A multiproxy approach to identify the Tambora volcanic fallout in 1810s from the Styx glacier in Victoria Land, Antarctica

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Background

A large explosive eruptions from equatorial region such as 1815 AD Tambora eruption, are able to spread volcanic signals all over the world. The fallout of volcanic products in ice core has offered useful time markers for reducing the uncertainty of the depth-age scale.

In case of glacier in Victoria Land, there is the major active volcanoes and hence prone to influence of regional volcanic activities. Therefore, in order to specify a specific volcanic record as a time marker, it is necessary to separate it from a regional volcanic signals.

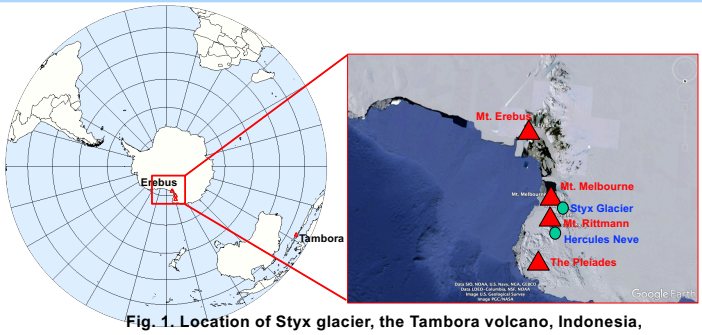

Fig. 1. Location of Styx glacier, the Tambora volcano, Indonesia, and some Antarctic volcanoes.

Here, we report Lead isotope ratios ($^{206}Pb/^{207}Pb$ and $^{208}Pb/^{207}Pb$) and concentrations of thallium (Tl) and major ions in a shallow ice core from the Styx Glacier (73°51 S, 163°41 E) in the Victoria Land, Antarctica, and analyzed for discriminating volcanic products of the 1815 AD Tambora eruption, Indonesia from local volcanic inputs.

Lead isotope ratios ($^{206}Pb/^{207}Pb$ and $^{208}Pb/^{207}Pb$) of volcanic vent ice samples from Mt. Rittmann are also reported here to evaluate outgassing from local volcano.

Materials and methods

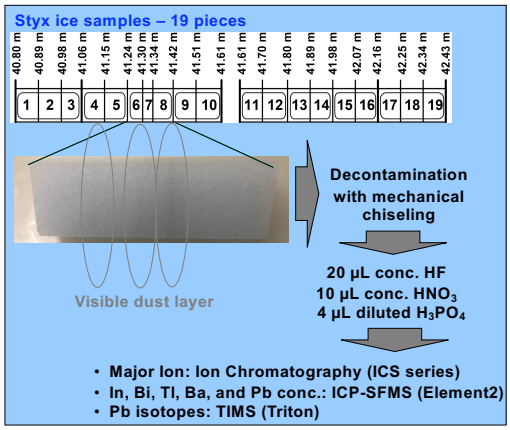

Fig. 2. Schematic diagram of measuring Styx ice samples.

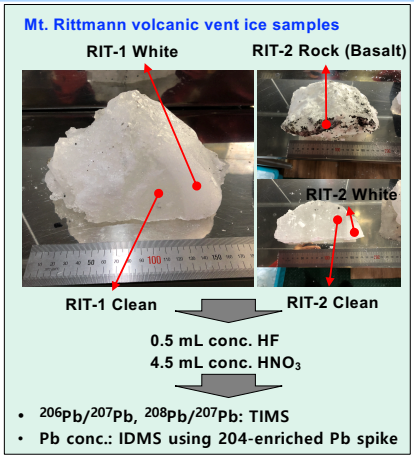

Fig. 3. Schematic diagram of measuring volcanic vent ice samples from Mt. Rittmann

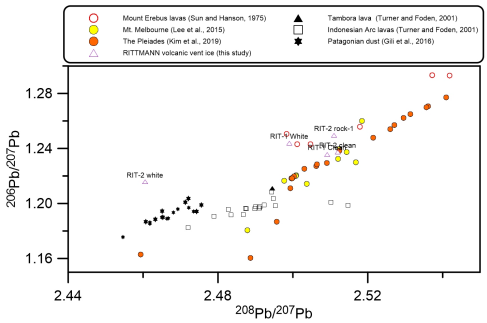

Fig. 4. $^{206}Pb/^{207}Pb$ vs $^{208}Pb/^{207}Pb$ isotope ratios measured in Mt. Rittmann volcanic vent ice. Also shown are Pb isotope ratios for relevant source areas. Lead isotope ratios of the volcanic vent ice samples are similar to those of Mt. Erebus and local volcanoes.

Results and discussion

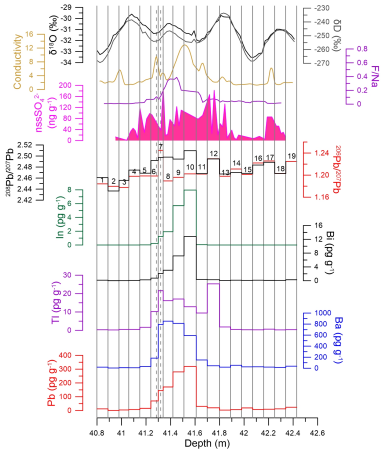

Fig. 5. Profiles of chemical species of Styx ice depths between 40.08 and 42.43 m.

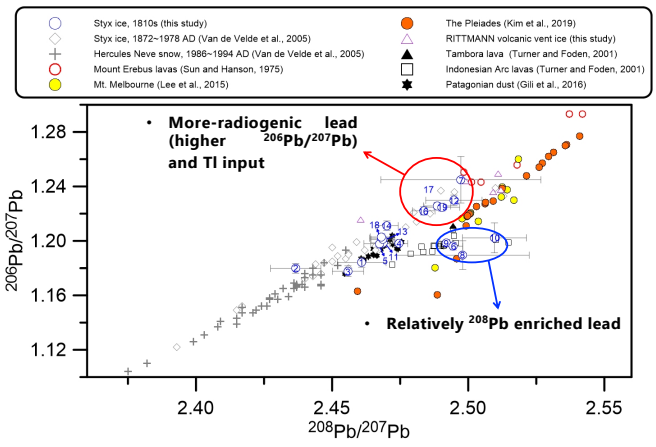

Fig. 6. $^{206}Pb/^{207}Pb$ vs $^{208}Pb/^{207}Pb$ isotope ratios measured in Styx ice with those of PSA samples

- The results show that the increases of volcanic SO_4^{2-} input are accompanied by either (1) input of Mt. Erebus-like more-radiogenic lead (higher $^{206}Pb/^{207}Pb$) and Tl or (2) Indonesian volcano-like relatively ^{208}Pb enriched lead.
- Lead isotope ratios in samples corresponding to the main volcanic event are similar to those of Indonesian volcanoes.
- More radiogenic Pb isotope signals are associated with emission from quiescent and explosive local volcanism .
- These results suggest that the Tambora volcanic input is overprinted by local volcanic aerosol input and that the isotope-based assessment of the Pb sources can help to discriminate between remote and local components of the volcanic input signals recorded in Victoria Land glaciers.

References

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