Ice sheet, atmosphere, and ocean dynamics in the Atlantic sector of Antarctica – IODP proposals 848 (Weddell Sea) and 902 (Iceberg Alley)

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IODP PROPOSAL 902
Late Neogene reconstruction of ice-sheet, atmosphere, and ocean dynamics in Iceberg Alley
Millennial-scale variability in Antarctic ice-sheet discharge during the last deglaciation

Iceberg Routing Through Iceberg Alley

- Cores are ideally located for three reasons:
  1. Antarctic Ice-sheet history
  2. East of Drake Passage (ACC)
  3. In the trajectory of Southern Patagonian dust source

Iceberg trajectories after Gladstone et al. (2001)
Stuart & Long (2011)
Highest Mean Iceberg Probability in Iceberg Alley

Iceberg Alley

- Probability of small icebergs (100-m to 3-km long; color coded) and large icebergs (≥ 6 km long, black lines), shown for the years 1993 – 2013. Credits Jean Tournadre (Ifremer).

- Iceberg Alley captures a specially integrated signal of Antarctic ice mass loss.

- Reconstruction past ice-sheet dynamics is this key location has therefore the potential to deliver unprecedented insight into the Antarctic glacial history.
Antarctic Ice-Sheet Discharges & Climate Development

Sprenk et al. (2013, GSL)

Weber et al. (Nature, 2014)

Antarctic Drilling Workshop College Station
M.E. Weber et al.
IODP proposals 848 & 902
**Plio-Pleistocene Dust Couplings**

Martinez-Garcia et al. (2011; Nature Geo)

- Marine cryogenic dust couplings will be used to constrain the chronology (by wiggle matching) and to study the dust transport history from Patagonia

Weber et al. (2012; QSR)
N-S transect work in the Scotia Sea

McCave et al. (2014, Nature Geo)

- Selected investigation areas in Pirie Basin (Site MD07-3133) and Dove Basin (Site MD07-3134) are in the center of previous, north-south oriented transect work on current speed and sea-ice extent.

Collins et al. (2013, QSR)
Specific Objectives 902-Full: Iceberg Alley

One drilling in Dove Basin and one in Pirie Basin (600-1000 m; with 10 alternate sites) should reconstruct, along a latitudinal transect, the evolution of the AIS through major Late Neogene transitions (Middle Miocene glacial intensification of the EAIS, mid-Pliocene warm interval, Late Pliocene glacial intensification of the WAIS, MPT, warm interglacials of the last 800 kyr, and glacial terminations). Major topics are:

- Establish the time frame with bio-, magneto-, and tephrostratigraphy, stable isotopes, paleointensity, and dust tuning
- Variability in and sources of AIS mass loss
- Relationship between AIS mass loss and global sea level
- Linkages between climate and AIS events and their interhemispheric phasing
- Effects of water-mass changes and ocean thermal forcing on ice-mass loss
- Dust-climate couplings and dust sources, as well as potential effect on iron fertilization and glacial CO2 drawdown
- Glacial-to-interglacial changes in the frontal systems and associated sea-ice shifts and the carbon cycle
- Changes in sea-ice extent and interaction with the Antarctic Circumpolar Current and the Southern Hemisphere westerlies
- Paleoceanographic changes of the Drake Passage and thermal isolation of Antarctica
- Paleoceanographic evolution of the ACC and Weddell Sea Bottom Water recorded by the five seismic units