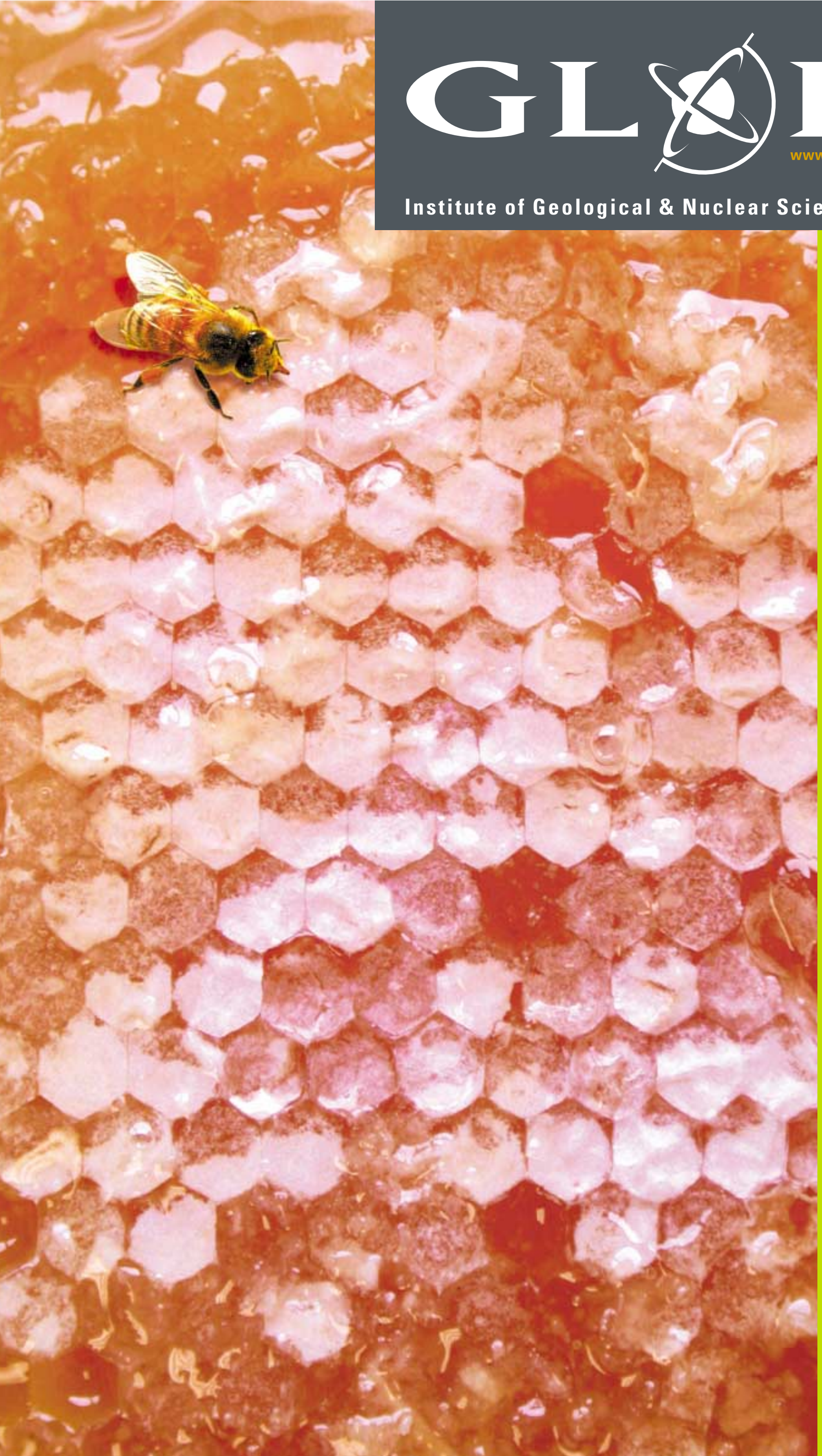

GLOBE

www.gns.cri.nz

Institute of Geological & Nuclear Sciences Newsletter

16

JUNE 2002

The Institute of Geological & Nuclear Sciences Limited (GNS) is New Zealand's leading provider of earth and isotope scientific research and associated commercial services. GNS is an independent, government-owned company.

Globe is published by GNS to publicise the research and consultancy work of the company.

DIRECTORY

Acting Chief Executive Officer

Graham Clarke

Commercial Services General Manager

Craig Finch
Phone: +64 4 570 1444
Fax: +64 4 570 4600

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Correspondence

We welcome comment on articles in *Globe* and on any related matters. Correspondence should be directed to John Callan at j.callan@gns.cri.nz

Circulation

Globe is distributed free of charge. Additional copies may be obtained from the Institute of Geological & Nuclear Sciences, PO Box 30-368, Lower Hutt, New Zealand.
Phone: +64 4 570 1444, Fax: +64 4 570 4600
Internet: http://www.gns.cri.nz

Production

John Callan (Editor) and Scenario Communications.

Publications

For information on GNS's extensive range of educational, general interest and scientific publications, please contact:
Janice Wright
Phone: +64 4 570 4866 (direct)
Phone: +64 4 570 1444
Email: j.wright@gns.cri.nz or visit:
www.gns.cri.nz/help/publications/index.html

Cover image: Honey is one of a number of natural products analysed for purity at GNS's Stable Isotope Laboratory. Story page 3.

ISSN NO: 1172-8922

Strategic alliances a priority for new CEO

Professor Alex Malahoff, Chief Executive designate of GNS, sees strategic alliances as a major thrust as GNS continues building itself into the premier geosciences organisation in Australasia.

Strategic alliances will enable GNS to develop more and better capabilities so it can make greater contributions to New Zealand and the Pacific Rim.

Dr Malahoff is scheduled to take up his appointment on 1 July 2002. For the past six months he has spent one week a month in New Zealand on GNS business, having direct input into company operations.

A GNS Board member for the past three years, Dr Malahoff is Professor of Oceanography at the University of Hawaii. He has also been a Director of the Hawaii Undersea Research Laboratory, a world-class centre for deep-sea exploration.

Much of his career has centred on the great tectonic features and submarine volcanism of the South Pacific, particularly the Hawaiian islands. Last year, he received an honorary doctorate from Victoria University of Wellington for his achievements in oceanography, geophysics, and marine engineering.

A veteran of more than 200 dives in US, Canadian, Russian, and Japanese research submersibles, he has developed world-class technologies for undersea exploration and researching marine geology. He is noted for his study of a newly-formed undersea volcano named Loihi which may eventually become an Hawaiian island.

He left New Zealand in the 1960s with an MSc from Victoria University and gained a PhD in geophysics at the University of Hawaii. In the 1970s he was in the first intake of the US Government's senior executive training scheme set up by Jimmy Carter. He was then seconded as chief scientist, National Ocean Survey of NOAA – the National Oceanic and Atmospheric Administration.

A speaker of five languages, Dr Malahoff is a strong believer in the value of science outreach activities. As well as building substantial links with the education, business, and government sectors, he is enthusiastic about keeping the public informed about developments in earth sciences.

GNS Chairman, Dr Derek Milne, said the GNS Board was delighted that Dr Malahoff had joined GNS, as his reputation and experience in earth and ocean sciences, together with his extensive international links, would be valuable to GNS.

For Dr Malahoff it is full circle. His first job after graduating from university was as a geophysicist with the former DSIR in Wellington. He will replace Graham Clarke who has been Acting Chief Executive since the departure of Dr Andrew West in 2001.

Prof Alex Malahoff (left) and Prof Alan MacDiarmid, 2000 Nobel Prize winner in chemistry, during a recent visit to GNS's Rafter Isotope Facility in Lower Hutt.

Zespri and GNS IsoScan work on quality control

GNS is working with ZESPRI Innovation Co Ltd to develop non-destructive ways of measuring kiwifruit quality. The aim is to have rapid low-cost assessment of fruit quality to improve inventory management. The new technologies will also provide growers with more detailed and comprehensive feedback, giving them greater confidence that management changes will result in better quality fruit.

At present, kiwifruit are tested destructively for many attributes. These destructive tests are time-consuming, expensive and can only be undertaken on samples of the crop. And because of the cost, many tests are currently undertaken on batched samples of fruit.

The approach being taken by GNS's IsoScan group is to develop techniques that are fast, accurate, and will enable measurement of individual fruit rather than batched samples. The new technologies have the potential to measure a range of attributes including chemical composition, density, moisture, shape, size and the presence of contaminants.

ZESPRI™ brand, the world leader in kiwifruit marketing, is continually looking for new and better ways to grow and select the most desirable fruit for its many international markets. ZESPRI Innovation Ltd's Nevin Amos says the non-destructive technologies being developed by IsoScan will allow a concerted move away from conventional quality assurance methods that destroy the fruit.

"In collaboration with IsoScan, we're assessing a range of low-cost, non-destructive techniques that will allow us to quickly and efficiently assess quality. Prototype models will be trialled in the upcoming season. Downstream, the benefits should be substantial."

IsoScan also works with the forestry, meat, and wool processing industries developing non-invasive techniques to improve product handling and quality control. More can be seen at www.isoscan.com

Contact: Joe Manning
Phone: +64 4 570 4637
Fax: +64 4 570 4657
Email: j.manning@gns.cri.nz

New honey purity test available at GNS

GNS has developed a new honey testing service to determine the purity of the product for export. Honey that has been deliberately or inadvertently contaminated by cane sugar or corn syrup can be rejected by authorities in the importing country.

New Zealand exports about 2000 tonnes of honey each year and until now there has not been a satisfactory local test to establish the purity of the product in relation to sugar content. GNS's Rafter Stable Isotope Laboratory in Lower Hutt now performs a test that is used routinely by authorities in Canada, the United States, and European Union countries to determine the purity of imported honey.

GNS scientists begin by extracting protein from honey dissolved in water. They then analyse the protein and the whole honey using isotope ratio mass spectrometry. The values of both are then compared. As honey and protein come from the same plants, their values should be similar. A difference of more than one unit on the scale points to more than 7 percent added sugar. This presents a problem if the product is labelled as pure honey.

Honey that fails this test is ruled not suitable for exporting to those countries that have adopted the test.

The Rafter Stable Isotope Laboratory is compiling a database of New Zealand honeys. As the database grows, it may become apparent that certain types of honey, or honey from certain areas, are more prone to failing the test. The stable isotope laboratory offers similar analyses to determine added sugar in a wide range of food and beverages, including wine.

The facility provides stable isotope analysis for clients worldwide, with more than 10,000 samples measured each year. Consisting of five mass spectrometers and a sample processing laboratory, it provides analysis of isotopes of carbon, nitrogen, oxygen, sulphur, plus deuterium. More can be seen at: www.rafterisotopes.co.nz

Contact: Kevin Faure or Graeme Lyon

Phone: +64 4 570 4637

Fax: +64 4 570 4657

Email: isotopelab@gns.cri.nz

GNS plays key role in final Continental Shelf surveys

New Zealand's $44 million Continental Shelf Project is on schedule with more than 80 percent of the scientific information already collected. GNS has participated in the final two marine surveys this year.

Under the United Nations Convention on the Law of the Sea, New Zealand has until 2009 to lodge its submission to extend its marine jurisdiction to the outer limits of the continental shelf. The extent of the continental shelf will be determined by the geology of the seafloor. On top of New Zealand's 200 nautical mile Exclusive Economic Zone, the shelf claim will cover an area up to nine times the area of New Zealand's landmass, and extend the country's marine jurisdiction to more than 3.5 million square kilometres.

Much of the research has involved the use of sound waves to determine the geology of the seafloor and the structure beneath the seafloor. Arguably New Zealand's biggest offshore science project for 20 years, it is helping to identify potential offshore resources for New Zealand, such as petroleum and mineral resources. It is also significantly boosting the knowledge of New Zealand's geology.

In March, GNS geophysicist Rick Herzer joined the US research ship *Melville* for a multi-beam bathymetry survey of the Bollons Seamount area, 700km south of the Chatham Islands, and the Wishbone Ridge area 500km northeast of the islands. The survey was designed to seek a connection between Bollons Seamount and the Campbell Plateau, and map the Wishbone Ridge at its junction with the Chatham Rise, to see if these two features can be confirmed as part of New Zealand's continental shelf as defined by the UN convention. A total of 43,500km^2 of seabed was mapped.

In May, GNS geophysicists Bryan Davy, Dan Barker and Hai Zhu joined NIWA's research ship *Tangaroa* for seismic surveys and seabed sampling to the east of New Zealand to map the continental shelf in this area.

As well as assisting with data collection, GNS is overseeing the processing of the seismic, gravity and magnetic data collected. GNS is also providing scientific and technical advice on many parts of the project, including the New Zealand – Australia boundary negotiations.

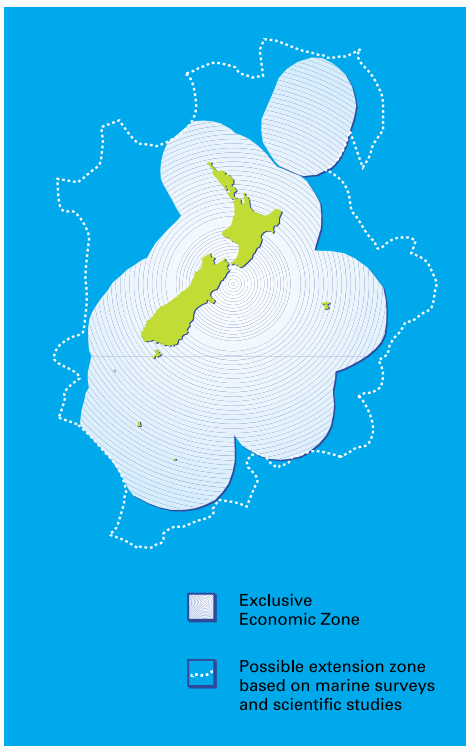
Australia will be one of the first countries to submit, and New Zealand should be able to glean valuable intelligence from the Commission's approach to Australia's case. The main organisations contributing to the project are Land Information New Zealand, GNS, NIWA, the Ministry of Foreign Affairs and Trade, and the Ministry of Economic Development.

Contact: Vaughan Stagpoole

Phone : +64 4 570 4803

Fax: +64 4 570 4603

Email: v.stagpoole@gns.cri.nz



Software development pays off

A seismic survey is one of the best ways for geoscientists to study the Earth's structure. Vibrations created at the surface of the Earth travel down through the layers of rock, with some of the energy being reflected back up at each boundary. By recording this reflected energy, and knowing the precise time the vibrations began, it is possible to build a complete 3D picture of the sub-surface geological structures. This technique is widely used in fields as diverse as construction engineering, oil exploration, and archaeology.

GNS's investment in developing seismic data processing software is paying off, with 25 companies, universities and research organisations around the world licensed to use this software.

The package, GLOBE Claritas™, comprises a suite of interactive tools and a host of modules that aid in both modelling and processing seismic survey data. In this way, the software helps to ensure that an expensive seismic survey yields the best possible results. In the past 12 months, GNS scientists have used GLOBE Claritas™ to ensure the success of surveys in Antarctica, and onboard survey ships helping to define the edge of New Zealand's continental shelf.

Commercial Processing Manager, Guy Maslen, says that the advantages of GLOBE Claritas™ are that it is flexible, user-friendly, and continually being improved by the people who maintain it. "GLOBE Claritas™ is written and developed largely by the scientists who use it. This ensures that the users can focus on the geoscience, and not on learning how to use the software" he says.

"It's clear from client feedback that the software meets the varying needs of commercial operators and academic researchers, and is quickly mastered by computer operators at all levels."

Contact: Guy Maslen

Phone: +64 4 570 4892

Fax: +64 4 570 4603

Email: g.maslen@gns.cri.nz

Mapping

High quality maps for Southland

GNS mapping staff have produced internationally-recognised, high quality maps for the innovative Topoclimate South project. The maps will enable Southland farmers to better match crops to soil types and climate, to optimise productivity, and encourage diversity and the sustainable use of land. The aim is to generate more jobs and a stronger regional economy from diversification and increased production.

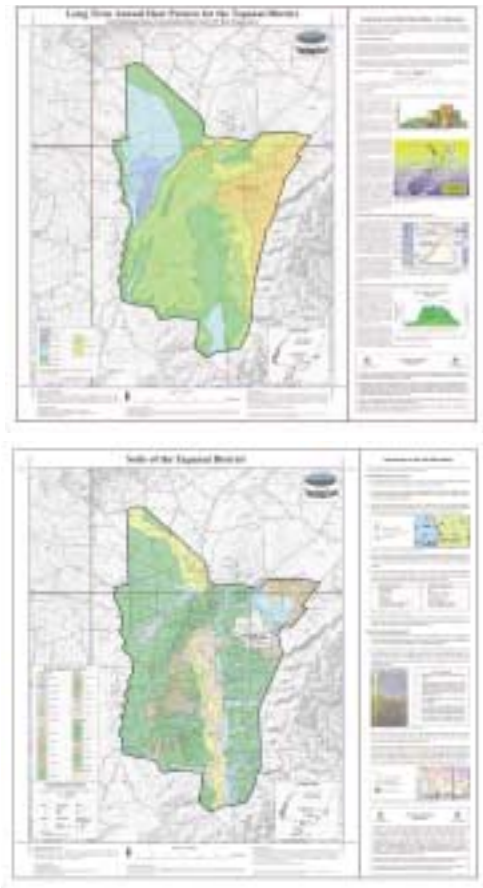
The GIS mapping team in Dunedin – Ben Morrison, David Thomas and Belinda Smith-Lyttle – used ArcInfo® GIS and Corel Draw to combine spatial data, collected as part of the Topoclimate project, and image data such as the LINZ 1:50,000 topography. The maps have been acknowledged by the Environmental Systems Research Institute (ESRI), a world leader in GIS technology, and published in their 2001 map book, *Geography – Creating Communities*.

The project has involved detailed soil mapping and collection of temperature data via automatic data loggers over three years. GNS staff digitised the data producing spatial layers, then transferred these on to templates developed in Corel Draw, which contained legend information and the background topographic image.

The soil and climate maps have been distributed to Southland farmers who are then able to have a site-specific analysis done on their property. Property sellers and buyers have been making good use of the service, as have farmers wanting to diversify and/or increase production.

The Topoclimate maps are a good example of GNS's ability to quickly produce maps containing diverse information that is crucial to sustainable development and productivity. GNS has recently provided maps on the geological hazards of the Southland region to be used in the Invercargill City Council Lifelines project, and has also upgraded the geological map of Invercargill. While some maps require intensive fieldwork or surveys to create thematic information, such as the Topoclimate South series, others can be created from computer manipulation of aerial photographs or satellite images.

(Left) Tuatapere is one of the many districts in Southland to benefit from the Topoclimate maps that GNS produced.



GIS is the means by which related or disparate map-based information can be combined and analysed for relationships. By pulling together data on the natural, built and social environments, GIS allows us to generate new information based on the interactions among a multitude of information layers.

The Topoclimate South maps are just one example of how new technology is allowing mapping specialists to model the real world in an increasingly wide variety of user-friendly ways. The maps were produced under contract to the Topoclimate South Trust.

Contact: Phil Glassey or Ben Morrison

Phone: +64 3 477 4050

Fax: +64 3 477 5232

Email: p.glassey@gns.cri.nz or b.morrison@gns.cri.nz

Catalyst for minerals industry

In partnership with Crown Minerals, GNS is building a digital information package on New Zealand's mineral prospectivity to help the development of the national minerals industry. The project will highlight New Zealand's mineral prospectivity to overseas exploration companies who may have discounted New Zealand in the past, or who are new to New Zealand.

Included in the information database will be geology, structure, geochemistry, current tenement information, and land use. Exploration companies will be able to use the information to assess prospects for gold in particular.

At present this type of New Zealand-wide digital database is not available, although parts of New Zealand have been mapped in detail. The project will map the prospectivity of New Zealand for gold mineralisation using new computer-based GIS techniques developed in Australia and Canada. The technique ranks areas according to their prospectivity.

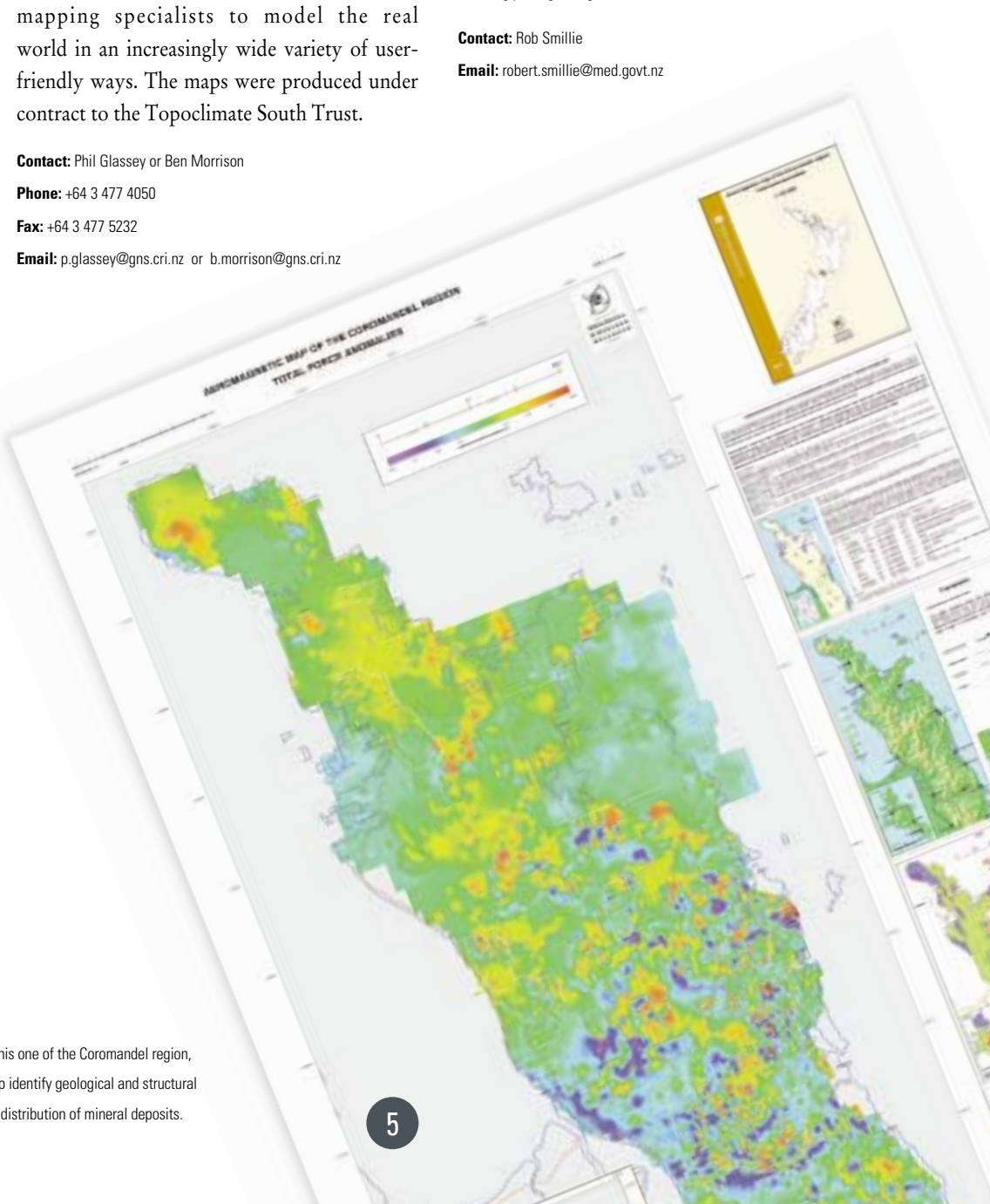
The project is scheduled to be finished in July 2002 and it is intended to present the results in New Zealand, Australia, and Canada soon after. Data and prospectivity maps will be available on CD and possibly over the internet.

Contact: Greg Partington

Email: g.partington@gns.cri.nz

Contact: Rob Smillie

Email: robert.smillie@med.govt.nz



(Right) Aeromagnetic maps, such as this one of the Coromandel region, are used in mineral exploration to help identify geological and structural features that control the location and distribution of mineral deposits.

Focus on nanotechnology

GNS's Rafter Research Centre is leading the charge internationally to develop "silicon nanowhiskers" for the electronics industry. Nanowhiskers are microscopic components for use in a wide range of electronics applications. Sometimes seen as the "missing piece" of silicon technology, they offer a potential link between silicon-based microelectronics and silicon-based optoelectronics.

As the electronics industry gets smaller and smarter, silicon nanowhiskers will be in demand as light emitters, electric field emitters, and as sensor devices. GNS and its collaborators are one of only a handful of groups worldwide working to manufacture silicon nanowhiskers commercially.

GNS ion beam scientist Andreas Markwitz and his team have made hundreds of prototype silicon nanowhiskers. They are currently refining their production process to make the product conform to predetermined specifications. The aim is to produce whiskers of varying lengths and densities for different applications.

Nanowhiskers are so small it is not possible to see them with an optical microscope. They are only visible with an atomic force microscope. Typically, they are 25-30 atoms in diameter and 100 atoms in length.

Making a nanowhisker involves a two-stage process starting with implanting low energy ions in a silicon wafer. The wafer is then subjected to rapid thermal annealing – typically at 1000degC for less than one minute. The silicon nanowhiskers are currently made offshore, but GNS is planning to buy an ion implanter so they can be made in New Zealand. The nanowhisker project is part of the MacDiarmid Institute for Advanced Materials and Nanotechnology, which is one of five national "centres of excellence" chosen from 45 original applicants.

Contact: Andreas Markwitz

Phone: +64 4 570 4637

Fax: +64 4 570 4657

Email: a.markwitz@gns.cri.nz

Nanotechnology scientist Andreas Markwitz holding a silicon wafer containing silicon nanowhiskers.

Deserved accolade for volcanologist

Senior volcanologist Colin Wilson was recently made a Fellow of the Royal Society of New Zealand. He was one of 13 new Fellows elected in late 2001 - there are currently 294 elected Fellows.

An outstanding physical volcanologist and observational geologist, he has helped bring about a fundamental change in the understanding of explosive volcanism in New Zealand and internationally. He is one of the most highly regarded and productive earth scientists in New Zealand, and is particularly well known for his research on the 1800-year-old eruption of Taupo Volcano, and for his work on the 26,500-year-old Oruanui eruption, also from Taupo. In fact Colin's work forms the basis of nearly every modern study of rhyolite volcanism in New Zealand.

His research describing ignimbrites generated by Taupo Volcano is regarded internationally as the most complete and important study of its kind undertaken in this field. Colin has an impressive publications record that includes seven articles in *Nature*. He has also collected numerous awards and honours. One of them – the Wager Prize – is awarded only once every four years to the most outstanding young volcanologist in the world.

Colin is one of the few in his field to have made a specific effort to establish quantitative eruption parameters. His experience in other disciplines has enabled him to draw on ideas from outside the typical boundaries of volcanology research. Although much of his work uses New Zealand examples, his research into ignimbrite deposits extends to Long Valley in central-eastern California, Yellowstone National Park, and Katmai in Alaska. Outside his personal research, Colin has done much to promote the science of volcanology through teaching, post-graduate supervision and mentoring young researchers.

Contact: Colin Wilson

Phone: +64 7 374 8211

Fax: +64 7 374 8199

Email: c.wilson@gns.cri.nz

A fresh look at earthquake risk modelling

A new way of modelling earthquake risk in New Zealand is helping engineers, planners, scientists, and insurance companies visualise the natural hazards to which buildings and other assets are exposed.

Developer of the technique, GNS seismologist Warwick Smith, says it is possible to use the software to examine the vulnerability of a city, suburb, or group of buildings.

"In Wellington, for instance, it shows the contribution that each of the major active faults makes to earthquake risk in the capital," Dr Smith says.

"For a corporate with large assets or for an insurance portfolio, it will show which active fault or faults are contributing most to their vulnerability."

This enables informed decisions to be made about risk management in terms of an appropriate level of insurance and reinsurance, the amount that might be invested in earthquake strengthening, or perhaps which assets could be sold.

The computer program is the result of bringing together a huge amount of information, some of which has only recently become available. It includes information about New Zealand's 305 known active faults, the expected severity of earthquake ground-shaking, modern valuation data, and the amount of damage that buildings and structures of various types can be expected to sustain. The analysis can be applied to a city, suburb, or any group of assets in New Zealand.

As expected, the Wellington Fault accounts for about 80 percent of the earthquake risk in the region. The Wellington Fault stretches about 75km from Cook Strait, through central Wellington, the Hutt Valley and into the Tararua mountain range. It ruptures, on average, once every 600 years. The last big movement, estimated at magnitude 7.6, was between 340 and 490 years ago.

By contrast, in Christchurch no single fault dominates the sources of risk. Instead, the major risk comes from a number of active faults, mostly to the northwest of the city.

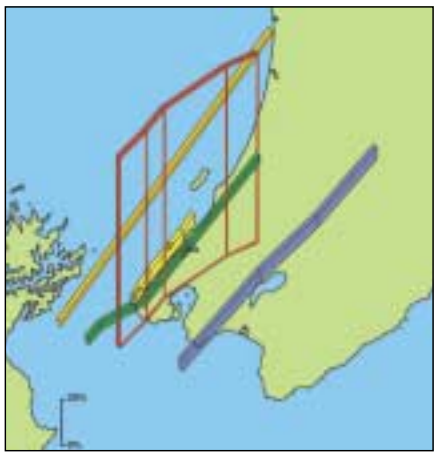
Contact: Warwick Smith

Phone: +64 4 570 1444

Fax: +64 4 570 4600

Email: w.smith@gns.cri.nz

Earthquake risk for a hypothetical portfolio of commercial buildings in Wellington



Of the main active faults in the Wellington region, shown below, the Wellington Fault accounts for about 80 percent of the earthquake risk, in terms of potential financial losses.

Recent Publications

Geology of the Auckland Area covers the geological and tectonic history of 11,800km² of the Auckland region including northern Waikato, the Coromandel Peninsula, and offshore islands. It summarises the region's geological resources, natural hazards, and engineering geology.

At the southern end of the map are Huntly and Te Aroha and at the northern boundary is Wellsford. Seven pages of the 74-page text are devoted to Auckland's wide range of geological resources, including ironsand deposits on the west coast, and metallic mineral deposits mainly in the Coromandel Peninsula.

It details extensive non-metallic resources, such as coal and peat deposits, in Waikato and Hauraki Plains respectively. Also covered are groundwater, cold water springs, and hot water. The map shows extinct seafloor volcanoes off Auckland's west coast, plus many geological faults beneath the continental shelf west of Auckland.

Available at $25 from GNS.
email: j.wright@gns.cri.nz

Geology of the Raukumara Area covers 11,700km² of the geologically complex East Cape region of the North Island from Wairoa in the south to Opotiki in the north. The 52-page text represents a synthesis of a large database, held by GNS, containing many layers of digital information that can be combined with other databases or customised to produce a wide range of derivative products at various scales.

The East Coast features New Zealand's highest concentration of oil and gas seeps – where gas, and in some cases oil, appear naturally at the surface. The seeps, which inspired the first search for oil and gas in the region over a century ago, have been recorded systematically.

Also recorded in detail are landslides, the biggest of which covers 18km² and rates as one of the biggest in New Zealand. The text includes sections on engineering geology and geological hazards, plus information on hot springs, groundwater, quarried aggregate and limestone, metallic minerals, and offshore bathymetry and geology.

Available at $25 from GNS.
email: j.wright@gns.cri.nz

For more information on GNS's nationwide geological mapping project visit:

http://www.gns.cri.nz/help/services/geospatial/qmap.html

Groundwaters of New Zealand is the most detailed and comprehensive text ever on New Zealand's groundwater resources. It is published by the New Zealand Hydrological Society and edited by Michael Rosen and Paul White of GNS. The 498-page well-illustrated text is the combined effort of 34 contributors and over 30 reviewers. As well as 15 regional summaries, it covers topics such as the chemistry of New Zealand's aquifers, rainfall and irrigation recharge, groundwater-surface water interaction, microbial contamination, groundwater and health, and groundwater management in New Zealand.

Available from the New Zealand Hydrological Society at NZ$99 for New Zealand customers, and NZ$135 for international sales.
email: rowel@xtra.co.nz

Outreach

Secondary schools tackle earthquakes

The Quake Trackers programme continues to increase its effectiveness in New Zealand secondary schools, raising awareness of earthquake hazards and making science education accessible and fun. The programme has 15 schools equipped with their own GPS-timed seismograph, with more schools keen to join.

As well as giving schools a seismograph and other equipment, the programme offers teaching modules and an interactive website. Originating in 1998, Quake Trackers is now a flourishing national network that combines information technology, earth sciences, physics, and geography.

It enables students to collect real earth science data, conduct experiments, and solve problems. The website contains over 100 pages of information and activities, including interactive computer programs.

Quake Trackers is a joint initiative by Victoria University and GNS, funded by the Earthquake Commission and by the New Zealand government through the Science and Technology Promotion Fund. Programme Manager, Michelle Robertson, and Design Engineer, Tony Haver, of Recon Inc who jointly run the programme, plan further enhancements in the near future including more packaged modules linked with the New Zealand curriculum.

They also have plans for accelerometers, earthquake datasets on CD, links with weather stations at schools for full environmental hazard assessment, and more hands-on experiments with dedicated equipment. The website is scheduled for an upgrade this year.

Some of the programme's exercises are almost tertiary level. But it's the simple experiments that can leave a lasting impression. At Mt Aspiring College, Wanaka, science teacher Tim Harper shows his students how wave amplitude changes with distance from the source. Students run up and down the walkway past the sensor while the seismograph records their footsteps. Results shown on the computer screen are "amazingly meaningful to the students and they're having fun," Tim Harper says.

Quake Trackers has grown to the point where it is seeking new sponsors to support further expansion. Sponsors can be assured of getting their name in front of secondary schools throughout New Zealand.

Contact: Hamish Campbell, Programme Director

Email: h.campbell@gns.cri.nz

Contact: Michelle Robertson, Programme Manager

Email: m.robertson@quaketrackers.org.nz

Contact: Tony Haver, Design Engineer

Email: t.haver@quaketrackers.org.nz

Website: www.quaketrackers.org.nz

The Quake Trackers team: Director Hamish Campbell of GNS (left), Manager Michelle Robertson, and Design Engineer Tony Haver of Recon Inc.

Marine geologist chosen for Voyagers exhibit

GNS marine geologist Cornel de Ronde is to be part of a new exhibition called Voyagers – Discovering the Pacific. Scheduled to open in July 2002 at Te Papa, the Museum of New Zealand, it will tell stories of epic exploration of the Pacific Ocean from pre-history to today.

The exhibition will feature 10 people of whom Cornel de Ronde is the only submariner.

In the historical section, there will be stories of Kupe, Captain James Cook, Tevake, and Sir Peter Blake. The contemporary area will profile Grant Dalton, Matahi Brightwell, Dame Naomi James, Hector Busby, David Lewis, and Cornel de Ronde.

A three-minute video clip will tell the story of the individual voyagers. In his video clip, Cornel describes what motivates him to explore the bottom of the ocean – one of the last frontiers on Earth. He explains what it's like to work for eight hours in a small research submersible and the significance of the submarine discoveries he has made. These include rare life forms, active seafloor volcanoes pumping huge volumes of hot fluids and gases into the ocean, and hydrothermal vents with their associated mineral deposits.

Distilling his life's work into three minutes has been a valuable exercise for Cornel. "I feel honoured to be included in an exhibition with such distinguished mariners. It's an acknowledgement of the importance of undersea exploration."

To accompany the film, Te Papa will display a black smoker chimney Cornel collected from the East Pacific Rise, 3500km west of Chile, in 1997. The 1.2m-tall, 70kg chimney is one of the largest ever brought to the surface in one piece. Thought to be only a few years old when it was accidentally knocked over by the US research submersible *Alvin*, the chimney has been cut in half to reveal glittering metallic crystals that formed as it grew on the ocean floor at a depth of 2.4km.

GNS is a foundation sponsor of Te Papa.

Contact: Cornel de Ronde

Phone: +64 4 570 4637

Fax: +64 4 570 4657

Email: c.deronde@gns.cri.nz

Marine geologist Cornel de Ronde being filmed for the new Voyagers exhibit at Te Papa, the Museum of New Zealand.

Coming up...

2002 Western Pacific Geophysics Meeting

When: 9-12 July 2002

Where: Wellington Convention Centre, New Zealand

Themes:

- deformation along major plate boundaries
- climate change and implications for the Antarctic and the Pacific
- space weather – impacts and prediction
- cities on active faults.

More information:
www.agu.org/meetings/wp02top.html

The 5th New Zealand Natural Hazards Management Conference

When: 14-15 August 2002
(Optional field trip 16 August 2002)

Where: Te Papa, Wellington

Who: Aimed at emergency managers, planners, risk assessors, utility managers, natural hazards researchers, and scientists.

Themes:

- Applying hazard management to best practice planning
- Natural hazard mitigation for industry
- Creating resilient communities through integrating science and practice
- Exploring new technologies – advances in science application.

Post-conference field trip: Will visit sites around Wellington to discuss hazard issues and see examples of successful hazard mitigation strategies.

More information and registration:

Diane Tilyard
Phone: +64 7 374 8211
Email: d.tilyard@gns.cri.nz
Website:
www.gns.cri.nz/news/conferences/hazconf2002.htm

Australasian Institute of Mining and Metallurgy Annual Conference 2002: 150 Years of Mining

When: 1-4 September 2002

Where: Hilton Hotel, Auckland

Themes: Geosciences, mining, metallurgy, environment, plus legal and economic issues.

Includes field trips to gold deposits in the North and South Islands plus geothermal fields, and ironsand and coal deposits.

Email: conference2002@ausimm.co.nz
Website: www.ausimm.co.nz

Preparing for a volcanic crisis in New Zealand

When: 14-15 October 2002 (Field trip 16 October)

Where: Wairakei Research Centre, State Highway 1, Taupo, New Zealand

Who: People involved in all aspects of natural hazards management including planners, engineers, local and central government administrators, insurance managers, civil defence officers, and emergency managers.

What: A state-of-the-art assessment of the volcanic hazards in New Zealand and an exploration of ways in which your organisation can prepare for a future volcanic crisis.

More information: Diane Tilyard
Phone: +64 7 374 8211, Fax +64 7 374 8199
Email: d.tilyard@gns.cri.nz
Website:
www.gns.cri.nz/news/conferences/volc6th.html