

# High Precision N<sub>2</sub>O Isotopic Analysis with the EnvirovisION as a conventional mass spectrometry analytical technique

Tuesday 9th<sup>th</sup> June 2026

ASITA

Dr Kyle William Robert Taylor



# EnvirovisION - configuration



## lyticOS™ Software Suite

Straight-forward, easy to use software for control of the entire system and automatic data processing



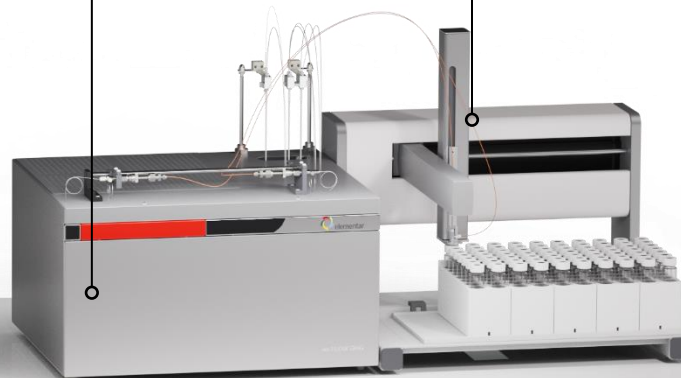
## isoprime visION stable isotope ratio mass spectrometer

Straightforward, high-performance measurement of  $^{15}\text{N}$  &  $^{18}\text{O}$  isotope ratios



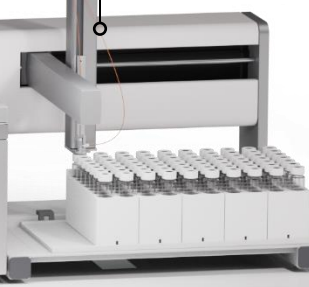
## iso FLOW GHG

Sample purification, cryogenic concentration and GC separation of  $\text{N}_2\text{O}$



## Gilson autosampler

Automated sampling process using dual core needle and septum sealed vials



# System Features – Highest precision analysis

- iso FLOW GHG delivers the highest performance greenhouse gas analyzer on the market
- Excellent precision for 100ml of N<sub>2</sub>O, CO<sub>2</sub>, and CH<sub>4</sub> at typical atmospheric concentrations
- Higher precision isotope analysis enables better resolution of different nitrate source allocation

Gas	Isotope	Precision (1 $\sigma$ , n=5, 100ml atmospheric conc.)	Previous specification (1 $\sigma$ , n=5, 100ml atmospheric conc.)
N <sub>2</sub> O	$\delta^{15}\text{N}$	$\leq 0.3 \text{ ‰}$	$\leq 0.5 \text{ ‰}$
	$\delta^{18}\text{O}$	$\leq 0.3 \text{ ‰}$	$\leq 1.0 \text{ ‰}$
CO <sub>2</sub>	$\delta^{13}\text{C}$	$\leq 0.2 \text{ ‰}$	$\leq 0.5 \text{ ‰}$
	$\delta^{18}\text{O}$	$\leq 0.2 \text{ ‰}$	$\leq 1.0 \text{ ‰}$
CH <sub>4</sub>	$\delta^{13}\text{C}$	$\leq 0.5 \text{ ‰}$	$\leq 0.5 \text{ ‰}$

# Post-ASITA Workshops!

## Post-ASITA Elementar Workshop: Registration



**Wed PM: 1:30 PM - 5:30 PM**  
***2 parallel sessions***

- Source Maintenance
- LyticOS Data Processing

**Thu AM: 08:30 AM - 1:00 PM** (*workshops start at 9:00*)  
***Possibly 2 parallel sessions (depending on final numbers for source workshop)***

- Source Maintenance
- EA & EA-IRMS

**Thu PM: 1:30 PM - 5:30 PM**  
***2 parallel sessions***

- Source Maintenance
- iso FLOW GHG for N2/N2O

# The Elementar IRMS Legacy: Made in Manchester

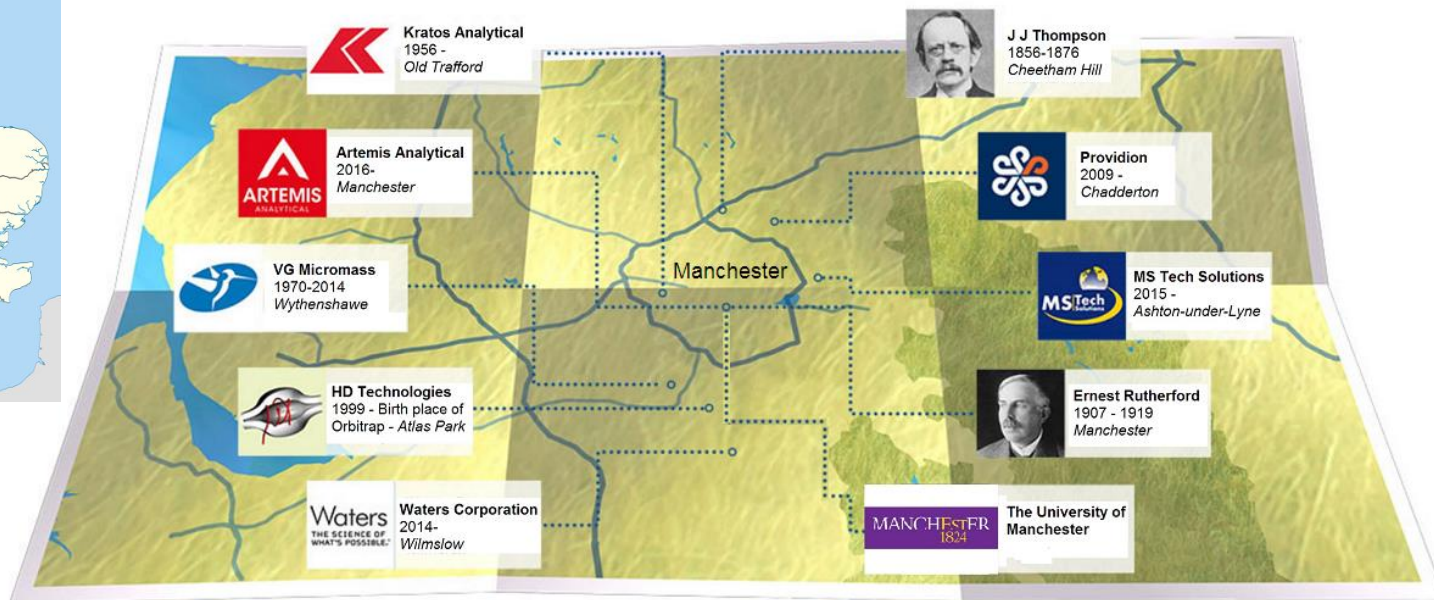
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ASITA 2026

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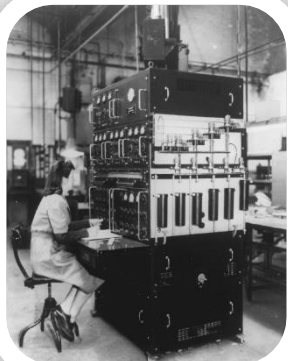


# Manchester – a History Steeped in Mass Spectrometry



<https://www.artemis-analytical.com/manchester-home-of-mass-spectrometry/>

1946



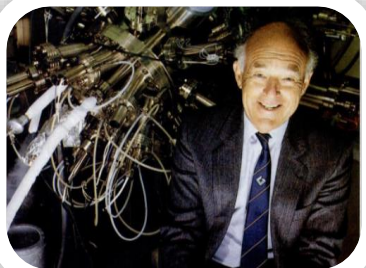
*Isotope analysis of uranium hexafluoride (UF<sub>6</sub>) by Anne Mettrick from MV on the MS1 mass spectrometer*

Metropolitan Vickers (MV) Electrical Company, based at Trafford Park in Manchester (UK), supplied the first commercial mass spectrometer to be built outside the USA (by Welsh chemist & physicist John Beynon). The first system was supplied to University of Liverpool (James Chadwick), for a project associated with the British contribution to the Manhattan Project. The successor MS2 included parts also used in the British Spitfire fighter plane!



*MVMS3, c. 1952 (David Walker, Univ. Hull)*

1962

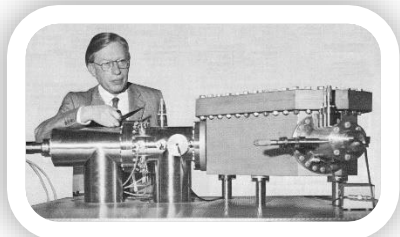


*Dr Bernard Eastwell, New Scientist 1987*

**Vacuum Generators Ltd. (VG) company** was formed in East Grinstead, UK by Dr Bernard Eastwell and Vic Treasure with a single product - the CR38 all metal right angled valve, specifically designed for innovative Ultra-High Vacuum (UHV) applications.



1968



*Physicist Robert D. Craig at VG*

Robert D. Craig joined VG, coming from the R & D department of Metropolitan Vickers (who built the first commercial mass spectrometer, the MS1, in 1946), and led their foray into mass spectrometry — from a tent pitched near the VG Charlwood Road facility. A portfolio of 1 cm & 6m single-focusing magnetic sector analyzers was developed, bearing the name **Micromass**.

1969

Tent-based mass spectrometry developments are suitably successful to prompt the formation of **VG Micromass Ltd**— with a total of 7 personnel, they set up shop in Winsford, UK—c. 30 miles south of Trafford Park in Manchester, continuing the mass spectrometry tradition in the North West UK (*Trafford Park 1969 pictured right, Manchester Evening News*)



1970

# Micromass 602

The Micromass 602 featured a dual collector and 6 cm radius (*pictured below at the University of Alberta, Canada*)



The Micromass 602 proved to be a reliable workhorse isotope ratio mass spectrometer, (IRMS) paving the way for the collection of vast quantities of data, globally. E.g. CSIRO Division of Atmospheric Research, Victoria, monitored isotopes in Tasmanian air CO<sub>2</sub> from 1977, until decommissioning in 1991! Scan the QR code to view a repository of published geoscience and environmental data generated using a Micromass 602 (hosted by PANGAEA)



1974

VG Micromass Ltd split to form four separate groups: **VG Isotopes**, VG Organic, VG Quadrupoles, and VG Data Systems; The rationale behind the split was B. Eastwell's 'Christmas card principle'; he posited that most people address Christmas cards to 50–100 people, and that therefore represents a natural maximum number of people with whom to associate in a company.



1976

# SIRA 9

*9cm radius IRMS*

The first IRMS to bear the name “SIRA” featured a manifold system for sampling multiple gas samples, and HP Basic software control. Of particular note for the SIRA 9 are analyses by prof. Nick Shackleton on carbonates in sediments retrieved from the Deep Sea Drilling Program (DSPD) / Ocean Drilling Program (ODP) / International Ocean Discovery Program (IODP) - e.g. ODP leg 113 in Antarctica which informed several important paleoclimate discoveries! Scan the QR code for an example data chapter from the ODP proceedings including SIRA-generated data:



*SIRA manifold at University of Tasmania, Australia*

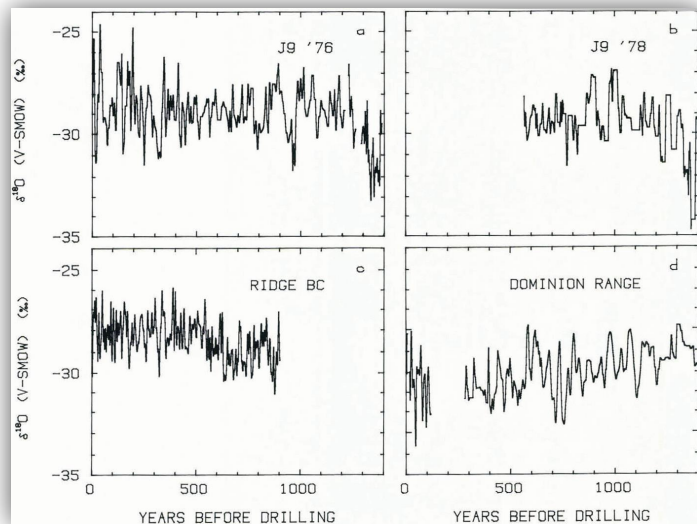




1978

# Micromass 903

9cm radius IRMS, First VG IRMS to feature a triple collector for simultaneous measurement of  $\delta^{13}\text{C}$  &  $\delta^{18}\text{O}$  in  $\text{CO}_2$



Some of the earliest long-term Antarctic ice core records were developed using a Micromass 903 IRMS (at University of Washington, Seattle), coupled to an automated online headspace equilibration system, the Micromass 5020 - much like the current day iso AQUA prep. Open access paper of 1400 years of ice core records is available following the QR code:

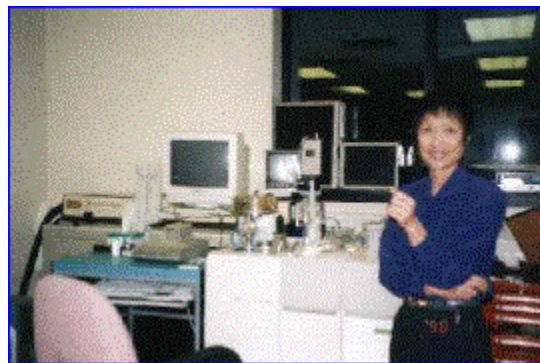
Grootes et al., 1 1400-year oxygen isotope history from the Ross Sea Area, *Antarctica Ann. Glac.* 14 (1990)



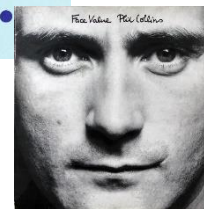
1981

# SIRA 12

*Updated electronics*



*Prof. Keiko Hattori stands with a CO<sub>2</sub> laser system interfaced to a VG Sira 12 for in-situ sulphur and carbon isotope analysis – University of Ottawa*



1984

# ANA SIRA 12

*Featured online EA-IRMS  
VG Isogas forms from VG Isotopes*



QUEEN THE WORKS





# SIRA 10

*Featured split flight tube for  $\delta^2\text{H}$  analysis*

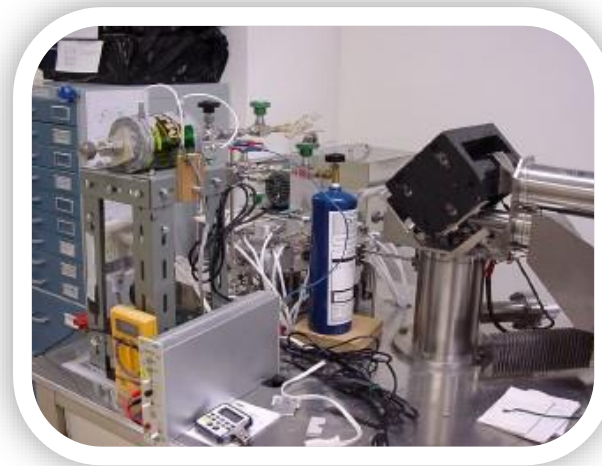
# PRISM I

*Large Radius IRMS*

The Institute for Planetary Materials, Okayama University, Japan host several legacy VG systems, all operational as of 2018. One SIRA 10 is dedicated to  $\delta^{34}\text{S}$  analysis of geological sulfur (materials are converted offline to  $\text{SO}_2$  for analysis by dual inlet *via* cracker tubes), where another is used for  $\delta^2\text{H}$  analysis of  $\text{H}_2$  or  $\text{H}_2\text{O}$  (via online Cr reduction). Users of the PRISM measure  $\delta^{13}\text{C}$  &  $\delta^{18}\text{O}$  of down to  $1\ \mu\text{l}$   $\text{CO}_2$  generated from silicates and carbonates.



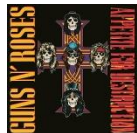
*Two VG SIRA 10 IRMS Instruments at the Institute for Planetary Materials, Okayama University, Japan*



1987

# PRISM II

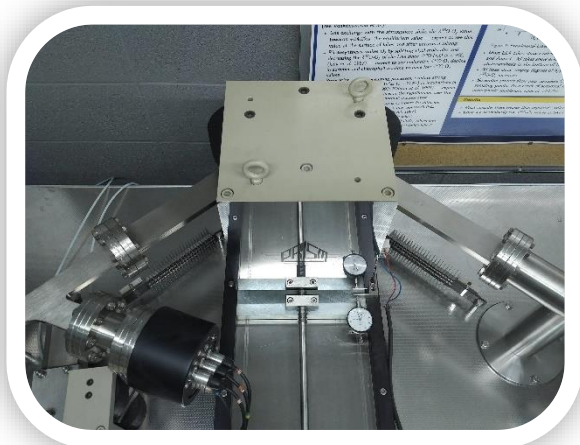
Large Radius IRMS



Alan Gagnon with a PRISM II at  
National Ocean Sciences  
Accelerator Mass Spectrometry  
(Woods Hole MA, USA)



VG PRISM at Institute for Planetary Materials,  
Okayama University, Japan



VG PRISM at University of Waterloo, Canada





1989

In 1989, VG Isogas merges back with VG Isotopes to form **VG Isotech**, and British American Tobacco (BAT) sold its majority stake in VG Instruments to Fisons (BAT had acquired the stake in VG in the early 80's).

**SIRA Series II** launched

A publication is submitted to Diabetologia documenting the first prototype of the VG ISOCHROM for GC-IRMS (based on interfacing with a SIRA 12). The system was used to measure exogenous  $^{13}\text{C}$  labelling of glucose at low enrichments. See QR code for open access paper:





# OPTIMA

OS2 based IRMS Software  
True Multi-tasking

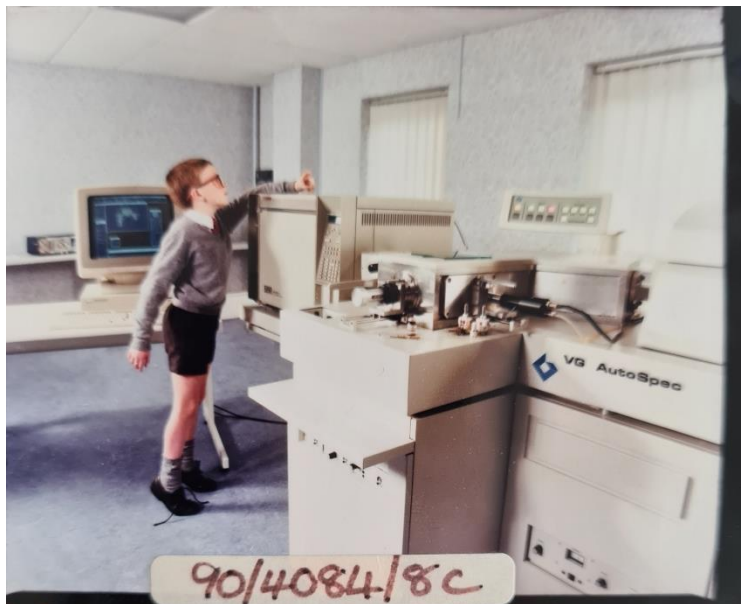


As attested to in these recent tweets, despite being over 30 years old many VG OPTIMAs remain in service to this day: for example, the VG OPTIMA at the British Geological Survey (BGS) , UK was only recently decommissioned (in Nov 2021) after analysing c. 100,000 carbonate samples for both  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  (and was the first IRMS used by Prof. Melanie Leng!). To follow Prof Leng on Twitter, see QR code:



1990

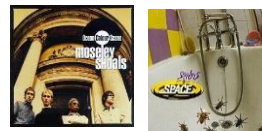
# VG Autospec



*Honorable mention – and an early start for an Elementar UK staff member who is still employed with us today (as was his father until retirement)*



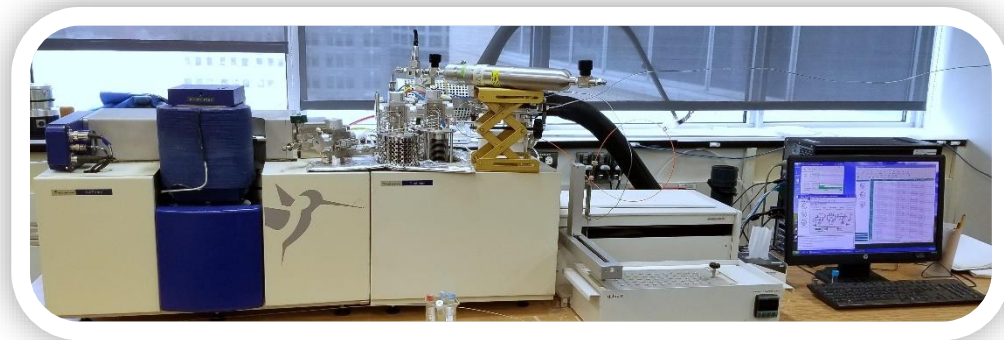
Thermo Instruments acquire Fisons Instruments, but are required to divest the IRMS products due to UK monopoly laws. These are then acquired by a small group of investors and incorporated as Micromass



# IsoPrime

*BenchTop IRMS  
MS Windows Software*

Waters purchase  
Micromass



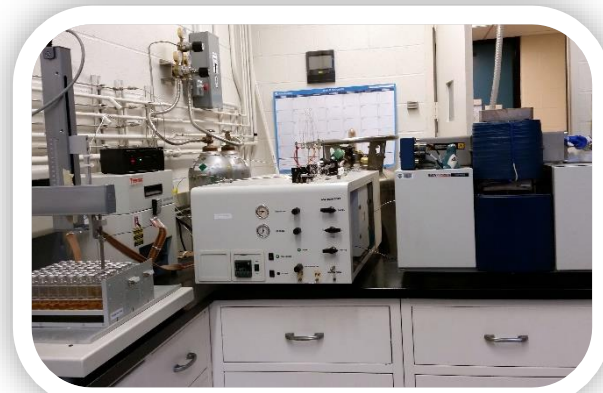
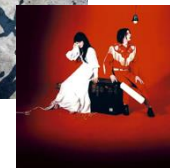
*A Micromass Waters-era benchtop IsoPrime IRMS with Dual Inlet and MultiCarb for high precision carbonate analysis, installed in the Light stable isotope geochemistry laboratory at Geotop-UQAM, Montréal, Canada. The facility also hosts several other legacy and modern IsoPrime IRMS systems: see their website at :*



2003



Waters divest the “Inorganic MS” (including IRMS) and sell to newly-formed GV Instruments (GVI), based in Manchester & headed by Dr. Tony Williams



*GVI-era Isoprime IRMS, still in use at the National Oceanographic Centre Southampton, UK (left) and University of Pittsburg, USA (right)*

2008



Thermo Electron Corporation acquire GVI, but are again required to divest the isotope (and Noble Gas) technologies.

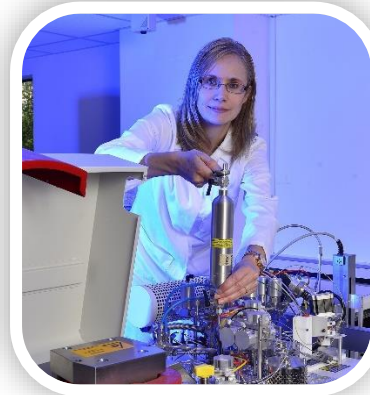


Elementar Analysensysteme GmbH purchase and incorporate the IRMS business as Isoprime Ltd. VG Isotech apps chemist Zenon Palacz formed Isotopx technologies

2010

## IsoPrime100

*100V Headamplifier  
IonVantage Software*



*IsoPrime100 systems housed at University of Bern, British Geological Survey, and University of Queensland*





# Isoprime visION

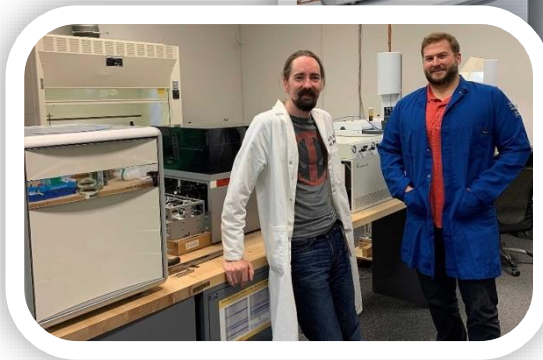


*Windows 10-based lyticOS software,  
significant system-ready and data  
processing automation*

*Kyle joins Isoprime Ltd as technical sales  
specialist!*



*GeovisION+ at  
National  
Oceanography  
Centre, Southampton  
(top), and  
PetrovisION+ at  
GeoMark, Houston  
(bottom)*



*Publication on whole  
crude oil analysis  
with PetrovisION  
(Barrie, Taylor &  
Zumberge, RCM, 2016)*



*Isoprime Ltd (now Elementar UK  
Ltd) are awarded the Queen's  
Award for Enterprise*



# Isoprime precisION

*Sister instrument to isoprime visION  
Enhanced inlet compatibility  
Novel Inlet Control Module  
Graphical interface for method  
development*

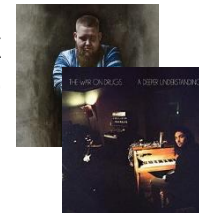
The National Environmental Isotope Facility (NEIF) at British Geological Survey (BGS) Nottingham, UK hosts several generations of Elementar IRMS, dedicated to challenging geological analyses; top right is an isoprime precisION with vario ISOTOPE cube for  $\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$ , and  $\delta^{34}\text{S}$  of solid geological and archaeological materials, behind it is a Geovision (isoprime visION with vario PYRO cube) largely dedicated to  $\delta^{18}\text{O}$  analysis of phosphate. Pictured bottom right is the recently installed isoprime precisION with iso DUAL inlet and iso CARB prep, for analysis of very small carbonates including single foraminifera.



2017



Isoprime Ltd becomes Elementar UK Ltd; change of name only, same management and ownership!



2021



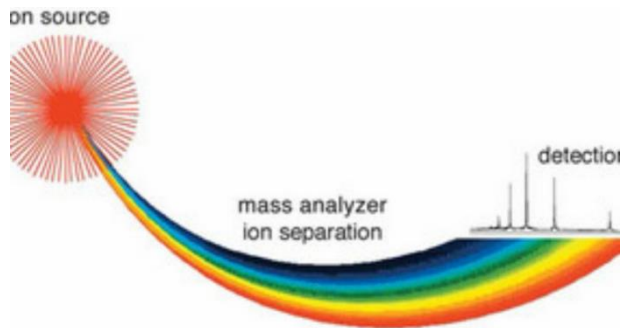
ionOS is renamed to lyticOS; change of name to reflect development of software for other Elementar analysers as well as IRMS. Current version 5.0 includes compound-specific chromatogram overlay, and a free data reader to encourage collaboration & data sharing

2022

Kyle Emigrates to Canada and joins Elementar Americas Inc. as IRMS Business Development Manager; first N. American Elementar IRMS User Meeting to be organized by Elementar Americas Inc., at James Madison University, Harrisonburg, VA



# Whatever Happened to the Hear-os? *I turned them into a Spotify Playlist...*





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