Investigating a possible Oruanui Eruption deposit in Pa Bay, NZ

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Introduction
Pa Bay is located in Banks Peninsula on the South island of New Zealand. Banks Peninsula is a volcanic formation, yet in Pa Bay there is a large sediment cliff of unknown origin. The cliff is 7.4 meters of loess bed packages (Figure 4 & 5). Cutting through the loess is a thin (2-8cm) layer of grey/white, very fine-to-clay-sized grains that appeared to be volcanic tephra. Roughly 27000 years ago, Taupo volcano on the North Island erupted in what is called the Oruanui eruption (Campbell 1986, Wilson 2001). Speculation that this layer in Pa Bay is from the eruption led to this project to confirm whether the layer is volcanic ash or not. This project aims to be a stepping-stone towards finding a time-marker in the Pa Bay sediment cliff because identifying time-markers within geological formations is key to creating the best picture possible for Earth’s history.

Methods
In order to study the Pa Bay sediments we had to go to the cliff face itself. A sample of the tephra layer within the cliff was taken in February 2016. Samples of the tephra were carefully excavated from the cliff face using a scraper. Samples from above and below the layer were also taken, though they did not end up being used. The four samples were brought back to University of Canterbury the same day. Before doing anything to the tephra sample, a preliminary description was done using a microscope. Then the sample was sieved through >350µm, >250µm, >180µm, >125µm, >63µm, and <63µm to assess the size distribution of grains within the layer.

For processing, we first sieved a different sample of the tephra layer that had not been previously sieved through a 1mm grate in order to use only the <1mm grains. We needed the glass shards from the tephra to look at under a microscope and send for geochemical testing for comparison against the composition of the Oruanui tephra. Rhyolite shards have a specific gravity of 2.4-2.6g, so we filtered to grains in heavy liquid of density 2.50 g/mL to separate rhyolite shards from the ash (EduMine). Continuing on with the samples denser than 2.50 g/mL (the sink), we then used heavy liquid of density 2.13g/mL to filter out the lighter grains (the float). The float was rinsed of heavy liquid using a centrifuge. After 3 rinsings the float was ready to go on glass slides. Thus the grains between 2.13-- 2.50g were pipetted onto slides and dried on a hot plate. Under the microscope it was seen that we successfully separated the glass shards from other grains in the ash layer (Fig 3). Time constraints prevented us from being able to send samples in for geochemical testing.

Results
Pa Bay cliff:
In the cliff itself the tephra layer was very distinct from the rest of the cliff. The tephra was more resistant than the surrounding loess and was grey/white where the loess was brown/tan. The
tephra stood out also because of how thin it was (2-8cm) compared to the larger bed packages in the cliff. There were also possible accretionary lapilli in ash layer, which are indicative of volcanic origin (Figure 1) (Self and Healy 1987). The samples did not survive transit from Pa Bay to University of Canterbury however, so we were unable to fully verify that was what they were.

Undisturbed sample:
The preliminary assessment of the tephra sample showed large glass shards among smaller grains of “tephric loess” (Vucetich and Howorth 1976). Initial sieving showed that a majority (insert percentage here) of the tephra was clay-sized, which is consistent with what is expected from volcanic tephras that travel long distances; smaller grains are light enough to fly further from volcanoes.

Microscope:
Microscopic glass was found in the sample (Fig 2). The abundance of glass grains found matches Campbell et al’s (1986) description of Oruanui tephra (also known as Kawakawa tephra):

“The volcanic glass forming Kawakawa Tephra typically has shards that are translucent, thin, curved, elongated, and often striated and vesicular. Confirmation that a layer is in fact tephra is easily made by microscopic examination of a disaggregated and washed sample to show the presence of the abundant and characteristic glass particles”.

The presence of microscopic glass, as well as glass visible through a hand lens throughout the sample further proves the layer is volcanic.

**Conclusion/Further research**
The layer found within the Pa Bay cliff face is volcanic tephra as defined by Campbell et al (1986) and based off of observations made on the samples we collected. There is also strong reason to believe that this tephra is from the Oruanui eruption that happened 26.5 ka (Campbell et al 1986, Wilson 2001). The Oruanui eruption is the youngest recorded eruption of Taupo volcano that had a wide enough ashfall deposit to make it as far South as Banks Peninsula and beyond (Vandergoes 2013) (Fig 3). Thus, future research should include running geochemical tests on the rhyolite samples we have from Pa Bay for comparison against Oruanui tephra. There will then be a time-marker in the cliff once the tephra layer is confirmed to be from the Oruanui eruption.
Figures

**Figure 1:** Possible accretionary lapilli

**Figure 2:** Photo taken from petrographic microscope at 100x magnification. Glass shards of various sizes are seen here.

**Figure 3:** Vandergoes et al. (2013) made this figure showing distributions of Oruanui tephra across New Zealand. The small numbers indicate locations Oruanui tephra has been found in both the North and South islands.
Figure 4: Cliff face at Pa Bay (7.4). Tephra layer is outlined in black lines.

Figure 5: Close up of cliff face at Pa Bay. Layer is outlined in black.
References


