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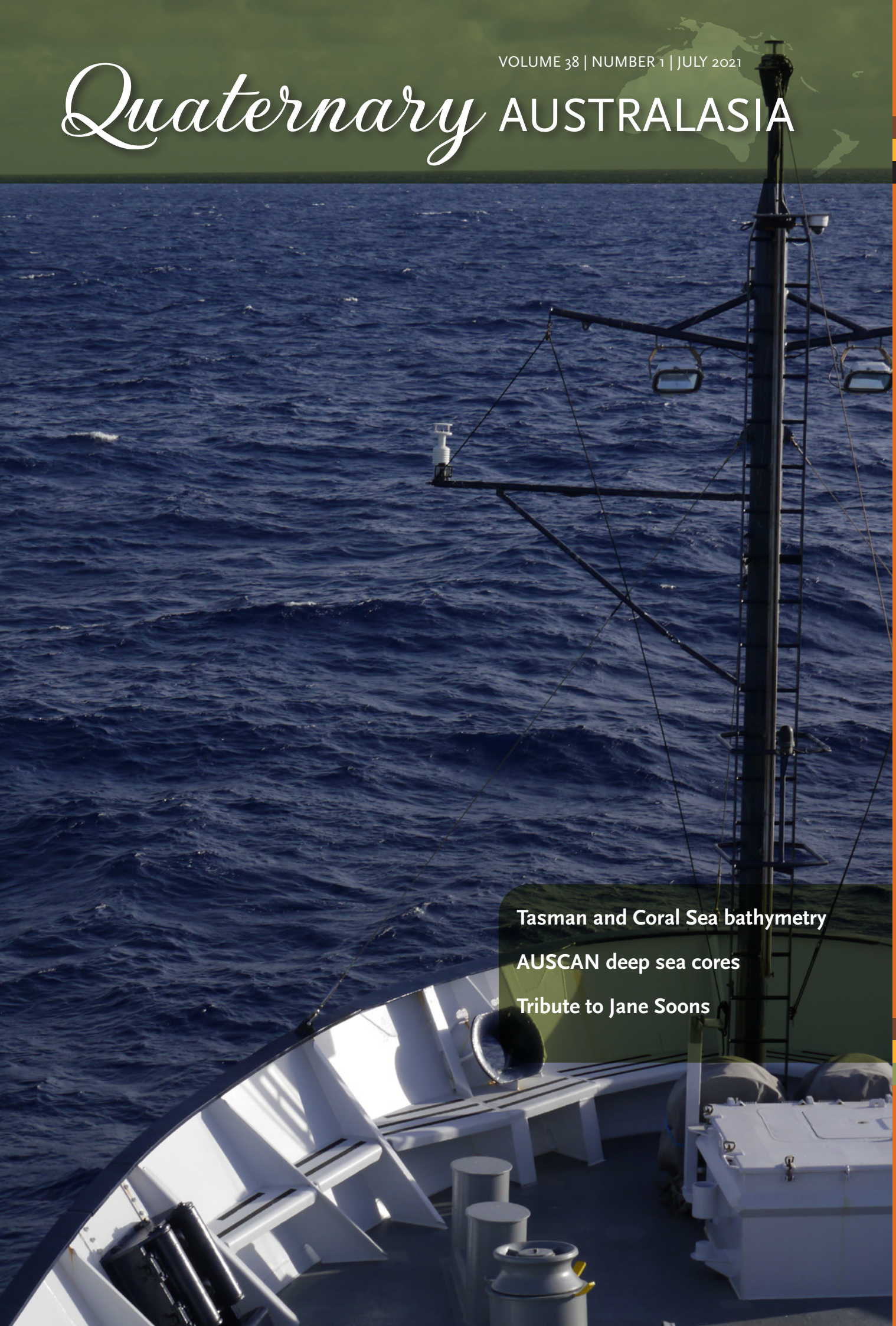
Quaternary AUSTRALASIA



Tasman and Coral Sea bathymetry

AUSCAN deep sea cores

Tribute to Jane Soons

EVALUATING EARTHQUAKE HAZARD AND RISK USING LIQUEFIED VOLCANIC-ASH LAYERS IN LAKES

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Liquefied volcanic-ash or tephra layers, for which we have coined a new term, 'tephra seismites', are preserved in lake sediments in numerous 20,000-year-old lakes in the Hamilton Basin in northern North Island. Up to five tephra layers in cores taken from the lakes show signs of liquefaction - the phenomenon seen during the Christchurch earthquakes - that include disrupted tephra layers, voids, and dykes (injectites). These features show that one or more of four newly-discovered 'hidden' faults in Hamilton (see map) were responsible for previously unrecognised prehistoric earthquakes within the past 20,000 years (Kleyberg et al., 2015). Around 30 lakes are scattered amidst the faults, and hence cores are being taken from almost all of these to build up a picture of which fault(s) may have been active in that time. We anticipate that lakes closest to faults that have been active will show more tephra seismites than those farther from the faults.

By studying the nature of the tephra seismites using CT scanning and physical and engineering (geotechnical) methods, the team aims to calculate the intensity of shaking that initiated the liquefaction in the tephra seismites, and to therefore develop a new understanding of seismic hazard and risk in and around Hamilton. The tephra layers provide a means of connecting and comparing the record from one lake to the next, and known ages on the tephras provide a chronology for the cores and liquefaction events (and hence potentially timing of earthquakes).

This novel approach to paleoseismicity could be applied elsewhere in New Zealand, and globally, to help date activity on hidden faults in low to moderate seismicity volcanic regions where faults and tephra seismites occur.

Funding is provided by a Marsden Fund grant (UOW1902) for the project "Earth-shaking insight from liquefied volcanic-ash (tephra) layers in lakes: using geotechnical experiments, CT-scanned lake sediment cores, and tephrochronology to map and date prehistoric earthquakes", and by an MBIE Endeavour Fund (Smart Ideas) grant (UOWX1903) for the project "Evaluating earthquake risk using liquefied volcanic-ash layers in lakes". The projects are led by Professor David Lowe and Dr Vicki Moon (University of Waikato, Hamilton). Others involved in the project, and supporting agencies, are listed on our website (which can also be used to keep track of progress): https://tephra-seismites.com/

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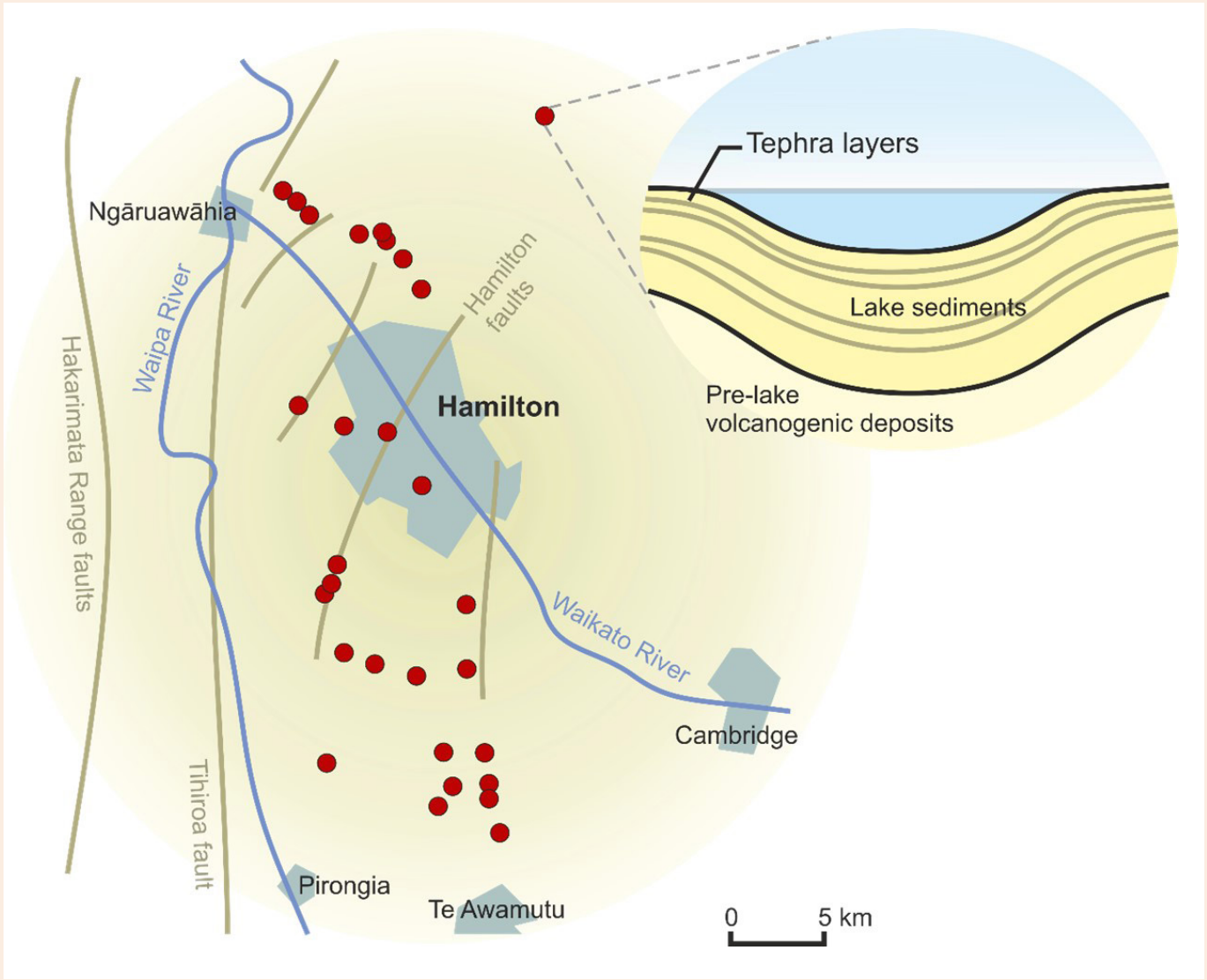
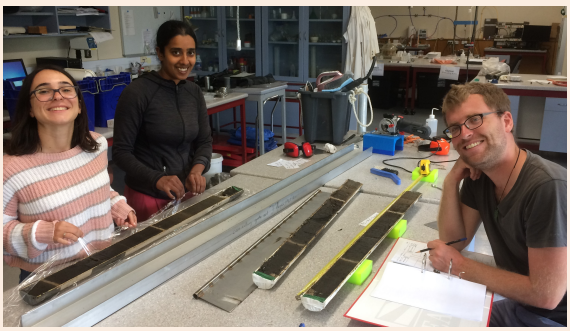
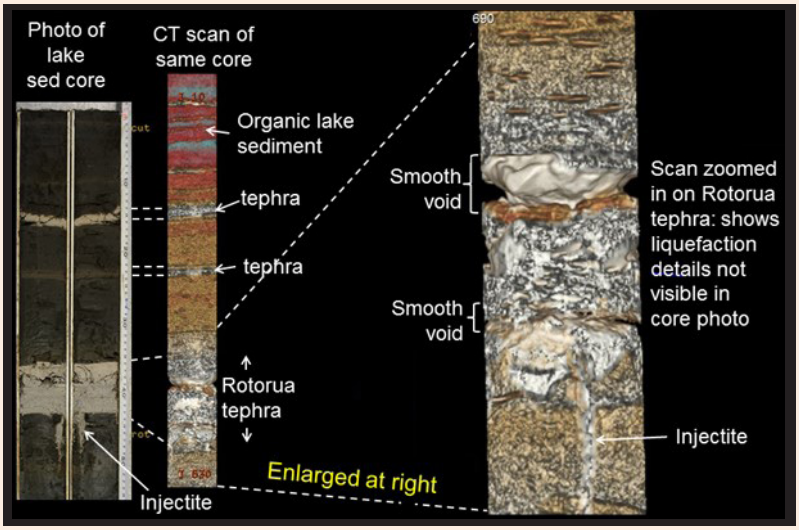


Above - Figure 1: Distribution of four newly-mapped Hamilton faults (after Moon and de Lange 2017; Moon and Spinardi 2019) and tephra-seismite-bearing lakes (red dots) in the Hamilton Basin. Multiple additional strands have been omitted for clarity.
Map credit: Max Kluger.

Left - Figure 2: Kindly collaborators from GNS Science and the Lakes 380 project (https://lakes380.com) coring on behalf of the Tephra Seismites project at Rotokaeo (Forest Lake) in Hamilton in October 2020.
Photo credit: David Lowe.





Top left - Figure 3: From left: Danche Chaneva (PhD student), Dr Tehnuka Ilanko (research officer), and Dr Max Kluger (front, postdoc) checking out pale tephra layers in a freshly opened lake sediment cores. Photo credit: David Lowe

Top right - Figure 4: Opened lake sediment core (far left) with two white rhyolitic ash layers visible, the upper being Waiohau tephra (14.0 cal ka) and the lower Rotorua tephra (15.6 cal ka). To the right are images derived by scanning the same core using CT imaging to show increased detail of the tephra seismite character. Image from Hopkins et al. (2021).

Above - Figure 5: Radiographer Nic Ross (back) with PhD student Danche Chaneva (front) putting a lake sediment core in a CT scanner at Hamilton Radiology. Photo credit: David Lowe