

【Grant-in-Aid for Scientific Research(S)】

Integrated Science and Innovative Science (New multidisciplinary fields)



Title of Project : Warming events and their impacts during the past 150,000 years viewed from Greenland ice

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Research Area : New multidisciplinary fields

Keyword : Global warming

【Purpose and Background of the Research】

To improve the projection of future Arctic climate and environment changes associated with global warming, including retreat of Greenland ice sheet, advancement in ice sheet and climate modeling is required. For this goal, long-term records of the past Arctic warmings and their impacts, and the understanding of the mechanisms are necessary. An international ice coring project NEEM (North Greenland Eemian Ice Drilling) was initiated to obtain the oldest ice core in the northern hemisphere, covering the last interglacial period Eemian, which is thought to be 3-5 °C warmer than today.

Under the NEEM project, we aim at reconstructing the climatic and environmental changes during the last interglacial (Eemian), early Holocene, and the abrupt climate changes in the last glacial period (DO events). Based on an accurate chronology, relative timing of changes in Greenland air temperature, greenhouse gases, sea level, global ocean temperature, Antarctic temperature and orbital parameters will be investigated. Results of this project will shed light on the mechanisms of climate and ice sheet changes, and also provide important data for improving climate and ice sheet models.

【Research Methods】

The NEEM ice core will be analyzed to reconstruct the climate and environment during early Holocene warming, abrupt warming events in the last glacial period, and entire Eemian with unprecedentedly high time-resolutions. An accurate chronology will be produced by O₂/N₂ ratio measurements. Xe and Kr in extracted air will be analyzed to reconstruct mean ocean temperature. Microscopic and DNA analyses of microbes, analysis of air content, and analyses of ions using a continuous flow analysis system and ion chromatographs will be also carried out to investigate changes of Greenland ice sheet, vegetation, sea ice, mineral dust, and atmospheric circulation. These data will be analyzed along with other data including

greenhouse gases and stable water isotopes, which will be obtained by the Japanese and international collaborators.

【Expected Research Achievements and Scientific Significance】

The accurate chronology determined by O₂/N₂ ratio measurements will be able to constrain the relative timing of changes in Greenland air temperature, greenhouse gases, sea level, Antarctic air temperature, global mean ocean temperature, and orbital parameters. The results will provide new insights into the mechanisms of glacial cycles. The data will also contribute to evaluate the impacts of warmings, such as glacial terminations and DO events, on global ocean temperature, ice sheet retreat, vegetation, sea ice, aridity in Asian deserts, and atmospheric circulation. The project will also produce valuable data to test and improve climate and ice sheet models.

【Publications Relevant to the Project】

- Steffensen, J.P, K.K. Andersen, M. Bigler, H.B. Clausen, D. Dahl-Jensen, H. Fischer, K. Goto-Azuma and 13 others, High resolution Greenland ice core data show abrupt climate change happens in few years, *Science*, 321, 680, DOI:10.1126/science.1157707, 2008.
- Kawamura, K. et al. Northern Hemisphere forcing of climatic cycles in Antarctica over the past 360,000 years. *Nature*, 448, 912-917, 2007.

【Term of Project】 FY2010-2014

【Budget Allocation】 168, 100 Thousand Yen

【Homepage Address and Other Contact Information】

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