Spaceward Bound New Zealand 2015

The inaugural expedition, in the Taupo Volcanic Zone, N. Island

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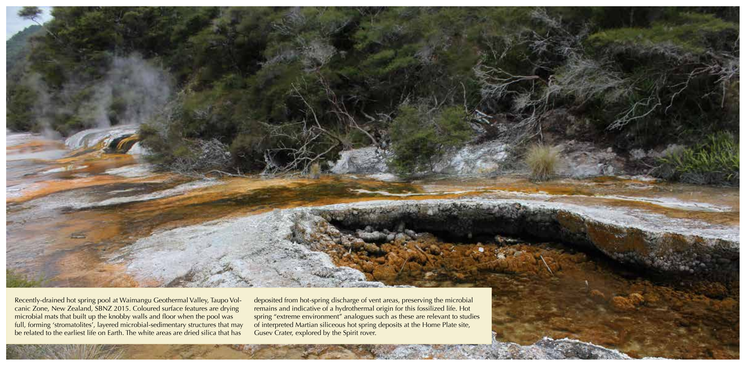
Background

In January 2015, the New Zealand Astrobiology Initiative (NZAI) organised an engaging, 6-day expedition for Kiwi educators and researchers, introducing them to the wonders of the Taupo Volcanic Zone in the central North Island. Partnering with NASA and incorporating speakers from all around the globe, Spaceward Bound New Zealand 2015 exposed its 50 participants to astrobiology research through a series of hands-on field trips and promoted New Zealand as a world-class site for astrobiology research.



Recently-drained hot spring pool at Waimangu Geothermal Valley, Taupo Volcanic Zone, New Zealand, SBNZ 2015. Coloured surface features are drying microbial mats that built up the knobby walls and floor when the pool was full, forming 'stromatolites', layered microbial-sedimentary structures that may be related to the earliest life on Earth. The white areas are dried silica that has deposited from hot-spring discharge of vent areas, preserving the microbial remains and indicative of a hydrothermal origin for this fossilized life. Hot spring "extreme environment" analogues such as these are relevant to studies of interpreted Martian silicious hot spring deposits at the Home Plate site, Gusev Crater, explored by the Spirit rover.

What is Spaceward Bound?

Spaceward Bound is an inquiry-based astrobiology and educational Moon-Mars analogue science expedition organised in New Zealand by NZAI and partners. Spaceward Bound originated at NASA Ames Research Center in 2006. The primary mission of Spaceward Bound is to train the next generation of space explorers by teaming teachers and scientists to explore scientifically interesting but remote and extreme environments on Earth as analogues for human exploration of the Moon, Mars, and other planets: http://quest.nasa.gov/projects/spacewardbound.

Previous Spaceward Bound destinations have included the USA, Canada, Namibia, the United Arab Emirates, and Australia. New Spaceward Bound expeditions in India and Romania are in the planning stages.

New Zealand as an astrobiology field site

New Zealand features some of the best sites in the world to study astrobiology-related extreme environments. The geographical setup, dynamic and active geological setting, and the science capability of New Zealand support the study of astrobiology. Within its Taupo Volcanic Zone, New Zealand has unique extremophiles in the hot springs, and recent and current explosive volcanism. Other regions in the country include access to the K-Pg Boundary (Marlborough Region) and the Dry Valleys of Antarctica. New Zealand is also a world-leader in biosecurity (essential to planetary protection) and has a rich cultural heritage derived from exploration, as Polynesians and Europeans arrived here guided by the stars. New Zealand's scientists encompass most of the required fields in astrobiology: microbiology, ecology, biosecurity, physics, astronomy, radio astronomy and geology. This represents an accessible yet rich knowledge base of local expertise.

While New Zealand benefits from excellent field sites and knowledge base, until 2014 astrobiology efforts had been scattered around the country without a centralized strategy for development. However, astrobiology is an emerging field. It was formalized as a field of study in the 1960's, yet NASA established the National Astrobiology Institute only in 1998 (preceded by an earlier Exobiology program).

The first New Zealand national recognition of astrobiology as a study field was supported by the Royal Astronomical Society, which voted in June 2014 for the establishment of the Astrobiology Group also known as New Zealand Astrobiology Initiative (NZAI). By doing so, the RASNZ identified the importance of astrobiology as a scientific discipline in the science and educational landscape of New Zealand. Astrobiology, seeking to answer questions such as 'what is life?' and 'are we alone in the Universe?', can contribute to "the knowledge, skills, and values to be successful citizens in the 21st century."

Field Trips

Kuirau Park & Waimangu

The expedition examined the hydrothermal systems in the Kuirau Park/ Waimangu geothermal fields and extremophile habitats associated with them. The instructional staff focused on fossil hydrothermal systems as a possible site for a search for life on Mars and gathered samples for geological and biological analyses. The expedition used field instrumentation to characterise the chemistry and mineralogy of the rocks and the physical and chemical properties of the waters. Participants also were encouraged to make observations to try to determine how many types of geothermal features were present (e.g., acid, alkaline, mixed) and what the driving environmental factors in their formation could be.

Mangatepopo / Tongariro

The expedition visited Tongariro Plateau, which displays a range of basaltic- and intermediate-composition eruption products. Space exploration was used here as a hook to investigate the tenacity of life in hostile environments.

Public event

Additionally there were opportunities to view and trial small science rovers and drones, and to learn about several challenges of exploration beyond Earth. One of such opportunities was the open day at Sulphur Point, Rotorua, which had attendance of about 200 visitors and members of the public, and a group of KiwiSpace Foundation members.

Parariki Stream

Parariki stream represents a great Mars analogue place due to the mixture of acid-sulphate-chloride in the spring, which is not common for a river bed. Mars also has river beds. The hot springs in silica at Home Plate site and the Martian silica are similar to those from Parariki Stream and an investigation was undertaken to discover what biomarkers are present in this environment, which might hold clues for similar processes on Mars. Samples were collected for microbial community analysis using genetic sequencing and for geochemical analysis, total organic content, LAL and ATP activity. Samples were also collected to add to the reference library for the SOLID immunoassay instrument designed to search for evidence of life on Mars.

Participants to SBNZ 2015 investigate life in hostile environments, Alpine Tongariro Crossing, New Zealand

A stop at a Mars analogue site, SBNZ 2015
Alpine Tongariro Crossing, New Zealand
This is a basin or crater filled with shallow, volcanic-derived sands and soils and weathered volcanic clasts that have eroded from the surrounding crater rim. Vegetation is sparse, in the form of low-profile surface lichen, or absent.

Fumarole in an abandoned quarry near Nga Awa Purua geothermal power station, SBNZ 2015. The fumarole is discharging hot gases from which sulphur is condensing to form needle-like crystals. Sulphuric acid is also condensing from the gas, forming droplets at the end of some of the crystals. Fumaroles on Mars (and elsewhere) could support life. They bring heat, water, carbon, sulphur and other gases from the interior to the surface and thus provide essential elements, warmth, and energy gradients. They also help understand the process going on inside of a planet.

Drone image of the researchers investigating Parariki stream, Rotokawa, New Zealand. Image aired by TV New Zealand. Spaceward Bound benefited from extended media coverage. The expedition was also supported with Twitter feeds #SBNZ and #SBNZ2015 and Facebook postings.

Spaceward Bound New Zealand 2015 expedition logo

This design is based on two concepts of the Maori world view:

Takarangi: is the expanding heavens design depicted in the prow of ancient Waka that signifies humanity's celestial origin born at the beginning of the Universe. **Koru:** represents growth and development, learning and teaching.

With the newly formed initiative of astrobiology supported by the Royal Astronomical Society of New Zealand, we acknowledge the unique indigenous traditional knowledge of Maaori through our logo that relates to our development as human race and to life in the Universe.

Activities

Lectures and trip briefings

Members of NZAI at the public event held at Sulphur Point in Rotorua, 2015

'A brief introduction to robotics' course for the students using arduino, VEX and 3D modelling software

A Dark Skies awareness drawing project was designed to challenge participants to think about different ways of interpreting knowledge.

Educational deliveries:

Eighteen out of the fifty participants in Spaceward Bound New Zealand identified themselves as teachers and educators.

An education workshop was held at the Mourea Te Takinga base, during which discussions have been held about the ways in which Spaceward Bound can enhance the New Zealand secondary schools resource pool. The emphasis went on 'Earth and Space Sciences' and 'Nature of Science' curriculum streams.

Spaceward Bound New Zealand expedition and follow-up aims to increase teacher awareness of, and exposure to astrobiology so that they understand the value of, and are better equipped to provide a science context in curriculum; provide relevant materials and resources to teachers from New Zealand for use in the classroom that assist students to understand their learning in a "real world" situation.
Spaceward Bound New Zealand aims to produce supplementary resources for teachers from the learnings of the expedition, which will be made available online.

Education workshop - SBNZ 2015 Mourea, Te Takinga

Deliverables:

The expedition promoted New Zealand as a significant astrobiological field research location and supporting the development of the NZ secondary schools education curriculum, but also encouraging university-level uptake of science related to astrobiology. Although astrobiology-related knowledge is taught in places as part of the Earth and Space Sciences Secondary Curriculum, until Spaceward Bound New Zealand 2015, there had been no national effort to integrate this field at educational and scientific research levels.

Acknowledgements

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