down to 20 m (matrix and laser-type dependent). As each ablation removes a minute amount of sample, replicate analysis will not be an issue for homogenous matrices. Carrier gas can be He, N_2, or ZeroAir, depending on the detector used (IRMS vs CRDS).

[1] Sahlstedt et al., 10.5194/egusphere-egu24-8785