Dating of 30m ice cores drilled by Japanese Antarctic Research Expedition and environmental change study

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1. Introduction

It is possible to reveal the past climate and environmental change from the ice core drilled in polar ice sheet and glaciers. The 54th Japanese Antarctic Research Expedition conducted several shallow core drillings up to 30 m depth in the inland and coastal areas of the East Antarctic ice sheet. Ice core sample was cut out at a thickness of about 5 cm in the cold room of the National Institute of Polar Research, and analyzed ion, water isotope, dust and so one. We also conducted dielectric profile measurement (DEP measurement). The age as a key layer of large-scale volcanic explosion was based on Sigl et al. (Nature Climate Change, 2014).

2. Inland ice core

Ice cores were collected at the NDF site (77º47'14"S, 39º03'34"E, 3754 m.a.s.l.) and S80 site (80º00'00"S, 40º30'04"E, 3622 m.a.s.l.). Dating of ice core was done as follows. Calculate water equivalent from core density. Accumulate water equivalent from the surface. Approximate the relation of depth - cumulative water equivalent by a quartic equation. We determined the key layer with nssSO42 - peak corresponding to several large volcanic explosions. The accumulation rate was kept constant between the key layers. As a result, NDF was estimated to be around 1360 AD and S80 was estimated to be around 1400 AD in the deepest ice core. We also looked at the data of past inland ice cores (DFS1997 and DF2001).

3. Coastal ice core

An ice core was collected at coastal H15 sites (69º04'10"S, 40º44'51"E, 1030 m.a.s.l.). Dating of ice core was done as follows. Calculate water equivalent from ice core density. Accumulate water equivalent from the surface. Approximate the relation of depth - cumulative water equivalent by a quartic equation. Basically we decided to summer (December) and winter (June) due to the seasonal change of the water isotope (δD or δ18O). In addition to the seasonal change of isotope, confirm the following. Maximum of SO42- / Na +, which is earlier in time than the maximum of water isotope. Maximum of MSA at about the same time as the maximum of the water isotope. Na+ is maximal immediately after the local maximum of the water isotope. The deepest age was estimated to be around 1940 AD.

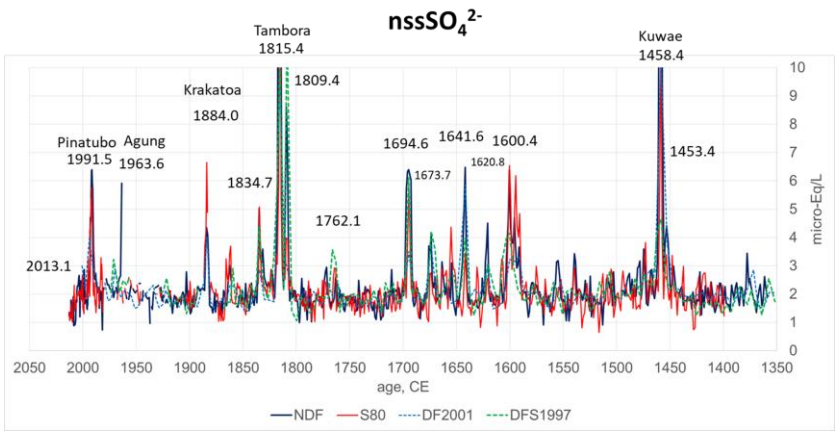

Fig.1. $nssSO_4^{2-}$ fluctuations and reference volcanic eruptions in ice cores at four inland sites.

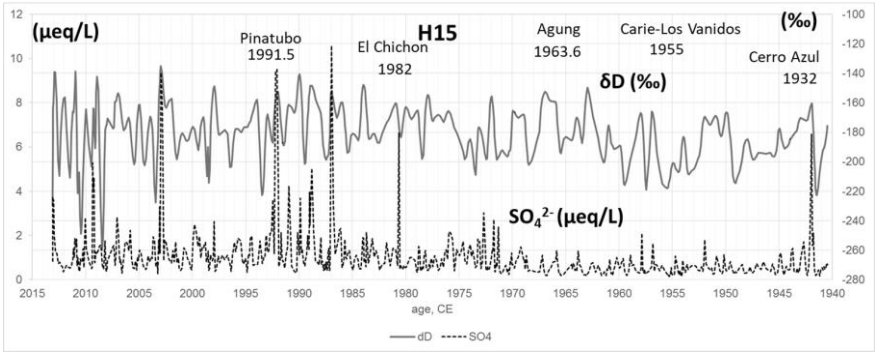

Fig.2. SO_4^{2-} and δ D fluctuations in ice core at coastal H15 site.

4. Example of results

In the inland area, the annual average surface mass balance decreased from 1450 to 1850 AD, but it has increased since 1850 AD. The annual mass balance of coastal H15 is consistent with the result of snow stake measurement.