

## SPACEWARD BOUND NEW ZEALAND FOR YOUTH 2017: A PILOT EXPEDITION USING A MĀTAURANGA MĀORI APPROACH TO TEACHING ASTROBIOLOGY IN NEW ZEALAND.

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**Introduction:** Mātauranga Māori is the Māori (New Zealand's indigenous people) system of knowledge and understanding of all things, past and present, that has been handed down from generation to generation, and which includes Māori ways of relating to the environment. The teachings of mātauranga Māori are based on the connectedness of knowledge with the environment from which it was derived. Māori trace their ancestry to the Universe itself, the Sun and Planets, which, according to their traditions, were created in a process similar to the modern Big Bang [1].

**STEM outreach using an integrated Māori approach:** In November 2016, a pilot Spaceward Bound for Youth expedition, based on the worldwide and successful NASA program [2], was developed with funding from the New Zealand Government (MBIE'S Unlocking Curious Minds fund) in collaboration with the educational arm of the iwi Ngāti Whakaue (one of the guardian tribes from the Te Arawa confederation of the Rotorua region, which hosts geothermal areas and active volcanoes) – Te Taumata o Ngāti Whakaue. In the process, 20 students (ages 8-16) and their families were engaged in the immersive learning of astrobiology according to the ancient unwritten teachings of Mātauranga Māori, in a hands-on experience that traced their pre-cultural origins within the geologically and dynamically active local environment of Rotorua. Rotorua is situated in a slumbering volcanic caldera within the Taupo Volcanic Zone, a region replete with hot springs, extremophiles, hydrothermal eruptions and active volcanoes. The expedition also explored extremophile life forms and geological processes relevant to possible settings for the origins of life.



Fig 1: Visit to Mount Tarawera during SBNZ for Youth 2016

The learning process involved students, parents and teachers living at

Te Takinga Marae (Māori meeting place) in Mourea, where they shared meals and planned for their daily field expeditions (e.g., making their own Jacob's staffs for measuring stratigraphic sections through paleo-geothermal rock outcrops and in quarries) over five days, with some instructors also alumni of the first Spaceward Bound New Zealand expedition from 2015. Activities involved examining plates extremophile strains from hot, acidic and alkaline pools in Rotorua collected a month prior to the expedition by the same group. Some were novel microbial strains according to global database comparisons. In addition, the students learned about and discussed Māori Astronomy, stars and the origins of the Māori people as taught by tribal leaders and tohunga (learned experts). An expedition to Mount Tarawera, the eruption of which in 1886 destroyed the world-famous Pink and White Terraces (hot springs) and killed approx. 120 people, was also undertaken to appreciate the relationship between water and volcanism, with parallels drawn to exploration for surface- or groundwater on other planetary bodies.

The students presented their integrated learning to a public audience at the marae upon completion of the wananga (immersion learning Māori workshop) to in an exercise that dynamically incorporated the Māori culture in STEM subjects – a major goal of Te Taumata o Ngāti Whakaue.



Fig 2: 9,000 year old silicified hot water creek deposit, analog for 3.5 billion year old silica deposits in Australia (some of the earliest life known on Earth), now preserved atop a quarry in farmland near Rotorua, the hometown of the 20 Māori student participants on 2016 SBNZy.

### References:

- [1] D. Hikuroa (2016): *RSNZ, Mātauranga Māori—the ūkaipō of knowledge in New Zealand online*, [2] M. Allner et al. (2010): *Acta Astronautica* 66, 1280–1284