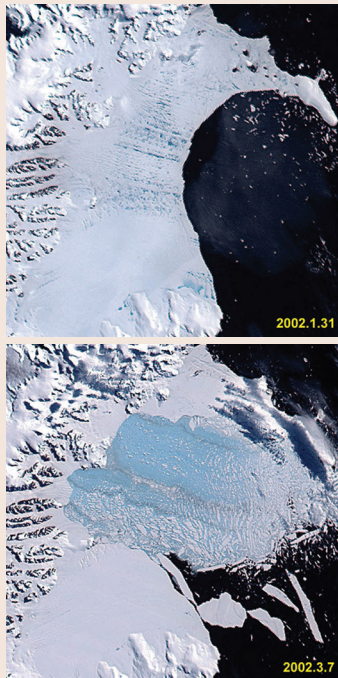


Research
Background
and
Importance

° Marine-based Western Antarctic Ice Sheet is vulnerable to global warming and subsequent sea level rise, and retreat of the West Antarctic Ice Sheet can accelerate global sea level rise and climate change. Recent disintegration and collapse of ice shelves in West Antarctica has drawn much attention because ice shelves buttress ice sheets.

This project is establishing an monitoring system for ice shelf movements and environmental changes of the ice shelf system in West Antarctica. We also reconstruct the past environmental changes caused by past climatic warming in the ice shelf area to understand the mechanism of ice shelf stability and impact of ice shelf collapse on environment.



Collapse of Larsen B ice shelf in March 2002 (MODIS satellite image)



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Monitoring
of abrupt
environmental
change in the ice
shelf system and
reconstruction
of Quaternary
deglaciation
history in West
Antarctica



Polar Climate Change
Research



Polar Earth-System
Sciences



Polar Life Sciences



Polar Ocean Environment



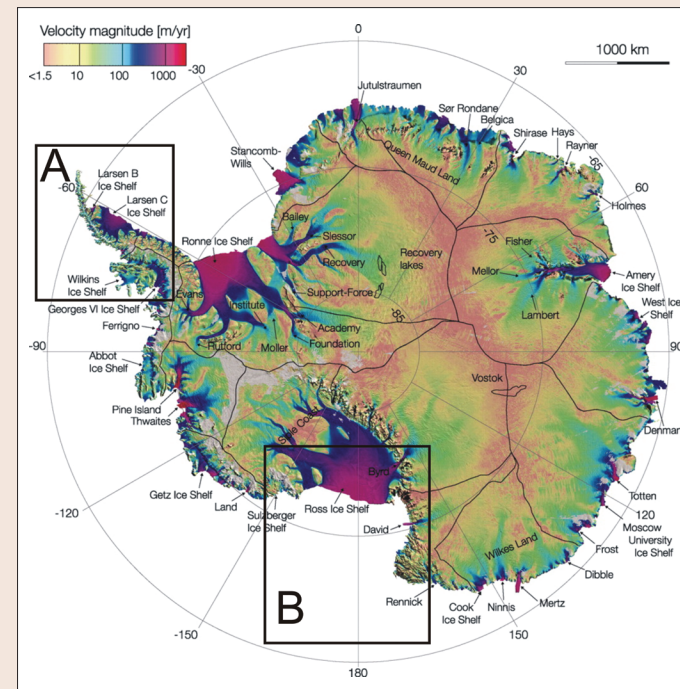
Arctic Research



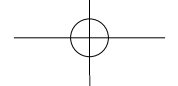
Promotion Program

Division of Polar Climate Change Research

Principle Investigator	Yoon, Ho Il
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Partner Organizations	South Florida Univ (US), NSIDC, Colorado (US), Scripps (US), GNS (NZ), NZARI (NZ), Victoria Univ Wellington (NZ), Korea Univ (Korea), PNU (Korea), SNU (Korea), Yonsei (Korea), Chonbuk (Korea), POSTEC (Korea)
Research Duration	Jan 2014 ~ Dec 2016 (3 yrs)
Research Area	° Antarctic Peninsula region: Larsen ice shelves, northwestern Weddell Sea, fjords of the western Antarctic Peninsula, Southern Ocean and Drake Passage near Antarctic Peninsula ° Ross Sea region: Ross embayment and Southern Ocean of Ross Sea sector



Study area.
(A) Antarctic Peninsula region: Larsen ice shelves, northwestern part of the Weddell Sea, fjords in the western part of the Antarctic Peninsula, Drake Passage, Bransfield Strait.
(B) Ross Sea region: Ross embayment and Ross sector of Southern Ocean (map from Rignot et al., 2011, Science)



Aim and Contents of research

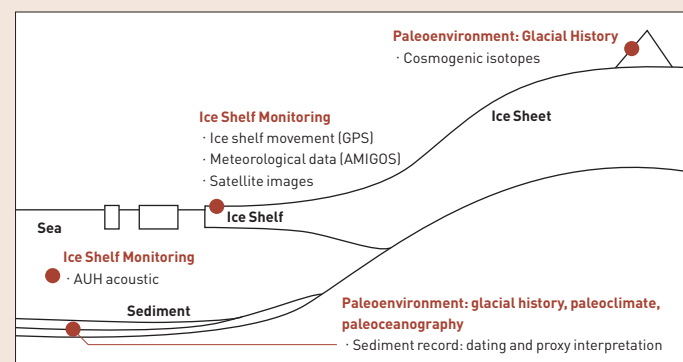
Purpose of the study

- To establish a monitoring system for ice shelf movements
- To reconstruct the environmental changes caused by past climatic warming in the ice shelf area of West Antarctica

Main research contents

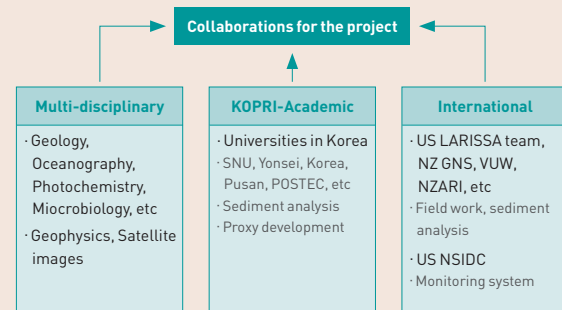
- Establishment of monitoring system (AMIGOS, GPS, seismometer, sediment trap, etc.) of abrupt environmental change of the ice shelf system in West Antarctica
- Reconstruction of the stratigraphic record from prior to the Last Glacial Maximum that reveals about the extent of the ice shelf under climate conditions of the last interglacial (approximately ~125 ka) when global conditions of sea level and average climate were higher and warmer, respectively, than today
- Reconstruction of late Quaternary glacial history and configuration of the West Antarctic Ice Sheet
- Marine biological, geochemical, and photochemical study of the role of meltwater and sea ice in ecosystem and impact of ice shelf collapse on marine ecosystem

Simplified diagram of the research topics/methods in the West Antarctic ice shelf regions.



Research method

Collaborations for the project



Methods

- Field work and sampling (Araon): seismic survey, Multibeam swath bathymetry, sediment coring (long core system, box core, gravity core, etc.), Sediment trap, CTD, etc.
- Monitoring system: GPS, AMIGOS, seismometer, AUH acoustics, remote sensing, etc.
- Paleoclimate reconstruction: sediment coring, radiocarbon age dating, cosmogenic isotope dating, proxies for paleotemperature and paleoproductivity, sediment geochemistry, etc.

Long core system installed on Araon. Ross Sea, Feb 2015.



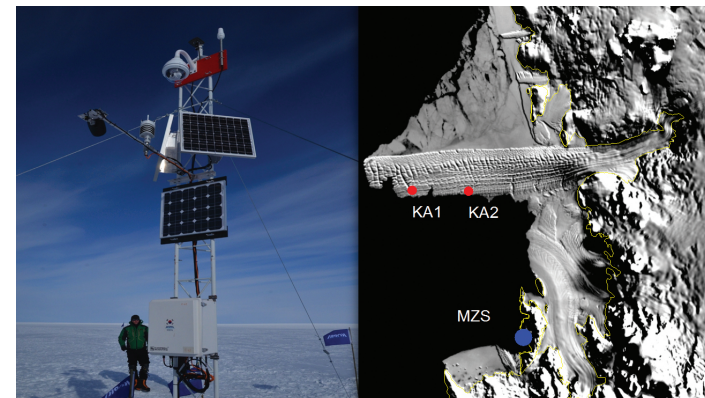
Box coring (left) and gravity coring (right) for collecting marine sediments. Ross Sea, Feb 2015.



Overall Outcomes

◦ Ice shelf monitoring system

- Installation of AMIGOS (Automated Met-Ice-Geophys Observing Stations) systems: Drygalski Ice Tongue, Ross Sea
- Installation of seismometers in Antarctic Peninsula region



AMIGOS system (left) and locations of AMIGOS systems on Drygalski Ice Tongue (right)

◦ Antarctic cruises

- Antarctic Peninsula and Weddell Sea (Korea, US): Nathaniel B. Palmer (2010, 2012), Araon (2013)
- Ross Sea (Korea, New Zealand, US): Araon (2015)

◦ Analysis of sediment core from Larsen C ice shelf region

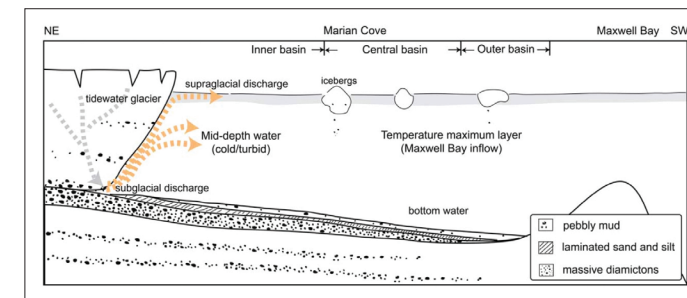
- Preservation of well-developed laminations in sub-ice shelf environment
- New marine geological analogue of sedimentation during the snowball earth period

◦ Evidence for Little Ice Age based on sediments from western Antarctic Peninsula

◦ Experimental evidence for the role of photochemical reaction of iron in ice on marine productivity

◦ Evidence for glacial-interglacial variations of Weddell Sea-originated deep water in Drake Passage

◦ Sedimentation model for Marian Cove, Antarctic Peninsula



Schematic diagram of water structures and glacial meltwater discharges in Marian Cove, Antarctica (Yoo et al., 2014, Antarctic Science)

Future Plans and Application

- Establishment of ice shelf-monitoring system and assessment of the stability of the West Antarctic ice shelves will help to predict the future deglaciation trend of the West Antarctic Ice Sheet, which is one of the most serious environmental threat facing mankind.
- Reconstruction of past environmental changes caused by climate warming will help to predict environmental impacts in response to future climate warming.
- Paleoclimate studies will help to improve paleoclimate proxies by applying them to ice shelf-proximal sediment samples which are less well studied than sediments from other regions in high latitudes.
- International collaboration with countries of more experience in polar marine cruises will be advantageous to the polar research activities of Korea.
- Further development of this project will be able to provide scientific information to policy makers of the impact of climate change on environment.
- Research activities and research conclusions can give a valuable information in science education and public outreach programs.