➢**EGU2020-6266**

New insights into the latitudinal ventilation variations in the Japan Sea since the Last Glacial Maximum: A radiolarian assemblage perspective

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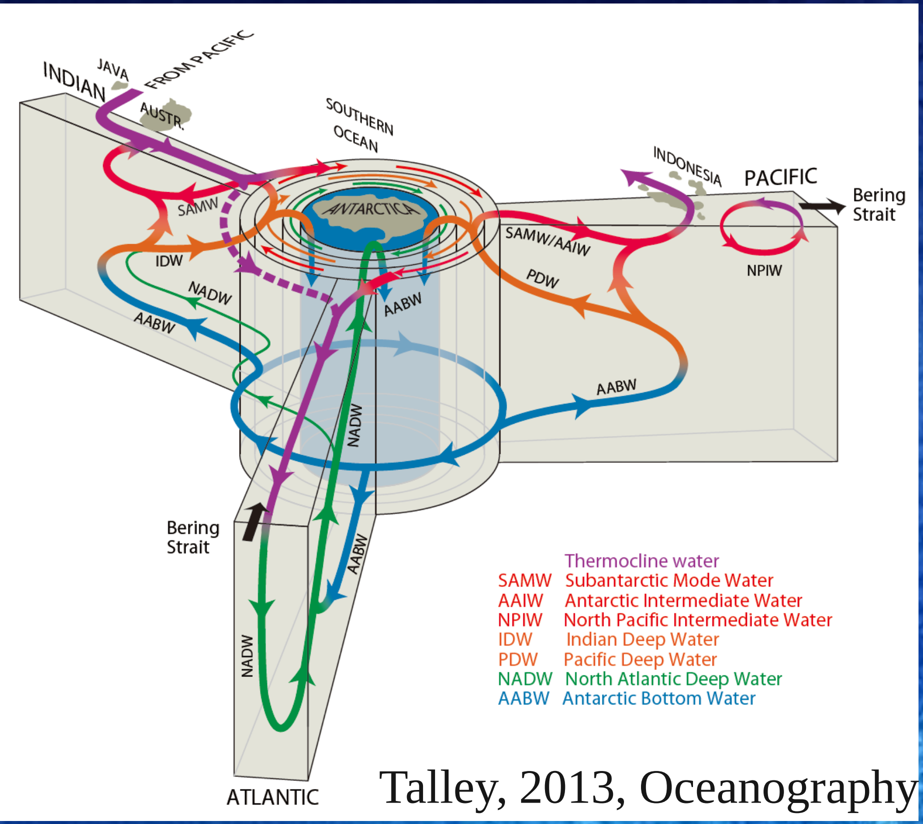
Global Meridional Overturning Circulation (MOC)

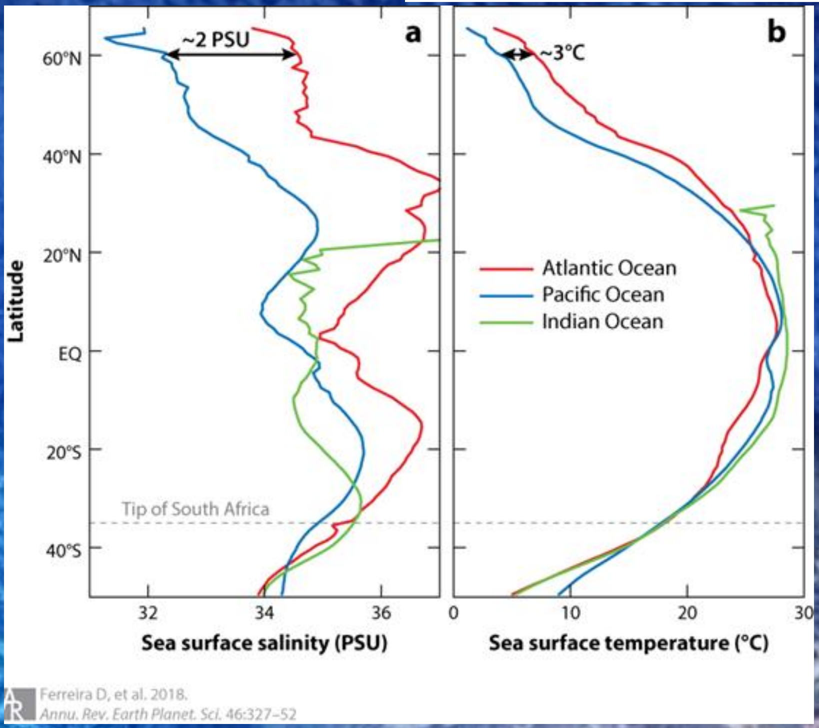


Talley, 2013, Oceanography

Why is no deep water formed in the North Pacific?

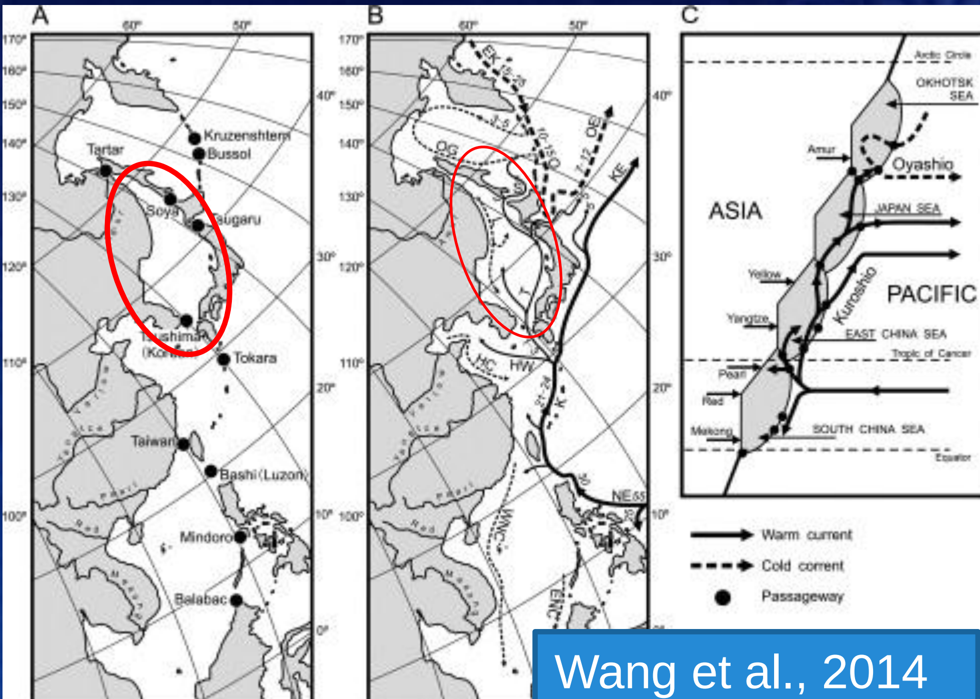
by Bruce A. Warren[1]

Journal of Marine Research, 41, 327-347, 1983

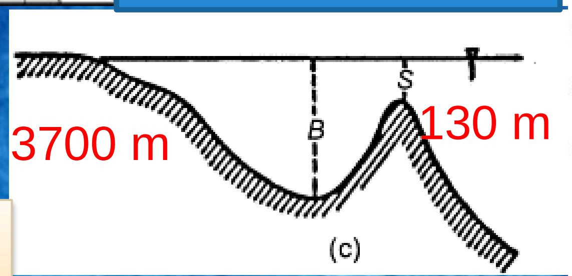


- MOC: vital component of the global climate system
- Regulator of CO_2 exchange between the atmospheric and marine carbon pools
- no deep-water formation in the open North Pacific at present

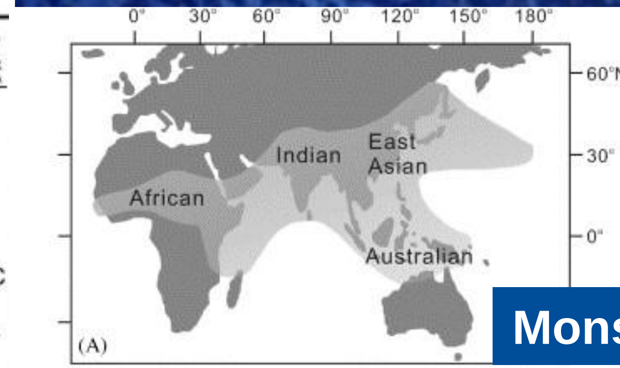
Japan Sea: a typical semi-enclosed marginal sea



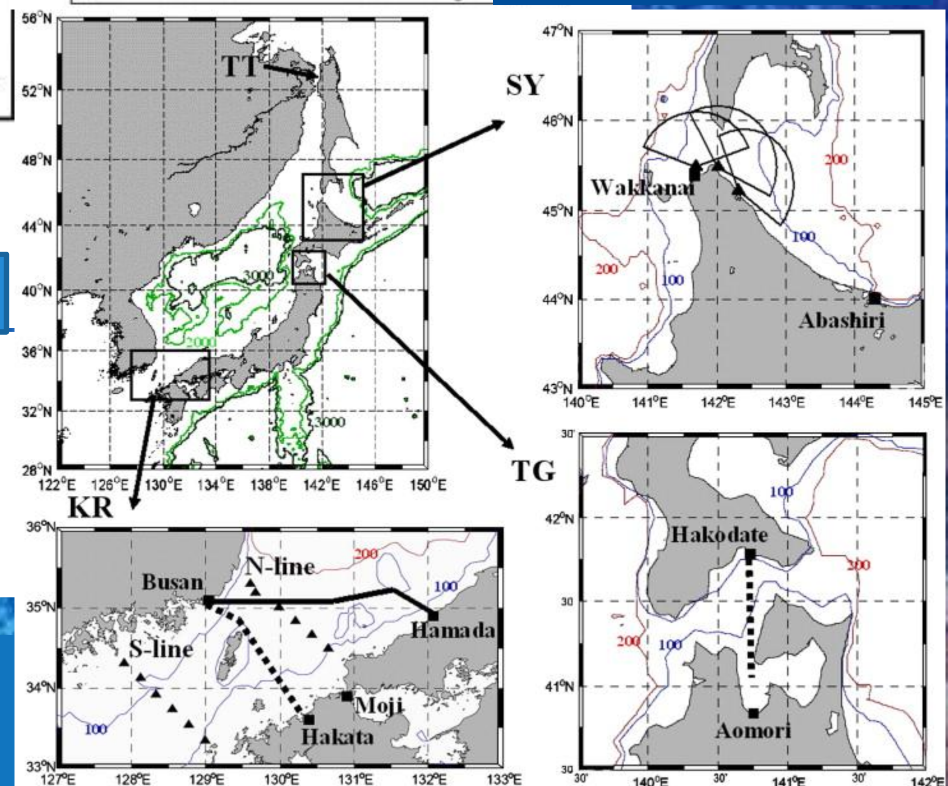
Wang et al., 2014



Japan Sea



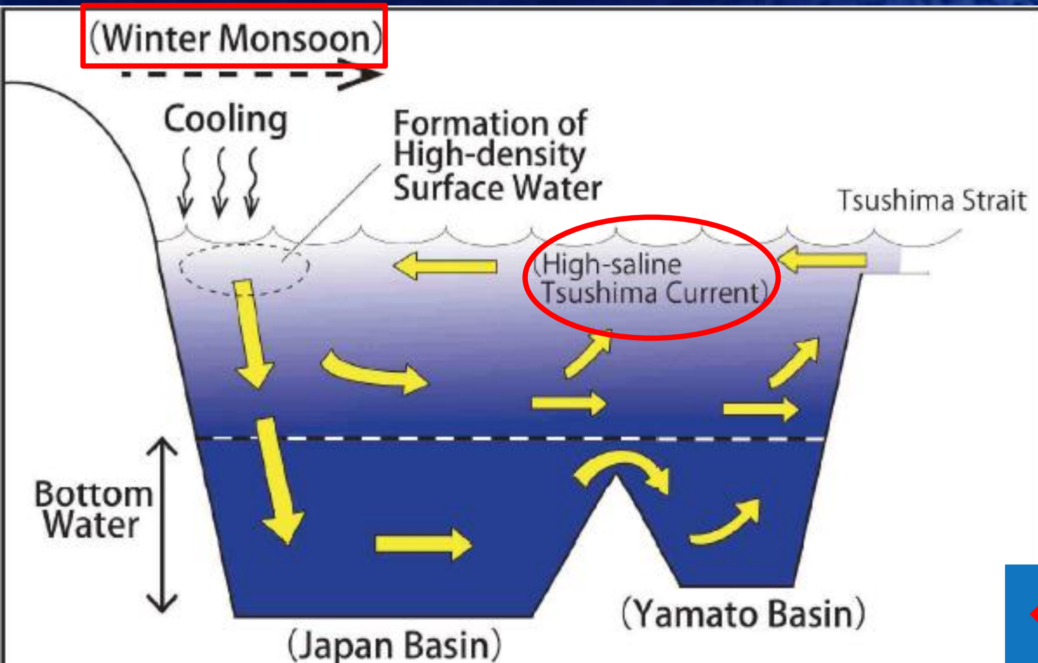
Monsoon System



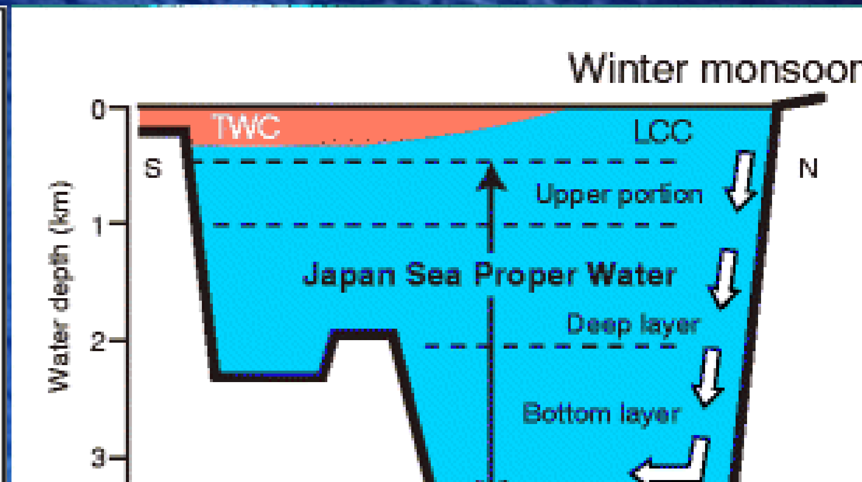
Na et al., 2009 JMS

- Deep basin with shallow straits
- Tsushima Warm Current inflow
- East Asian Monsoon

Japan Sea Proper Water (JSPW)



Gamo et al., 2014



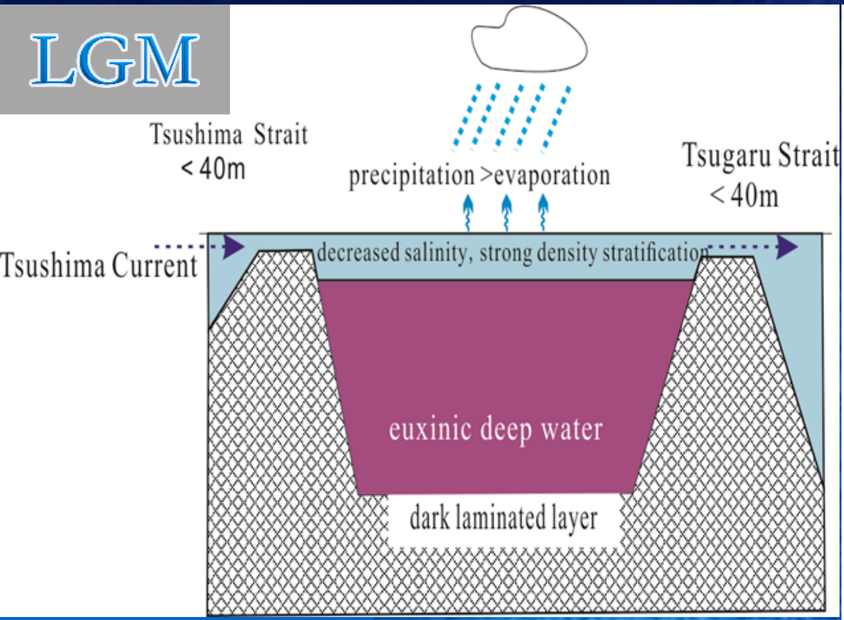
Itaki, 2016

- Surface water density: SST&SSS

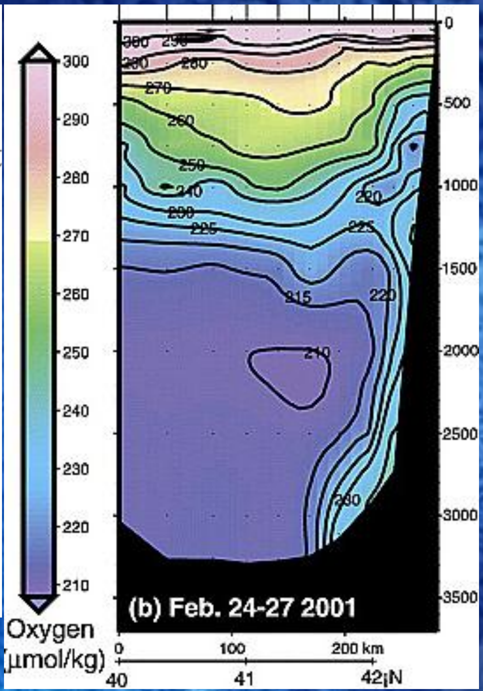
- Upper JSPW: 400-1000 m
- Deep water: 1000-2000 m
- Bottom water: below 2000 m

- With its **own deep-water formations** within the Sea itself
- In relation to the **high saline water** supply from the **TWC**
- Under the influence of **intense winter EAM winds**

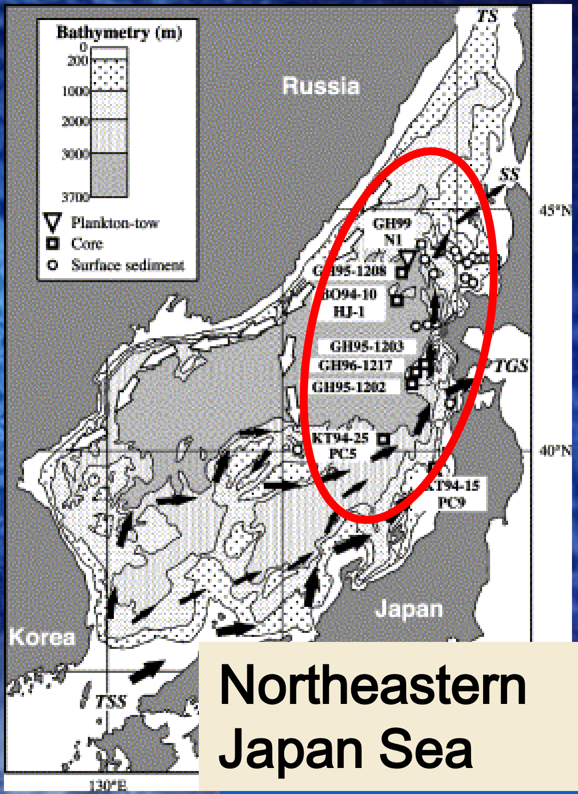
Deep-water evolution in the Japan Sea since the LGM still remains uncertain



Tada et al., 1999



Talley et al., 2003

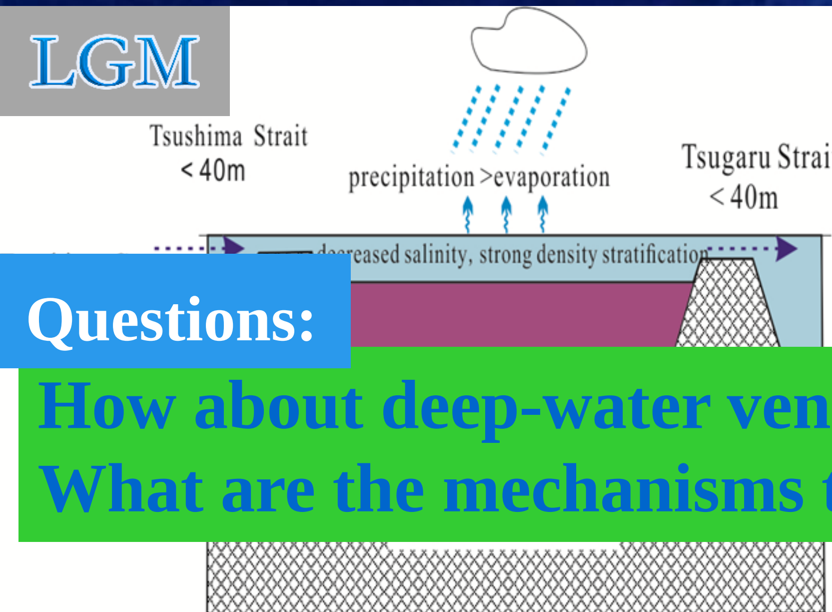


Northeastern Japan Sea

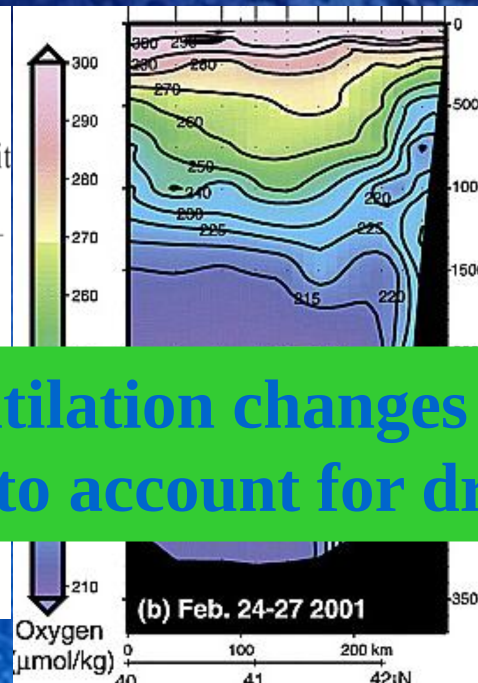
Itaki et al., 2004

- Japan Sea underwent remarkable changes in deep ventilation from anoxic deep water during the LGM to most oxygen-rich ocean basins at present

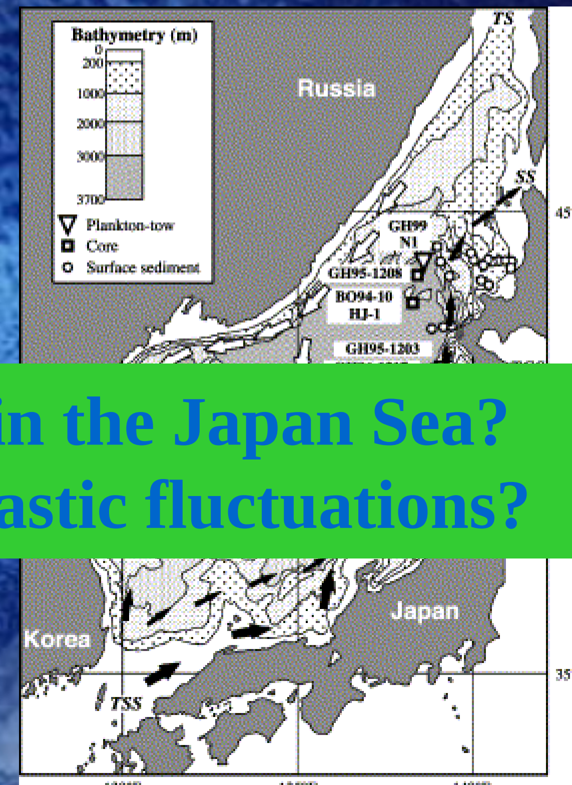
Deep-water evolution in the Japan Sea since the LGM still remains uncertain



Tada et al., 1999



Talley et al., 2003



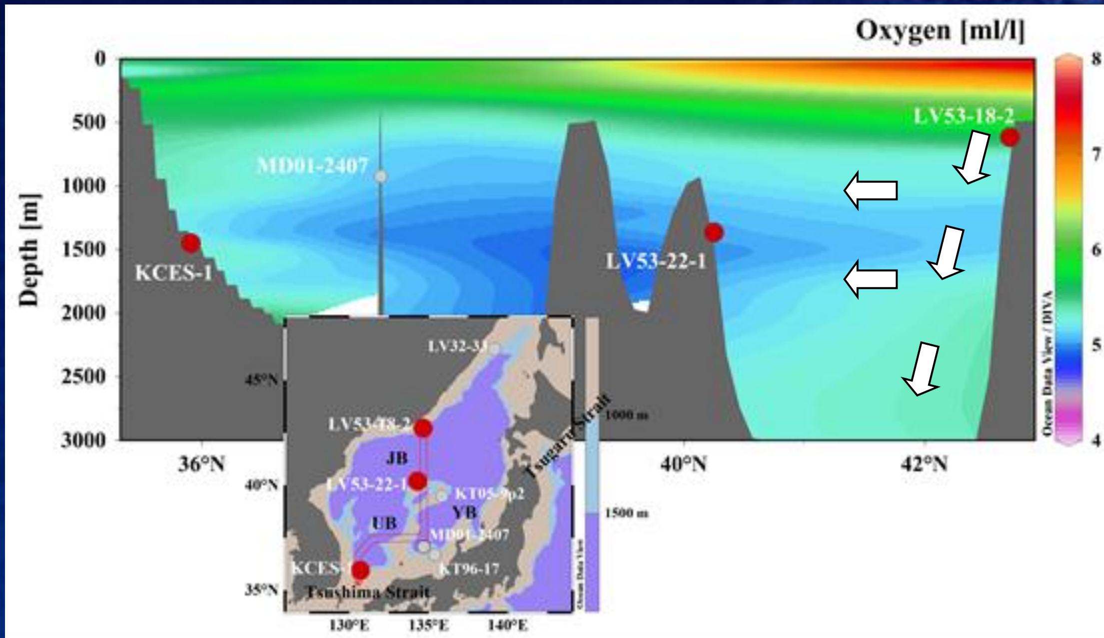
Itaki et al., 2004

Questions:

How about deep-water ventilation changes in the Japan Sea?
What are the mechanisms to account for drastic fluctuations?

- **Japan Sea underwent remarkable changes in deep ventilation from anoxic deep water during the LGM to most oxygen-rich ocean basins at present**

Core Location



- Benthic forams barren
- Benthic forams δ^{13}C ×
- B-P ventilation ages ×
- Redox sensitivity element (Molybdenum (Mo)) LV53-22-1√
- Total sulfur (TS) KCES-1√
- Radiolarian assemblage in four cores√

□ Core KCES-1
35° 56′N, 130° 41′E
Water depth: 1463 m

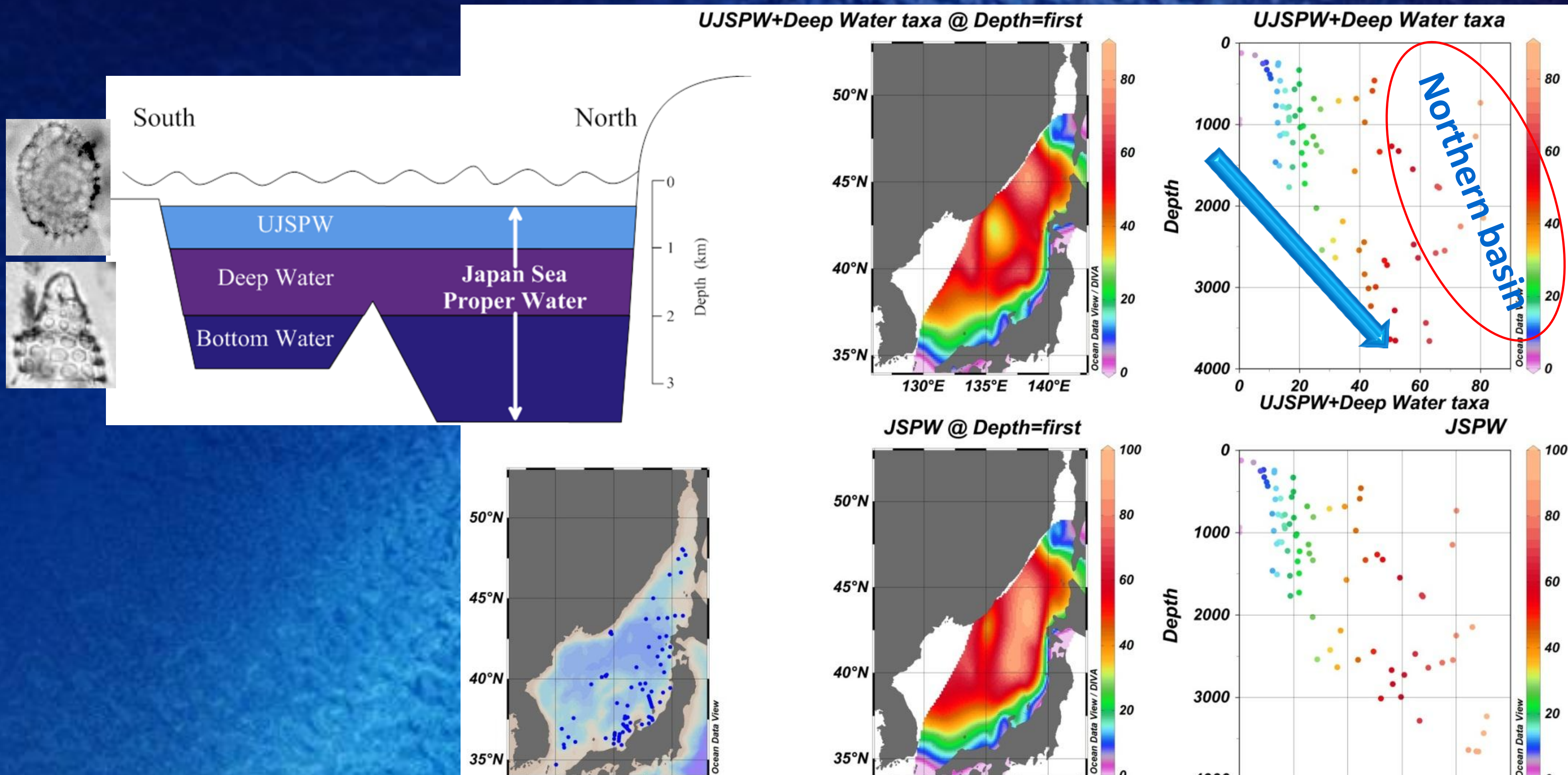
□ Core LV53-22-1
40.20 ° N, 134.28 ° E
Water depth: 1333 m

□ Core LV53-18-2
42.93 ° N, 134.73 ° E
Water depth: 551 m

□ Core MD01-2407
Water depth: 932 m
Itaki et al., 2007 Palaeo-3

Radiolarian: JSPW indicator

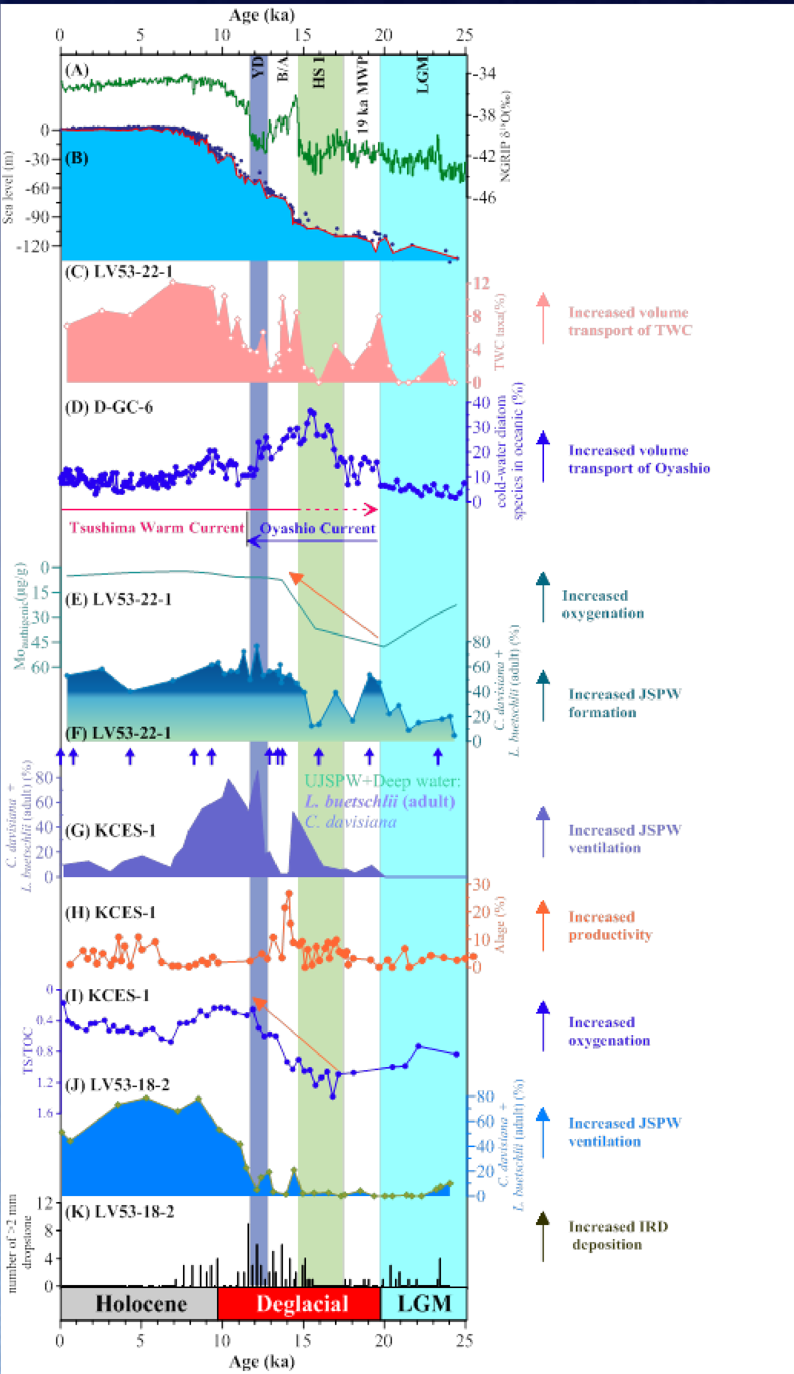
surface sediment samples



JSPW Assemblage

L. buetschlii (adult): Upper JSPW (400-1000 m)
Cycladophora davisiana: deepwater-living (maximum abundance 1000-2000 m) (Itaki, 2003)

Ventilation evolution



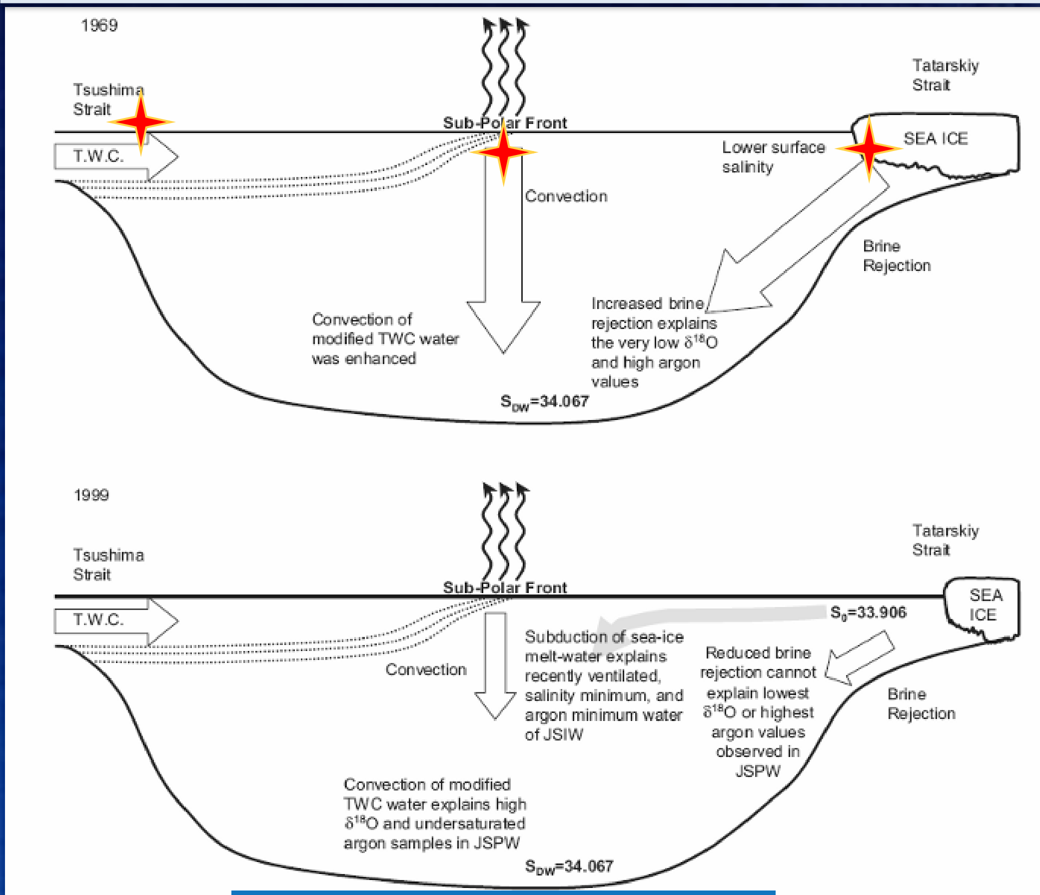
- The ventilation changes vary graetly in three core sites.

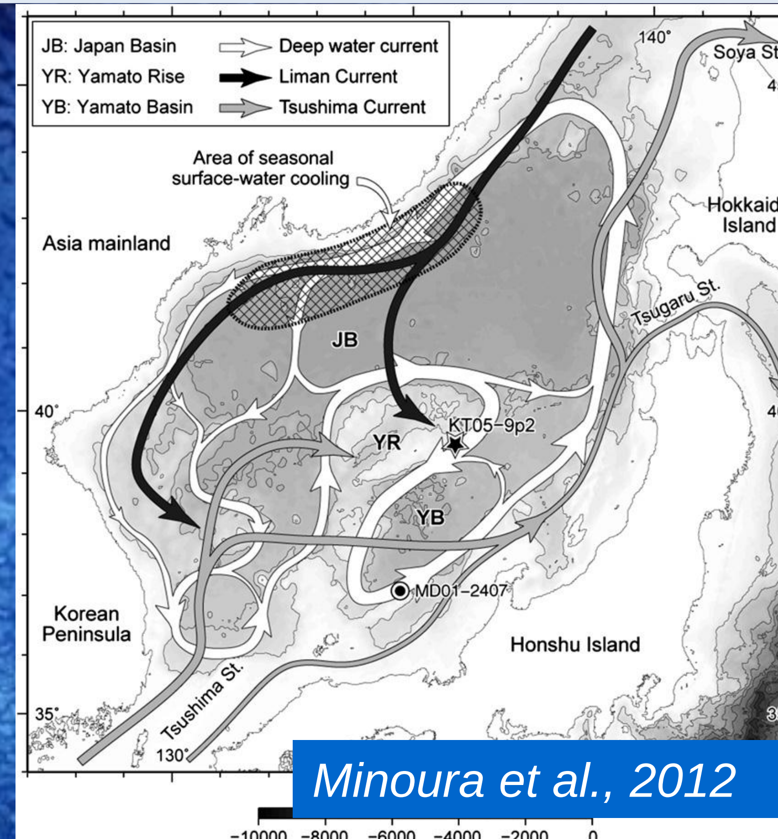
- Timing of well ventilated deep water:
central Japan Sea: HS 1-B/A
southwestern Japan Sea: YD
Northwestern Japan Sea: 11.5 ka

- JSPW formation was closely related to the surface hydrography condition.

- Mainly controlled by SSS?

JSPW formation





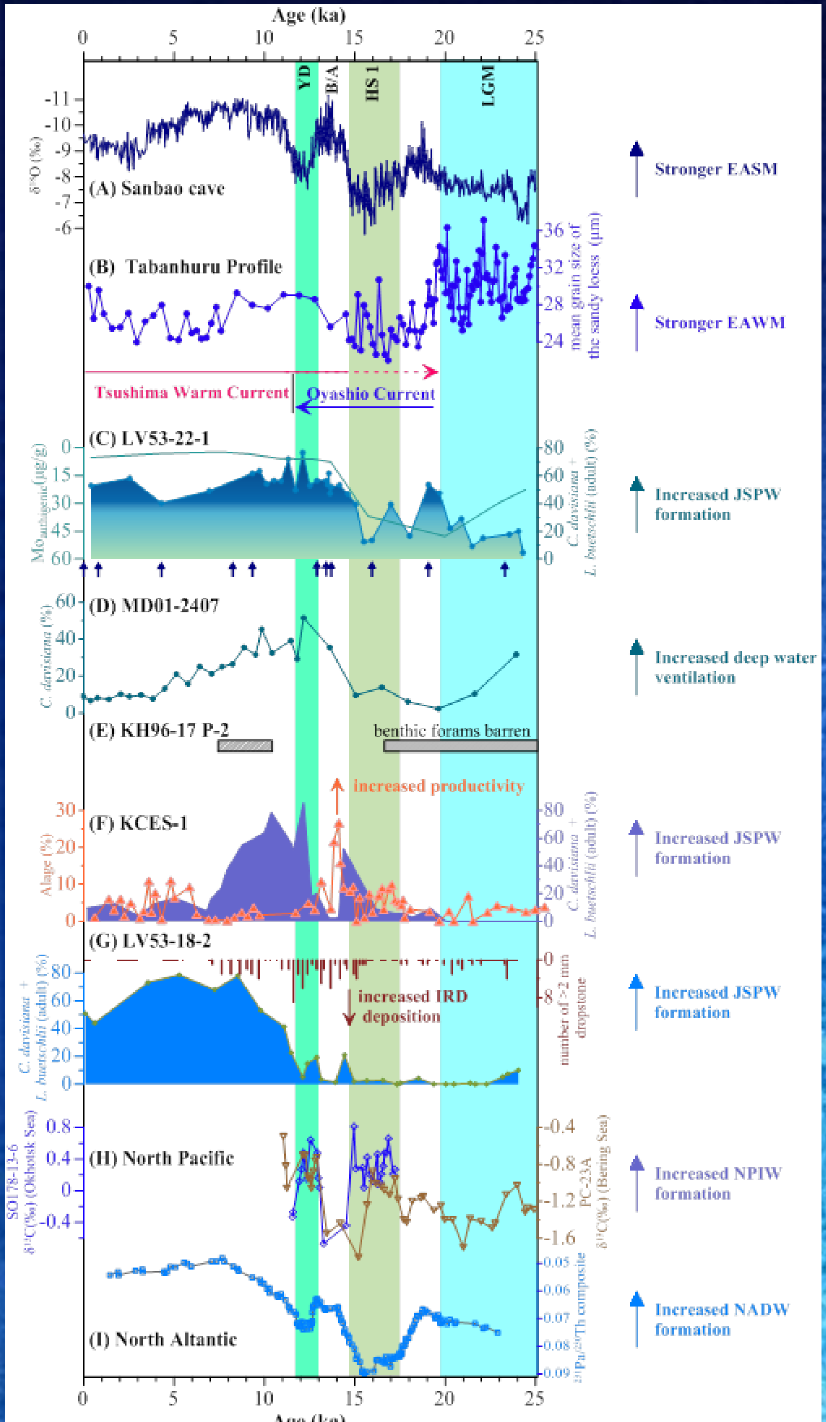
Minoura et al., 2012

- Deep convection
- Brine rejection (sea ice)

Kuh Kim et al., 2008
Journal of Oceanograohy

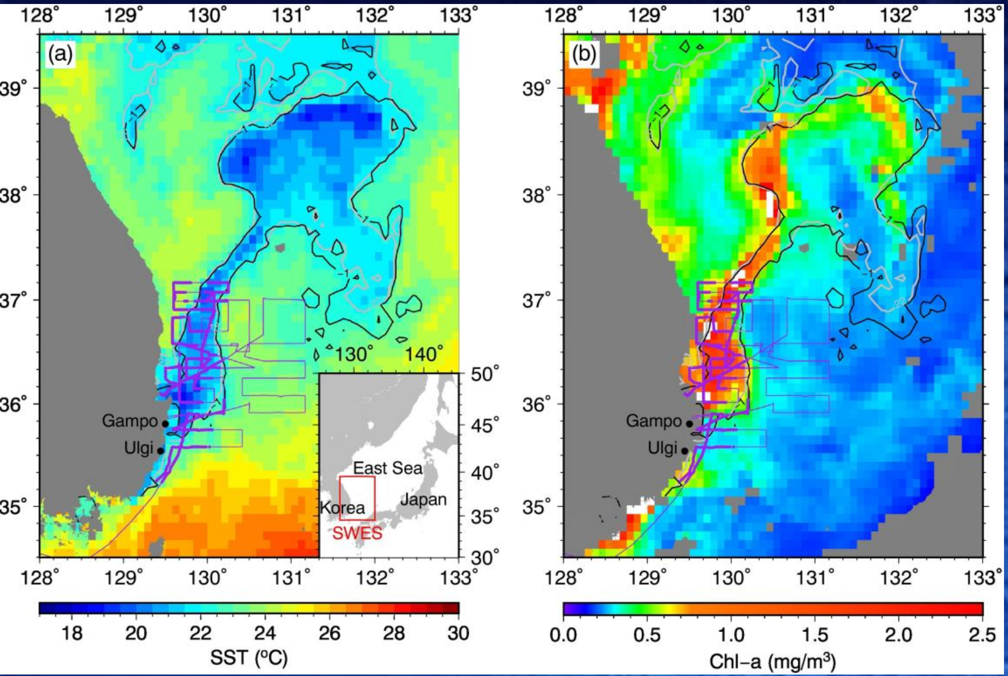
- **Deep convection played a more important role in deglacial JSPW formation?**

JSPW comparision



- impact of primary production on deep ventilation
- reduced air-sea gas exchange under expanded sea ice
- JSPW had diffenernt ventilation pattern compared with NPIW and AMOC

Productivity vs Oxygen supply



Kim et al., 2017JMS

	UB	East JB	YB
Primary production Satellite obs.	**266**	233	256
Sinking POC flux (~ 1000 m)	**9.1**	4.4	8.7
$\Delta^{14}C$ (‰)	**11 ± 15**	− 21 ± 20	− 3 ± 28

Hahm et al., 2019 JMS

- The observation of primary production enhanced by coastal upwelling in the southwest Japan Sea when prevailing southerly winds blow

Conclusion

- Radiolarian assemblage records have revealed a distinct basin-scale transition in JSPW ventilation from anoxic to oxic during the deglaciation

- It must be recognized that there is significant potential for bias in the timing of the JSPW ventilation changes among regions

- The deglacial JSPW ventilation was closely related to sea-level rise and the strength of the Tsushima Warm Current, superimposed by regional signals (e.g., productivity and sea ice).

THANKS