

RANGITOTO VOLCANO

Using paleomagnetism to constrain the duration of eruptions

Introduction

The Rangitoto volcano is situated just outside Auckland city, an island full of myths and mystique. Rangitoto formed 6000 years ago, with its last eruption only 550 years ago. What happened in between has somehow been a mystery, but recent studies suggest that what we previously thought we knew about the volcano might not be true...

Results

Paleomagnetic measurements have not given enough data to make any reliable conclusions about the duration of the volcano's activity. However, paleointensity data implies that there would have been a longer period of eruptions in a timespan of about 1000 years. On the other hand, data of paleoinclination indicates that most of the eruptions would have taken place within roughly 150 years. The paleointensity dataset shows a stronger apparent structure than the paleoinclination data, and therefore makes it easier to match a specific period of time in the reference dataset. Because of this, it is suggested that further paleointensity measurements are made in order to strengthen the current model.

Method

Paleointensity measurements are an indirect dating method, where the so-called natural remanent magnetization (the word remanent comes from the Latin rema 'neo, which means remain) of a rock is used to calculate the intensity of the ancient magnetic field.

When magma is cooling and crystallizing, a magnetization is saved within the rock. This is a thermoremanent magnetization (thermo = heat), and is saved within the samples from the lava of Rangitoto.

During paleointensity experiments the samples are successively heated up in cycles to 600 °C to demagnetize them in a zero field, and give them a new thermoremanent magnetization in a known magnetic field. With this measured information, it is possible to calculate what the intensity of the magnetic field was when the lava was erupted. This is then compared to a dataset of the paleointensity in the area.

Hypotheses

- Either there was a major but short period of eruptions of ca 150 years, which would have been the main shield building phase of the volcano, or
- there was a prolonged period of eruptions scattered over the years from the formation of the volcano, 6000 years ago.

Background

About one third of New Zealand's population lives in Auckland. It is therefore of great importance to know more about the volcanoes in the area. Rangitoto is situated in the Auckland volcanic field, and is the youngest and largest of about 50 volcanoes. Paleointensity measurements have been made to make a better age model in order to prepare for any future hazards.

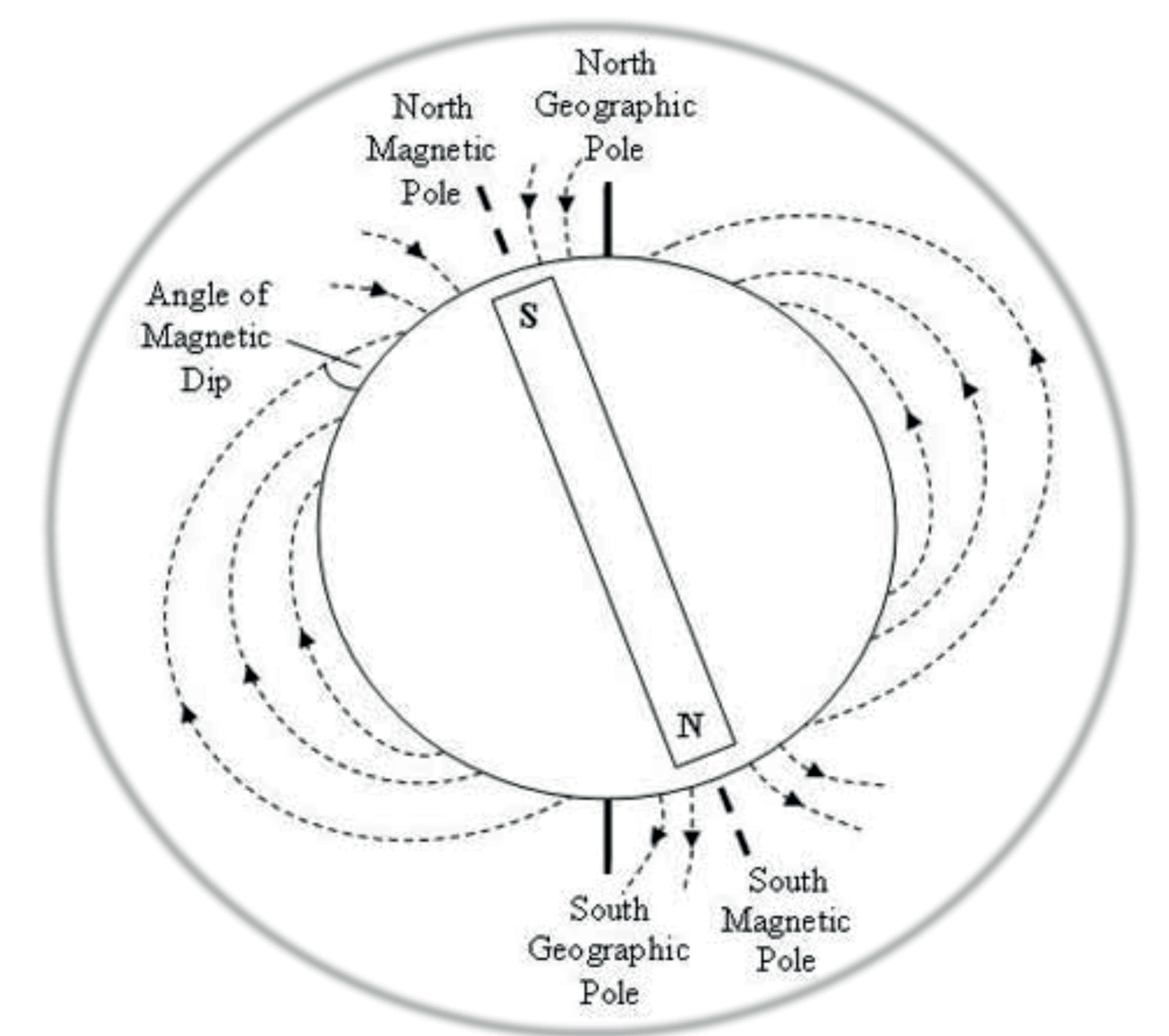


Fig 3. The Earth magnetic field is generated through convection in the liquid iron-rich outer core. The geomagnetic field can be illustrated as a single magnetic dipole in the middle of the Earth, aligned to the rotation axis. The is fluctuating over the years though, and the intensity is dependant on where on Earth you are.

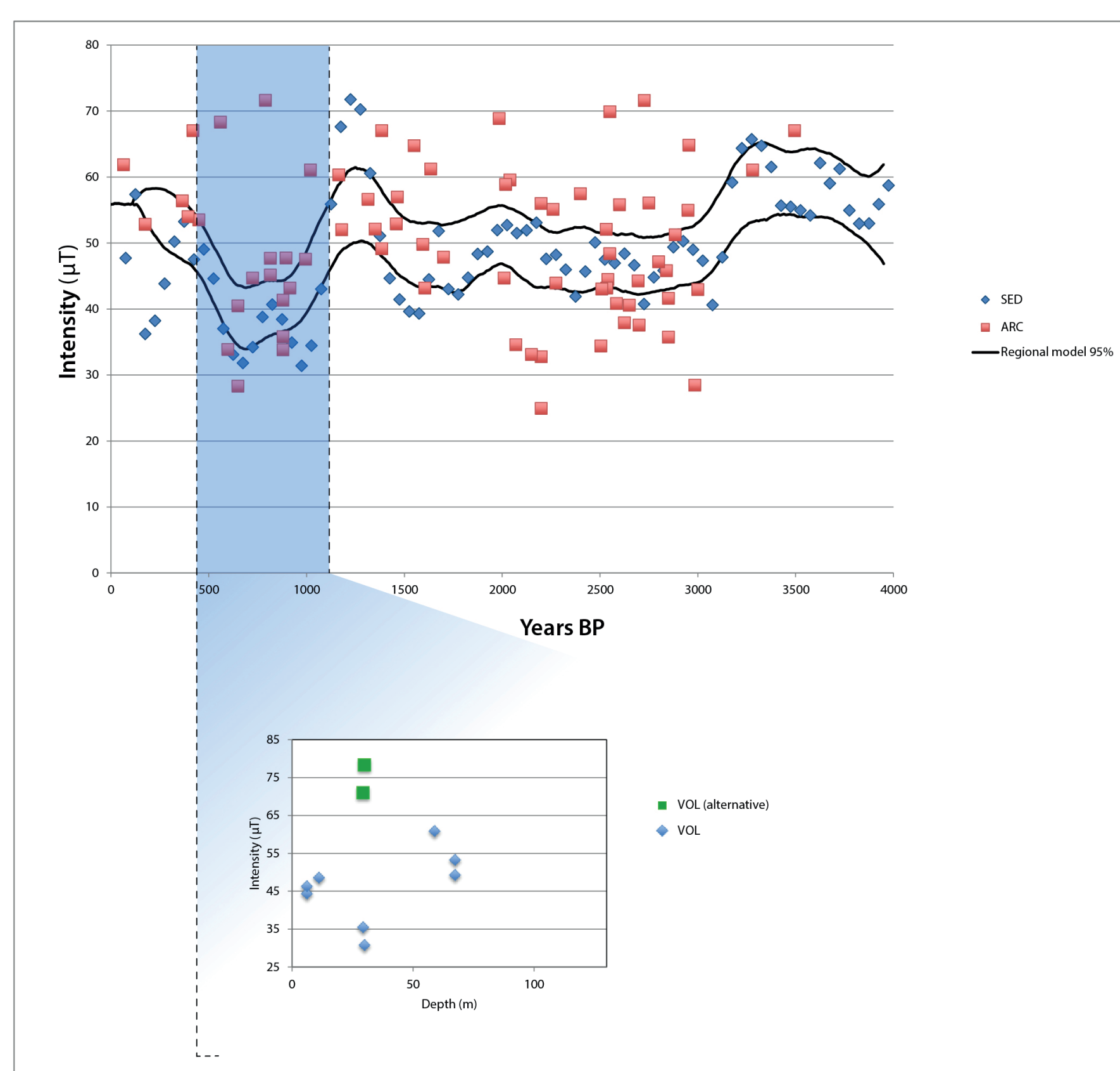


Fig 1. The paleointensity data has been combined with results from microwave experiments of samples from the same drill core from Rangitoto. It has been compared to a regional dataset from the online database GEOMAGIA.v50. The data can be interpolated within a time span of 1000 years and thus supports the second hypothesis, that the eruptions would have been scattered over a longer period of time.

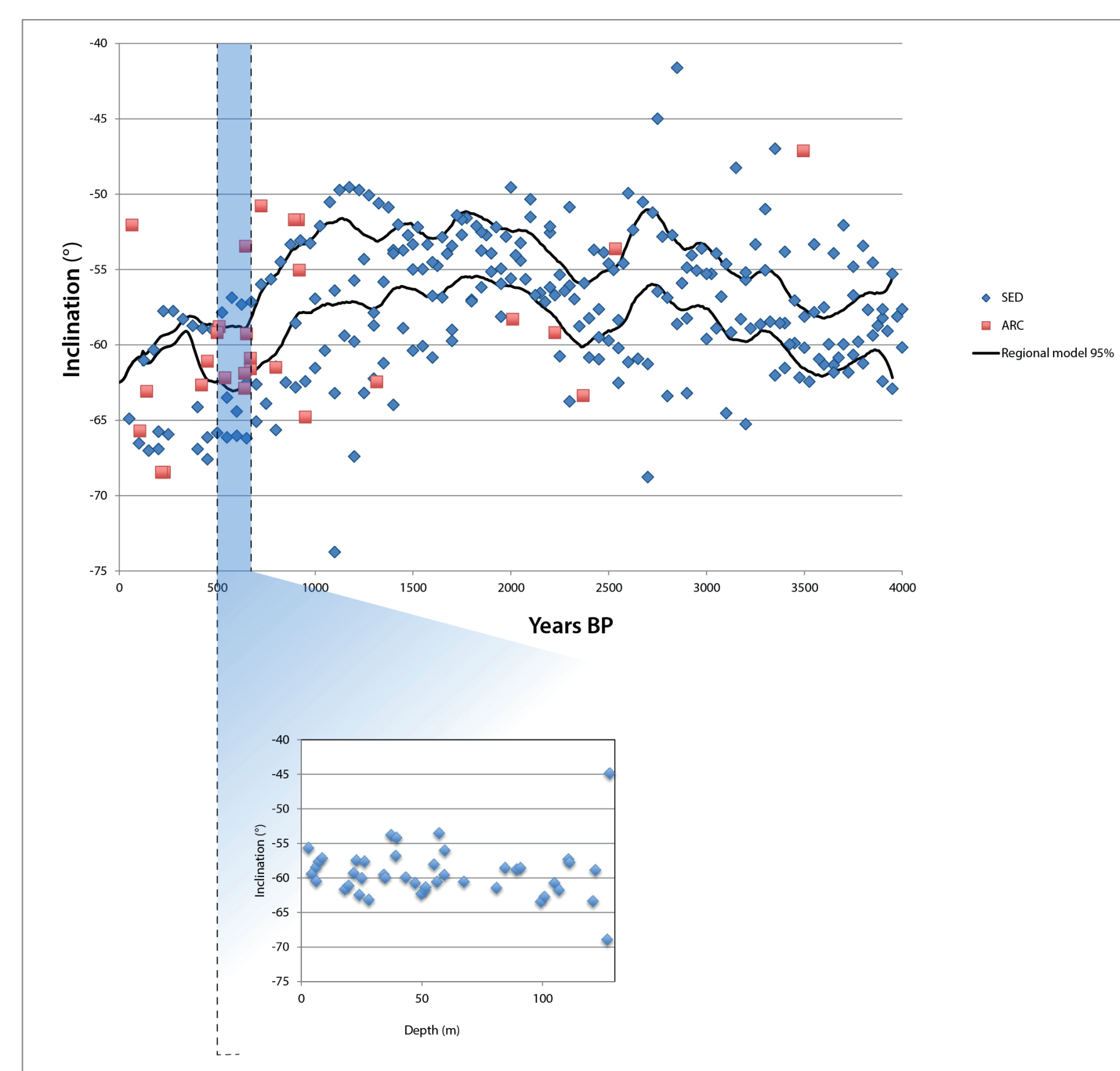


Fig 2. The inclination dataset is retrieved from the same Rangitoto drill core and are compared to a regional dataset from the online database GEOMAGIA.v50. The date fits into a time span of roughly 150 years, and supports the first hypothesis of a massive phase of eruptions in a shorter period of time.

Rangitoto in Māori means „bloody sky“ but its original name is..

Ngā Rangi-i-totongia-a Tama-tekapua which means "the days of the bleeding of Tama-te-kapua". This does not, as one can think, origin from a volcanic outburst, but from a great battle between two Māori tribes about 670 years ago.



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