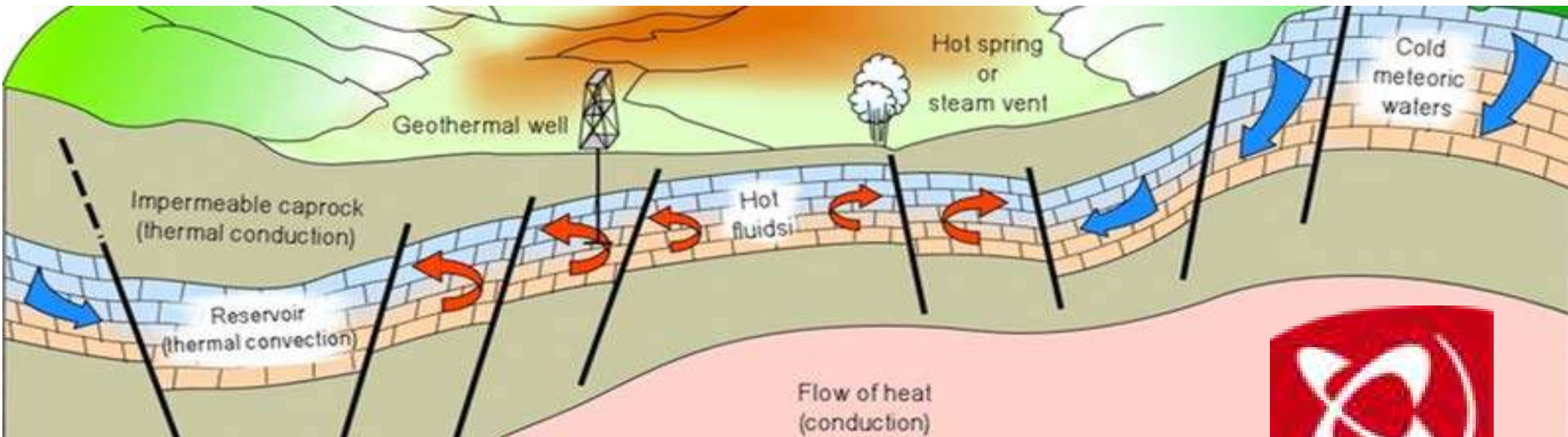


Geothermal Research at GNS Science Recent Developments and Future Plans



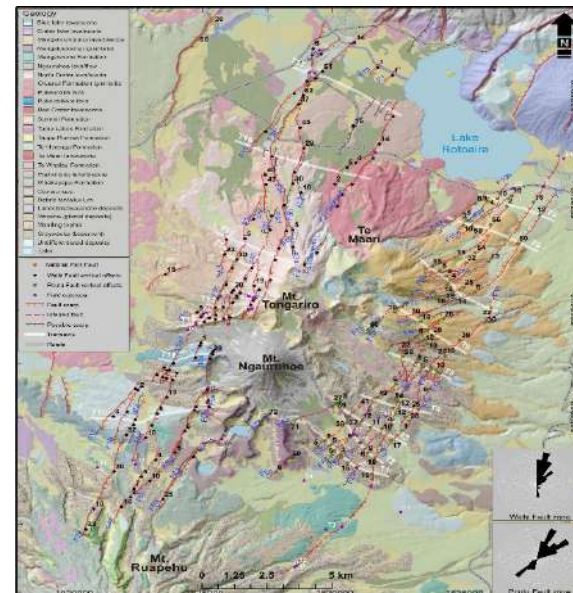
Geothermal Resources of New Zealand (GRN)

- **Structure, Heat and Fluid Flow**
- **Deep Resource Delineation - Geophysics**
- **Deep Resource Delineation – Fluid-Rock Interaction**
- **Reservoir Modelling**
- **Ecology and Biodiversity**
- **Low Enthalpy Geothermal Systems**
- **Reservoir and Plant Chemistry**
- **Direct Use and Society**

Current Budget – \$3.37 million

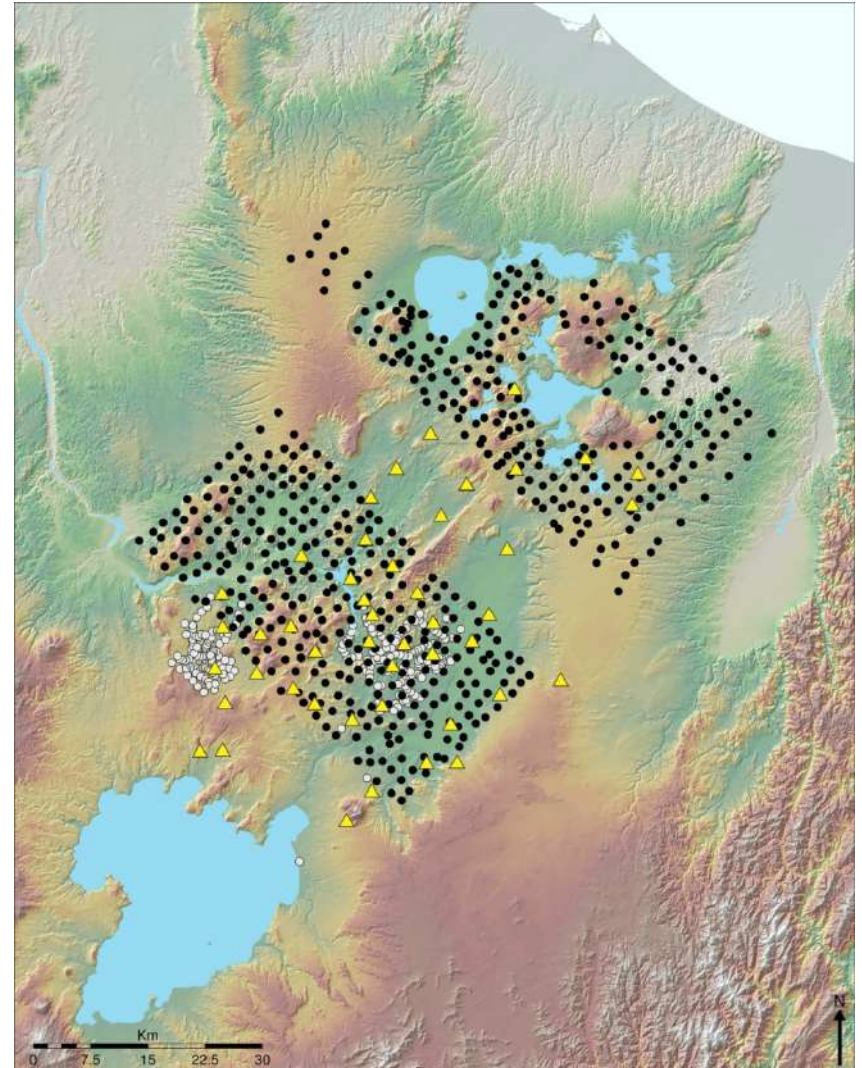
Structure, Heat and Fluid Flow

- PhD thesis (Massiot) “Fracture System Characterisation and Implications for Fluid Flow in Volcanic and Metamorphic Rocks”
- PhD thesis (Gomez-Vasconcelos) “Paleoseismology, Seismic Hazard and Volcano-tectonic interactions in the Tongariro Volcanic Centre, NZ” - results will feed into the understanding of spatial and temporal evolution of geothermal fields



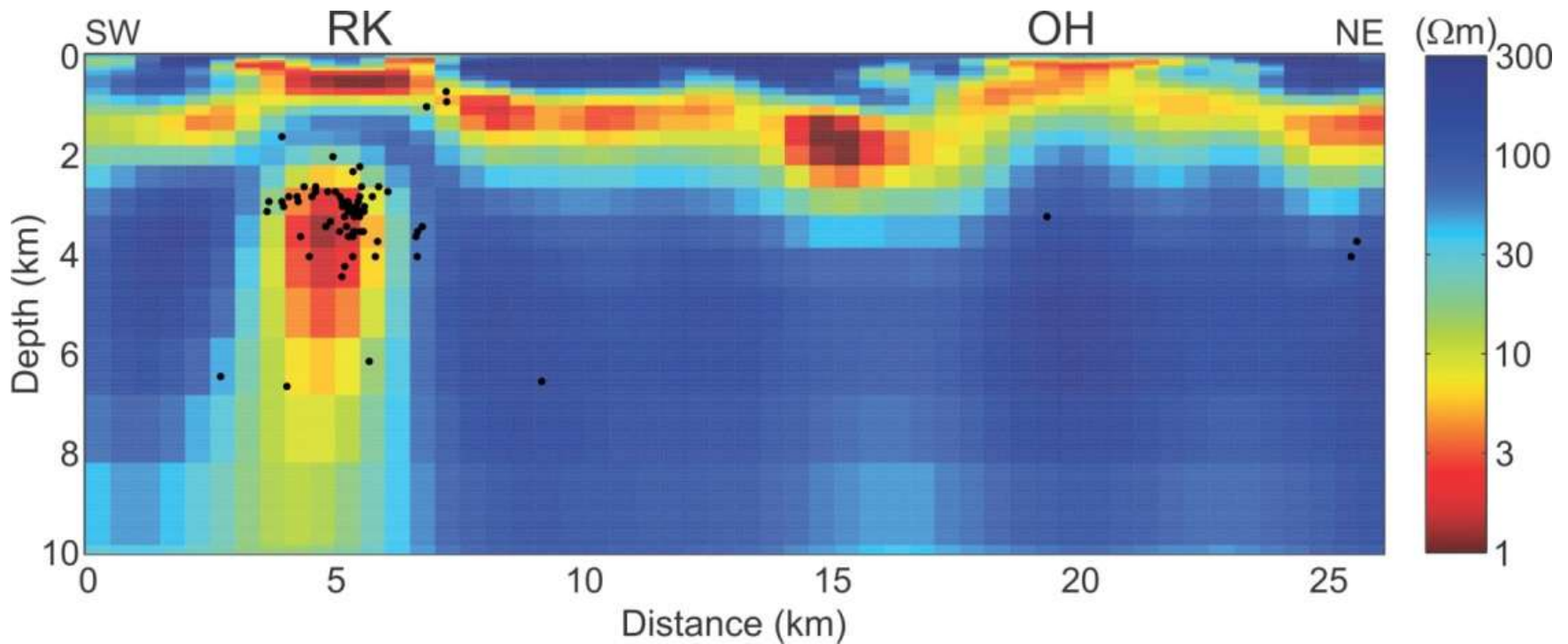
Deep Resource Delineation - Geophysics

- Geophysics to identify heat sources, permeability and fluids, and potential targets for deep drilling
- Seismics, Magnetotellurics, Magnetics, Gravity
- Fundamental impact on location of hidden resources and siting of drilling targets



Deep Resource Delineation - Geophysics

- 16 domestic clients collaborating with GRN research

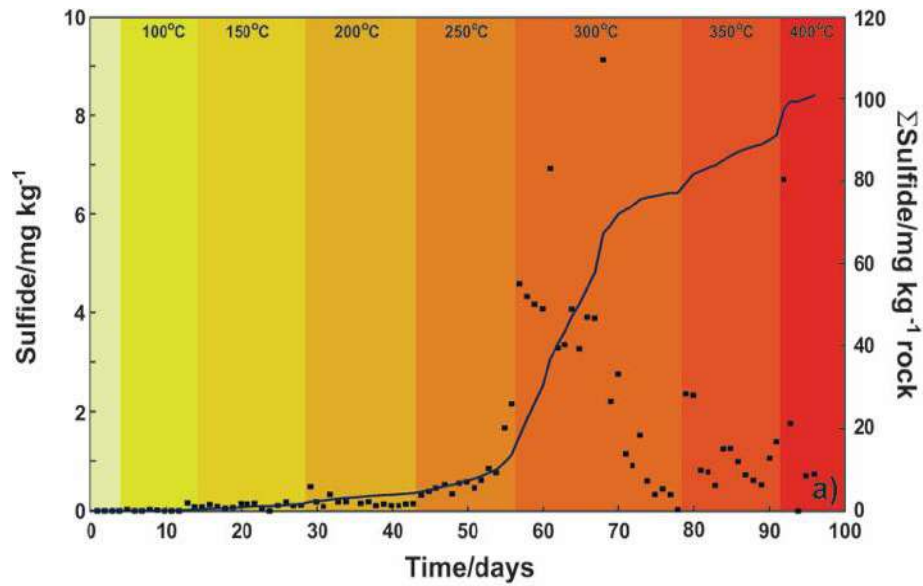


(Bertrand et al., 2015)

Rotokawa: Resistivity and seismicity show compelling correlation. Magmatic intrusion *discovered* at ~4-5 km

Deep Resource Delineation – Fluid/Rock Interactions

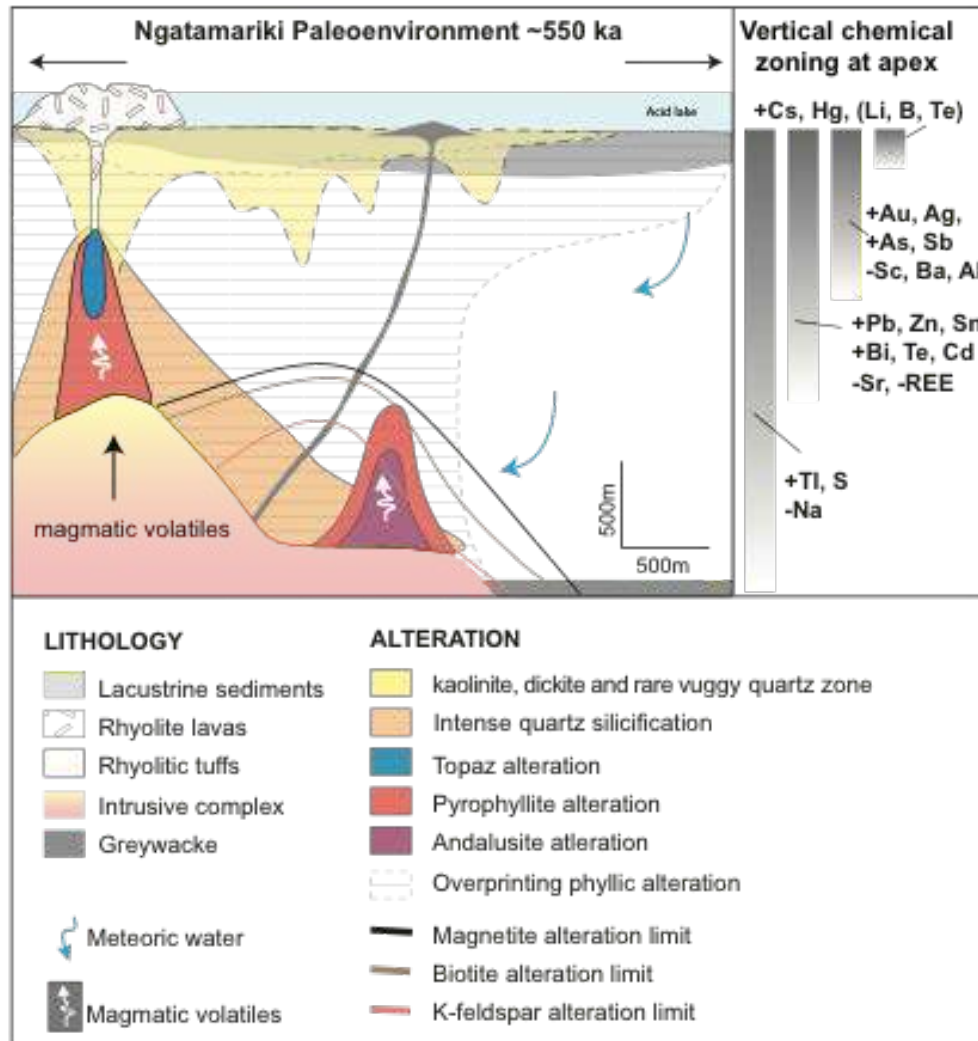
- constraining deep processes, reservoir conditions, and surface manifestations to assess the viability, the chemistry, and lifetime of the hydrothermal events



(Mountain et al., 2016)

Sufficient sulfide present in the basement rock of the TVZ to account for the sulfur present in the geothermal systems

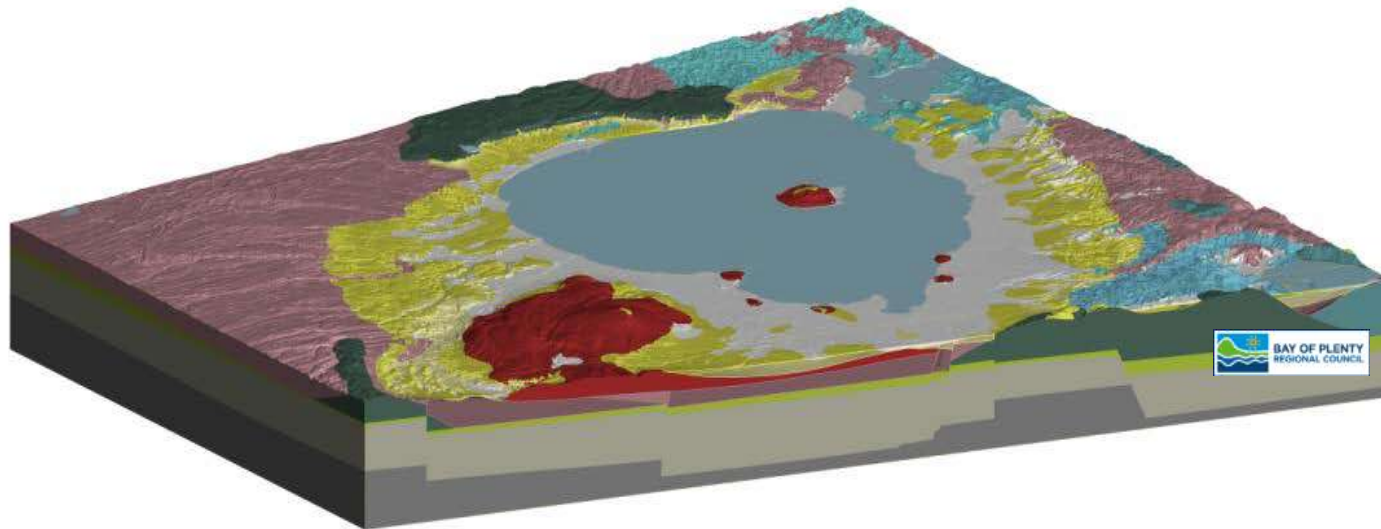
- Hydrothermal and chemical zoning above an intrusion: Case study of Ngatamariki: Understanding heat and mass transfer at depth (Chambefort)



(Chambefort et al., 2017)

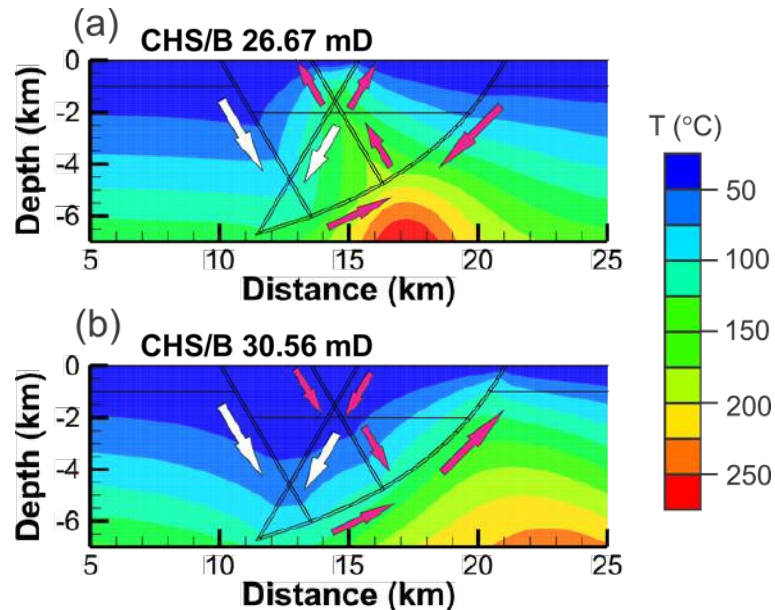
Reservoir Modelling

- Development of new codes, tools and techniques to improve reservoir modelling



(courtesy S. Alcaraz, GNS)

Reservoir Modelling



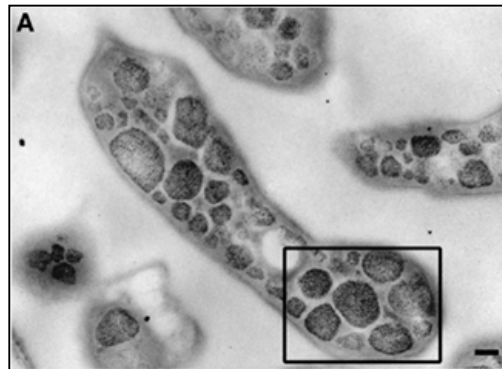
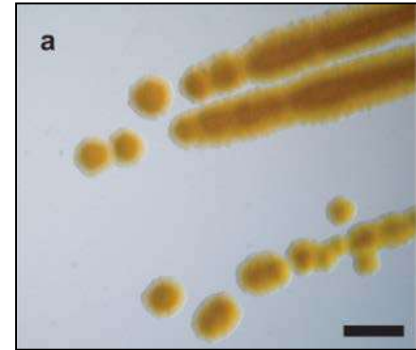
Numerical modelling of the Ngakuru Graben fault system. Small changes in permeability have large effects on geothermal activity

Collaborative work to understand the formation and decline of relic geothermal systems in the TVZ, involving geologists, structural geologists, geothermal modellers and geodynamic modellers.

(Kissling et al., in prep)

Biodiversity and Ecology

- Isolation of novel taxa from NZ geothermal ecosystems
- 1000 Springs Project (now funded by GRN)
- New methods for enriching novel bacteria from geothermal ecosystems
- Investigation extremophilic organisms that convert methane and carbon dioxide into biomass as a supplement for agriculture



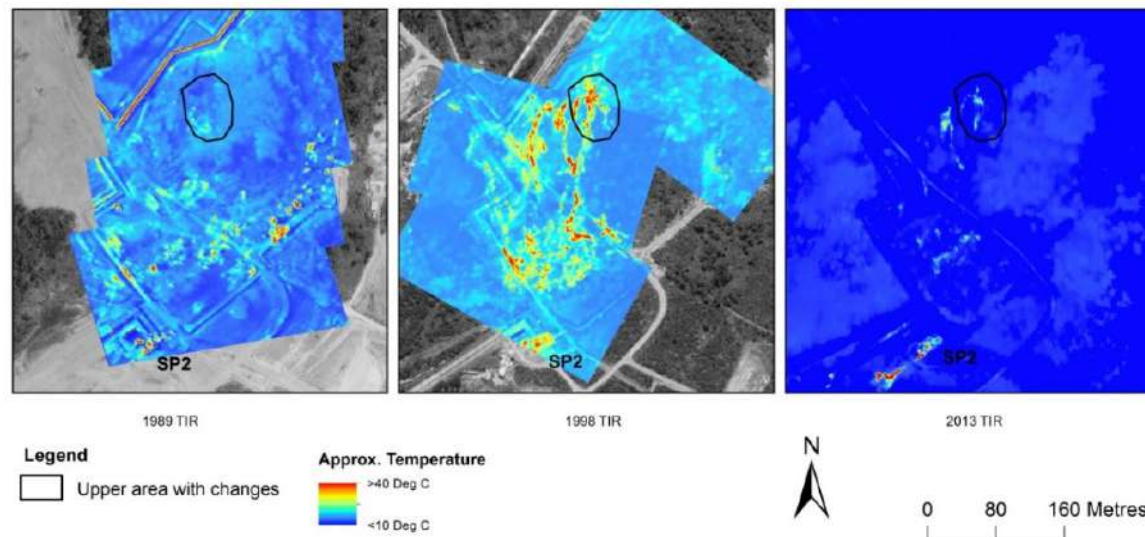
Biodiversity and Ecology

- **Monitoring and Restoration of geothermal ecosystems**



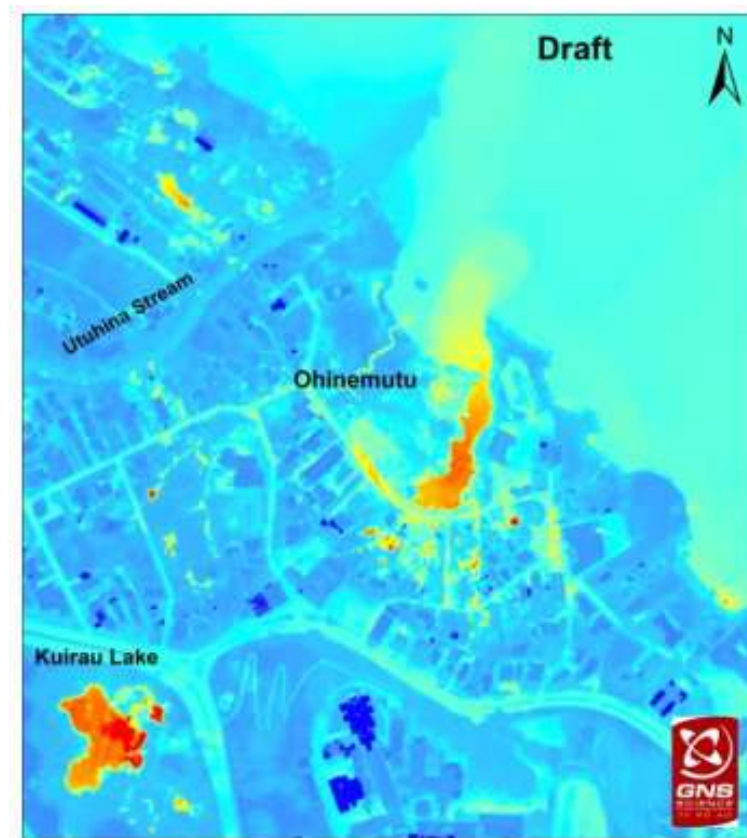
Shallow Geothermal Systems

- Delineation of low temperature near surface geothermal systems, e.g., delineated the near surface extent of the Okauia low temperature geothermal system
- Deciphering the interaction between geothermal aquifers, groundwater aquifers and surface features



Shallow Geothermal Systems

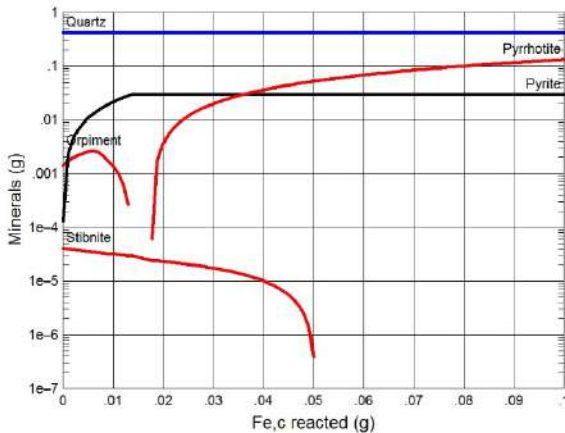
- Hazard identification for infrastructural projects



(courtesy R. Reeves, GNS)

Reservoir and Plant Chemistry

- Cold water injection trials, e.g. Te Mihi (with Contact Energy)



- Modelling heavy metal (Sb & As) corrosion in geothermal infrastructure (with Quest Integrity)

- PhD Thesis (Olsen) “The Hydrothermal Chemistry of Antimony in Sulfide Solutions”



Geothermal and Society – Direct Use

- Providing geodata for development and implementation of technologies for geothermal direct use
- Development of regional data for the uptake of geothermal heat pump technology
- Providing geodata for geothermal planning and policy



New Zealand Geothermal Association

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[http://nzga.co.nz/nz-geoheat-strategy](#)

NZ Geoheat Strategy

- Download it: [Geoheat_Strategy_for_New_Zealand_-_2016_Draft](#) (pdf, 799KB)

The New Zealand Geoheat Strategy is a geothermal industry-led initiative to increase the direct heat use from our nation's geothermal resources.

The draft strategy was developed during 2015 and early 2016 using a consultative approach with the geothermal industry, heat users, Māori, government (local, regional, central), economic development agencies and others.



The New Zealand Geothermal Association is hosting the strategy and is inviting feedback on the draft document.

If you would like to provide feedback on the draft document please email your comments to info@nzgeoheat.nz or phone Brian Carey 07 374 0211.

Read the NZ Geoheat Draft Strategy [here](#).

Feedback to be received to info@nzgeoheat.nz before the 31st May 2016 please

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Contact Us

Simon Bendall
Email Simon

Re-alignment of the Programme

- **inherited from three previously contestable funds**
- **resources are aligned more by discipline rather than outcomes**
- **re-alignment on three long term outcomes that have high economic and social impact**

Geothermal Research at GNS

- 1. Delineation and Use of Low Enthalpy Resources**
- 2. Understanding the TVZ – Structure and Dynamics**
- 3. Understanding the TVZ – Source and Circumstances**
- 4. Environment and Sustainability**



Thank you for your attention.