

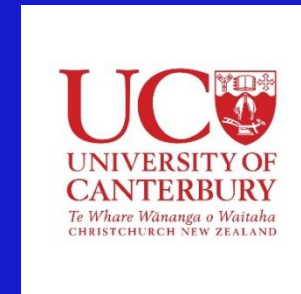


Earth Sciences
New Zealand

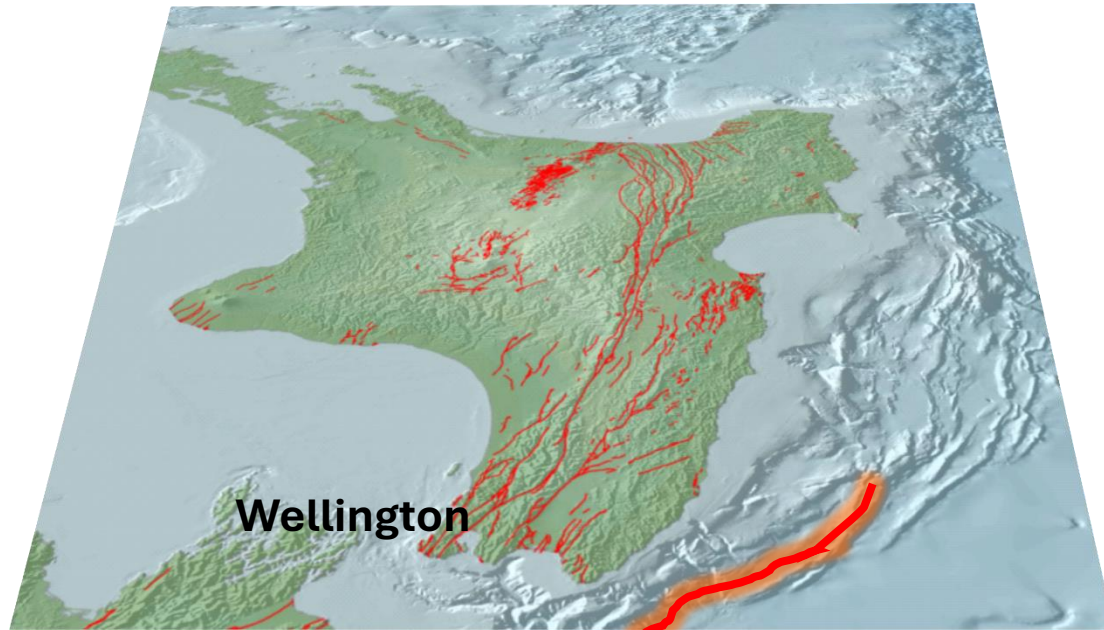
Large landslides as ground motion calibrators in the Hikurangi margin, Wairarapa, NZ

Dr Rob Langridge,
Earthquake Geologist, ESNZ

Team: Abbie Underwood, Andrea Wolter, Tim Stahl, Sally Dellow, Brenda Rosser, Hannu Seebeck, Jen Andrews, Joe Potangaroa et al.

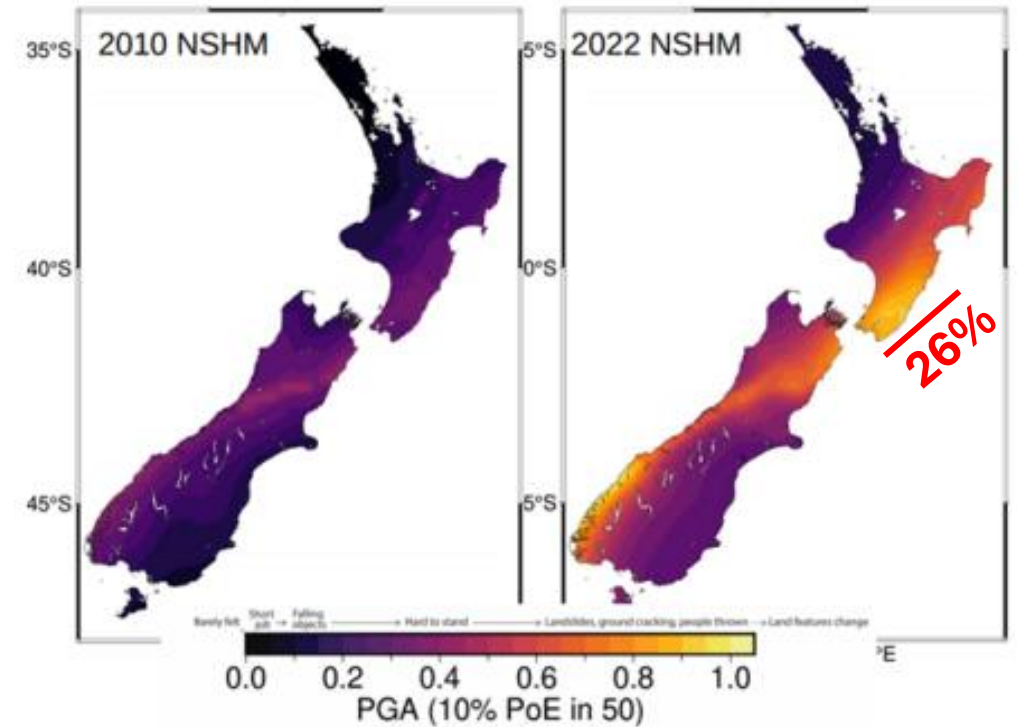


- Wellington Region's Earthquake Setting



- Related to the Hikurangi SZ are many active faults that cut through the Australian Plate, “**upper plate faults**”, e.g. Wellington Fault.
- The **subduction interface** lies ~20 km beneath Wellington
- Both can generate large earthquakes, independently and simultaneously.

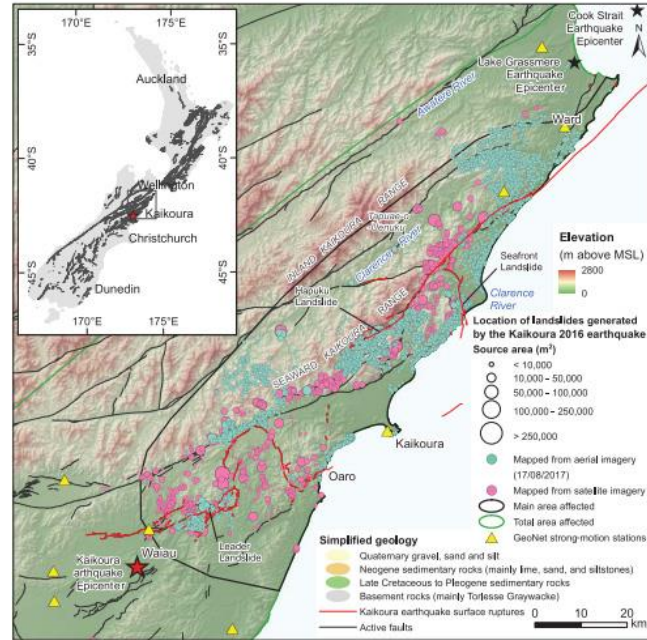
Motivation - Δ NSHM 2012 vs. 2022



<https://nshm.gns.cri.nz/HazardMaps>

Location	2010 PGA(g)	2022 PGA(g)
Auckland	0.05	0.13
Wellington	0.32	0.82
Christchurch	0.17	0.42
Dunedin	0.1	0.26

Landslides in 2016 M_w 7.8 Kaikōura EQ

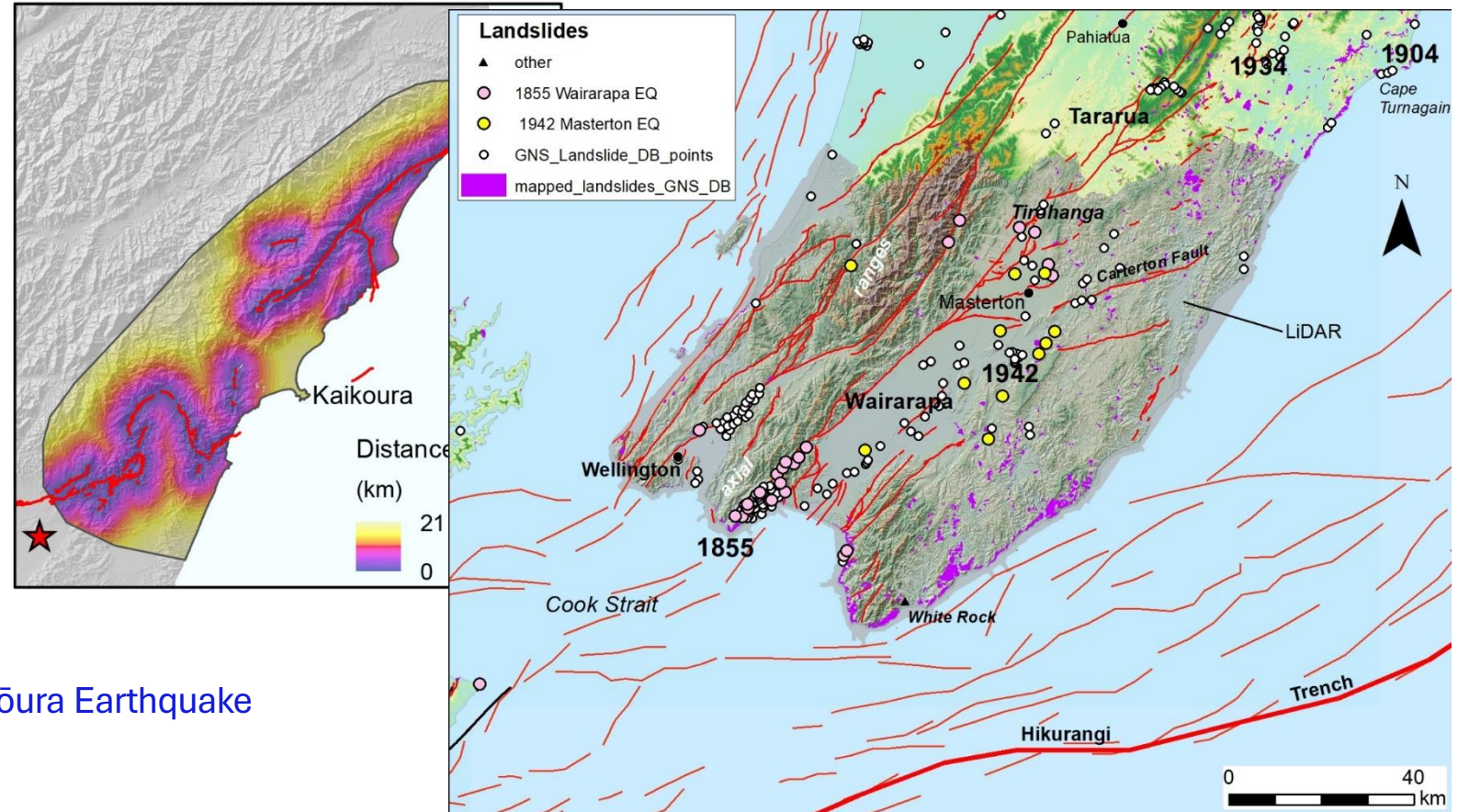


Massey et al. (2018)

- ~30,000 landslides from M_w 7.8 Kaikōura Earthquake
- Multi-fault, upper plate rupture zone

Underwood A et al. 2026. Reducing uncertainty in landslide age-Roughness modelling through roughness analysis of coseismic landslides from the 2016 M_w 7.8 Kaikōura earthquake
– poster presentation at the IAG conference, February 2026

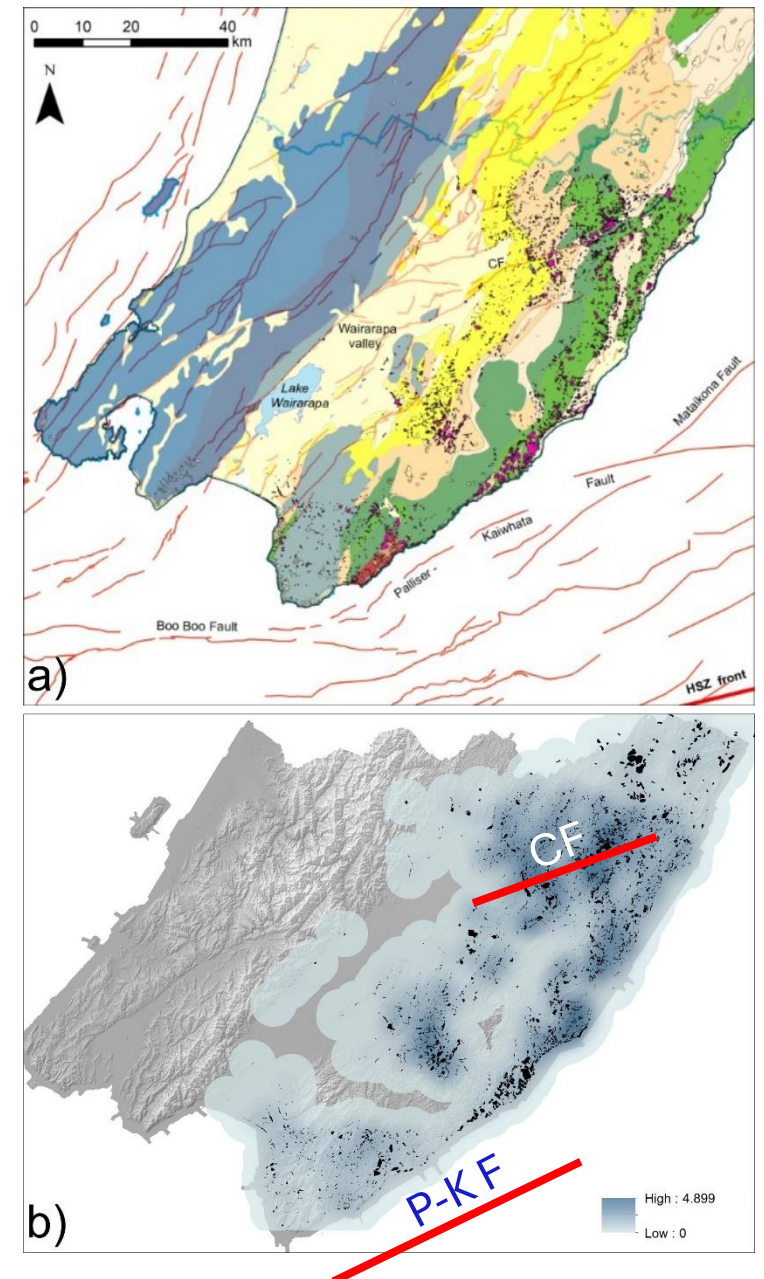
c.f. Wairarapa region



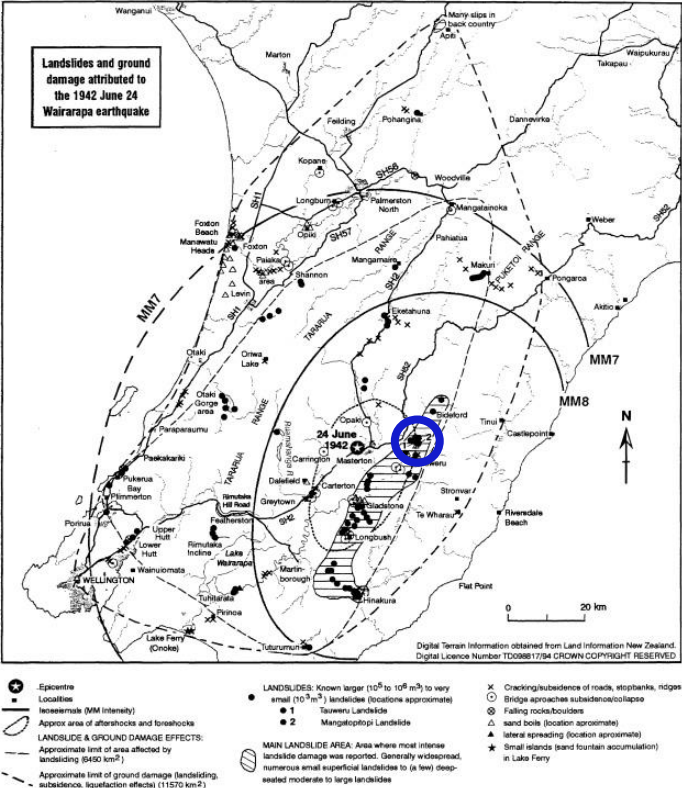
- A century of large to great earthquakes (1855-1942)
- Landslides mapped after or well after earthquakes
- The project has added a significant volume of new landslides

Results of landslide mapping

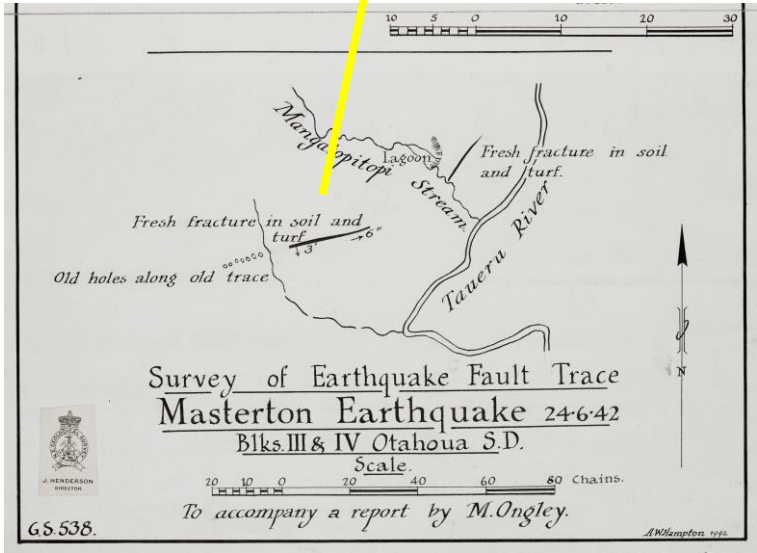
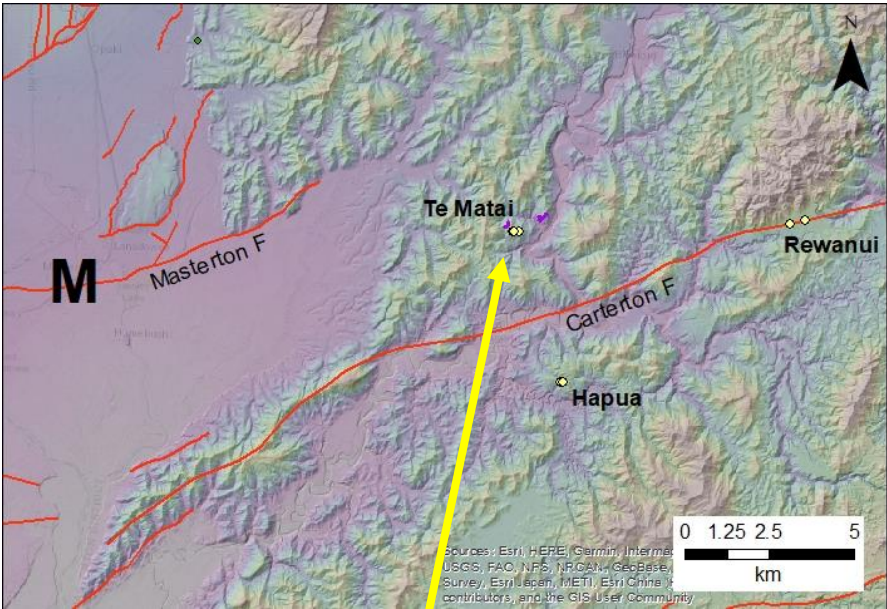
- Wairarapa landslides controlled by several factors
- Incl. lithology, proximity to active faults, slope angle, PGA
- The geology is dominated by uplifted marine sed. rocks of forearc
- Landslides concentrated along coastal strip close to Palliser-Kaiwhata Fault
- Also around Carterton Fault, where our field studies were focused



June 1942 $M_w \sim 7.0$ EQ - co-seismic landslide scar (Te Matai)



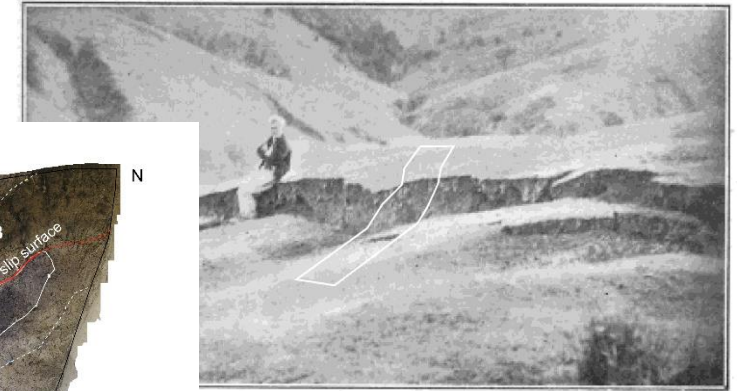
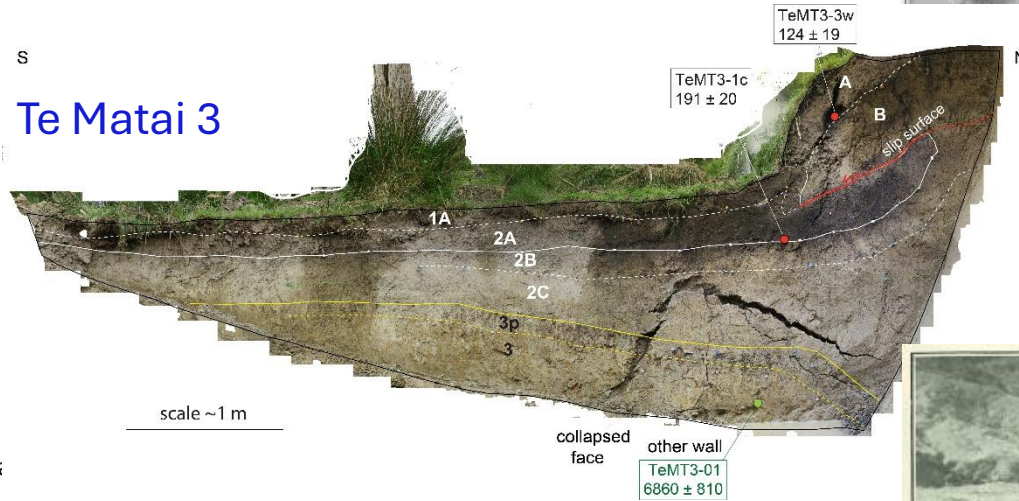
Downes et al. (2001)



1942 Wairarapa I EQ - co-seismic landslide scar (Te Matai)



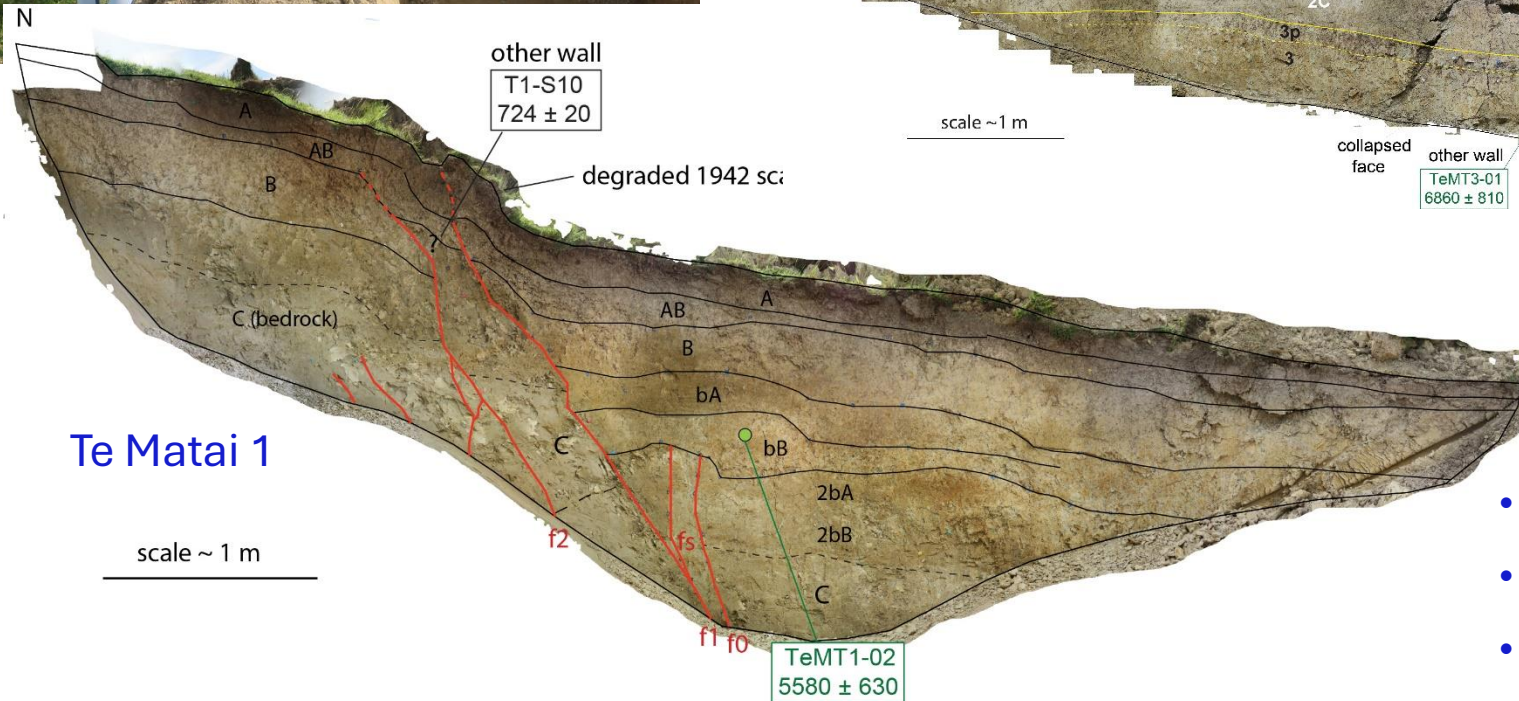
Te Matai 3



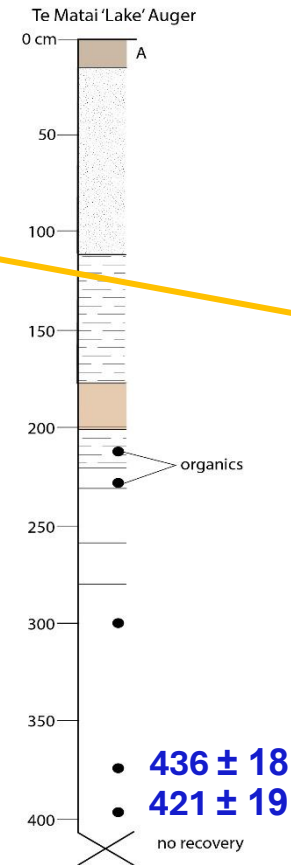
Te Matai 2

- 1942 co-seismic movement confirmed in walls
- A pre-1942 movement logged
- Bracketed in Mid-Holocene (c. 4360-7180 BP)

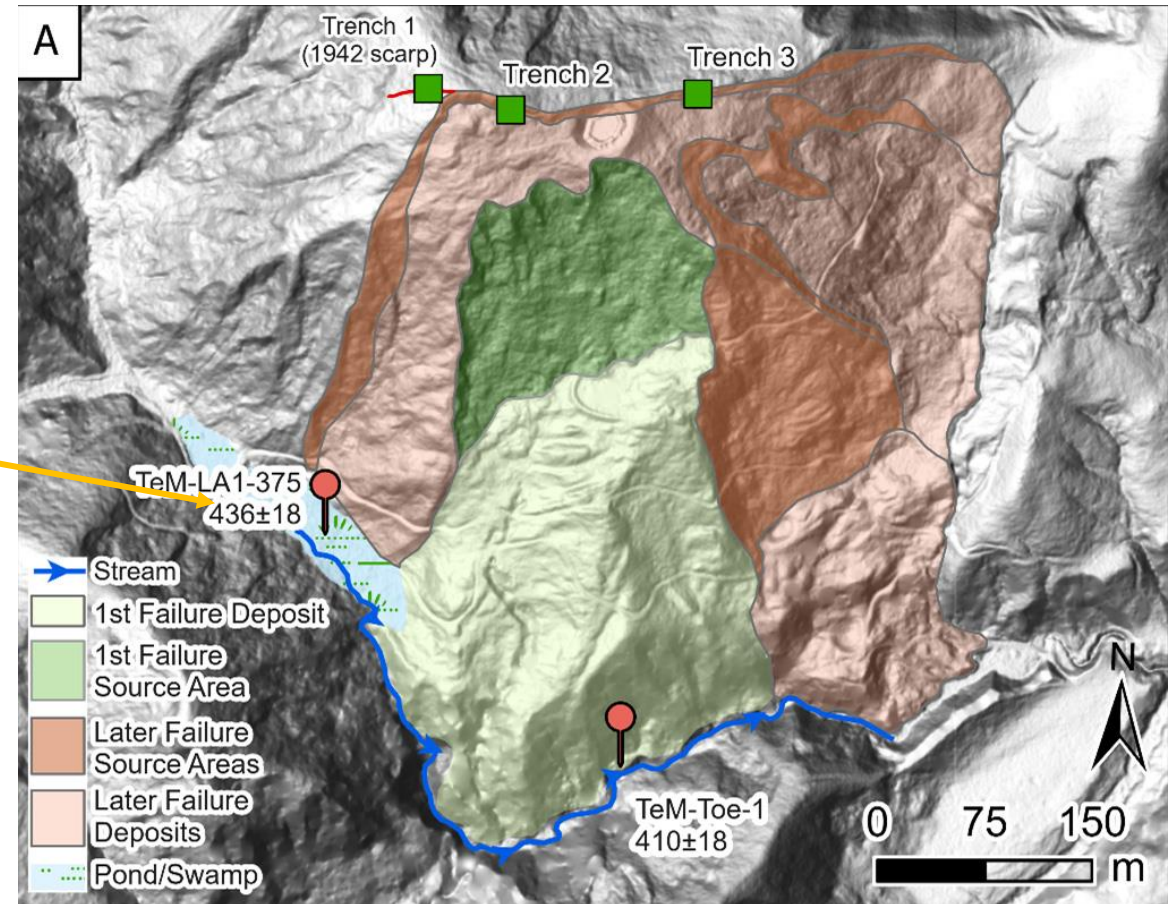
Te Matai 1



major Te Matai hillslope movement

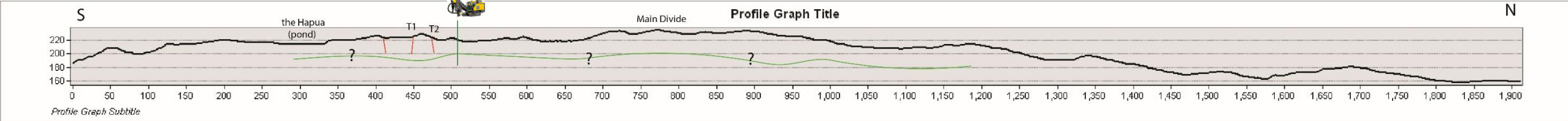
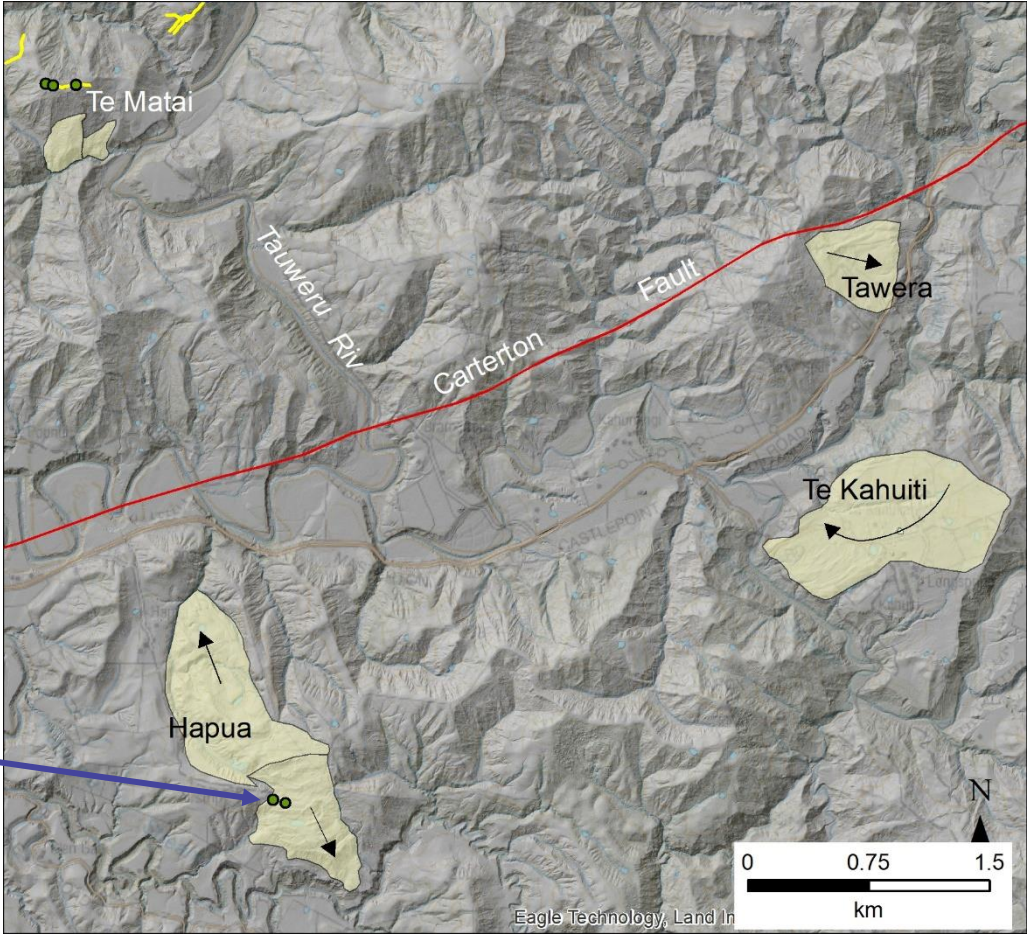


- a major hillslope failure
- blocks side valley
- bracketed by three dates to 336-496 cal yr BP
- coincident with most recent subduction EQ?

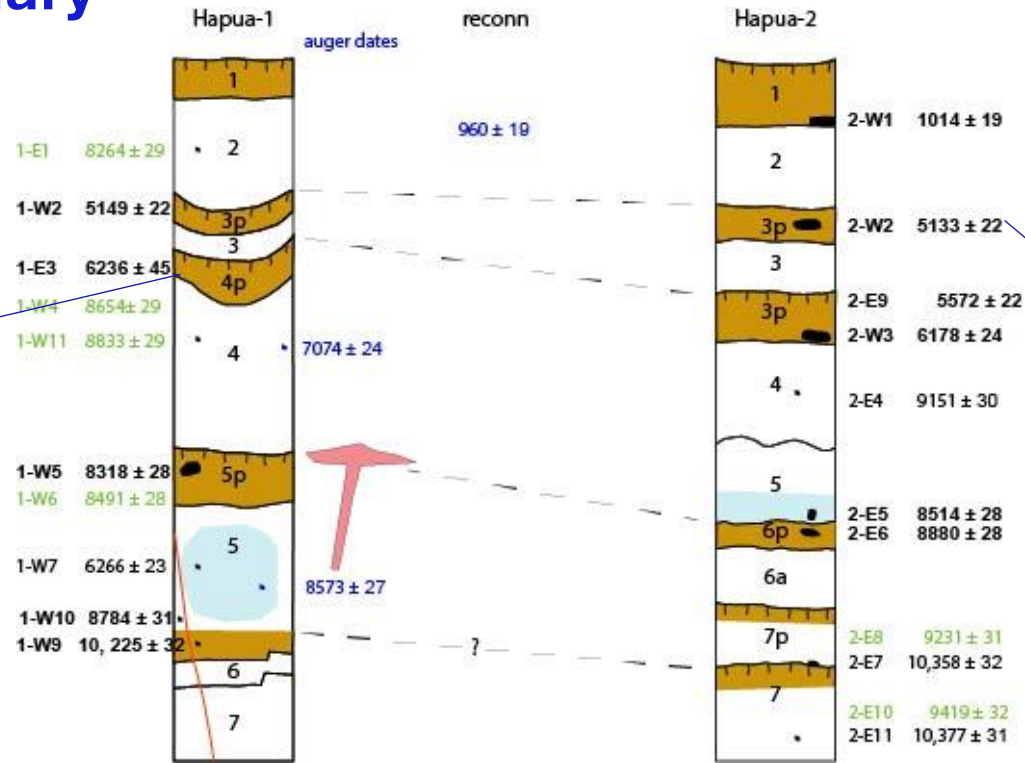
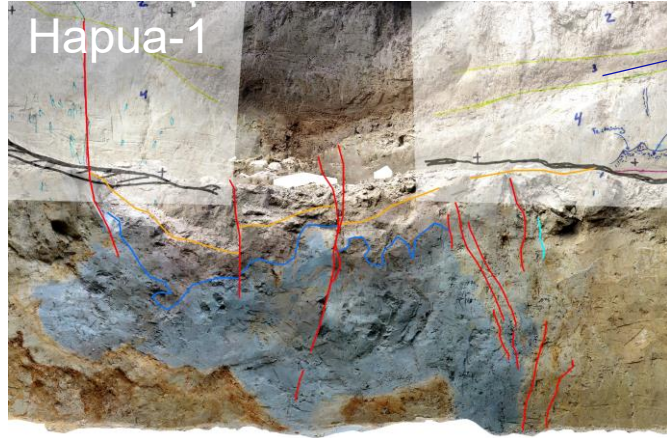


Te Matai farm – summary
1942, last Hikurangi?, Mid-Holocene

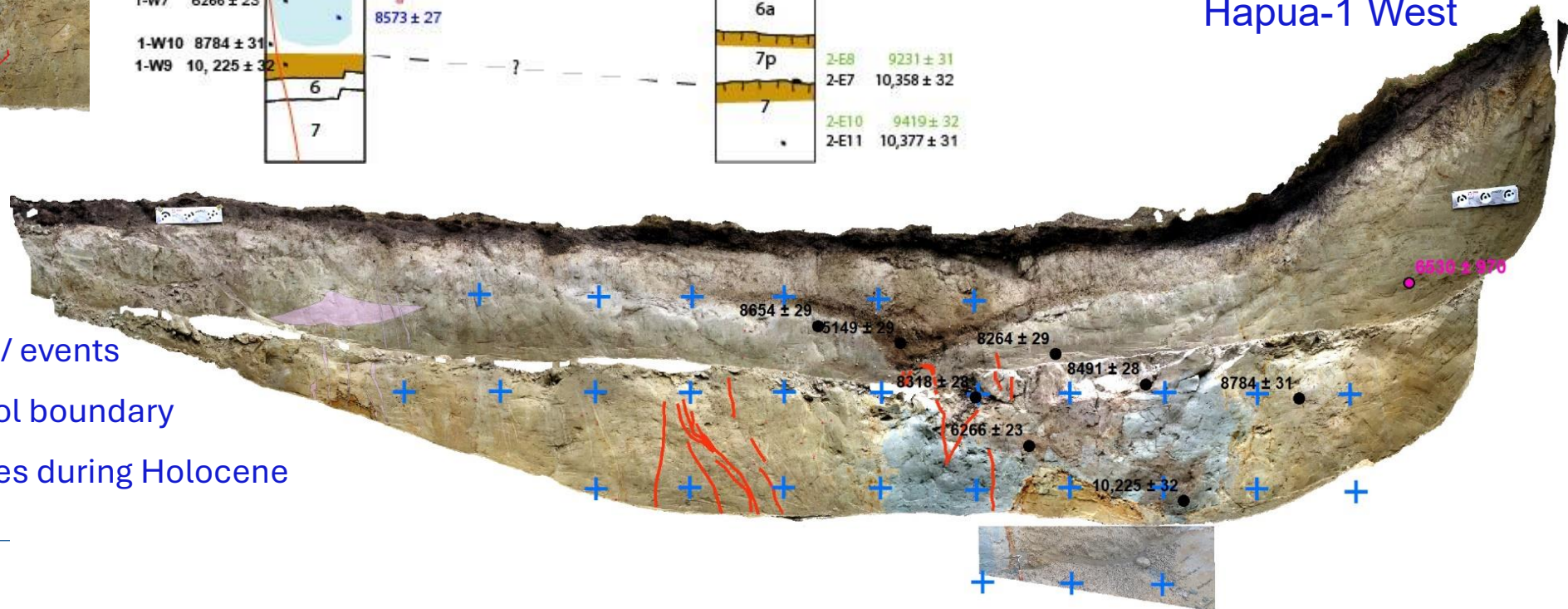
Hapua Landslide – a very large block slide



Hapua trenching summary

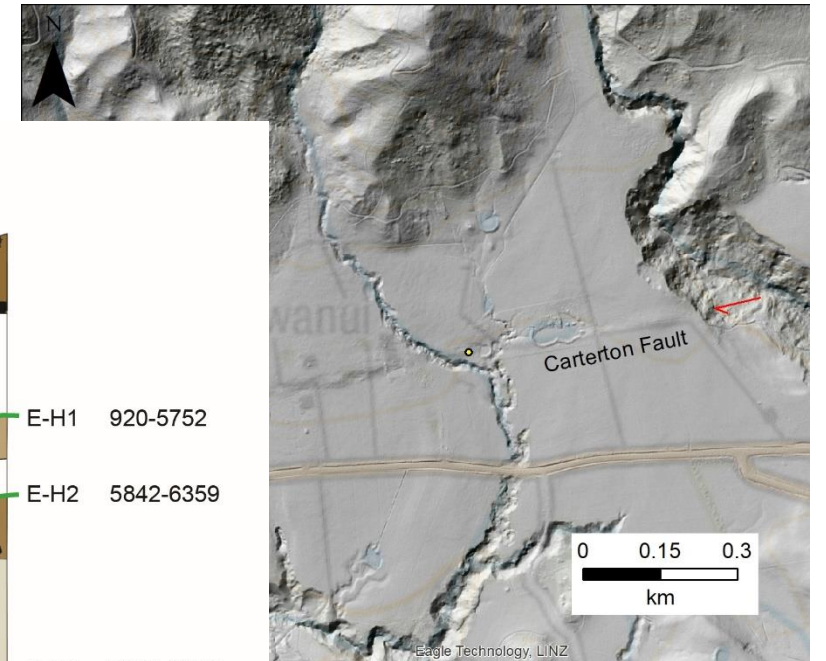
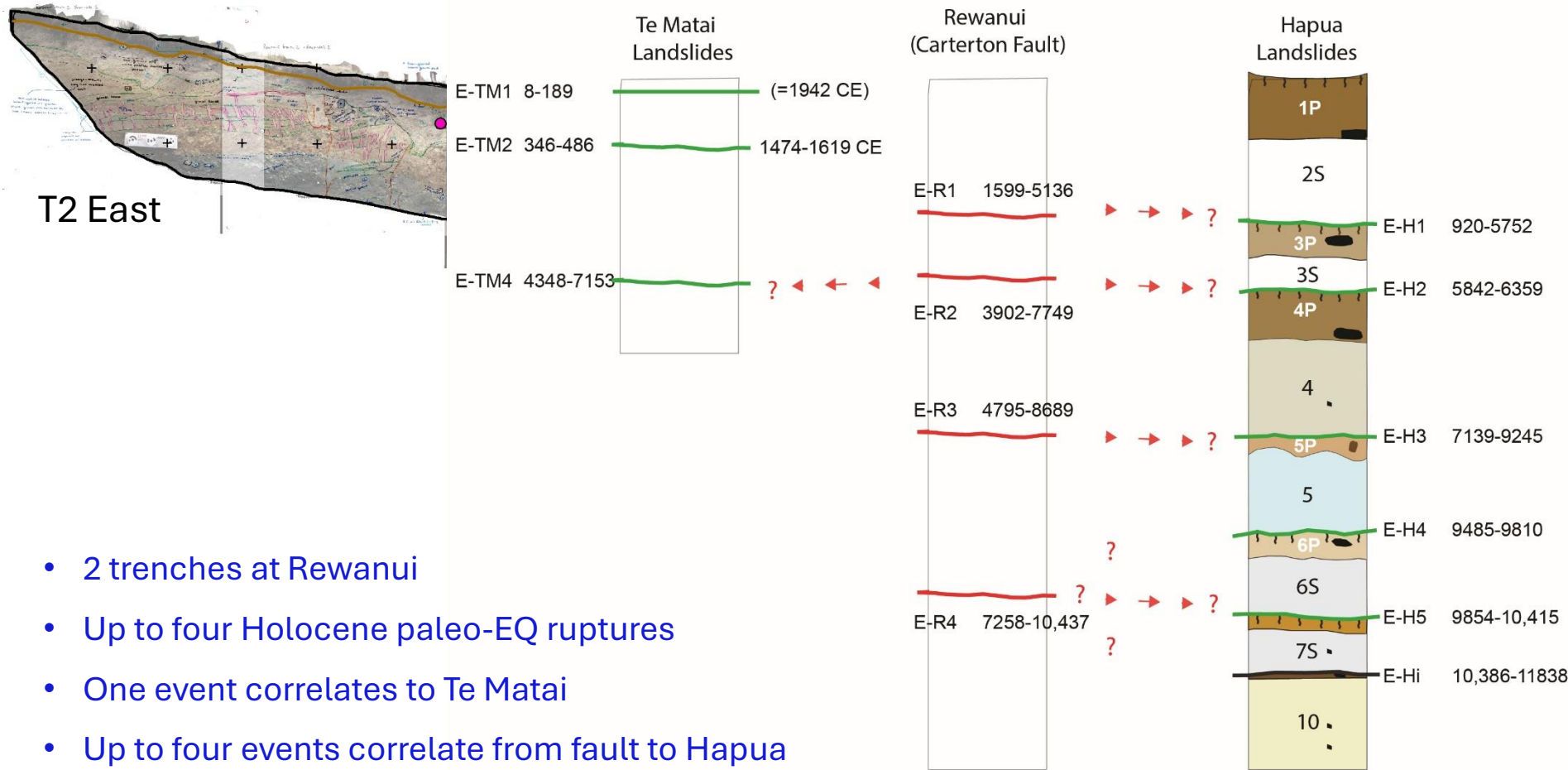


Hapua-1 West



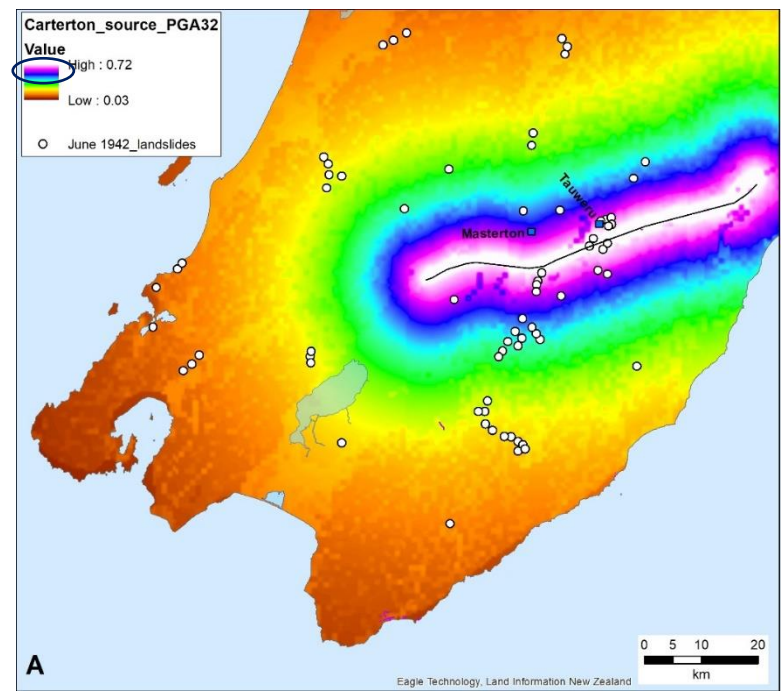
- 2 trenches, 23 C-14 dates
- Complementary strat/ dates/ events
- Landslide initiated at ~Pl./Hol boundary
- Landslide reactivated at times during Holocene

LS site-correlation to Carterton Fault



- 2 trenches at Rewanui
- Up to four Holocene paleo-EQ ruptures
- One event correlates to Te Matai
- Up to four events correlate from fault to Hapua
- Landslide /hillslope reactivations could be co-seismic
- 2 other events correlate to June 1942 and sthn Hikurangi?

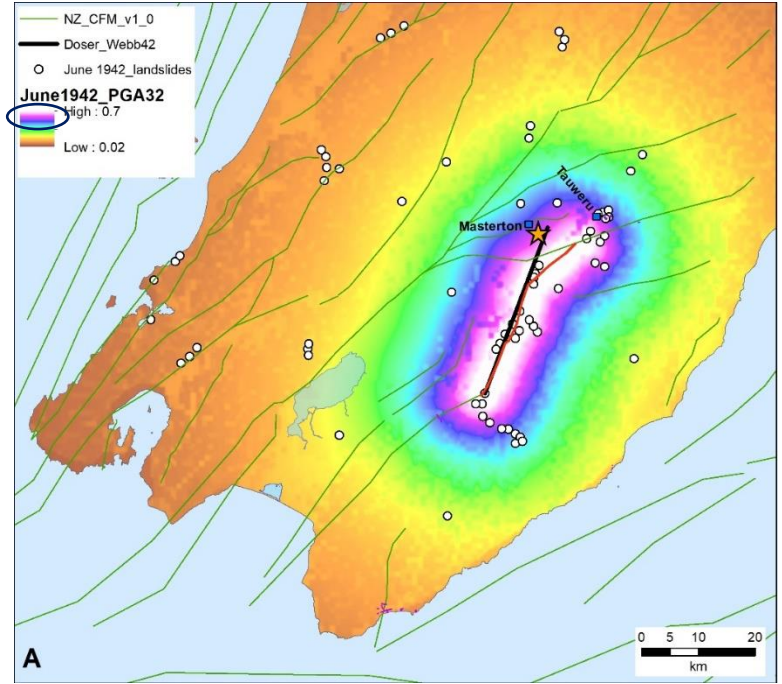
PGA modelling for active fault sources



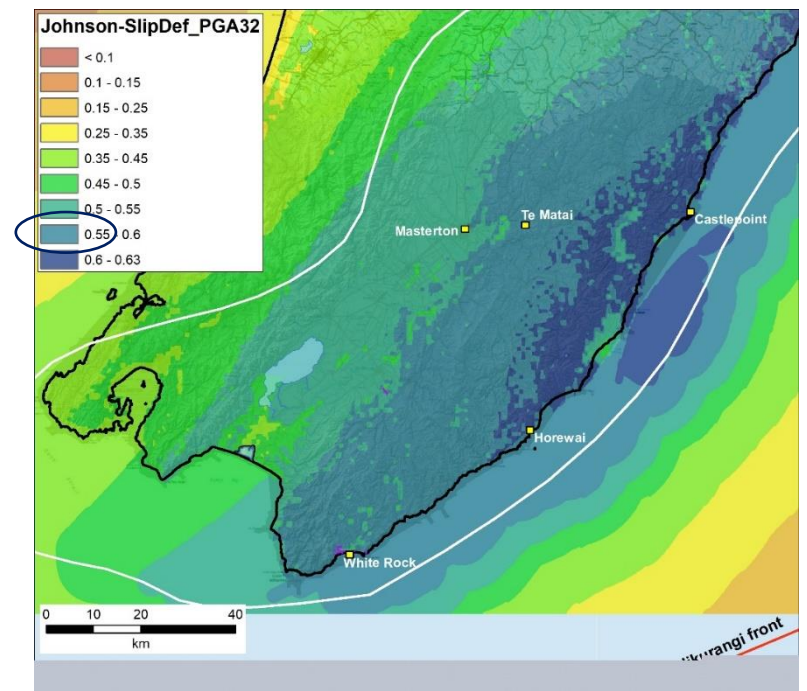
Carterton

NZ Community Fault Model (CFM)
Seebeck et al. (2024)

bespoke June 1942 source



full southern Hikurangi



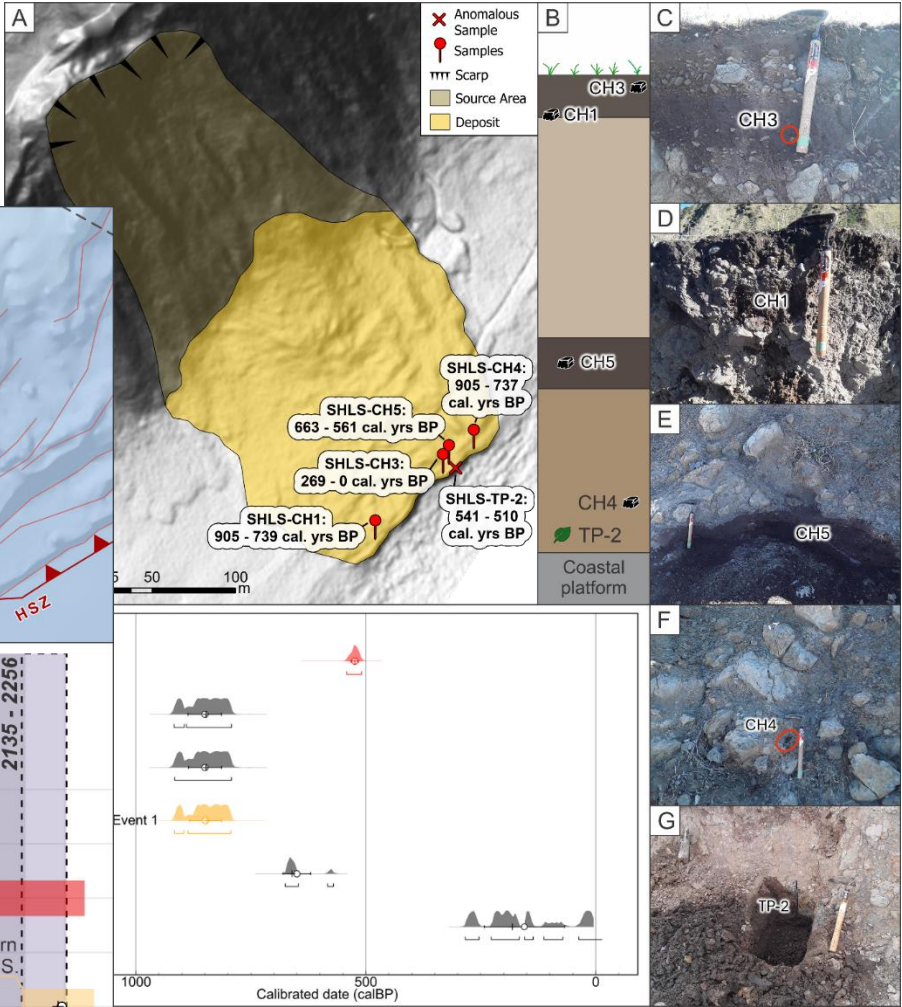
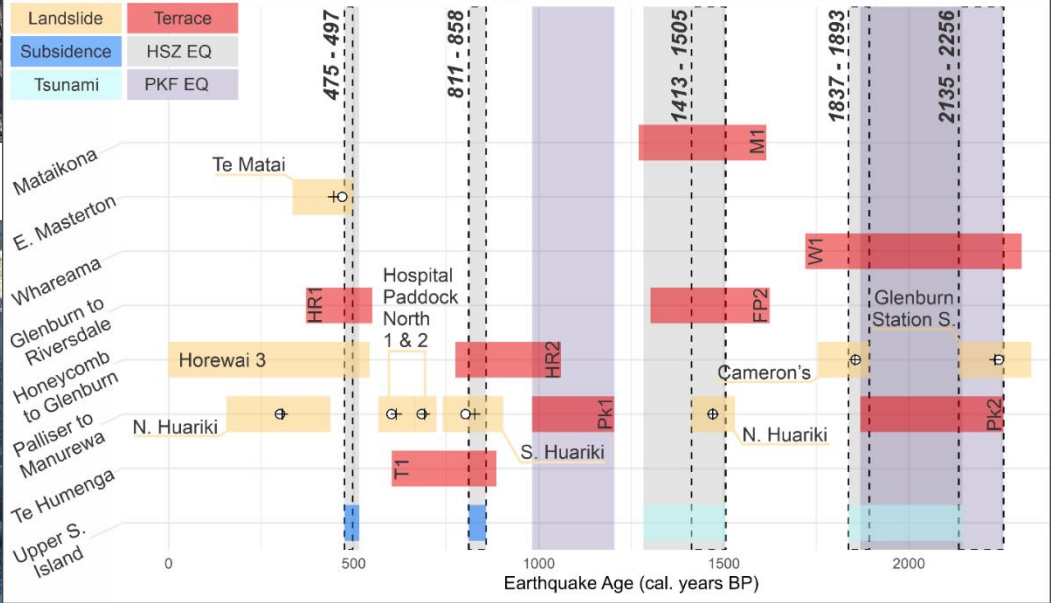
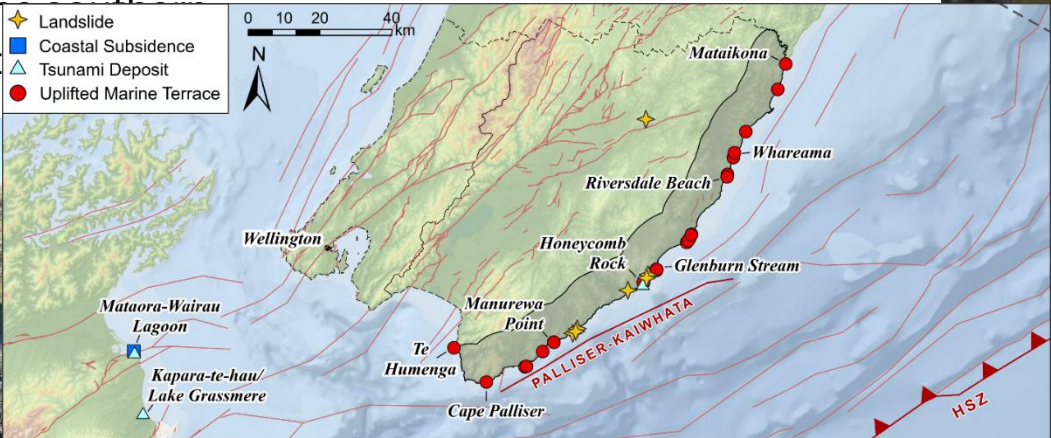
- ‘Carterton’ can generate LSs in its corridor
- ‘bespoke’ mimics 1942 EQ effects
- ‘Carterton’ unlikely to generate 1942 LSs
- ‘sthn Hikurangi’ can generate coastal LSs
- ‘sthn Hikurangi’ can set off Te Matai hillslope

First manuscript submitted!

Abbie Underwood et al.(in review): Large landslides as proxies for paleoearthquakes in the Hikurangi subduction margin, Aotearoa

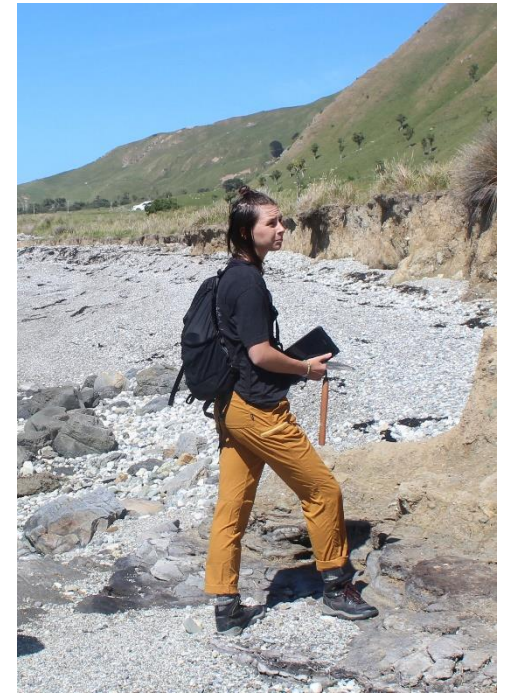


Huariki South Landslide



Conclusions

- Perhaps the first coordinated paleoseismic / landslide project undertaken in NZ?
- Huge potential for dating landslides and relating to seismic sources (PGA and EIL tool)
- Always some doubt about their origin, but...
- Collective landslide distribution can be the sum of upper plate and Hikurangi EQs
- As fault records become better we might better match landslides etc
- Huge potential for landscape ‘slope-roughness’ studies (some of Abbie’s ongoing work)



Abbie



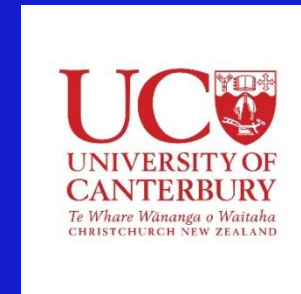
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? Questions / pātai ?

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Lessons from the 2016 Kaikōura earthquake

