# Dynamite explosions reveal secrets about what happens under tectonic plates

February 5 2015

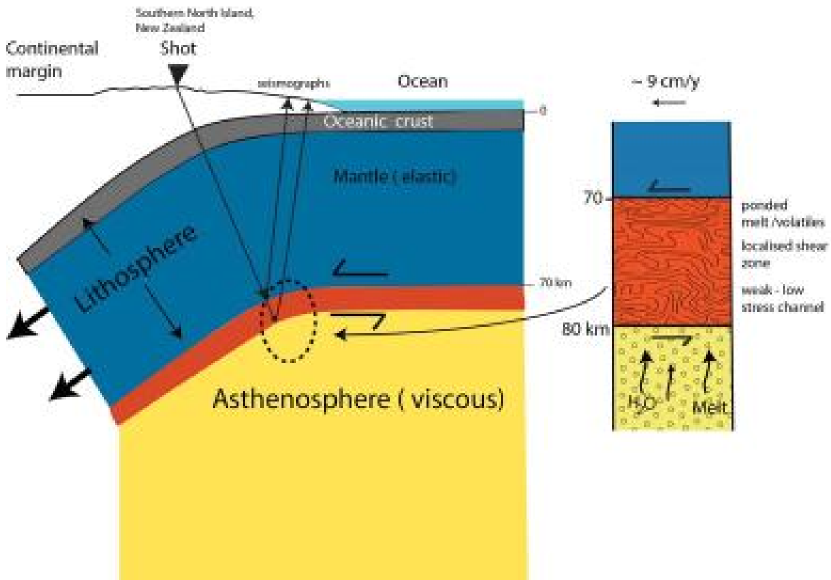
(Phys.org)—Professors Tim Stern and Martha Savage and Drs Simon Lamb and Rupert Sutherland from Victoria's School of Geography, Environment and Earth Sciences—along with scientists from GNS Science and universities in the United States and Japan—developed new methods to get the most detailed images yet of the base of the tectonic plate beneath Wellington.

A paper on the team's finding, entitled A seismic reflection image for the base of a tectonic plate, has been published in the February 5, 2015 edition of the prestigious international scientific journal, *Nature*.

The team recorded reflected seismic waves from an array of controlled underground dynamite explosions across the southern part of the North Island, which gave the scientists an image of the bottom of the Pacific Plate, 100 kilometres beneath the Earth's surface. The recordings were many times higher resolution than what has been previously achieved, and showed that Earth's tectonic plates are gliding on a distinct layer of 'soft' rock, only 10 kilometres thick and weak enough to allow the plates to shift many centimetres per year.

"The idea that Earth's surface consists of a mosaic of moving plates is a well-established scientific paradigm, but it had never been clear about what actually moves the plates around," says Professor Stern. "To work this out requires an understanding of what happens at the bottom of a tectonic plate. It's been difficult to obtain the necessary detailed images at such great depths using the usual method of recording natural earthquake waves.

"But by generating our own seismic waves using higher frequency dynamite shots we were able to see how they became modified as they passed through different layers in the earth. This, along with some new techniques in seismic reflection processing, allowed us to obtain the most detailed image yet of an oceanic tectonic plate."




Cartoon showing the oceanic lithosphere of the Pacific plate subducting beneath the continental Australian plate. The blown up piece shows what we interpret to the be a ~ 10 km thick channel at the base of the plate where melts have ponded, and high strain rates have focused and localised the melt into a thin layer. This channel is likely to be of low viscosity and weak, and effectively allows the plates to slide unhindered by any convective connection to the viscous mantle beneath. Credit: Tim Stern

Professor Stern says the thinner layer beneath the plate appears to contain pockets of molten rock that make it easier for the plates to slide on. "This means that the plates can be pushed and pulled around without strong resistance at the base. A weak slippery base also explains why tectonic plates can sometimes abruptly change the direction in which they're slipping. It's a bit like a ski sliding on snow.

"Understanding this boundary between the base of cold, rigid tectonic plates and the underlying hot, convecting mantle underneath is central to our knowledge of plate tectonics and the very formation and evolution of our planet."

Professor Stern says being recognised by such an internationally-respected scientific journal indicates the significance of the team's discovery. "This study also demonstrates the long-standing ability of New Zealand's geoscience community to leverage international funds—in this case from Japan and the United States—into New Zealand for the purposes of making fundamental discoveries about how the earth works."

**More information:** "A seismic reflection image for the base of a tectonic plate." *Nature* 518, 85–88 (05 February 2015) DOI: 10.1038/nature14146

Provided by Victoria University