New data will help predict shaking experienced in earthquakes

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Wellington, New Zealand. Credit: Unsplash/CC0 Public Domain

Findings of a new paper published this week will help predict the shaking Wellington can expect to experience in earthquakes and shed light on why the city saw so much damage from the 2016 Kaikoura quake.

The paper, by Master of Science student Alistair Stronach and Professor Tim Stern from the School of Geography, Environment, and Earth Sciences at Te Herenga Waka—Victoria University of Wellington, shows the thickness of soft sediments beneath Wellington city is up to two times greater than previously thought.

"When earthquake waves pass through layers of sediment—as opposed to basement rock—they increase in intensity and lead to more shaking. This can have a devastating effect on cities, even when earthquakes are located several hundred kilometers away," Professor Stern said.

In the 2016 Kaikoura earthquake, strong waves were produced that got "trapped" in the sediment basin beneath Wellington and caused unexpected damage in the Pipitea and CentrePort area of the city, he said.

"Fortunately, no lives were lost but several high-rise buildings had to be demolished and the wharf at CentrePort was so badly damaged it was out of commission for months."

The vulnerability of this area to seismic waves stems from both the depth of the sediment and the fact it is mostly reclaimed land.

Data from the research will be used in future computer simulations to predict the shaking that may be expected in different areas of Wellington city.

"These simulations are vital in planning for building design and identifying parts of the city most vulnerable to intense shaking from both local and distant earthquakes," Mr Stronach said.

The research, funded by the Earthquake Commission and published in the *New Zealand Journal of Geology and Geophysics*, used high-precision measurements of the Earth's gravity field to make a map of the sedimentary thickness beneath Wellington city.

Measurements were made with a state-of-the-art gravity meter, which can pinpoint gravity differences to one part in 100 million.

"We took measurements throughout Wellington's central business district and along the outer hills of the city. We identified a maximum thickness of about 540m near the Wellington Regional Stadium, which is twice previous estimates," Mr Stronach said.

The research also mapped an extension of the recently discovered Aotea Fault as it passes from the harbor near Clyde Quay Wharf to under Waitangi Park, before heading south, roughly along the line of Kent Terrace.

"Based on our modeling, this fault has several splays—or limbs—across the lower slopes of Mt Victoria and shows up as a steep step in the basement rock beneath the Te Aro part of downtown Wellington," Mr Stronach said.

More information: Alistair Stronach et al, A new basin depth map of the fault-bound Wellington CBD based on residual gravity anomalies, *New Zealand Journal of Geology and Geophysics* (2021). DOI: 10.1080/00288306.2021.2000438

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