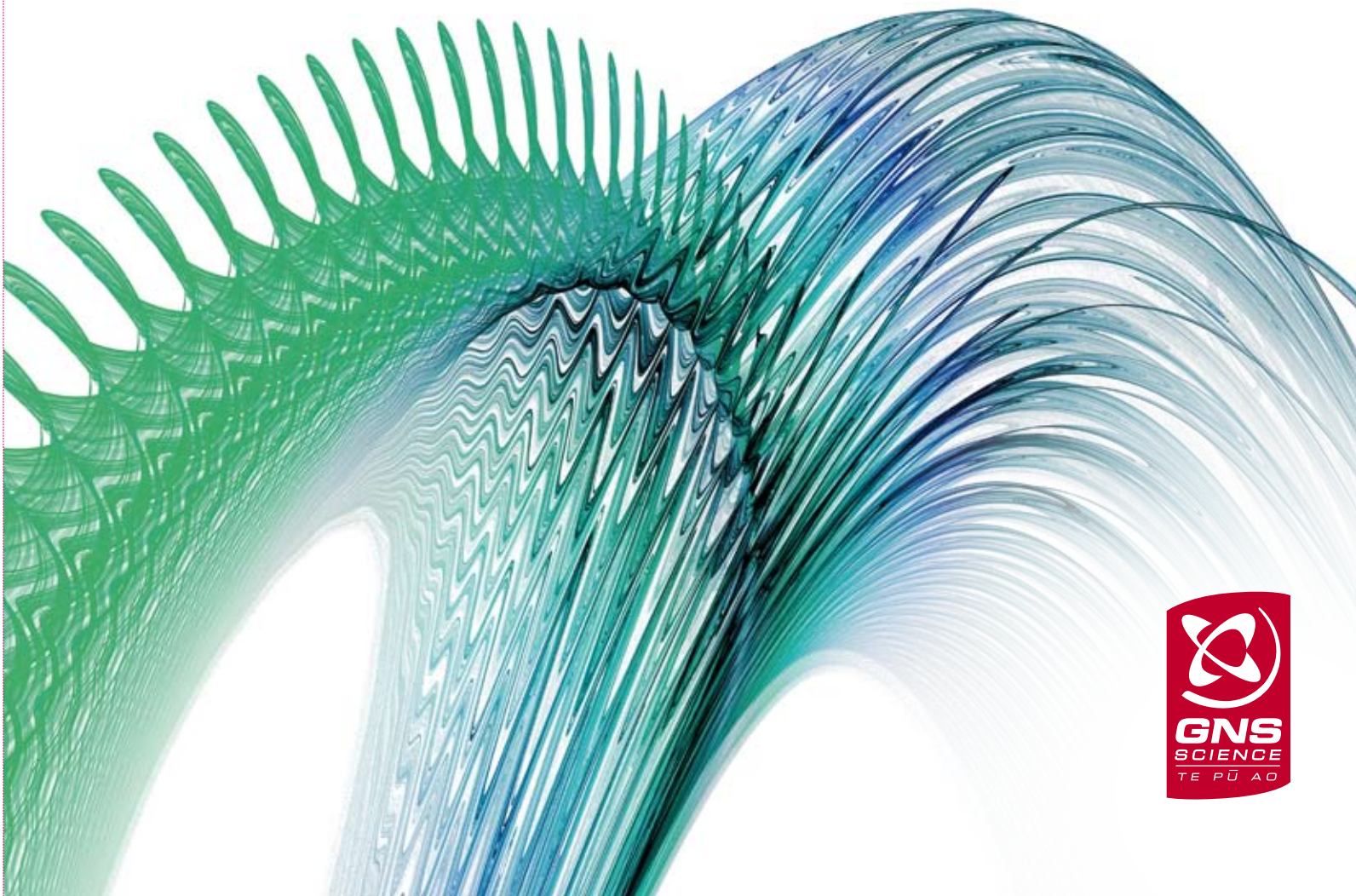
inside knowledge

stable isotope science and services



GNS SCIENCE
TE PŪ AO

contact us

To know more about the services and expertise of GNS Science's Stable Isotope Laboratory team visit:

www.gns.cri.nz/nic/stableisotopes

or call us on

+64 4 570 4645

or email us at

stableisotopes@gns.cri.nz

Technical Team includes:
Valerie Claymore
Laboratory Manager
Andy Phillips
Mass Spectrometer Engineer
Jannine Cooper
Mass Spectrometer Technician
Pam Rogers
Sample Preparation Technician

NIC Location

National Isotope Centre
30 Gracefield Road
Lower Hutt 5010
PO Box 31312
Lower Hutt 5040
New Zealand
T +64-4-570 1444
F +64-4-570 4657

Principal Location

GNS Science
1 Fairway Drive, Avalon
Lower Hutt 5010
PO Box 30 368
Lower Hutt 5040
New Zealand
T +64-4-570 1444
F +64-4-570 4600

Other Locations

Dunedin Research Centre
764 Cumberland Street
Dunedin 9016
Private Bag 1930
Dunedin 9054
New Zealand
T +64-3-477 4050
F +64-3-477 5232

Wairakei Research Centre
114 Karetoto Road
Wairakei 3377
Private Bag 2000
Taupo 3352
New Zealand
T +64-7-374 8211
F +64-7-374 8199

GNS SCIENCE TE PŪ AO

new perspectives

From understanding the diets of prehistoric people, to exploring climate and environmental issues, GNS Science's Stable Isotope Laboratory at the National Isotope Centre plays a pivotal role in numerous areas of research.

You can be certain of our leading edge capability in isotopic analysis. We offer a specialist team and five mass spectrometers. We also embrace a long tradition of scientific research and excellence: our Stable Isotope Laboratory opened back in 1959.

Based in Wellington, New Zealand, the Stable Isotope Laboratory is held in high international esteem, with ongoing research and industry partnerships around the globe.

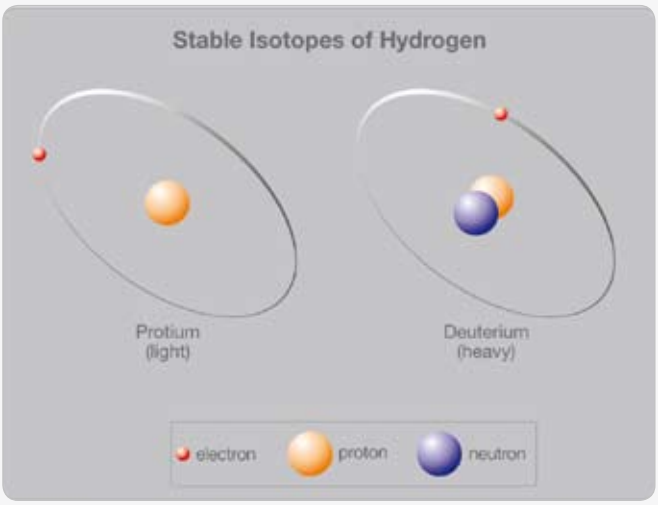
Within New Zealand, the Stable Isotope Laboratory is the leading provider of isotope science expertise and associated commercial applications.

This brochure introduces our expertise.

GNS SCIENCE
TE PŪ AO

stable isotopes

Stable isotopes provide a powerful range of tools for research



Isotopes are atoms with the same number of protons and electrons, but different numbers of neutrons. This gives them different atomic weights for the same atomic number.

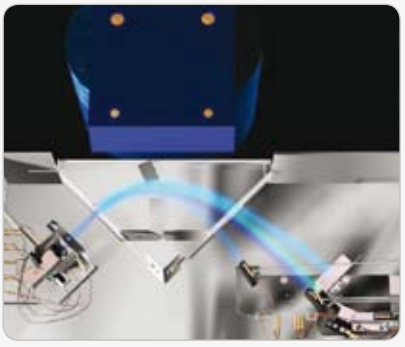
Stable isotopes occur naturally and are not radioactive. While the isotopes of an element have similar chemical behaviour, during certain processes the ratio of heavy to light isotopes change. The isotopic ratio can reveal where the material is from, what processes it has gone through, and how much it has changed.

Isotopic ratios are measured using an isotope ratio mass spectrometer (IRMS). There are two main modes of IRMS: dual inlet (DI) and continuous flow (CF). Each has advantages for different applications.

Stable isotope ratios are expressed as delta values (δ) in units of per mil (‰) which relate to international scales. To calculate the delta value of an unknown sample you compare the measured isotope ratio of a known reference to the measured isotope ratio of the sample.

Latest technology

Our facility offers five mass spectrometers and numerous peripherals for automated sample preparation. In addition, we operate a modern and well-equipped offline sample-processing laboratory.



Mass spectrometers

- GV Instruments IsoPrime DI and CF
- GV Instruments IsoPrime CF
- Europa Geo 20-20 DI and CF
- PDZ Europa Geo 20-20 DI and CF
- MicroMass 1202 DI.

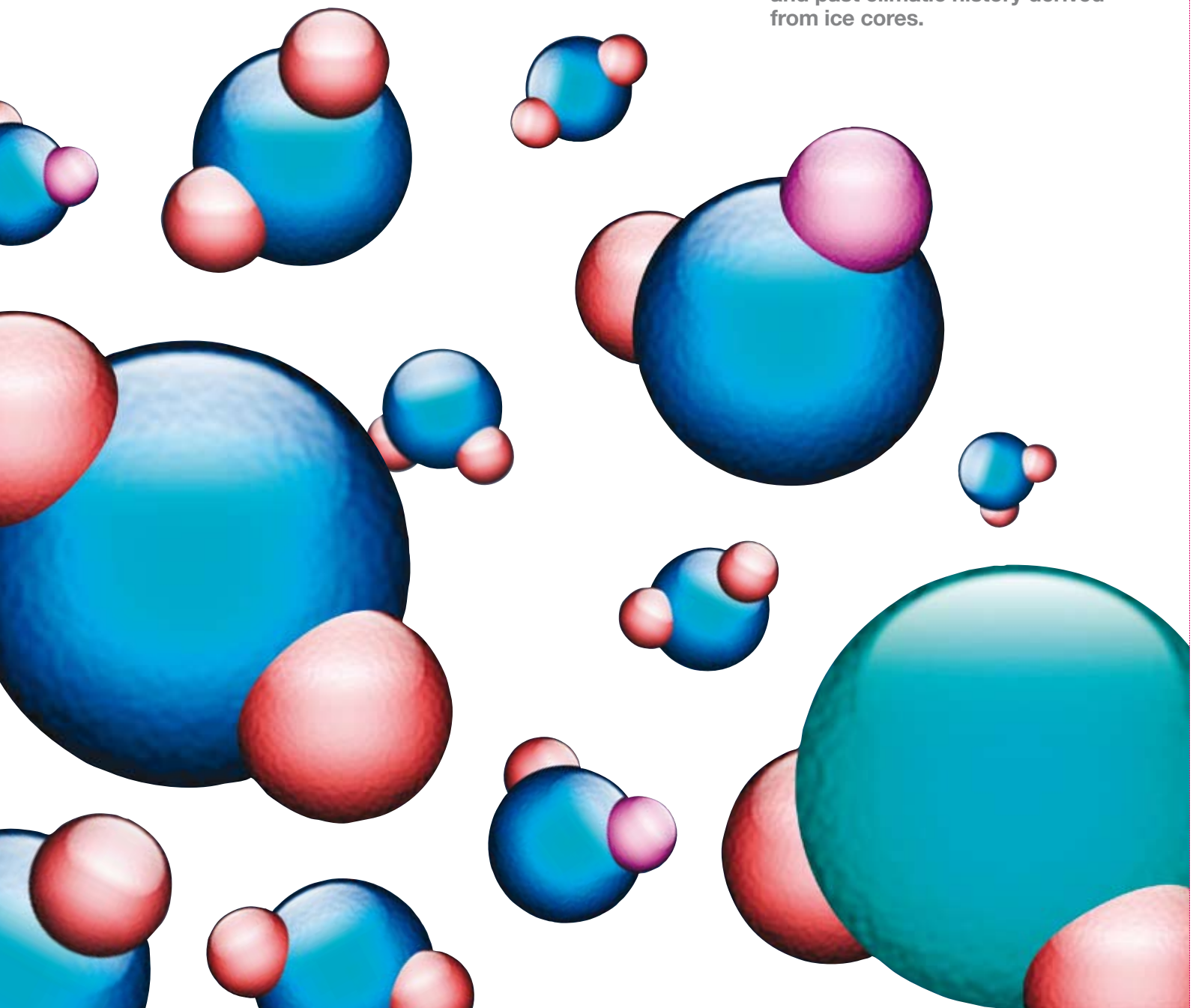
Mass spectrometer peripherals

- GV Instruments AquaPrep for $\delta^{18}O$ values of water
- GV Instruments PyrOH for δD values of water
- HEKAtech HT-EA for $\delta^{18}O$ and δD values of solid samples
- Agilent Gas Chromatograph for Compound Specific Isotope Analysis (CSIA) for $\delta^{13}C$ and δD values of liquids and gases
- PDZ Europa CAPS for $\delta^{13}C$ and $\delta^{18}O$ values of carbonate samples
- PDZ Europa ANCA for $\delta^{13}C$ and $\delta^{15}N$ values of organic samples
- Sercon SEA for $\delta^{34}S$ values of inorganic and organic samples.

Complementary Services

Additional analytical services by other GNS Science laboratories can complete the scope and understanding in your isotopic study. For a list of all our services visit www.gns.cri.nz/services

Stable isotopes of water can tell us all about the source of the water, the extent of evaporation, and past climatic history derived from ice cores.



optimum scientific accuracy

GNS Science's Stable Isotope Laboratory supports research in hydrology, geothermal, mineral and hydrocarbon resources and environmental and climate geoscience.

We also offer specialist support for ecology, archaeology, detection of food adulteration, and a wide range of geological applications. Our on-site, purpose-outfitted laboratories and specialist technicians can process many types of inorganic and organic material for isotope analysis. To assure you of optimum scientific accuracy, our scientific team are also committed to an ongoing programme of research and development of techniques.

Please contact us to obtain no-obligation technical advice on your specific research aims and sampling requirements for stable isotope analyses.

Collaboration welcome

Researchers from universities, governments, and commercial organisations worldwide call on us for stable isotope analysis for an impressive range of projects and applications. We welcome collaborative research proposals as well as the opportunity to assist and contribute to research design. Our team also participates in international ring-tests such as Forensic Isotope Ratio Mass Specrometry (FIRMS), and International Atomic Energy Agency (IAEA) calibration tests. We have made and supplied international standards to the IAEA.

A growing list of international research partnerships since 2005 includes:

- Department of Ecology and Marine Science and Department of Earth Sciences, French Reunion University, France
- Research Center for Coastal Lagoon Environments, Shimane University, Japan
- English Heritage, UK
- Department of Geography and Geology, Indiana State University, USA
- Department of Earth Sciences, Indian Institute of Technology, Bombay, India
- Research School of Earth Sciences, Australian National University, Australia
- Centre of Excellence in Ore Deposits, University of Tasmania, Australia.

Areas of expertise

- Paleoclimate: analysis of oxygen and hydrogen isotopes of ice cores to reconstruct past climate
- Environment: analysis of nitrogen isotopes in water systems, to understand effects of land use and pollution on estuaries, lakes and near-shore marine systems
- Ore deposits: analysis of hydrogen, carbon, oxygen and sulphur isotopes of minerals associated with ancient ore deposits, and minerals actively forming at hot springs and submarine volcanoes
- Soils, forests and agricultural research: analysis of carbon, nitrogen and oxygen isotope ratios in organic matter, water and greenhouse gases
- Hydrology: analysis of oxygen and hydrogen isotope ratios in water, and dissolved carbon in the natural added tracers of environmental and engineering systems
- Fluid geochemistry: applying oxygen, carbon, hydrogen, nitrogen, and sulphur isotope geochemistry to geothermal and volcanic hydrothermal environments
- Geology: analysis of hydrogen, carbon, oxygen and sulphur isotope ratios of rocks from all environments – to better understand how they formed
- Paleodiet and ecology studies: analysis of carbon, nitrogen and sulphur isotopes, to investigate ancient diet and food web relationships
- Forensic studies: detection of food and beverage adulteration and compound - specific analysis of illegal substances
- Hydrocarbon research: analysing carbon and hydrogen isotope ratios in oils, gases, and source rocks to differentiate between different families of oil and their source rocks.

our people and work

Our people and facilities are internationally recognised for excellence in research partnerships delivering global science outcomes.

Frozen diaries and deep water mysteries

Dr Nancy Bertler uses ice cores from Antarctic coastal regions to reconstruct the climate history of the planet. The information contained in the ice of the vast Antarctic ice sheets resembles detailed diaries of past climate conditions, minutely describing temperatures, accumulation, storminess, atmospheric circulation patterns, greenhouse gas concentrations and sea-ice extent through past millennia with sub-annual resolution. This information helps us to understand climate drivers and allows us to predict changes in a warming world.

Email n.bertler@gns.cri.nz

Ice core drilling on the McMurdo Ice Shelf, Antarctica.

Bruce Christenson sampling high temperature fumarole gas emissions on White Island volcano, New Zealand.

Insight into heat-source environments

Dr Bruce Christenson specialises in studying volcanic hazards and geothermal resources, using chemical and stable isotope analysis of hydrothermal fluids. Bruce has advanced the development of techniques that provide fundamental insights into the nature and locations of the magmatic heat sources driving volcanic and geothermal systems.

Email b.christenson@gns.cri.nz

Cycling of nutrients through the earth

Dr Troy Baisden focuses on using carbon and nitrogen isotopes to quantify relationships between soil carbon storage and nutrient cycling in productive and natural ecosystems. His work's strong foundation in modelling allows understanding of carbon and nitrogen cycles to be extended nationally, and to be connected to economic models.

Email t.baisden@gns.cri.nz

Troy Baisden collecting soil horizons for isotope analysis, Manawatu coast, New Zealand including climate change and water quality.

Understanding environmental contamination, petroleum and more

Dr Karyne Rogers focuses on environmental research, using stable isotopes to detect the source and fate of anthropogenic nitrogen and carbon in aquatic systems and determining the effects of urbanisation and landuse change on biodiversity of macrofauna. She contributes to New Zealand's petroleum basin assessments, using both bulk and compound-specific isotope analyses to elucidate oil families and associated source rocks. Also, as a scientist-in-residence at Te Papa Museum, she is applying stable isotope techniques to heritage and cultural materials to determine their source and provenance.

Email k.rogers@gns.cri.nz

Dr Klaus-G. Zink is an organic geochemist. He specialises in studying molecular and stable isotopic compositions of petroleum and source rocks to correlate oils, gases and their source rocks. He also has experience in using molecular and isotopic data in paleoclimate and environmental studies to track rapid changes in temperature and vegetation during late glacial to Holocene times.

Email k.zink@gns.cri.nz

"Jar burial" sites, Cardamom Mountains, Southern Cambodia.

Reading nature's barcodes

Dr Nancy Beavan-Athfield uses stable isotopes as 'nature's barcodes' – to quantify both modern and ancient diets of animals and humans. Dietary analysis assists the study of extant and extinct animal populations, and provides a window into past human populations to understand issues such as the development and change in societies over time.

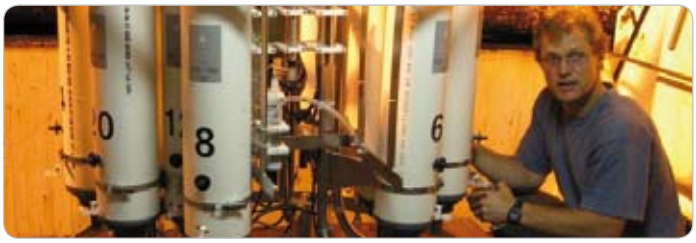
Email n.beavan@gns.cri.nz

Going to the source of mineral deposits

Dr Kevin Faure specialises in the study of stable isotope geochemistry, particularly in its application to mineral deposits and palaeoenvironmental studies. Kevin is part of a GNS Science team that is researching vent fluids associated with active submarine volcanism along the Kermadec Arc. Recently he has applied knowledge gained from exploring active submarine volcanoes to discovering gas hydrate deposits that occur under the sea bed along the Hikurangi margin of New Zealand.

Email k.faure@gns.cri.nz

Dr Cornel de Ronde specialises in seafloor hydrothermal systems, in particular those associated with submarine arc volcanoes. He has led a New Zealand team for the past 8 years that has systematically explored, both physically and chemically, hydrothermal vent fields along the Kermadec-



Kevin Faure with GNS Science's Hydrothermal Plume Profiling instrumentation.

Tonga arc and around the world. His focus has been on the global scale of hydrothermal emissions from intraoceanic arcs and the formation of massive sulphide deposits associated with the vent fields, using stable isotope analysis of sulphur.

Email cornel.deronde@gns.cri.nz