

# ANALYSIS OF DIATOM ASSEMBLAGES IN SEDIMENTS FROM THE AMUNDSEN SEA, ANTARCTICA

Lorena Rebolledo<sup>1</sup>, So-Young Kim<sup>2\*</sup>, Dhong-Il Lim<sup>3</sup>, Sang-Hoon Lee<sup>2</sup>



<sup>1</sup>Chilean Antarctic Institute, IDEAL-Center, Punta Arenas, Chile

<sup>2</sup>Division of Polar Ocean Sciences, Korea Polar Research Institute, Incheon, Korea,

<sup>3</sup>Library of Marine Samples, Korea Institute of Ocean Science and Technology, Geoje, Korea



## Introduction

The Amundsen Sea Polynyas, located off the Western Antarctic Peninsula is the most productive region (per unit area) in the Antarctic. In the Southern Ocean where carbonate preservation is scarce, sedimentary marine diatom records have shown a good proxy potential to provide insight on environmental and oceanographic changes. Here, we present temporal variabilities in diatom assemblages and geochemical properties in a sediment core ANA08B-33 in order to examine their capability to record oceanographic changes in the western Antarctic polynya environment.

## Results

Age constrains for core ANA08B-33 based on “bulk-sediment” AMS-<sup>14</sup>C dating has been previously described in Kim et al. 2016 (Core B; a linear sedimentation rates of 13 cm/yr). Figure 2 shows downcore variations in diatom counts and contents of opal, TOC and TN as well as considerable changes in the main ecological diatom assemblages preserved in core ANA08B-33. Overall, diatom abundance and opal contents show a good relationship ( $R^2=0.75$ ,  $n=12$ ,  $p<0.01$ ). Major diatom assemblages are sea-ice related group (Group C) and nutrient-enriched water group (Ch. resting spores; Group A). A distinctive feature can be identified in core ANA08B-33 in terms of a significant transition in the marine sea-ice proxy (*F. curta* + *F. cylindrus*/*F. kerguelensis*); characterized by lower values below 24cm (before ca. 1850 years BP) and a two-fold higher values above 20cm (after ca. 1540 years BP), corresponding well with geochemical proxy variations.

## Materials and methods

Biogeochemical properties including opal, total organic carbon and total nitrogen were measured in Korean Polar research Institute (KOPRI) and Library of Marine Samples (LIMS). Siliceous microfossil analysis was carried out at Chilean Antarctic Institute (INACH), Chile. Permanent slides were mounted on Norland optical adhesive and cure on UV-lamp. Slides were counted with an optical microscope (Carl Zeiss, Germany) at 1000× magnification. The diatom assemblages can be classified into five ecological groups: nutrient-enriched water assemblage (Group A), open water assemblage (Group B) and sea-ice related assemblage (Group C), with a minor contribution (< 1%) of marine benthic assemblage (Group D) and stratified water assemblage (Group E), according to Campagne et al., (2016).

### Sampling site

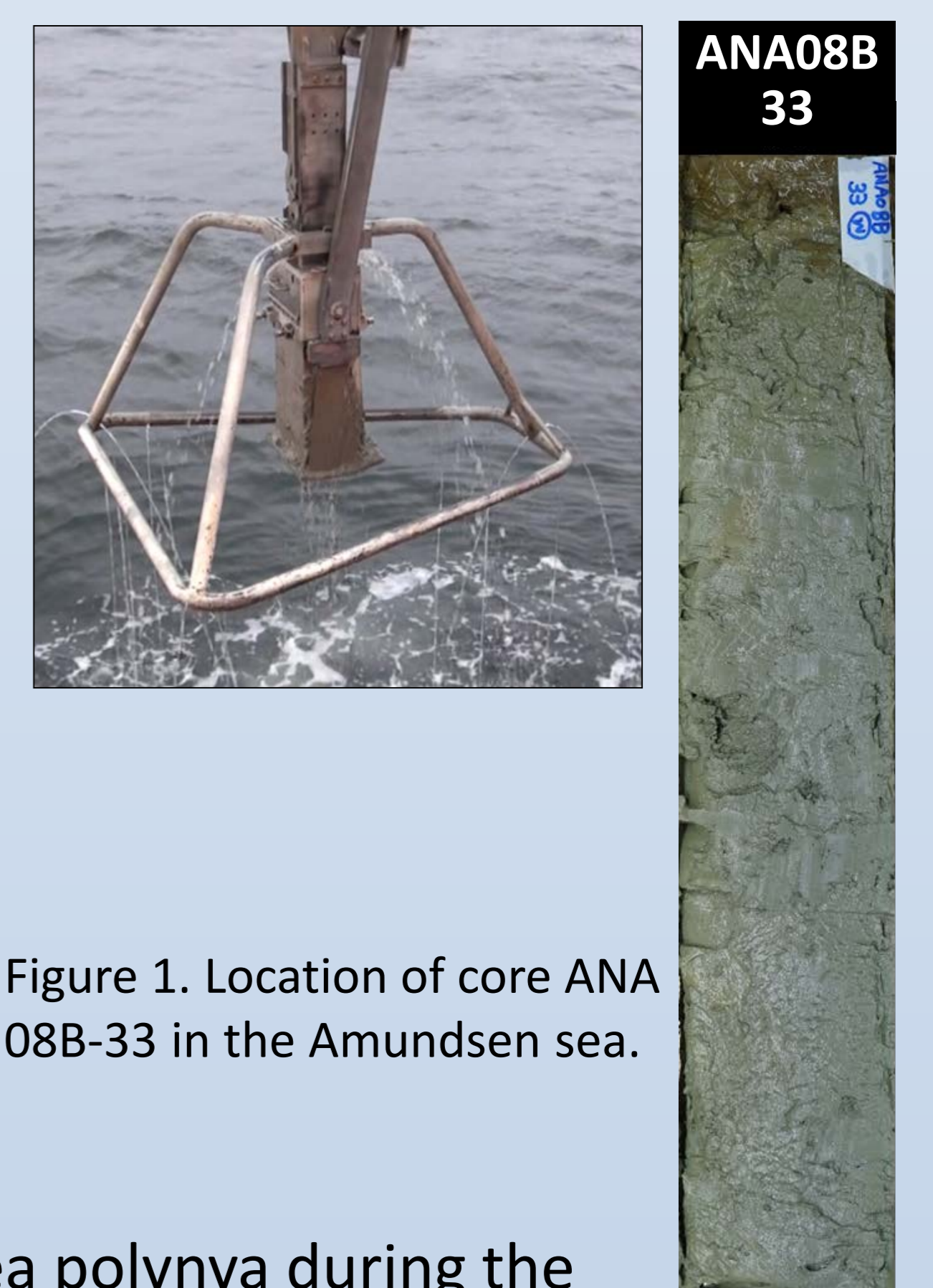
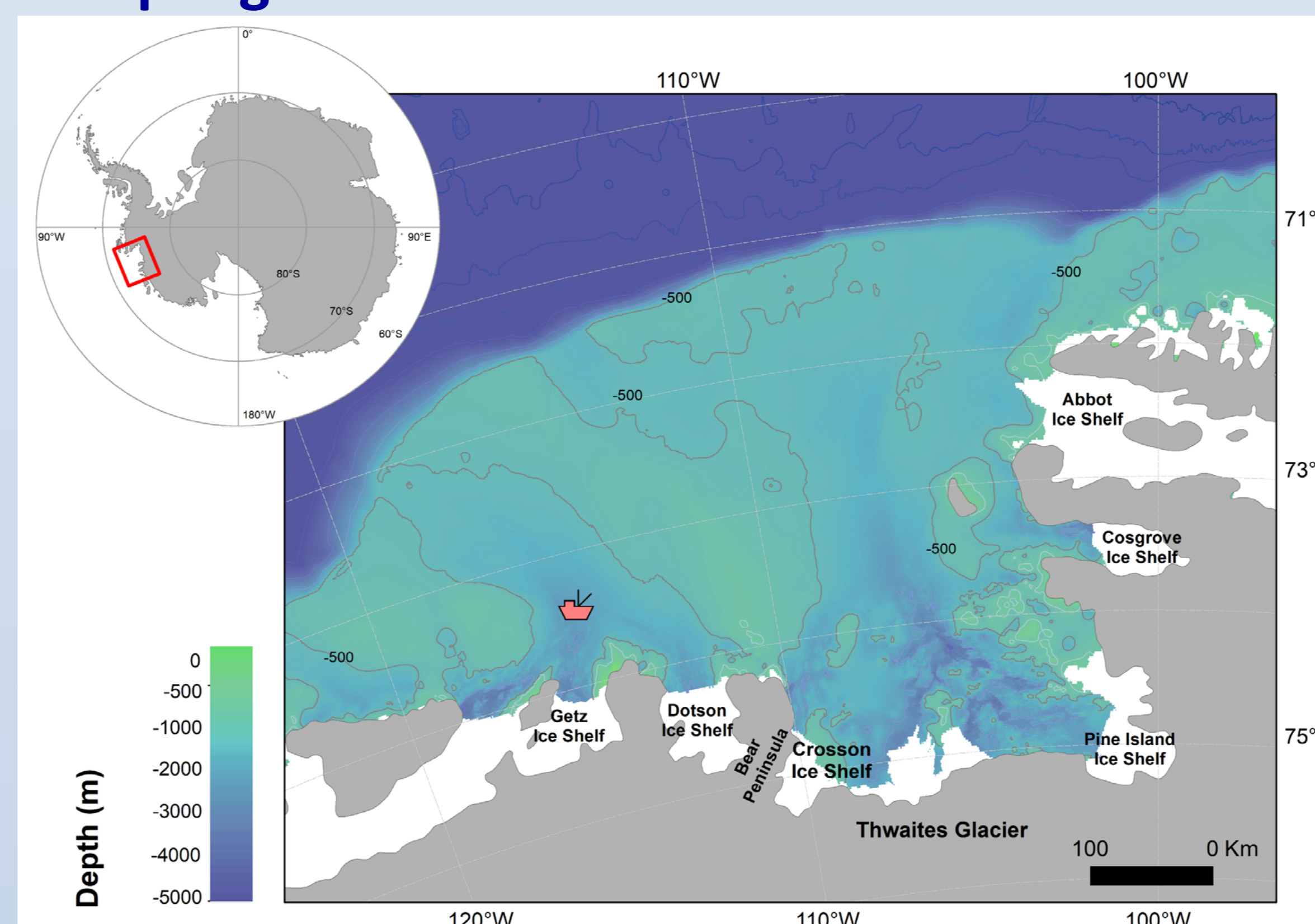


Figure 1. Location of core ANA08B-33 in the Amundsen sea.

A 38-cm long box core was recovered from the Amundsen Sea polynya during the ANA08B cruise on the Icebreaker ARAON in 2019 (Fig.1; 73°16'46.26"S-114°56'59.64"W, water depth: 827m).

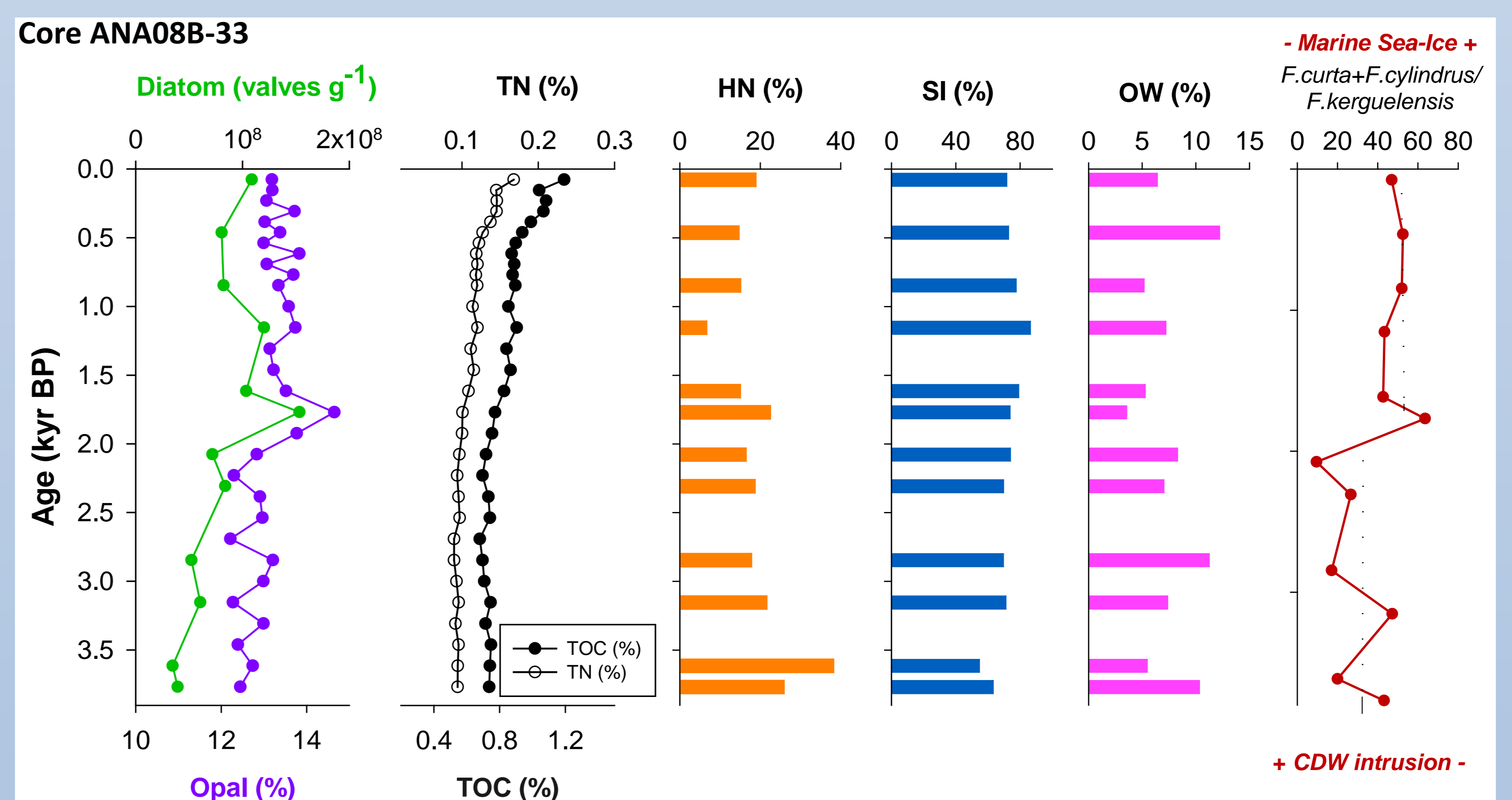


Figure 2. Downcore fluctuations in diatoms (valves  $g^{-1}$ ), opal (%), TN (%) and TOC (%) and ecological diatom assemblages: high nutrient (orange), sea-ice related (blue), open water (pink) groups and sea-ice proxy based on the ratio of *F. curta*+ *F. cylindrus*/*F. kerguelensis* (red line).

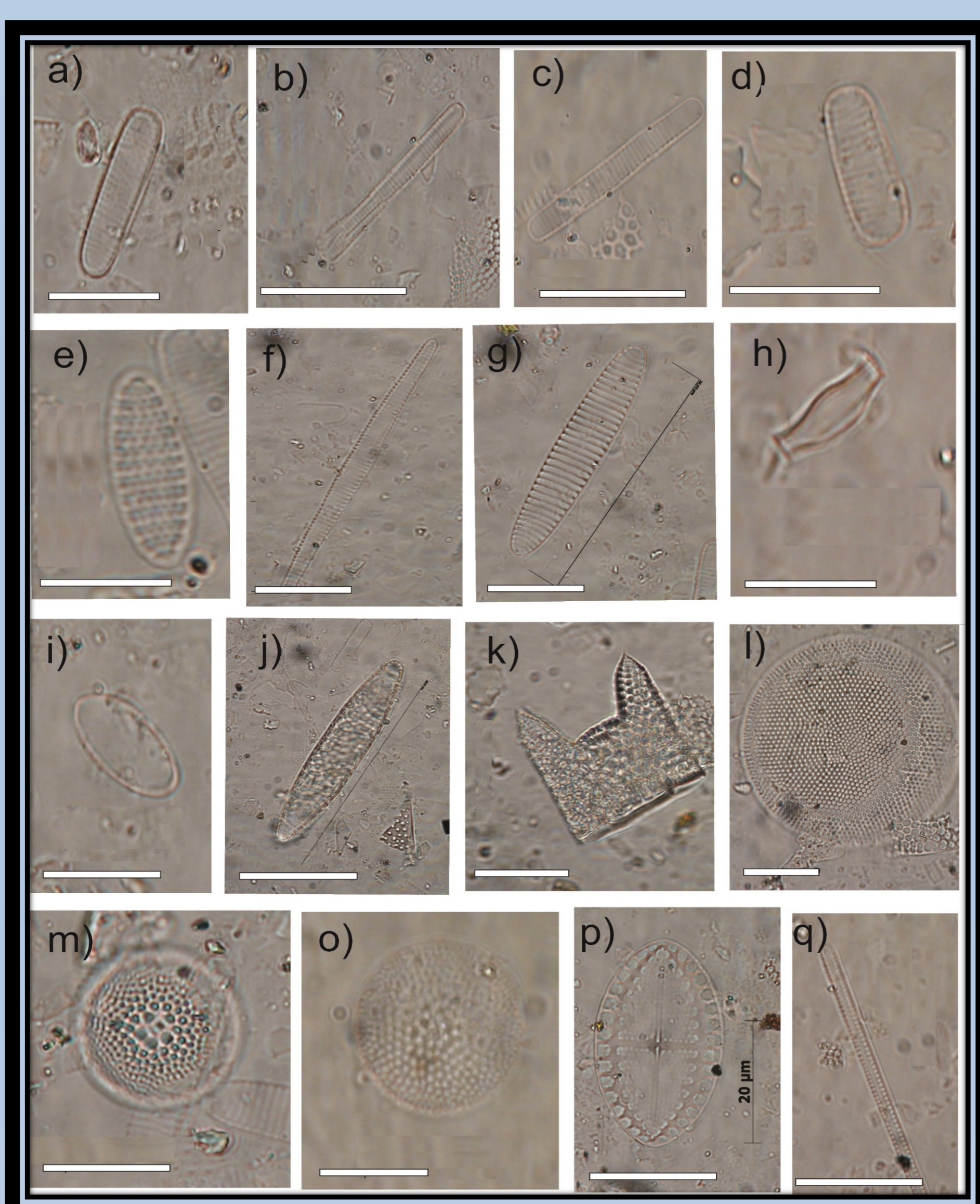


Figure 3. Main diatoms assemblages on core ANA-08B-33, Amundsen Sea where: a) *Fragilariopsis curta*, b) *F. cylindrus*, c) *F. vanheurcki*, d) *F. nana*, e) *F. kerguelensis*, f) *F. obliquecostata*, g) *F. ritscheri*, h) *Chaetoceros didymus* resting spore (RS), i) *Ch. sp.* (RS), j) *Eucampia antarctica* var. *recta*, k) *Eucampia antarctica* var. *recta*, terminal, l) *Thalassiosira tumida*, m) *Th. gracilis* var. *gracilis*, o) *Th. antarctica* morphotype (T1, cold), p) *Cocconeis costata* var. *costata*, q) *Trichotoxon reinboldii*. The scale are in 10  $\mu m$  in: a), d), e), h), i), n), o) and 20  $\mu m$  in: b), c), f), g), j), k), p) and q).

## Conclusions

- Diatoms are a major component of siliceous microfossil assemblages in core ANA-08-33 (up to 98%).
- The sea ice-related diatom assemblage (Group C) was the most dominant ecological group. A prominent increase in the ratio of *F. curta*+*F. cylindrus*/*F. kerguelensis* after ca. 1.7 kyrs suggest an apparent oceanographic change in the Amundsen Sea, tentatively associated with extension of polynya environments forced by changes in an ocean current regime (e.g. the Circumpolar Deep Water).

## References

- Campagne, P., Crosta, X., Schmidt, S., Noëlle-Houssais, M., Ther, O., Massé, G 2016. Sedimentary response to sea ice and atmospheric variability over the instrumental period off Adélie Land, East Antarctica. *Biogeosciences* 13: 4205-4218.
- Kim, M., Hwang, J., Lee, S.H., Kim, H.J., Kim, D., Jang, E.J., Lee, S., 2016. Sedimentation of particulate organic carbon on Amundsen Shelf, Antarctica. *Deep-Sea Research II* 123:135-144.

## Acknowledgements

This research is supported by the Korea Polar Research Institute research program (PE19060), INACH Program (240305) and IDEAL-Center.

# ANALYSIS OF DIATOM ASSEMBLAGES IN SEDIMENTS FROM THE AMUNDSEN SEA, ANTARCTICA

So-Young Kim

Lorena Rebolledo<sup>1</sup>, So-Young Kim<sup>2\*</sup>, Dhong-Il Lim<sup>3</sup>, Sang-Hoon Lee<sup>2</sup>

<sup>1</sup>Chilean Antarctic Institute, IDEAL-Center, Punta Arenas, Chile

<sup>2</sup>Division of Polar Ocean Sciences, Korea Polar Research Institute, Incheon, Korea

<sup>3</sup>Library of Marine Samples, Korea Institute of Ocean Science and Technology, Geoje, Korea

[kimsy@kopri.re.kr](mailto:kimsy@kopri.re.kr)

## ABSTRACT

The Amundsen Sea Polynyas, located off the western Antarctica Peninsula is the most productive region (per unit area) in the Antarctic. Here, we present temporal variabilities in diatom assemblages and geochemical properties in a sediment core ANA08B-33 in order to examine their capability to record oceanographic changes in the western Antarctic polynya environments. A 38-cm long box core was recovered from the Amundsen Sea polynya during the ANA08B cruise on the Icebreaker *ARAON* in 2019 (73°16'46.26"S-114°56'59.64"W, water depth: 827m). Overall, the siliceous microfossil assemblages in core ANA08B-33 consisted mainly of diatoms (97%), followed by silicoflagellates (2%), with a minor contribution and sponge spicules and radiolarians. The diatom concentrations (valves g<sup>-1</sup>) and opal contents (%) show a strong positive relationship ( $R^2=0.74$ ,  $n=12$ ,  $p<0.01$ ). The diatom assemblages can be classified into five ecological groups: nutrient-enriched water assemblage (Group A), open water assemblage (Group B) and sea-ice related assemblage (Group C), with a minor contribution (< 1%) of marine benthic assemblage (Group D) and stratified water assemblage (Group E). The Group C accounts for 72% (*Fragilariopsis curta*, *F. cylindrus* and *Thalassiosira antarctica* (T1, morphotype of cold waters)), followed by the Group A (*Chaetoceros* resting spores, 19%) and Group B (*F. kerguelensis* and *Thalassiosira tumida*, 8%). A particular note is for a significant transition in the marine sea-ice proxy (*F. curta* + *F. cylindrus*/*F. kerguelensis*) characterized by lower values below 24cm (before ca. 1850 years BP) and a two-fold higher values above 20cm (after ca. 1540 years BP), corresponding well with geochemical proxy variations. These results suggest an apparent oceanographic change in the Amundsen Sea, tentatively associated with extension of polynya environments forced by changes in an ocean current regime (e.g. the Circumpolar Deep Water).