

Biochemical and physical characterization of multi-year and first-year ice in the Lincoln Sea (between Canada and the North Pole)



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Introduction:

- Record minimum summer SIE observed in September 2012¹.
- Rapid decline of Arctic Summer sea ice extent with reductions of MYI and a Shift to an ice pack dominated by FYI².
- The contributions of FYI vs. MYI algae for Arctic primary production are unknown. Therefore ecological implications of a shift to more FYI are uncertain.

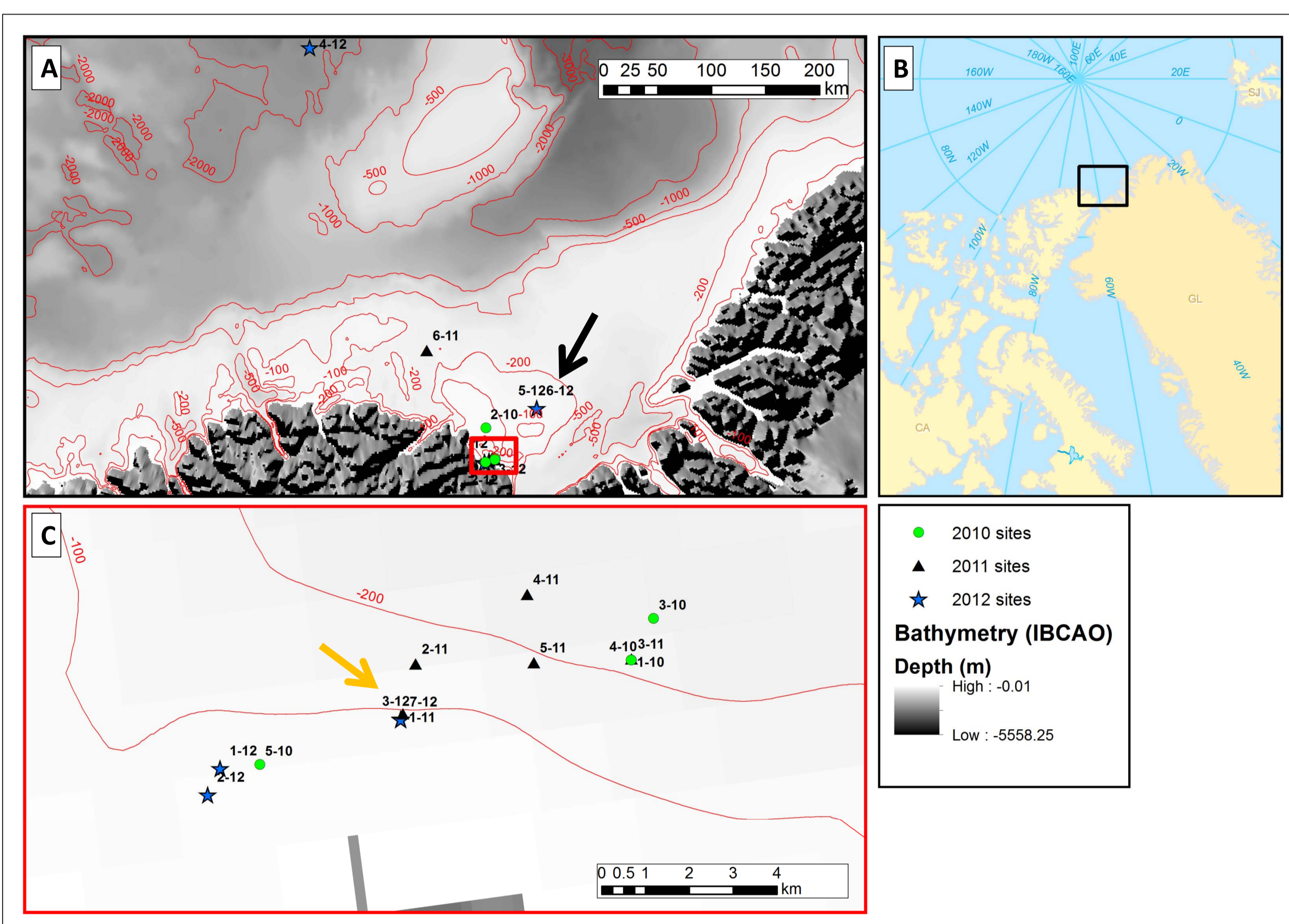


Figure 1: Maps of the Arctic Region: A) showing the Lincoln Sea study site with sample site locations; B) an overview map and; C) zoomed region of coastal (landfast sea ice) sample sites near CFS Alert.

Study Site:

- Lincoln Sea region of the High Arctic Ocean (Figure 1). Campaigns based out of CFS Alert on Ellesmere Island, Nunavut. This region is home to the thickest ice in the Arctic and will be one of the last refuges for MYI in the near future.

Methods

Ice cores

- Extracted with a 9 cm diameter Kovacs ice corer.
- Cores processed for chl *a*³, texture, salinity and temperature.
- Recorded core length, snow depth and freeboard.

Floe Scale (100-1000 m) Snow and Ice Surveys

- Ice thickness surveys using drill holes and EM-31 (5-20 m spacing's)
- Snow depth probe surveys (1-5 m spacing's)

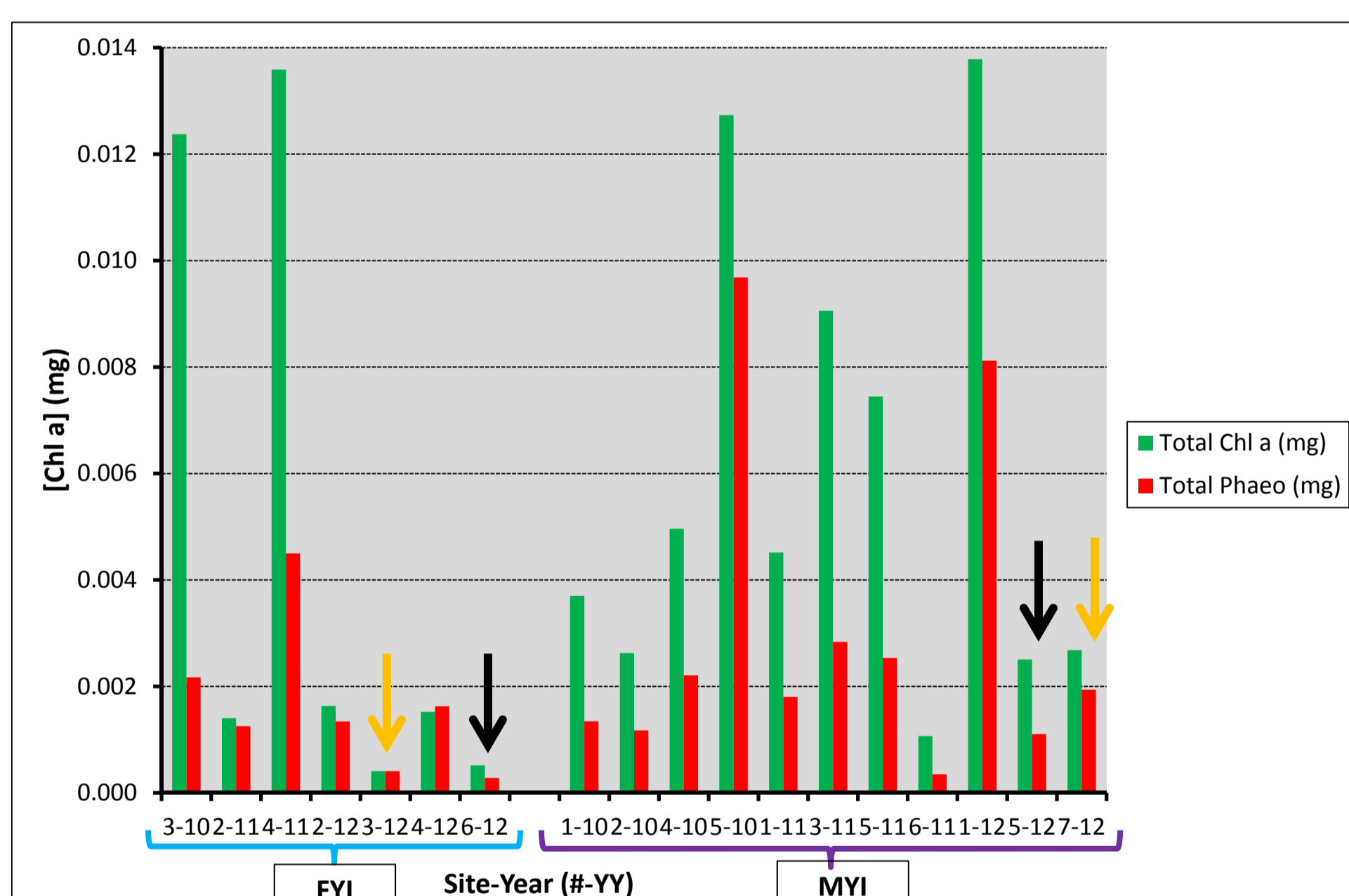


Figure 2: Total chl *a* content in FYI and MYI cores extracted from locations in Figure 1. Arrows correspond to locations that are adjacent to each other (locations shown in Figure 1).

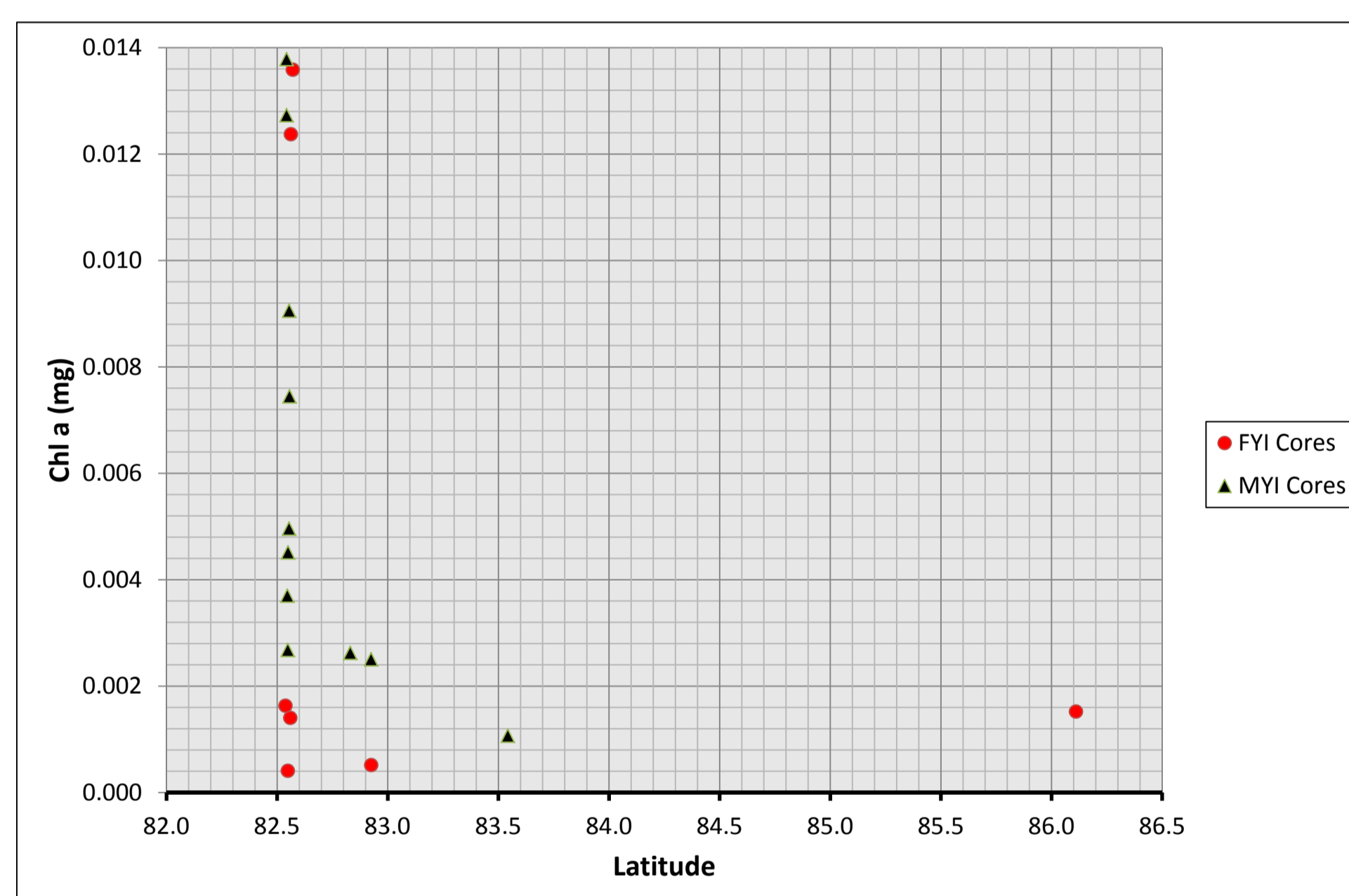


Figure 3: Total Chl *a* content vs. latitude. Latitude is an indicator for distance from the coast.

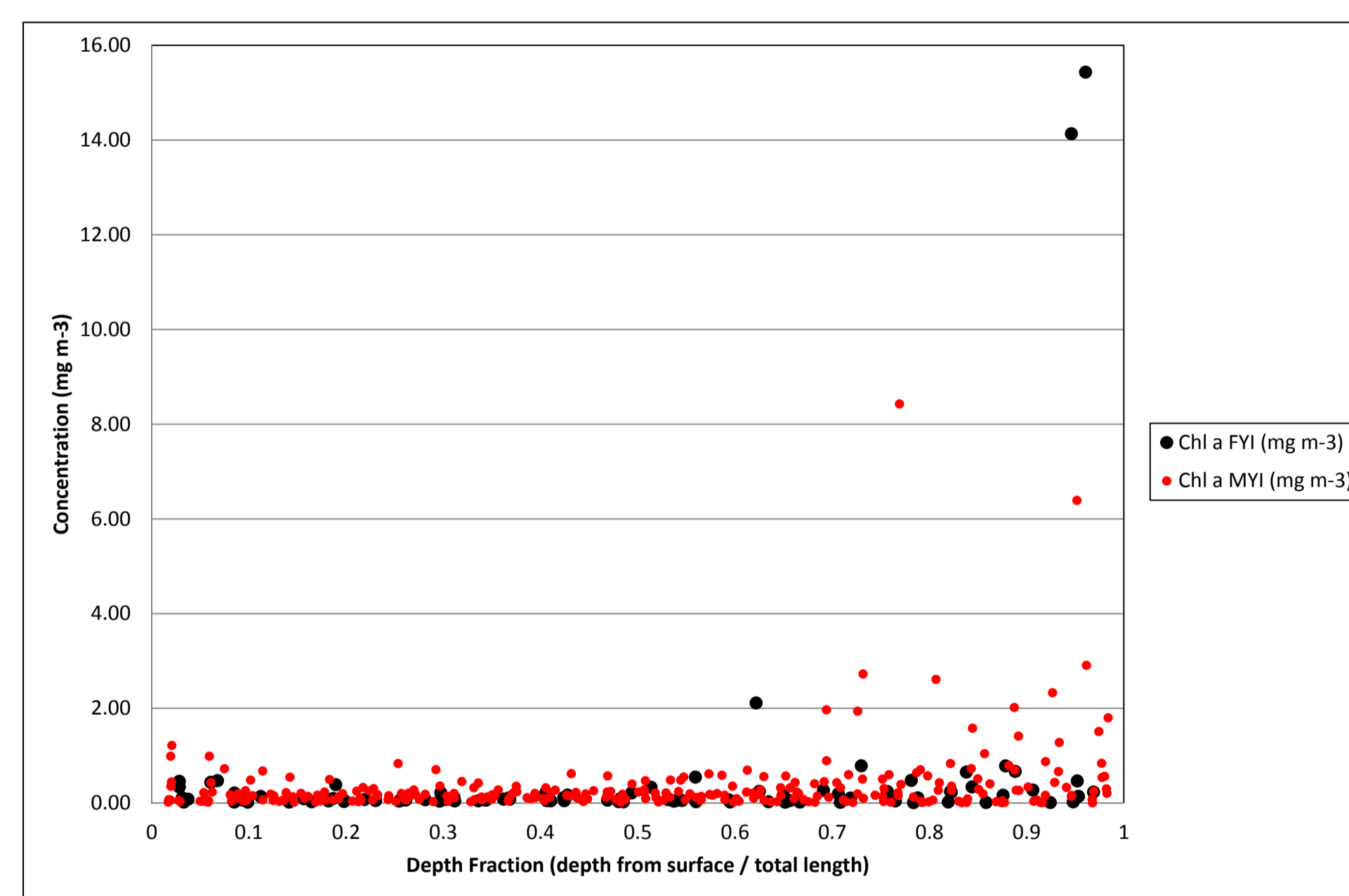


Figure 4: Chl *a* concentrations for MYI and FYI cores vs. depth fraction (which is the depth divided by total length).

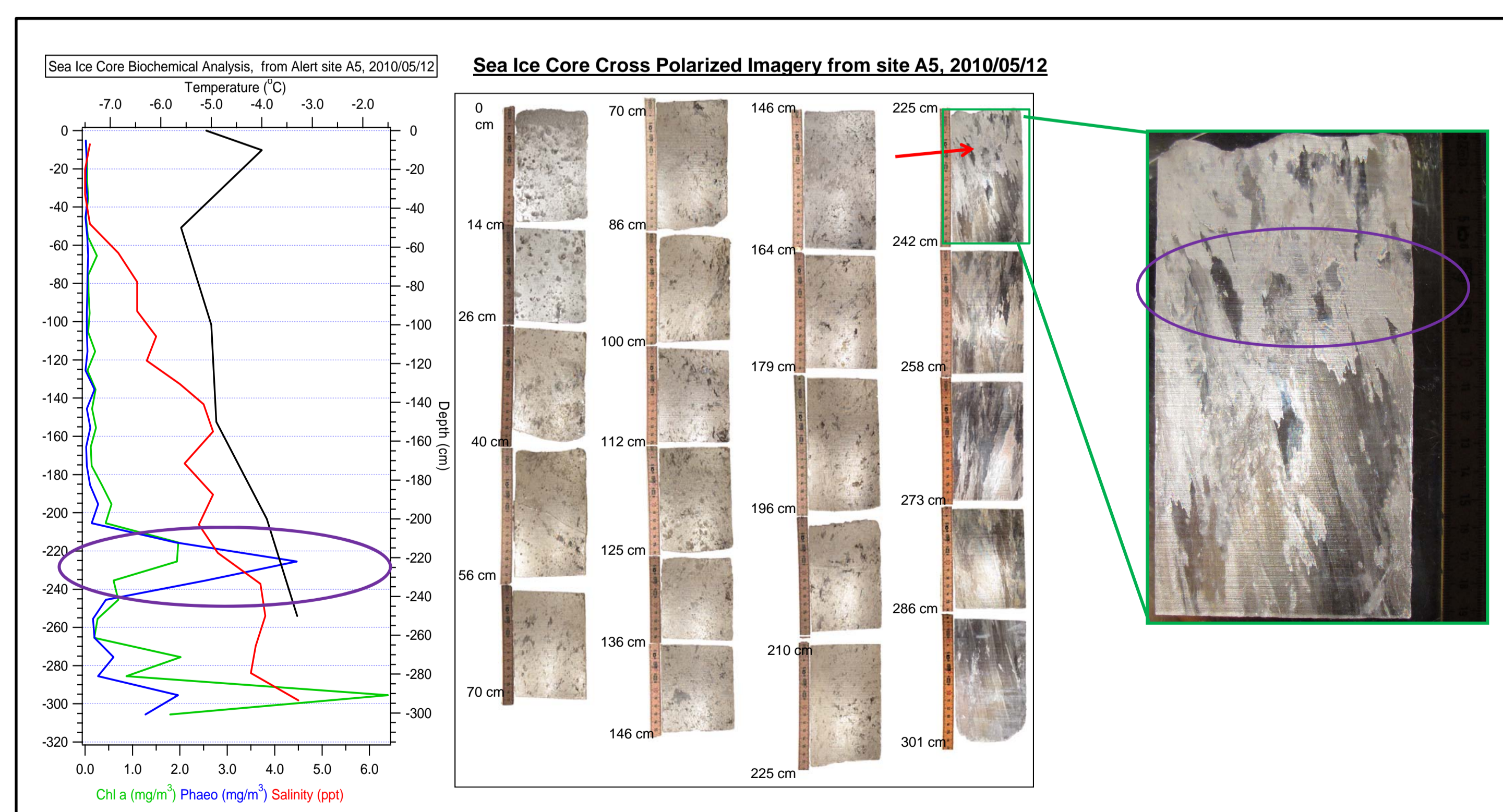


Figure 5: Vertical salinity, chl *a* & phaeopigment profiles for MYI core 5-10 with corresponding thick section cross-polarized texture images.

Results:

- A total of 11 MYI cores demonstrated a mean total chl *a* content of **0.93 mg/m²** (sd = 0.64); mean total phaeopigment content of **0.47 mg/m²** (sd = 0.45); mean chl *a* concentration of **0.35 mg/m³** (sd = 0.22); and mean phaeopigment concentration of **0.17 mg/m³** (sd = 0.15; Figure 2)
- A total of 7 FYI cores demonstrated a mean total chl *a* content of **0.71 mg/m²** (sd = 0.85); mean total phaeopigment content of **0.26 mg/m²** (sd = 0.21); mean chl *a* concentration of **0.58 mg/m³** (sd = 0.77); and mean phaeopigment concentration of **0.19 mg/m³** (sd = 0.15; Figure 2).
- Higher chl *a* content in sea ice near coast (e.g. lower latitudes; Figure 3).
- Higher concentrations and content of chl *a* near the bottom of the sea ice cores (Figure 4).

References:

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