Changes in the Antarctic Circumpolar Current strength at the Pacific entrance of the northern Drake Passage over the past ~ 1.5 million years

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1. Introduction

The Antarctic Circumpolar Current (ACC) is the world's largest current system in the Southern Ocean connecting the Atlantic, Pacific and Indian oceans basins. The ACC fundamentally affects the global meridional overturning circulation. The major geographical constriction for the transport of the ACC is the Drake Passage. Through the Drake Passage, fresh and cold waters return to the Atlantic ("cold water route") affecting the strength of the Atlantic Meridional Overturning Circulation.

Three major oceanographic fronts are seen within the ACC. Their position is not stationary but changes through time at various time scales. In the Drake Passage area, the location of the fronts is crucial. It has been shown that during glacial times, a northward position of the fronts and the southern westerly winds causes a reduction in the flow of the ACC thus weakening the cold water route through the Drake Passage.

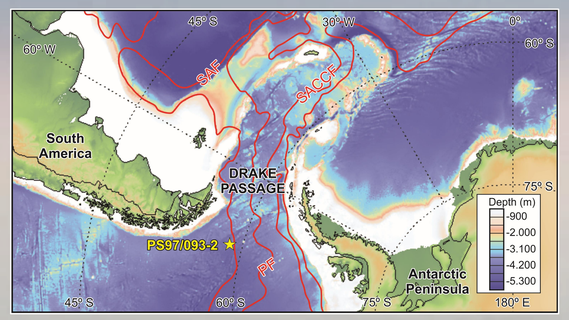

Fig. 1. *Map showing the Drake Passage region and the oceanic fronts: SAF, Subantarctic Front, PF, Polar Front, SACCF, southern ACC Front. The yellow star indicates the location of core PS97/093-2.*

2. Objectives

The general objective of this work is to reconstruct the intensity of the ACC over the past ~1.5 myr based on a multi-proxy approach of core PS97/093-2. The core is 16.45 m long and was collected at the Pacific entrance of the Drake Passage area near the Subantarctic Front and within the main flow of the ACC (57° 29.95'S, 70° 16.48'W, 3780 m water depth) (Fig.1).

- ❑ To develop an age model for core PS97/093-2 based on oxygen isotopes of foraminifera, traditional biostratigraphy, and tuning to sediment and ice core records.
- ❑ To use the ($\overline{SS}$) proxy in core PS97/093-2, to reconstruct changes in ACC current strength (McCave et al. 1995) .
- ❑ To combine with records of grain-size sensitive elements (i.e. Zr/Rb), in order to obtain high-resolution records of bottom water circulation changes.

3. Preliminary results and conclusions

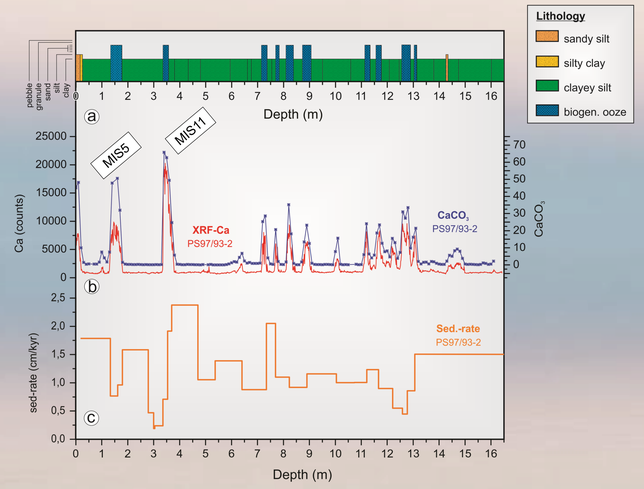

Fig. 2. a) *Core description of PS97/093-2 from PS97 Cruise Report (Lamy 2016).* ***b)*** *XRF Ca core-scanner record compared with % $CaCO_3$ content, and* ***c)*** *Sedimentation rate vs. core depth (m).*

- ✓ Sediment core PS97/093-2 consists of a recurring sequence of distinct lithologies (from base to top): Whitish gray calcareous ooze, that changes into a dark clay void of biogenic components, or a transitional diatomaceous fine-grained sediment. The dark gray clay gradually changes into a diatomaceous silt, more greenish gray (Fig.2a).
- ✓ Carbonates: correlation of $CaCO_3$ to XRF Ca counts XRF shows a very good fit. These records from core PS97/093-2 indicate that Ca content is higher during interglacial periods with two marked peaks related to MIS5 and MIS11 (Fig. 2b).
- ✓ Age model: Preliminary age of PS97/093-2 is based on biostratigraphic markers, the graphical correlation of magnetic susceptibility and density records of the core to Antarctic ice-core temperature records EPICA Dome C (Jouzel et al. 2007) and the Lisiecki and Raymo (2005) benthic isotope stack and the comparison with geochemistry data.
- ✓ The age model based on these preliminary correlations indicates that sedimentation rates vary from 2.25 to 0.25 (cm/kyr) (Fig. 2c).

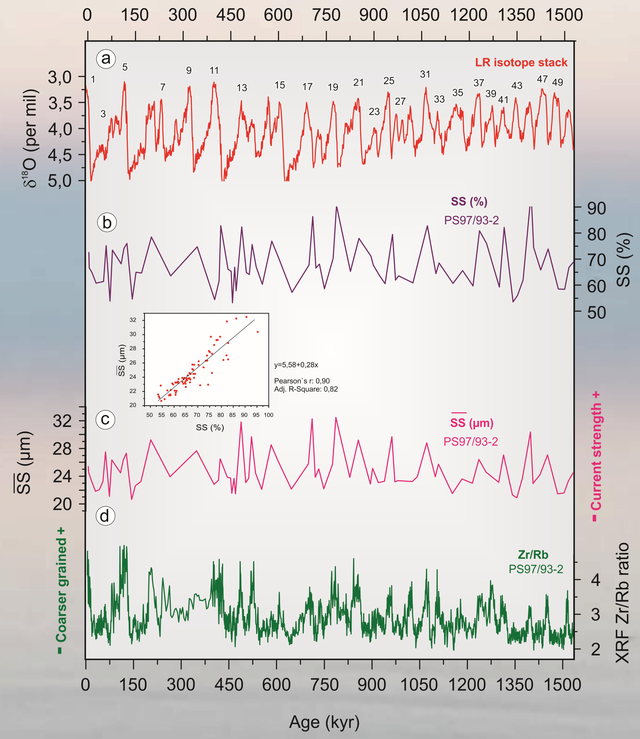

Fig. 3. *Preliminary age of PS97/093-2 compared with the first 75 $\overline{SS}$ measurements and the Zr/Rb record.* ***a)*** *Lisiecki and Raymo benthic isotope stack, numbers mark Marine Isotope Stages.* ***b)*** *SS percentage and* ***c)*** *$\overline{SS}$ results.* ***d)*** *Zr/Rb (XRF 30 kv) fluctuations. Relationship between $\overline{SS}$ and percentage of SS (inset).*

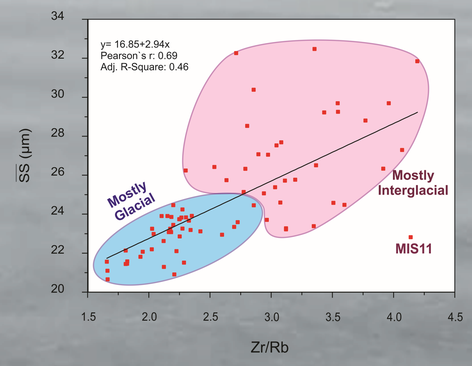

Fig. 4. *Relationship between $\overline{SS}$ and Zr/Rb fluctuations.*

- ✓ Based on the age model, a preliminary age of ~1.5 myr was estimated for core PS97/093-2 (Fig. 3a).
- ✓ In general, the mean sortable silt ($\overline{SS}$) grain size (10–63 μm) of the terrigenous sediment fraction shows higher values during interglacial times. This proxy was developed by McCave et al. (1995) as a proxy for estimating relative changes in the near-bottom flow speed in deep-sea sediments (Fig. 3b,c).
- ✓ Zr/Rb ratios primarily reflect grain size changes, and peak values are generally associated with interglacials (Fig. 3d).
- ✓ Preliminary results on ($\overline{SS}$) and Zr/Rb of XRF scanner point to warm stages being characterized by high current strength (Fig. 3).
- ✓ The seems to be a linear relationship between ($\overline{SS}$) and Zr/Rb. In general, most ($\overline{SS}$) values <24 μm and Zr/Rb <3 belong to Glacial stages, whereas values >24 μm and >3, respectively, are usually for Interglacial stages.

Acknowledgments

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