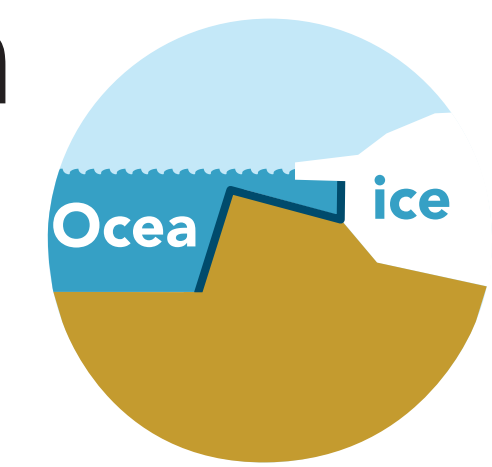


Surface-water density variability across the Eocene-Oligocene transition at Falkland Plateau, south Atlantic Ocean

Inferred from process length variability of *Operculodinium centrocarpum* dinoflagellate cysts



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Introduction

The Eocene-Oligocene transition marks the onset of continental-scale Antarctic glaciation. While the root cause for this glaciation is thought to be a decline of atmospheric CO₂ concentrations, favouring amplified positive feedback mechanisms that drove outward growth of the ice sheet, little is known about the regional oceanographic consequences of Antarctic glaciation, and the importance of those. We here study dinoflagellate cysts from an ocean sediment core from the Falkland Plateau, close to the subtropical front today, and further South during Eocene-Oligocene times. Using a novel dinoflagellate cyst-based proxy, we reconstruct surface-water density (~salinity) conditions across the EOT.

The Site

Deep Sea Drilling Program Site 511 is located on the Falkland Plateau (Fig. 1). Calcium carbonate stable isotope records have recognized the Oi-1 at ~100 mbsf (Fig. 2). The drilled sequence is part of extensive drift deposits that formed around the structural highs in the Falkland region.

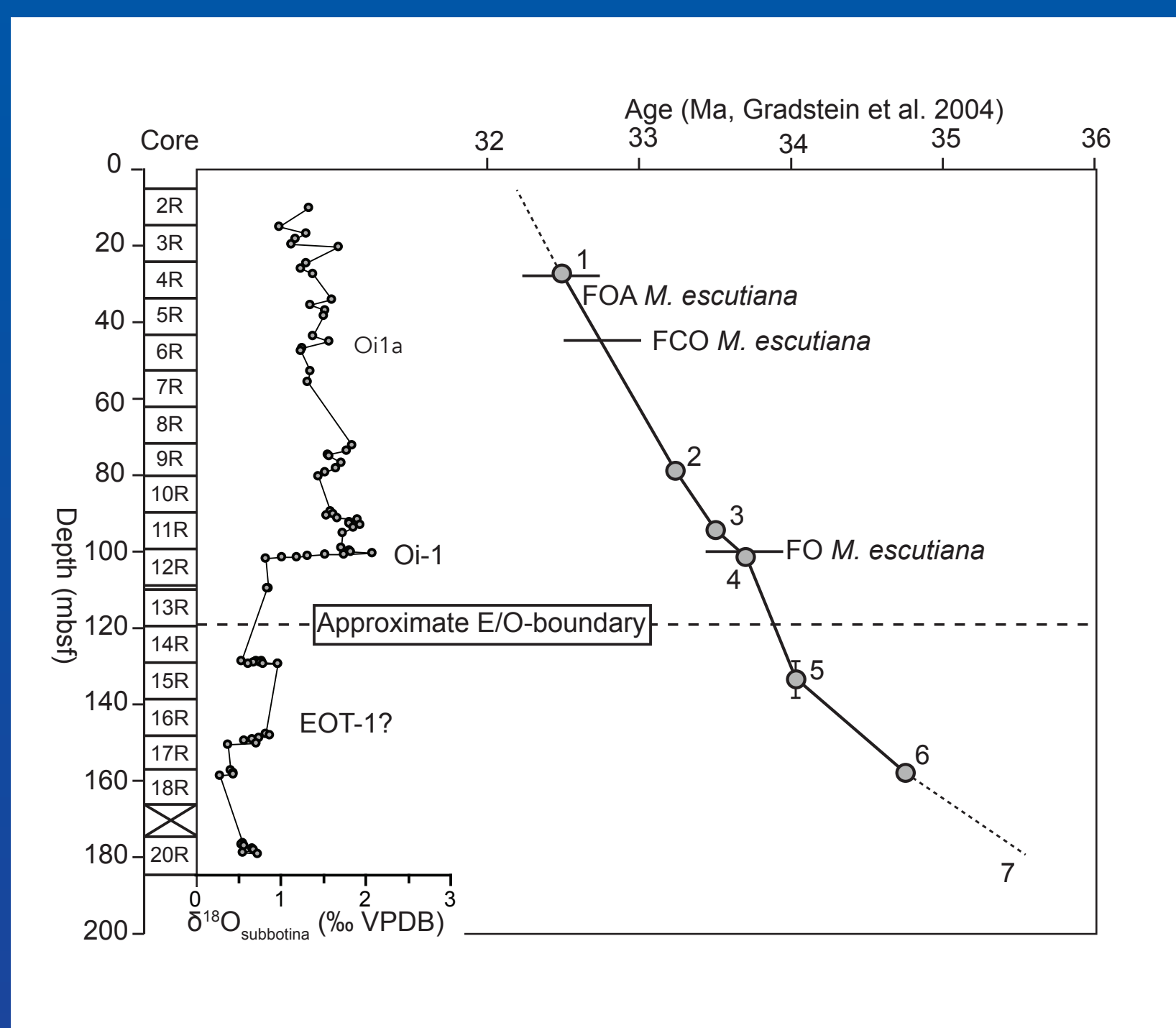


Fig. 2. Thermocline (Subb.; red) $\delta^{18}\text{O}$ from DSDP Site 511. dashed line represents the Eocene-Oligocene boundary (figure from Houben et al., 2011).

The toolbox

Operculodinium process length

- *Operculodinium* common in most samples
- 4 categories (A-D) % process length of cyst diameter
- Avg. process length per category yields mean process length for each sample
- Qualitative changes in surface water density
- Trends through EOT compared to TEX₈₆-based SST

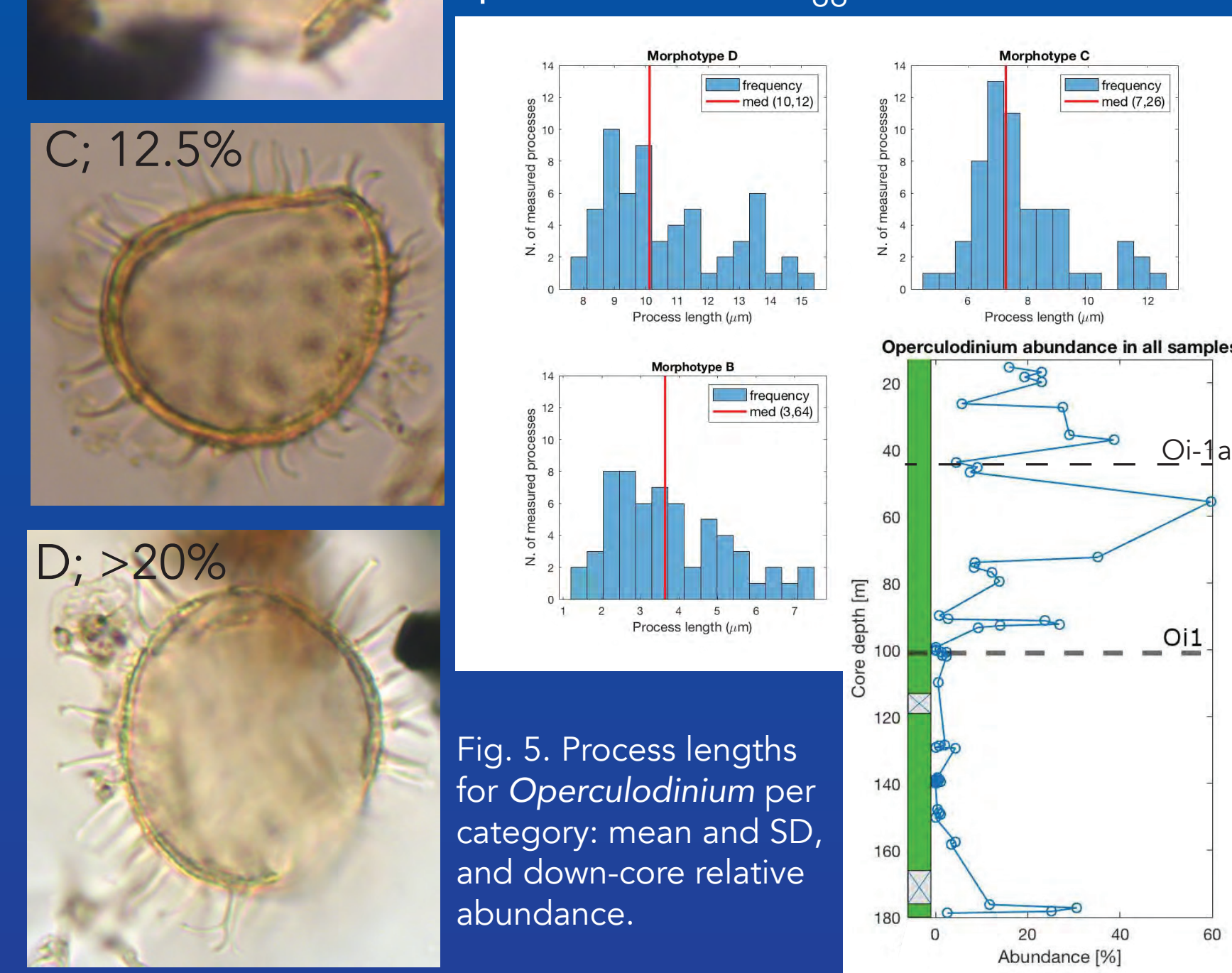


Fig. 5. Process lengths for *Operculodinium* per category: mean and SD, and down-core relative abundance.

The modern system

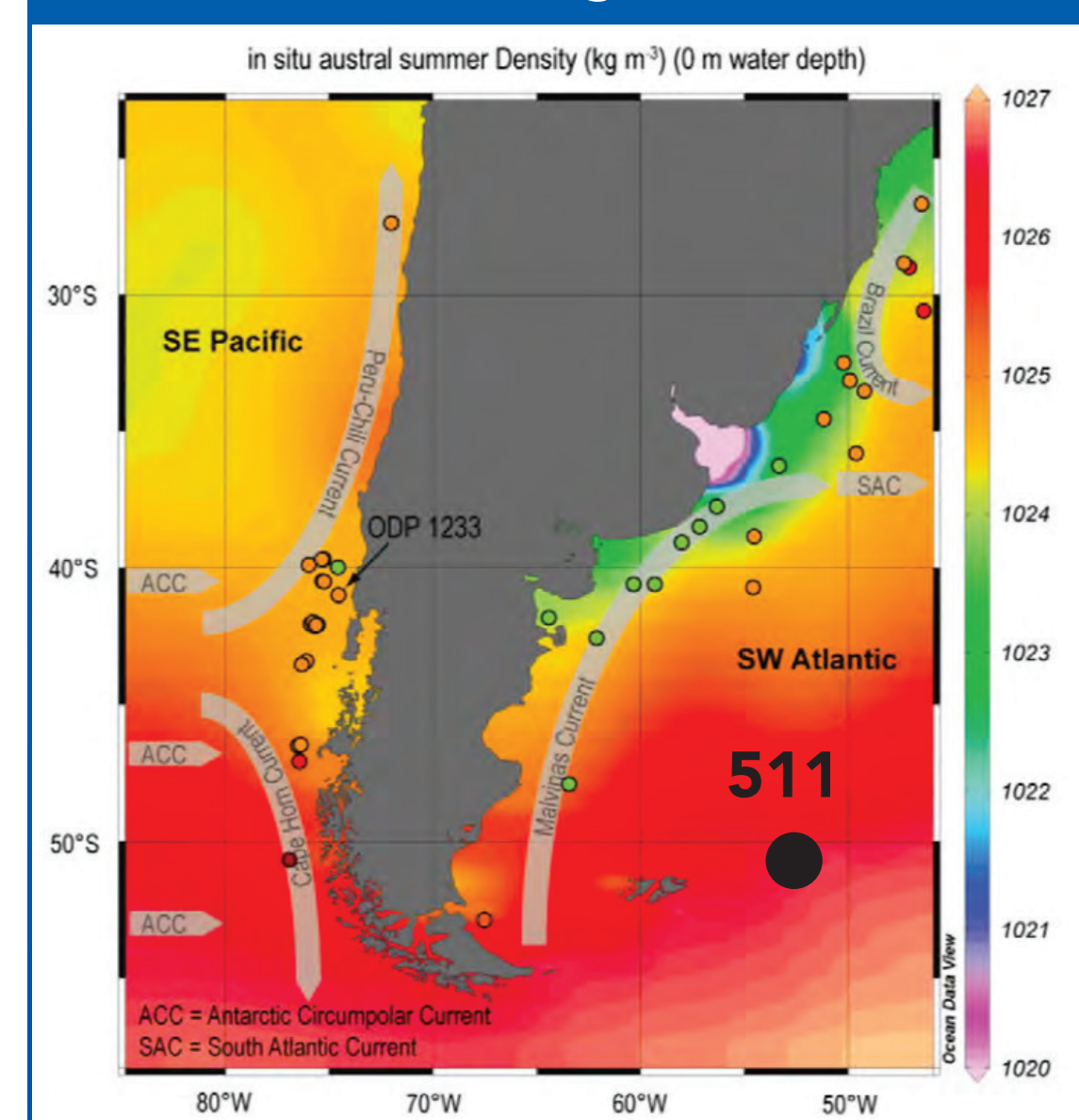


Fig. 1. Present-day summer density around Site 511. Terrestrial freshwater does not reach Site 511 today. Surface water (SW) density increases towards the South because of strong T decrease. Warmer SSTs made SW density lower during EOT, with increasing density at EOT cooling. From: Verleye et al., 2012 Marine Micropaleontology

Fig. 2. Present-day Summer fresh-water flux (FWF). The Falklands were at EOT times more to the southeast wrt Antarctica, so more into the path of the FWF. Higher precipitation over Antarctica likely favoured iceberg discharge, but warmer oceans likely melted them more easily during EOT.

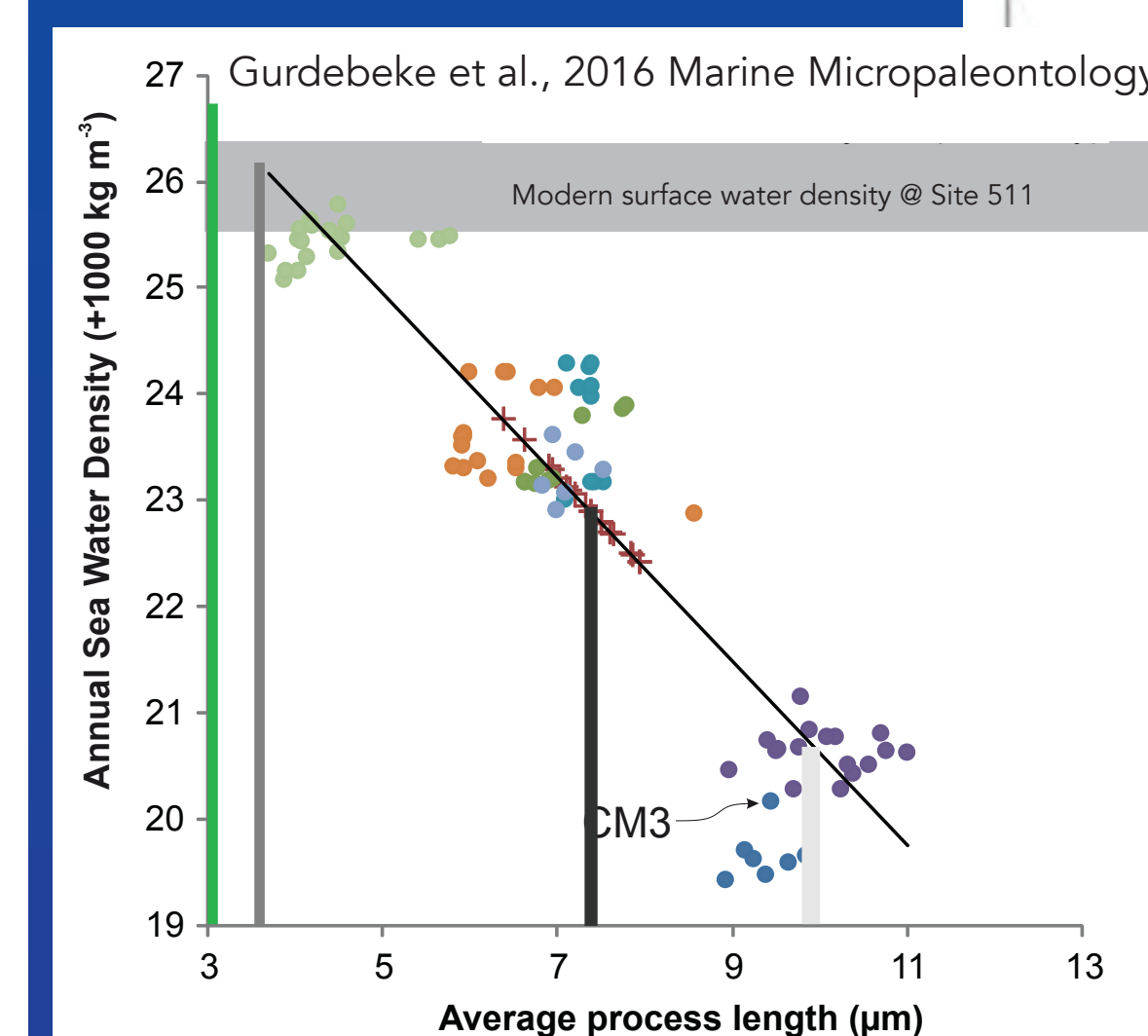
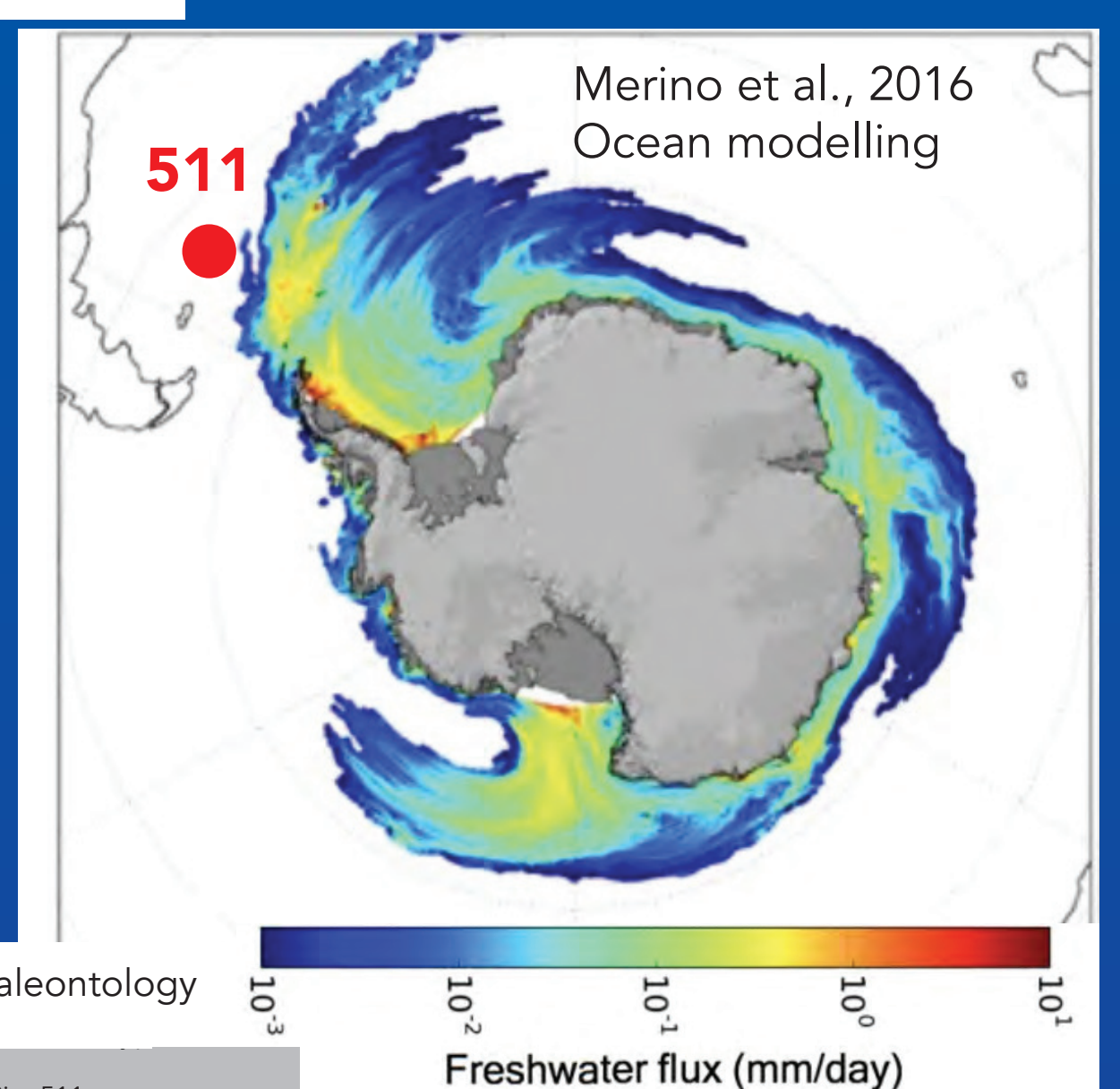
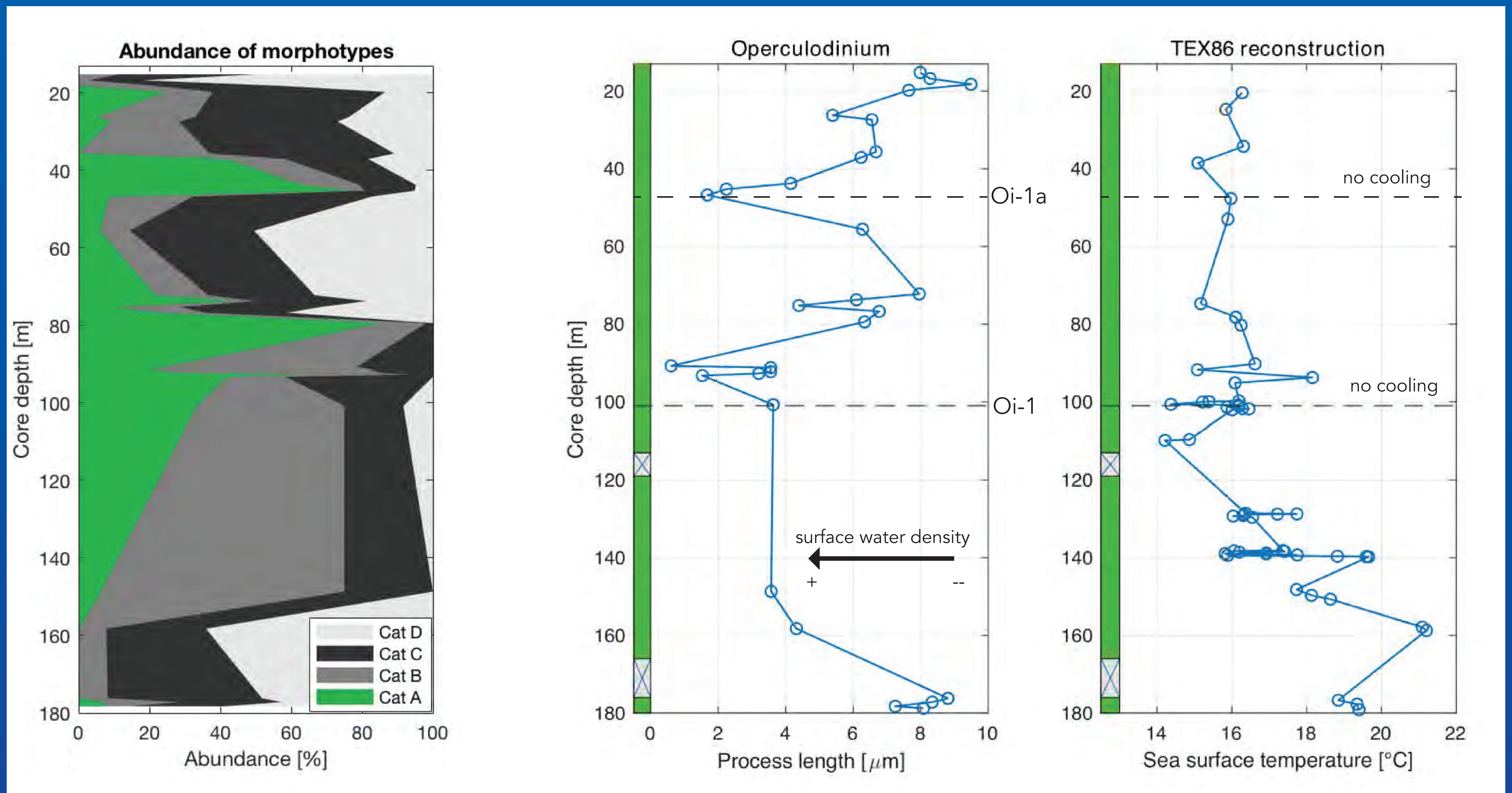


Fig. 3. Modern calibration curve for *Operculodinium* cyst process length and surface-water density.

Shorter processes = higher density

Results



Take Home Message

- EOT sees sw density increase: T effect? Subtropical front migration?
- Oi-1 and Oi-1a are associated with increased surface-water density, in absence of local T cooling: effect of salinity change?
- Palynological assemblages suggest frontal system migration, no runoff changes
- Gradual Oligocene SW freshening: effect of ice berg flux increase?
- Process length changes across study interval large compared to modern calibration

Outlook

- Increase temporal resolution
- Direct quantification of process lengths (w/o categories)
- Pair results with qualitative proxies for terrestrial runoff (terrestrial/marine ratios, BIT index) to evaluate fe source