



ICMGP 2024
CAPE TOWN • SOUTH AFRICA • 21 - 26 JULY
CAPE TOWN INTERNATIONAL CONVENTION CENTRE

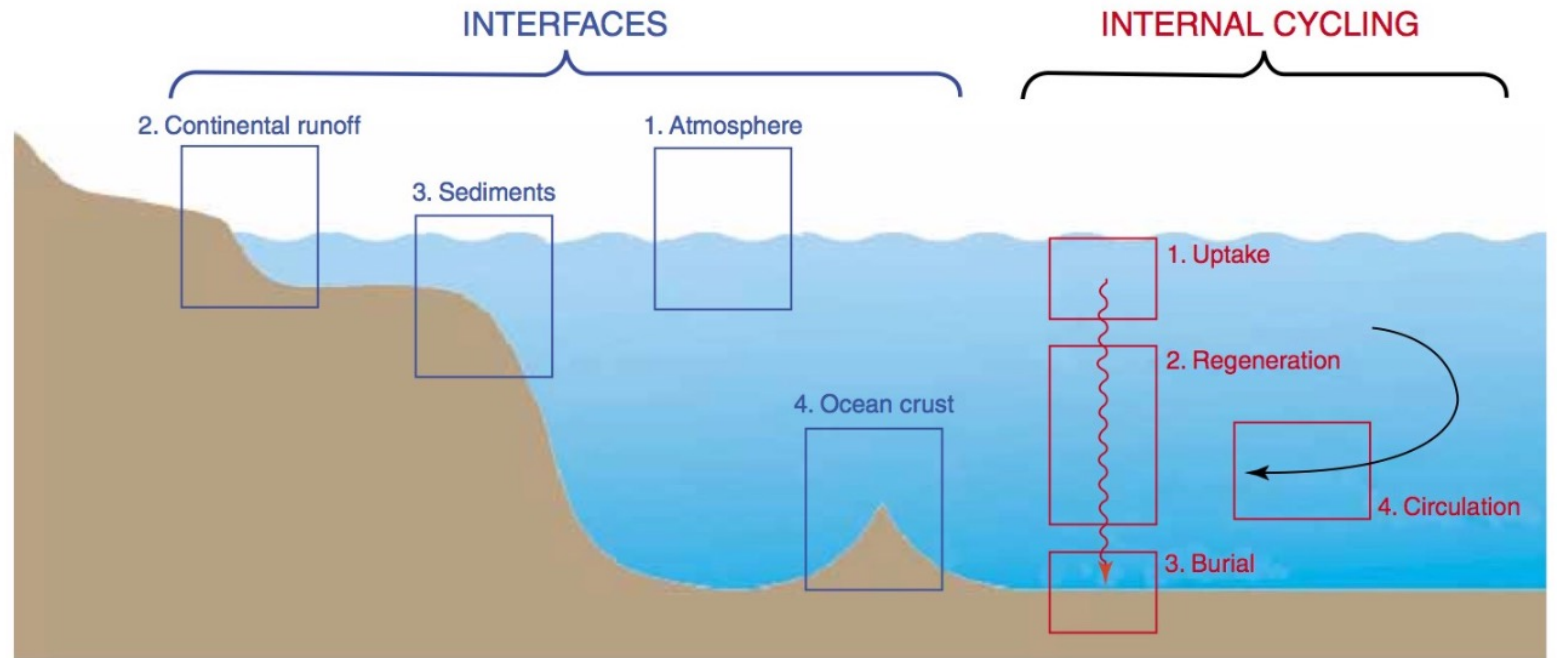
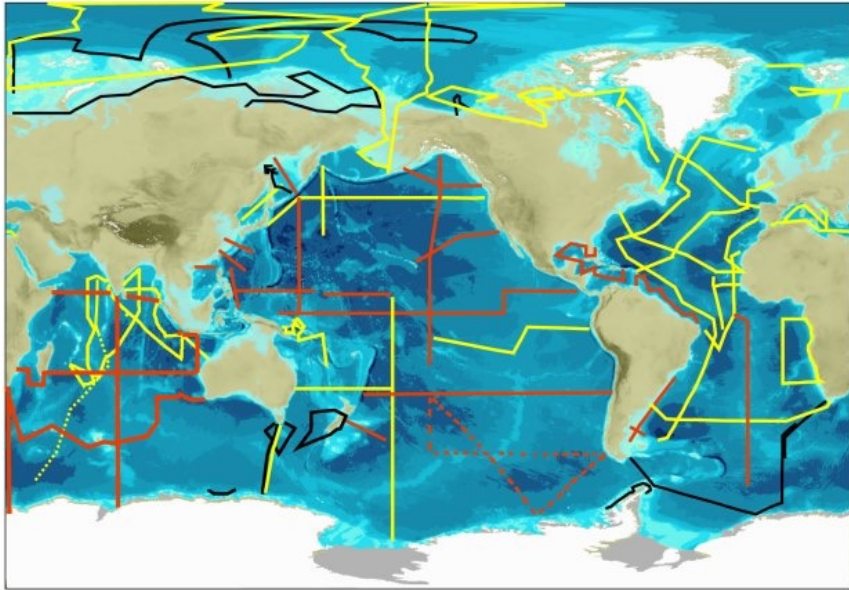
Mercury speciation across the South Pacific and Southern Ocean along U.S. GEOTRACES (GP-17 OCE): a preliminary report

**Marissa C. Despins, Carl H. Lamborg, Robert P. Mason,
Yipeng He and Chad R. Hammerschmidt**

Contact: mdespins@ucsc.edu



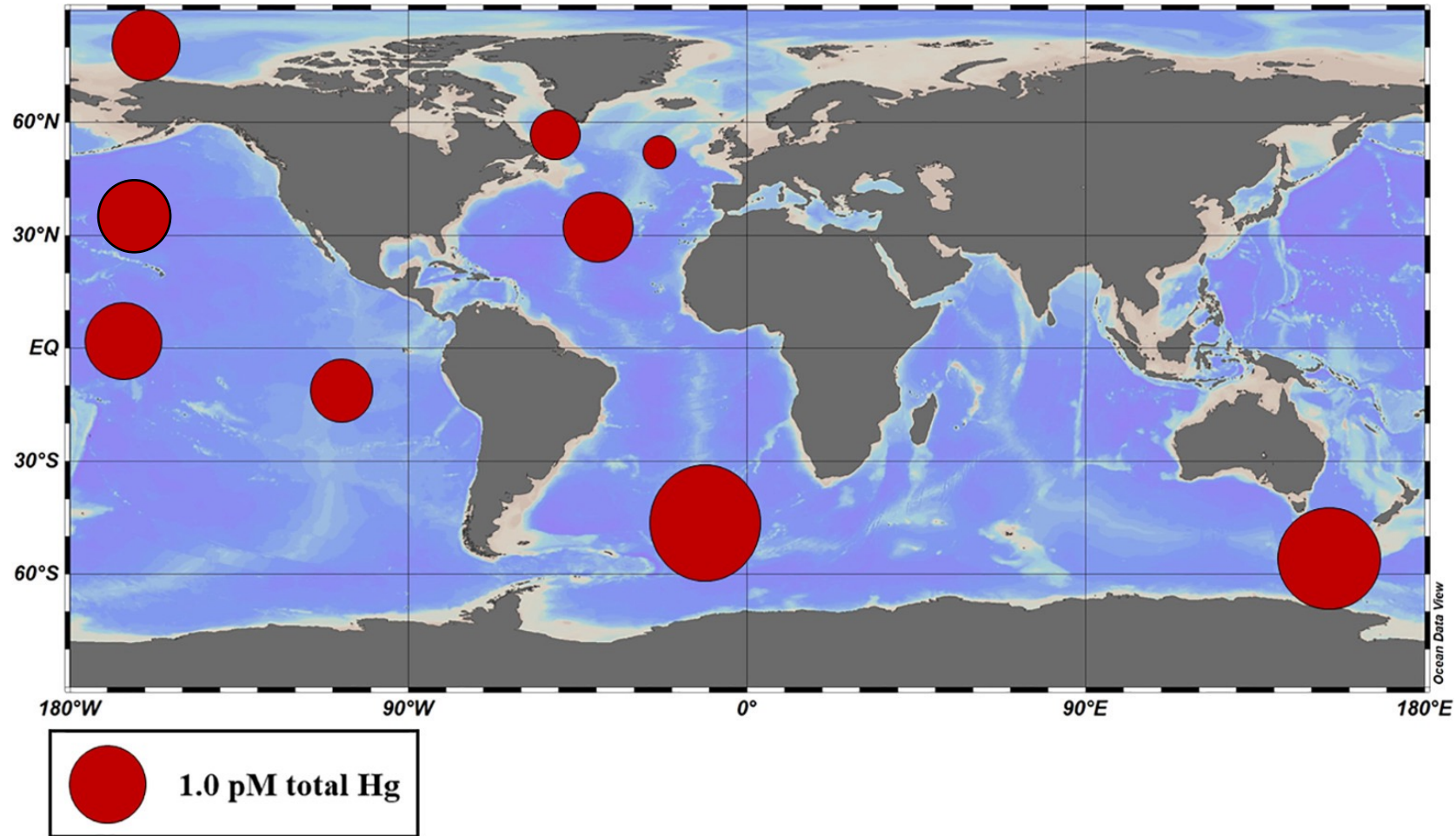
GEOTRACES



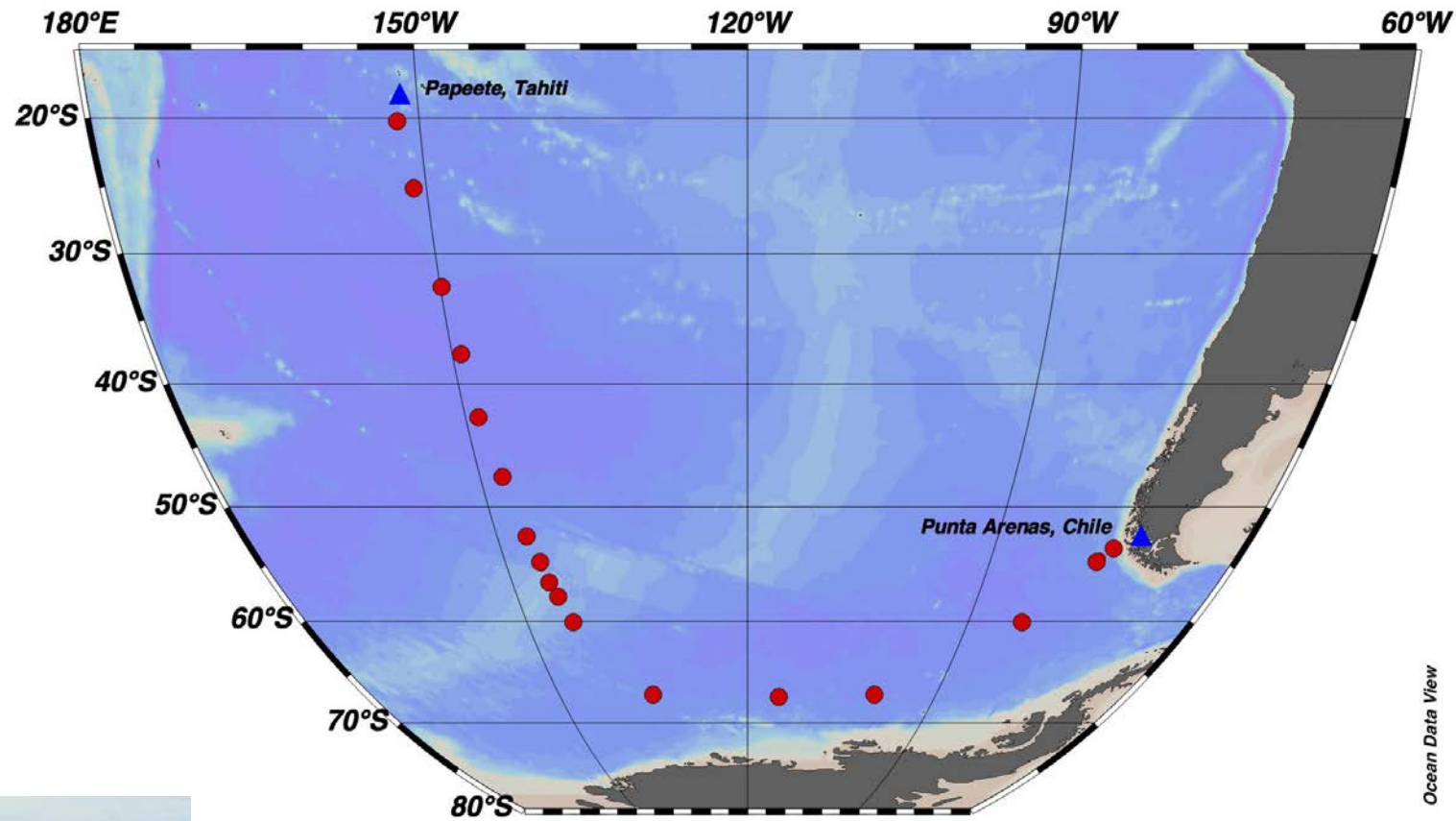
GEOTRACES Website

“To identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions.”

Pelagic Hg Water Column Measurements



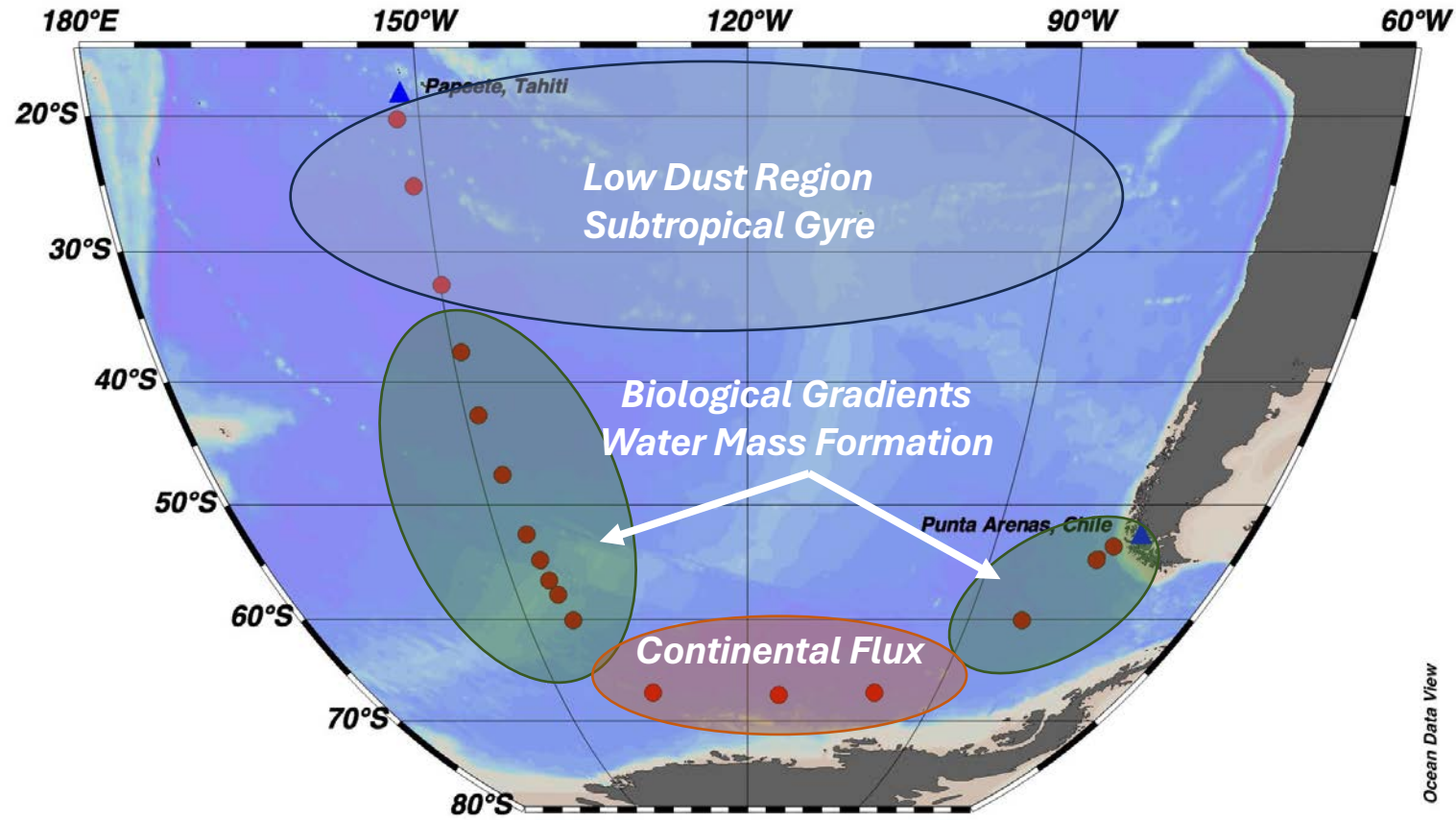
U.S. GEOTRACES: GP-17 OCE Cruise Track



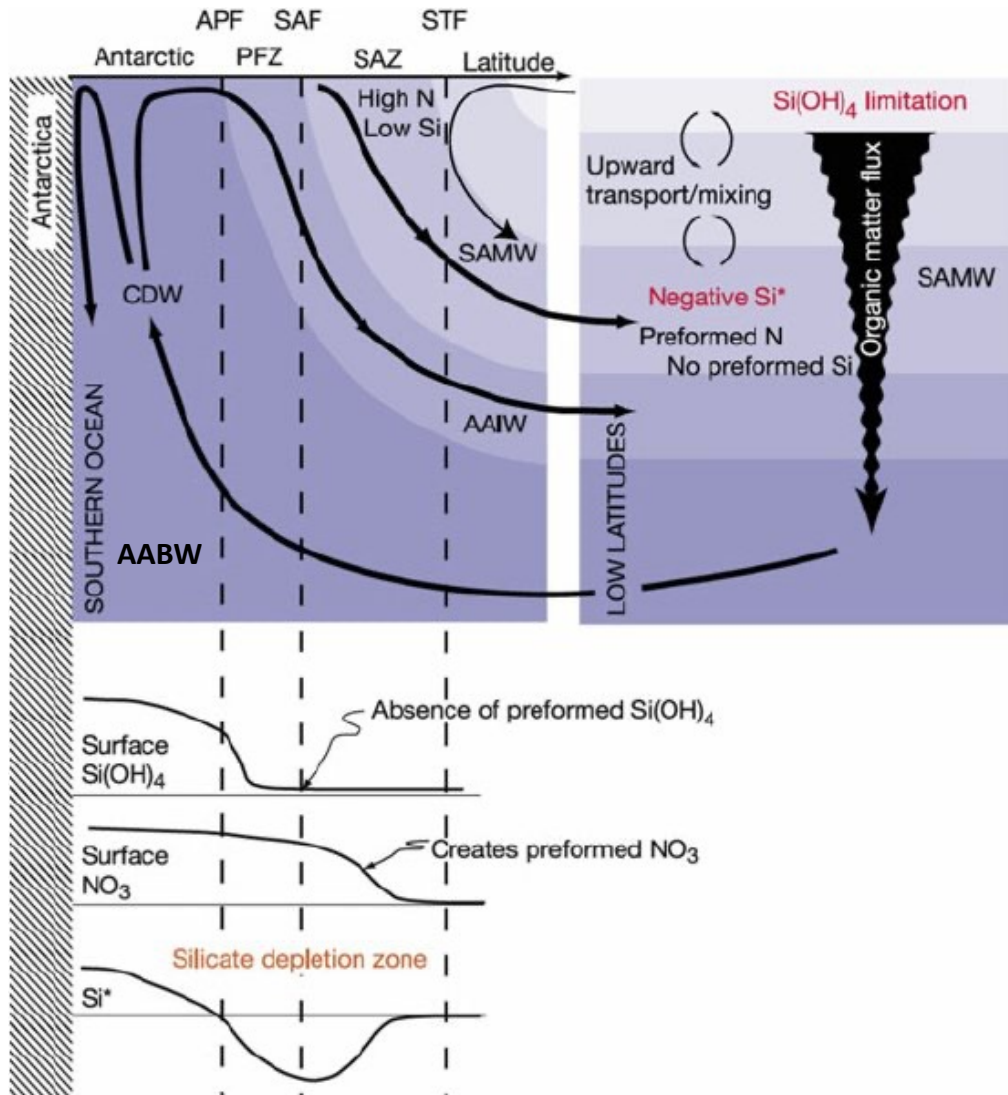
Papeete, Tahiti to Punta Arenas, Chile
R/V Roger Revelle
Nov. 2022 – Jan. 2023 (Austral Summer)



U.S. GEOTRACES: GP-17 OCE Cruise Track



South Pacific and Southern Ocean Fronts



Fronts:

STF: Subtropical Front

SAF: Subantarctic Front

PF: Polar Front

Water Masses:

SAMW: Subantarctic Mode Water

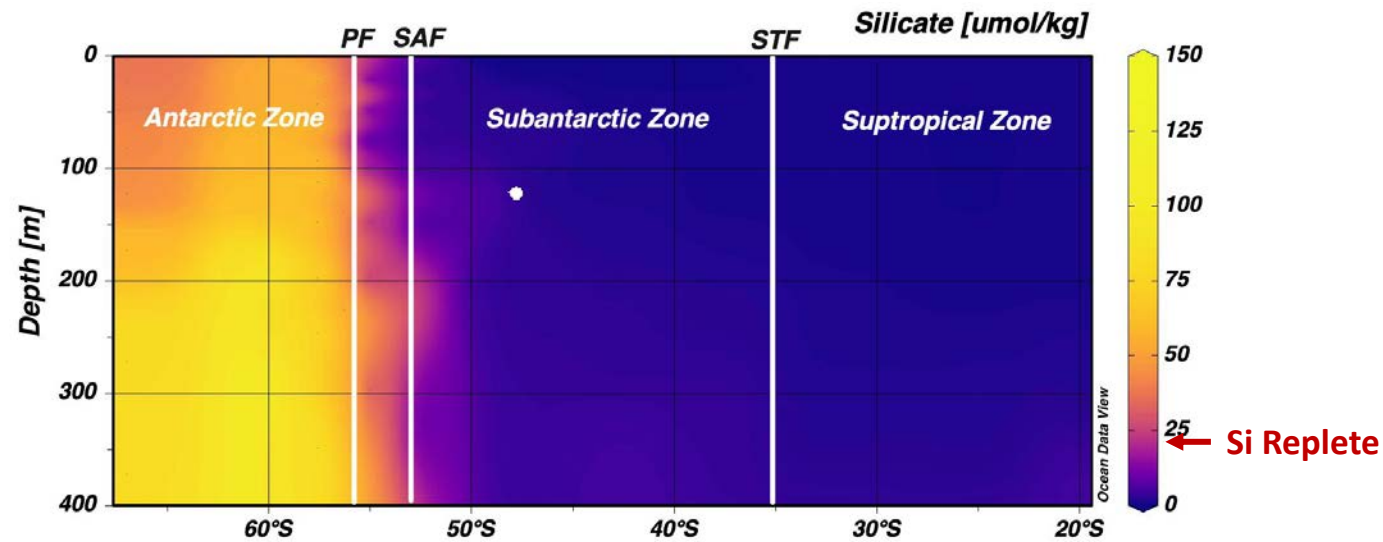
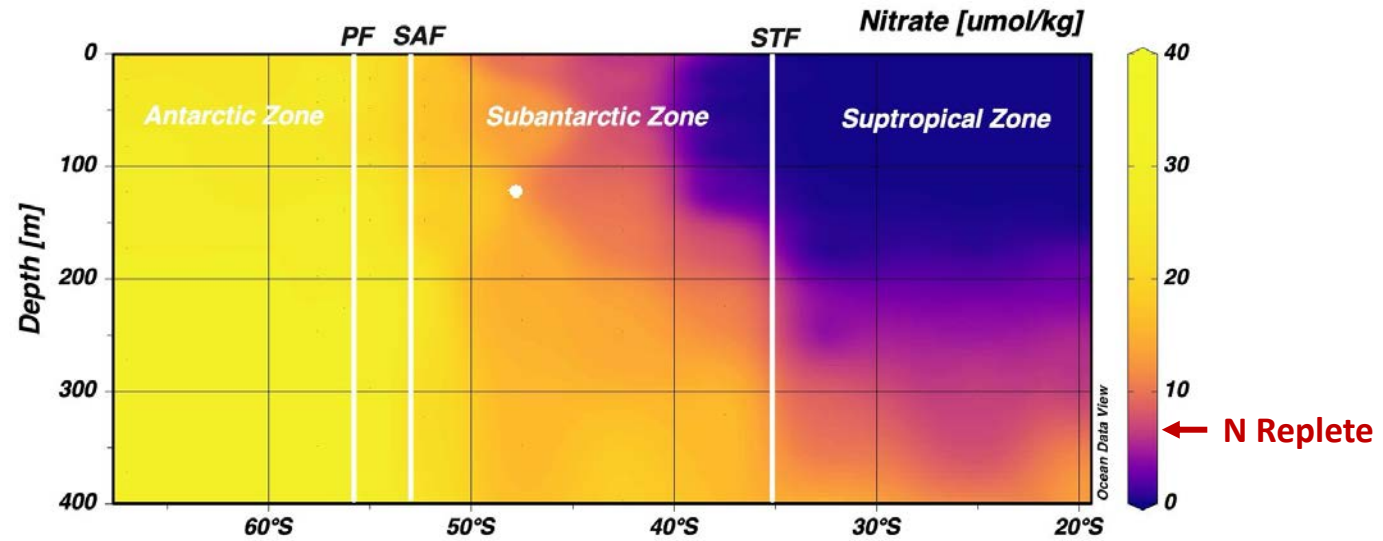
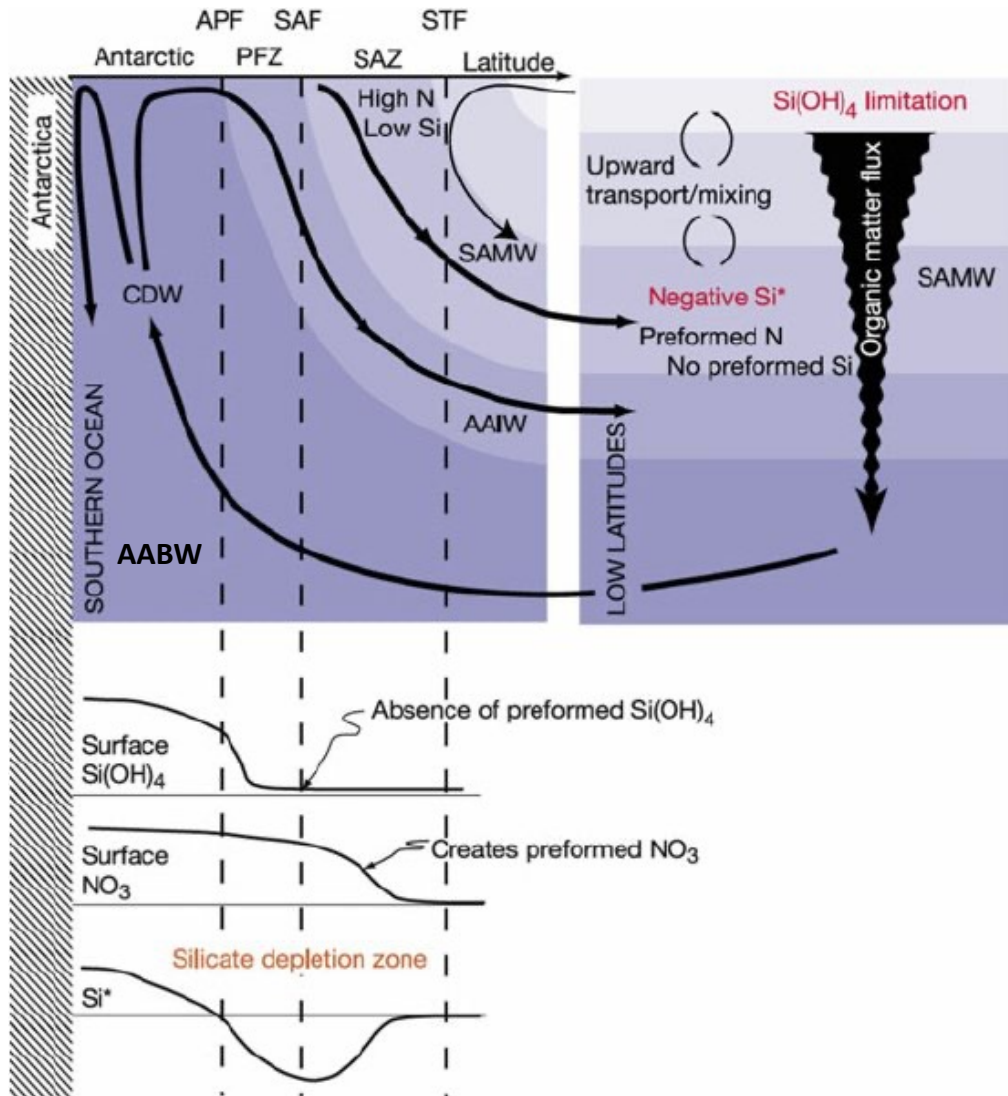
AAIW: Antarctic Intermediate Water

UCDW: Upper Circumpolar Deep Water

LCDW: Lower Circumpolar Deep Water

AABW: Antarctic Bottom Water

Nutrient Gradients (data from GP-17 OCE)



Mercury Speciation Across Fronts

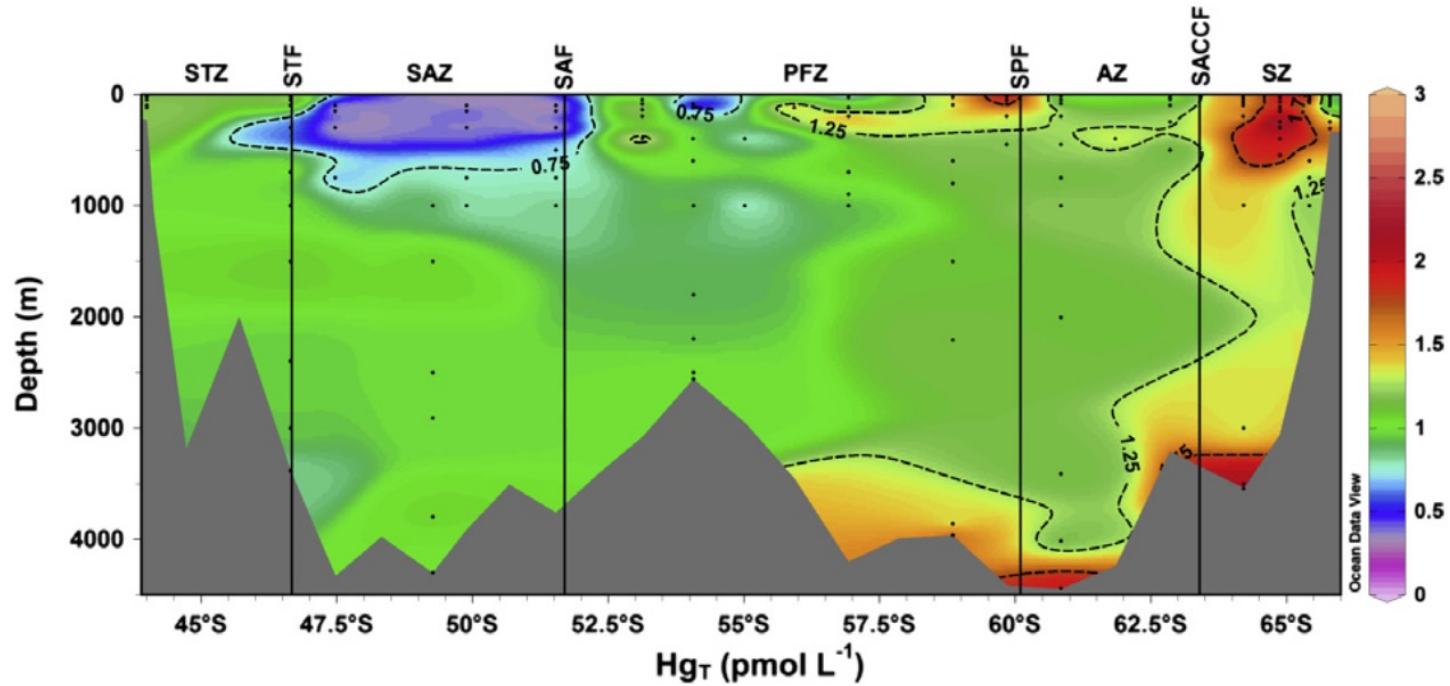


Fig. 3. Total mercury (Hg_T) distribution along the SR3 CASO-GEOTRACES transect in the Southern Ocean.

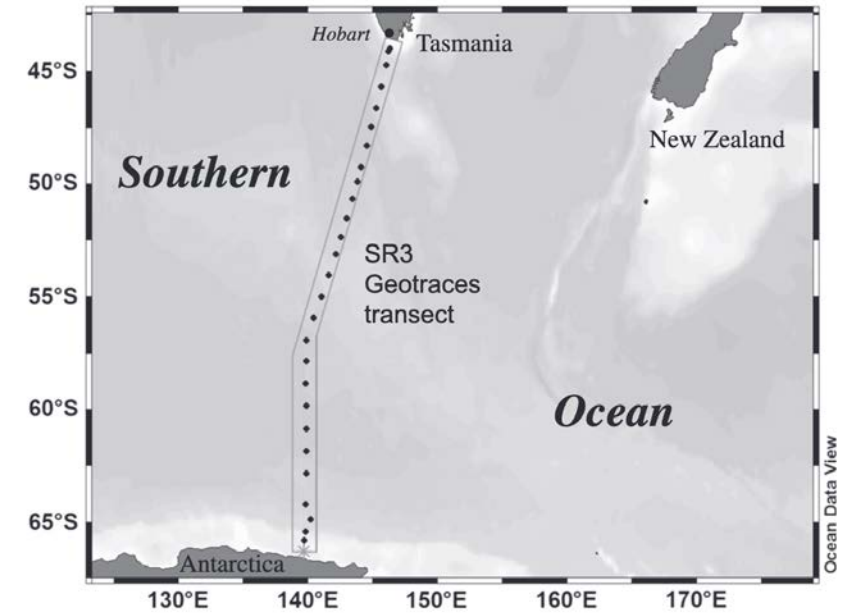


Fig. 1. Sampling stations along the SR3 CASO-GEOTRACES transect in the Southern Ocean.

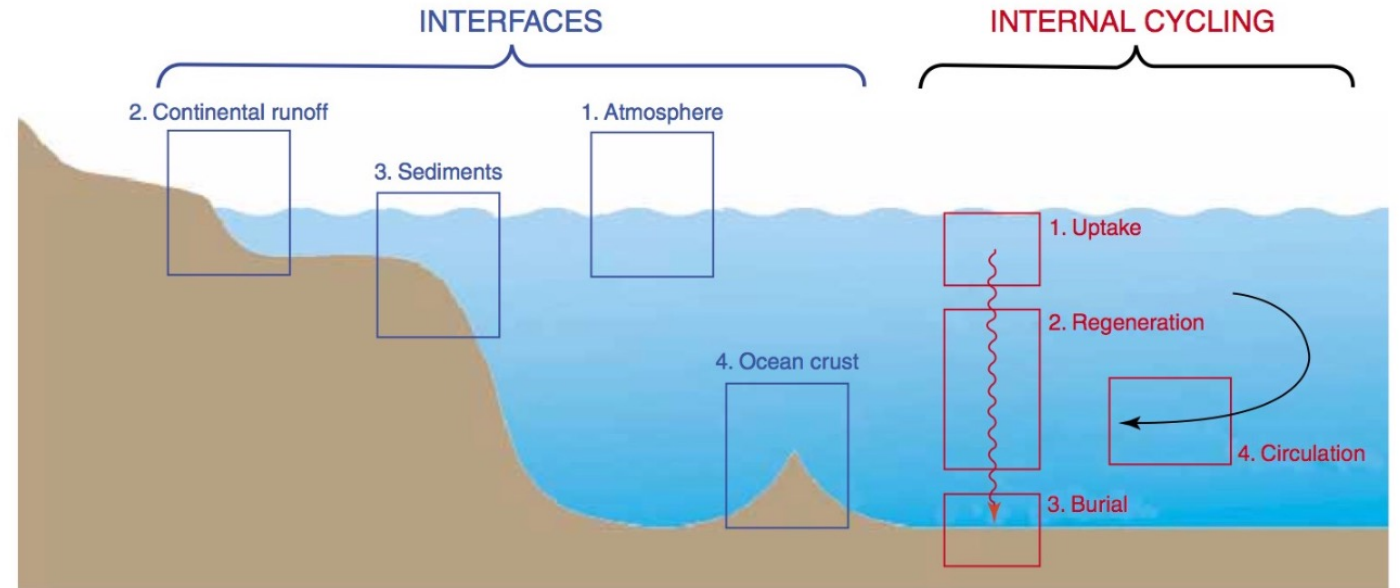
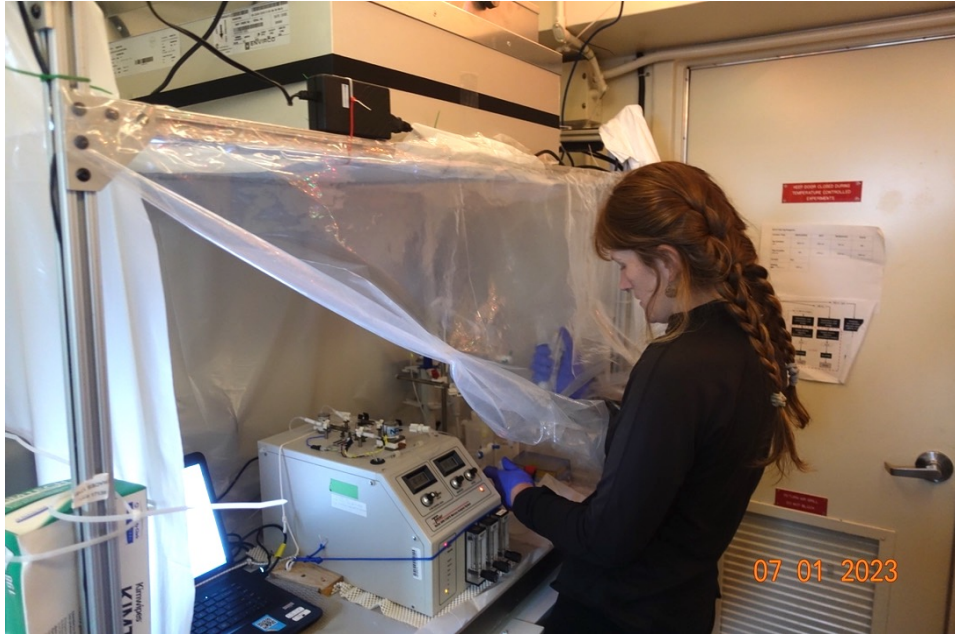
Objectives:

Objective 1: Determine Hg speciation across the South Pacific and Southern Ocean.

Objective 2: Ascertain sources, sinks, and cycling of Hg across this region.

Objective 3: Quantify abundance and assess shifts in Hg cycling microbial communities across Southern Ocean fronts.

Mercury Species - GP-17 OCE



GEOTRACES Website

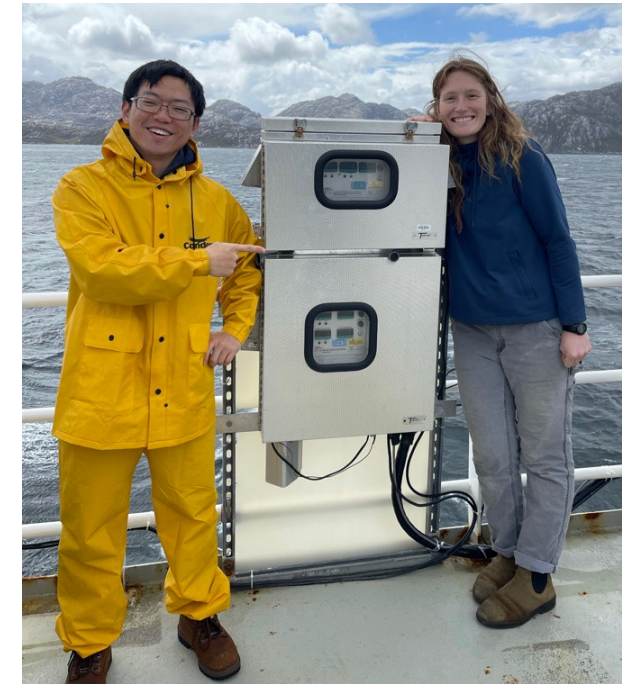
Dissolved Water Column	Surface Water Continuous Sampling	Particulate Water Column	Atmospheric
- Elemental Mercury (Hg^0)	- Hg^0	- HgT	- Aerosol Hg
- Total Mercury (HgT)	- Dimethylmercury (DMHg)	- MMHg	- Hg^0
- Monomethylmercury (MMHg)	- Hg Isotopes	- DNA and RNA	- Reactive Gaseous Mercury
- Hg Isotopes			- Hg Isotopes

Mercury Species - GP-17 OCE

Air-sea exchange of elemental Hg and dimethylmercury in the South Pacific and Southern Ocean

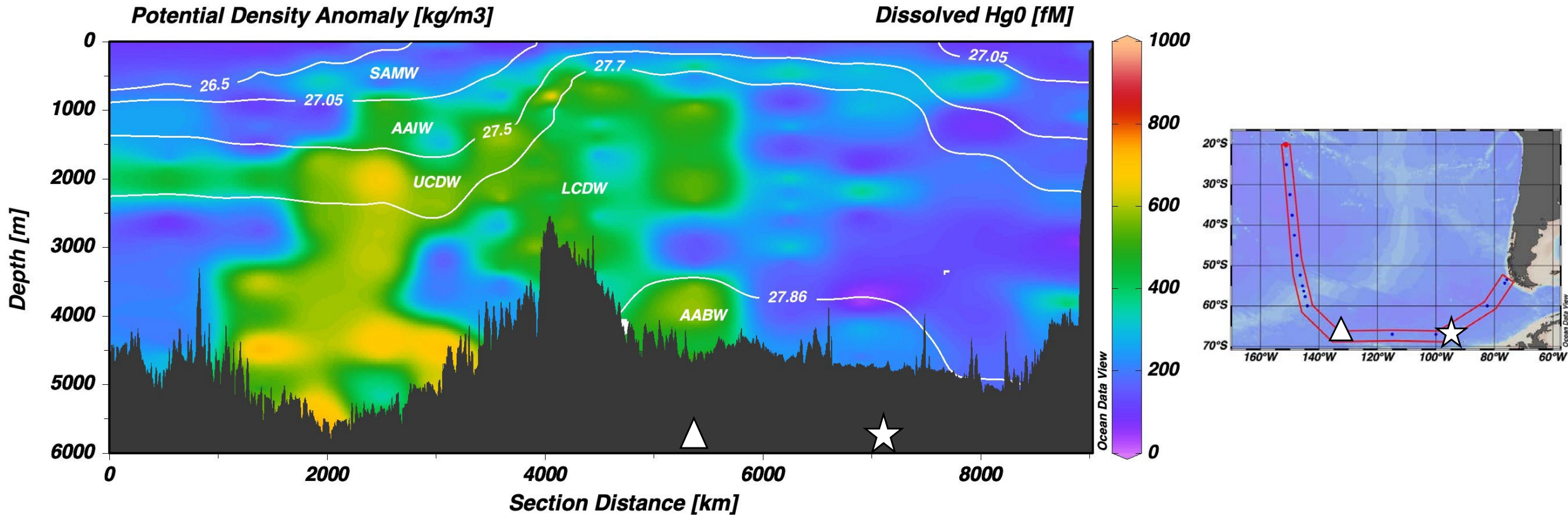
Session 13: Special Session Hg in the Southern Hemisphere
Part (I)

15:30 Today!



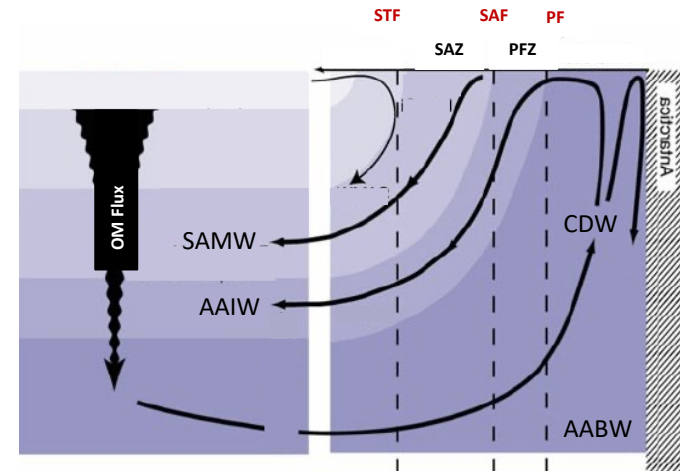
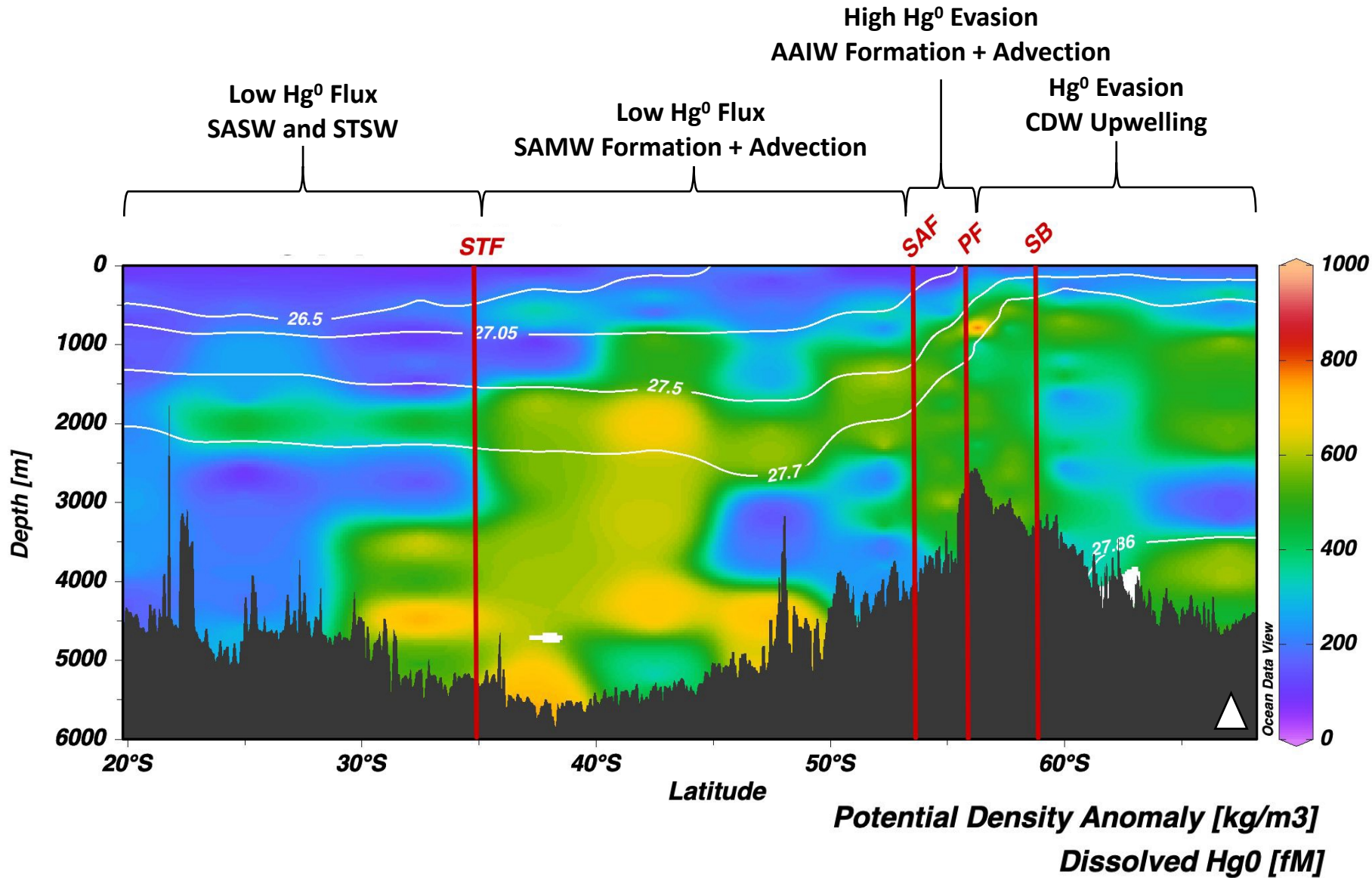
Dissolved Water Column	Surface Water Continuous Sampling	Particulate Water Column	Atmospheric
- Elemental Mercury (Hg^0)	- Hg^0	- HgT	- Aerosol Hg
- Total Mercury (HgT)	- Dimethylmercury (DMHg)	- MMHg	- Hg^0
- Monomethylmercury (MMHg)	- Hg Isotopes	- DNA and RNA	- Reactive Gaseous Mercury
- Hg Isotopes			- Hg Isotopes

Elemental Mercury – Full Transect

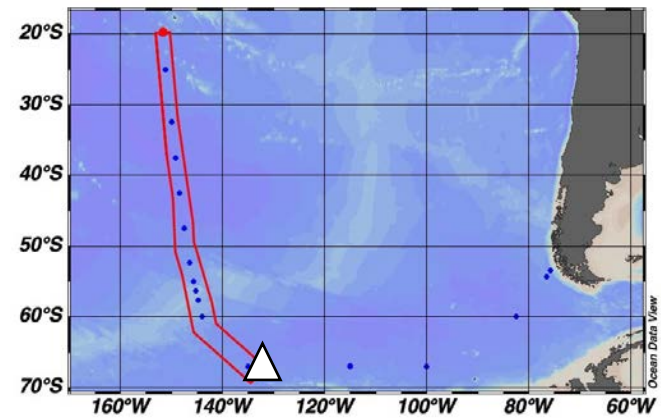


- No water mass division due to low Hg⁰ in eastern Southern Ocean region.
- SAMW has the lowest Hg⁰ while UCDW has the highest.
- Potential hydrothermal contribution around Pacific Ridge.

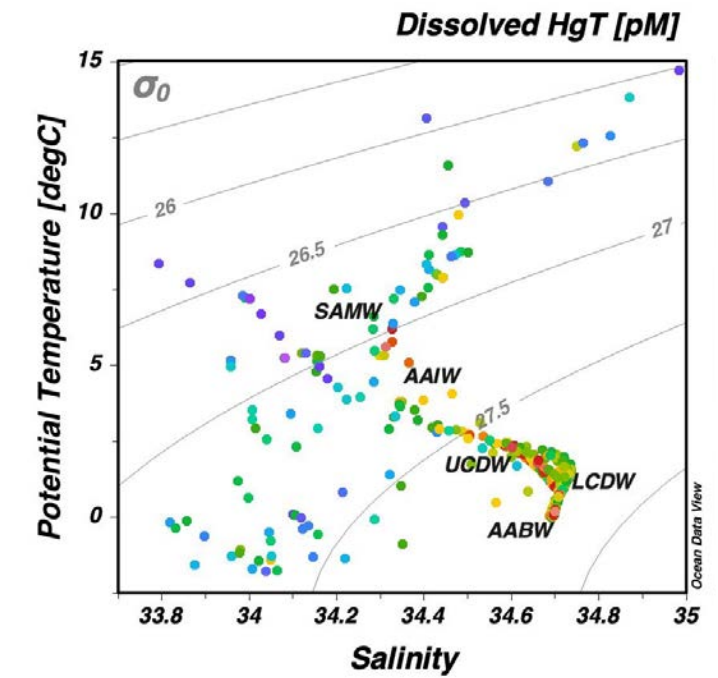
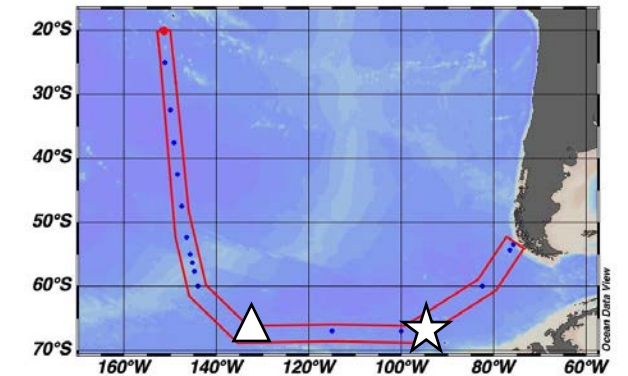
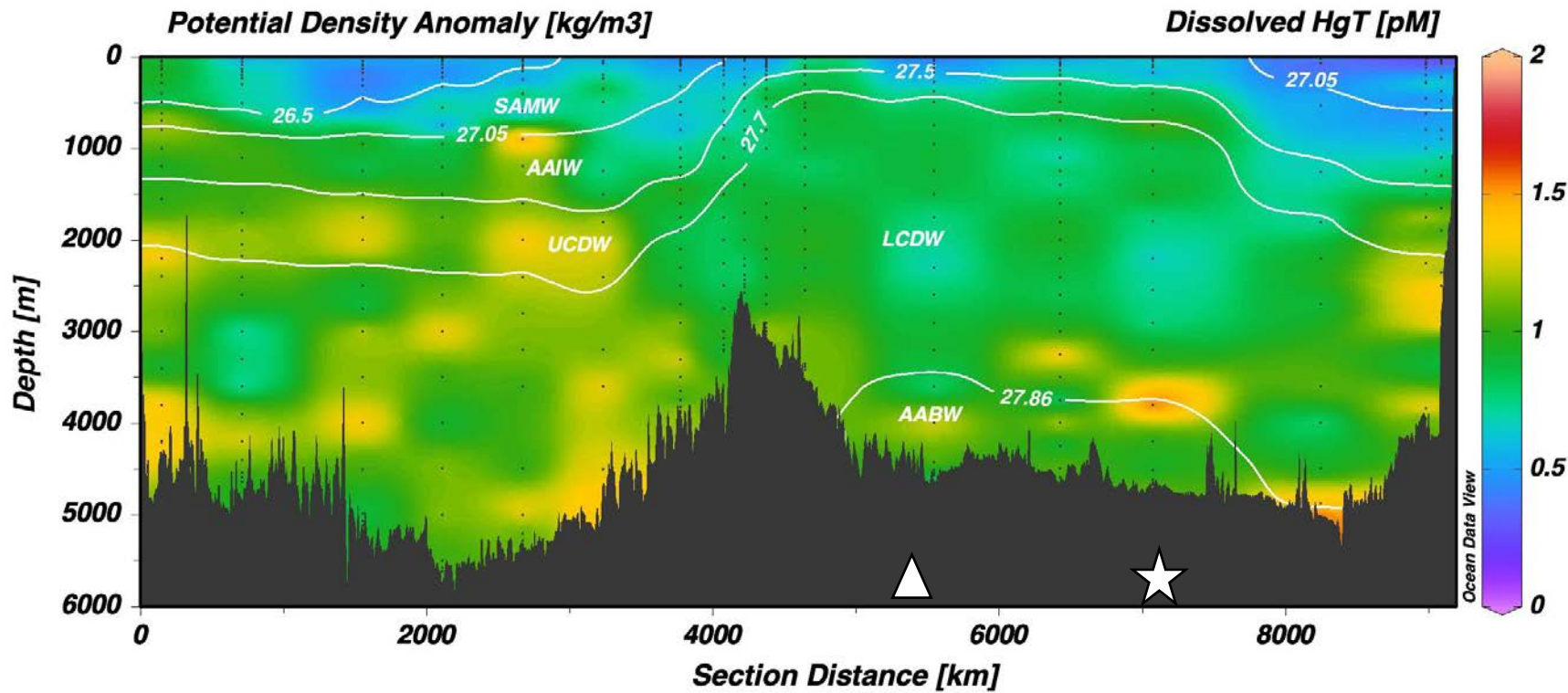
Elemental Mercury – Meridional Transect



Modified from Palter *et al.*, 2013

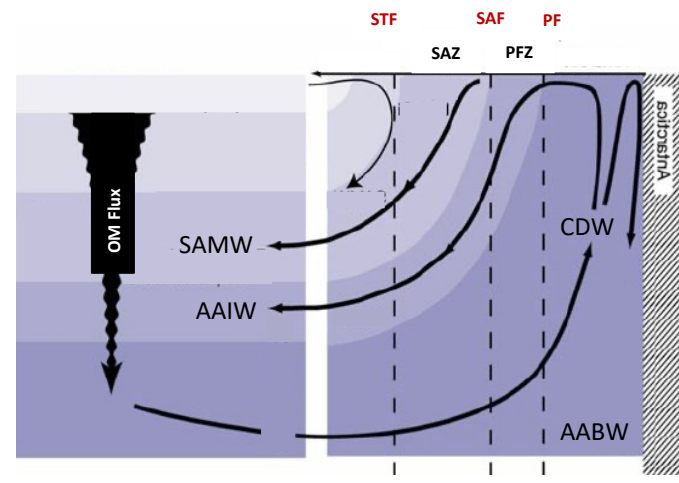
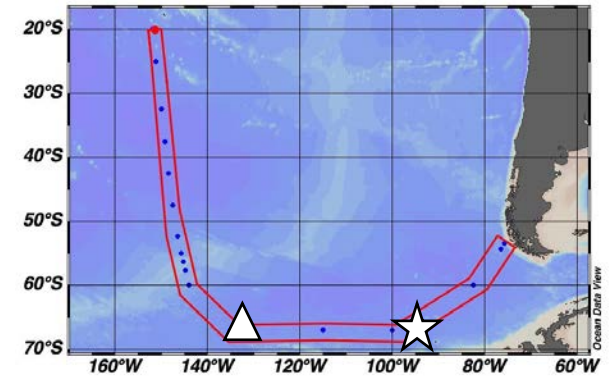
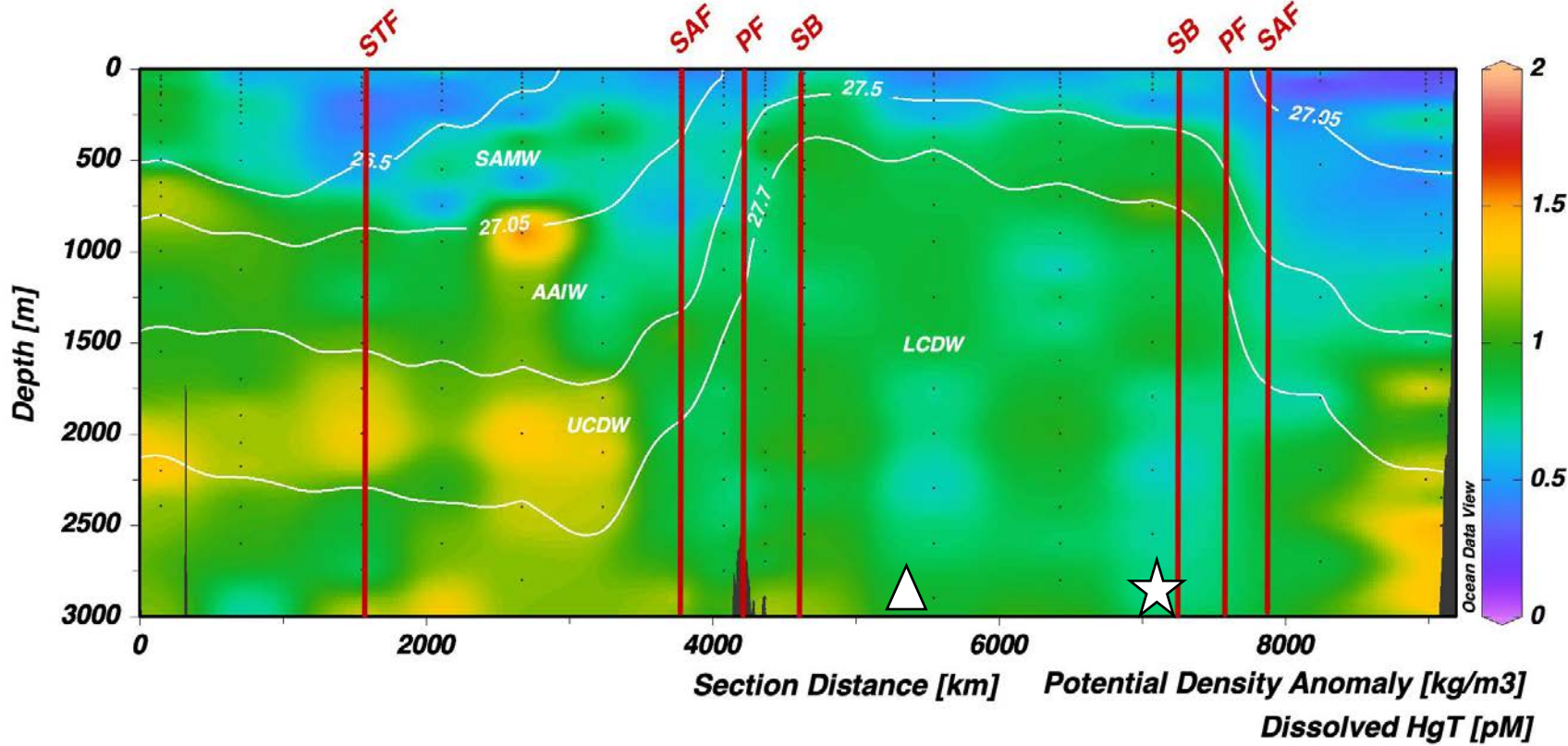


Total Mercury – Full Transect



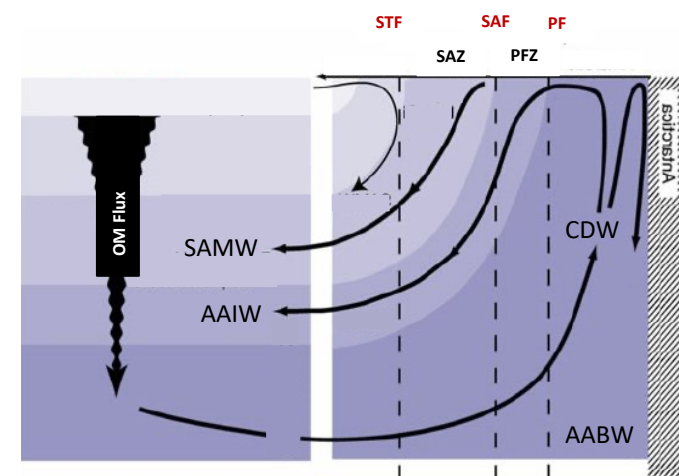
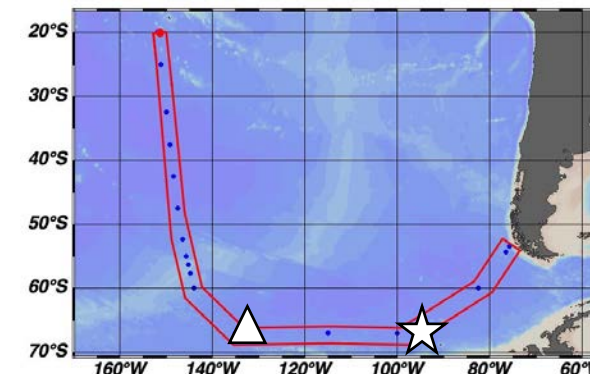
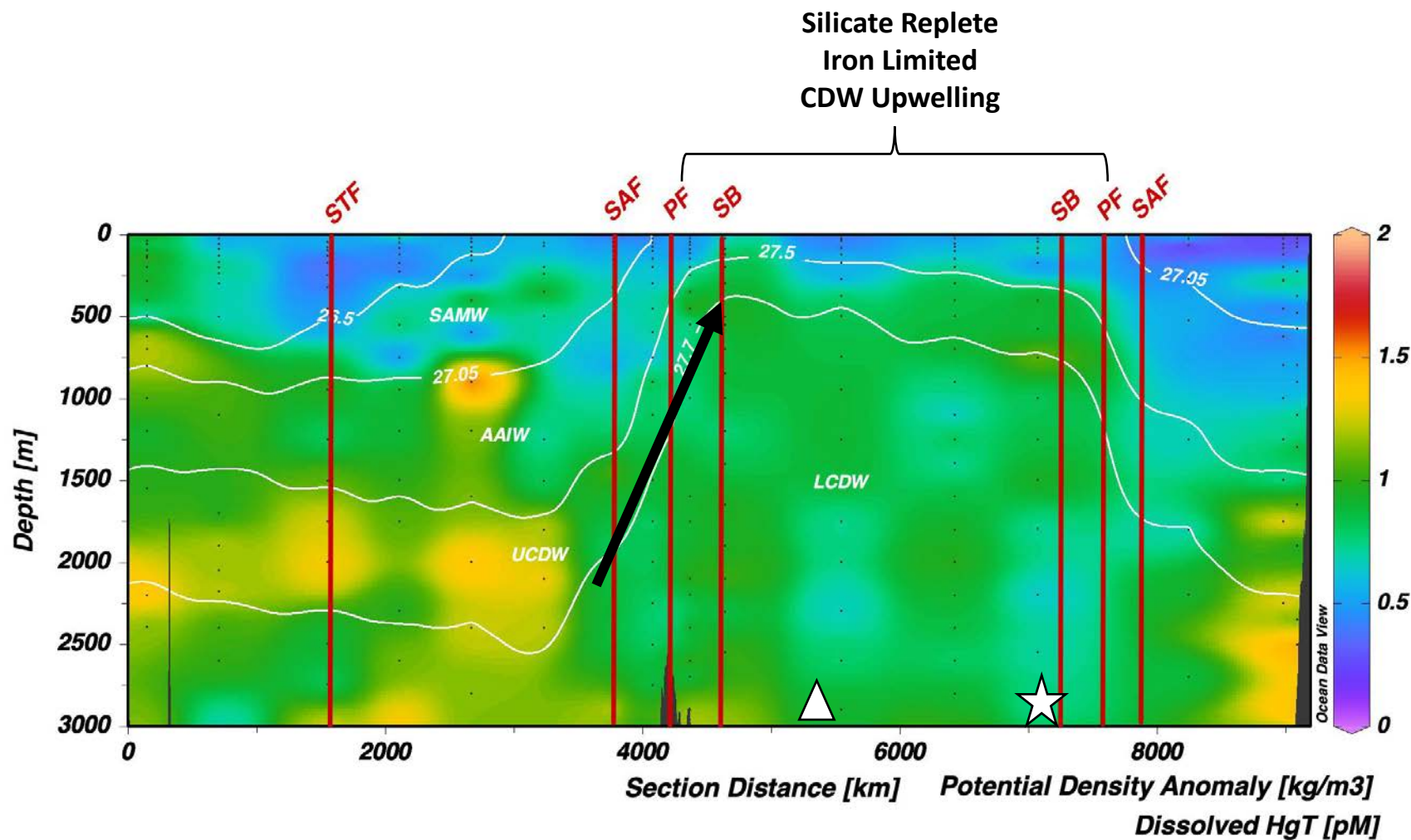
- Potential continental flux from Chilean shelf.
- UCDW has the higher HgT concentration while SAMW and AAIW <700m has lower HgT.
- Comparable to previous findings (Cossa *et al.*, 2011).
- GP-17 ANT Amundsen Sea.

Total Mercury – Full Transect (<3000m)



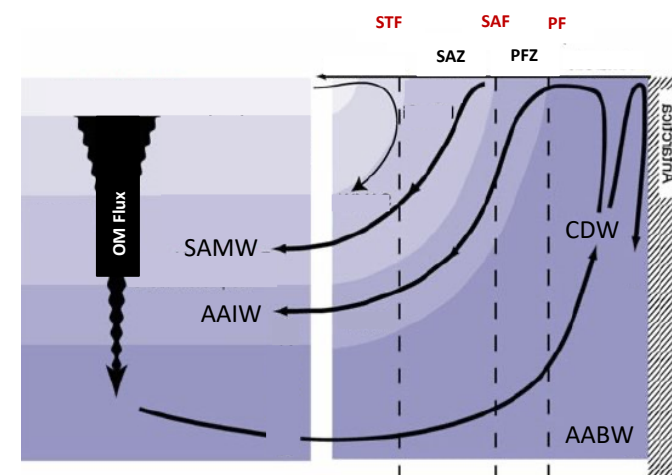
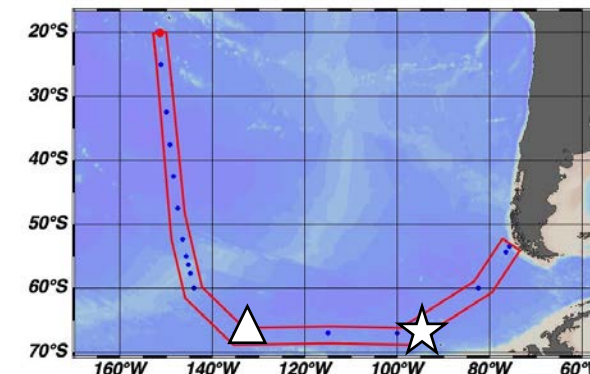
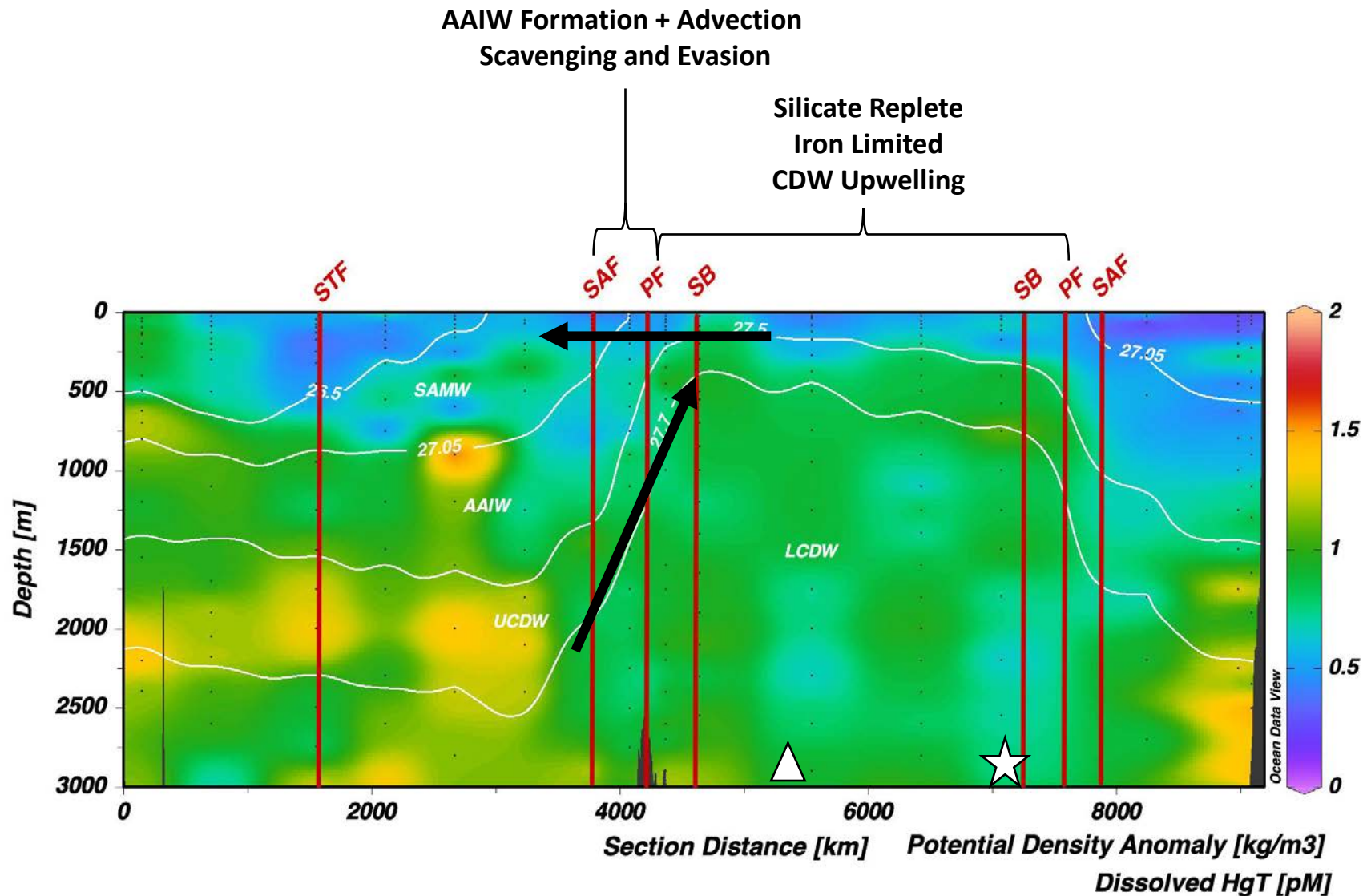
Modified from Palter et al., 2013

Total Mercury – Full Transect (<3000m)



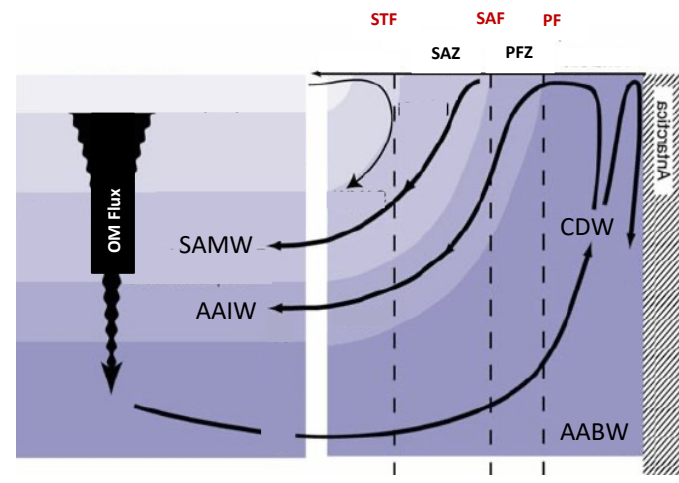
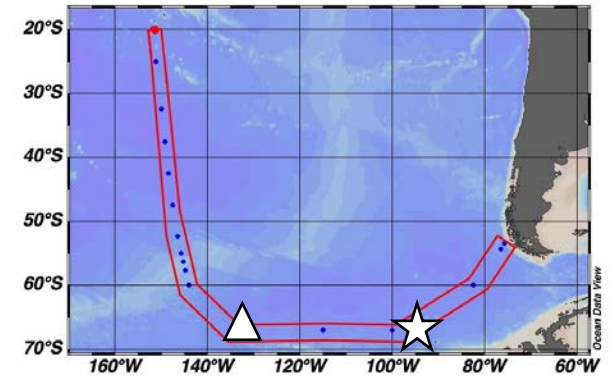
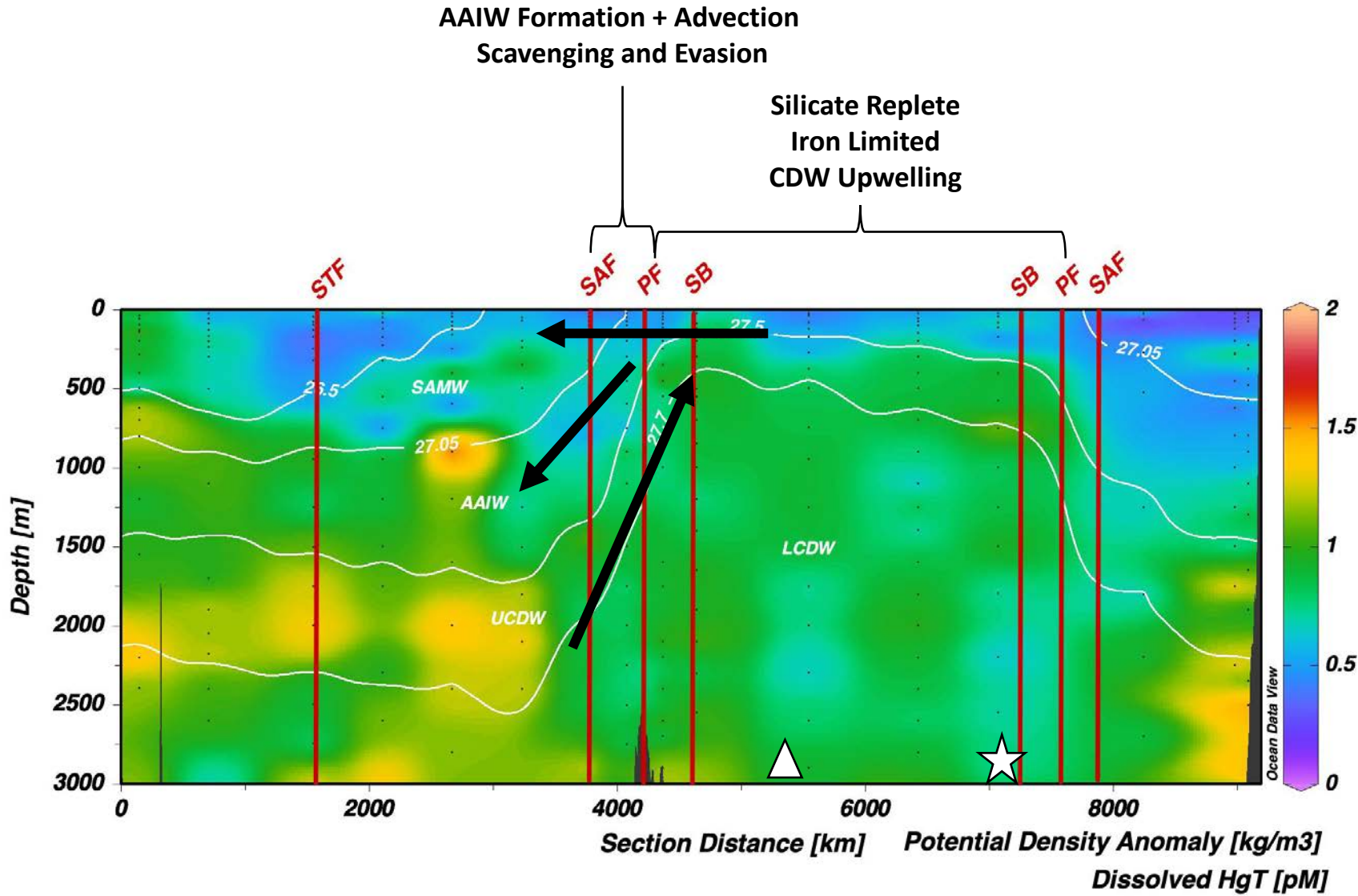
Modified from Palter et al., 2013

Total Mercury – Full Transect (<3000m)



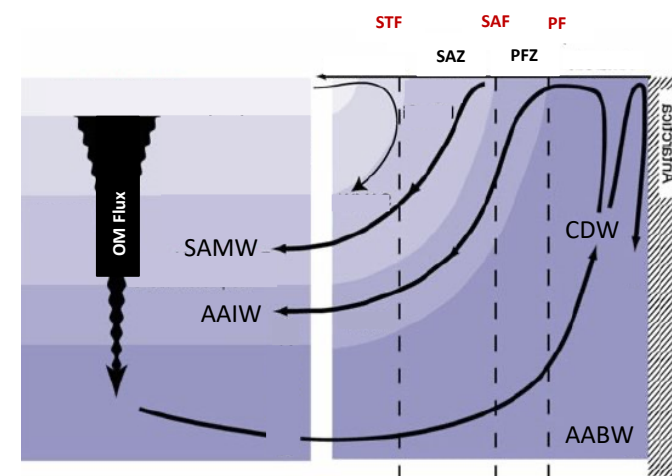
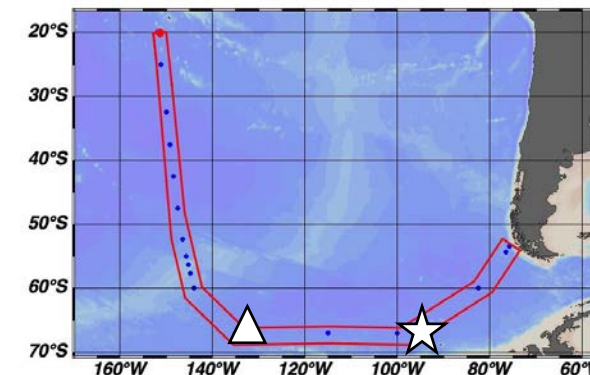
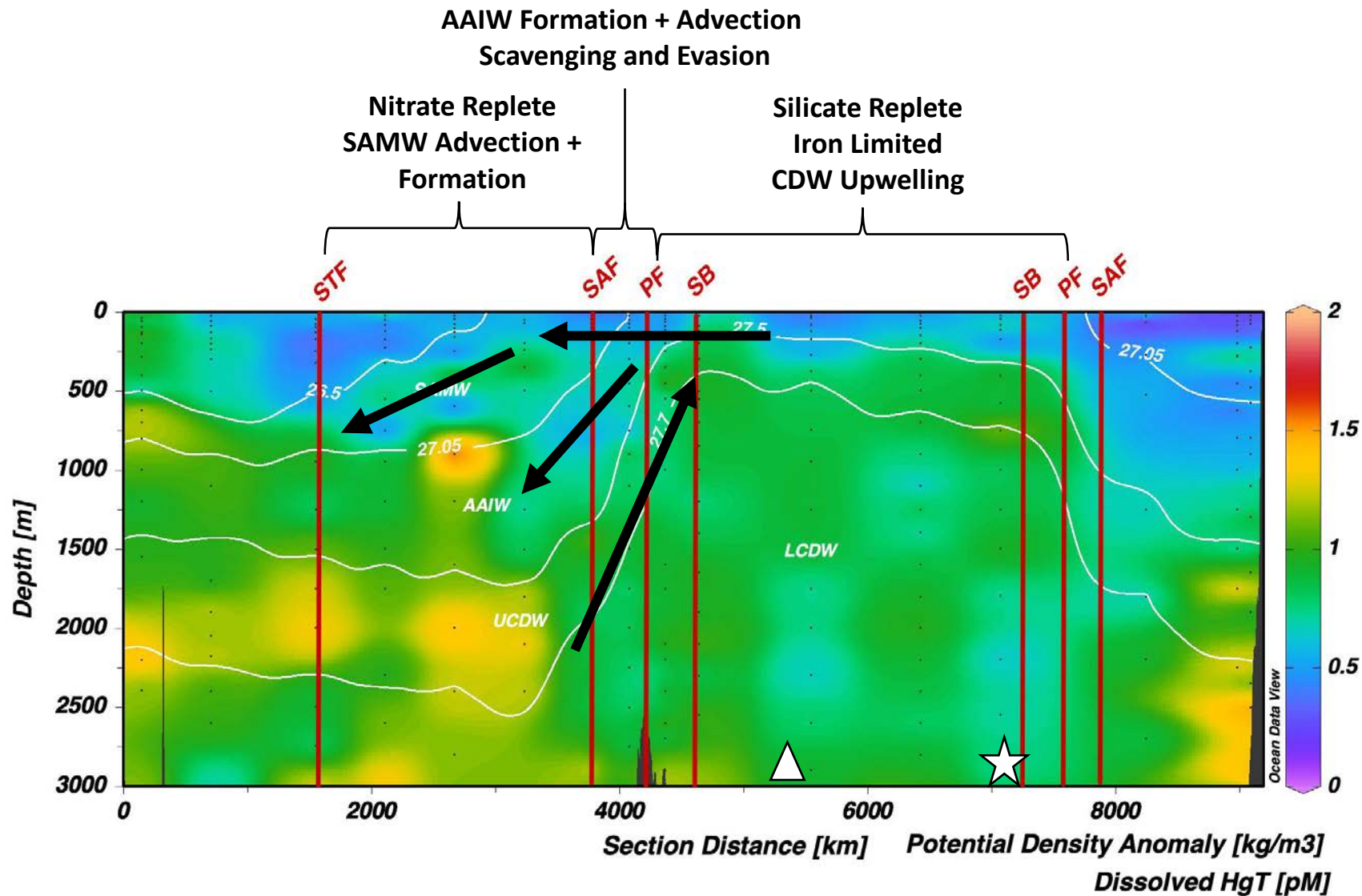
Modified from Palter et al., 2013

Total Mercury – Full Transect (<3000m)



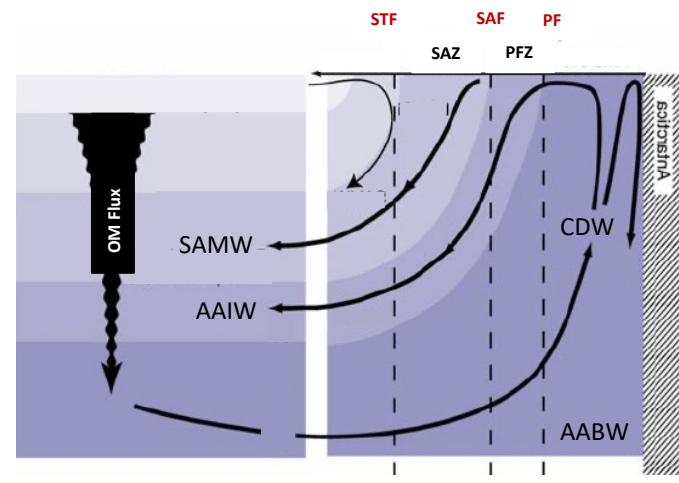
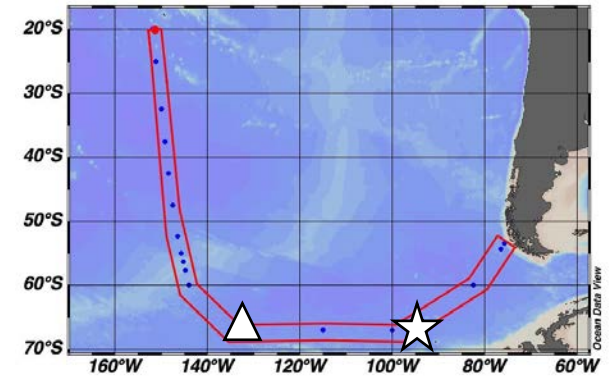
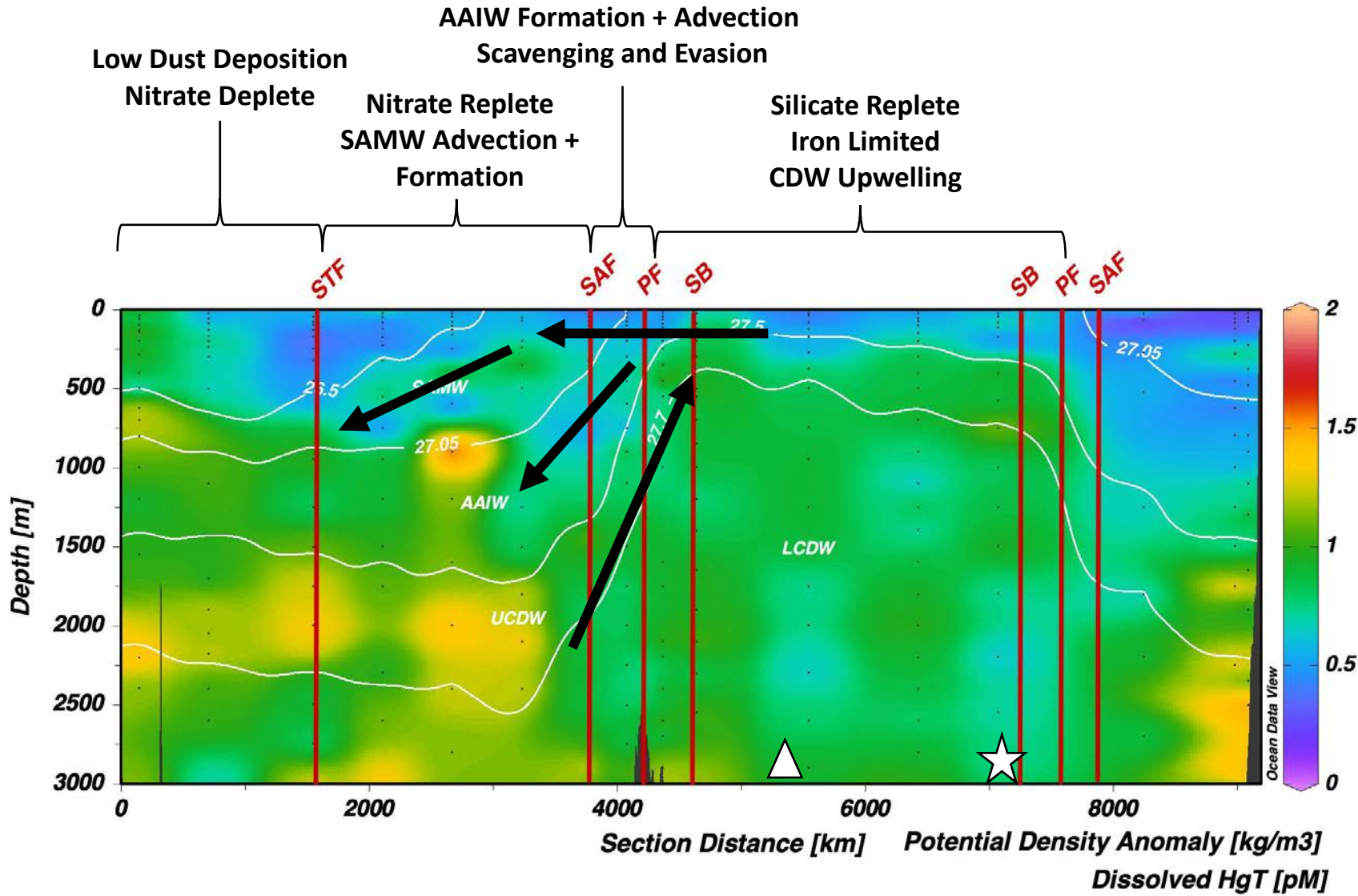
Modified from Palter et al., 2013

Total Mercury – Full Transect (<3000m)



Modified from Palter et al., 2013

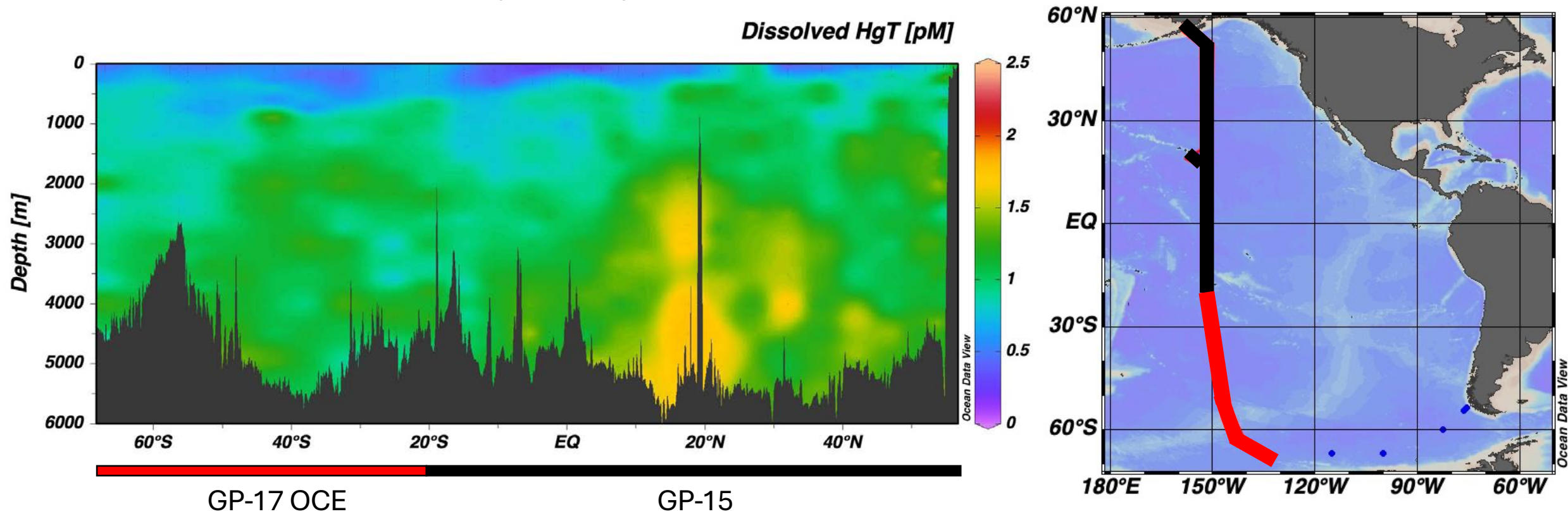
Total Mercury – Full Transect (<3000m)



Modified from Palter et al., 2013

Total Mercury – Meridional Pacific Ocean Transect

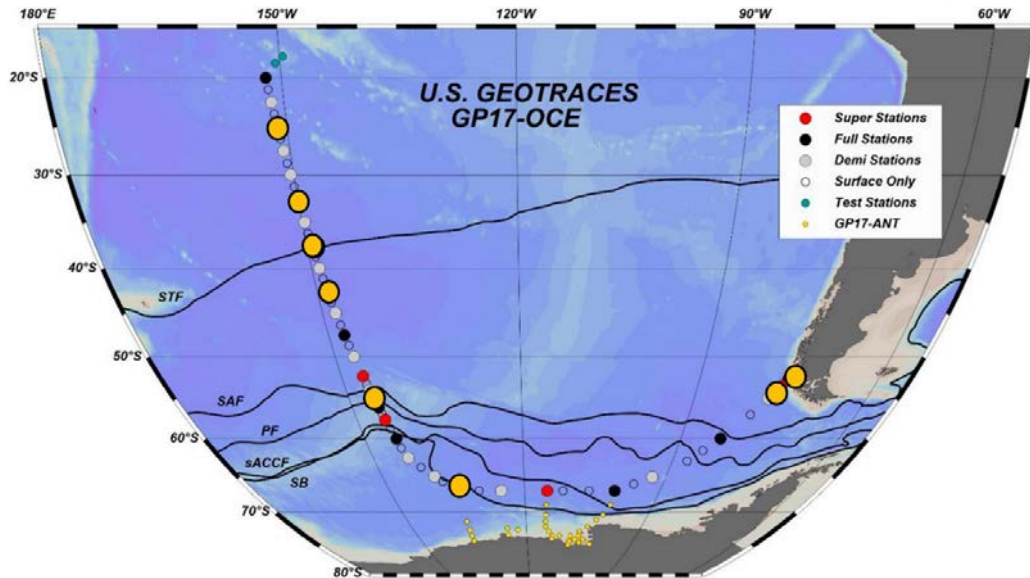
- U.S. GEOTRACES GP-15 (2018)
- U.S. GEOTRACES GP-17 OCE (2022-23)



Preliminary Conclusions

- With the currently available data, Hg evasion, scavenging, and remineralization driven by the Southern Ocean currents seem to be determining Hg speciation (HgT and Hg^0) in this region.

Next Steps...



- Complete analyses of other Hg species.
- Compile other data such as particle speciation, radioactive isotopes (Ra, Th, He) to determine fluxes, sources, sinks, and water mass ages.
- Sequence genetic samples and conduct metagenomics.

Acknowledgements



- Chief Scientists and GP-17 OCE Super Techs.
- Captain and Crew of the *R/V Revelle*
- Scripps Ocean Data Facility
- The U.S. GEOTRACES program
- Lindsay Starr



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SANTA CRUZ



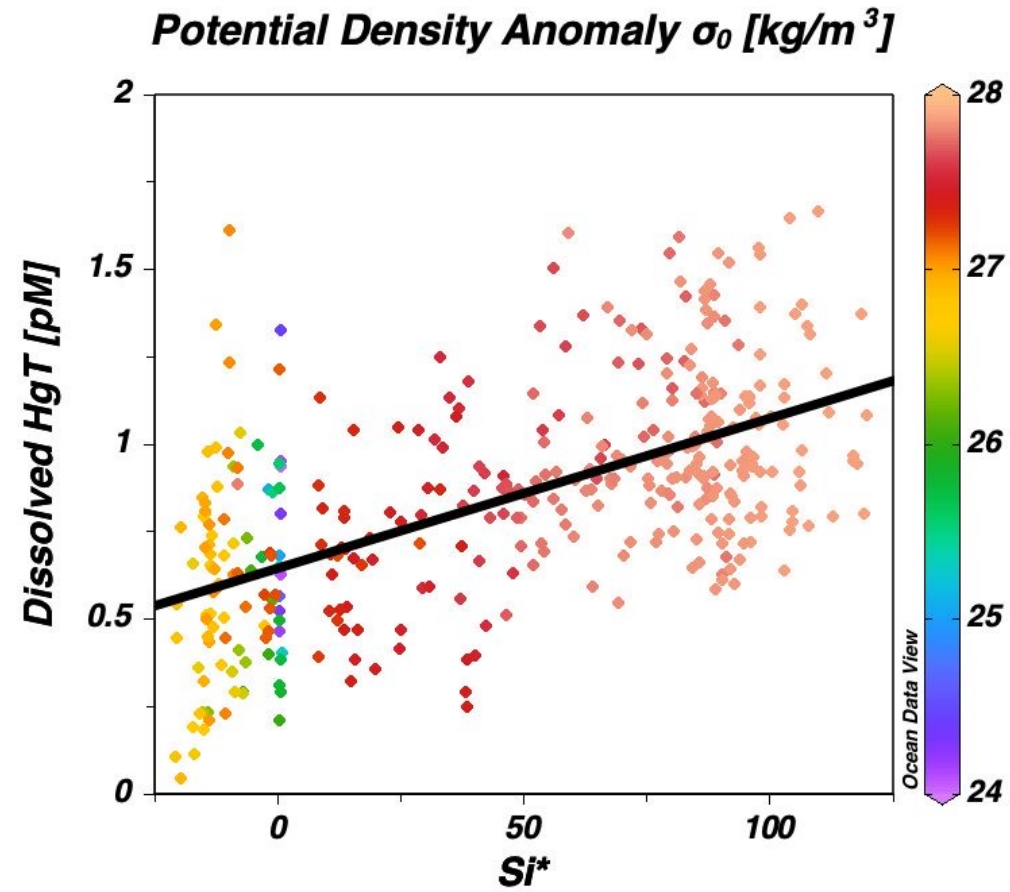


**Thank you!
Questions?**

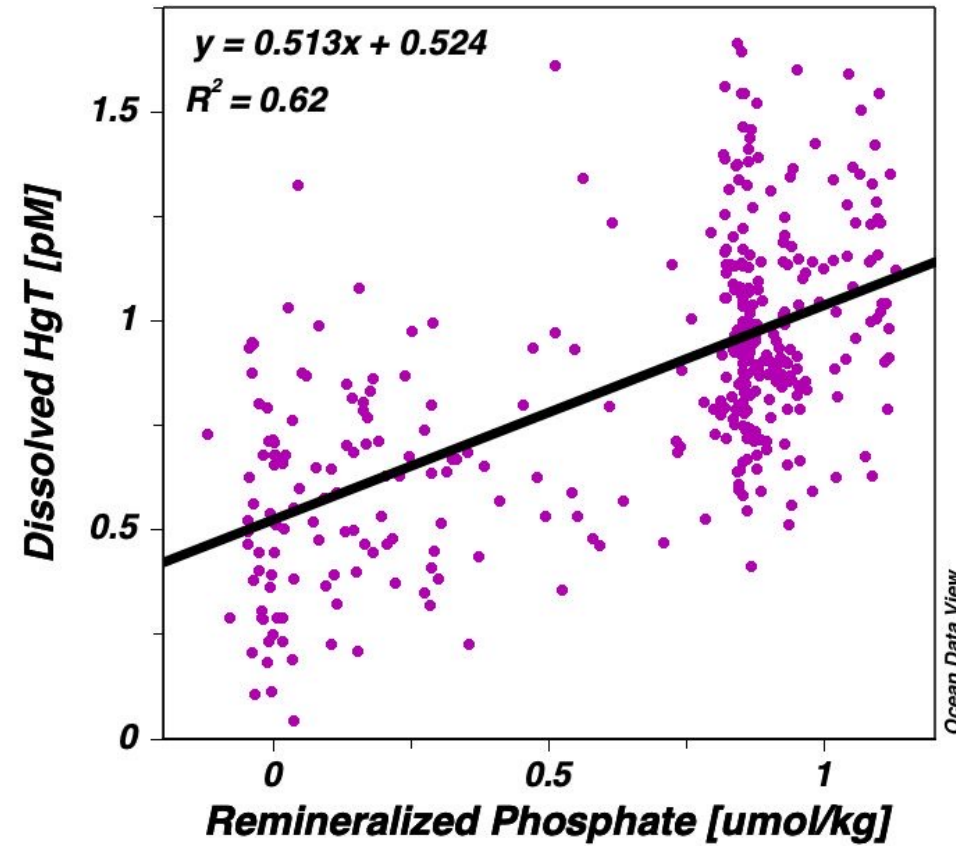
Contact: mdespins@ucsc.edu

Extra Slides

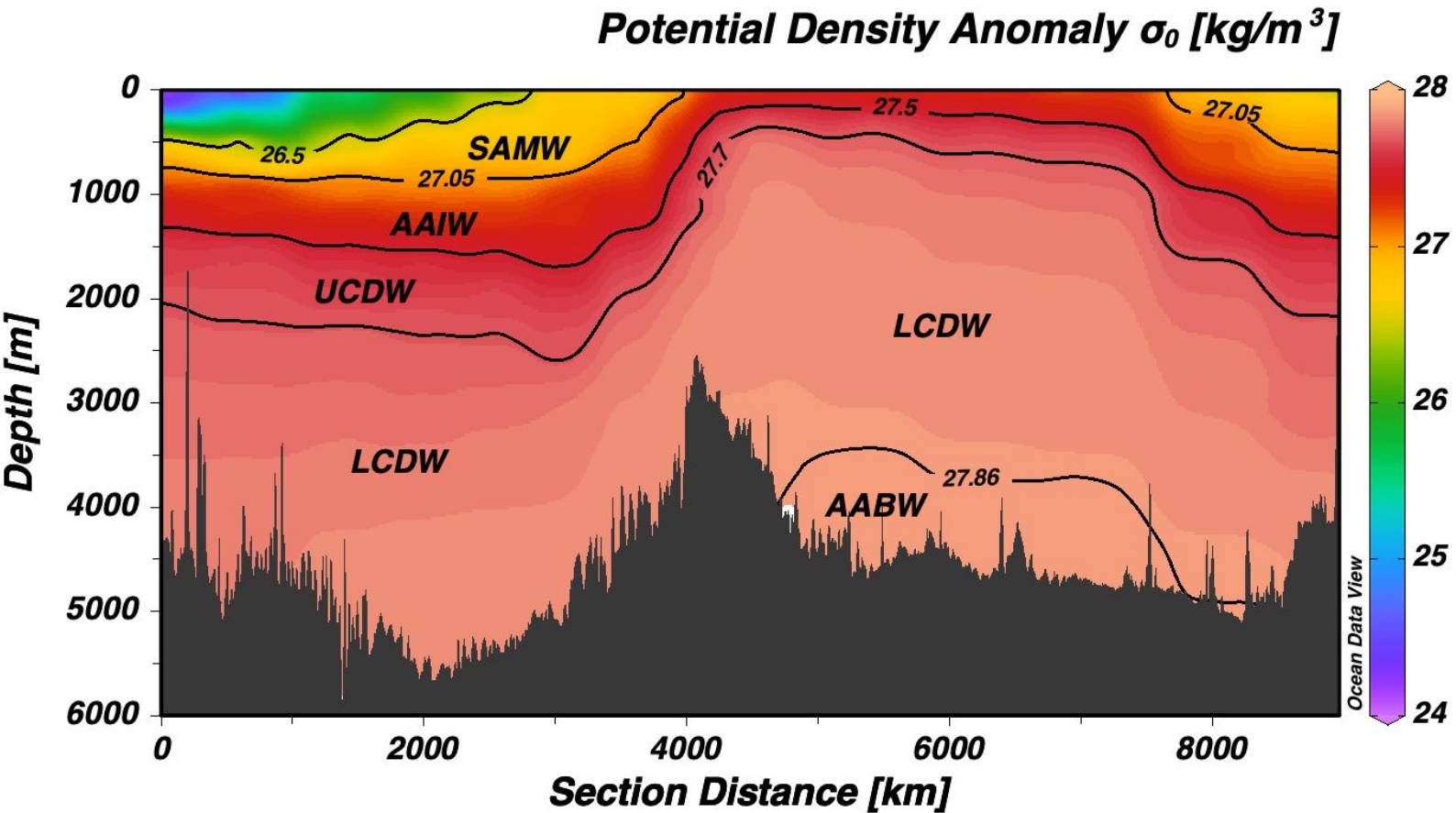
Si* and HgT



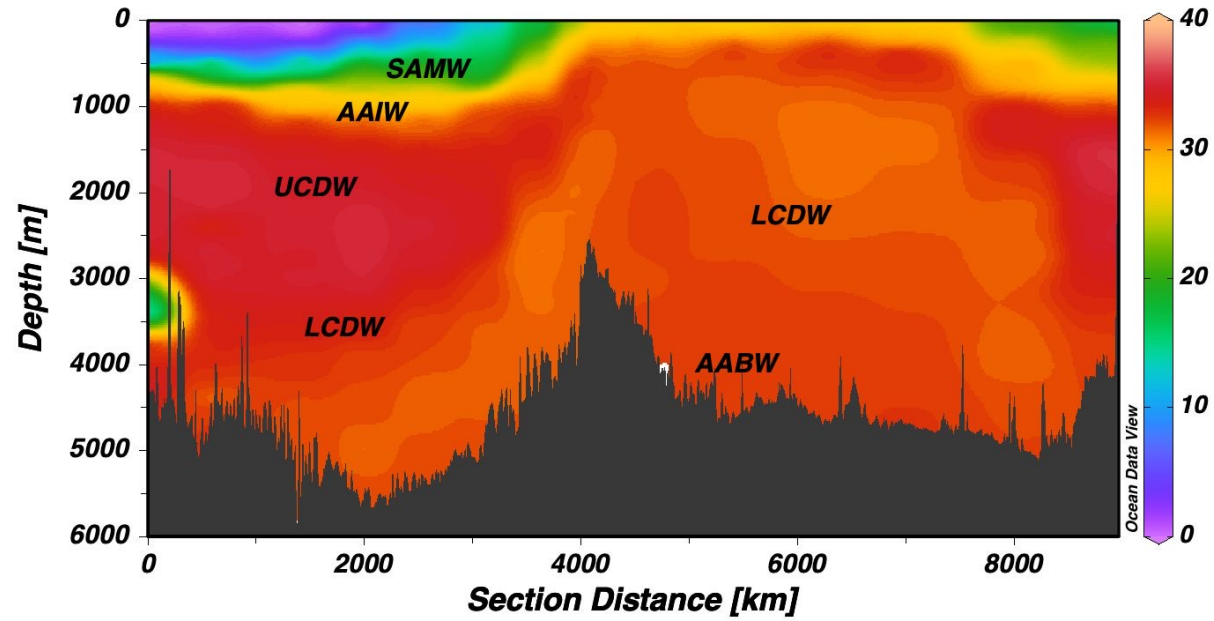
Total Mercury – Full Transect



Water Masses



Nitrate [umol/kg]



Oxygen [umol/kg]

