Antarctica's Cenozoic Ice and Climate History: New science and new challenges of drilling in Antarctic waters
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# DRAKE-SCOTIA GATEWAYS

## Onset and development of the Drake Passage and Scotia Sea gateways and their influence on global ocean circulation and climate

*PROPONENTS:*

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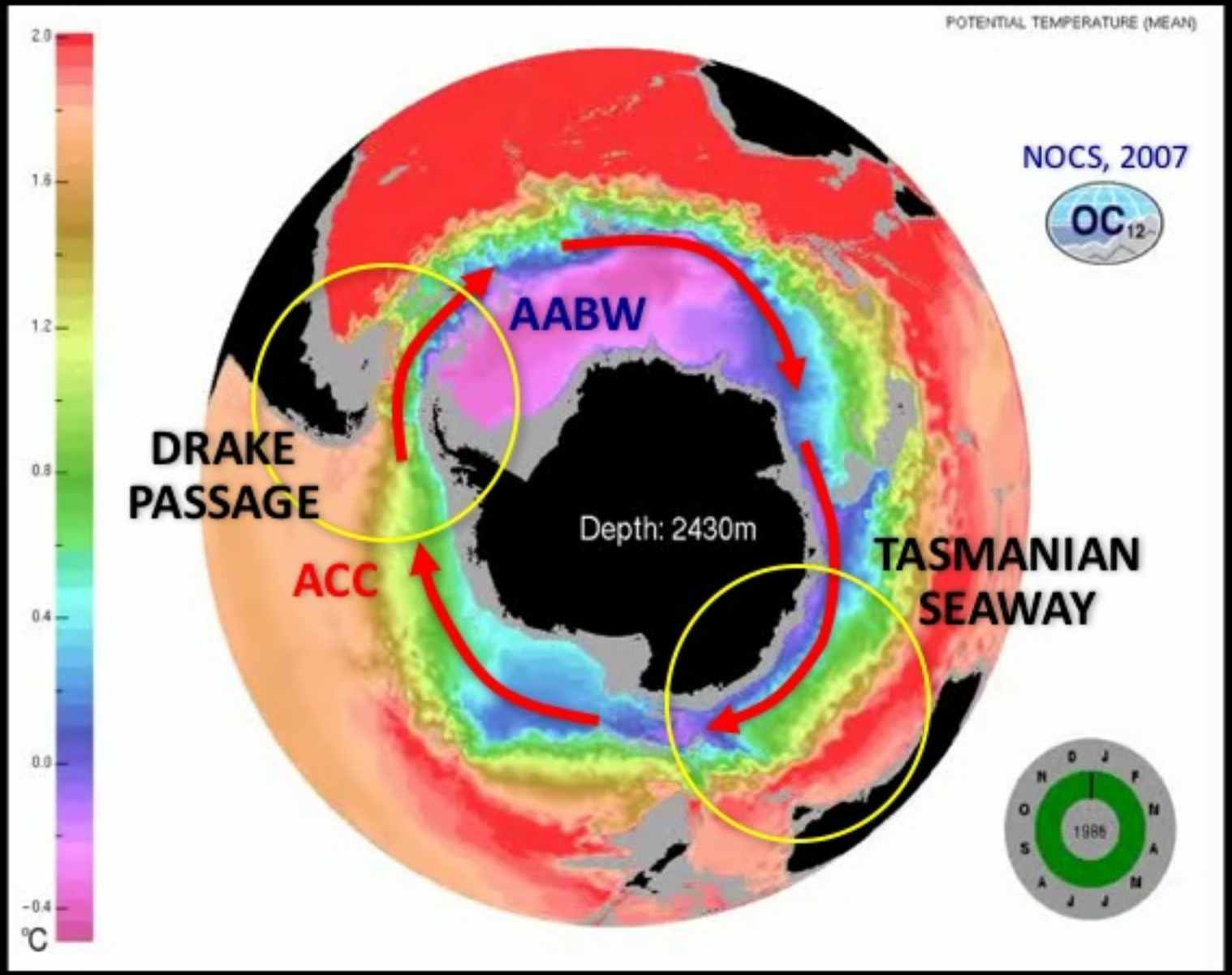
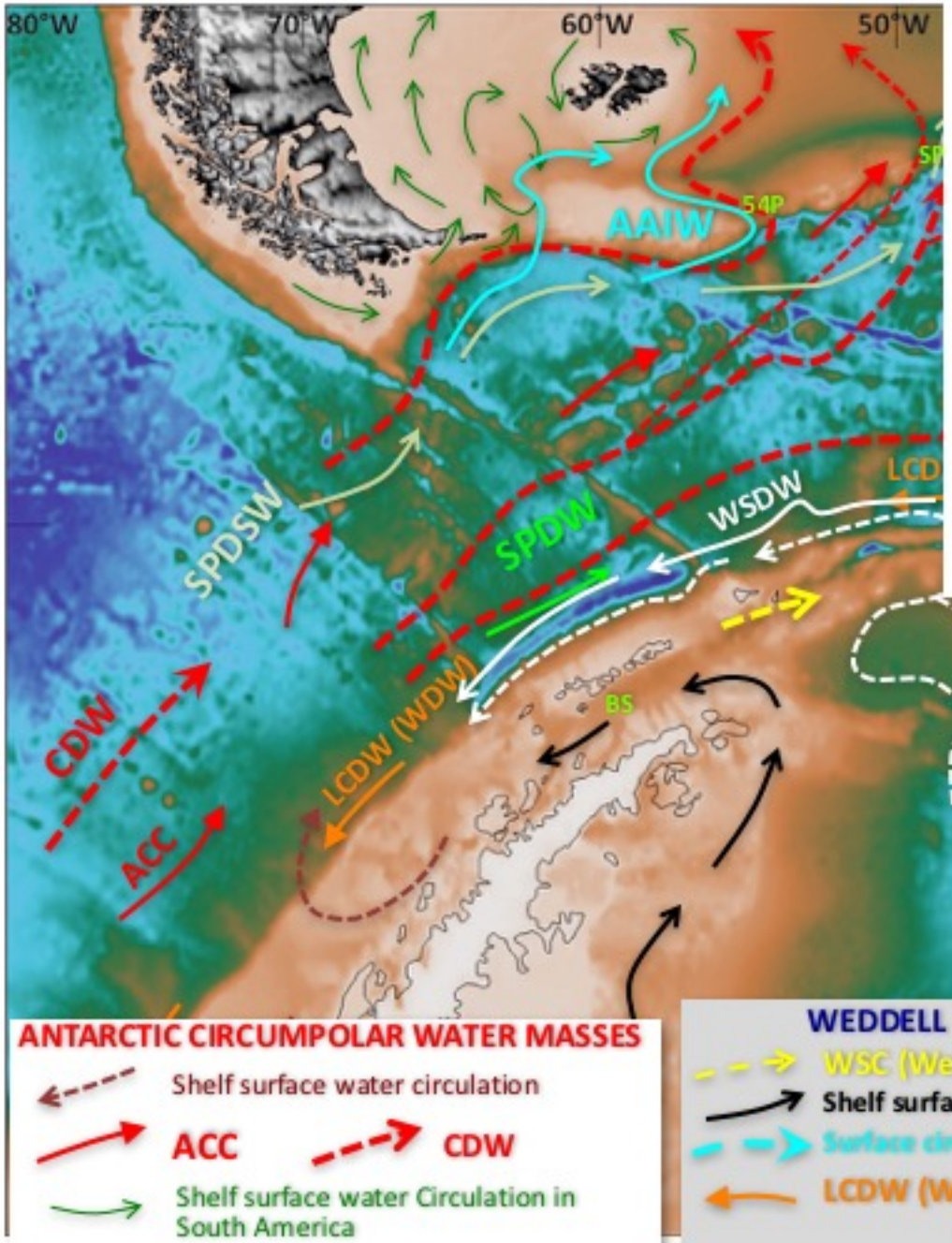
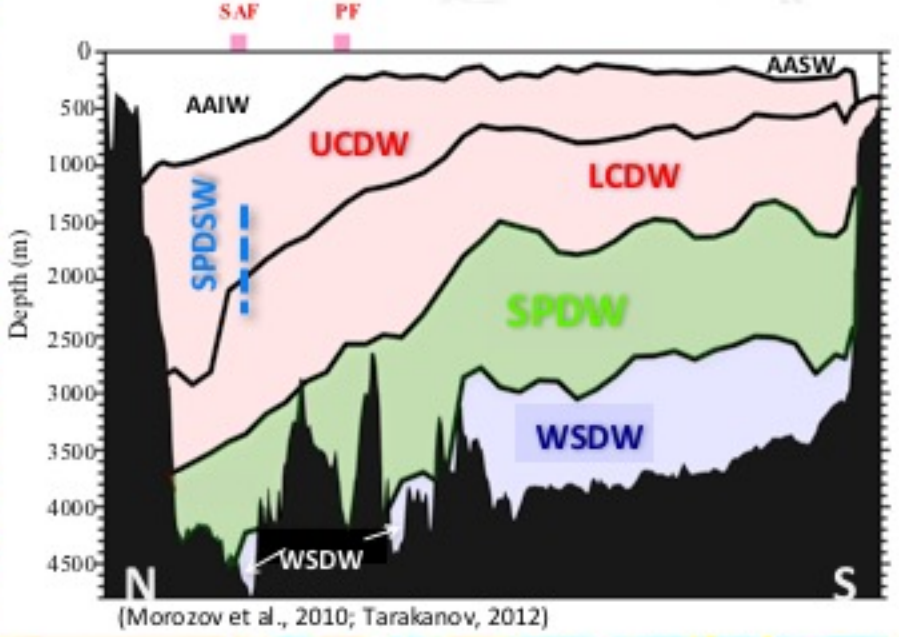
TALK OUTLINE
I. INTRODUCTION
II. IODP 868 FULL PROPOSAL: DRAKE-SCOTIA GATEWAYS
III. CONCLUDING REMARKS

# This area represents a critical deep-water seaway for the ACC and AABW



# WATER MASSES CIRCULATION




(Morozov et al., 2010; Tarakanov, 2012)

**ANTARCTIC CIRCUMPOLAR WATER MASSES**

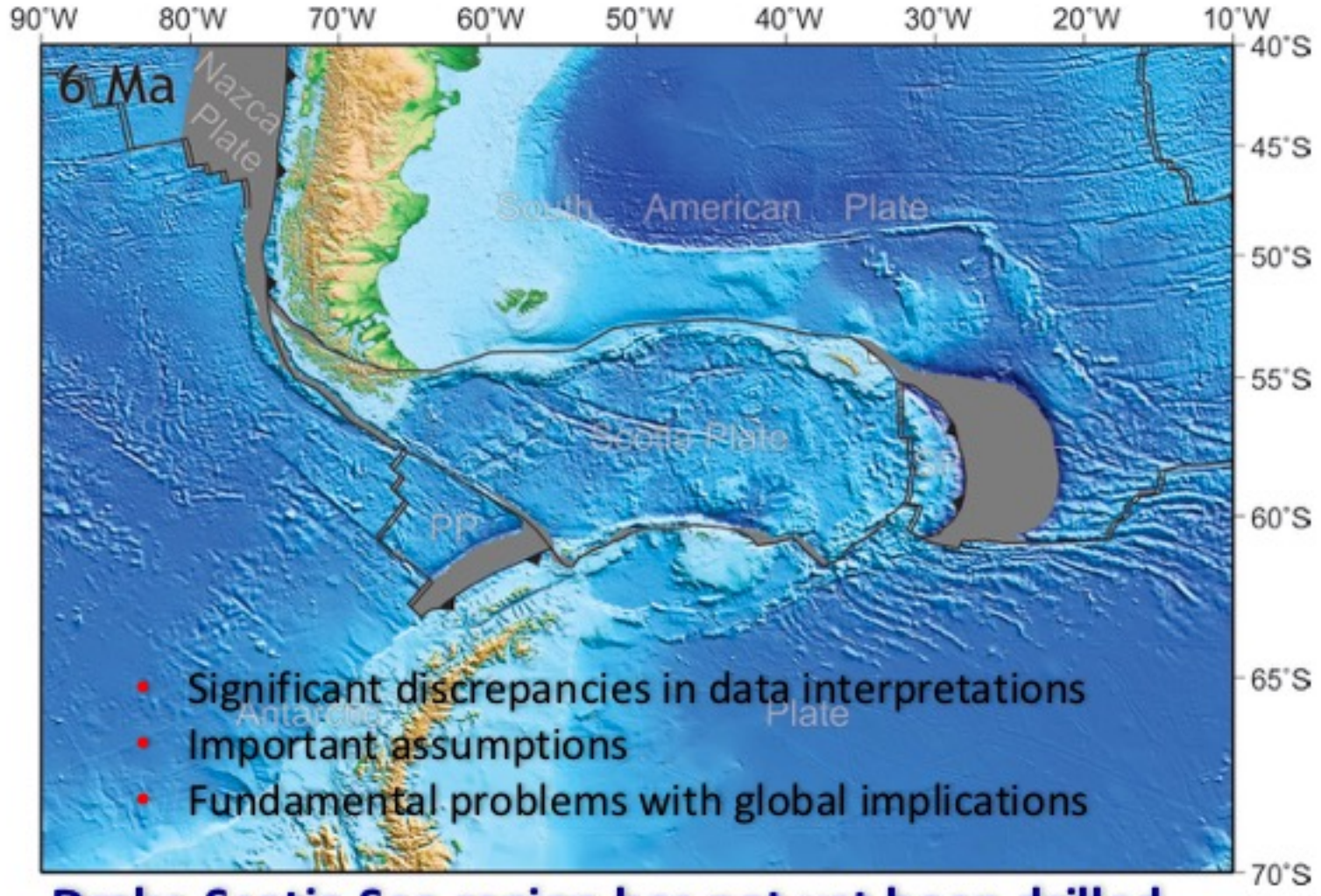
- Shelf surface water circulation
- ACC
- CDW
- Shelf surface water Circulation in South America

**WEDDELL WATER MASSES**

- WSC (Weddell Sea Confluence)
- Shelf surface water circulation
- Surface circulation of the Weddell Gyre
- LCDW (WDW)
- WSDW
- AABW
- WSBW

er depth (Km)
3.5
4
4.5
5
70°S

# DRAKE-SCOTIA SEA RECONSTRUCTIONS




**Drake-Scotia Sea region has not yet been drilled for scientific purposes**

(*Only one previous proposal:* IODP 634 Full, Barker et al. 2005)

(Eagles & Jokat, 2014)

AWI

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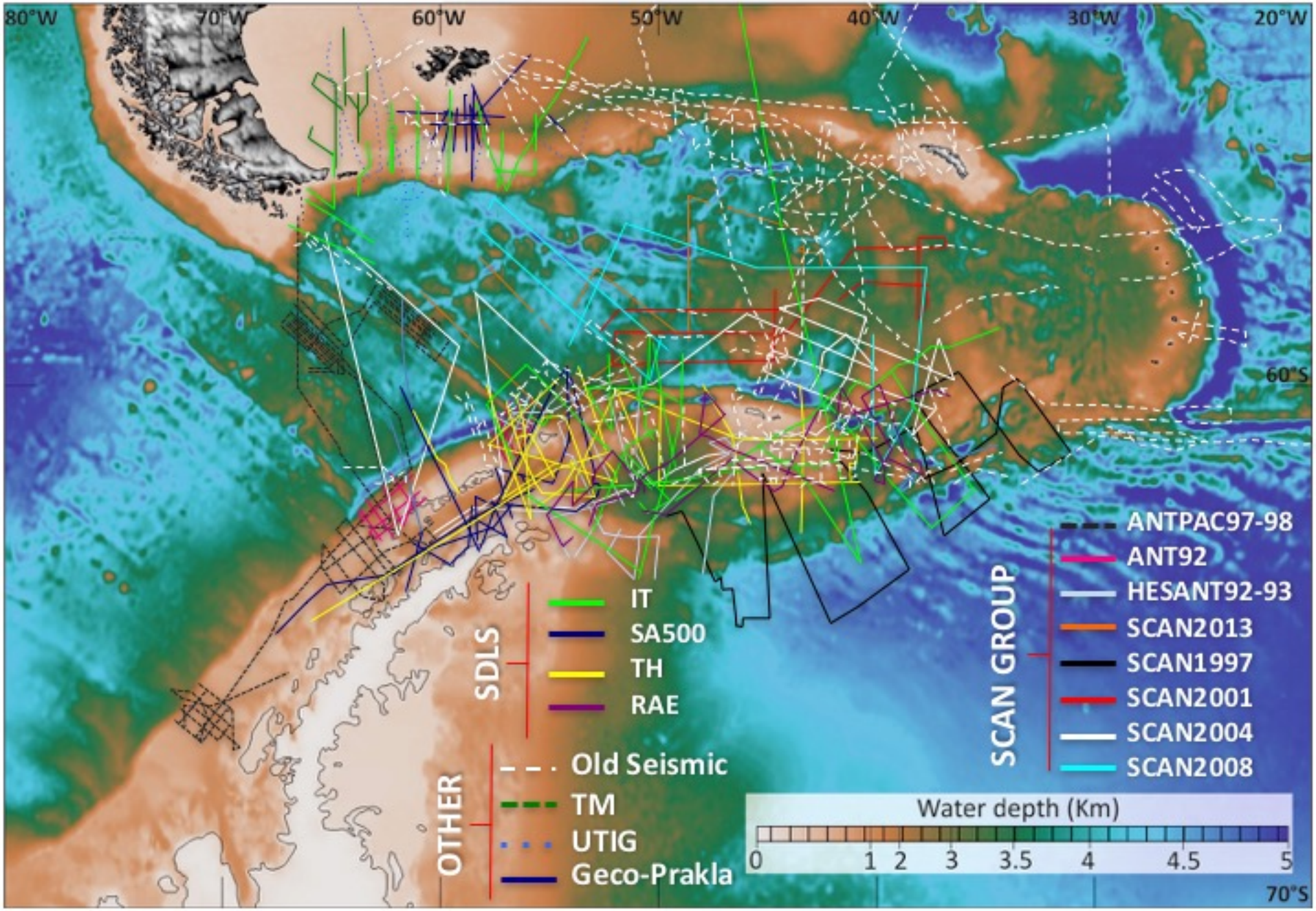
# IODP PRE-PROPOSAL: DRAKE-SCOTIA GATEWAYS



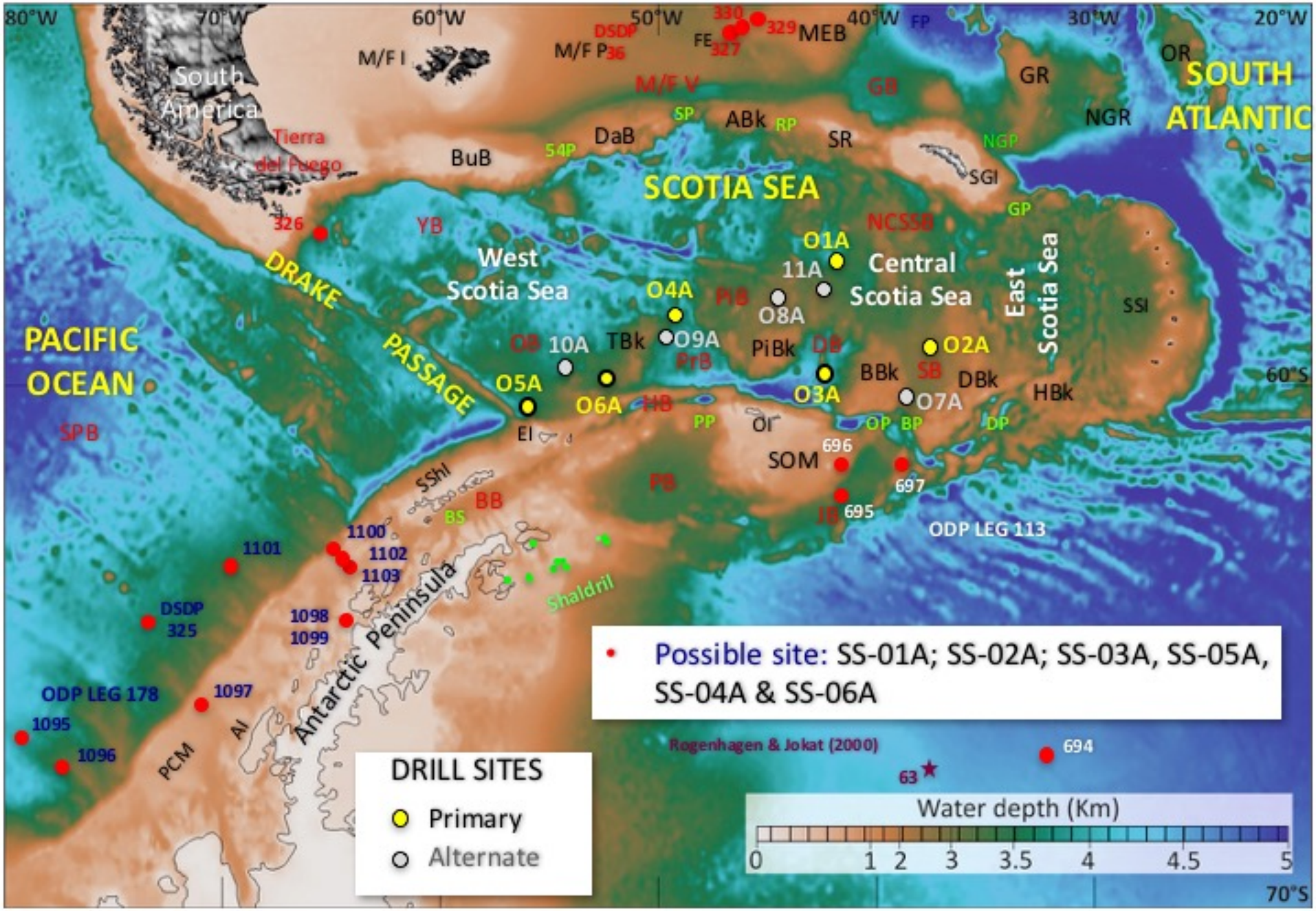
IODP PROPOSAL:DRAKE-SCOTIA GATEWAYS

- **DRAKE-SCOTIA GATEWAYS** aiming to determine the time of opening and pattern of development of seaways in the Drake Passage (DP) and the Scotia Sea (SS), and their influence on global ocean circulation, biotic evolution and climate.

- Uncertainties over the early stages of development of the DP-SS will be resolved through drilling in basins in the central and southern Scotia Sea.

- We address fundamental questions posed in the IODP Science Plan for 2013-2023 and their outcomes are relevant to the SCAR – PAIS Science Programme.

# DRAKE-SCOTIA GATEWAYS



IODP PROPOSAL:DRAKE-SCOTIA GATEWAYS

| SCIENTIFIC OBJECTIVES | *Hypothesis?* |
|---|---|
| 1. *Plate tectonic processes and their effects on Earth surface processes* | • *Internal and external processes are linked in both the long- and the short-term* |
| 2. *Oceanic gateways and their influence on climatic, biotic and oceanographic changes* | • *Opening of the seaways in the DP and SS was a three-phase event. 1) shallow and intermediate proto-ACC; 2) deeper ACC; 3) new deep seaways for the AABW.* |
| 3. *Paleoceanography and global climatic significance of the onset of water mass formation;* | • *The onset of water masses occurred at different times and had significantly influenced global circulation and climate.*<br>• *External factors of climate change have directly influenced the ACC and the AABW over time* |
| 4. *Ice sheets, sea-level changes, bottom currents and sediment architecture* | • *Interplay among climate, ice sheets, sea level and ocean circulation controls deep marine sedimentation*<br>• *The Scotia Sea rapidly changed to a system dominated by bottom current processes, first via the ACC and later, by the WSDW.* |
| 5. *Deep life in a polar environment* | • *The deep biosphere has adapted to survive in extreme conditions spanning complex and variable geodynamics.* |

IODP PROPOSSAL:DRAKE-SCOTIA GATEWAYS

- **Presented in 2014** = IODP 868-Full
- *Objectives* = Tectonic, sedimentary & paleoenvironmental reconstructions. More focused on tectonics objectives (onset and basin evolution) and evolution until Late Miocene.
- **Deep (basement) objectives** for dating the oceanic crust in several basins.

- **IODP SEP Evaluation** = January 2015
- *Recommendation*= Deactivate, **BUT encourage the proponents to submit a new pre-proposal**
- Panel recognizes the importance of the proposed science
- Panel did not consider / mention the tectonic objectives

# SEP Recommendations

- REFINE THE HYPOTHESES
- HOW THE RECORD SHOULD BE DATED?. Panel feels that age control methods need to be clearly defined and assessed.
- PALEO-ENVIROMENTAL PROXIES. Improve the paleoceanographic objectives and more discussion about the proxies. Panel propose to include more paleoceanographers in the proposal.
- Panel propose to include more sedimentologists in the proposal
- SEDIMENT RECORD TO RECONSTRUCT ANTARTIC ICE-SHEET CHANGE. Expand and improve this part in the proposal
- DEEP BIOSPHERE. More complete development or removal from next proposal

# SEP Recommendations: Drilling strategy

- Revaluate the proposed sites. 6-7 sites are too much for a simple leg. **So, options?**
- Deep penetration (> 1000 m) which makes achieving objectives higher risk.
- Identifying shallower targets and multiple alternate sites will be critical to the success of the expedition.

- **Multi-phase drilling project (MDP)?**
  .- 2 Leg, 6-7 Sites.
  .- All basins to be drilled.
  .- Only way to achieve the onset and evolution of Drake-Scotia gateways
- **2 independent legs with 6-7 Sites?**
  .- All basins to be drilled.
- **Only 1 leg with 3 Sites?**
  .- 2 basins to be drilled.

# CONCLUDING REMARKS


- **DRAKE-SCOTIA GATEWAYS** proposal represents a chance to understand the global link between tectonic, paleoceanographic, climatic, biotic, ice-sheet, sea-level and bottom current changes from Eocene to recent time.

- Major paleoenvironmental and paleoceanographic changes, and their global consequences.

- The Drillship JOIDES Resolution is expected to operate in the South-Atlantic Oceans in 2019 / 2020, so the proposal is timely.

- Potential results will be integrated with those from other regional studies, including ODP Leg 113 (1987); ODP Leg 178 (1998); IODP 732-Full; IODP 847-Full; and IODP 862-Pre.