IN TODAY'S WORLD WE NEED...

RESILIENCE

TO MEET THE DIVERSE
AND CHANGING SOCIETAL,
ENVIRONMENTAL AND
ECONOMIC CHALLENGES
PLACED UPON US.

Presented to the House of Representatives pursuant to section 17 of the Crown Research Institutes Act 1992

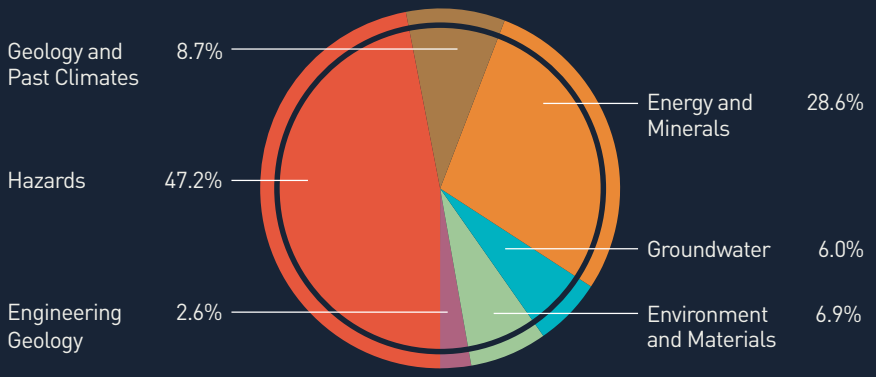
THROUGH THE GREAT WORK
OF OUR SCIENTISTS, WE MEET
THESE CHALLENGES EVERY DAY
TO PROTECT OUR ENVIRONMENT
AND MAKE NEW ZEALAND A
SAFER, MORE PROSPEROUS
PLACE TO LIVE.

GNS SCIENCE

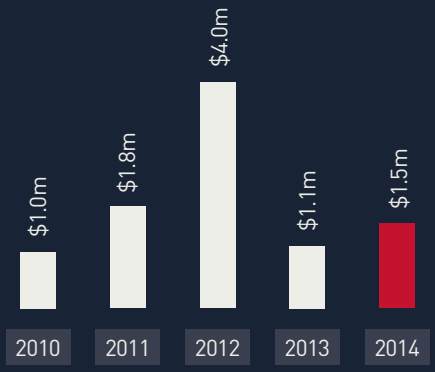
CONTENTS

FINANCIAL HIGHLIGHTS

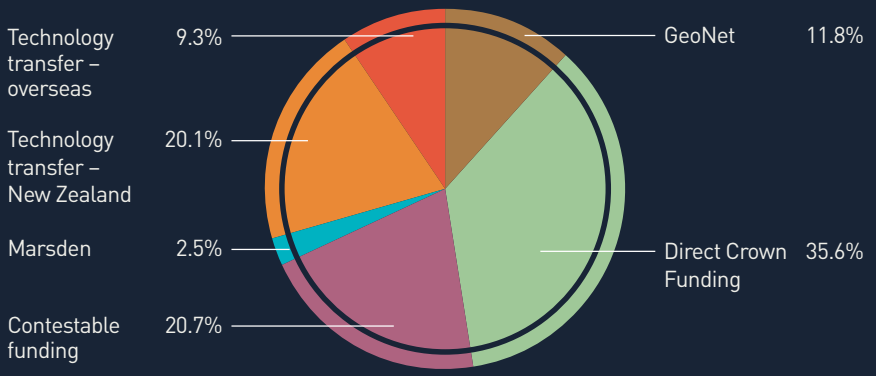
REVENUE BY SECTOR OUTCOME AREAS



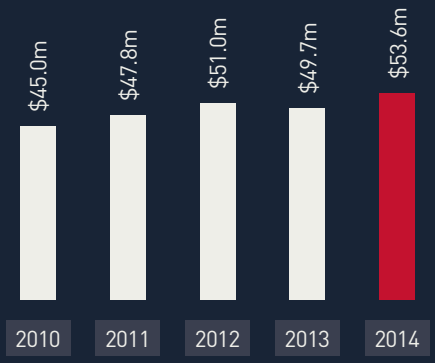
AFTER TAX PROFIT



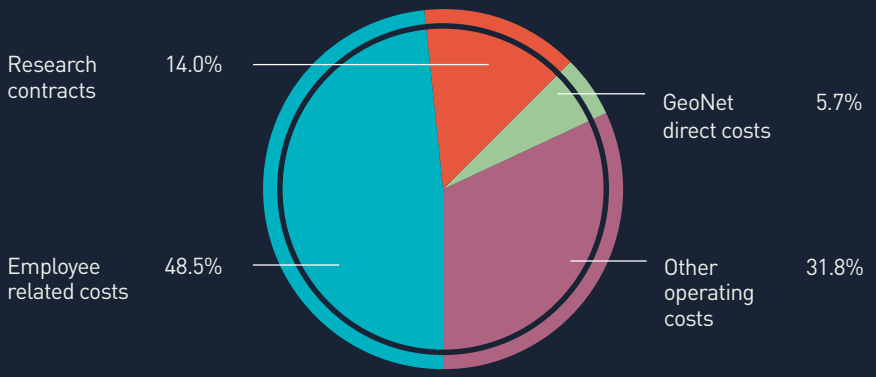
REVENUE SOURCES



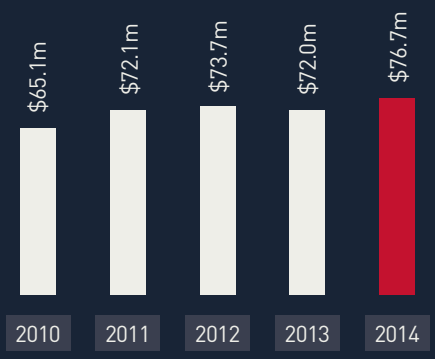
TOTAL ASSETS



EXPENSE ANALYSIS



REVENUE



ECONOMIC RESILIENCE

Our diverse contributions to building a stronger economy range from providing expert knowledge in the quest for geologically based resources to supporting the sustainable management of our existing resources. Just as nature can give, it can also take away – in seconds. So another major focus for us is helping to protect our wealth from the impacts of natural hazards.

With New Zealand's current reliance on fossil fuels comes a reliance on the international markets we source them from. Producing our own petroleum resources not only delivers financial benefits and jobs, it also decreases our reliance on those markets and increases our security of supply. GNS Science supports the petroleum industry by helping to identify potential new subsurface accumulations and advising on the environmentally responsible management of existing ones.

Since the 1980s we have contributed to the discovery of new oil and gas fields in Taranaki and have drawn industry and government attention to other areas of high potential. This industry is New Zealand's fourth largest export earner, contributing around $1.7 billion in export revenues in 2013 plus $800 million in taxes and royalties. As a small island economy remote from the world's major energy markets, New Zealand needs scientific leadership to benefit from its natural energy endowments.

We also maintain a strong capability in the science of geothermal energy. Geothermal accounts for 16% of our electricity production and GNS Science's work in understanding this resource and helping to identify and develop new geothermal fields is vitally important for this industry.

We believe geothermal will be a major contributor in achieving the Government's goal of renewables making up 90% of New Zealand's energy generation by 2025.

Perhaps lesser known, but equally important, is our innovative work in materials science. This is where we implant atoms into the surface of materials to achieve a range of properties such as super-toughness, ultra-smoothness, and resistance to corrosion. This part of our business has its roots in the pioneering work of Lord Ernest Rutherford. It supports a growing number of industries including energy, transport, medicine, security, electronics, agriculture, and high-value manufacturing. Importantly, it is helping to ensure that New Zealand companies can secure access to a global market in nano-structured materials and nano-electronics potentially measured in billions of dollars.

Exports of premium honey generate more than $120 million a year, and this is another industry that benefits from our expertise in understanding the chemistry of isotopes. The quality premise behind our primary products is vital to the continuing success of these exports, and our work plays a crucial role in food authentication and maintaining consumer confidence.

The risk modelling we do, as well as quantifying the physical and financial impacts of geological hazards, informs important business decisions by a range of public and private sector organisations. Understanding the probabilities of natural disasters – and assessing the likely losses from them – allows for improved building designs and earthquake codes and fairer setting of insurance premiums.


DIGGING
DEEP

SOCIETAL RESILIENCE

We contribute to societal wellbeing by helping to protect communities from the impacts of natural disasters, and by sharing our knowledge and experience for the benefit of New Zealanders and the international community.

While we can't prevent natural disasters from happening, we can help ensure that communities are well-prepared. Our work helps mitigate against the effects of a wide range of natural disasters, including earthquakes, tsunami, volcanic eruptions, and landslides.

Thanks to the vision of the Earthquake Commission and the expertise of GNS Science, New Zealand has a world-leading geohazards monitoring network in GeoNet. The information provided by the 600-odd instruments in its national network not only improves our understanding of geological hazards, it also meets society's ever-growing need for better and faster information. This has been borne out by the huge numbers of hits the GeoNet website receives every time a moderately large quake or minor eruptive activity occurs (632 million last year, including 49 million in one day).

Through our engineering geology work and liquefaction studies, supported by our mapping expertise, we have a much better understanding of how the ground beneath our feet will respond in earthquakes and landslides. This not only helps to identify how existing buildings and infrastructure will perform during a geohazard event, but is also a vital tool in shaping decisions about building design and land use as we plan for our future.

In the same way, monitoring of our volcanoes helps us better understand the likely impacts of an eruption, as well as ensuring we have early warning when volcanic unrest occurs. And not forgetting the water peril, we operate a network of tide gauges around the New Zealand coast and on offshore islands to track incoming tsunami.

We also support New Zealand's role as a responsible global citizen and help develop diplomatic relations by sharing our skills and knowledge in numerous countries, particularly in the Asia-Pacific region. Our hazards staff work closely with communities in Indonesia, Vietnam and the South Pacific to reduce exposure to risk.

We also have a strong commitment to education and developing New Zealand's understanding of science. Our programmes to engage school students with science, and our strong support of postgraduate students, all help in the development of the role of science in New Zealand's future.

DEALING WITH PRESSURE

ENVIRONMENTAL RESILIENCE

Our contribution to protecting the environment is multi-dimensional. It ranges from the bottom of the ocean to the air in our cities. And it spans climate studies of the deep past to helping test models of future global climate. Our overall aim is to improve the environmental knowledge base and help in mitigating against environmental issues that affect New Zealand.

A key aspect of our climate studies is collecting and analysing ice cores from Antarctica and New Zealand's shrinking glaciers. From this we can understand how the Earth behaved in past periods of warming and cooling. This enables more accurate forecasts of the impacts of rising temperatures and sea levels.

To augment this, our palaeontologists study tiny fossils found in marine environments going back more than 100 million years. A surprising amount of environmental information can be deduced from these critters. It includes the temperature and chemistry of the oceans and the relative proportions of atmospheric gases during the time they were alive, and even the nature and extent of prehistoric vegetation.

Groundwater makes up 30% of the water delivered to our taps. GNS Science expertise in locating aquifers and understanding the intricate systems that influence their development allows us to support local authorities in making informed decisions on the management of freshwater resources.

Our materials and groundwater teams contribute to a better understanding of how land use affects waterways. Our scientists are examining the make-up of the sediments in New Zealand waterways to understand where they come from and how they impact the waterways. Parallel to this, our groundwater specialists investigate the complex interactions between groundwater and surface water, which helps us understand how nutrients travel from farms to our streams, rivers and lakes.

Our monitoring of air quality around New Zealand enables us to identify air pollution and its sources so councils can take steps to manage activities that contribute to it. Recent work, for example, has identified carcinogenic substances in the air as a result of home owners burning treated timber in their fireplaces. Councils have responded with education programmes to discourage the burning of treated timber.

New Zealand's entire offshore sovereign area is 5.7 million square kilometres. This is equivalent to 14 times the size of California, or 1% of the Earth's surface. Large parts of this realm are unmapped and unexplored. As well as precious ecosystems, this area of seafloor almost certainly contains trillions of dollars of minerals and biological resources. The systematic work of GNS Science in understanding the geology and its relationship with the biodiversity of this area will help in prudent marine management in the decades ahead as the world looks increasingly to the oceans for its wealth, food and energy needs.

KEEPING IT CLEAN

FROM STRENGTH TO STRENGTH

Left to right:
Tom Campbell – Chairman,
Mike McWilliams – Chief Executive

$76.7m
Record Company revenue

$1.55m
After-tax profit

GNS Science had a profitable and productive year that was characterised by a significant improvement in financial performance. The Company attracted record revenue of $76.7 million and consistently delivered relevant science and technology in accord with Government expectations for development of New Zealand's geological resources, parallel growth of a society and economy that is resilient to natural hazards, and technological innovations that benefit the nation.

Financial results

Relative to the previous financial year, after-tax profit increased by 35% to $1.55 million, representing a significant improvement in return on equity of 5.4% compared to 4.2% in the previous year. Each of the three research divisions made a profit.

Company revenue grew by 6.6% to a record $76.7 million and was derived from research contracts (59%), domestic technology transfer (20%), international technology transfer (9%) and our EQC contract to operate the GeoNet monitoring network (12%). Direct Crown Funding of $27.1 million accounted for 35% of total revenue. EBITDA per FTE increased by 12% over the previous year and now approaches $20,000.

Dividend

The GNS Science Board is pleased to declare a dividend of $250,000 to the shareholders as provided for in our Statement of Corporate Intent.

Capital investment

GNS Science made capital investments of approximately $6.0 million during the financial year in science infrastructure, information technology infrastructure and in building and laboratory improvements. The bulk of our science infrastructure expenditures were for new instrumentation in geochemical, geophysical and materials science instruments and facilities. Our IT capital expenditures were made to upgrade core computing infrastructure throughout the Company, to significantly increase our information storage capacity, and to build a new 448-core high performance computer facility for earth simulation and modelling. Following a significant capital investment in previous years, our Wairakei geochemical laboratories were officially opened in August 2014 and we have begun a significant capital improvement project at our National Isotope Centre in Gracefield.

Independent four-year review

GNS Science was reviewed by an independent four-person panel as part of a process recommended by the 2010 CRI Taskforce. This review provided an independent assessment of our current effectiveness and future potential in delivering on the purpose and outcomes set out in our Statement of Core Purpose. The review assesses governance effectiveness, financial viability and sustainability, and it identifies opportunities, barriers to success and alignment to government priorities. The panel found many positive features including a strong track record built upon nearly 150 years of history. GNS Science is seen as a trusted advisor to the nation. There is a passion for science and for benefiting New Zealand embedded throughout the organisation's highly motivated workforce.

The panel noted GNS Science's excellent reputation with its key customers for being responsive, open and honest. Its financial performance and controls are good and the organisation is generally well equipped with research infrastructure. All its activity is underpinned by sound policies, processes, systems and structures. We are seen as having very strong science, some world-leading. We have effective relationships with key stakeholders and we are committed to our purpose throughout the organisation.

According to the panel, GNS Science is highly relevant to delivering what the public and our owners require from a CRI with a strong and respected brand. The appointment of the new CEO provides the opportunity for a significant refresh of strategy, style and some management. The panel expects that GNS Science will respond positively to this review. If it does, and if it delivers on a robust action plan, the panel believes the Company will continue to flourish. This will allow the Company to leverage new opportunities, such as the National Science Challenges, and build upon its national and international standing as a research organisation delivering value to New Zealand.

The panel identified five key opportunities for further organisational development: clarity of strategic direction; business performance; accountability for medium-term business targets; establishing a high-performance culture; and Māori partnering. We had already begun working on these opportunities for development, in most cases well before the review commenced.

Innovation and research highlights: Geological Resources

Geological mapping The long-running QMAP quarter-million scale Geological Map of New Zealand project is complete. All of the 21 onshore map sheets and a new geological map of South Victoria Land, Antarctica, have been published. A seamless digital map has been compiled by digitally stitching the individual QMAPs that cover all of New Zealand including the Chatham Islands and harmonising the vast amount of feature attribute data. These data are available as a published DVD and can be accessed online as a GIS-based

digital map for the whole country that is the authoritative version of New Zealand's geology. This product has been eagerly awaited by a wide range of end-users and has been made available to New Zealand Petroleum & Minerals to include in their 2014 Petroleum Exploration Data Pack. The DVD is the first publication in a new "GNS Science Geological Map" series that will be the series in which all future geological maps, both digital and printed, will be published. In coming years, we will turn our mapping attention to New Zealand's considerable offshore marine estate, the fourth largest exclusive economic zone in the world.

Hikurangi subduction zone ocean bottom seismometer experiment
A research consortium led by GNS Science and including NIWA and eight Japanese and US universities safely and efficiently deployed 37 ocean bottom seismometers and pressure sensors in the Hikurangi subduction zone. Here, the Pacific plate is being thrust beneath the Australian plate and is capable of generating a magnitude 9 event similar to the one that caused Japan's devastating earthquake and tsunami in 2011. The seismometers, some weighing up to 200kg, will spend a year under water capturing small events that land-based instruments are unable to measure. They will also monitor slow-slip earthquakes, fault movements that take place over weeks or months. The project has attracted global attention and was jointly funded by New Zealand through GNS and the Oceans 2020 programme, and the US and Japanese National Science Foundations.

Advantage New Zealand 2014 Geotechnical Petroleum Forum GNS Science and New Zealand Petroleum & Minerals jointly hosted this conference at Te Papa in Wellington. The forum was a great success and was attended by approximately 300 petroleum industry professionals from domestic and international companies. GNS offered three field trips and two workshops for participants before and after the meeting. The meeting was a clear scientific, reputational and financial success for our staff, who made more than 40% of the oral presentations and won awards for Best Overall Presentation, Best Poster and Best Student Poster.

Innovation and research highlights: Natural Hazards

Review of tsunami hazards in New Zealand This update was undertaken on behalf of the Ministry of Civil Defence and Emergency Management. The review examines all likely sources of tsunami that could affect New Zealand and evaluates their potential to generate tsunami, the likely waves produced, and the likely size of tsunami at the coast. It builds on the 2005 Review of Tsunami Hazard and Risk in New Zealand and summarises the current state of knowledge, highlighting the results of new research and changes in scientific understanding since 2005. An important conclusion is that tsunami generated by nearby offshore ruptures now constitute a larger threat, while distant tsunami generated across the Pacific are less of a risk. We are now responding to requests from regional councils to update their tsunami hazard assessments.

Alpine Fault drilling project At the time of publishing, an international science team was planning to drill a 1.3km deep hole into the Alpine Fault near Whataroa, north of Franz Josef on the West Coast in the South Island to learn more about the nature of the fault and the earthquakes it can produce. This location is regarded by scientists as one of the best sites in the world to study the inner workings of a major plate boundary fault. The deep borehole will enable examination of rock extracted from the fault zone and the installation of sensitive monitoring equipment to record small earthquakes and measure temperature, pressure and a range of chemical conditions. The project involves scientists and funding from more than a dozen organisations from New Zealand, Canada, France, Germany, Japan, the United Kingdom, and the United States. It is being led by scientists from GNS Science, Victoria University of Wellington, and the University of Otago.

This project follows significant advances in understanding the Alpine Fault with the publication of age estimates for the last 24 surface-rupturing earthquakes on the South-Westland section of the fault at Hokuri Creek. These ages show that large earthquakes occur relatively regularly at intervals averaging 330 years.

Innovation and research highlights: Environment and Materials

Monitoring atmospheric fossil fuel CO_2 in New Zealand GNS Science is collaborating with The University of Auckland on a pilot study of urban fossil fuel CO_2 monitoring to demonstrate the ability to quantify fossil CO_2 in a New Zealand city. We perform this type of emissions work in conjunction with the INFLUX programme in the USA which provides funding and several hundred samples per year for high precision measurement by accelerator mass spectrometry at our National Isotope Centre.

RICE (Roosevelt Island Climate Evolution) Project RICE is an international collaboration between New Zealand, United States, Denmark, United Kingdom, Germany, Australia, Italy, China, and Sweden. The aim of the project was to recover and isotopically measure in great detail a deep ice core from Roosevelt Island in Antarctica to determine the stability of the Ross Ice Shelf and West Antarctica in a warming world. Processing of the 761m RICE core at our Gracefield ice core laboratory is now complete, generating gigabytes of data from over 100,000 discrete samples. This is the longest high resolution record available from West Antarctica to date and will yield unprecedented knowledge of the stability of West Antarctic ice sheet and hence future sea level rise.

Collaboration: National Science Challenges

The National Science Challenges are designed to take a more strategic approach to Government investment in science by targeting a series of goals which, if achieved, would have major and enduring benefits for New Zealand. The Challenges provide an opportunity to align and focus research on large and complex issues by drawing scientists together from different institutions and across disciplines to achieve a common goal through collaboration.

GNS Science is proud to be collaborating with a wide cross-section of the nation's research providers through participation in the National Science Challenges.

We are the host and contract holder for the Resilience to Nature's Hazards challenge, whose goal is to ensure that natural hazard risks in New Zealand are better understood and managed, reducing vulnerability and improving response and recovery. Our partners in Resilience are 10 Crown Research Institutes, industry research providers and universities.

We are also active participants in the Deep South, Biological Heritage and Sustainable Seas challenges, whose respective goals are understanding the role of Antarctica and Southern Ocean in determining our climate and our future; protecting and managing our biodiversity while improving biosecurity and enhancing resilience to harmful organisms; and enhancing utilisation of our marine resources within environmental and biological constraints.

Collaboration: Natural Hazards Research Platform

GNS Science leads the Natural Hazards Research Platform which has been operating for five years. The Platform was established to provide secure long-term funding for natural hazards research, and to enhance the ability of research providers and end-users to work together. Our partners are NIWA, The University of Auckland, Massey University, University of Canterbury and Opus International Consultants.

Research conducted under the aegis of the Platform develops quantitative estimates of geological and weather-related hazards such as earthquake, volcano, flood, snow, wind, rainstorm, landslide, and tsunami activity in New Zealand. The research also evaluates how well New Zealand society is prepared for these perils, and responds to any national need in hazard mitigation or disaster recovery.

An independent international panel reviewed Platform operations at the five-year milestone and concluded that the Platform had fulfilled expectations, that the collaborative model has proved to be effective in achieving its goals, and that end -users were satisfied with its performance.

Collaboration: Indonesia disaster risk reduction initiative

We have begun a major project to help Indonesia become better prepared for the impacts of earthquakes, tsunami, volcanic eruptions, floods and landslides. The seven-year project follows a successful two-year pilot funded by the NZ Aid Programme in Central Sulawesi and West Sumatra.

With a population of 250 million and frequent natural disasters, Indonesia has had to rely on international aid to help it recover from natural disasters numerous times. Its economic growth has also suffered repeatedly. To combat this, the Indonesian government is taking action to reduce losses from natural disasters and to strengthen community resilience. It has made local governments responsible for managing hazards and risks. However, the ability of provincial and district governments to achieve this varies widely.

During the next five years, we will work in four provinces to reach a total population of 3.75 million people. One of the elements of our project is a series of New Zealand-based and in-country workshops that will include case studies from other districts in Indonesia and New Zealand. One of our roles is to help local governments in Indonesia understand and manage their own hazards and risks and improve communications at all levels of the community. This collaborative project marks the first nationally consistent approach to local capacity building in risk reduction. It will draw on New Zealand's expertise in disaster risk reduction, preparedness and risk management. The numerous natural hazards that New Zealand and Indonesia have in common put us in a strong position to share our knowledge to reduce risks and increase preparedness.

Collaboration: University partnerships

The nation's research universities continue to be important collaboration partners for GNS Science. A significant fraction of our research publications have university co-authors, and four of our science staff hold joint faculty appointments. Our staff supervise about 140 students at seven New Zealand universities and several overseas universities, a 40% increase over last year. We provide scholarships to 33 university students, a number similar to previous years.

Staff

By year end, our total staff numbers had increased by 7 to 392, representing 371 full-time equivalent positions. Scientists and technicians continue to comprise about 60% of our workforce, with support staff making up the remainder. Staff turnover decreased to 6.1% from 6.5% during the financial year.

Health and safety performance

Four of our 392 staff lost a total of 11 work days due to injury last year, which is clearly 11 too many. Our ACC accreditation status was upgraded to Tertiary (the highest category) from Secondary, reflecting the post-audit observation that the Company is now characterised by continuous improvement and best practice framework.

Changes to the GNS Science Board

We welcome Sarah Haydon to the Board of Directors of GNS Science. Sarah is an experienced company director with strong commercial, financial and audit committee experience, who was previously Chief Financial Officer for OfficeMax NZ Ltd. She brings knowledge of several industry sectors relevant to GNS Science, having spent 13 years in the oil industry in the UK. Sarah is a director of NZX-listed Cavalier Corporation Ltd, and recently retired as a director of AsureQuality Ltd.

Sarah succeeds Jane Taylor, who has been appointed as Deputy Chair of our sister Crown Research Institute Landcare Research. We thank Jane for six years of excellent service to GNS Science as a Director and as Chair of the Audit and Risk Committee.

Tom Campbell
Chairman

Mike McWilliams
Chief Executive

GNS SCIENCE STATEMENT OF CORE PURPOSE

Purpose

GNS Science's purpose is to undertake research that drives innovation and economic growth in New Zealand's geologically-based energy and minerals industries, that develops industrial and environmental applications of nuclear science, that increases New Zealand's resilience to natural hazards and that enhances understanding of geological and earth-system processes.

Outcomes

GNS Science will fulfil its purpose through the provision of research and transfer of technology and knowledge in partnership with key stakeholders, including industry, government and Māori, to:

- increase resource security and economic benefit from the development and diversification of New Zealand's oil, gas, geothermal energy and minerals industries
- increase New Zealand's resilience to natural hazards and reduce risk from earthquakes, volcanoes, landslides and tsunami
- improve the sustainable management of and increase economic returns from groundwater resources
- create value for New Zealand industry through the use of isotope and ion beam technologies
- increase understanding of the geology and past climates of New Zealand, the Ross Dependency and Antarctica
- enhance the geotechnical engineering that underpins New Zealand's transport and energy infrastructure.

Scope of operation

To achieve these outcomes, GNS Science is the lead CRI in the following areas:

- geothermal energy, oil, gas, gas-hydrates (including carbon sequestration)
- mineral and geobiological resources
- geological hazards, risk mitigation and societal impacts of natural hazards
- earth-system processes and landscape evolution
- groundwater processes and quality
- the geological component of global environmental processes and climate change
- application of nuclear and isotope science and ion beam technology.

GNS Science will work with other research providers and end-users to contribute to the development of the following areas:

- high-value manufacturing
- freshwater management
- hazards management
- ocean floor exploration
- climate change adaptation and mitigation
- Antarctica.

Operating principles

GNS Science will:

- operate in accordance with a statement of corporate intent and business plan that describes how GNS Science will deliver against this statement of core purpose, and describes what the shareholders will receive for their investment
- meet its obligations as a Crown Company and remain financially viable, delivering an appropriate rate of return on equity
- develop strong, long-term partnerships with key stakeholders, including industry, government and Māori, and work with them to set research priorities that are well linked to the needs and potential of its end-users
- maintain a balance of research that provides for the near-term requirements of its sectors and demonstrates vision for their longer-term benefit
- transfer technology and knowledge from domestic and international sources to key New Zealand stakeholders, including industry, government and Māori
- develop collaborative relationships with other CRIs, universities and other research institutions (within New Zealand and internationally) to form the best teams to deliver its core purpose
- provide advice on matters of its expertise to the Crown
- represent New Zealand's interests on behalf of the Crown through contribution to science diplomacy, international scientific issues and/or bodies as required
- seek advice from scientific and user advisory panels to help ensure the quality and relevance of its research
- establish policies, practices and culture that optimise talent recruitment and retention
- enable the innovation potential of Māori knowledge, resources and people
- maintain its databases, collections and infrastructure and manage the scientific and research data it generates in a sustainable manner, providing appropriate access and maximising the reusability of data sets
- seek shareholder consent for significant activity beyond its scope of operation.

This statement provides key guidance to the GNS Science board for developing its statement of corporate intent, which sets out GNS Science's strategy for delivering against its core purpose. GNS Science's performance will be monitored against the outcomes and operating principles in this statement.

STAFF AWARDS, HONOURS AND DISTINCTIONS

Malcolm Arnott and **Mark Lawrence** and others won best overall poster at the Advantage Geotechnical Petroleum Forum in 2014.

Chris Bromley was named as the Hochstetter Lecturer for 2014 by the Geoscience Society of New Zealand. A major part of this award is a national tour in which Chris gives lectures on his recent research in geothermal science.

Cornel de Ronde was awarded the Society of Economic Geology Honorary Lecturer for 2014 and presented lectures in Germany and Switzerland. He was also awarded the AusIMM Distinguished Lecturer for 2014.

GNS Science was part of an industry collaboration that won an award at the 2014 KiwiNet Research Commercialisation Awards. The AJ Park Commercialisation Collaboration Award went to Titanium Technologies New Zealand. This is a collaboration involving GNS Science, University of Waikato, Callaghan Innovation, The University of Auckland, the Titanium Industry Development Association, and various industry partners. The group is developing high-end surface treatments to give titanium properties such as ultra-hardness for special applications in agriculture, medicine, energy production, and the marine industry.

Stuart Henrys received the NZ Geophysics Prize from the Geoscience Society of New Zealand for a paper on the seismic transect of the lower North Island project published in the *G-Cubed* journal (Geochemistry, Geophysics, Geosystems).

Ed Mroczek and **Duncan Graham**, and three co-authors from Contact Energy, won the Best Paper award at the 35th New Zealand Geothermal Workshop for a paper on silica scaling and cold water injection at Wairakei.

The Port Hills Response Group, which includes 18 GNS Science staff, received a commendation from the New Zealand Society for Earthquake Engineering for their geotechnical work on the Port Hills. The commendation noted the group's achievements in gathering, shaping, and applying knowledge to reduce the impact of earthquakes on our communities.

Tim Naish, Director of Victoria University's Antarctic Research Centre and GNS Science staff member, won the Martha T Muse Prize for his outstanding research into understanding Antarctica's response to past and present climate change and the role of the ice sheets in global sea level change through time.

Cathal Reilly won best presentation prizes at the Geoscience Society of New Zealand annual conference in 2013 and the Advantage Geotechnical Petroleum Forum in 2014.

Rupert Sutherland was elected a Fellow of the Royal Society of New Zealand.

Marianna Terezow was awarded the Kingma Award by the Geoscience Society of New Zealand for her outstanding contributions in the form of co-authored publications, fossil collection and curation work, and outreach.

Julian Thomson won the Harold Wellman Prize for his contribution to geology with the discovery of a large fossil whale jawbone found at Palliser Bay last year.

Rob van der Raaij won the Peoples' Choice Poster at the New Zealand Hydrological Society conference in November 2013 for his poster 'Dissolved methane in New Zealand groundwaters'.

15 individual or group awards, honours and distinctions

VISION MĀTAURANGA

GNS Science is committed to developing partnerships with Māori to identify iwi aspirations and align our internal processes to help realise them. We have undertaken a number of projects with Māori that have contributed to the social, cultural, environmental and economic wellbeing of Māori communities for the benefit of Aotearoa.

Highlights include the following:

Te Kura Whenua Wānanga (Earth science forum)

This year we partnered with Ngāti Kahungunu Iwi Incorporated in Hawke's Bay to deliver a four-day hands-on earth science forum (wānanga) at Kohupatiki Marae at Whakatu near Hastings. With our guidance, participants explored Hawke's Bay landforms to learn about earthquakes and tsunami, the local impact of distant volcanic eruptions, minerals and groundwater, and climate and sea level change. The wānanga provided an opportunity to build awareness and understanding of geology and geological processes.

Māori Geothermal Symposium

Early in 2014, together with industry partners, we ran a two-day Māori Geothermal Symposium in Rotorua. About 160 delegates attended and heard presentations from GNS Science, Contact Energy, Mighty River Power, Scion, and regional councils. An initiative from the event is the setting up of a Māori focus group to explore the development of direct-use geothermal heat in the central North Island. A priority for this group is to identify sites where we can investigate whether low temperature applications are feasible. This resource is capable of providing relatively low-cost, long-term energy and heat supply with low carbon emissions.

Agreement with post-Treaty settlement iwi

In April 2014 we signed an agreement with Ngāti Rangiwewehi representatives, from Bay of Plenty, to further strengthen our joint working relationship where we are focused on earth science and environmental issues. Ngāti Rangiwewehi is an iwi of the Te Arawa confederation of tribes, with its main base being to the northwest of Lake Rotorua. The agreement formalises our existing relationship and opens the way for expanded collaboration in areas such as geothermal energy, minerals, and geobiological resources. In recent years, we have worked with this Iwi to evaluate the use of ground-source heat pumps to heat and cool their buildings in Rotorua. We also continue to develop strategic partnerships with other iwi groups to help ensure they achieve their aspirations in the areas of environment, natural resources, and earth sciences.

STAKEHOLDER SURVEY FINDINGS

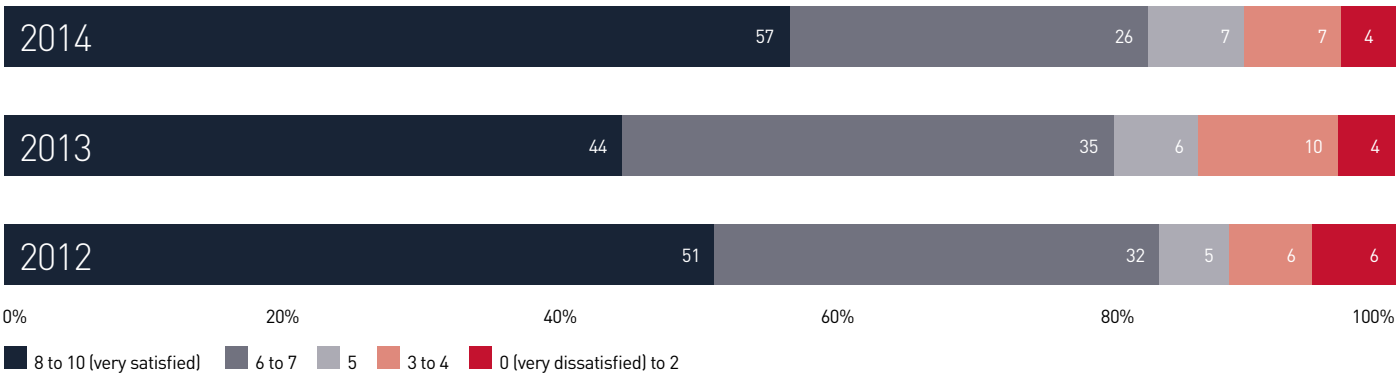
83%
satisfaction rate with our work in last 3 years

Eighty-three percent of clients and stakeholders who have interacted with us in the past three years have expressed satisfaction with the quality of their experience, a survey of our clients has found. The survey of 140 of our stakeholders was undertaken by Colmar Brunton on behalf of the Ministry of Business, Innovation and Employment between May and June 2014. This is the third successive year that MBIE has conducted surveys of Crown Research Institute stakeholders and clients.

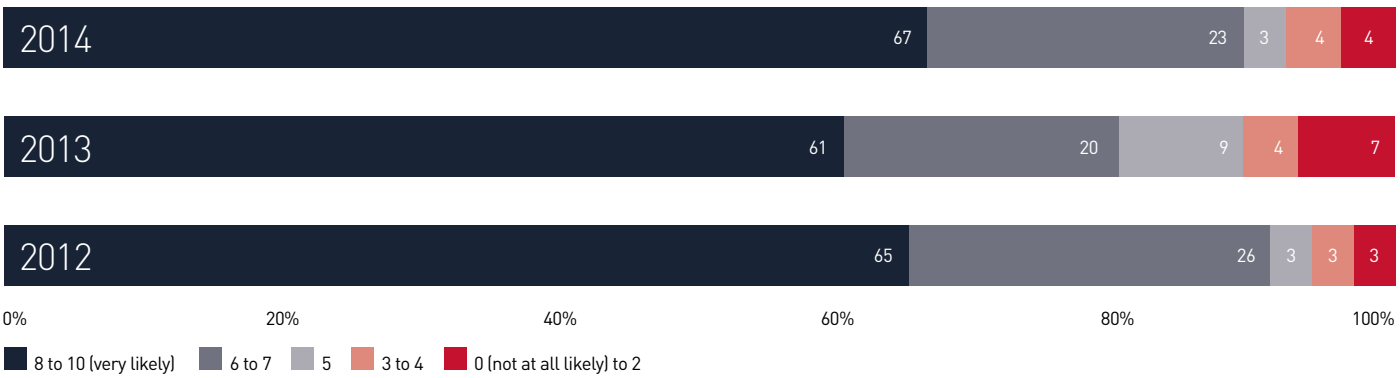
Key points from the 2014 survey:

- Respondents came from a wide variety of sectors
- Just over 80% were confident that GNS Science understands the research priorities in their sector
- 75% were satisfied or very satisfied with the way that GNS Science sets its research priorities
- 83% of all respondents, and 93% in the business sector, were satisfied or very satisfied about their overall experience in dealing with GNS Science
- 93% were satisfied with access to GNS Science's knowledge or technology
- Respondents identified better communication, increased knowledge on specific projects and sectors, and more collaboration as areas that GNS Science could work on to improve its external relationships
- Respondents identified expertise, knowledge, skillsets, good client engagement, and a positive attitude of staff as the main strengths of GNS Science.

OVERALL SATISFACTION WITH GNS SCIENCE



LIKELIHOOD TO RECOMMEND GNS SCIENCE



BEING A GOOD EMPLOYER

We have many initiatives that make GNS Science a great place to work. They also underline our commitment to being a good employer. During the past year, our key focus areas were:

- Health and safety – increased focus on keeping the workplace safe
- Capability and capacity – further developed the workforce and succession planning framework to identify capability and capacity gaps across the organisation
- Science career path – reviewed the indicators used to measure performance in science to ensure they are fair and transparent.

Workforce profile

Our workforce is balanced, diverse, and stable.

- 40% of our staff are under the age of 45
- The average age of all staff is 47 – 44 for women and 49 for men
- 6% of staff have reached the age of retirement eligibility, and 9.3% of the remainder will reach retirement eligibility in the next five years
- Our gender split is 38% female and 62% male
- Our staff turnover for the past 12 months was 6.1%, compared to 6.5% the previous year
- As at 30 June 2014, we employed 392 staff (FTE 371)
- Many of our staff were born overseas which contributes to a rich and diverse culture within our organisation.

Leadership, accountability and culture

Our leadership programme is the main vehicle for developing current and future leaders. It is for managers, project leaders, staff in senior specialist roles, and staff who have been identified for leadership development. In addition, over the past year we have been working in collaboration with other CRIs to develop and implement a pan CRI leadership programme. The aim is to develop leadership capabilities across CRIs to ensure we are getting the best from our leaders.

Recruitment and induction

In the past year, we appointed 29 new staff (13 female and 16 male), with 16 of these appointed to scientific and technical roles. For those recruits who are from overseas, we work to reduce barriers for applicants moving to New Zealand. This includes:

- bringing a prospective employee and their partner/family to New Zealand to meet staff and see their future working environment
- help with travel and relocation arrangements
- induction workshops for new staff where they are introduced to key staff and made familiar with Company operations and policies. This includes an introduction to health and safety expectations and responsibilities.

We survey new staff twice – after 90 days and at one year to assess the impact of our induction programme.

The lack of Māori applicants for our science roles continues to be a concern. However, figures obtained from Victoria University of Wellington show that there is a very low number of Māori graduates in earth sciences. This year we have continued with Te Reo Māori classes for staff and we also formally celebrated Matariki.

Remuneration and conditions

Our terms and conditions of employment strongly reflect our good employer philosophy. In employee surveys, staff say they value the range of benefits made available to them.

Our system for remuneration review and promotion is robust and transparent with our remuneration bands being based on market data supplied by the Hay Group and MHR Global (Cubiks Rewards), which is updated annually. Our remuneration review process includes regular feedback between staff and their line managers and performance-related pay increases. There is also provision for lump sum payments for exceptional performance.

This year we undertook an independent review of our remuneration system and science career path which concluded they are gender-neutral. This underlines our commitment to Equal Employment Opportunities.

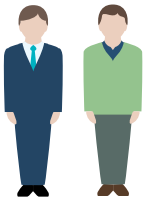
There is voluntary membership of the PSA, and 53% of staff are members. We have an excellent relationship with the PSA and this contributes positively to the operation of our organisation.

Our employment conditions include generous sick leave, income protection insurance, and life insurance cover. Our offices feature ample free parking, cycle storage, and showers. We also have arrangements with gyms and sports facilities so staff can enjoy memberships at attractive rates.

We have developed a Reward and Recognition Guide to provide managers with ideas on how to recognise employees who have gone above and beyond what is expected of them.

Female staff

38%



Staff turnover

6.1%

Average age

47 yrs

Employee development

This year we spent $285,000 on professional development, an average of $727 per person.

We continue to educate managers and staff in the areas of professional development, especially in how we can provide our staff with on-the-job opportunities rather than simply seeing training courses as the only development option.

Science career path

Our science career path provides a formal career structure for science staff with four career path steps for technicians and five for scientists. This is an entirely merit-based system. We have more male staff at the senior levels and we are seeking further information about this to see what steps we can take to address it.

This year 16 staff were successful in their applications for progression on our science career path. These applications are reviewed by a panel of Principal Scientists who make recommendations to the Executive Management team for approval.

Flexibility and work design

A number of staff continue to opt for flexible work arrangements which includes working part-time, flexible start and finish times, and a phased retirement programme. This helps to attract and retain staff at different stages of their careers. Nine percent of our staff work part-time (less than 30 hours/week). We also support staff so they can readily return to work after periods of parental leave or ill health.

Harassment and bullying prevention

We work diligently to ensure a positive working environment for all staff. Our code of professional practice, put in place in 2004 and reviewed every two years, sets out behaviour standards expected of all staff. We are reviewing our harassment policy to ensure it is consistent with guidelines produced by WorkSafe New Zealand. All our policies go through a consultation process with staff. As part of our induction process, we actively engage new staff in workplace behaviour expectations. We do not tolerate any form of bullying or harassment.

Safe and healthy working environment

We are committed to a safe and healthy working environment for everyone using our premises, including contractors and students. We have made improvements to our health and safety practices and culture. We apply the lessons learnt from health and safety incidents to continually improve the safety of our working environments.

We were delighted to move up from Secondary to Tertiary status in the ACC Workplace Safety Practices programme during the year. This year we launched our online hazard register which is used across the organisation. A revamp of our intranet has provided an opportunity to rearrange the health and safety pages so they are easier for staff to use.

Wellbeing initiatives include flu vaccinations, and two-yearly eye examinations and regular medicals for all field and laboratory staff. Counselling sessions are available where a need is identified.

Personal and family security

We provide financial assistance for employees and their families in the event of death or injury through life and income protection insurance schemes. We help staff with retirement planning by holding retirement seminars. We also offer a group scheme for medical insurance to which 25% of staff subscribe. Fifty-four percent of staff contribute to KiwiSaver schemes.

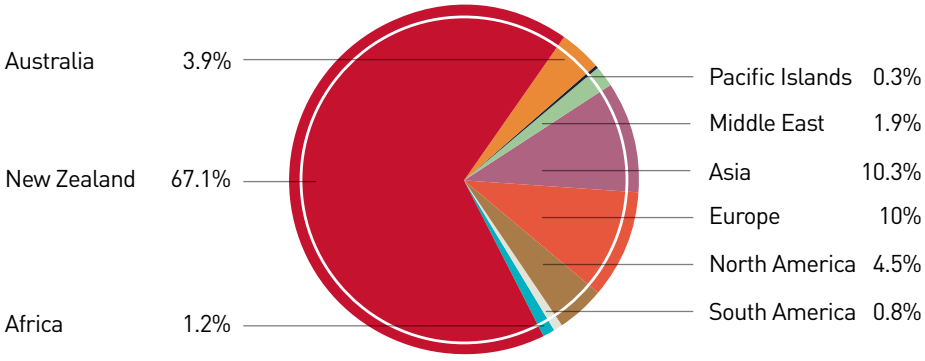
Workforce and succession planning

We set up an annual companywide workshop involving executive and tier three managers to review all aspects of succession planning. A key output was workforce development action plans, which we will be working through over the coming year.

Staff exit

We invite staff to undertake an exit interview when they resign. The information gathered helps in fine-tuning our employment policies and procedures. This benefits current and future staff.

WHERE OUR JOB SEEKERS COME FROM (SELF-DECLARED)



ENERGY AND MINERALS

OUTCOME 1 OF OUR STATEMENT OF CORE PURPOSE

INTRODUCTION

Our activities in this area are designed to bring economic benefits to New Zealand by contributing to the security, development and diversification of New Zealand's oil and gas, geothermal, and mineral resources.

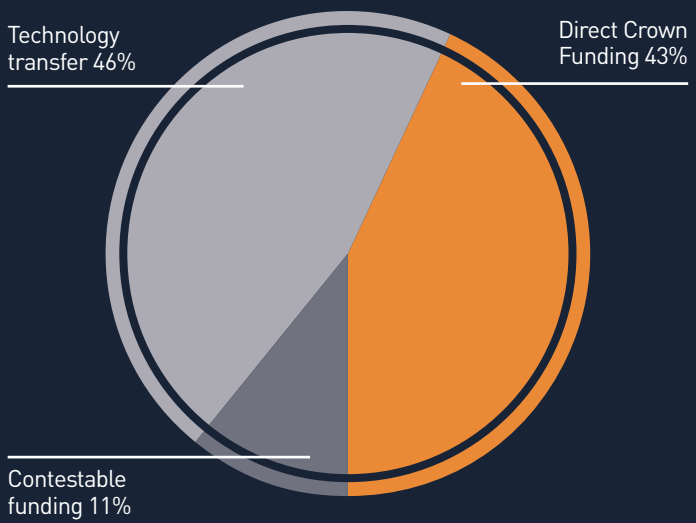
Our petroleum geoscience research and technology transfer focuses on mapping, analysing and quantifying the factors that control how petroleum forms, migrates, and is trapped in sub-surface structures. This aids the discovery of new oil fields, and optimises the management of existing fields.

In geothermal energy, our scientific advice to industry on physical and chemical properties of prospective and producing fields increases levels of confidence in exploration by reducing the risks associated with drilling and production.

For the minerals industry, we identify the extent and grade of offshore and onshore mineral resources.

For New Zealand's marine territory, we work with national and international organisations to investigate the nature of the seafloor and sub-seafloor. The aim is to provide quality information so government agencies and other organisations can make informed decisions about the potential resources and conservation needs of the Exclusive Economic Zone and its Continental Shelf Extension.

REVENUE SOURCES



FUELLING THE UPSTREAM OIL AND GAS SECTOR

The biggest event of the year in terms of our interaction with the petroleum exploration industry was the inaugural Advantage New Zealand 2014 Geotechnical Petroleum Forum, in April. Working in partnership with New Zealand Petroleum & Minerals, GNS Science conceived and helped to plan and host the two-day conference, held at Te Papa, which attracted more than 300 people from New Zealand and overseas.

We also conducted two pre-conference fieldtrips, to the Wairarapa and Marlborough regions, and held a full day post-conference geoscience workshop for 70 delegates at our Lower Hutt campus. These conference add-ons proved to be highlights for attendees, who especially welcomed the opportunity to contribute to a series of nine interactive specialist sessions at the workshop. Importantly, these sessions allowed us to directly test the relevance of our research with the industry. For our 35 staff who participated, the forum and workshop also represented an unrivalled networking opportunity. The forum contained a special learning programme for students, designed to inspire them to become the industry's next generation of expertise.

With a focus on subsurface geology, geophysics and associated disciplines, the Advantage forum was the first purely technical petroleum conference in New Zealand for over a decade, making it a draw-card for explorers and producers alike. It had extra pulling power as it featured the release by Energy Minister Simon Bridges of the 2014 petroleum exploration blocks offer in which 405,000 square kilometres of onshore and offshore acreage was made available for industry evaluation. Forum presenters covered a broad range of geoscientific material in support of the 2014 blocks offer.

The forum was a most effective venue for showcasing government-funded applied research on New Zealand's petroleum basins. Our expectation is that technical events like the forum, in conjunction with promotional activities undertaken by NZ P&M, will contribute to a growing international awareness of the petroleum potential across New Zealand. Ultimately this should lead to greater success in the search for new oil or gas finds.

We look forward to a repeat event planned for 2016, which will present similar opportunities for interaction and sharing of information between oil and gas professionals in government and industry.

GNS Science provides technical assistance to exploration companies operating in New Zealand as well as to other companies evaluating block offers and considering bidding for petroleum exploration permits. The almost 50 specialists in our petroleum geoscience team have a broad range of expertise and many decades of cumulative experience. They play a vital role in an industry that is New Zealand's fourth largest export earner.

Industry feedback on the Advantage Forum

"As a representative of a company that is new to New Zealand, I found that the Advantage New Zealand 2014 Geotechnical Forum was not just well organised, it had a range of cutting-edge technical presentations on the geology of New Zealand that helped kick-start our prospectivity assessment of your sedimentary basins and expose us to the latest research and ideas on the petroleum systems. The application of these new concepts has been critical to our new ventures assessment work."

DR DARREN FERDINANDO
Senior Staff Geologist
Murphy Australia Oil Corporation
Perth, Australia

"The informal discussions at the workshop were extremely useful in understanding the extent of geoscience resources that GNS Science could provide to the oil and gas industry in New Zealand. Their geological and geophysical data and technical expertise are particularly valuable to energy companies exploring for hydrocarbon resources in New Zealand."

DR FREYD RAD
Senior Geoscience Advisor
Anadarko Petroleum Corporation
Houston, Texas

RECENT INNOVATIONS

(2012) Developed Petroleum Basin Explorer web portal which has over 1600 registered users from 63 countries who have downloaded 8000 documents

(2012) Developed micro-earthquake monitoring techniques for reservoir management

(2012) Completed interpretation of the airborne geophysical survey data of Northland

(2013) Provided geoscience input into feasibility studies to harvest rock phosphate from the Chatham Rise

(2013-2014) Sold nine major petroleum geoscience database products to industry to help in the quest for new petroleum discoveries

(2013-2014) Developed basin-wide petroleum fluid-pressure plots to help unravel the complex story of oil and gas distribution in the Taranaki Basin

(2013-2014) Successfully trialled a new method for community engagement and consultation in Taranaki

(2013-2014) Introduced new scanning technique as part of reservoir provenance studies

EXPERTISE IN GEOTHERMAL ENERGY SCIENCE IN DEMAND

Our expertise in geothermal energy science is in demand in a number of Pacific Rim countries where we provide a broad range of services from field assessments to effectiveness auditing. This year we have been particularly active in the Philippines, where we work with four energy companies, the largest of which is Energy Development Corporation. EDC is one of the larger geothermal energy companies in the world with nearly 1200MW of installed capacity.

Our technical advice, training, and expert reviews help EDC to increase the performance and value of its geothermal developments. We have also provided scientific and technical review opinion for EDC's geothermal energy interests in South America. This gives confidence to EDC shareholders that the company is making the best choices to increase the performance and value of its geothermal resources. Our services include technical advice, training, expert reviews, and powerful numerical modelling of geothermal reservoirs.

This consultancy work broadens our skills and experience which we are then able to apply at home to enhance New Zealand's geothermal energy production. EDC is broadening its energy portfolio to include wind and hydro. At the same time, the company is working to improve efficiencies of existing geothermal fields while also developing new greenfield prospects.

EDC has also asked us to help them assess the possibility of using direct heat at some fields as an adjunct to generating electricity. EDC has been doing this on a small scale for drying produce. Our objective is to see if it can be scaled up.

REVAMPED GEOTHERMAL LABORATORIES KEEP WORLD-CLASS EDGE FOR NEW ZEALAND

Our newly upgraded geothermal and groundwater laboratories at Wairakei, north of Taupo, reinforce our position as a provider of world-class analytical services to the geothermal and groundwater industries. In the past year, the 1100 square metre facility underwent a multi-million dollar revamp that included an upgrade to its lab equipment. The facility is now capable of a wider range of analytical services to a higher precision than before. By almost any measure, it is without peer in the Southern Hemisphere.

Included within the facility are the New Zealand Geothermal Analytical Laboratory, the GNS Science Extremophile Laboratory, and other specialist analytical facilities. A unique feature is the combination of sophisticated analyses and expert interpretation of the results. This added value capability is vital to the health of New Zealand's geothermal industry.

There have been laboratories on the site of our Wairakei office since the 1940s and these early facilities were integral to the development of the Wairakei Geothermal Power Station in the 1950s. More recently, they have played a crucial role in the renaissance of geothermal energy since 2004.

The facility's mix of research and commercial work supports geothermal energy operators in New Zealand, iwi, and regional councils in their geothermal exploration and development initiatives, environmental monitoring, and power station efficiency and consenting needs.

In addition, it assists geothermal energy development in the Philippines, Indonesia, Peru, and Chile.

In another part of the facility is the GNS Science Extremophile Laboratory, which contains about 1500 strains of micro-organisms that live in the geothermal and volcanic areas of the central North Island. These microbes thrive at high temperatures, in highly acidic or strongly alkaline environments, and in high concentrations of heavy metals – conditions that would kill other life forms.

Research on extremophiles, and their bioactive compounds, has led to exciting developments in applied science. Pilot projects have shown that they can benefit a wide range of industrial processes, help remediate contaminated land, and help make a new generation of pharmaceuticals. Our extremophile research group has strong industry and scientific links both in New Zealand and internationally and is well placed to ensure that New Zealand can benefit when commercial spinoffs arise from this work.

"Mighty River Power has been one of the largest geothermal developers in recent years, completing three power stations since 2008. Fluid chemistry is an important component in monitoring the performance of the geothermal fields and power plants that we operate. Having a state-of-the-art GNS Science Laboratory here in New Zealand offers Mighty River Power and the geothermal industry easy access to a range of fluid analysis techniques that enhances our confidence in the quality of geochemical data which is essential to our geothermal operations."

FARRELL SIEGA
Geochemistry Manager
Mighty River Power
Rotorua

IMPACTS ENVISIONED IN OUR STATEMENT OF CORPORATE INTENT

Theme	Near-term goals	Progress/achievement
Geothermal energy		
Resource characterisation	Enhanced understanding of the physical and chemical nature of fluids and flow pathways below existing drilling depths	Conducted laboratory and field-based studies to better characterise deep geothermal reservoirs and identify possible constraints that might inhibit their development and/or use. Includes powerful numerical and 3D geophysical modelling of deep reservoirs.
	Experimental determination of simulated chemical changes at deep crustal temperatures and pressures	Continued research on mitigating detrimental impacts of corrosive properties of fluids at high temperatures and pressures, and identifying the source of fluids that could be expected beyond depths of 2 kilometres.
	Better knowledge of how subsidence affects surface features and ecosystems, and reinjection mitigation	Continued to provide expert technical advice, research and analysis at geothermal fields where this might be an issue. The public delivery of our work and the potential effects of subsidence are an important consideration for the awarding of resource consents.
Sustainable development	Assessment of productivity and sustainable development of geothermal resources in NZ	Our focus, and the focus of the industry, has been on improving sustainability and efficiencies of existing geothermal developments. A measure of this work is well performance in its widest sense.
	A GIS-based geothermal database of geological, physical, chemical, and microbiological descriptors	Built a website detailing the microbial diversity, location, and geochemical information for 1000 geothermal hotsprings in NZ's central North Island.
Physical and biological surface effects	Promotion of the understanding and application of low temperature geothermal resources	As a result of our research and development activities, workshops, seminars and extensive public engagement, we have recorded nationwide growth in the uptake of low temperature geothermal applications.
Oil and gas		
Petroleum systems	Quantified critical parameters that control petroleum formation, migration, and confinement with calibration to industry data and known resources in Taranaki	Presented our Taranaki research findings to industry at the Advantage 2014 conference. Includes distribution of gas to oil ratios with reservoir depth and pressure, petroleum charge modelling around the Maui Field, and database compilations for several Taranaki reservoir formations. These studies provide important ground-truthing for understanding and modelling the distribution of petroleum phases within a basin – a key industry goal.
	Advanced understanding of the geological framework and prospectivity in the Northland, East Coast, Reinga, Pegasus, Canterbury and Northland basins	Released important information on East Coast source rock properties to exploration companies as a web-based database. Unveiled results of seismic mapping of Pegasus and Canterbury Basins at the Advantage 2014 conference. Published new results from paleogeographic maps and seismic mapping from Great South Basin in the APPEA conference journal. Developed multi-client reports on prospectivity screening for Reinga/greater Taranaki (NW quadrant) and Great South/Canterbury (SE quadrant) offshore basins.
Frontier provinces	Establish environmental and production parameters for east coast (North Island) gas hydrate reservoirs	Participated in joint NZ-German research voyage that identified a 50-square-kilometre sub-seafloor area east of Gisborne that is rich in gas hydrates. This extensive deposit is venting methane gas through the water column.
Emerging energy technologies	Provision of expert advice to government on CO_2 storage in sedimentary basins	Represented New Zealand interests in carbon capture and storage (CCS) at CO2CRC symposium and planning meetings, and presented expert advice to CCS forum, as well as discussions with MBIE. Continued to liaise with industry representatives on the topic of storing liquid CO_2 in NZ sedimentary basins. A GNS-led publication on the interaction of CO_2 with subsurface resources has been viewed internationally about 100 times.
Minerals		
Onshore prospectivity	Provision of newly interpreted geochemical, aeromagnetic and radiometric information to government and industry	Produced publications and conference presentations on a biogeochemical survey in the Reefton Goldfield and interpretations of aeromagnetic surveys of Otago and the Longwood Range of Southland.
Submarine exploration	Provision of new offshore geophysical and geochemical information to government and industry	Collected new geophysical and geological data on the Colville Ridge and the Reinga Basin, funded by Oceans 2020 and in collaboration with NZ Petroleum & Minerals.
Exploration pathfinders	Determination of the georesource potential of one lake in the Taupo Volcanic Zone	Measured the amount of geothermal heat entering through the lakefloor at Lake Rotomahana near Rotorua.
	Improved access to mineral resources data by explorers, government agencies and the public	Promotion of minerals data availability through minerals industry magazine articles and conference presentations, and ongoing upgrade of data in the minerals databases.

GROUNDWATER

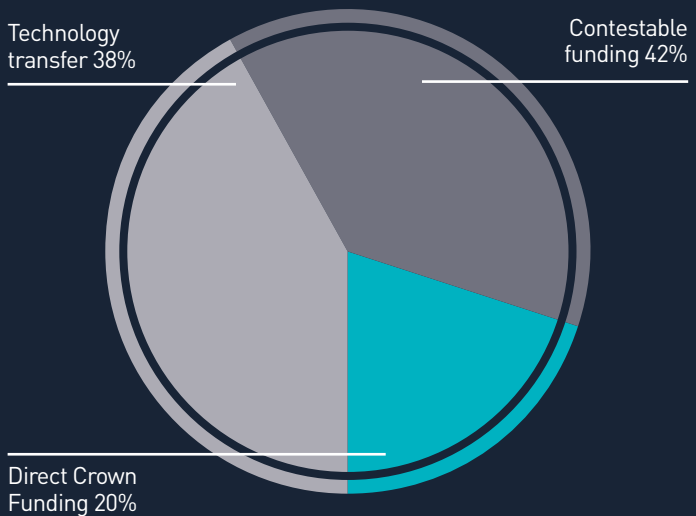
OUTCOME 2 OF OUR STATEMENT OF CORE PURPOSE

INTRODUCTION

Groundwater accounts for roughly 30% of New Zealand's consumptive water use. There is wide agreement that improved management of groundwater stems directly from a better understanding of the resource itself.

Our research and analytical capabilities are designed to significantly improve the understanding of aquifer systems and help in the effective management of groundwater resources. We use innovative methods to monitor, characterise and map New Zealand's aquifers. End-users rely on our aquifer maps and 3D models to ensure sound management of fresh water.

REVENUE SOURCES



Total revenue

6.0% of our total Company revenue

FASTER AQUIFER INFORMATION

Our hydrogeology group is trialling advanced techniques for obtaining information for management and exploration of aquifers by using publicly available geophysical data captured by aerial surveys. This involves using advanced computing techniques to obtain information over large areas of land at a resolution and speed that would be inconceivable using traditional aquifer mapping techniques.

Initial results show that aerial electromagnetic data can confirm the locations of known aquifers and can be used to quickly identify previously unmapped aquifers in a region. However, a lack of 'hard' data such as ground-based hydrological, geological, and geophysical information results in some uncertainty with this method. Consequently, we are in the process of increasing the amount of 'hard' data to enable more robust assessments.

There are 200-plus known aquifers in New Zealand and about 30% of New Zealand's population relies on the groundwater in these aquifers for freshwater supplies. In many cases there is insufficient knowledge of aquifers to properly address the management of water quality and allocation. Our focus is on correcting this knowledge deficit to facilitate environmentally sustainable management of these water resources.

For the trial, conducted in collaboration with Deltares in the Netherlands, we used publicly available data that were collected by mining company Glass Earth in 2007. The trial covers nearly 13,000 square kilometres of Otago with the data acquired by helicopter. Ground penetration for the data ranges from 60m to 150m. We further processed the data to obtain more accurate and higher resolution depth information. Although it was acquired mainly for mining purposes, it is fortuitous for Otago that the data contain information useful for other purposes.

So far, we have focused on three case study areas where there are known aquifers that have not yet been accurately delineated both horizontally and at depth. They are the Ida Valley, Ettrick Basin, and Lake Dunstan (pictured above). Rather than identifying water directly, the data identify hydraulically conductive materials such as gravels, sand, and sandstone where water is likely to occur. We found that the technique gives an instant overview of likely aquifer zones that may deserve further investigation.

The project is part of the six-year Smart Aquifer Characterisation research programme, which is funded by the Ministry of Business, Innovation and Employment. Its aim is to develop innovative techniques to characterise New Zealand aquifers more efficiently than traditional methods. One way of doing this is to use pre-existing data, or data that can be collected over large areas with minimal time and cost.

"The team at GNS Science are often our first port of call for key technical guidance for our regional monitoring and science development programmes. The expertise and analytical services they offer are critical to the development of a regional scale understanding of our natural resources. We find the staff accessible, highly professional and committed to working collaboratively with our science team. In short, great people and great expertise."

DR CLINT RISSMANN
Principal Scientist
Environment Southland

RECENT INNOVATIONS

(2012) Facilitated regional council access to the Geothermal-Groundwater national database

(2013) Developed smartphone access to aquifer and geology databases in Bay of Plenty

(2013) Developed a modelling tool to better understand surface water-groundwater interactions in the Lake Taupo catchment

(2013) Improved sensitivity and doubled throughput in our Water Dating Laboratory, already the most accurate such laboratory in the world

(2013) Developed guidelines for councils to help protect streams, wetlands, and wells that receive inflow from groundwater

(2013-2014) Developed new computer techniques to process airborne electromagnetic data to derive information on the lateral extent and depth of aquifers to help groundwater managers estimate the storage capacity of aquifers

(2013-2014) Trialled temperature-sensing techniques – satellite, airborne, and fibre optic – to show how they can complement each other for more cost effective characterisation of groundwater-surface water interactions over relatively large scales.

IMPACTS ENVISIONED IN OUR STATEMENT OF CORPORATE INTENT

Theme	Near-term goals	Progress/achievement
Groundwater quantity and quality	Delivery of national groundwater data to end-users	Set up new national protocols for data transfer to improve stakeholder access to national and regional datasets. Also deployed new interactive capability for access to the Groundwater and Geothermal database.
	New techniques to quantify reach-scale ground and surface water exchange fluxes in space and time	The use of radon gas and distributed temperature sensing has provided exciting new possibilities to characterise reach-scale ground and surface water interactions.

VALUABLE TOOL IN GROUNDWATER MANAGEMENT

We are continually looking for more effective ways to measure groundwater and surface water interactions. These two resources are strongly interconnected and the quality and quantity of one directly affects the other. Streams, rivers and lakes are continually losing and gaining water from aquifers. Knowing where these interchanges occur, and how much water is being exchanged, can help significantly in managing the quality of our fresh water bodies.

In a pilot project this year, we have been measuring the concentration of radon gas in river water at various points along rivers to identify areas where groundwater is entering the river. Our focus is radon-222, which is a radioactive isotope of radon. It is widely used as a naturally occurring tracer in environmental studies. Its parent product is uranium, which occurs naturally in small concentrations in rocks and soil.

While water is underground, it picks up small amounts of water-soluble radon gas. When water comes to the surface, the radon-222 degasses from the water and enters the atmosphere. So surface waters have lower concentrations of radon-222 than aquifer waters. It is the difference in concentrations that enables us to identify aquifer inflows.

In our pilot, we used glass vials to sample river water at 500m intervals. The vial is sealed underwater to prevent loss of radon to the air. We then measure the alpha particle radiation in the sample, which relates directly to radon concentration. Areas where aquifer inflow is occurring are easily identified as a spike on a graph. The method enabled us to identify an aquifer inflow zone in the Hutt River that had not previously been recognised. This means that water that has been underground for a period, possibly a year or longer, is entering the river system.

In summary, radon measurement improves our ability to identify stretches of river that are gaining groundwater. In addition, it provides another tool to study the transport of nutrients from farms to streams and rivers.

"GNS Science provides information and expertise of fundamental importance for groundwater management by the Waikato Regional Council. Detailed geological mapping, modelling and associated geophysics inform our understanding of hydrogeologic systems in three dimensions. Environmental tracer work is also very important for water quality protection through consideration of lag times and groundwater-surface water interactions."

JOHN HADFIELD
Senior Groundwater Scientist
Waikato Regional Council

ISOTOPES AND ION-BEAM TECHNOLOGY

OUTCOME 3 OF OUR STATEMENT OF CORE PURPOSE

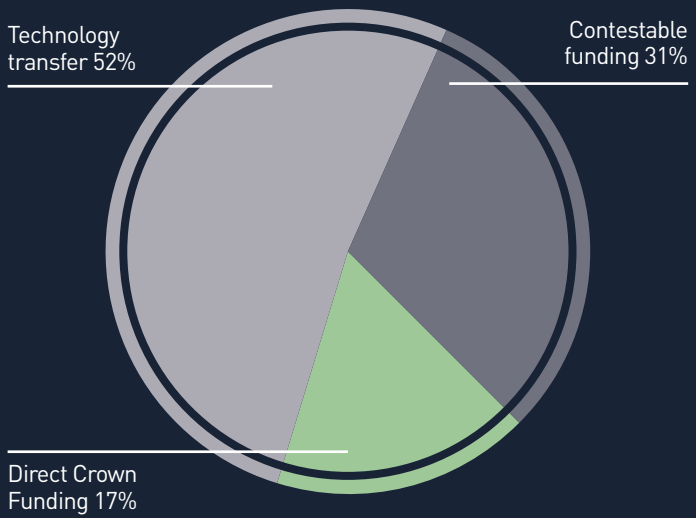
INTRODUCTION

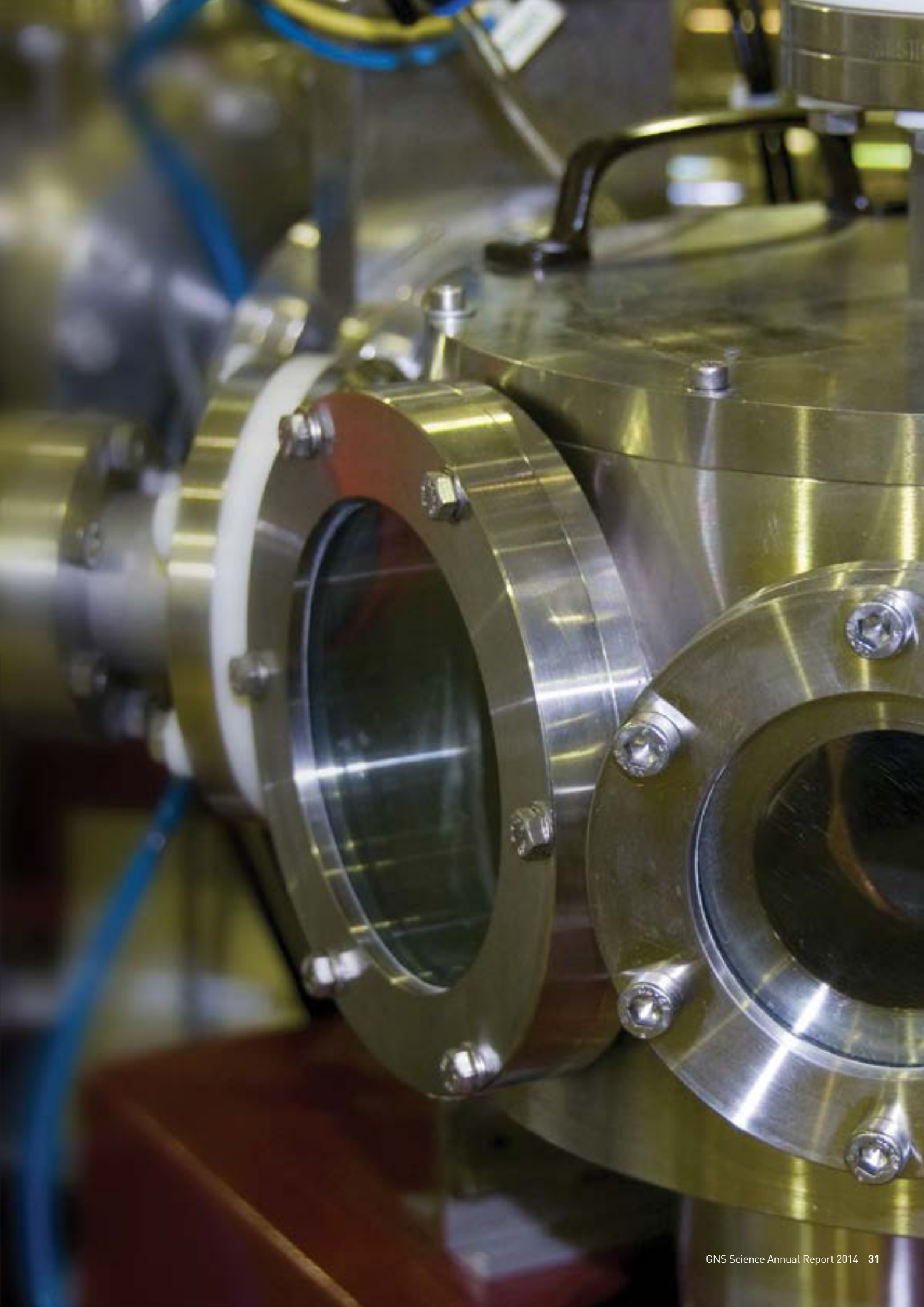
Our isotope and ion-beam technologies support the earth sciences in the broadest sense, as well as industries and environmental sciences. We use our ion-beam technology to analyse fine-particle air pollution in urban areas so councils can make informed policy and mitigate poor air quality.

We also use this technology to develop materials with superior physical, electrical, magnetic, and optical properties by depositing other elements, atom-by-atom, onto the surface of the base material, usually a metal. This supports high-value manufacturing industries and the development of specialised nano-materials for industry.

Our isotope technology is used in age dating, environmental tracing, and food authentication.

REVENUE SOURCES





MEDICAL APPLICATIONS FOR NANOTECHNOLOGY TEAM

Our nanotechnology team has expanded its repertoire of nano-engineered structures to include medical applications. This year, working with a New Zealand company that makes custom medical implants, we coated a titanium hip joint with a wafer-thin layer of pure silver to reduce chances of post-operative infection in the patient. The antimicrobial properties of silver are well known.

Christchurch company, Ossis, was asked by one of its customers if it could provide a silver coating to a custom titanium implant they were designing for that customer. Ossis asked us to coat the implant with 'nano-silver' that would last the lifetime of the patient. To do this we used a technique known as sputtering. In our 'sputter chamber' the target is showered with silver atoms that chemically bond with the titanium. The silver ion is bioactive and helps ward off infection.

Inside the chamber, silver atoms are sprayed with enough energy to penetrate the top half dozen atoms on the surface of the titanium. This helps to ensure a lasting bond. The finished layer of silver is about 300 atoms, or 30 nanometres, thick. Our chamber is equipped to measure precisely the thickness of deposition layers.

We offer a two-day turnaround time, which in this case was compatible with treatment schedules. Custom implants are used where normal implants are unsuitable, or if there are other complications with individual patients. They help to speed recovery and rehabilitation times.

Our purpose-built 'sputter chamber' can coat substrates with a wide range of permanent metallic nano-coats including gold, platinum, zinc, germanium, aluminium, and alloys such as iron-nickel. Each coating delivers a particular set of properties to a substrate making it, for instance, extra hard, corrosion-resistant, ultra-smooth, or improving its electrical conductivity.

We operate a range of ion-beam technology techniques that enable manufacturers to change the properties of metal and metal surfaces to give improved lifetime performance and greater utility. Until recently, some of these high-value techniques were prohibitive for New Zealand industries. We have scaled them and made them affordable for the local market. As well as medicine, applications include agriculture, food processing, security, manufacturing, transport, and construction.

Project started: 2013

Project duration: Ongoing

Number of scientists involved: Five

Collaborations: With Ossis on this occasion. Other projects involve various industry and university partners in New Zealand and internationally.

Funding: Most research occurs within our Core and MBIE-funded programmes. We undertake a range of commercial projects as clients require.

Progress communicated by: Research papers; presentations to government agencies and industry groups, conferences; workshops; client reports; mainstream and specialist media

Direct beneficiaries: Patients having joints replaced

Long-term beneficiaries: All New Zealanders. Increasingly, nanotechnology applications will affect every aspect of daily life.

Clients: Our new materials technology team, which consists of five scientists and five technical and support staff, delivers benefits to clients and partner organisations in many sectors. This includes medicine, agriculture, food processing, security, geothermal energy production, transport, and construction. Together these sector groups represent a significant part of the New Zealand economy.

IMPACTS ENVISIONED IN OUR STATEMENT OF CORPORATE INTENT

Theme	Near-term goals	Progress/achievement
Air particulate pollution	Identification of the sources of air particulate matter pollution in Auckland, Wellington, Nelson, and Christchurch	Air particulate monitoring programmes in Auckland, Wellington, Nelson and Christchurch have successfully identified the sources of urban air pollution. In Auckland we were able to identify trends in particulate matter pollution emitted from a range of sources; this is important information for developing and implementing air quality management policy.
New materials	Development, with industry, of a magnetic field sensor (MFS) using ion-beam implantation technology	Developed prototypes of MFS for non-GPS navigation systems, and proximity sensing for security applications. Working with industry partner to assess commercial applications.

RECENT INNOVATIONS

(2012) Developed ion-beam method for anti-corrosion preparation and coating of industrial pipes
(2012) Developed an air-sampling technology for hourly identification of sources of air-particulate pollution
(2013-2014) Worked with export honey industry to find out why manuka honey is failing authentication lab tests
(2013-2014) Designed and built an ion implanter for the Australian Nuclear Science and Technology Organisation

LEARNING THE SOURCE OF RIVER SEDIMENTS

Our environment and materials scientists are trialling a new method to identify the origin of sediments and nutrients that build up in rivers and estuaries and put ecosystems at risk. The aim is to help councils and others responsible for waterways to manage sediment and nutrient inflows into rivers. The trial focused on the Oreti and Aparima rivers and was undertaken at the invitation of Environment Southland, and funded by DairyNZ.

Environment Southland wanted to learn more about the processes involved in the high rates of accumulation of sediment and nutrients in two of its rivers and their estuaries. Over time, they had observed significant physical changes including a build-up of silt and reduced oxygen levels in parts of the two rivers. Environment Southland wanted to find the respective contributions made by the various land uses in the river catchments.

Using our ion-beam facility, we analysed soil from 54 farms and analysed 19 samples of suspended river sediment. The facility fires a beam of protons at a sample of sediment and analyses the X-rays and particles that are emitted. We measured 25 elements in the samples and determined their respective concentrations.

A key finding was that the elemental composition of the sediment changed as it travelled down the river. As the sediment flowed toward the estuary, the organic fraction – hydrogen, carbon, nitrogen, and oxygen – reduced. At this stage, it is unclear if these elements simply dropped out of suspension, or reacted with the riverbed, or were lost by some other process. Further work is needed to see if firm links can be made between land use and the amount of sediment and nutrient found at different stages in the river.

To our knowledge, this is the first time such detailed elemental analysis has been applied to the entire composition of river sediment.

Project started: July 2013

Project duration: Ongoing

Number of scientists involved: 4

Collaborations: Environment Southland and DairyNZ

Funding: DairyNZ

Progress communicated by: A major report for Environment Southland, research papers, presentations to government agencies, and conferences and workshops

Direct beneficiaries: Environment Southland, land owners in the river catchments, flora and fauna in the rivers and estuaries

Long-term beneficiaries: All New Zealanders

NATURAL HAZARDS

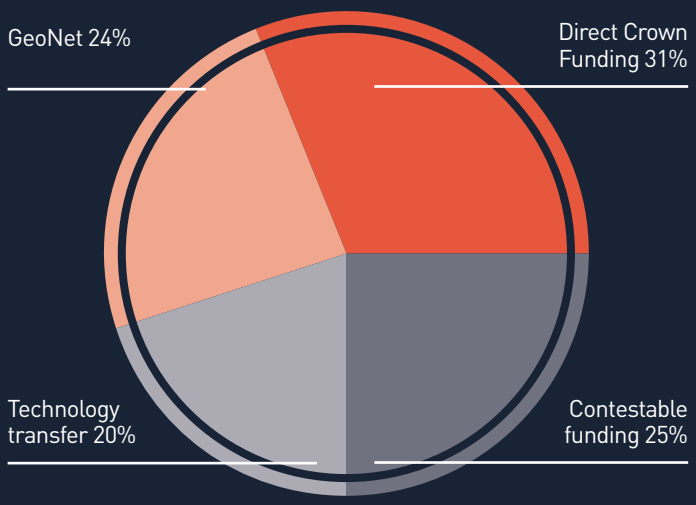
OUTCOME 4 OF OUR STATEMENT OF CORE PURPOSE

INTRODUCTION

Our research and applied work in this area helps to reduce New Zealand's risks from earthquakes, volcanoes, landslides, and tsunami. The outcomes are increased resilience of society, buildings and infrastructure. This reduces loss of life as well as moderating insurance costs through better engineering and planning.

In partnership with the Earthquake Commission and supported by Land Information New Zealand, we operate GeoNet – the national network for monitoring geological hazards. Data from this network provide underpinning information for downstream geohazards research. We also host the Natural Hazards Research Platform – the multi-agency group that delivers most of New Zealand government-funded applied hazards research. Finally, we undertake social science research to support Civil Defence and other agencies to prepare for, and respond to, natural hazards.

REVENUE SOURCES



Total revenue

47.2% of our total Company revenue

SQUASHED EXTINCT VOLCANOES LINKED TO TSUNAMI ON THE EAST COAST

A group of our scientists, working with a colleague from Imperial College in London, have shown that extinct undersea volcanoes can trigger tsunami as they are subducted under the North Island. The finding is the result of a multi-year investigation focused on two unusual tsunami that hit the Poverty Bay coast in 1947.

Although the tsunami were quite large and caused damage, they were not preceded by a large offshore earthquake and violent ground-shaking, which is the normal pattern of events. Instead they were preceded by quakes of magnitude 5.6 and 5.9 respectively, which produced slow rolling motions that lasted for some minutes. Poverty Bay residents of 67 years ago reported feeling seasick.

Our scientists (pictured above) suspected that the events were triggered by extinct volcanoes getting 'stuck' and then suddenly sliding on the subducting plate interface, 60km east of Gisborne. They found that geophysical data and eye witness accounts from the time perfectly matched their theory. This type of tsunami-producing earthquake is rare and was first recognised by scientists 35 years ago.

Using seismic and magnetic data largely from the oil exploration industry, the scientists located two extinct volcanoes under the seafloor east of Gisborne and coinciding with the 1947 earthquake epicentres. Millennia ago the extinct volcanoes became partly squashed as they sunk beneath the Australian plate east of Gisborne. However, their height inhibited the subducting plate from sliding smoothly and the area around the volcanoes became stuck, which caused a build-up of tectonic strain. When they became 'unstuck' in 1947, the Pacific plate moved to the west quickly, but not as fast as a normal earthquake rupture.

Modelling by our tsunami scientists found that a slow rupture under the seafloor, at least half as slow as a normal earthquake rupture, can significantly amplify the size of the tsunami waves. This counter-intuitive phenomenon resulted in waves that were up to 10m high during the 1947 tsunami. This would normally be out of proportion for earthquakes of such modest magnitude.

Called 'tsunami earthquakes', they are one of three distinct types of earthquake. The other types are normal earthquakes that rupture violently in seconds, and slow-slip earthquakes where movements occur slowly and gradually over weeks or months. The civil defence message for all earthquakes remains the same. Where shaking is either unusually strong or lasts for a minute or more, people should head to higher ground. It is likely there are other subducted seamounts along the North Island's east coast, generating further tsunami-genic earthquakes of this type over long time periods.

Project started: 2008

Project duration: Work occurred progressively over six years in parallel with other research projects

Collaborations: Imperial College of London

Funding: Core funding under MBIE contract

Immediate beneficiaries: International science community, civil defence organisations, Poverty Bay residents

Long-term beneficiaries: International science community, civil defence community, all New Zealanders, all coastal populations worldwide where tsunami can be a threat.

DECISION SUPPORT TOOL FOR LAND-USE PLANNING

We have developed a decision support tool to provide guidance to local authorities on how to implement a risk-based approach to natural hazards in land use plans. Consisting of an interactive website, it provides a framework for a rational decision-making process to determine what is acceptable, tolerable, or unacceptable risk. Councils can then set policies accordingly with the aim of increasing community resilience by lowering or negating the consequences of natural hazards.

At present, planning policy for developing land gives only limited attention to the consequences of natural hazards such as earthquakes, floods and tsunami. It is common for land use planning to be based on likelihood of a natural hazard, such as a one in 100-year event. Likelihood alone does not specify consequences of a natural hazard event. And sometimes decisions are based on an 'acceptable level of risk', which is not defined. As a result, many existing developments may have significant risks that communities may not be aware of.

Currently there is no consistent approach on risk reduction in land use planning, resulting in some council decisions being overly restrictive, and others too permissive. Funded by Envirolink, the online 'toolbox' is free and is designed to support risk-based land use policy and plan development in local government. It consists of five well-defined steps including knowing your hazard, working out the severity of consequences, and the likelihood.

Each step takes the user through a set of actions outlined in a table format. It guides councils in evaluating multiple natural hazards and engaging internal audiences as well as the wider community in decision-making. Importantly, it is not about stopping development – it is about smarter development.

The toolbox enables land use planners and decision-makers to quantify potential consequences and determine a level of risk, with associated controls. It can apply equally well to existing developments for decisions on infill housing, or changes to land use. It can also help with decisions on the siting of critical infrastructure such as electricity substations.

The toolbox was released in September 2013 and a number of councils are exploring its benefits. Among these, the Bay of Plenty Regional Council and Thames-Coromandel District Council are leading the way in making it part of their planning approaches.

The toolbox is available at:
http://tinyurl.com/mdszu65

"GNS Science's toolbox is underpinning the Bay of Plenty Regional Council's policy approach to natural hazards. It has demonstrated that risk management can be applied to controlling the use of land to avoid or mitigate natural hazards. With the ongoing support of its authors, BOPRC has engaged the community in the setting of risk thresholds and established a risk-based natural hazards policy framework to be included in the region's Regional Policy Statement."

MARTIN BUTLER
Regional Planner
Bay of Plenty Regional Council

LEARNING FROM THE TONGARIRO ERUPTION

Mount Tongariro's eruptions in August and November 2012 have yielded a large amount of new knowledge and understanding in volcanology and in managing a volcanic crisis. This is clearly evident in a special collection of research papers which were published recently to mark the second anniversary of the eruption. The volume highlights the extensive capability New Zealand has in volcanology and the role that this can play to improve resilience during future episodes of volcanic unrest.

The 17 papers, seven of which are led by GNS Science staff, feature in a special issue of the *Journal of Volcanological and Geothermal Research*. The publication underlines the high level of collegiality among the volcano research and emergency management communities and the benefits this represents for New Zealand. Lead authors represent seven different New Zealand organisations and co-authors are from several domestic and international research institutions.

The pre-dawn eruption on 6 August 2012 consisted of three successive dense ash plumes and ballistic ejections. Lava blocks about 1m in diameter were thrown up to 1.5km from the crater. The eruption was preceded by a debris avalanche, similar in pattern to eruptions at Te Maari crater going back over 150 years.

Scientists believe the avalanche was probably caused by upward seepage of hydrothermal or magmatic fluids and vapour which made the vent system unstable. The initial slope failure shifted about 700,000 cubic metres of material, moving at a rate of up to 20m per second to a distance of about 2km downslope. The sudden unburdening of this load acted like the popping of a champagne cork causing the main eruptions.

The eruption sequence could easily be overlooked in terms of its modest size and minor consequences. However, it focused scientific and societal thoughts on questions that are common to all reawakening volcanoes, such as: 'Will there be more eruptions?' and 'Is this a precursor to a bigger event?' Based on these questions, our scientists developed, for the first time, probabilities for a range of eruption scenarios, and regularly updated these for the public.

We could therefore express both the hazardous nature of the volcanic unrest, and also the inherent uncertainties. A subsequent eruption on 21 November 2012 reminded us that these key questions are indeed relevant and that the uncertainties were real and need to be reviewed regularly.

The New Zealand volcano science community responded to the unrest by working closely across disciplines and institutions to answer multiple questions and offer reliable science information to the public and end-users. A specific example was an end-user workshop, called 'Te Maari Day', held in March 2013. This event allowed scientists to share their research and get input from the wider end-user community. The eruption and subsequent workshop reminded us that during an eruption, there is seldom a single definitive source of scientific knowledge. It remains a challenge to integrate the variety of scientific views and results from a range of disciplines and from different agencies.

The Te Maari eruptions illustrate that even with excellent monitoring and science capability and well engaged end-users, it is still very challenging to meet public expectations for rapid and definitive information when dealing with a restive and uncertain volcano. The Tongariro special issue documents some of these challenges and the associated science and management response. As always, this work endeavours to set a new standard for international best practice in volcano monitoring, science delivery and natural hazard management.

"GNS Science provides essential data, information, advice and expert monitoring for volcanic unrest which is of fundamental importance to the management of volcanic risk by the Department of Conservation and associated end-users such as the police and local councils. GNS's operation of the EQC-funded GeoNet system is of huge mutual benefit and the cooperation between the three agencies is vitally important in and around Tongariro National Park and on Raoul Island. Similarly the geochemical, geophysical and social research undertaken by GNS is very valuable for current management and likely to provide dividends in the future. Nowhere was this better demonstrated than during and following the 2012 eruption of Tongariro."

DR HARRY KEYS
Technical Advisor – Volcanology
Department of Conservation

RECENT INNOVATIONS

(2012) Developed tsunami inundation models and evacuation plans and routes for vulnerable localities in New Zealand

(2012) Developed tsunami mitigation techniques relevant for Samoa and other South Pacific nations

(2012) Developed and installed GeoNet Rapid for fully automated sub two-minute advice of earthquake locations and magnitudes

(2012-2014) Worked with Indonesian authorities to build disaster risk management capability

(2013-2014) Developed rapid alert system to enable KiwiRail to focus quickly on areas where its rail network might have suffered damage in an earthquake

(2013-2014) Installed new monitoring equipment at White Island and Tongariro to improve the early detection of volcanic unrest

(2014) Publicised a range of future quake scenarios, and their likelihoods, within a few days of the Eketahuna earthquake on 20 January 2014

(2014) Developed an online risk-based planning toolbox to help local government incorporate the consequences of natural hazards into land-use policy development

IMPACTS ENVISIONED IN OUR STATEMENT OF CORPORATE INTENT

Theme	Near-term goals	Progress/achievement
Hazard monitoring	Improved speed and quality of earthquake location and provision of more detailed derivative information with a particular focus on the mid-upper South Island	Installed six new permanent seismic stations in the past year: five in the South Island and one in Wellington. Temporary deployments provided improved aftershock data for Eketahuna and Cook Strait quakes. Also upgraded 20 strong motion stations and three GPS stations.
	Better understanding of volcanoes, earthquakes, landslides and tsunami, with a focus on Canterbury seismicity and Tongariro and White Island eruptions	Continued making incremental advances in understanding these geological hazards through analysis of high quality data. Major work on 2012 Tongariro eruption (see opposite) represents an important milestone in volcanology and public engagement.
Geological hazards	Availability of more comprehensive asset data leading to wider uptake of the RiskScape multi-hazard tool by local authorities	Released RiskScape V3.0. It includes web portal updates, greater functionality and building population assets for all of NZ. Developed online asset repository and mobile real-time asset capture application (RiACT) and successfully used it to create RiskScape asset modules in NZ and overseas.
Risk and society	Continued support of Christchurch recovery through social science on psychosocial recovery, community resilience, public policy and land-use planning	Continued to work with CERA and other agencies providing advice and research to help formulate policy and as part of long-term community recovery in Canterbury. It includes resilience modelling and wellbeing surveys.
	Domestic constituency and trusted partnerships to support international opportunities for NZ companies in natural hazards risk management	Continued to work closely with NZ companies in developing international opportunities. Successful multi-year projects underway in Indonesia and Vietnam.

ENGINEERING GEOLOGY

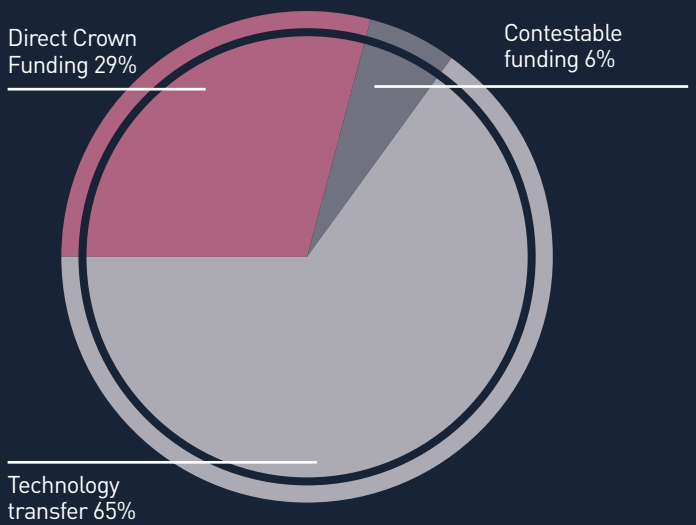
OUTCOME 5 OF OUR STATEMENT OF CORE PURPOSE

INTRODUCTION

One of the silver linings of the Canterbury earthquake sequence is the large amount of new knowledge we have gained from investigating slope stability, liquefaction, and the impact of ground conditions on building performance. All of this is applicable to other parts of New Zealand.

We also continue with our traditional work that underpins the development and sound management of New Zealand's engineered infrastructure, particularly in the energy and transport sectors. This includes power generation and transmission facilities, water and gas networks, housing, mines, and road and rail networks.

REVENUE SOURCES



PROTECTING OUR HIGHWAYS FROM GEOLOGICAL THREATS

We are working with the NZ Transport Agency to develop a method of assessing the relative risks of geological hazards to its highway network. In a pilot project, we investigated the risks along the 120km-long road between Te Anau and Milford, one of the most scenic roads in New Zealand. The road is used by 200,000 vehicles each year, or about 550-a-day. We developed a methodology that can be applied at multiple places on the national road network to reduce risks to road users by proactively managing potential geological threats.

NZTA wanted to better understand the exposure of the Milford Road (pictured above) to geological hazards. They already had a well-developed snow and ice avalanche control programme, and they were keen to investigate the risk to road users from other mass movement hazards such as landslides and rockfall.

We supplemented our existing data, including maps, aerial photos and LiDAR, with additional aerial photos to increase our understanding of the region's geology and hazards. This enabled us to better define rockfall and landslide-prone areas and estimate impacts on road users if these areas failed. The study assesses 27 sections of the road where risk is based on likelihood of events and consequences in terms of risk to life.

The risk assessment framework is based on an 'event tree model' which can be applied to any section of highway and enables NZTA to identify the main hazards and scenarios which can lead to fatalities at a given location. Based on the results, NZTA can make decisions about intolerable risks and then apportion remediation spending accordingly. The framework can be updated so risk estimates can be refined as more data become available. It can also encompass other hazards such as volcanic eruptions and tsunami inundation, thus making it adaptable to any part of the country.

Project started: 2013

Project duration: Ongoing

Number of scientists involved: 4

Collaborations: TTAC Ltd – a UK-based risk consultancy company

Funding: NZ Transport Agency

Progress communicated by: A major report to NZ Transport Agency

Direct beneficiaries: NZ Transport Agency and the 200,000 vehicles that use the highway each year

Long-term beneficiaries: Motorists that use the Milford Highway and businesses that rely on it staying open.

Clients: Our Engineering Geology team has clients in many sectors. As well as NZTA, this includes KiwiRail, energy infrastructure companies, hydro-electricity companies, local and regional councils, other engineering consultants, developers, the Canterbury Earthquake Recovery Authority, the Department of Conservation, the Ministry for the Environment. In addition, members of the public and overseas organisations use this team's expertise and databases.

RECENT INNOVATIONS

(2011-2014) Completed a series of major reports on slope stability and rockfall risk to help with zoning for Port Hills area of Christchurch

(2011-2014) Provide ongoing monitoring and assessment of geological hazards for the 307km-long Maui Gas Pipeline

(2012-2013) Developed new subsurface 'site period' maps of Wellington and Lower Hutt to help in the building of structures that are more resistant to earthquake shaking

(2014) Developed a risk assessment tool for the NZ Transport Agency to help rank the geological hazards along the Milford Highway.

IMPACTS ENVISIONED IN OUR STATEMENT OF CORPORATE INTENT

Theme	Near-term goals	Progress/achievement
Resilient buildings and infrastructure	Assessment of responses of engineered structures to different ground conditions, based on Canterbury earthquake data	Analysed Christchurch seismic and geotechnical data to assess how ground-shaking and ground conditions affected building performance

PORT HILLS RECOVERY

Our Engineering Geology team has used its unique set of capabilities to provide risk assessments for quake-damaged parts of the Port Hills in Christchurch to underpin challenging zoning decisions. The team recently produced the final set of reports for the Christchurch City Council as part of a series of expert analysis on the risk of landslides, cliff collapse, and rockfall.

The most recent reports covered 126 dwellings where the risk from landslides was considered intolerable with regard to the threshold defined by Christchurch City Council. This means that at these dwellings the risk to life from a landslide in any one year is equal to, or greater than, one in 10,000.

The reports involved months of mapping, monitoring and modelling supported by drilling investigations and surface inspections. Of the 126 properties, the Canterbury Earthquake Recovery Authority had already 'red-zoned' 89 due to the risk of rockfall or cliff collapse, leaving 37 that needed either demolition or remedial protection work.

Based on our reports, the Council and CERA decided to buy 16 of the remaining properties where there was no cost-effective engineering solution to reduce the risk from slope failure or rockfall hazards. This left 21 properties that could be 'saved' through various engineering interventions.

In just one part of the Port Hills – Redcliffs – up to 24,000 cubic metres of debris fell from the slope during the 22 February 2011 earthquake. And in subsequent earthquakes, the cliff recessed by up to 7m.

A central issue was the extensive ground cracking that occurred in some parts of the Port Hills following the extended earthquake sequence. As well as indicating significant ground deformation, it also gave rainwater an easy entry point to make many areas potentially more prone to landslides.

Our reports made a number of recommendations for short, medium, and long-term reduction of risk. This enabled the Council to focus on high priority areas to increase the resilience of this desirable part of Christchurch.

Reports produced by GNS Science for the Christchurch City Council, and shared with the Canterbury Earthquake Recovery Authority, have provided valuable and thorough geotechnical information that has been critical in the Government's Port Hills zoning decisions. All of the decisions made impact on people's homes and livelihoods, so the work GNS Science has undertaken has been crucial in giving confidence and reassurance to CERA and property owners.

ROGER SUTTON
Chief Executive
Canterbury Earthquake Recovery Authority, Christchurch

GEOLOGY AND PAST CLIMATES

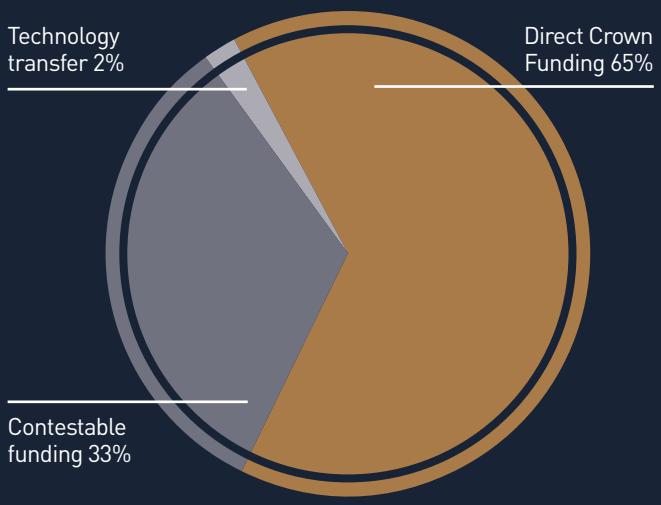
OUTCOME 6 OF OUR STATEMENT OF CORE PURPOSE

INTRODUCTION

Our research increases the understanding of the geology and past climates of New Zealand, the Ross Dependency and Antarctica. We provide region-wide geological, geochemical, and geophysical information to improve knowledge of the dynamic processes occurring at and adjacent to the tectonic plate boundary.

As well as on-land mapping, we work to understand the geological makeup of our EEZ and the Extended Continental Shelf. This region represents 96% of our territory, but remains poorly mapped and explored. Finally, our activities in Antarctica help to guide government policy development in climate change and environmental issues.

REVENUE SOURCES



$6.7 million

Total revenue

8.7% of our total Company revenue

COURSE A DIRECT BOOST TO SCIENCE QUALITY

Each year we host the only course in New Zealand that covers specialist techniques for reconstructing past environments dating back to 2.5 million years ago. Such is its popularity and usefulness, that it is now a required part of postgraduate earth and environmental science courses at some universities.

This year 55 participants from throughout New Zealand attended the eleventh annual Quaternary Techniques Course – a two-day event hosted at our National Isotope Centre in Lower Hutt. It caters for those engaged in earth and environmental sciences and where age-dating is a central analytical technique. Participants are mostly postgraduate students and their lecturers. The 27 expert presenters, from Crown Research Institutes and universities, cover an extremely wide range of topics.

The course started over a decade ago as a way of showcasing the range of capabilities at the National Isotope Centre. It has grown considerably in size and scope and now more fully encompasses the environmental science community in New Zealand.

By being subjected to the techniques covered at the course, environments such as lakes, peats, marine sediments, cave deposits, ice cores and tree rings can give up secrets they have been holding for millennia.

Our course gives participants a comprehensive overview of analytical techniques such as radiometric dating, magnetism, tephrochronology, and optically stimulated luminescence. There is an emphasis on hands-on learning and there are practical demonstrations by leading scientists on both days.

Sessions include interpreting isotope data, choosing a technique that best fits the environment and the research objective, and using appropriate proxies for climate change work. The course empowers participants to try new analytical techniques and become more proficient with the methods they may be using already. This enables them to plan and execute their research projects with more certainty that they will achieve valid and meaningful results. Everyone benefits when science is more powerful, more precise, and more productive.

Project started: 2003

Project duration: Ongoing

Number of scientists involved: 27 presenters, including 11 from GNS Science

Collaborations: All the New Zealand universities, plus NIWA

Funding: Comes from a mix of registration fees and our 'Global Change through Time' research programme

Direct beneficiaries: The 55 postgraduate students and their lecturers who participate

Long-term beneficiaries: Those engaged in earth sciences and environmental sciences in New Zealand. This translates to more rigorous and more useful science.

RECENT INNOVATIONS

(2011-2014) Collected and analysed 763m of ice core from Roosevelt Island in Antarctica to determine annual climate conditions going back many thousands of years

(2012-2013) Completed 3D model of Canterbury subsurface to help with geotechnical engineering and groundwater management

(2012-2014) Completed quarter-million scale digital geological map of NZ and made it available on the web

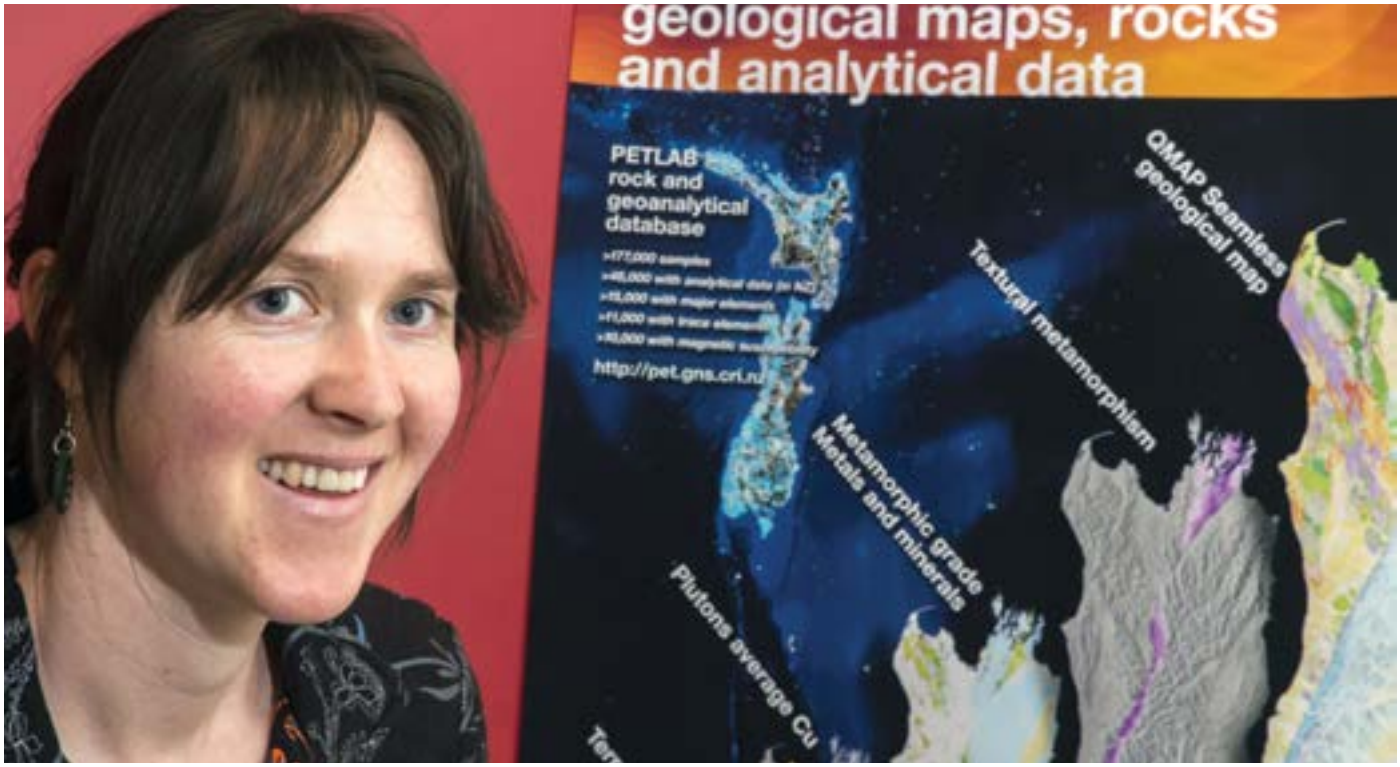
(2013) Determined how the ocean circulation around NZ worked in prehistoric times when the world's climate was slightly warmer than today

(2013-2014) Created new depositional model of interest to the petroleum industry for a potential East Coast source rock as a spin-off from investigating the link between climatic cooling and deposition in the Paleocene (66-56 million years ago)

(2014) Developed touring exhibition featuring 70 million year-old dinosaur footprints found near Nelson. It will tour NZ centres in 2014 and 2015

IMPACTS ENVISIONED IN OUR STATEMENT OF CORPORATE INTENT

Theme	Near-term goals	Progress/achievement
Isotope biogeoscience	Enhanced the understanding of soil carbon dynamics and fossil fuel CO_2 emission inventories	Published an article on atmospheric verification of point source fossil fuel CO_2 emissions as tested at Kapuni and also presented the work at four conferences. A Masters student has expanded this work by examining historic point source emissions using tree rings.
	Capability for *in-situ* ^{10}Be and ^{26}Al dating of exposures and erosion, with Victoria University of Wellington	The collaboration with VUW has been used for a challenging reproducibility of our joint methods, with rock samples from Lake Ohau. We are gaining experience in efficient processing of different rock/sediment sample types with different methods to maximise ^{10}Be concentrations and facilitating the building of a community of New Zealand users and providers of terrestrial cosmogenic nuclide techniques.
Paleoclimate	Enhanced interpretation of sedimentary records and ice cores for climate reconstruction and testing of climate models	Completed water isotope analysis of Antarctic ice core for the top 500m and correlated with other high-resolution ice core records to reconstruct temperature history of the Ross Sea region over the past 15,000 years. Initiated collaboration with ice sheet, ocean, and atmospheric modelling groups to further improve data interpretations.
	Contribution to the Intergovernmental Panel on Climate Change (IPCC) fifth Assessment Reports	Contributed to IPCC-5th Assessment Reports for Working Group 1 (Paleoclimate Archives) and Working Group 2 (Australasia).
Biostratigraphy	Refined age control of geological intervals relevant to petroleum exploration	Produced more detailed biostratigraphic zonation schemes for Late Cretaceous and Paleocene marine strata in the East Coast Basin, also applicable to other New Zealand sedimentary basins.
Regional geology	Digital delivery of QMap seamless geological map as a GIS dataset	Seamless QMAP completed and available as GNS Science Geological Map 1 on DVD as well as an upgraded web service.
	Geological datasets and 3D models completed for the Christchurch urban area	Completed basement, regional and city centre maps and 3D geological and geotechnical models of Christchurch.
Tectonics, structure and landscape evolution	Enhanced PETLAB National Rock and Geoanalytical Database	Improvements include connecting the PETLAB database to the NZ stratigraphic lexicon (STRATLEX) database, enabling users to search by formal hierarchical stratigraphic name, and the addition of thousands of tephra geochemistry analyses.
	Improved understanding of crustal motion, and its application to hazard and resource assessment	Determined crustal deformation in Canterbury and more broadly across NZ, and won international funds to investigate the Alpine Fault and Hikurangi subduction thrust at depth.



NEW NATIONAL GEOLOGICAL MAPS

Our geological mapping team continues to produce useful derivative products from its national mapping programme. A significant product developed this year is the 1:250,000-scale Geological Map of New Zealand, available as a DVD. It seamlessly links together 21 individual geological maps of the country and puts New Zealand in an elite club of countries that have a national digital map of their entire land area to a high and uniform standard.

The new map provides regional-scale information and is a better quality, more up-to-date representation of New Zealand's geology than its predecessor geological maps. It is made up of many layers of information and each one can be queried extensively. For example, a user can query the geological units layer to show all areas within New Zealand where sandstone is present, or all sandstone deposits of a particular age. Alternatively, multiple layers can be analysed to find all potential ore-bearing rocks close to faults which moved at a particular geological time. The new map shows the uppermost rock unit and leaves aside veneers of soils, tephra, and scree.

Another highlight is the rich information that can be extracted from the geological features such as age of rocks, movement of faults, relationships among various rock units, and geological units and their boundaries.

The map comes with free viewing software to help users make the most of the data. The information is intended for use at a regional scale only, and is already in demand by a wide range of users including the insurance sector, mineral and petroleum exploration companies, for geological hazard assessment, and for planning. Its utility also extends to schools and universities.

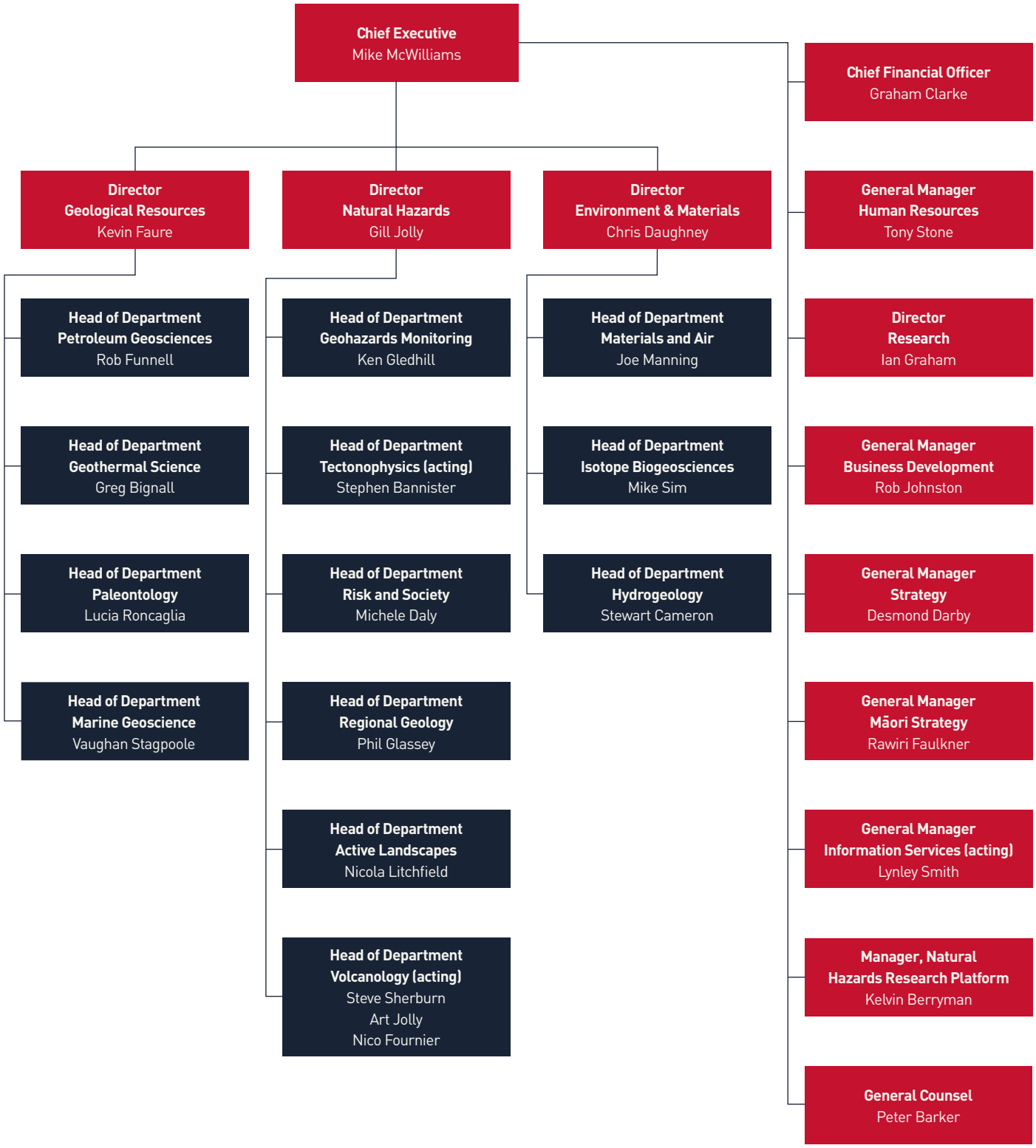
Our geologists will update the data annually as new information and interpretations come to hand. They will also restructure the data and terminology to conform to the developing world-wide geological data standards.

Another product launched this year is the 1-to-1,000,000 scale Geological Map of New Zealand, also available as a DVD product. It has involved a synthesis and simplification of the 21 individual geological maps to create a more generalised view of New Zealand geology, including offshore islands. Both map products are powerful and versatile information tools.

"The quarter-million scale maps and associated geological data from GNS Science have always been, and continue to be, an integral part of Kenex's business development and operations. We started Kenex in New Zealand, and our head office remains in Wellington, because New Zealand was the first country to provide nationwide seamless geological coverage of digital data that allowed us to develop and provide a proof of business concept to the wider mineral and energy exploration community. We now operate worldwide and the data GNS provides is still some of the best quality and value for money, and remains critical to our business operations."

DR GREG PARTINGTON
Kenex
Perth, Western Australia

ORGANISATIONAL STRUCTURE



BOARD OF DIRECTORS

Tom Campbell[1]
Chairman
BSc, AFinstD
(Appointed 1 July 2009) Invercargill

Tom is Chair of the Energy Efficiency and Conservation Authority, and a Director of Todd Corporation, Electricity Invercargill Limited, and PowerNet Limited. He was formerly Managing Director of Comalco in New Zealand. He was also formerly Chairman of New Zealand Aluminium Smelters and of Anglesey Aluminium in the UK.

Hon Ken Shirley[2]
Deputy Chairman
BSc
(Appointed 1 July 2010) Wellington

Ken is a former Minister of Fisheries, and Associate Minister of Agriculture, and Forestry and Health. He is Chief Executive of the NZ Road Transport Forum, a Director of the Motor Industry Training Organisation, and a member of the Human Rights Review Tribunal. He is a former Chief Executive of the Researched Medicines Industry Association, the NZ Forest Owners Association, and Organics Aotearoa NZ.

Belinda Vernon[3]
BCom
(Appointed 1 July 2011) Auckland

Belinda is currently a consultant with a background in accounting and shipping, and is a Member of the Maritime NZ Authority. She has previously worked in senior accounting roles in the shipping industry. She is a former Member of Parliament (1996-2002), and Chair of the Auckland Philharmonia Foundation.

Professor Steve Weaver[4]
BSc Hons, PhD, DSc, FGS, FNZIC, FRSNZ
(Appointed 1 July 2010) Christchurch

Steve is Deputy Vice-Chancellor (Research) and former Head of the Department of Geological Sciences at the University of Canterbury. He has held academic appointments at Birmingham, London and Nairobi universities. He is a Fellow of the Royal Society of New Zealand and is a board member of the Canterbury Medical Research Foundation, the New Zealand Brain Research Institute, and REANNZ. Steve has published extensively on the geology of New Zealand, Antarctica and East Africa, specialising in igneous petrology, volcanology, isotope geochemistry, tectonics and environmental science.

Dr Claire McGowan[5]
PhD, MBA
(Appointed 1 July 2010) Hamilton

Claire is Chief Executive of Waikato business incubator Soda Inc. She is also the founder and Managing Director of Commercialisation Advisors Limited (COMMA). Claire is a Director of four other companies including Te Arawa Management Limited, Grosvenor Financial Services Group, and AUT Enterprises. Her research training was in molecular microbiology and her MBA project was in risk management of pharmaceutical projects with Pfizer Pharmaceuticals in the UK. She has experience in the New Zealand venture capital and investment banking industries.

James Johnston[6]
LLB
(Appointed 1 July 2013) Wellington

James is a commercial lawyer and Chairman of Partners at Rainey Collins Lawyers, where he heads the Business & Personal Legal Services Team. He is a former Chair of the New Zealand Law Foundation and was the Lead Legal Counsel for the Ngāti Porou Treaty Settlement negotiations with the Crown. He is also the Chairman of Toi Whakaari, the New Zealand Drama School, Chairman of the Samuel Marsden School Management Board, and is an External Specialist Advisor to the Ministry of Justice Legal Aid Services Group. James is a New Zealander of Ngāti Porou descent.

Sarah Haydon[7]
BSc, ACA, MInstD
(Appointed 1 July 2014) Auckland

Sarah is a Director of Cavalier Corporation Limited, a Council member of Unitec, Chair of New Zealand Riding for the Disabled Association Inc, an Executive Committee Member of Waste Disposal Services, and a trustee of a charitable trust. She is a chartered accountant and has worked for BP in the UK and also on international project work, and was CFO at OfficeMax New Zealand. Sarah has an extensive background in strategic planning, finance, general management and organisational development. She has led very large teams of people and has strong HR and people skills.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MANAGEMENT TEAM

Mike McWilliams[1]
Chief Executive
PhD, Australian National University

Mike leads the Executive Management Team, directs the management of the Company and is responsible for strategy, policy, investment and science programmes. Before joining GNS Science in September 2013, he served as Chief of the Division of Earth Science and Resource Engineering at CSIRO between 2008 and 2013. There he led the development and transfer of new technologies to solve national challenges in the Australian energy and minerals sectors. He was Professor of Applied Physics and Director of the John de Laeter Centre for Isotope Research from 2006 to 2008. Mike was a scientist and teacher at Stanford University for 29 years, beginning as a postdoctoral scientist and culminating as Professor of Geological and Environmental Science.

Desmond Darby[2]
General Manager, Strategy
PhD, State University of New York at Stony Brook

Desmond leads our strategy formation across the government and the private sectors, and advises the Chief Executive in these areas. He also manages the public relations and outreach staff, and co-ordinates student scholarships and supervisions. He previously managed our crustal dynamics team, and led the major research programme on The Effects of Plate Tectonics on New Zealand. Desmond is a Director of New Zealand Synchrotron Group Ltd and was chair of FRST's Postdoctoral Fellowship Advisory Committee.

Kevin Faure[3]
Director, Geological Resources Division
PhD, The University of Cape Town

Kevin leads the Petroleum, Geothermal, Paleontology and Marine Geoscience Departments. He specialises in stable isotope geochemistry and has researched and published on ore deposits, submarine volcanoes, gas hydrates, and geothermal springs. He joined GNS Science in 1997 and has previously worked as an exploration and mining geologist in South Africa, and as a research scientist at the Geological Survey of Japan.

Chris Daughney[4]
Director, Environment and Materials Division
PhD, McGill University, Montreal

Chris leads the Environment and Materials Group, which is New Zealand's premier source of applied isotope science capability. It comprises research infrastructure as well as research teams and commercial service units in materials and air, isotope biogeosciences, and hydrogeology. Chris specialises in aqueous environmental geochemistry. His areas of interest include the chemical evolution of groundwater at the catchment scale and the use of tracer methods for evaluating in-situ rates of water-rock interaction.

Graham Clarke[5]
Chief Financial Officer
Chartered Accountant
BCA, CA

Graham leads the Company's finance operations ensuring appropriate policies, procedures and practices are developed and maintained. His team provides the full range of financial services to support the Company's operations, including financial reporting and advice to management and to the Board to allow them to effectively undertake their respective roles. His team also takes responsibility for various operational aspects including procurement, property, insurance, and internal audit. Graham is a Director of Meatvision Limited, one of our joint venture operations.

Rob Johnston[6]
General Manager, Business Development
BSc, Dip ORS, Dip Tchng

Rob's portfolio includes managing the Company's commercial operations and intellectual property issues. Rob joined GNS Science in 2004. He has extensive experience in managing information systems, corporate functions and processing operations in New Zealand companies. This includes senior positions with Tasman Forestry and Public Trust.

Lynley Smith[7]
Acting Manager, Information Services
BCom, University of Otago

Lynley leads the Information Services team which provides essential support for GNS Science with IT infrastructure and operations, applications development, records management and library services. Lynley joined GNS in 2008 and has over 20 years' experience in the IT industry, in both the private and public sectors. She has held both line management and project management roles, and been responsible for developing applications for a wide range of organisations.


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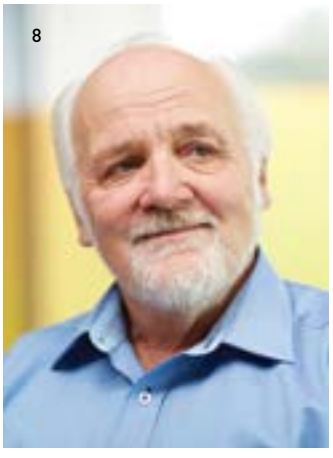
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Peter Barker[8]
General Counsel
Barrister and Solicitor

As General Counsel, Peter provides legal and commercial advice to GNS Science. He is a commercial lawyer with experience in intellectual property. Peter has been a partner in a national law firm, and has worked in the finance and film industries.

Rawiri Faulkner[9]
General Manager, Māori Strategy
BA, Victoria University of Wellington

Rawiri has the role of building strong relationships between GNS Science and iwi to find ways of unlocking the innovation potential of iwi/Māori communities. He also provides support for our staff and management to develop Māori research and innovation as an integral part of what we do. Rawiri's extensive experience includes previous positions at the Foundation for Research Science and Technology and the Ministry of Research Science and Technology, as well as a variety of roles in local government. He also holds a number of governance roles. He has iwi affiliations to Ngāti Whakaue, Ngāti Huia, Ngāti Toa Rangatira and Ngai Te Rangi.

Tony Stone[10]
General Manager, Human Resources
Diploma in Industrial Relations, Victoria University of Wellington

Tony joined GNS Science in 2003 and was appointed General Manager, Human Resources in 2007. He is a trained mediator. Tony's responsibilities include payroll, training, recruitment, health and safety, and employee relations. Prior to joining GNS Science, Tony held HR positions in a number of private, public and health sector organisations.

Ian Graham[11]
Director, Research
PhD, Victoria University of Wellington

Ian is responsible for maintaining an overview of Government-funded research across the organisation. He monitors the quality and delivery of contracted and core-funded research, seeks ways to maintain viable research revenue streams, and ensures that lines of communication with Government funding bodies, other Crown Research Institutes and universities are open and constructive. Ian is an isotope geochemist with applied expertise in volcanology, mineralisation, climate change, and basement geohistory.

Kelvin Berryman[12]
Manager, Natural Hazards Research Platform
PhD, Victoria University of Wellington

Kelvin manages the research platform that integrates New Zealand's government-funded research in natural hazards. The portfolio encompasses geological and weather-related hazards, integrated natural hazard risk, resilient engineering and infrastructure research, and societal and land-use planning aspects of natural hazard mitigation. Kelvin has a research background in geology with specialisations in mapping, active fault studies, coastal terraces and tsunami deposits, and hazard and risk assessment.

Gill Jolly[13]
Director, Natural Hazards Division
PhD, Lancaster University; MA, University of Cambridge

Gill was appointed to lead the Natural Hazards Division in August 2014. It consists of 124 staff who undertake research and consultancy in earthquakes, volcanoes, landslides, tsunami, geological mapping, engineering geology, earthquake engineering, risk modelling, and social sciences. Gill is a volcanologist and joined GNS Science in 2006. Her background is in magma physics and lava flow dynamics, but she has had a diverse career including mineral exploration, environmental geochemistry, and 3D geological modelling of ore deposits. She was formerly a director at the Montserrat Volcano Observatory in the West Indies.

PERFORMANCE INDICATORS

These indicators include those specified in our Statement of Corporate Intent.	**Group Actual 2014**	Group Budget 2014	Group Actual 2013
Financial Performance Measures			
Return on equity	**5.4%**	8.1%	4.2%
Non-government revenue[1]	**44.1%**	46.6%	45.0%
Return on assets[2]	**3.9%**	6.7%	3.1%
Operating margin[3]	**9.6%**	10.8%	8.9%
NPAT margin	**2.0%**	3.0%	1.6%
Profit[3] per FTE ($000s)	**19.9**	22.7	17.8
Chargeable time of science staff	**71.5%**	75.0%	74.3%
Quick ratio	**1.44**	1.21	1.43
Equity ratio	**54.2%**	62.8%	55.8%
Technology transfer and contestable revenue[4]	**64.5%**	65.3%	62.6%
Revenue growth	**6.6%**	5.6%	(2.3%)
Technology transfer revenue growth	**5.3%**	14.6%	(5.4%)
Capital renewal	**1.12**	1.14	1.21
Return reinvested	**4.6%**	7.3%	3.3%
Other Performance Measures			
Human Resources:			
Full-time equivalents (FTEs)	**371**		360
Scientists and specialists	**260**		252
Science support	**54**		51
General support and management	**57**		57
Distribution of science effort (FTEs):			
Science	**161**		147
Technology transfer	**153**		156
Staff turnover	**6.1%**		6.5%
Training and development ($000s)	**906**		1,021
Work days missed due to injury	**11**		0
– number of staff involved	**4**		N/A
ACC workplace safety accreditation	**Tertiary**		Secondary
Staff engagement (% proud to work at GNS Science)	*****		84.0%
User input descriptors			
Number of user advisory groups	**7**		8
Number of user advisory group meetings	**13**		10
Research collaboration descriptors			
Number and percentage of peer-reviewed publications with other New Zealand or international institutions:			
Number	**189**		214
Percentage	**91%**		87%
Number of visiting researchers hosted	**90**		101
Value of research contracts to other research organisations ($000s)	**9,269**		8,195
Percentage to New Zealand universities	**70%**		72%
Value of research contracts from other research organisations ($000s)	**2,708**		2,514
Percentage from New Zealand universities	**53%**		40%
Number of graduate scholarships funded	**33**		36
Number of graduate students supervised	**141**		100

	Group Actual 2014	Group Actual 2013
Technology transfer descriptors:		
Technology transfer effort (FTEs)	**153**	156
Number of commissioned reports to users	**261**	278
Total revenue received from clients ($000s)	**22,508**	21,384
Number of new patents registered	**4**	2
IP licensing (incl technologies, products, services) in New Zealand and overseas:		
Number	**29**	29
Value ($000s)	**1,587**	1,197
Client feedback average score (out of 10)	**7.0**	7.5
Number of projects achieving outcomes or creating opportunities for iwi/Māori	**26**	27
Number of international fora with staff representing New Zealand	**4**	17
Database use:		
Number of databases accessible to the public via the web	**26**	30
Registered external users of GNS Science data	**5,909**	3,187
Number of unique users accessing the GNS Science website:		
per annum	**488,565**	341,610
daily peak	**18,149**	11,647
Number of hits to the GeoNet website:		
per annum	**632,000,000**	438,000,000
daily peak	**49,000,000**	20,116,000
Science descriptors:		
Research science effort (FTEs)		
by scientist	**133**	122
by science support staff	**28**	25
Number of peer-reviewed science papers and book chapters (in preceding calendar year)	**275**	310
Number of research monographs and maps (in preceding calendar year)	**4**	2
Number of other journal papers and publicly available science reports (in preceding calendar year)	**74**	55
Publication rate (peer-reviewed science papers/monographs/chapters per science FTE)	**2.1**	2.6
Total number of citations of science publications for each of the five preceding calendar years:		
2013	**5,796**	–
2012	**6,361**	6,361
2011	**5,298**	5,298
2010	**5,704**	5,704
2009	**4,525**	4,525
2008	**–**	3,571
Use of science – h_1-score (number of science publications cited at least this number of times)	**84**	75
Scientist visibility – h_2-score (number of staff with an h-score at least this number of times)	**20**	19
Total number of international and significant New Zealand awards, and invitations to participate on international committees and editorial boards	**18**	12
Number of new Marsden-funded projects	**4**	4

[1] proportion of revenue that is not from Crown research funding

[2] profit is before interest and tax

[3] profit is before interest, tax, depreciation and amortisation

[4] proportion of revenue that is from commercial operations and contestable funding

* no staff climate survey carried out for the 2013/14 year

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Wairakei Research Centre
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Taupo 3352
New Zealand

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Fax: +64 7 374 8199
Email: wairakei@gns.cri.nz

Dunedin Research Centre
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New Zealand

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Fax: +64 3 477 5232
Email: dunedin@gns.cri.nz

Our office locations

Directors

Tom Campbell
(Chairman)

Hon Ken Shirley
(Deputy Chairman)

Sarah Haydon

James Johnston

Dr Claire McGowan

Belinda Vernon

Prof Steve Weaver

Executive

Chief Executive
Dr Mike McWilliams

Director
Natural Hazards
Dr Gill Jolly

Director
Geological Resources
Dr Kevin Faure

Director
Environment and Materials
Dr Chris Daughney

Chief Financial Officer
Graham Clarke

General Manager
Business Development
Rob Johnston

General Manager
Human Resources
Tony Stone

Director
Research
Dr Ian Graham

General Manager
Strategy
Dr Desmond Darby

General Manager
Māori Strategy
Rawiri Faulkner

General Counsel
Peter Barker

Manager, Natural Hazards
Research Platform
Dr Kelvin Berryman

Acting Manager
Information Services
Lynley Smith

Business Development and Marketing Managers

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ANZ

Auditor

Jacqueline Robertson
Deloitte
On behalf of the
Auditor-General

Solicitors

Minter Ellison Rudd Watts

Websites

www.gns.cri.nz
www.geonet.org.nz
www.globeclaritas.com

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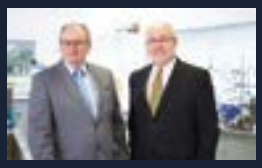


P8 Steven Boniface

P14 Fiona Coyle

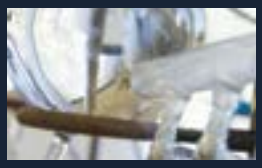
P19 Margaret Low

P20 Some of the 300 delegates at the Advantage 2014 conference at Te Papa – Jeff McEwan

P21 Southern Negros geothermal field, the Philippines – Brian Carey

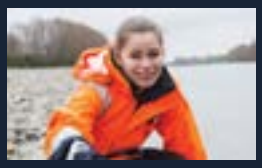
P22 Nga Awa Purua 138MW geothermal power station – image courtesy of Mighty River Power

P24 Water Dating Laboratory, Lower Hutt – Margaret Low



P25 Water Dating Laboratory, Lower Hutt – Margaret Low

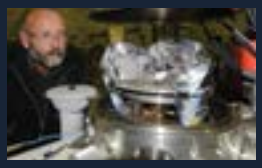
P26 Clyde Dam and Lake Dunstan, Otago – Lloyd Homer



P27 Water dating technician Heather Martindale sampling in the Hutt River – Margaret Low

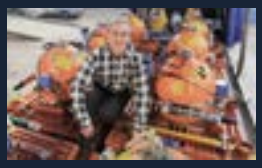
P28 Laboratory supervisor Kelly Lyons in the radiocarbon preparation lab – Kate Whitley

P29 Margaret Low



P30 Physicist and electronics engineer John Futter in the ion-beam lab – Margaret Low

P31 Isotope scientists Bill Trompetter and Travis Ancelet in the ion-beam lab – Margaret Low



P32 Marine geophysicist Stuart Henrys preparing to deploy ocean-bottom seismometers east of Gisborne – John Callan

P33 Volcanologist Lauriane Chardot measuring volcanic gas emissions on Mt Tongariro – Karen Britten

P34 Xiaoming Wang, William Power, and Caroline Holden – Margaret Low

P35 Tauranga Harbour, Mt Maunganui and Papamoa – Dougal Townsend

P36 Goechemist Bruce Christenson sampling gas at the Te Maari vent on Mt Tongariro – Karen Britten

P38 Margaret Low

P39 Geodetic surveyor Neville Palmer collecting GPS data in Fiordland – Sigrun Hreinsdottir

P40 Milford Sound and the Milford Road – Graham Hancox

P41 Whitewash Head, Sumner, Christchurch – Camilla Gibbons

P42 The Pinnacles near Omarama, Mackenzie Basin, north Otago – Lloyd Homer

P43 Crater Lake, Mt Ruapehu – Karen Britten

P44 Participants at the 11th Quaternary Techniques Workshop – Margaret Low

P46 Geologist Delia Strong – Margaret Low

P49 Board of Directors portraits – Steven Boniface

P51 Management team portraits – Steven Boniface