A Paleolimnological Reconstruction of Mid and Late Holocene Climate Change in South Georgia

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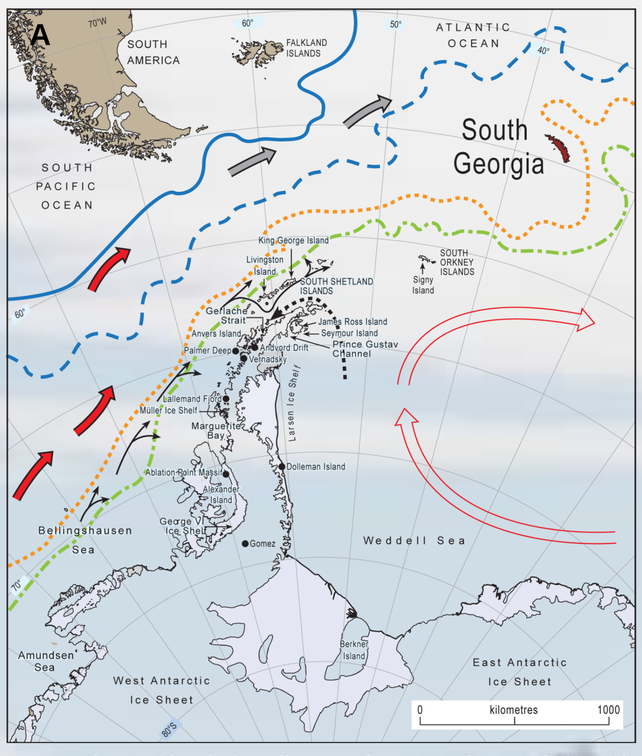
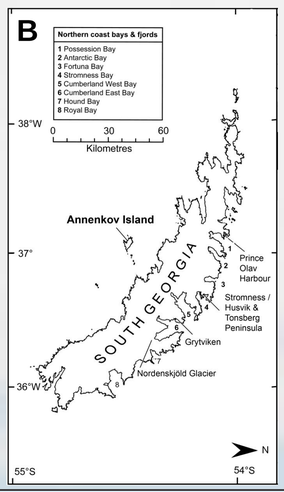
Introduction & Aims

The Earth's climate undergoes significant changes, which are not yet fully understood. South Georgia is located at the barrier between Antarctica and the mid-latitudes in the Southern Hemisphere which makes it a key location to determine the main drivers of past and present-day climate variability and to assess whether the climate in the South Atlantic was synchronous with Antarctica, South America or the North Atlantic region.





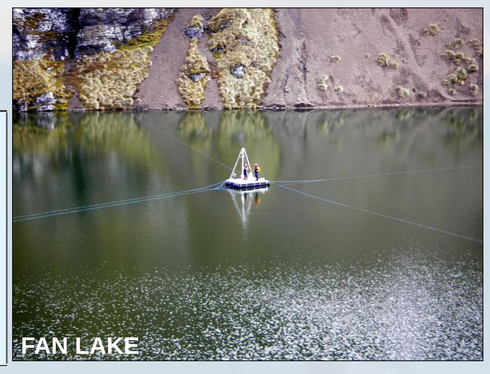


Fig. A: Circulation diagram from Bentley et al. (2009). Fig. B: Map showing the location of Annenkov Island.

Here we performed a sedimentological, high resolution (ITRAX) geochemical, and fossil diatom and pigment analysis of a 5.41m long, ca. 8000 cal yr old, sediment core from Fan Lake, Annenkov Island, South Georgia in an attempt to separate the influence of Holocene paleoclimatic variability from changes in catchment stability and glacier activity.

Diatom stratigraphy

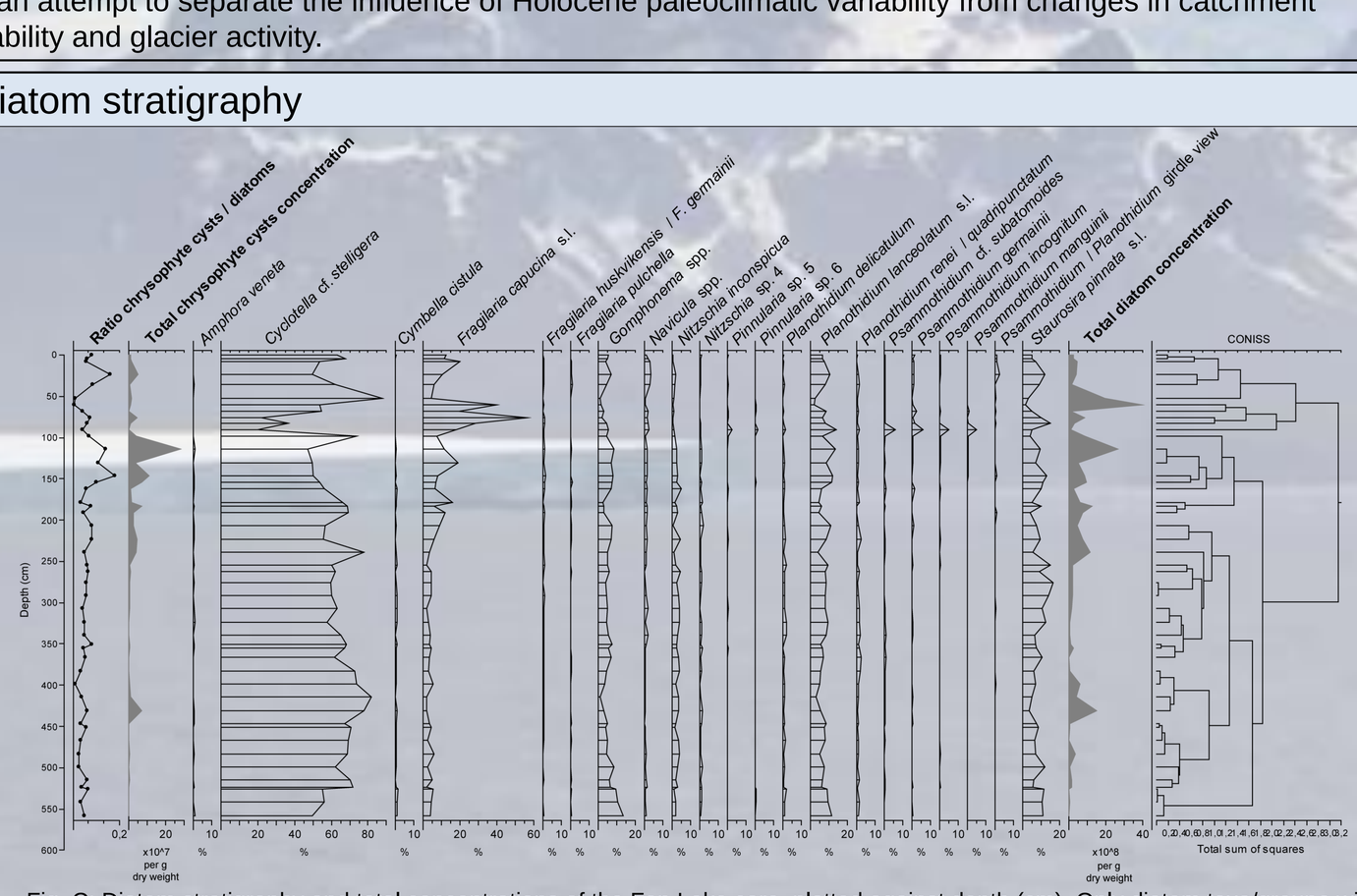


Fig. C: Diatom stratigraphy and total concentrations of the Fan Lake core, plotted against depth (cm). Only diatom taxa/groups with a relative abundance exceeding 1% are shown. The ratio of chrysophyte cysts versus diatoms and total chrysophyte cysts concentrations are added on the graph.

The diatom composition of the core is dominated by the planktonic centricate *Cyclotella* cf. *stelligera*. Most remarkable is the *Fragilaria capucina* s.l. peak between ca. 100 and 50 cm depth and the preceding little peaks of *Psammothidium* taxa. Higher total diatom concentrations are established from 250 cm depth on.

Fossil pigment stratigraphy

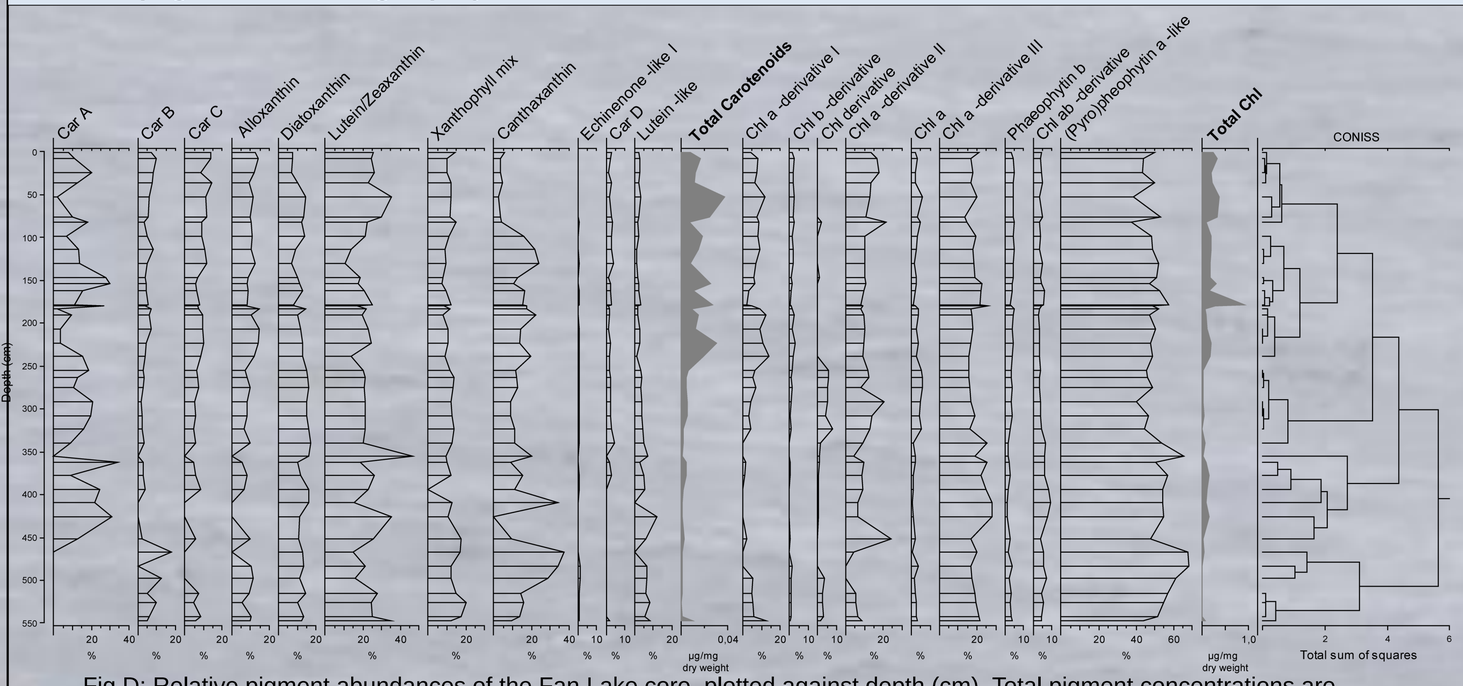


Fig D: Relative pigment abundances of the Fan Lake core, plotted against depth (cm). Total pigment concentrations are expressed in µg/mg dry weight.

Total carotenoid and total chlorophyll concentrations are largely similar throughout the core with higher total concentrations from 250 cm depth on. Most remarkable is the decline of the relative abundance of canthaxanthin from 90 cm depth until the top of the core.

Geochronology / Lithology

The dating of this core remains controversial. Between ca. 420 cm and 250 cm depth all samples have the same age (ca. 4000 cal yr BP). We are working on improving the age model and currently have two possible options / alternatives, one of which we have applied to create the diagram under "Preliminary Interpretation / Discussion".

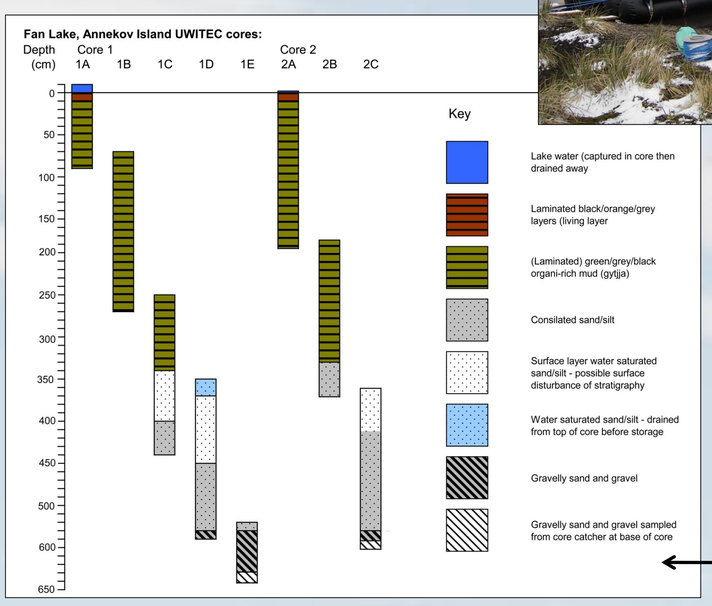


Fig. E: Schematic overview of the lithology.

The most important shift in lithology is the transition from sand/silt to laminated dark organic-rich mud at ca. 250 cm depth.

Preliminary Interpretation / Discussion

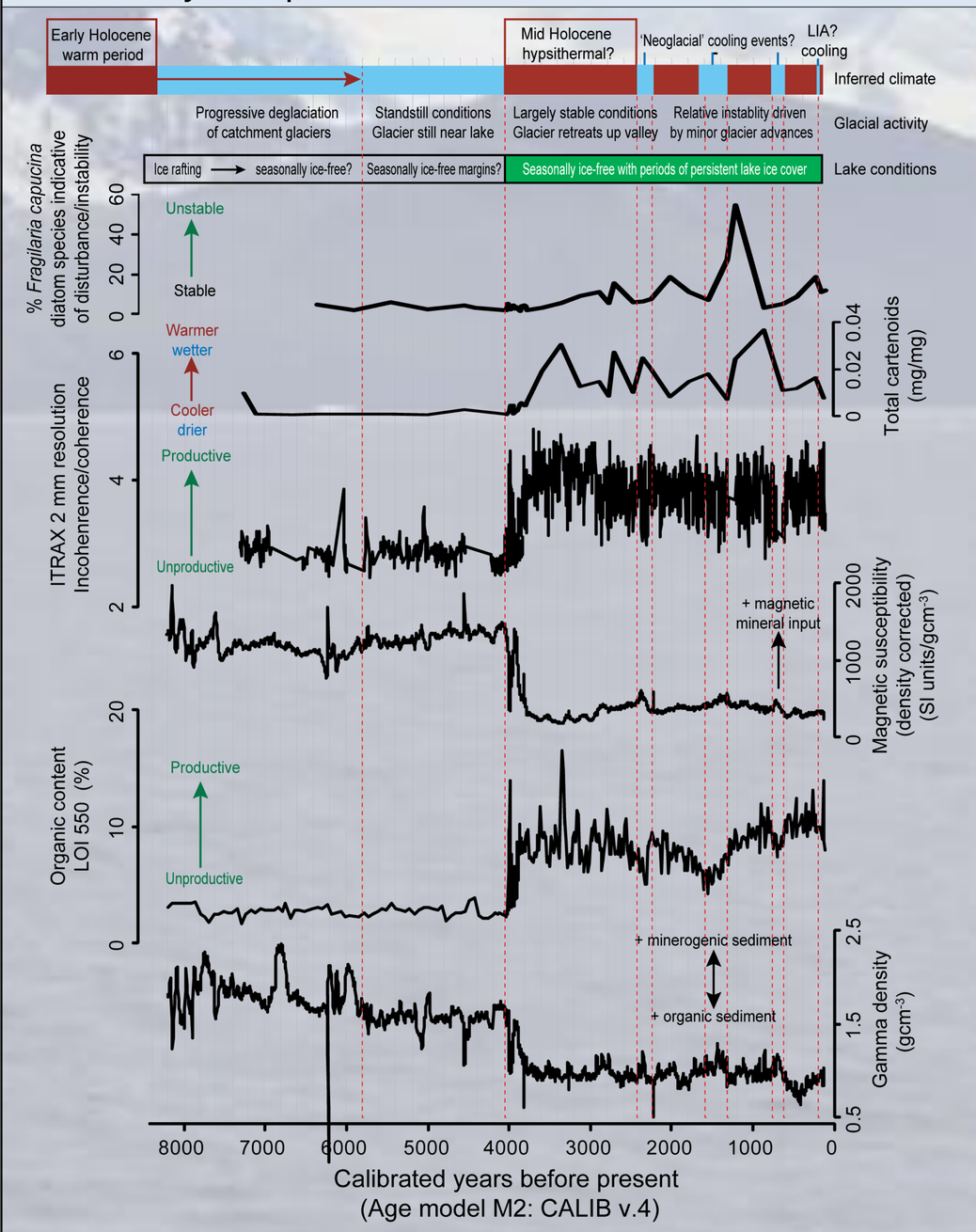


Fig. F: Overview of the different proxies analysed in the Fan lake core.

While radiocarbon ages of events in the top 250 cm of this core appear to be broadly in line with some other studies on South Georgia, the chronology of the lower half still poses several questions.

The main lithological division in the profile is marked by the establishment of a finely laminated sedimentation at ca. 250 cm (4000 cal yr BP) which is also picked out by the diatom and pigment analysis. This change is characterized by a reduction to low stable magnetic susceptibility values and a step-change increase in organic matter, and is probably related to deglaciation of the lake catchment during the 'Mid-Holocene Hypsithermal'.

Although the diatom composition is dominated by a single species (i.e., *Cyclotella* cf. *stelligera*), relatively minor, but sometimes significant fluctuations in other diatom species occur in the top 250 cm (mid-late Holocene). Interestingly, the most remarkable change in the diatom record occurs at c. 100 cm (1000 cal yr BP), which is possibly associated with deglacation following one of four relatively minor 'post-cooling events' during the late Holocene.