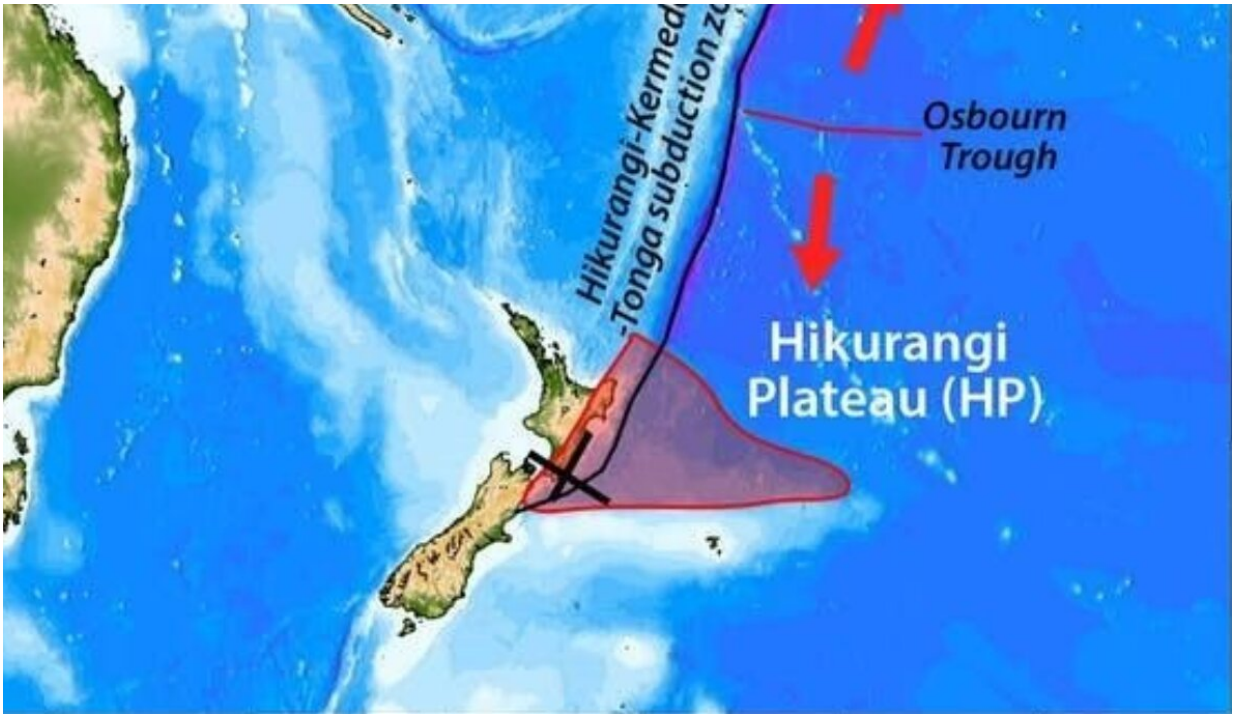
World's largest 'lava lamp bubble' under NZ

May 29 2020



Credit: Victoria University of Wellington

Seismic wave-speeds have revealed part of an ancient volcanic "superplume" beneath New Zealand, highlighting connections between the Earth's deep interior and the surface we live on.

Research by Te Herenga Waka–Victoria University of Wellington geophysicists Professor Tim Stern and Associate Professor Simon Lamb, together with colleagues, indicates that the North Island sits on part of

the "largest volcanic outpouring" on Earth, created by an upwelling in the Earth's deep interior.

That event happened about 120 million years ago when a giant plume of hot rock detached itself from the core-mantle boundary, about 3000 km below the Earth's surface, and rose rapidly to the surface as a superplume.

A paper on the findings of Professor Stern and Associate Professor Lamb, both from the School of Geography, Environment and Earth Sciences, has been published today in the leading United States journal *Science Advances*.

Professor Stern says the ancient superplume connected the Earth's deep interior with the planet's surface.

"In the 1970s, geophysicists proposed that the Earth's mantle was undergoing a churning motion, rather like a lava lamp, and hot blobs of buoyant rock rose up as plumes from as far as the Earth's core.

"Melting of this rock near the surface could then be the cause of prolific volcanism, such as that observed in Iceland or Hawaii.

"Even larger volcanic outpourings have happened in the geological past, of which the biggest known occurred in the southwestern Pacific in the Cretaceous Period during the time of the dinosaurs, forming a continent-sized underwater volcanic plateau.

"Subsequently, the motion of the tectonic plates broke up this plateau, and one fragment– today forming the Hikurangi Plateau—drifted away to the south, and now underlies the North Island and also the shallow ocean offshore."

Professor Stern and colleagues studied the speed of seismic waves (vibrations) through these rock layers to determine their origins and features.

"The key observation in the new study is that seismic pressure 'P' waves–effectively soundwaves—triggered by either earthquakes or man-made explosions travel through the mantle rocks beneath the Hikurangi Plateau much faster than are observed beneath most of the sea floor, reaching speeds of 9 kilometers a second," he says.

"A peculiar feature of these high speeds is that they are equally high for seismic vibrations traveling in all horizontal directions, but much lower for those vibrations traveling vertically upwards."

That difference between vertical and horizontal speed allowed Professor Stern and Associate Professor Lamb to match the Hikurangi Plateau rocks with those of the Manihiki Plateau north of Samoa and the Ontong-Java Plateau north of the Solomon Islands, which have the same speed characteristics.

That showed they were all part of the same superplume.

"The extraordinary thing is that all these plateaux were once connected, making up the largest volcanic outpouring on the planet in a region over 2000 km across."

Associate Professor Lamb says it came as a surprise that the "flow predicted for a giant mushroom-shaped superplume head would produce in mantle rocks exactly these very high speeds and this peculiar speed distribution".

"The associated volcanic activity may have played an important role in Earth history, influencing the planet's climate and also the evolution of

life by triggering mass extinctions.

"It is an intriguing thought that New Zealand now sits on top of what was once such a powerful force in the Earth."

Professor Stern says the geological community had been close to rejecting the idea of plumes altogether.

"Direct evidence for their existence has been elusive. But, with this study, we now have both hard evidence that such plume activity did indeed occur and also a fingerprint method to detect fragments of the largest plumes of all–superplumes–rising up from near the Earth's core."

More information: Tim Stern et al. High mantle seismic P-wave speeds as a signature for gravitational spreading of superplumes, *Science Advances* (2020). DOI: 10.1126/sciadv.aba7118

Provided by Victoria University of Wellington