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# New Zealand Micro-Organisms

Acknowledgements:

New Zealand C.R.I. G.N.S

GERM - The GEological Resource Map of New Zealand database is a mineral deposit inventory of mineral, rock aggregate, building stone, coal, oil, gas, thermal water, and cold-water spring occurrences. More than 10,000 sites such as quarries, mines, dredges, wells, outcrops, seeps, springs, or fields are catalogued. Entries contain summary information on location, geology, geochemistry, exploration, production and use. The data were complied between 1986 and 1993. There has been no systematic update of the data since 1993.

## Novel Microbial Isolates

Many novel microorganisms are readily detected in New Zealand's extreme habitats. Hot springs, bubbling mud pools, crater lakes, undersea volcanoes and other geothermal environments are without exception 'extreme'. The only life forms that survive such harsh conditions are unique forms of microorganisms – which are colloquially known as 'extremophiles'. These microorganisms thrive where temperatures can be as high as 120˚C, the pH can range from highly acidic to strongly alkaline, and there are elevated concentrations of salts and/or heavy metals.

New Zealand is renowned for it's unique biodiversity. It is especially endowed with a richness of extremophilic microorganisms. The nation's location on the collision boundary between two tectonic plates has created a chain of undersea and terrestrial volcanoes and geothermal systems, ideal environments that are supportive of extremophilic microbial communities. These habitats extend from the Kermadec Arc down through the Taupō Volcanic Zone (TVZ, see Figure), ending at Mt Ruapehu.

Of particular note are:

- a novel extremely acidic and thermophilic methanotroph from the phylum Verrucomicrobia
- multiple bacterial strains from the candidate division OP10
- a thermophilic strain of Acidobacteria
- thermophilic cellulose-degrading strains of Chloroflexi

## Microorganisms inhabiting Submarine Volcanoes

Submarine volcanoes occur most commonly at the margins of tectonic plates and host diverse biological systems. The fluids emanating from hydrothermal vents on submarine volcanoes are rich in dissolved metals and gases, which support the growth of microorganisms. Larger macro-organisms such as shrimp, barnacles, tube worms, crabs and fish then graze the microbial populations forming, a complex food web.

However, life around hydrothermal vents is not easy. The fluid temperatures leaving the vents often are in excess of 300ºC (>572ºF) and pressures can be >200 atmospheres. Yet microorganisms are able flourish at these vents. Thermophiles (microorganisms that can live at temperatures in excess of 60ºC) thrive on the margins of these vents and one particular hyperthermophile, Pyrolobus fumarii, grows at a maximum temperature of 113ºC and stops growing at temperatures below 90ºC.

New Zealand has a large number of submarine volcanoes all supporting a rich variety of macro- and microorganisms. New Zealand is situated at the margin between two colliding tectonic plates, the action of which has caused the formation of >70 submarine volcanoes in a 1,220km stretch of ocean north of New Zealand's North Island, known as the Kermadec Arc. Manned submarines have been used to investigate how these volcanoes form, the chemistry of the hydrothermal fluids and biology these vents support.

Microbiologists at GNS Science are interested in the types of microorganisms that inhabit

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these vents (especially the heat-loving microbes), what dissolved gases and metals they use for growth and whether or not there are any microbial types unique to New Zealand waters. Researchers use molecular DNA and classical culturing techniques to study the microbial diversity of hydrothermal vents on submarine volcanoes.

Microbial ecology data collected from such sites is then used to in conjugation with geochemical and geological information to piece together a picture of how these ecosystems function and possibly give an insight into what scientists think life on the primeval Earth may have been like.

## Microbial diversity at Brothers Volcano

This is a submarine biodiversity project example. One submarine volcano in the Kermadec Arc, known as Brothers Seamount, has been studied during two separate manned submarine expeditions.

At one particular vent (Sample 854-2A), an extraordinary quantity of unique microbial species has been discovered. One-third of the bacterial species discovered belong to unique kingdoms that contain no known cultivated microorganisms. In other words, the majority of the inhabiting microbial species or their closest relations have never been grown in the laboratory and most cases are only distantly related to known microorganisms.

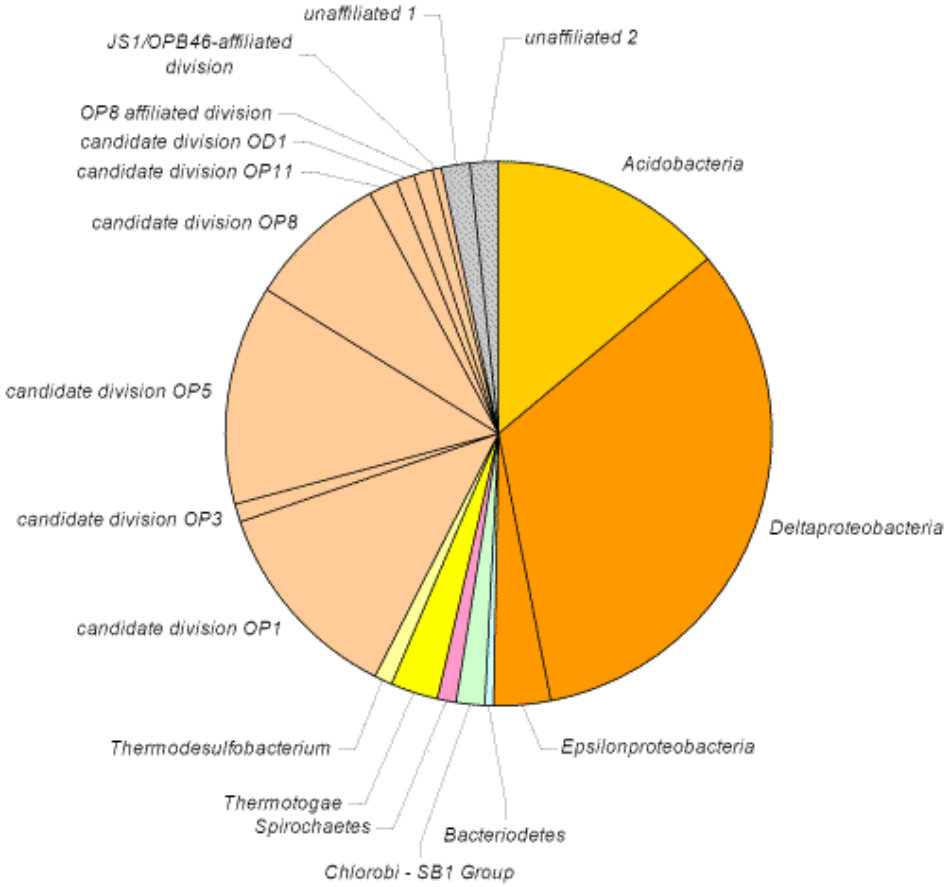


Figure: The diversity of bacterial species collected from the outflow of a 67ºC hydrothermal vent at Brothers Seamount. The pie wedges represent the percentage of each taxon within the total number of microbial species analysed.