iso DUAL INLET

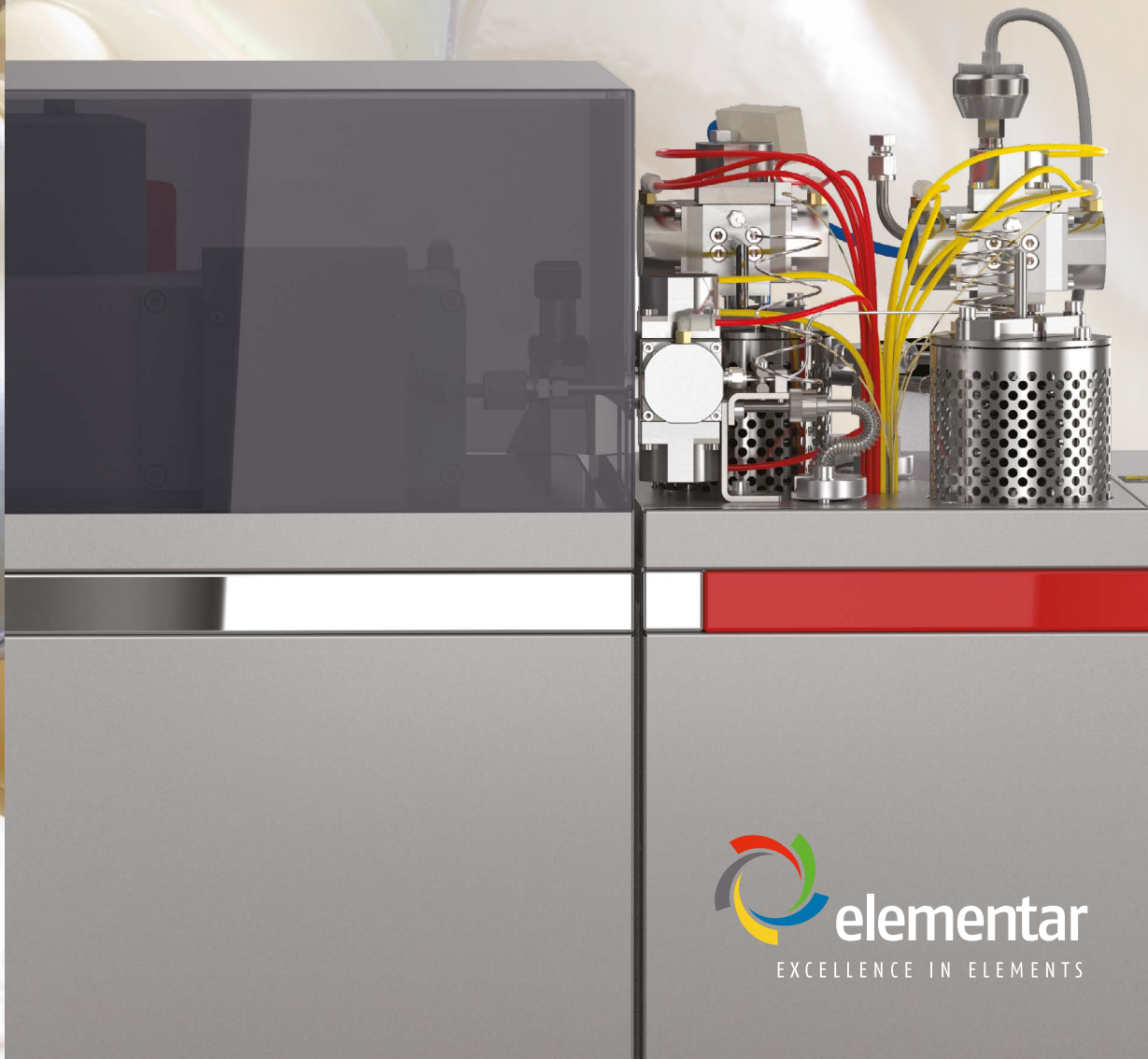
High precision gas, carbonate and water analysis

Great flexibility

High sensitivity

Small footprint

High data quality



elementar
EXCELLENCE IN ELEMENTS

iso **DUAL INLET**

Exceptional performance in a compact footprint

iso **DUAL INLET** is a peripheral inlet system for the **isoprime precisION** isotope ratio mass spectrometer (IRMS). The instrument uses highly refined vacuum technology to perform multiple comparisons of pure sample gas with a reference gas, generating an isotopic ratio with unsurpassable precision.

iso **DUAL INLET** can be enhanced by using the optional iso **MANIFOLD** to perform automated analysis of pure sample gases prepared in special sample containers or quartz ampules. For even more functionality, carbonate and water samples can be analyzed automatically – with exceptional levels of sensitivity, precision and accuracy – using the optional iso **MULTI PREP**.

CONFIGURATION

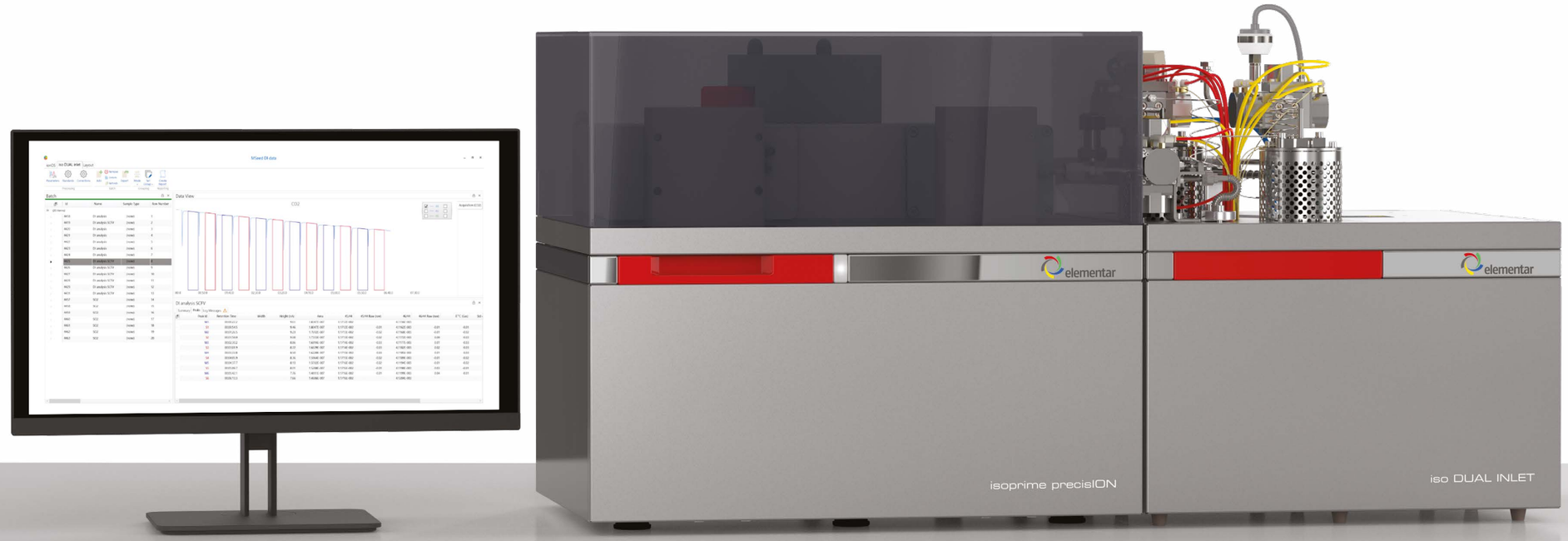
- **isoprime precisION** IRMS for $\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$, $\delta^{18}O$ and $\delta^{2}H$ analysis
- iso **DUAL INLET** system for delivering reference and sample gas to the IRMS via a changeover valve
- lytic**OS**® Software Suite for complete, automated control of the instrument
- **Ar**DB cloud license for database creation and quality control management

Understanding past climatic changes is crucial for predicting and mitigating future climate events.

By examining historical variations, scientists can identify natural climate cycles and comprehend how the planet reacts to various stimuli, including changes in greenhouse gases, solar radiation and volcanic activity. Comparing past events to current trends allows us to assess the extent and pace of human-induced climate change, and develop effective strategies for adaptation and mitigation.

iso **DUAL INLET serves as a valuable tool for paleoclimatologists in unravelling this complex narrative.**
It helps scientists to achieve the highest isotopic precision when analyzing various sample types – like carbonate microfossils, ice cores, surface waters and pure gases – improving the accuracy of paleoclimate models and providing policymakers with informed insights to aid in shaping our planet's future.

The gold standard in isotopic precision



lytic**OS**® Software Suite

lytic**OS** offers users unrivalled levels of automation for the iso **DUAL INLET**, reducing instrument contact time through:

- Automatic handling of sample gases expansion and chopping routines, bringing the sample gas intensity into range without having to be pre-programmed to do so
- Automated data processing, including multi-point isotope calibration
- Real-time datalogging of instrument parameters for evaluating system performance
- Full compatibility with our suite of continuous flow inlets, including automated switching between modes using the **centrION** gas handling system

Introducing iso **DUAL INLET**

isoprime precisION IRMS

The **isoprime precisION** is a 5 kV magnetic sector IRMS, with market-leading gas ionization and mass resolution performance in the most compact footprint possible.



Seamless gas switching

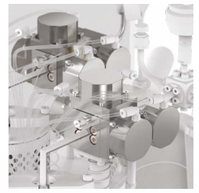
The changeover valve delivers sample and reference gases alternately into the **isoprime precisION** for isotopic comparison and has a dedicated 'waste' turbomolecular pump. Users can customize the integration and comparison profile used to optimize the precision of the measurement.





Precision matched gas capillaries

The capillaries that provide the conduit from the sample and reference blocks to the changeover valve are meticulously prepared to ensure both sample and reference gases are treated identically. This includes carefully balanced crimp restrictions that control the flow of gases into the ion source.



Identical sample and reference blocks

The sample and reference blocks are the same to ensure that sample and reference gases receive identical treatment during handling and preparation for analysis. An integrated bakeout heater allows individual components to be independently baked to improve vacuum conditions and remove contamination.

High capacity gas bellows

The reference and sample gas bellows act as reservoirs for handling gases. The 100 ml reference bellows provides a large dynamic range and allows long automated runs without the need for refilling. Both bellows use a direct drive motor with fine stepper control for high precision and automated rapid beam balancing, which further improves analytical precision.

Compact bench-top system

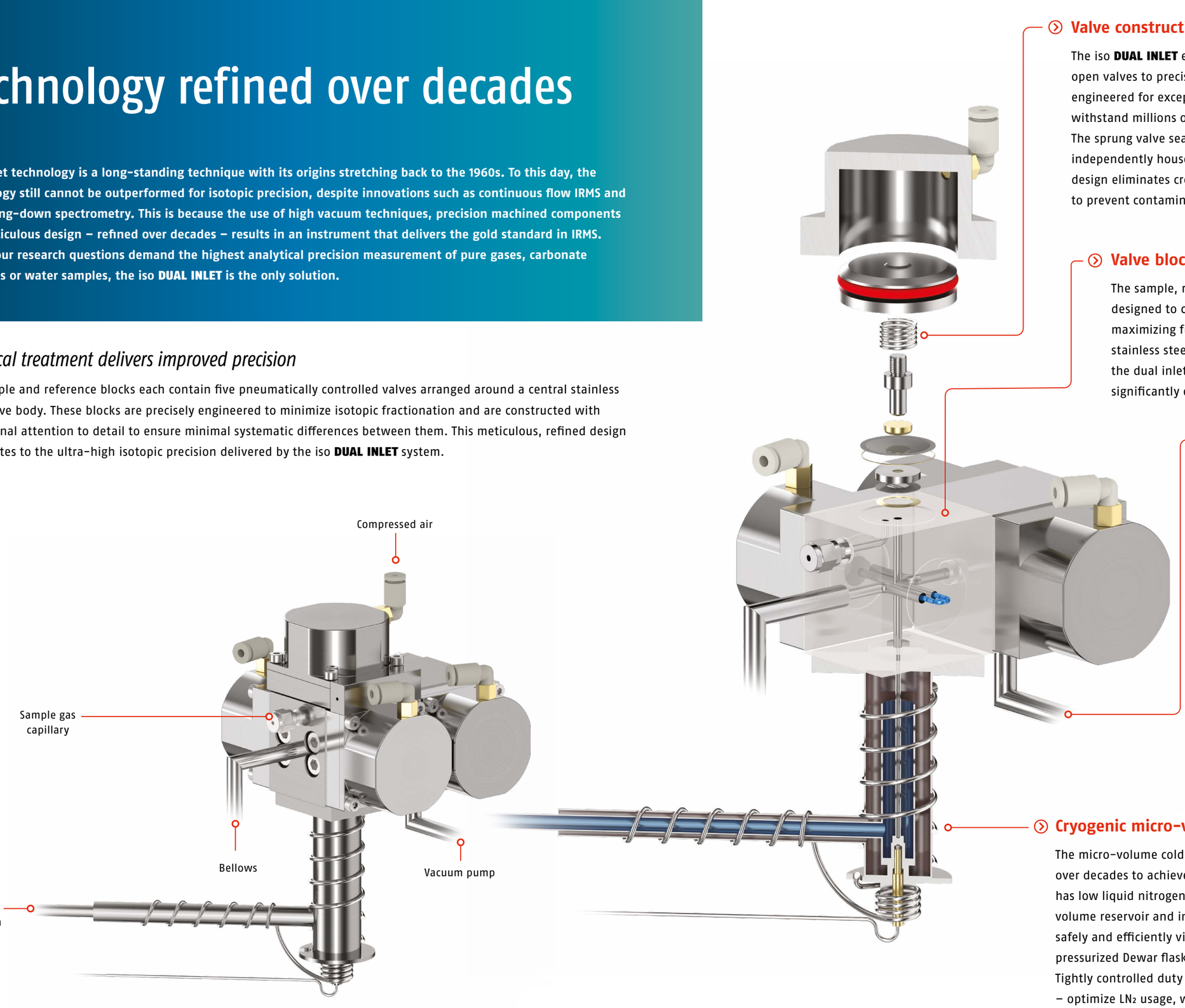
The iso **DUAL INLET** is a compact benchtop module that is located directly to the right-hand side of the **isoprime precisION**. This modular system saves laboratory space and can be configured depending on your research requirements.

Technology refined over decades

Dual inlet technology is a long-standing technique with its origins stretching back to the 1960s. To this day, the technology still cannot be outperformed for isotopic precision, despite innovations such as continuous flow IRMS and cavity ring-down spectrometry. This is because the use of high vacuum techniques, precision machined components and meticulous design – refined over decades – results in an instrument that delivers the gold standard in IRMS. When your research questions demand the highest analytical precision measurement of pure gases, carbonate materials or water samples, the iso DUAL INLET is the only solution.

Identical treatment delivers improved precision

The sample and reference blocks each contain five pneumatically controlled valves arranged around a central stainless steel valve body. These blocks are precisely engineered to minimize isotopic fractionation and are constructed with exceptional attention to detail to ensure minimal systematic differences between them. This meticulous, refined design contributes to the ultra-high isotopic precision delivered by the iso **DUAL INLET** system.



Valve construction

The iso **DUAL INLET** employs 14 pneumatically operated, normally-open valves to precisely control gas flows. These valves are engineered for exceptional durability, and are designed to withstand millions of operations without requiring maintenance. The sprung valve seals against a high performance PCTFE seat, independently housed for easy serviceability. The carefully refined design eliminates cross-seat leaks and incorporates a gold ring seal to prevent contamination from external sources.

Valve block construction

The sample, reference and changeover blocks are carefully designed to create ultra-low internal volumes, while maximizing functionality. The blocks are constructed from stainless steel with precision-drilled gas pathways, bringing the dual inlet valves into extremely close proximity to significantly enhance sample sensitivity.

Vacuum technology

The iso **DUAL INLET** system incorporates two turbomolecular pumps to achieve the high vacuum essential for precise isotope analysis. These pumps are strategically positioned beneath a stainless steel manifold, minimizing wetted surfaces within a compact footprint. One pump is dedicated to the changeover valve, ensuring optimal gas flow during analysis, while the other efficiently evacuates the reference and sample blocks (as well as any optional sample preparation systems). Rotary pumps provide standard backing support, with optional scroll pumps available for oil-free operation.

Cryogenic micro-volume cold-finger

The micro-volume cold-finger features a unique design, refined over decades to achieve exceptional robustness and reliability. It has low liquid nitrogen (LN_2) consumption due to an internal micro-volume reservoir and intelligent temperature control. LN_2 is delivered safely and efficiently via a Venturi pump, eliminating the need for pressurized Dewar flasks or moving parts within the laboratory. Tightly controlled duty cycles – using a direct-mounted thermocouple – optimize LN_2 usage, while an integrated heater ensures thorough baking after each sample to prevent contamination.

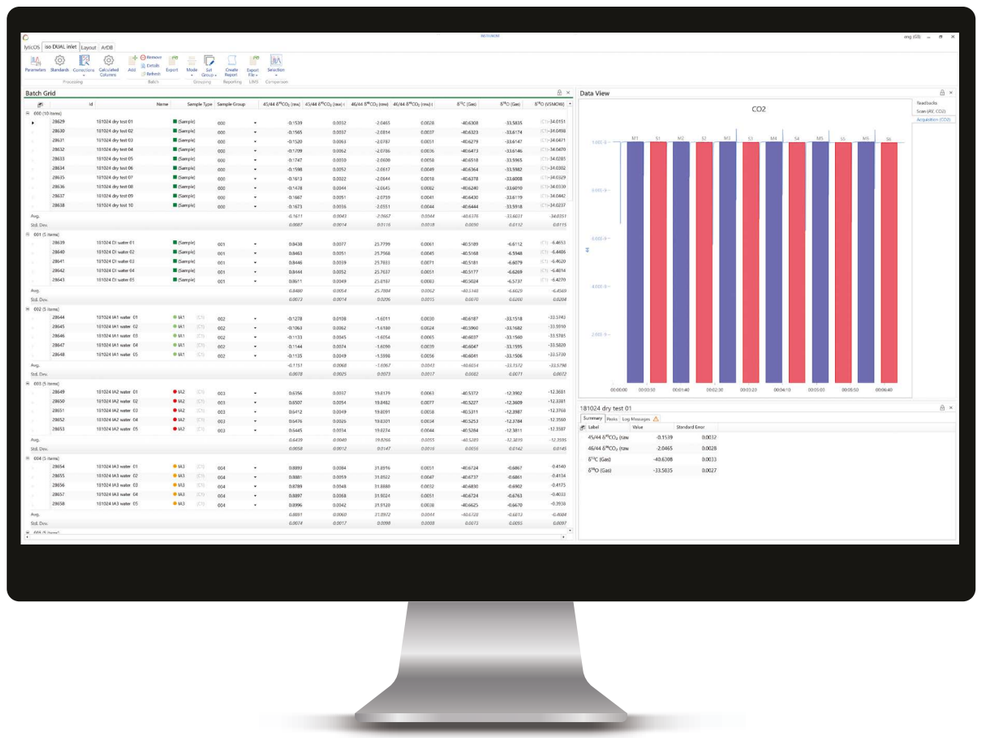


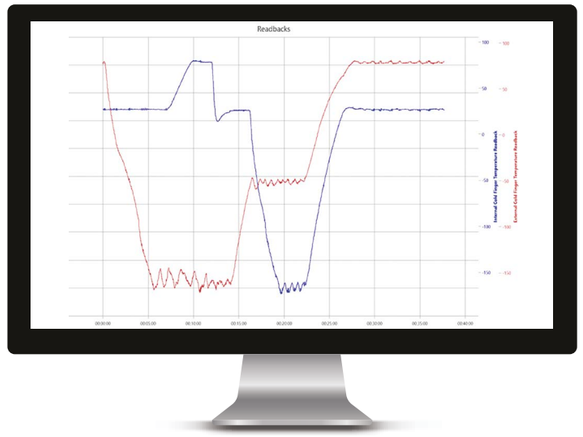
lyticOS® Software Suite

The most advanced stable isotope software ever created

lyticOS has been developed for stable isotope analysis, offering a range of advanced features to support the IRMS community. The software works together with our range of IRMS instruments and inlets, offering complete control, method development and data processing to simplify day-to-day activities and streamline laboratory workflows.

lytic**OS** is designed to be simple to use, with an intuitive user interface offering unrivalled intelligent control of your IRMS. Its clear iconography and structure provide a wide range of powerful features to match the everyday needs of IRMS users. Intelligent automation ensures optimal results while minimizing the need for user intervention. This helps to standardize analytical protocols and data processing, providing greater insights from every experiment.





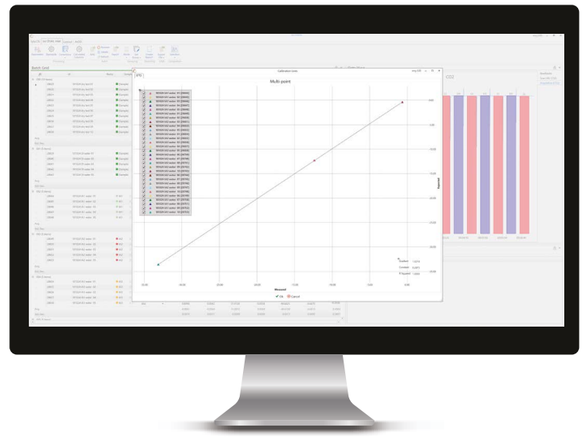
lyticOS
SOFTWARE SUITE BY ELEMENTAR

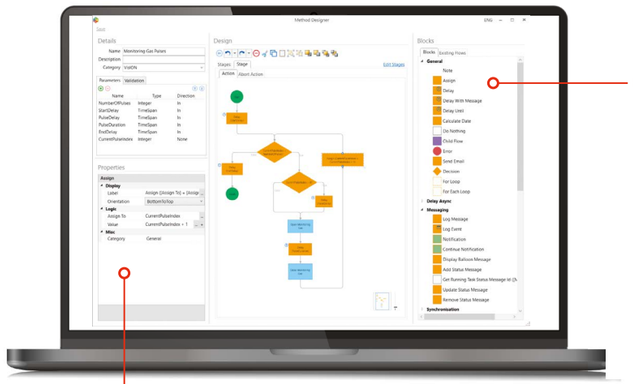
Powerful data logging

lytic**OS** records all instrument outputs, enabling comprehensive retrospective analysis of system performance and operating conditions. This capability empowers users to generate a detailed understanding of system behavior and visualize results graphically.

Automatic multi-point isotope calibration

lytic**OS** provides automated multi-point isotope calibration of raw data for immediate interpretation of results, without needing to export your data to a separate spreadsheet. Calibrations are based on a custom-defined library of isotopic standards, using transparent calculation procedures and visualizations to show each data point relative to a multi-point calibration curve.





Logical methods

lytic**OS** offers logic-based decision-making within your methods. The iso **DUAL INLET** uses a combination of time-based and event-driven methods to provide more flexible sample handling. This allows the system to automatically change its acquisition behavior based on either input parameters or the real-time status of the instrument.

Intuitive workflow design

The Method Workflow Designer makes it easy to create and maintain methods visually, without the need for specialist programming skills. It avoids the use of complex programming languages, using a straightforward drag and drop approach with sample-by-sample method customization and easily defined process logic to build and edit methods.

iso **DUAL INLET**

An instrument that matches your needs

The iso **DUAL INLET** system can be configured in multiple ways to meet your specific analytical requirements. Whether you need ultra-precise isotope measurements of single, pure gas samples or fully automated analysis of carbonates, waters, and pure gases, the iso **DUAL INLET** delivers exceptional analytical precision across a wide range of sample types.

iso **CARB PREP**



iso **CARB PREP** enables automated analysis of carbonate materials. Using needle-based vial sampling, iso **CARB PREP** delivers acid into the sample vial using a direct-drive pump followed by CO_2 concentration via a micro-LN_2 reservoir cold-finger.

Sample types

Pure carbonates, carbonate minerals, fossil foraminifera, speleothems

Sample introduction

Up to 180 carbonate samples prepared into septum-sealed vials and placed in heated autosampler tray.

iso **MULTI PREP**

iso **MULTI PREP** uniquely combines the automated analysis of carbonate and water samples into a single instrument. Switching between modes requires nothing more than a change of sampling needle.

iso **AQUA PREP**



iso **AQUA PREP** enables automated analysis of water samples using isotopic equilibration. The iso **AQUA PREP** delivers high-precision $\delta^{18}O$ and $\delta^{2}H$ isotopic analysis using needle-based vial sampling. The sample gas is cryogenically dried prior to analysis.

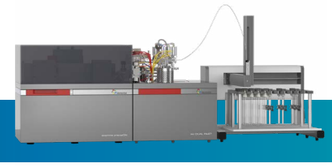
Sample types

Surface water, groundwater, glacial/snow melt, marine/costal waters

Sample introduction

Up to 180 liquid samples prepared into septum-sealed vials and placed in heated autosampler tray.

iso **MANIFOLD**



The iso **MANIFOLD** autosampler module allows the iso **DUAL INLET** to handle pure gas samples prepared in specially designed tubes.

The iso **MANIFOLD** is completely automated, giving you the ability to analyze pure gas samples overnight and during the weekend.

Sample types

Pure simple gas

Sample introduction

Sample gases prepared into iso **MANIFOLD** sample or cracker tubes. Up to 50 sample tubes placed into autosampler tray for unattended analysis.

iso **DUAL INLET**



iso **DUAL INLET** uses highly refined vacuum technology to perform multiple comparisons of pure sample gas with a similar reference gas, generating an isotopic ratio with unsurpassable precision. Can also introduce monitoring gas in CF modes for better compliance with health and safety requirements.

Sample types

Pure simple gas

Sample introduction

¼" Swagelok® union connection to sample container such as flask, syringe, quartz cracker tube, or other sample vessel used in your laboratory.

isoprime precisION



isoprime precisION is a compact, bench top stable isotope ratio mass spectrometer with a 5kV accelerating voltage for isotopic ratio analysis of C, N, H, O & S, as well as other niche analyses such as CO_2 clumped isotopes. The iso **DUAL INLET** is coupled to the **isoprime precisION** via the change-over valve which alternates between sample and reference gas allowing high precision isotopic analysis.

iso **DUAL INLET**

High precision analysis of pure gases

The iso **DUAL INLET** is a high performance peripheral inlet system designed for the **isoprime precisION** IRMS instrument. This system builds on decades of expertise and continuous development to deliver pure gases directly to the IRMS ion source, ensuring the highest possible isotopic precision for pure gas samples.

When precision matters

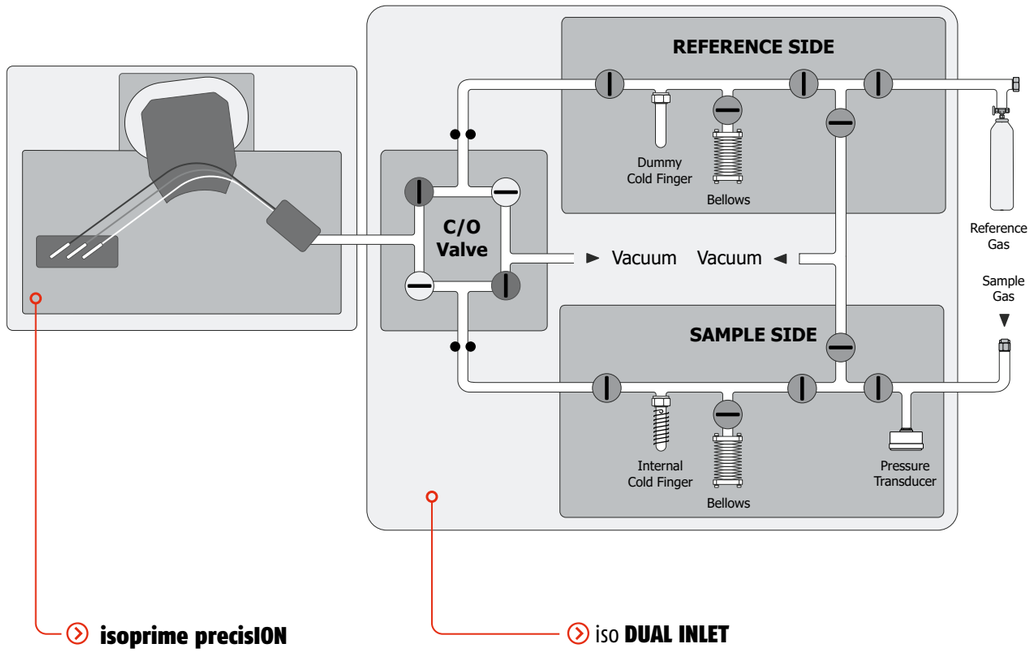
The iso **DUAL INLET** represents the simplest configuration of our dual inlet system. Although it is often paired with the iso **MULTI PREP** for automated carbonate and water sample preparation, it can also be used by laboratories with established off-line sample preparation protocols. These laboratories typically prepare gases from raw samples, purifying them and sealing them in quartz break-seal ampules or other similar vessels. When requiring the highest isotopic precision of a small number of samples, iso **DUAL INLET** is the perfect choice.

Introducing your sample

The sample side of the iso **DUAL INLET** is equipped with a simple ¼" Swagelok® tube fitting for introducing sample gases. This could be from a lecture bottle, a quartz break-seal in a cracker tube, or a home-made inlet system, which can be controlled using our Novel Inlet Control Module (NICM). The introduction of the sample gas is controlled by the lytic**OS** Software Suite, automating the analysis once the sample is delivered to the instrument.

Delivering isotopic precision

The iso **DUAL INLET** employs the principle of identical treatment for sample and reference gases. This means that the pressures of both gases are matched precisely before analysis. They are then alternately introduced into the ion source through the changeover valve and precision-matched inlet capillaries. By conducting multiple comparisons of sample and reference gases, and integrating for extended periods of time, the iso **DUAL INLET** can achieve near-shot-noise limits, delivering significantly better isotopic precision than is attainable with continuous flow IRMS.



Analyze small samples

The iso **DUAL INLET** has a cryogenic LN_2 micro-volume cold-finger installed on the sample inlet block as standard for samples introduced at low gas pressure, particularly CO_2. The system will concentrate the sample gas into the iso **DUAL INLET** dependent on the pressure reading from the on-board pressure transducer, and collect all available sample gas prior to analysis.

Work with any sample gas pressure

After the sample gas has been introduced into the iso **DUAL INLET**, the instrument can automatically determine the ideal handling strategy using the on-board pressure transducer. This ensures that the best strategy for analysis is selected according to the gas pressure and user-defined threshold settings, which means that you do not need to know the gas sample pressure before starting your analysis.

Clumped isotopes

The measurement of multiply substituted isotopologues – commonly known as 'clumped isotopes' – has become increasingly common in recent years as a paleothermometer. The **isoprime precisION** can be upgraded with suitably configured Faraday collector arrays to perform these measurements, using the iso **DUAL INLET** to analyze CO_2 sample gas and deliver high precision isotope measurements for extremely low abundance isotopologues. Customized ion beam integration strategies and unique sampling processes can also be easily implemented in the lytic**OS** Software Suite.

GAS	ISOTOPE	SAMPLE SIZE BAR µL	INTERNAL PRECISION 2σ (‰)
CO_2	$\delta^{13}C$ $\delta^{18}O$	100	≤0.010 ≤0.016
CO_2	$\delta^{13}C$ $\delta^{18}O$	< 1 using cold finger	≤0.020 ≤0.030
N_2	$\delta^{15}N$	100	≤0.010
O_2	$\delta^{18}O$	100	≤0.010
H_2	$\delta^{2}H$	100	≤0.10
SO_2	$\delta^{34}S$	100	≤0.010

Standard specifications for pure gas analysis using iso **DUAL INLET**

iso **MANIFOLD**

High throughput analysis of pure gases

The optional iso **MANIFOLD** autosampler module allows the iso **DUAL INLET** to handle pure gas samples prepared in specially designed tubes. The iso **MANIFOLD** is completely automated, giving you the ability to analyze pure gas samples overnight and during the weekend.

A range of options

Sample gases can either be prepared directly in the specially designed iso **MANIFOLD** sample tubes – by integrating the tubes into your off-line sample preparation set-up – or into quartz break-seal tubes placed inside iso **MANIFOLD** cracker tubes. Using the iso **MANIFOLD** sample tubes gives the highest degree of automation.

Increase your throughput

The high capacity iso **MANIFOLD** can accommodate up to 50 iso **MANIFOLD** sample tubes or 20 quartz break-seal cracker tubes. The autosampler can be accessed at any time, allowing already processed samples to be replaced with new samples to extend the analytical sequence beyond the rack capacity.

Combine your set-up

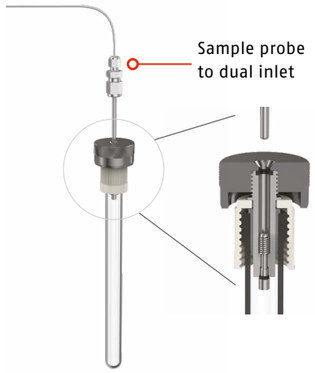
The iso **MANIFOLD** uses the same autosampler as the iso **MULTI PREP**, iso **CARB PREP** and iso **AQUA PREP** peripheral inlet systems, and is compatible with all configurations with no compromise in analytical performance. Transitioning between autosampler configurations can be performed in minutes, adding valuable flexibility to the system.

Integrate with your off-line prep rig

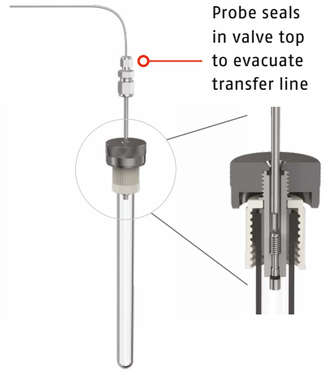
Tube adapters allow the sample tubes to be filled directly on your off-line preparation system. The adapter body has a 1/4" tube stub for connection to the prep system using a Swagelok® Ultra-Torr compression fitting. The opposite end of the body has a probe for insertion into the sample tube. This feature provides an extremely efficient and completely gas-tight solution for the rapid and safe transfer of gaseous samples without the risk of loss or contamination.



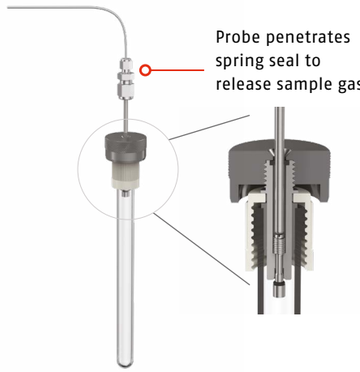
Step 1



Step 2



Step 3



iso **MANIFOLD** *sample tubes*

The iso **MANIFOLD** sample tubes comprise of a valve cap fitted into a glass tube using an ultra-high vacuum seal. The valve cap allows the autosampler to connect the iso **DUAL INLET** to each sample tube in turn. All parts are designed to be easily serviceable for maintenance.



iso **MANIFOLD** *cracker tubes*

The iso **MANIFOLD** cracker tubes are designed to allow the analysis of quartz break-seal tube samples. They have a spherical ball joint half way down the length of the glass tube for cracking a 6 mm OD quartz tube.



GAS	ISOTOPE	PRECISION 2σ (‰)	n
CO_2	$\delta^{13}C$	≤0.02	10
	$\delta^{18}O$	≤0.04	

Standard specifications for pure gas analysis using iso **MANIFOLD**

iso **MULTI PREP**

Carbonate and water analysis in a single instrument

iso **DUAL INLET** is a critical tool for performing high precision isotopic analysis of natural, biological and environmental carbonate samples, as well as water samples. iso **DUAL INLET** is uniquely able of automatically analyze both carbonate and water samples in a single system using the optional iso **MULTI PREP** upgrade.

Sampling strategy

Carbonate and water samples are prepared into septum-sealed sample vials, which are penetrated using specially designed needles. This strategy gives iso **MULTI PREP** the unique ability to analyze carbonate samples using acid digestions, as well as water samples via equilibration.

Switch mode in seconds

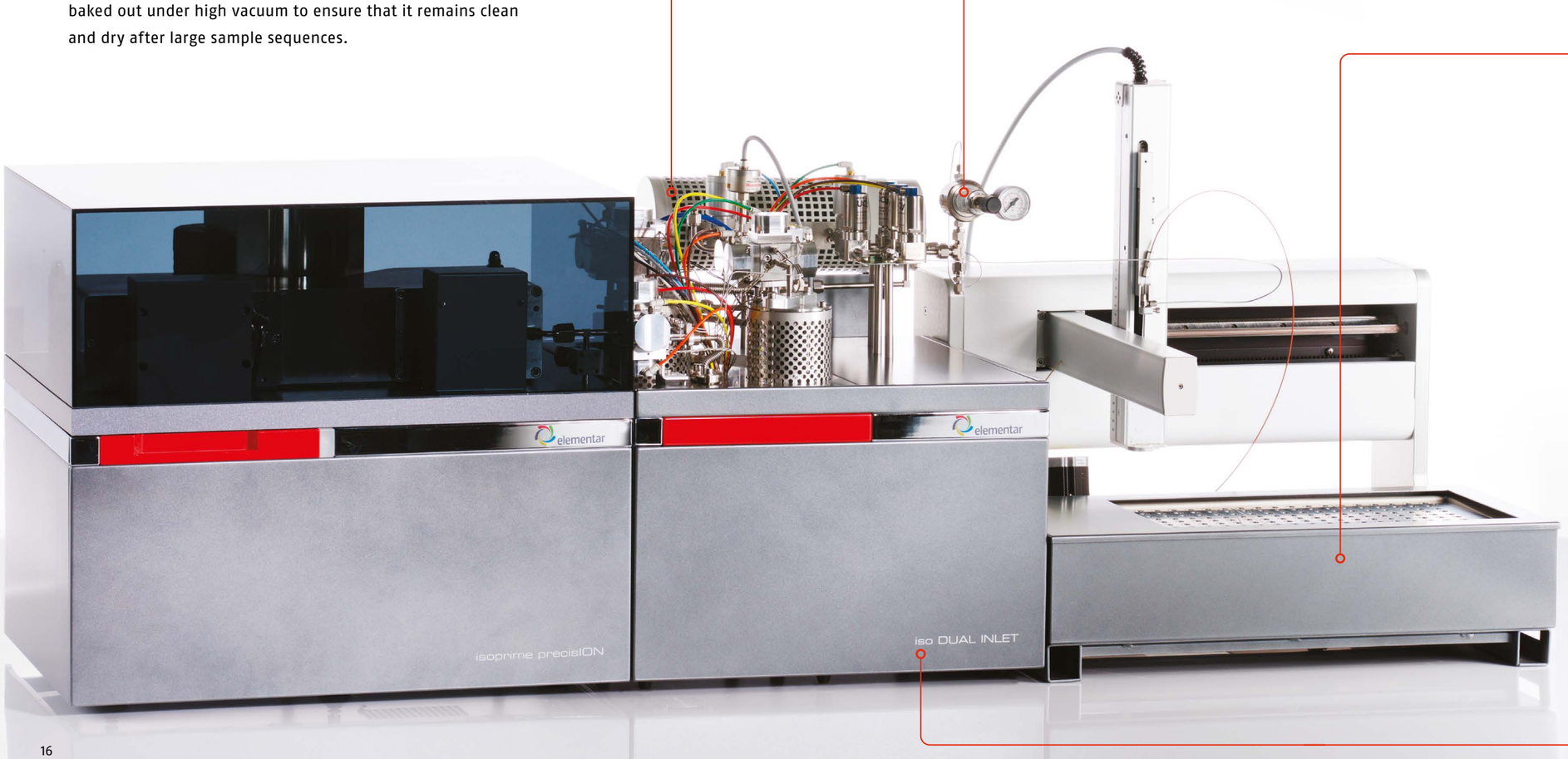
When choosing the iso **MULTI PREP** configuration, your instrument is capable of the highest achievable precision for carbonate and water isotope analysis. What's more, switching between carbonate and water only requires changing a sampling needle, giving you complete flexibility.

On-line cryogenic water trap

The iso **MULTI PREP** uses a cryogenically-cooled water trap to remove any water produced by acid reactions or from equilibrated water samples. The water trap is cooled to −95 °C using a closed-circuit chiller unit, and can also be baked out under high vacuum to ensure that it remains clean and dry after large sample sequences.

Gas flushing

The iso **MULTI PREP** uses gas flushing during carbonate and water analysis. When analyzing carbonates, gas flushing ensures that the needle is kept clear of acid vapor ingress using an inert, dry gas. For water analysis, the gas flush delivers CO_2 or H_2 equilibration gases into the sample vial.



Heated sample tray

Up to 180 sample vials can be placed in the thermostatically controlled sample tray, which can operate between 30 and 90 °C (± 0.1 °C across the tray), giving almost 400 % more sample capacity than other systems. The tray can also be accessed mid-sequence, making it possible to modify and expand sample sequences on the fly.

Highest performance in the smallest footprint

Upgrading the iso **DUAL INLET** for automated carbonate and water analysis adds additional components, but its footprint remains almost 55 % smaller than other systems. It also offers the highest possible precision and sensitivity, making it the ideal choice for any laboratory.

iso **CARB PREP**

Automated high precision carbonate analysis

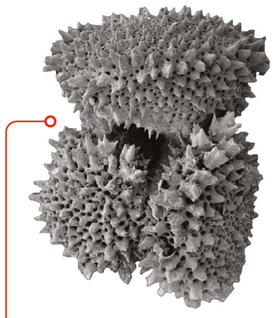
iso **DUAL INLET** can be upgraded with the iso **CARB PREP** system for automated analysis of carbonate materials. The iso **CARB PREP** is capable of analyzing samples such as microfossils down to 20 µg, with the highest possible isotopic precision for $\delta^{13}C$ and $\delta^{18}O$.

"Many of our methods help set global benchmarks for a particular analysis and we obtain exceptional precision and very high throughput. We often work with Elementar on improvements as we demand the highest level of performance on the smallest sample sizes which not only requires knowledgeable staff at the BGS but also exceptional instrumentation and technical support from Elementar."

Prof Melanie Leng, British Geological Survey, UK

Microfossils as climate archives

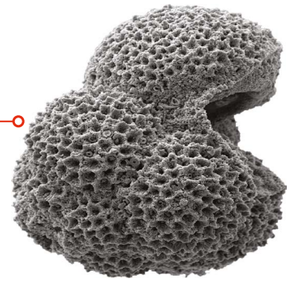
Microscopic calcifying organisms such as foraminifera, ostracods, and coccolithophores play a vital role in paleoclimatology. These species incorporate oxygen isotopes from seawater into their calcium carbonate shells as they grow, preserving geochemical signatures of past environmental conditions. Analysis of $\delta^{18}O$ values in fossilized microfossils allows scientists to reconstruct ocean temperatures, ice volume changes, and shifts in global climate systems. Their abundance, evolutionary diversity, and excellent preservation in marine and lacustrine sediments make them valuable for generating high-resolution, well-dated climate records. Due to the small size and low mass of individual specimens, these analyses demand instruments with exceptional sensitivity and precision. The iso **DUAL INLET** system, used in conjunction with iso **CARB PREP**, provides a powerful platform for extracting detailed paleoclimate insights from even the most delicate carbonate microfossils.



Species: *Acarinina topilensis*

Location: Subtropical north Atlantic Ocean

Age: ~40 million years old



Species: *Guembelitrioides nuttalli*

Location: Tropical Pacific Ocean

Age: ~42 million years old



Species: *Orbulinoides beckmanni*

Location: Subtropical north Atlantic Ocean

Age: ~40 million years old

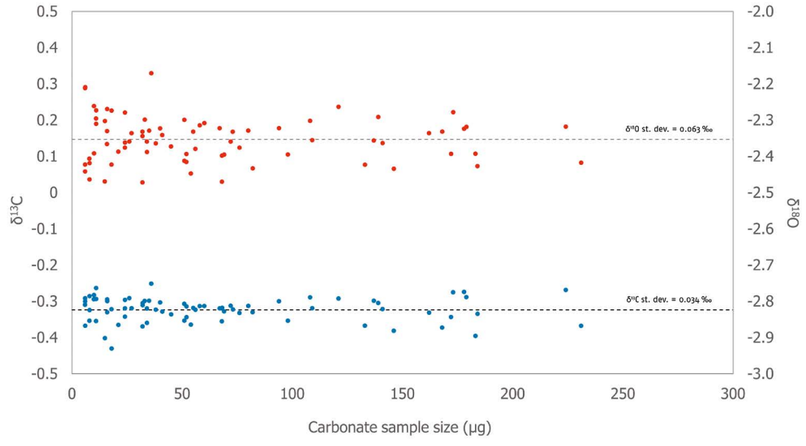
Foraminifera images kindly supplied by Prof. Kirsty Edgar, University of Birmingham, UK

Unique needle-based sampling

The iso **CARB PREP** employs a unique dual-core needle for efficient sample handling. This innovative design allows the needle to both evacuate the sample vial and deliver acid without removal, preserving the integrity of septa seals. This enables the analysis of even the smallest carbonate samples.

Micro-volume cold-finger

The iso **CARB PREP** employs a micro-volume cryogenic cold-finger to efficiently trap the CO_2 generated from carbonate reactions. The external cold-finger design minimizes liquid nitrogen consumption while achieving rapid cooling times. An on-board thermocouple precisely monitors temperatures, and an integrated bakeout assembly maintains the trap's cleanliness between sample analyses.



Plot of $\delta^{13}C$ and $\delta^{18}O$ from calcite carbonate materials ranging from 5 – 130 µg

GAS	SAMPLE SIZE	ISOTOPE	PRECISION* 2σ (‰)	n
CO_2	20–200 µg	$\delta^{13}C$	≤0.04	10
		$\delta^{18}O$	≤0.08	

Standard specifications for pure carbonate analysis using iso **CARB PREP**

* subject to a 10 % rejection based on an outlier test

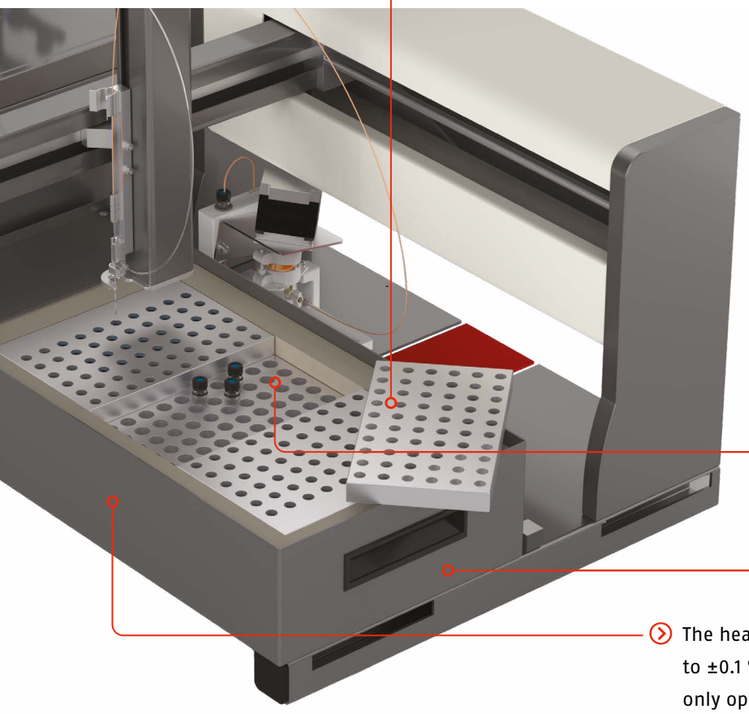
Choose to do things differently

iso **CARB PREP** is unique – it does things differently from other dual inlet carbonate instruments. When you choose the iso **CARB PREP** for your carbonate analysis, you're choosing a system that will streamline your lab processes, boost efficiency and maximize your throughput, while delivering state-of-the-art precision and sensitivity performance.

Heat the sample, not the entire instrument

While elevated temperatures accelerate carbonate acid digestion and increase sample throughput, high precision isotopic measurements need precise temperature control. Other instrument designs often involve placing the entire sample preparation system in a large, heated oven. In contrast, iso **CARB PREP** employs a more efficient approach, heating only the sample vial in a dedicated sample tray. This innovative solution confers numerous advantages, including:

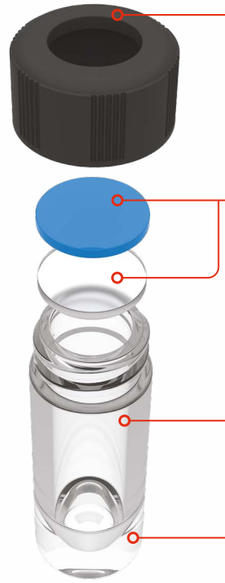
- The iso **CARB PREP** sample tray can accommodate up to 180 sample vials, and can be accessed while the instrument is running. Oven-based systems cannot be accessed during operation, since the temperature will be affected.



- Sample tray temperature stabilizes rapidly when vials are added, allowing acquisition to start almost immediately, compared to oven-based systems that take up to an hour to stabilize at the reaction temperature.
- Heating a relatively small sample tray uses far less energy than a heated and fan-circulated oven enclosure, as well as being quieter to operate.
- The heated sample tray temperature can be controlled to ±0.1 °C between 30 and 90 °C. Oven-based systems only operate up to approximately 70 °C.

Sample vials that make your life easier

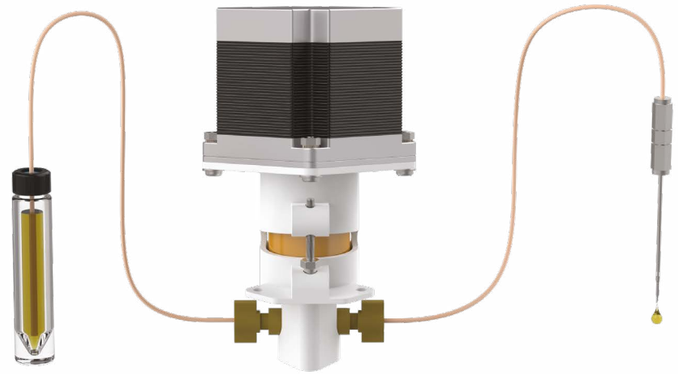
Carbonate analysis is performed in flat-bottomed, septum-sealed borosilicate glass vials with a conical section for focusing the acid onto the carbonate sample. These vials simplify workflows compared to other instruments, with benefits including:



- Samples can be weighed in advance, sealed in the vial, then stored awaiting analysis, allowing efficient workflow planning.
- Septa provide a consistent, leak-free seal compared to O-ring sealed sample vials, which need to be carefully aligned to ensure leak-tight fitting before evacuation.
- Carbonate samples can be weighed directly into sample vials on a microbalance, reducing the number of sample preparation steps and potential for errors.
- The vials have flat bottoms, making them easier to handle and work with compared to round-bottom vials.

Deliver your acid with precision

Precise delivery of high specific gravity orthophosphoric acid to your sample vial is critical. The volume and speed of delivery should be carefully controlled and consistent to ensure that samples are treated identically. The iso **CARB PREP** does this using a direct-drive, bi-directional pump which is considerably more sophisticated than gravity-fed acid systems and with full control of the pump from lytic**OS** software, you are in complete control of your sample preparation processes.



iso **AQUA PREP**

Automated high precision water analysis

iso **DUAL INLET** can be enhanced with the optional iso **AQUA PREP** system for the automated analysis of water samples using isotopic equilibration. The iso **AQUA PREP** delivers the highest $\delta^{18}O$ isotopic precision of any commercially available instrument, representing the best solution for paleoclimatology research. The systems can measure both freshwater and seawater samples for $\delta^{18}O$ and $\delta^{2}H$ (using a catalyst) without any issues with salt and mineral content, since the water sample is analyzed via headspace equilibration rather than direct measurement.

Unmatched $\delta^{18}O$ precision

The iso **AQUA PREP** sets the standard for $\delta^{18}O$ precision in water sample analysis. With a remarkable sample precision of better than 0.05 ‰ (1δ, n=10), it surpasses the capabilities of both continuous flow IRMS and cavity ring-down spectroscopy systems and is considered the gold standard for the isotopic analysis of water.

Exceptional sample throughput

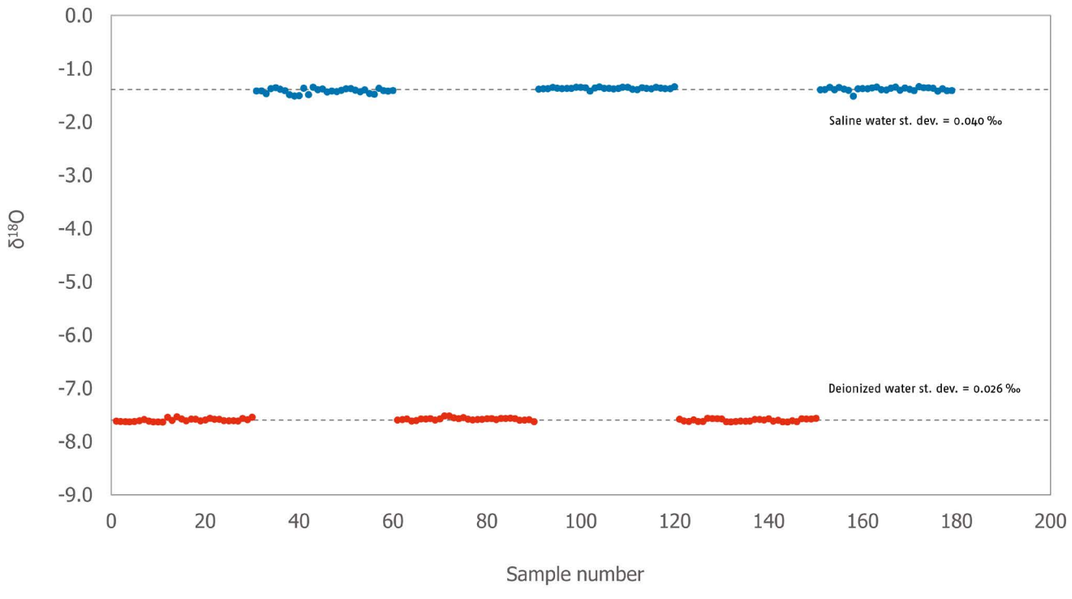
The instrument can analyze up to 180 samples in a single sequence, and delivers exceptional stability with no drift or intra-sample memory evident throughout the run. Coupled with parallel sample processing control, the system only takes ~20 minutes per analysis (after equilibration).

Simple set-up

The iso **AQUA PREP** uses a needle-based technique for analyzing samples prepared in septum-sealed vials. 200 µl of sample water is typically prepared into a 4 ml vial and isotopically equilibrated with pure CO_2 or H_2 gas using a single-core needle.

High performance water trap

The in-line water trap uses a closed-circuit refrigerant to cryogenically freeze water vapor coming from the sample vial. An automated bake and pump-out strategy keeps the system free from inter-sample memory.



Plot of $\delta^{18}O$ from 90 deionized water and 90 saline water samples analyzed in alternating batches of 30 samples

Isotopic equilibration meets dual inlet precision

The iso **AQUA PREP** is unique in its ability to combine water sample preparation through isotopic equilibration with dual inlet analysis. This integrated approach enables the precise measurement of oxygen or hydrogen isotopes in water samples, unaffected by salt, mineral, or organic contaminants. By employing the dual inlet method's multiple sample-reference comparisons, the iso **AQUA PREP** surpasses the precision that can be achieved with continuous flow IRMS techniques.

- Analyzing water via headspace equilibration ensures no interference from contamination, which is not possible via direct injection techniques
- The iso **AQUA PREP** delivers consistent sample gas loads to the ion source from the sample vial, reducing linearity effects and further increasing external measurement precision
- Automated sample equilibration routines deliver pure H_2 or CO_2 equilibration gas to the sample vial using an expansion/fill routine, rather than through-flow of the sample vial, as used in continuous flow analysis
- Dual inlet technology allows the instrument to be pumped out between samples, and baked to ensure no intra-sample memory effects

GAS	SAMPLE SIZE	ISOTOPE	PRECISION 2σ (‰)	n
CO_2	200 µl	$\delta^{18}O$	0.05	10
H_2	200 µl	$\delta^{2}H$	1.0	

Standard specifications for water analysis using iso **AQUA PREP**

isoprime precisION

The foundation of your dual inlet analysis

The most flexible IRMS

The **isoprime precisION** IRMS forms the foundation for the iso **DUAL INLET** system, and can seamlessly switch between dual inlet and continuous flow modes. This allows your instrument to be used for multiple sample types across a range of application areas, giving you the most flexible instrument to achieve your research goals.



Customize your instrument

For novel research requirements, choose a customized Faraday collector array for simultaneous acquisition of up to 10 ion beams. For ultimate flexibility, the Novel Inlet Control Module (NICM) allows you to integrate your own custom inlet systems and devices, as well as create your own software controls and processes.

COMPLETE FLEXIBILITY

ELEMENTAL ANALYSIS
- vario ISOTOPE select
- vario ISOTOPE cube
- vario PYRO® cube
- iso **TOC**® cube

CHROMATOGRAPHY
- GC5
- LiquiFace

HEADSPACE ANALYSIS
- iso **FLOW**
- iso **FLOW GHG**

SOFTWARE
- **Ar**DB

Great flexibility

The only dual inlet instrument to combine carbonate and water analysis in a single system

High sensitivity

Measure carbonate samples down to 20 µg thanks to the micro-volume LN_2 cold-finger

Small footprint

Almost 55 % smaller footprint than other dual inlet carbonate instruments

High data quality

Exceptional precision for carbonate and water analysis

Elementar – your partner for excellent elemental analysis

Elementar is the world leader in high performance analysis of organic and inorganic. Continuous innovation, creative solutions and comprehensive support form the foundation of the Elementar brand, ensuring our products continue to advance science across agriculture, chemical, environmental, energy, materials and forensics markets in more than 80 countries.

Elementar Analysensysteme GmbH
Elementar-Straße 1 · 63505 Langenselbold (Germany)
Phone: +49 (0) 6184 9393-0 | info@elementar.com | www.elementar.com

elementar
EXCELLENCE IN ELEMENTS

Art.-No. 10001023g, 02/2026 A