

LATE HOLOCENE PALEOCLIMATIC RECORD OF SEDIMENT NEAR JOINVILLE ISLAND: PRELIMINARY RESULTS

¹Min Kyung Lee, ¹Kyu-Cheul Yoo, ²Young-Suk Bak, ¹Ho Il Yoon

mklee@kopri.re.kr

¹Korea Polar Research Institute, KIOST, Incheon 406-840, KOREA

²Department of Earth and Environmental Sciences, Chonbuk National University, Jeonju 561-756, KOREA



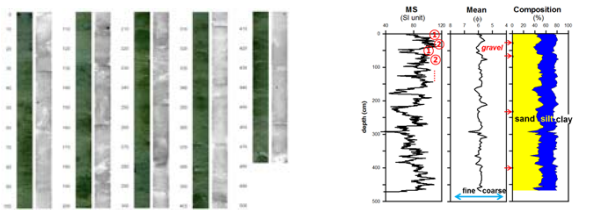
Abstract

A 4.76-m-long sediment core JV10-GC01 covering about 4000 years was collected from the Weddell Sea located near the Joinville Island, the northern tip of the Antarctic Peninsula. Six AMS radiocarbon ages were determined by carbonate shells. No age inversions were observed, implying a lack of reworking during deposition. Sedimentological, geochemical, and micropaleontological parameters were analyzed to reconstruct paleoenvironmental changes. The records of total organic carbon, diatom abundance, diatom assemblage suggest that Neoglacial period was lasted for about 1300 years from 2500 to 1200 yr BP. The onset of Neoglacial in this study is contemporaneous with James Ross Island, Bransfield Basin, and Maxwell Bay. However, the periods of Neoglacial, MWP, LIA are different from the Firth of Tay, although two sites are very close. In this core sediment, about 500 year periodicity of climate cooling is observed since 3000 yr BP. It may be correlative with 550-yr cyclicities in North Atlantic circulation patterns during the Holocene.

Purpose

- To reconstruct paleoenvironmental changes at the northern tip of the Antarctic Peninsula (AP)
- To compare timing of past climate events on both sides of the AP
- To understand climatic forcing mechanisms acting on the AP

Sedimentology



Alternations of

- olive green (OM-rich) layer (low MS value)
- medium to dark gray layer (high MS value)

MS, sand content, mean : (+) correlated

Gravel - insignificant (open ocean)

Introduction

Antarctic Peninsula



Michalchuk et al. (2009)

- the most rapidly warming region
- rising at six times the global mean ($0.6 \pm 0.2 \text{ }^\circ\text{C}$) during the 20th century (Houghton et al., 2001; Vaughan et al., 2003)

long, narrow, snow-capped mountain range
→ barrier to tropospheric & oceanographic circulation

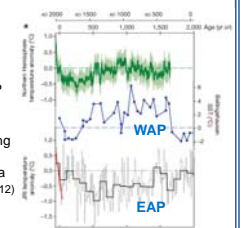
west : warmer maritime conditions
east : colder continental climate

Eastern vs. Western AP

Holocene paleoclimatic changes between the WAP and EAP

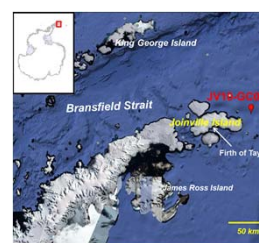
- Diachronous across AP (Bentley et al., 2009)

- Opposite pattern during the Late Holocene by cooling of the Weddell Sea (Mulvaney et al., 2012)



Mulvaney et al. (2012)

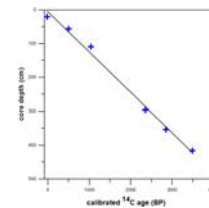
Study area



JV10-GC01
: 4.76 m long core sediment

(63° 7.764' S / 54° 47.076' W)
water depth : ~ 450 m

Age model



six AMS ¹⁴C dates (shell)

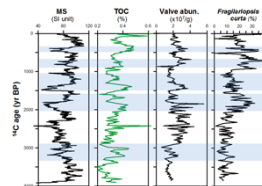
$$X = 8.3 * Y \quad (R^2 = 0.99)$$

4.76 m, ~3900 yr BP

sedimentation rate : 0.12 cm/yr

Paleoclimate & paleoenvironments

Proxies



TOC - diatom abundance
- F. Curta content
: (+) well correlated

MS- TOC
: (-) opposite aspect

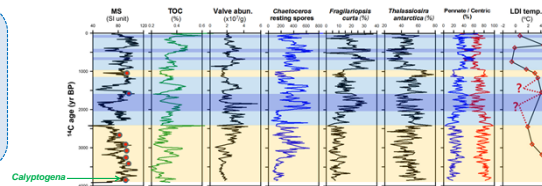
F. Curta : sea ice indicator

High primary productivity in the Weddell Sea in the marginal ice edge environment (Buffen et al., 2007 and references therein)

TOC ↑ (low MS) : relatively cold (high productivity in ice marginal zone)

TOC ↓ (high MS) : relatively warm (TOC diluted terrigenous input)

Reconstruction



LIA : 700, 400, 100 yr BP

MWP : 1100 to 1000 yr BP

Neoglacial : 2500 to 1200 yr BP (seasonal sea-ice)

Warm period : 3900 to 2500 yr BP (open ocean - stratified)

T. Antarctica (47%) - F. curta (14%) : (-) correlated

T. antarctica : warm, open water condition

Chaetoceros resting spores

: high productivity / water stratification (meltwater input)

Pennate (sea-ice) / Centric (warm)

LDI (Long Chain Diol) index (lipids of diatoms of the genus Proboscia)

: available for SST reconstruction (Rampen et al., 2012)



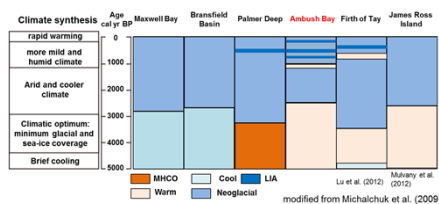
Calyptogena

- mostly occurred before 2500 yr BP

observed in low O₂, high H₂S environment : stratified, stable environment by meltwater input (2400-3500 yr BP)

: consistent with Chaetoceros RS high

Comparison

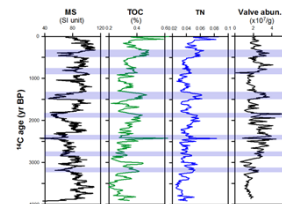


The onset of Neoglacial : coeval with JRI, Maxwell Bay, Bransfield Basin

Comparison with the Firth of Tay (30 km SW) : timing of onset of Neoglacial, MWP, LIA are different

similar conditions in large-scale seawater circulation
local factors : topography, wind patterns, ...

Periodicity



~ 500 yr cycle of cooling

consistent with the 550 yr-cooling near King George Island (Yoon et al. 2010)

correlative with reduced CDW influenced by reduced NADW production (Chapman and Shackleton, 2000)

Summary

Ambush Bay sedimentary record provides high-resolution marine paleoclimate record for recent 4000 yr on the northern tip of AP region.

The onset of Neoglacial period is consistent with other WAP and EAP site, but different from the close site Firth of Tay.

Since about 3000 yr BP, cooling cycles of 500-yr is observed.