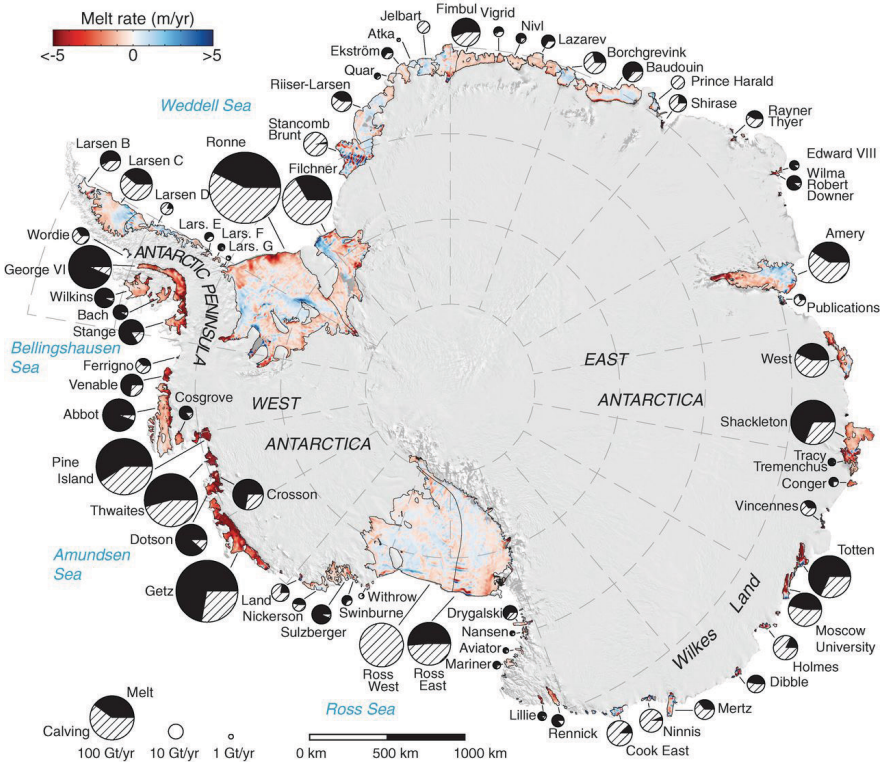
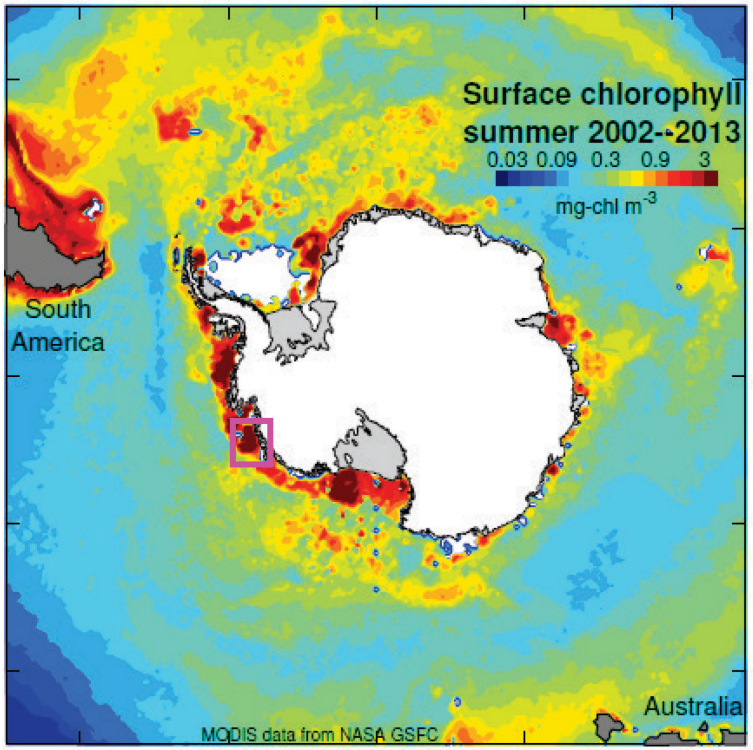
# Rationale for GEOTRACES GP 17 Amundsen Sea Transect

## Why the Amundsen Sea sector?



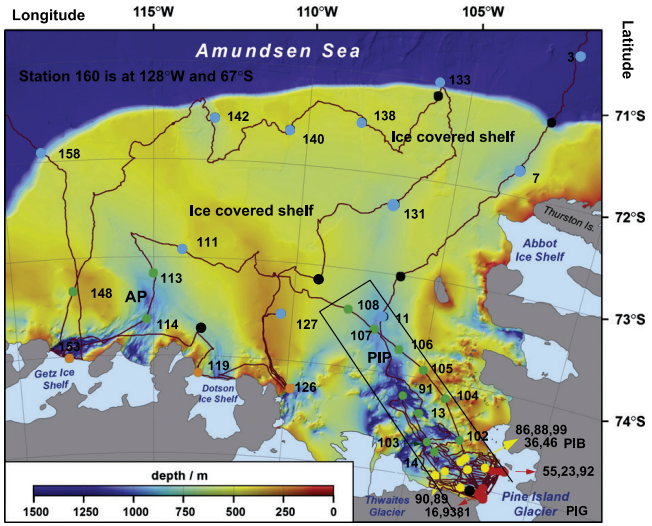

Rignot et al., 2013

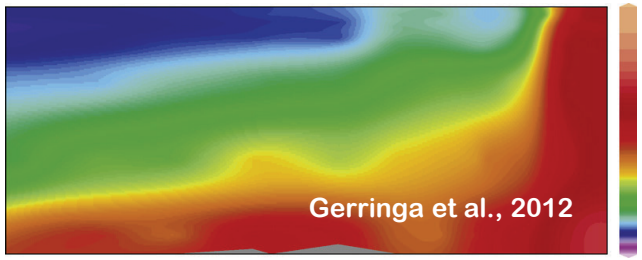


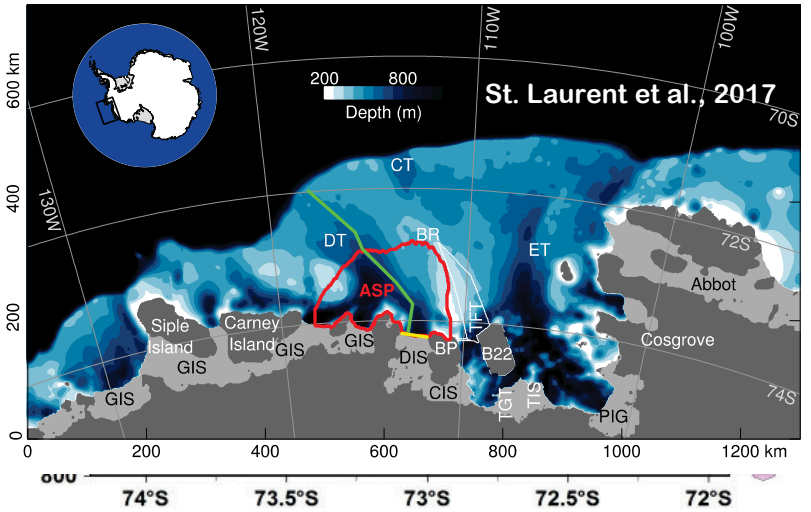

**~50% of net melting from 10 small warm-cavity ice shelves in the SE Pacific that account for 8% of the ice shelf area**

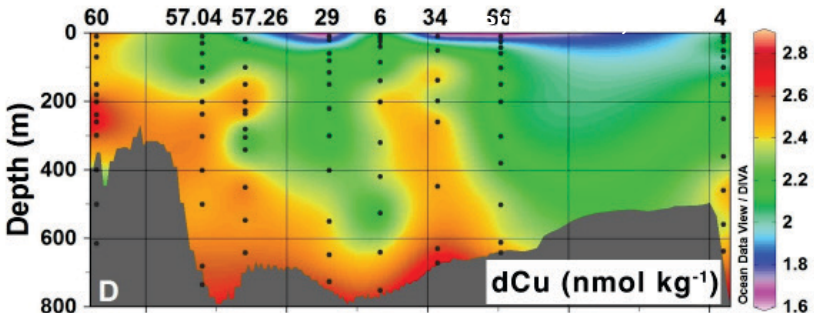
**Amundsen Sea polynya has highest net primary production per unit area on the Antarctic continental margin**

# Rationale for GEOTRACES GP 17 Amundsen Sea Transect



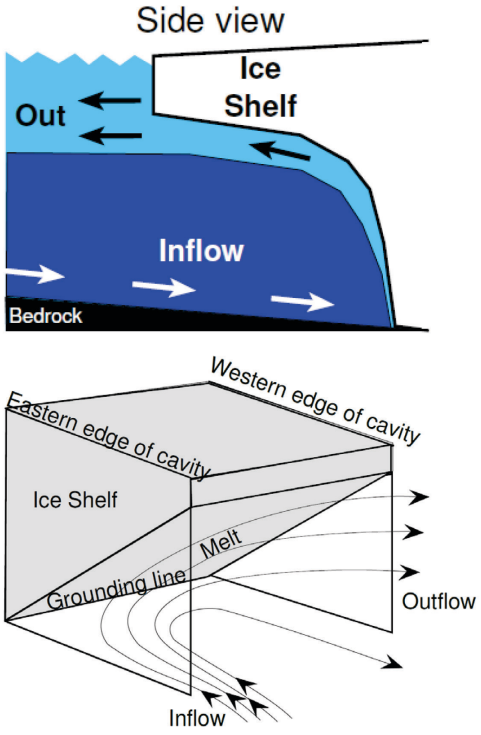



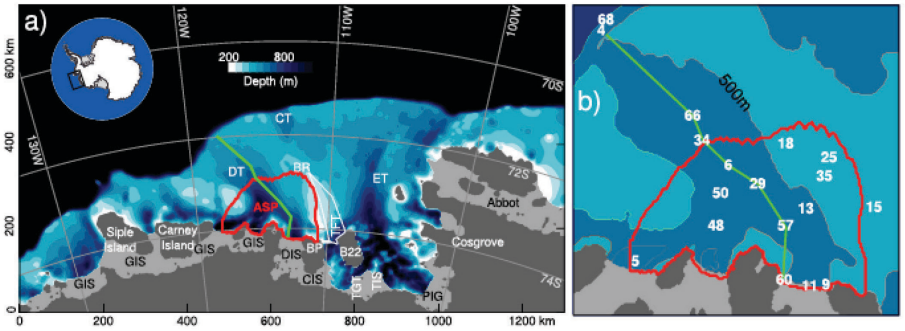




**DynaLiFe (left) and ASPIRE programs (right) documented elevated dissolved Fe adjacent to ice shelves and seafloor in Pine Island and Amundsen Sea polynyas, inferred to fuel the intense phytoplankton blooms in these locations**

# Rationale for GEOTRACES GP 17 Amundsen Sea Transect




Figures: Mike Dinniman




St. Laurent et al. (2019)

**Modeling work by St. Laurent et al. (2017, 2019) has examined dissolved Fe sources and impacts on surface waters in and around ASPIRE project domain**

**Model results suggest that glacial and benthic inputs dominate, facilitated by buoyancy- driven "meltwater pump" associated with melting ice shelves**

# Rationale for GEOTRACES GP 17 Amundsen Sea Transect

**Important implications of recent modeling work by St. Laurent et al. (2019):**

- **westward transport of dissolved Fe from upstream (PIP) contributes to ASP bloom**
- **dissolved Fe (L) and biogenic carbon flux (R) elevated over shelf downstream of ASP**

St. Laurent et al. (2019)

St. Laurent et al. (2019)

# Rationale for GEOTRACES GP 17 Amundsen Sea Transect

**Important implications of recent modeling work by St. Laurent et al. (2019):**

- **westward transport of dissolved Fe from upstream (PIP) contributes to ASP bloom**
- **dissolved Fe (L) and biogenic carbon flux (R) elevated over shelf downstream of ASP**

**<u>Limitations</u> – *No empirical constraints on:***

**1) Fe supply (processes or rates)**

**2) Fe loss (biological uptake, scavenging)**

**3) Regeneration**

**4) Cell stoichiometry**

**5) Fe stress**

**6) Upstream boundary conditions**

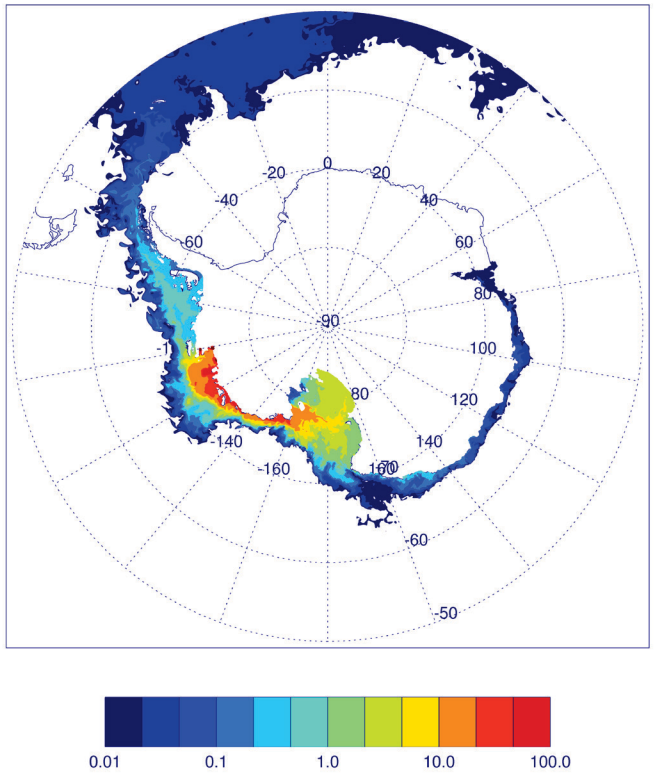
**St. Laurent et al. (2019)**

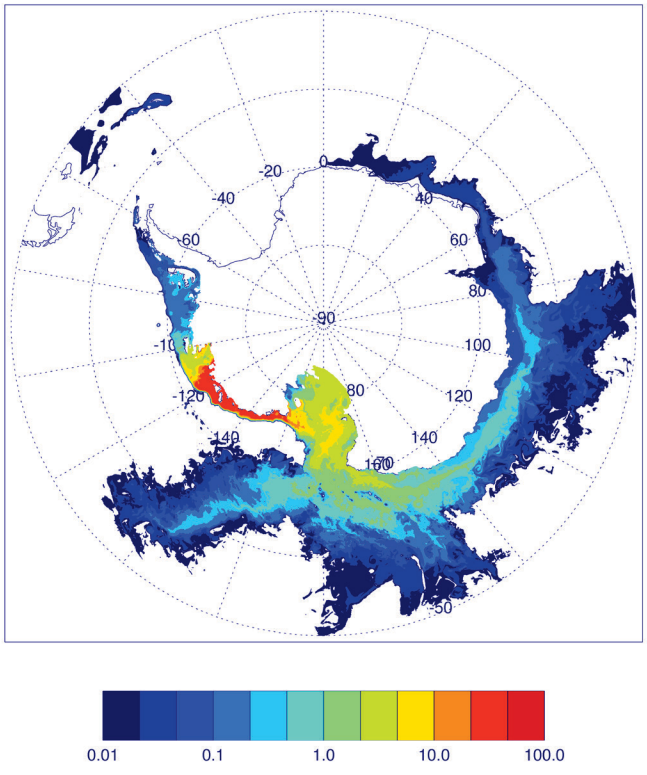
# Rationale for GEOTRACES GP 17 Amundsen Sea Transect

Loose et al. (2018)

**Recent work provides evidence of volcanic helium-3 inputs in association with glacial meltwater near Pine Island ice shelf, raising possibility of hydrothermal TEI inputs**

# Rationale for GEOTRACES GP 17 Amundsen Sea Transect




Figures: Mike Dinniman

**Pan-Antarctic ROMS modeling indicates potential influence of ice shelf melt water (fresh water, Fe, other TEI's): figures show conservative melt water tracer derived from Amundsen Sea sector in surface (L) and bottom (R) model layers after 7 years**

# Rationale for GEOTRACES GP 17 Amundsen Sea Transect

**To robustly address these questions, GEOTRACES would bring measurements of:**

1) **Noble gases (glacial ice melt sources)**
2) **Multi tracers (sea ice melt sources)**
3) **$\delta^3$He (hydrothermal sources)**
4) **Ra (sediment sources)**
5) **$\delta^{56}$Fe (sediment source processes)**
6) **$\varepsilon_{Nd}$ (sediment source provenance)**
7) **Th (scavenging and export)**
8) **pFe + cell quotas (uptake, regeneration & scavenging)**
9) **Dissolved Cd & Zn, AOU (regeneration)**
10) **Fe speciation (bioavailability and scavenging behavior)**
11) **BioGEOTRACES (physiological status)**

# Rationale for GEOTRACES GP 17 Amundsen Sea Transect

**Additional information that may be gained by combining results from Antarctic shelf and offshore Southern Ocean:**

**(1). Water mass end-member TEI composition:**

- **Essential boundary conditions for coastal models**
- **Needed for OMPA analysis of sources and sinks**

**(2). Large-scale lateral concentration gradients:**

- **Needed to characterize continent as net source or sink of TEIs for open-ocean**

**(3). Multi-tracer distributions (e.g., Ra isotopes, $\varepsilon_{Nd}$, REE patterns, $\delta^3$He, stable metal isotopes)**

- **Needed to constrain sources and identify processes for those TEIs for which the Antarctic continent serves as a net source to the open ocean**