Introduction to scenario

Palaeomagnetic basics

Analysis of results

Preliminary interpretations

Constraining the Eruption History of the Rangitoto Volcano using Palaeomagnetic Data

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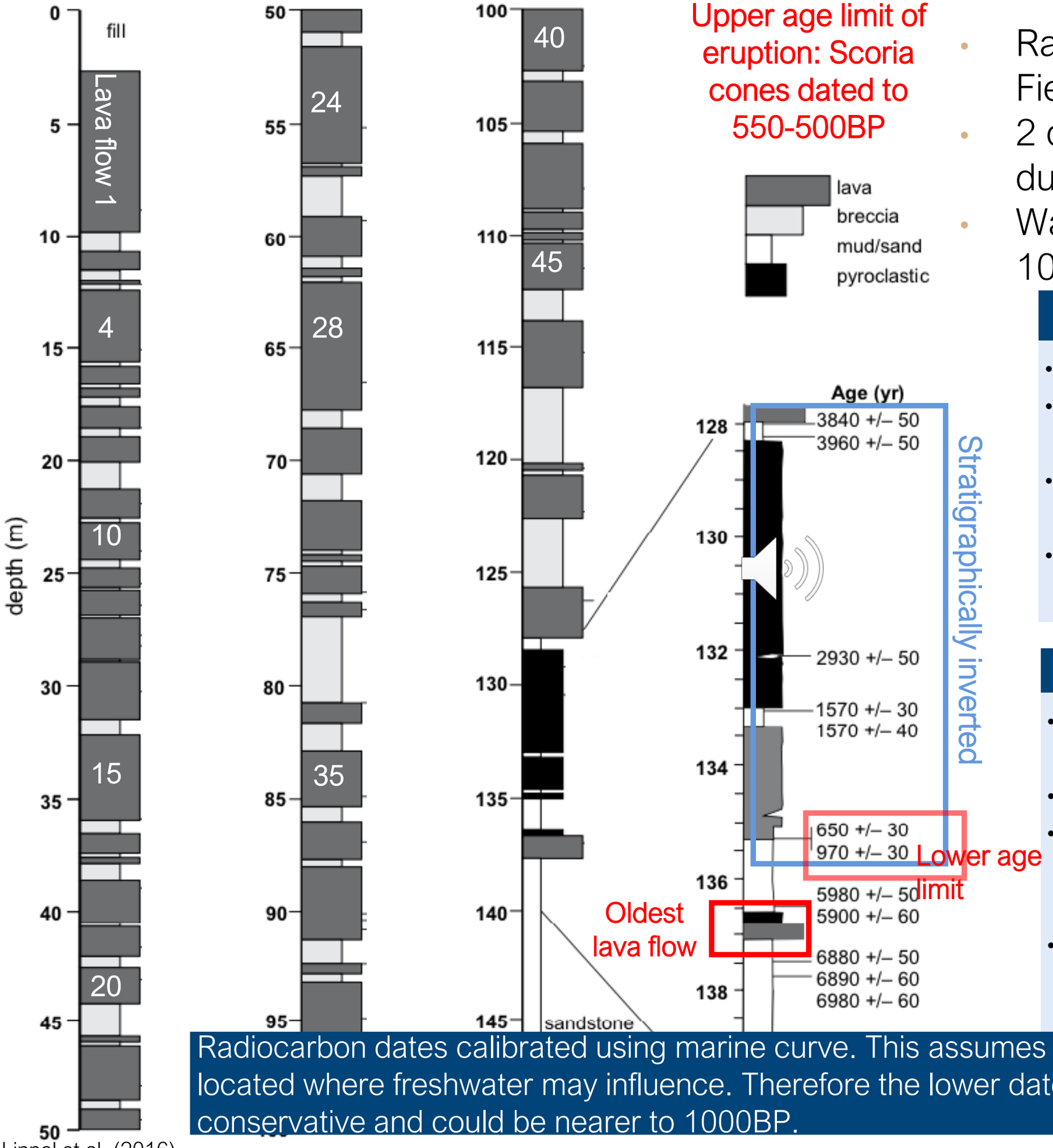


Linnel et al. (2016)

- Rangitoto, Auckland Volcanic Field (AVF), New Zealand
- 2 different hypothesis on eruption duration
- Was main shield building phase 10^2 or 10^3 year duration?

Linnell et al. (2016)

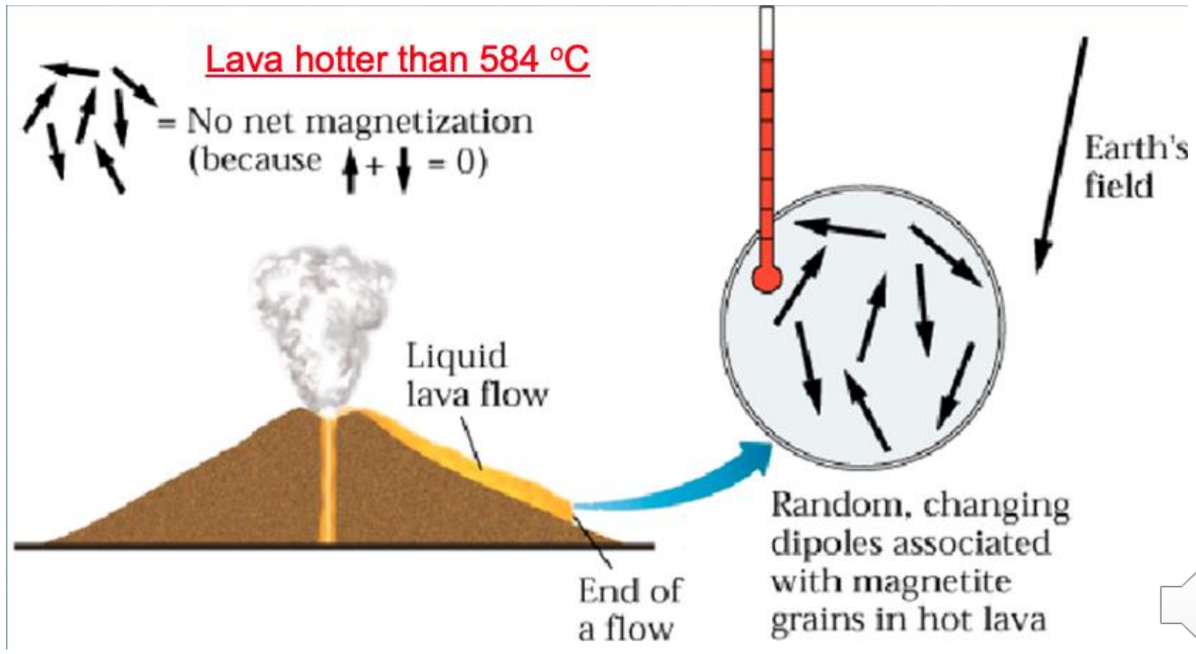
- Core taken 2014
- Radiocarbon dates (see figure) suggest early activity at 6000BP
- Dormant until main shield building phase at 600BP (polygenetic)
- Main eruption phase duration of ~100 years

Shane et al. (2013)

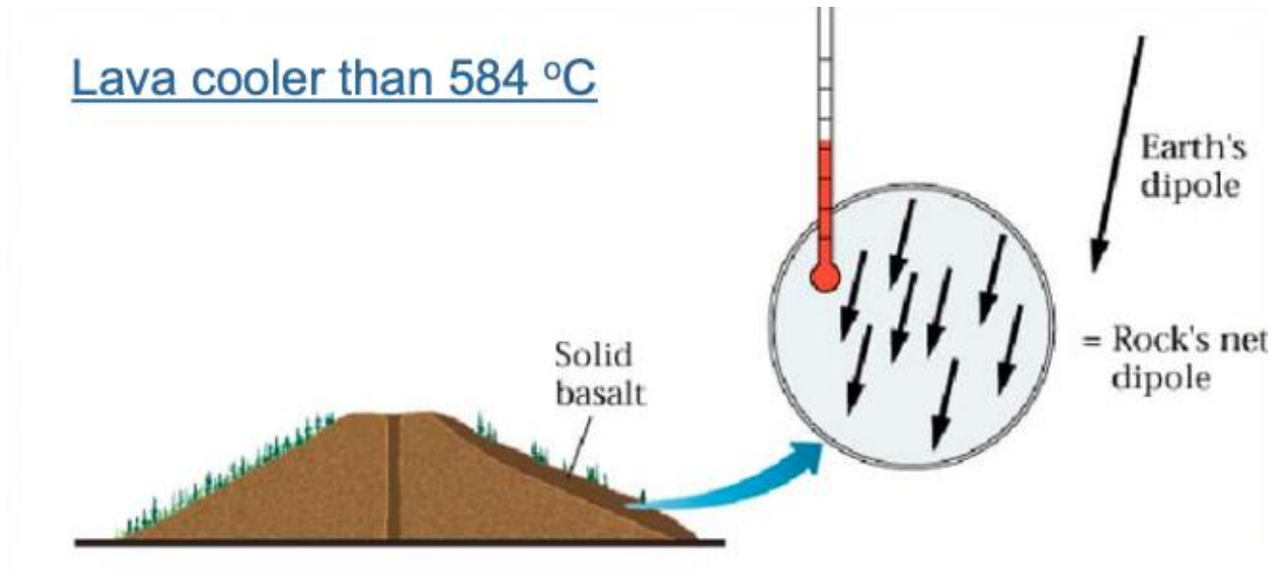
- Studied cores from nearby Lake Pepuke
- Dated basaltic crypto-tephra
- Lavas representing Rangitoto are dated to 1498±140 cal yr BP to 504± 6 cal yr BP
- Main eruption phase duration of ~1000 years (monogenetic)

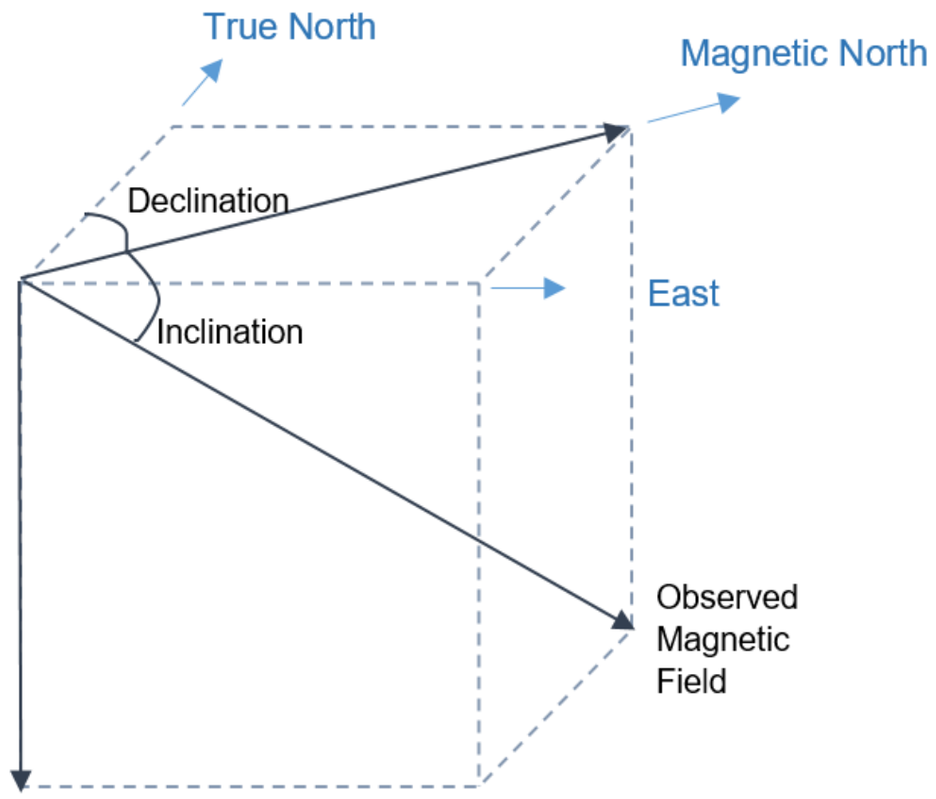
Radiocarbon dates calibrated using marine curve. This assumes purely marine signal but Rangitoto is located where freshwater may influence. Therefore the lower date limit of 650 BP is likely too conservative and could be nearer to 1000BP.

Basics of palaeomagnetism



Boundary at which a magnetic mineral can hold a permanent magnetisation





Declination and inclination: give direction of the geomagnetic field
Intensity: gives the strength

Will retain this information unless the lava is exposed to extreme temperature or field strength

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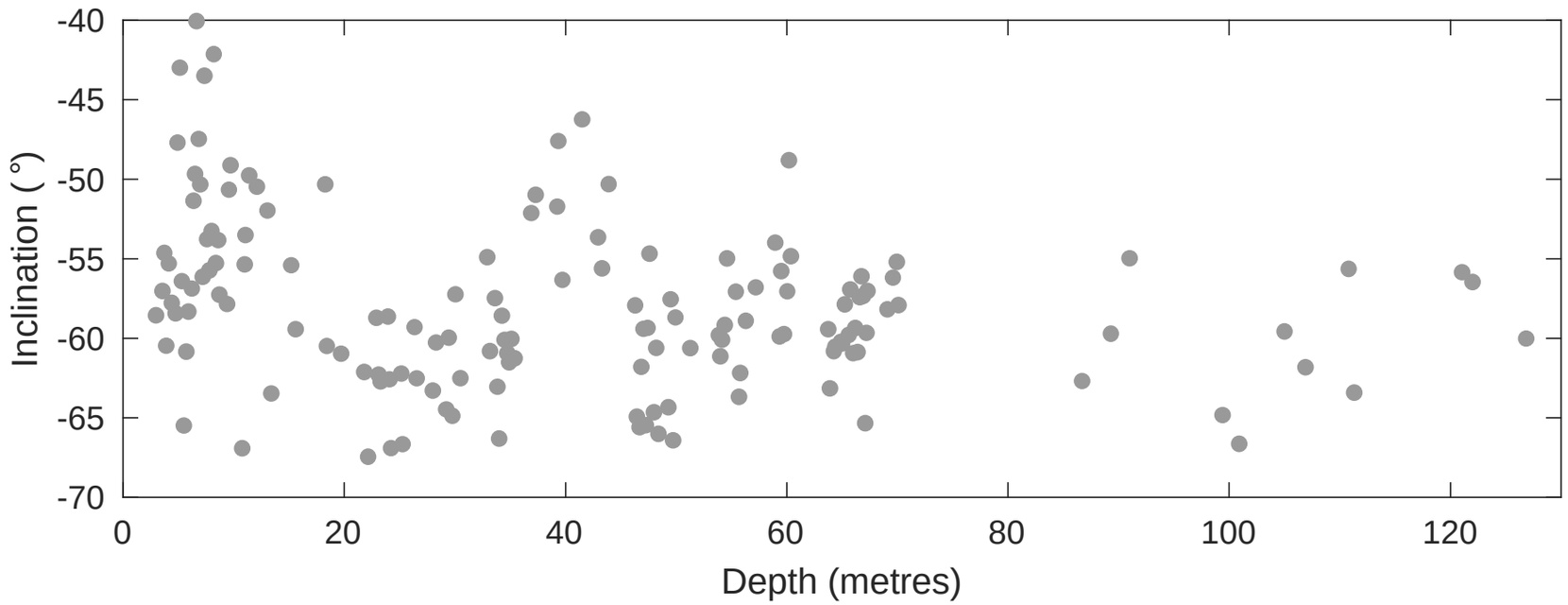
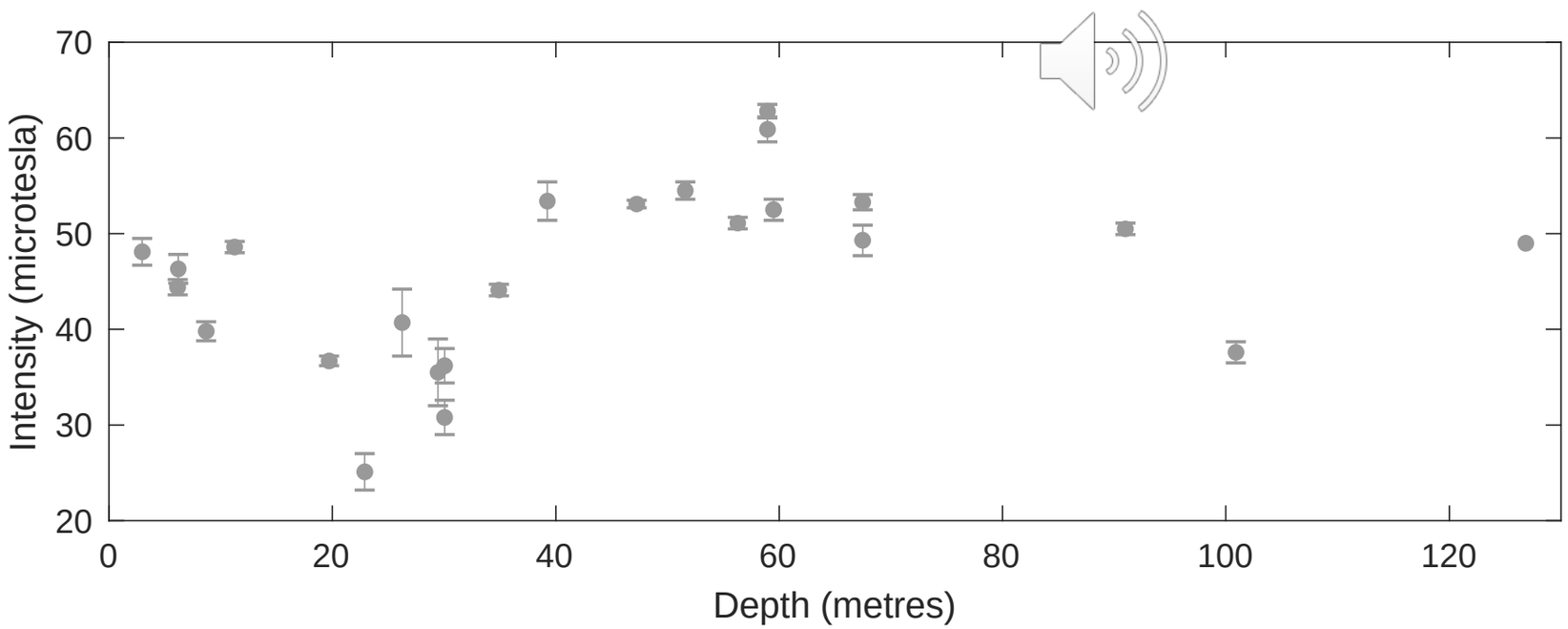
Data by depth

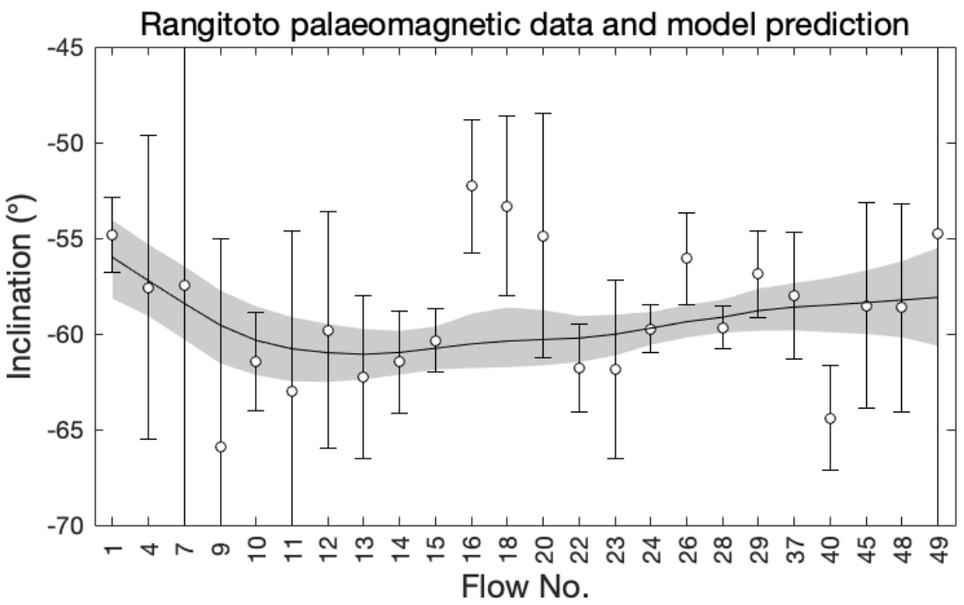


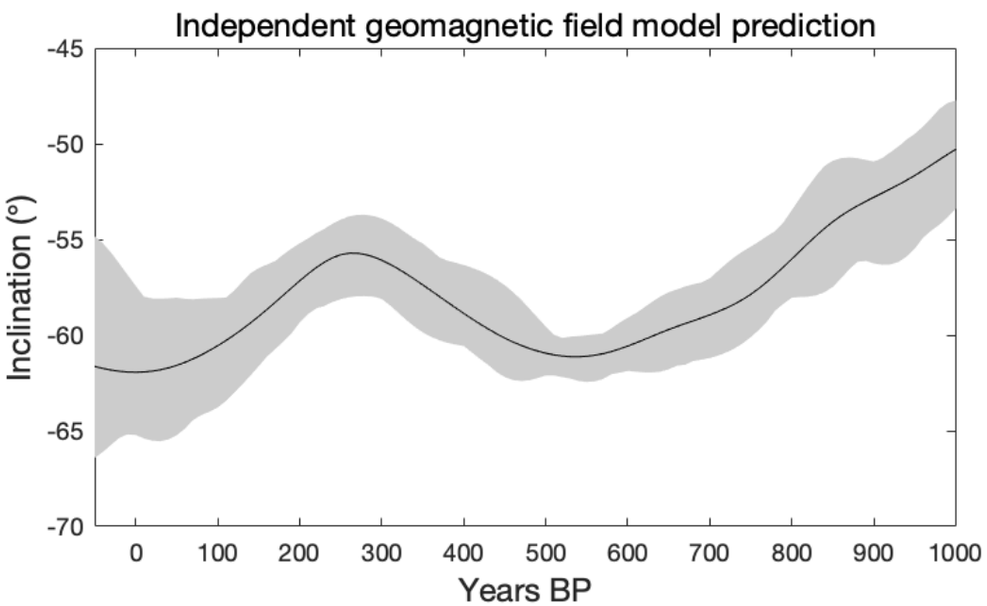


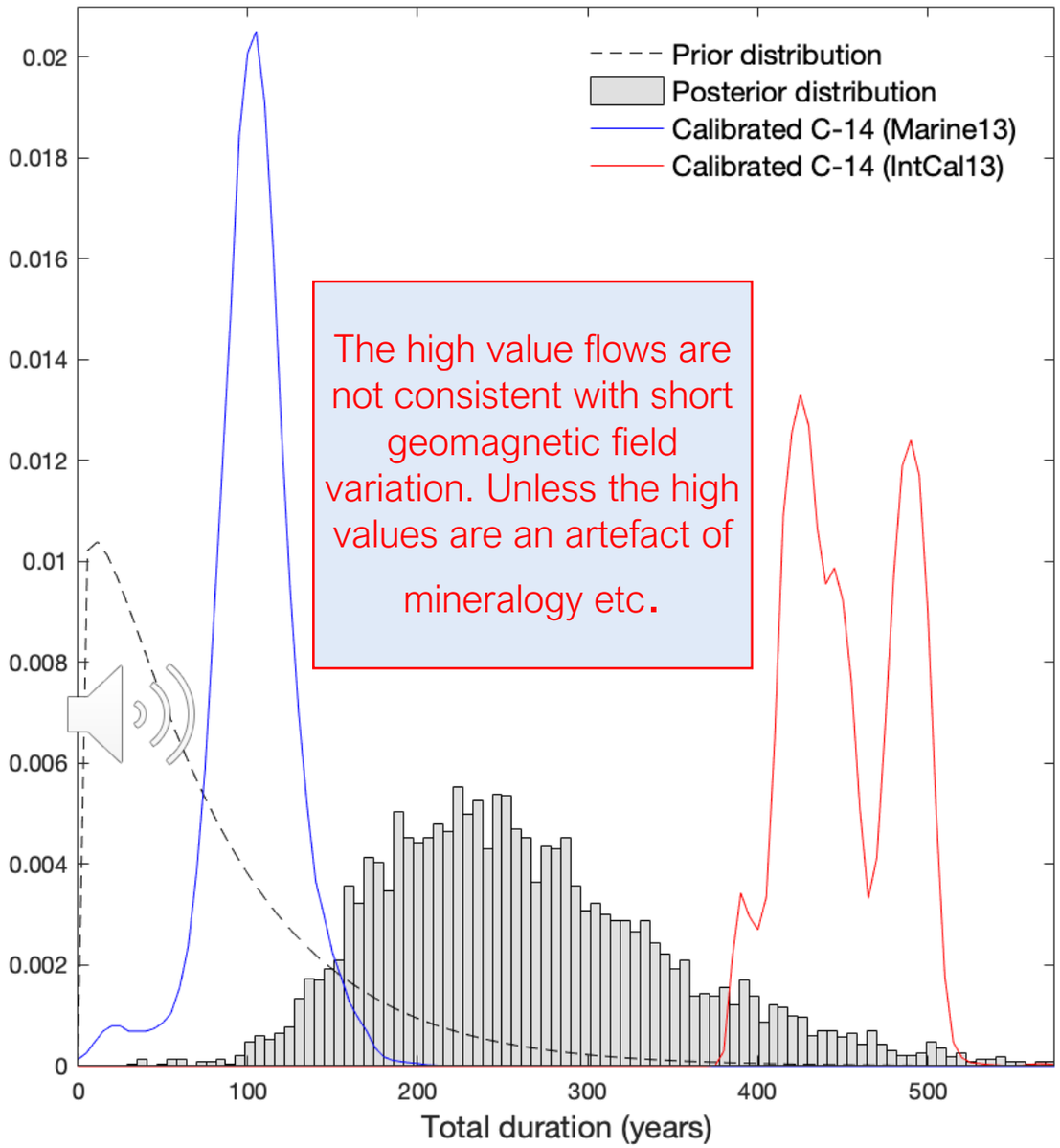
High inclination and high intensity values are observed at around 40 metres and 60 metres depth.

Figure: plots showing inclination and intensity by depth. The PI success rate was low for thermal Thellier experiments, so all measurements were taken on the MWS system at the Geomagnetism Laboratory at the University of Liverpool, UK. Note that the lava flows have very different thicknesses which could limit the number of samples from each taken. We were provided with more parts of the upper core hence the imbalance. More samples from the bottom half of the core were received 2020 and will be measured end of 2020 (COVID-19 may delay this).

Modelling the data







The high value flows are not consistent with short geomagnetic field variation. Unless the high values are an artefact of mineralogy etc.

Figure: plots showing the statistical model parameters and the preliminary results. The circle points on the inclination plot are the average inclination value (and 95% error) for each lava flow where three or more measurements were taken. Note that the lava flows have very different thicknesses which could limit the number of samples from each taken. The next plot is the COV-LAKE model (Hellio and Gillet 2018) from Rangitoto's co-ordinates. The final plot shows the a priori information and a histogram showing the most likely duration of eruption.

REFERENCES: **Linnell, T.,** Shane, P., Smith, I., Augustinus, P., Cronin, S., Lindsay, J. and Maas, R. (2016) Long- lived shield volcanism within a monogenetic basaltic field: The conundrum of Rangitoto volcano, New Zealand. *GSA Bulletin* 128 (7-8), 1160-1172. **Shane, P.,** Gehrels, M., Zawalna-Geer, A., Augustinus, P., Lindsay, J. and Chaillou, I. (2013) Longevity of a small shield volcano revealed by crypto-tephra studies (Rangitoto volcano, New Zealand): Change in eruptive behavior of a basaltic field. *Journal of Volcanology and Geothermal Research* 257, 174-183. **Hellio, G.** and Gillet, N. (2018) Time-correlation-based regression of the geomagnetic field from archeological and sediment records. *Geophysical Journal International* 214, 1585-1607.