worlds of discovery

national isotope centre

GNS SCIENCE
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Isotopes – keys to the past, present and future

The key purpose of our scientific activities is to make use of the mass (weight) differences between different varieties (isotopes) of the same element to decipher their genesis and their physical, chemical and biological sources. The source may be natural – water, oil, wood, rock, soil – or artificial – air pollutants, water contaminants, fertilisers, pesticides. Therefore, analysis of the distinctive isotopes of a material allows us to understand its ecological and environmental past, present and future. Isotopes also have applications which provide significant technological opportunities for New Zealand businesses and the economy.

Discovery

national isotope centre

Gaining insights into real rates of climate change. Enhancing the health and safety of all New Zealanders. Opening fresh opportunities for New Zealand businesses. Striving for a sustainable future. In these and numerous other areas, the expertise of GNS Science is continually leading to discoveries that enrich our world.

World-leading expertise

Isotope sciences offer opportunities for advances in nearly all branches of science and in many industries. The work of the National Isotope Centre (NIC) is highly regarded around the world. The NIC is New Zealand's number one provider of isotope science expertise and associated commercial applications. We deliver research and industry applications around the globe. But at the heart of all our work is the fact that it needs to be of long-term benefit to New Zealand.

Our basic science teams span climate research, environmental protection and sustainability, nanotechnology, and hydrocarbons research. Our applied commercial teams focus on radiocarbon dating, ion beam analysis, stable isotope analysis, and water dating.

The NIC is an integral part of GNS Science, based in Lower Hutt, New Zealand, and employs 45 scientists and technicians, plus support staff.

Core NIC equipment:

- Linear accelerators
- Ion beam implantation and analysis
- Ice core research laboratory and storage
- Water dating laboratory
- Stable isotope laboratory

Contact us

You can find out more about the NIC and GNS Science on our web site. To discuss how our expertise can support your work or project, please contact us.

Visit www.gns.cri.nz/nic

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Inspiration

For the environment

Global climate change and greenhouse gas issues are of fundamental importance to the world's present and future generations. By signing the Kyoto protocol, New Zealand has committed to the search for innovative social and technological solutions. Success depends on knowledge.

Our scientific teams do research to:

- Understand long-term climate trends as well as abrupt climate changes
- Gain insight into changing levels of carbon in the water, atmosphere and land
- Quantify New Zealand's greenhouse gas emissions and absorptions

The outcomes of these research programs are providing significant input into the global response to climate change. We also explore New Zealand's unique situation and needs, helping to support development of New Zealand government policy, and the country's preparation and readiness for potential impacts of climate change.

For innovation and technology

The NIC is continually exploring opportunities to drive the future economic success of New Zealand.

Around the world, isotope sciences are widely recognised as a key to new technology and understanding. By working with businesses and organisations nationally and globally to build understanding and deliver commercial solutions, we are helping to ensure New Zealand gains long-term benefit from scientific advances. It's about New Zealand being a global player.

Our key commercial work revolves around:

- Developing non-invasive scanners for industry, to analyse the composition of specific products and materials such as meat, fruit, timber and metal
- Offering detailed insight into product type, quality and readiness for market
- Researching different aspects of nanotechnology and the potential application for commercial products of the future
- Developing techniques to better understand and to benefit in a sustainable way from New Zealand's petroleum and gas resources

For public health and safety

Air, water and land are all essential to health and safety – for people and all other forms of life.

We undertake diverse research to monitor and better understand key health and safety issues – and share this understanding with organisations and communities around New Zealand and the world.

Our public health and safety focus includes:

- Water dating to understand aquifiers and their suitability for drinking, irrigation and recreation
- Pinpointing the exact source and makeup of toxic emissions and their impacts on air quality
- Assessing food quality

For a sustainable future

As global resources become increasingly scarce, and environments increasingly threatened, issues of sustainability take on ever more importance. This is recognised by protocols such as the World Summit on Sustainable Development for Clean Water, Health, Agriculture and Energy, as well as the United Nations' Millennium Development Goals.

In numerous ways, we are working to support the long-term protection and sustainable use of resources, locally, nationally and internationally.

Our research includes:

- Supporting effective management of water and geothermal resources
- Ensuring food safety and security
- Assisting the protection of land and water environments from pollutants

Also important to the future, we are proud to assist universities in expanding their education portfolios. We give students access to our research facilities, and offer them opportunities for hands-on experience and learning in isotope sciences.

Action

Ice

The NIC's Ice Core Research Laboratory is a new purpose-built state-of-the-art cold storage and research centre, where scientists push the frontiers of climate-change research.

Ice cores from up to 700m depth are retrieved mainly from Antarctica and New Zealand's Southern Alps. New Zealand is a key geographical location in such study, as we're at the boundary of the polar front between northerly and southerly airflow systems.

In conjunction with researchers from other national and overseas centres, NIC scientists are unravelling southern hemisphere climate evolution over the last several thousand years. The analysis of the ice, its impurities, and the air trapped in the ice is improving our understanding of what drives climate change. This also provides crucial knowledge to forecast future climate impacts on New Zealand.

Soil

Predicting how soils will influence and respond to climate change is a critical aspect of managing agricultural and forest ecosystems.

Soils store carbon in their organic matter – they currently hold more carbon than the atmosphere and all the world's plants combined.

However, the capacity of soil to hold organic matter is sensitive to climate. Soils are predicted to react to local warming by releasing carbon as carbon dioxide, the most important greenhouse gas causing global warming. This positive feedback accelerates the speed of climate change. Soil organic matter also underpins the health of ecosystems, sustaining plant production through nutrient and water retention.

How much soil carbon could be released by local warming, causing more global warming and pressure on sensitive ecosystems? Research at the NIC on carbon cycling in soils will deliver improved understanding of how fast and how much soils are likely to respond to climate change. This in turn will suggest which soil management practices are most likely to mitigate environmental damage – by maximising soil organic matter.

Water

Water Dating Laboratory specialists are delivering powerful knowledge for protecting and cleaning up our lakes.

Using the isotope signature of water, our scientists are finding out the exact ages of many different sources of groundwater travelling into our lakes. This allows them to determine the water's nitrate contamination over time.

A good example is the clear picture now being built up of how long groundwater takes to reach Lake Rotorua, where much of the groundwater is 30 to 100 years old. This will enable land to be "retired" in the most effective places. Because the natural nitrate levels in old groundwater are being determined, present changes in groundwater and lake contamination can also be identified. Further, we are able to accurately forecast future levels of lake contamination, as groundwater feeds into the lake.

This understanding is vital to effective action. Ten springs feed into Lake Rotorua. The volume of groundwater in just one of them is five times that of the whole lake!

In other areas of New Zealand, NIC groundwater dating specialists are working to understand the size and flow of groundwater systems. This is crucial: over-extraction of water means the whole system collapses. Knowing what the resource can bear means it can be used in a sustainable way.

Primary Products

The ISOSCAN team has developed many prototype real time and non-invasive scanning systems. Several of these world-first systems have been successfully commercialised for the timber, horticulture, meat, and mineral industries.

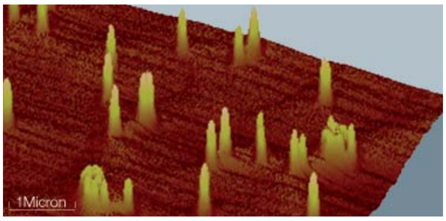
One example is a scanner to measure the green density (incorporating wetness) of timber. This enables mills to easily sort each piece of timber, before kiln drying, so the drying time ensures the correct final moisture content.

The increased accuracy means less timber is over-dried, and there is far less chance of warping. That in turn means less wastage when timber is planed to straight. Further, because kiln time is more efficient, there are big energy savings.

In Australia around 80 percent of all structural timber is now scanned with our solution; it has also been sold in North America. The benefits are quickly realised, with payback on the investment usually within six months.

Another successful NIC solution measures the fat content of meat (both loose and boxed). This allows meat processors to ensure all their meat has the ideal fat percentage to maximise financial return. Because all of the meat is scanned in real time, this solution is far more reliable than sampling techniques. When necessary, meat can simply be repackaged to achieve the ideal fat percentage. In a competitive industry, the savings are major. This NIC-developed scanner is licensed to a US company and is sold globally.

Working with industry partners, our team continually has new scanners under development – always helping to deliver a powerful edge.



Atomic structures

NIC scientists are developing prototype nanostructures (atomic-scale structures) that will form the basis of electronic equipment of the future.

For example, using our unique fabrication process we have built silicon nanostructures, for which we hold an international patent. These are tiny silicon-based structures that are highly conductive to small amounts of electricity and emit bright light. They could well become a key component of the next-generation television and computer screens. These will be highly energy efficient, brighter, sharper and faster to respond than plasma and LCD screens.

In another exciting development, we are modifying zinc oxide material to produce diodes that are highly efficient emitters of light. This is likely to lead to a new generation of Light Emitting Diodes (LED) for domestic and industrial use. Similarly, these would be brighter and more energy efficient than existing technology.

Carbon-based materials

Accurate dating of carbon-based materials has created an international reputation for NIC's Rafter Radiocarbon Laboratory.

For over 50 years the Rafter Radiocarbon team has delivered expert analysis for, and entered numerous professional collaborations with, a wide range of clients including geologists, climate-change researchers, antiquarians, and archaeologists.

Today, this strong foundation enables us to expand the horizons of radiocarbon dating. We support research in a host of other scientific areas, including archaeology, geology, atmospheric studies, and dating of past earthquakes and eruptions. We even determine the ages of deep ocean fish species to advise government on management and sustainability of fish stocks.

The NIC provides a range of advice, services and collaborations at both a national and international level. Key collaborators include:

- University of Auckland
- Victoria University of Wellington
- University of Canterbury
- University of Otago
- University of Waikato
- Lincoln University
- Massey University

- Industrial Research
- Crop and Food Research
- HortResearch
- NIWA
- Landcare Research
- The MacDiarmid Institute

- New Zealand Local Government authorities
- New Zealand Central Government agencies
- New Zealand industry

- Australian Nuclear Science and Technology Organisation
- International Atomic Energy Agency
- US and European universities

Discover more:

To know more about New Zealand's National Isotope Centre please visit

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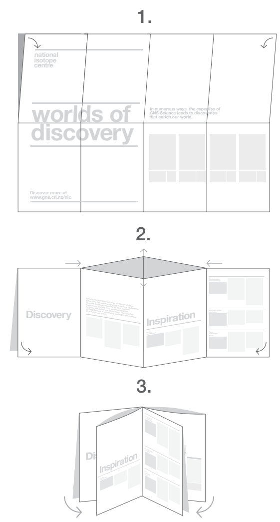

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