Deep-sea sediments and stratigraphy on the Juan de Fuca ridge

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Deep-sea sediment types

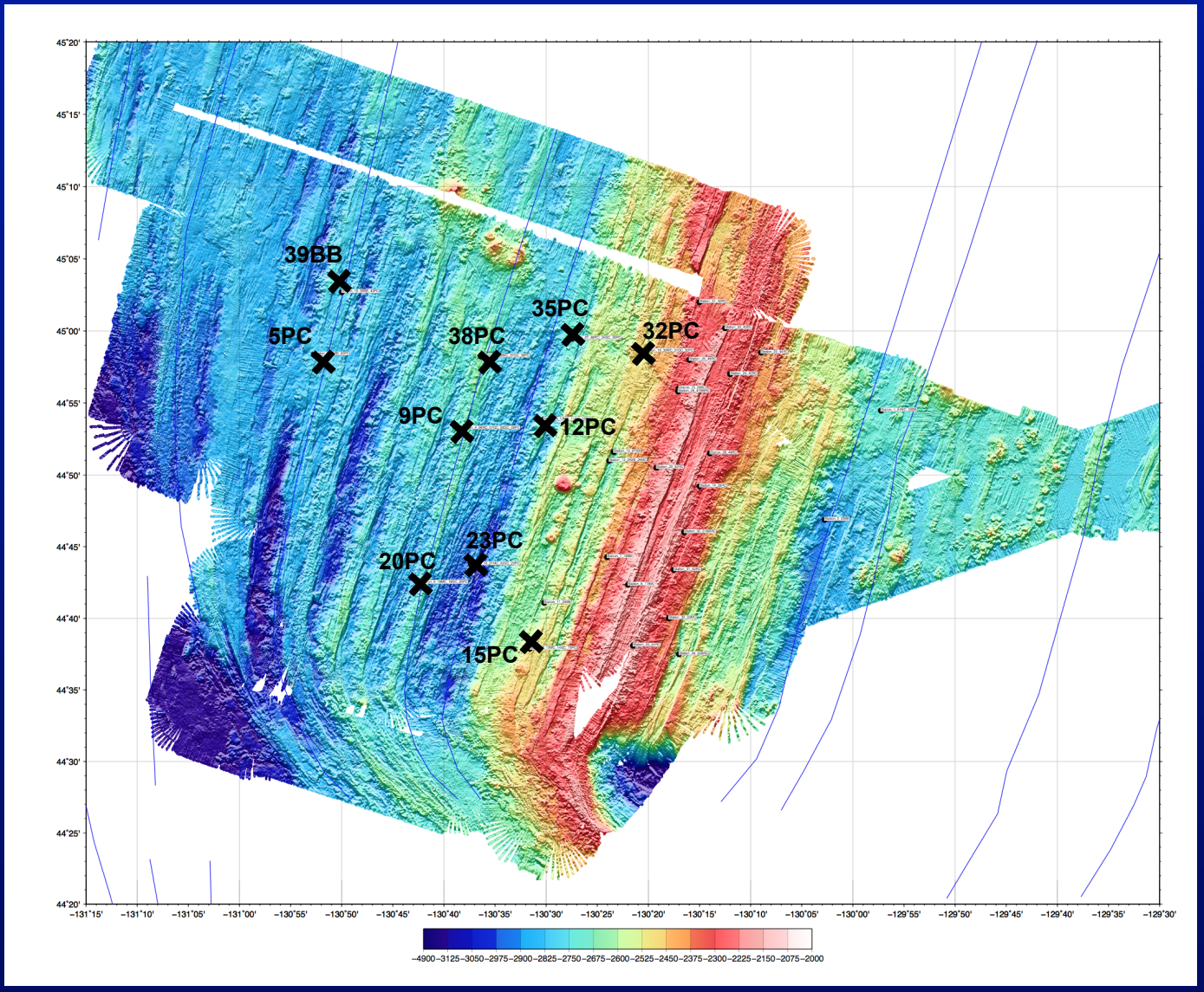
Biogenic: $CaCO_3$, opal (amorphous biosilica), C_{org}

Lithogenic: Hemipelagic rain, dust, ice-rafted debris, clay

Authigenic: Precipitates from seawater, porewater, vents

Volcanogenic: From subaerial and submarine eruptions

Cosmogenic: Extraterrestrial



10 Multi-cores

9 Gravity cores

9 Big Berthas

2 Big Bertha-RC

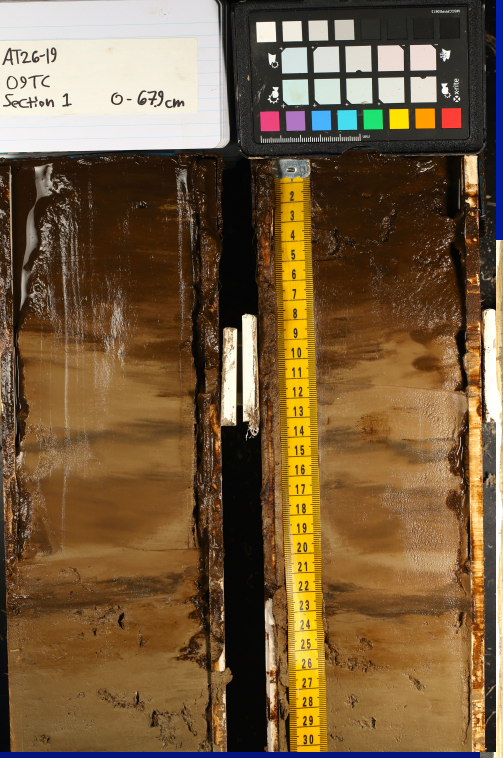
13 Rock cores

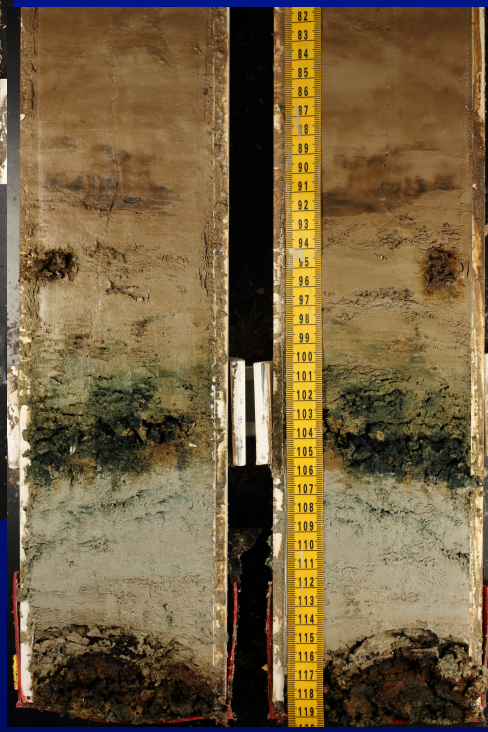
9 Piston cores

Basemap courtesy of Boulahanis, Gibson and Carbotte

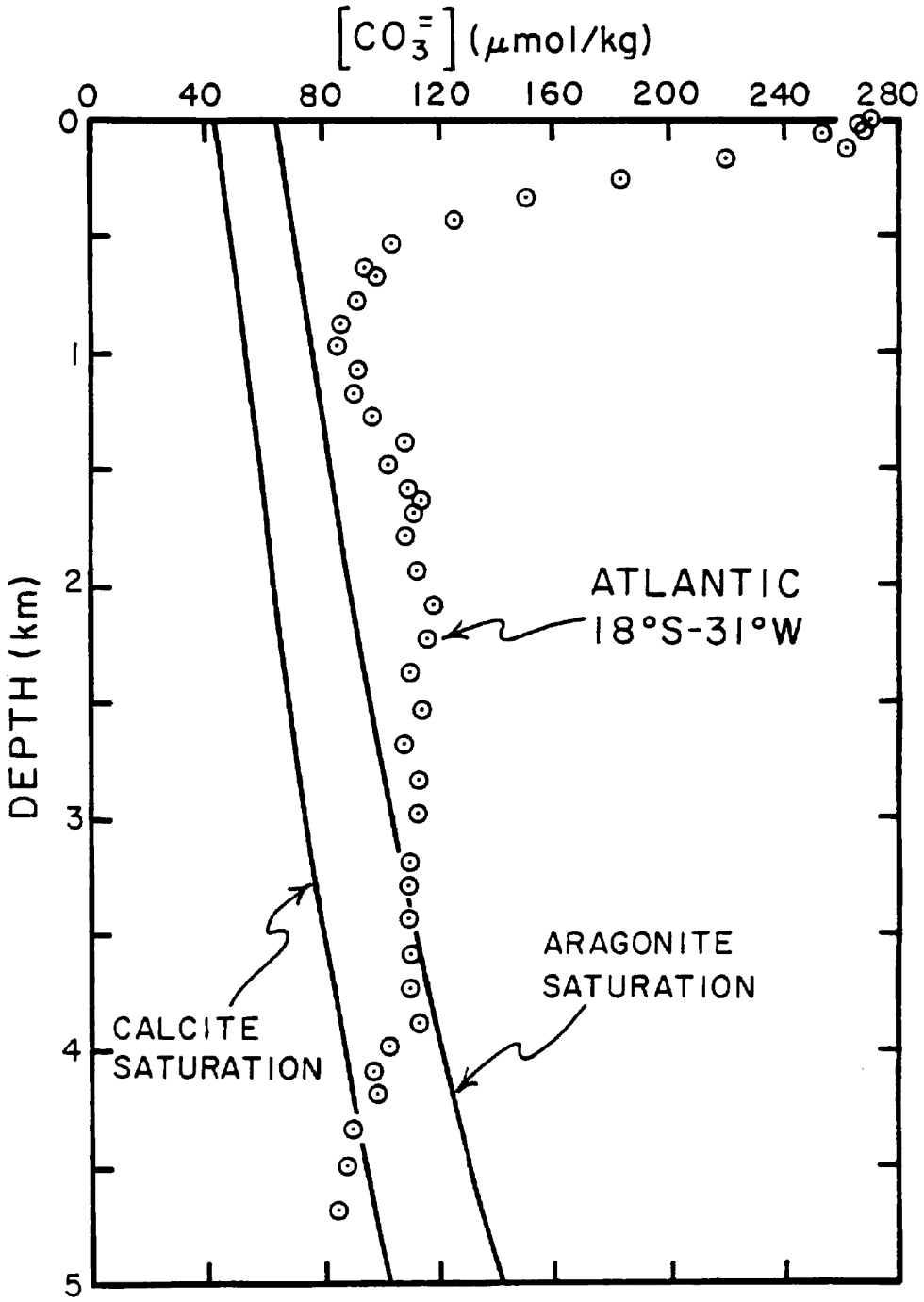
Examples of JdF ridge sediments

(All sediment types are present in VOICE cores)





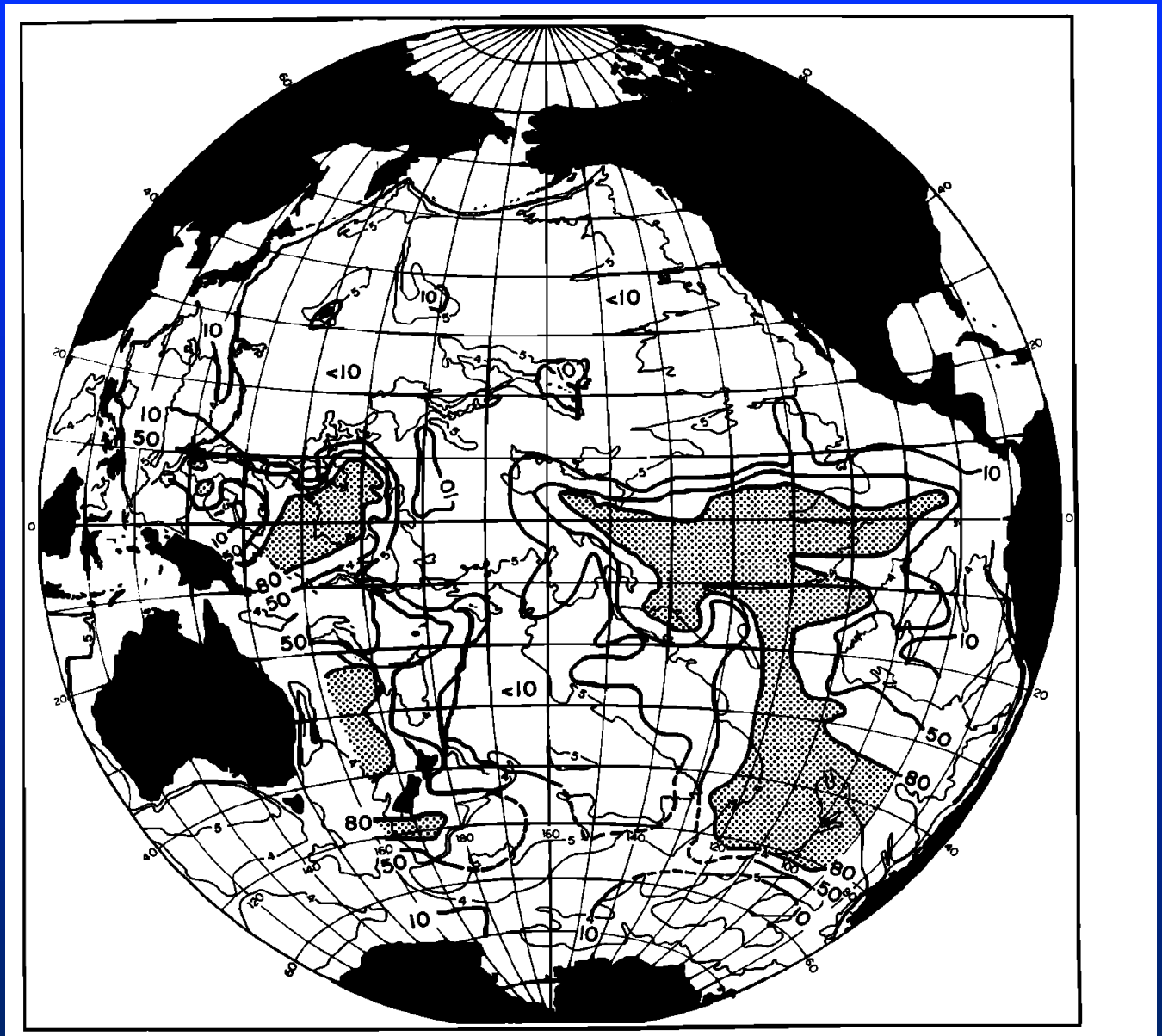
G. Henry et al., shipboard



Ocean depth and sea-water chemistry, through the varying concentration of dissolved carbonate ion [$CO_3^{=}$], combine to control the preservation and thus the deposition of $CaCO_3$ on the seafloor.

The deep North Pacific is generally among the most corrosive deep-sea environments in the modern ocean.

Figure after Broecker and Peng, 1982

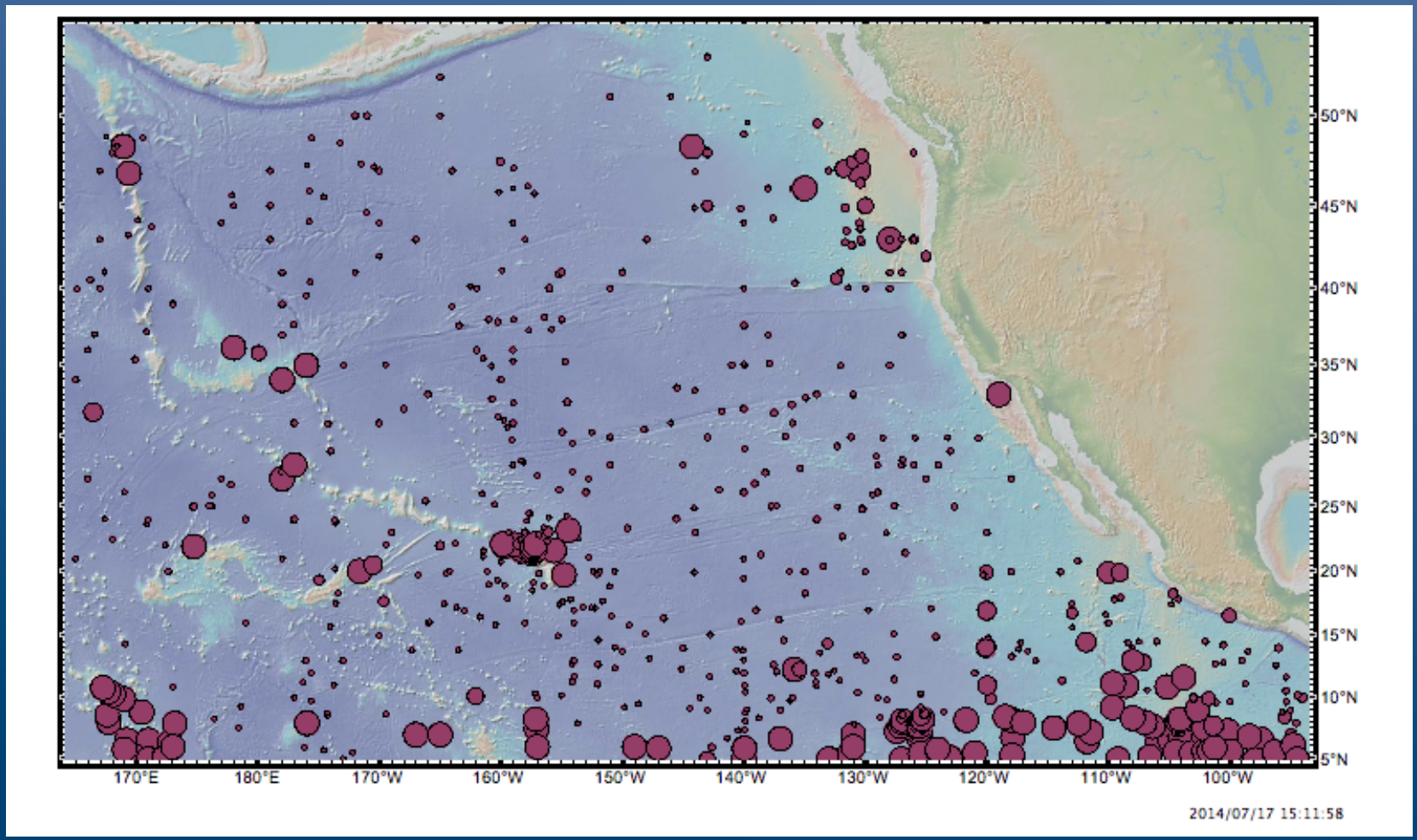


1. A contour map of calcium carbonate percentages in Pacific surface sediments. The bathymetry is after *Menard* [1964].

Berger et al., 1976

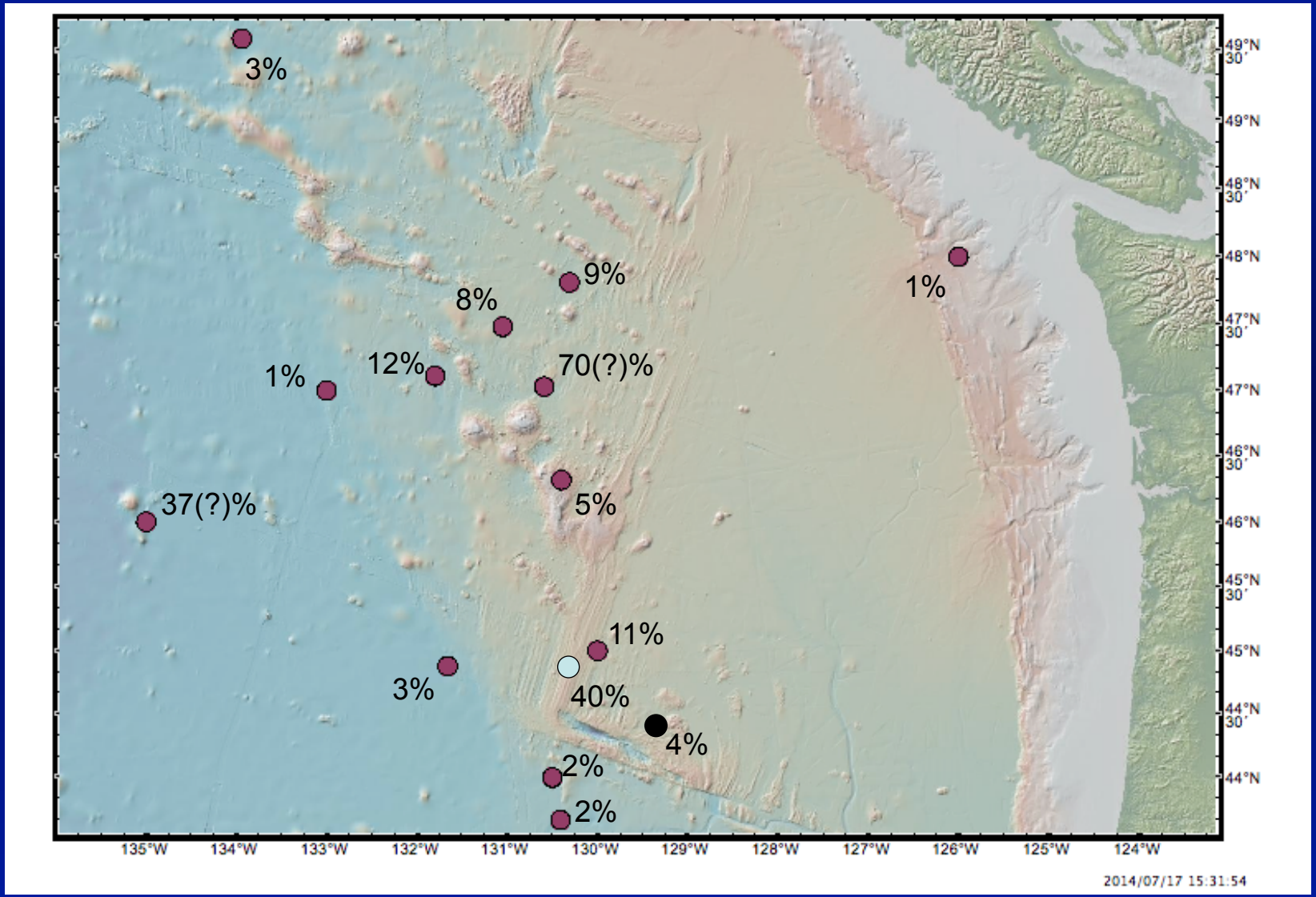
Seafloor $CaCO_3$ content

(smallest symbols <1%, largest symbols > ~20%)



Archer 1999

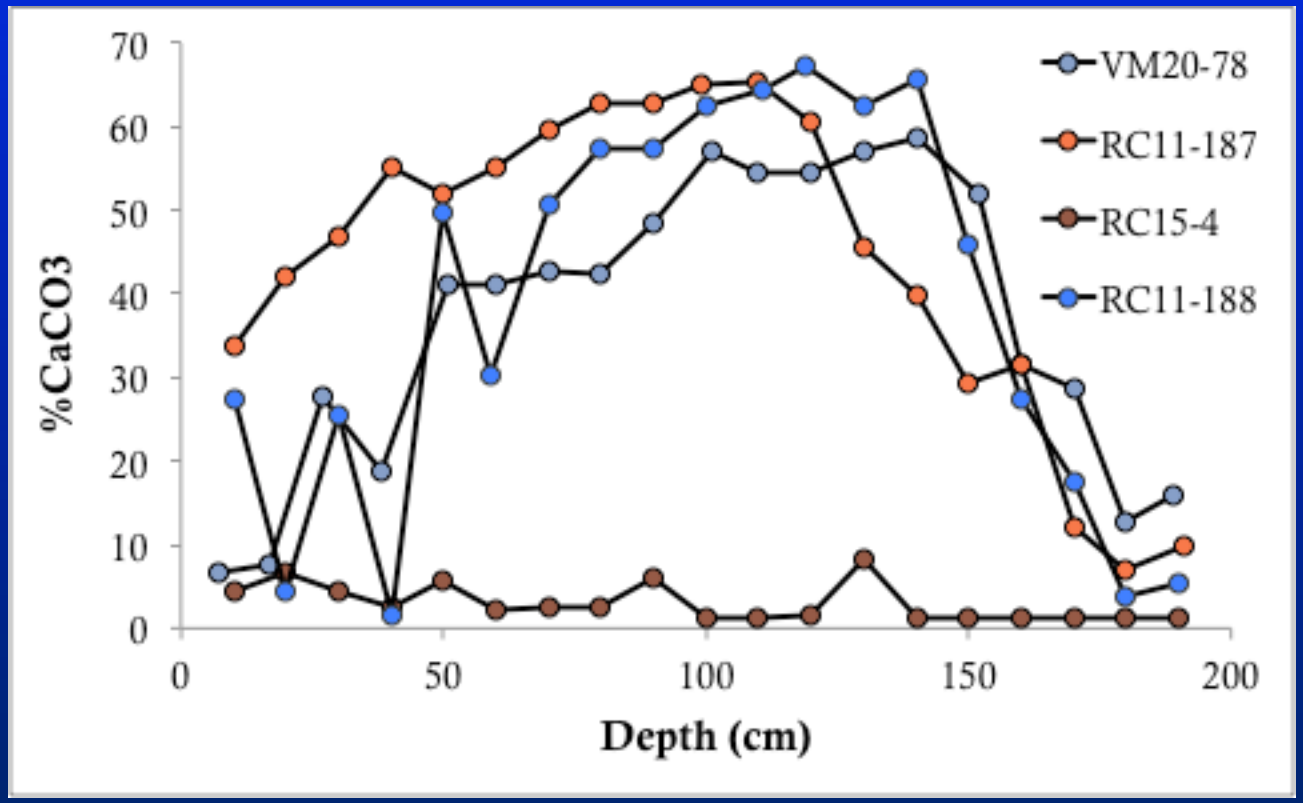
Seafloor $CaCO_3$ content near Juan de Fuca ridge



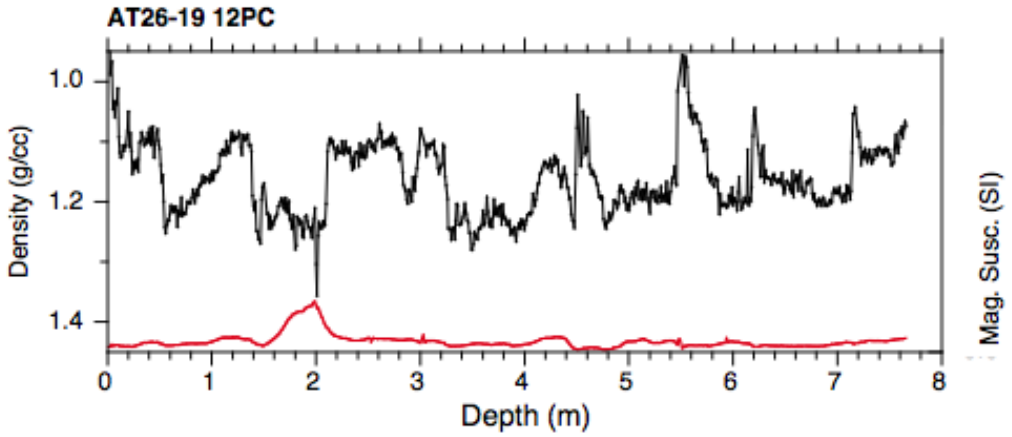
Archer, 1999

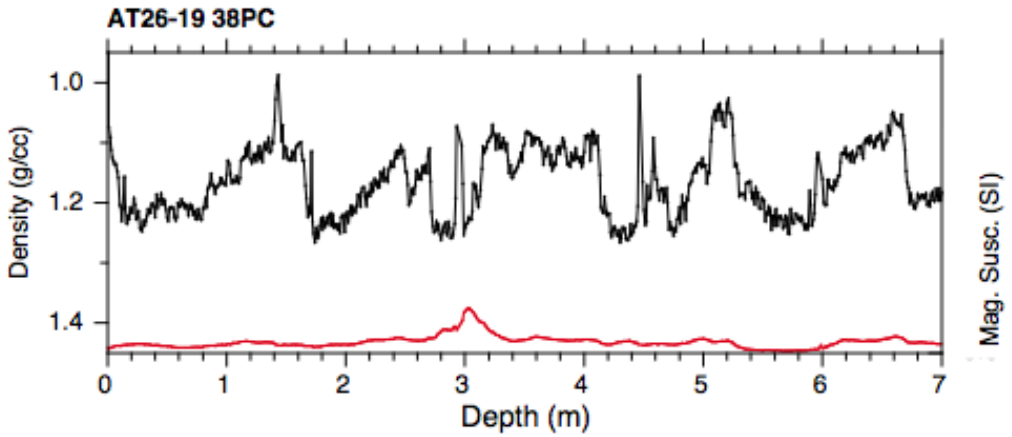
Pre-cruise $CaCO_3$ content data from existing JdF cores

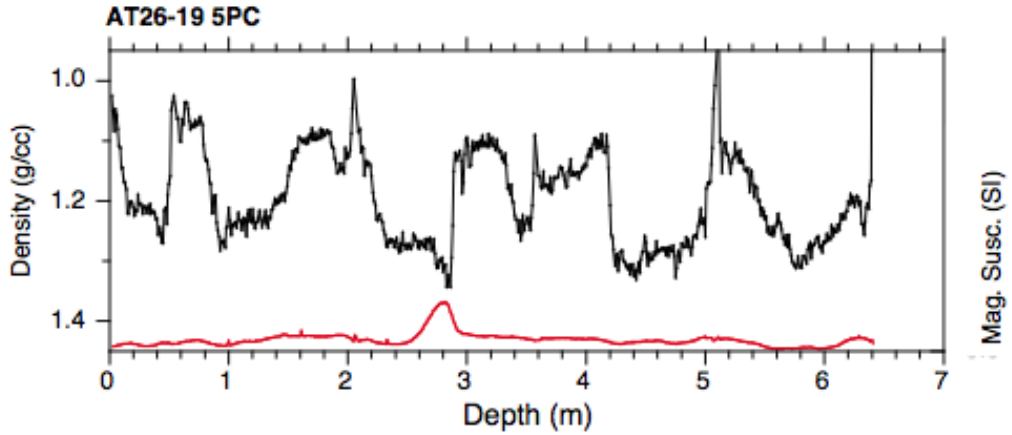
(suggests substantial burial in the past)



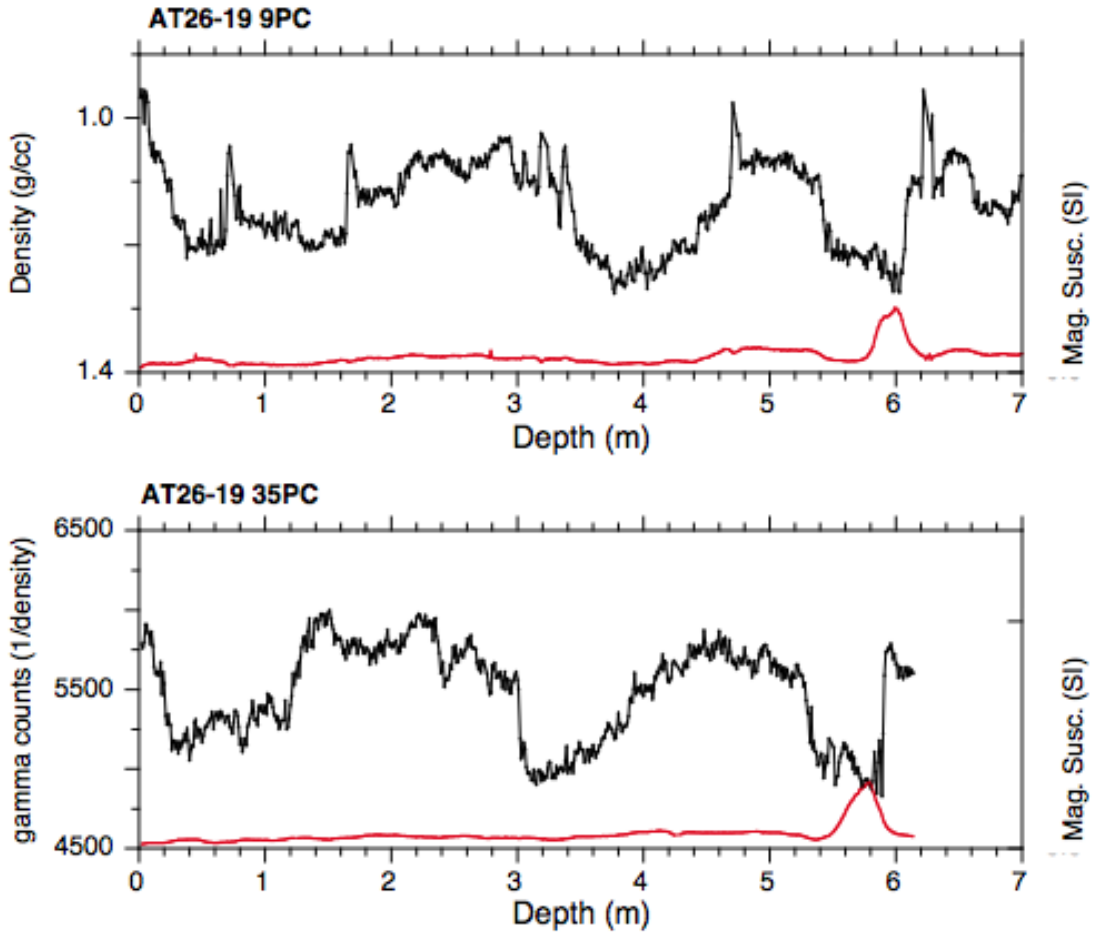
Costa et al., unpub.







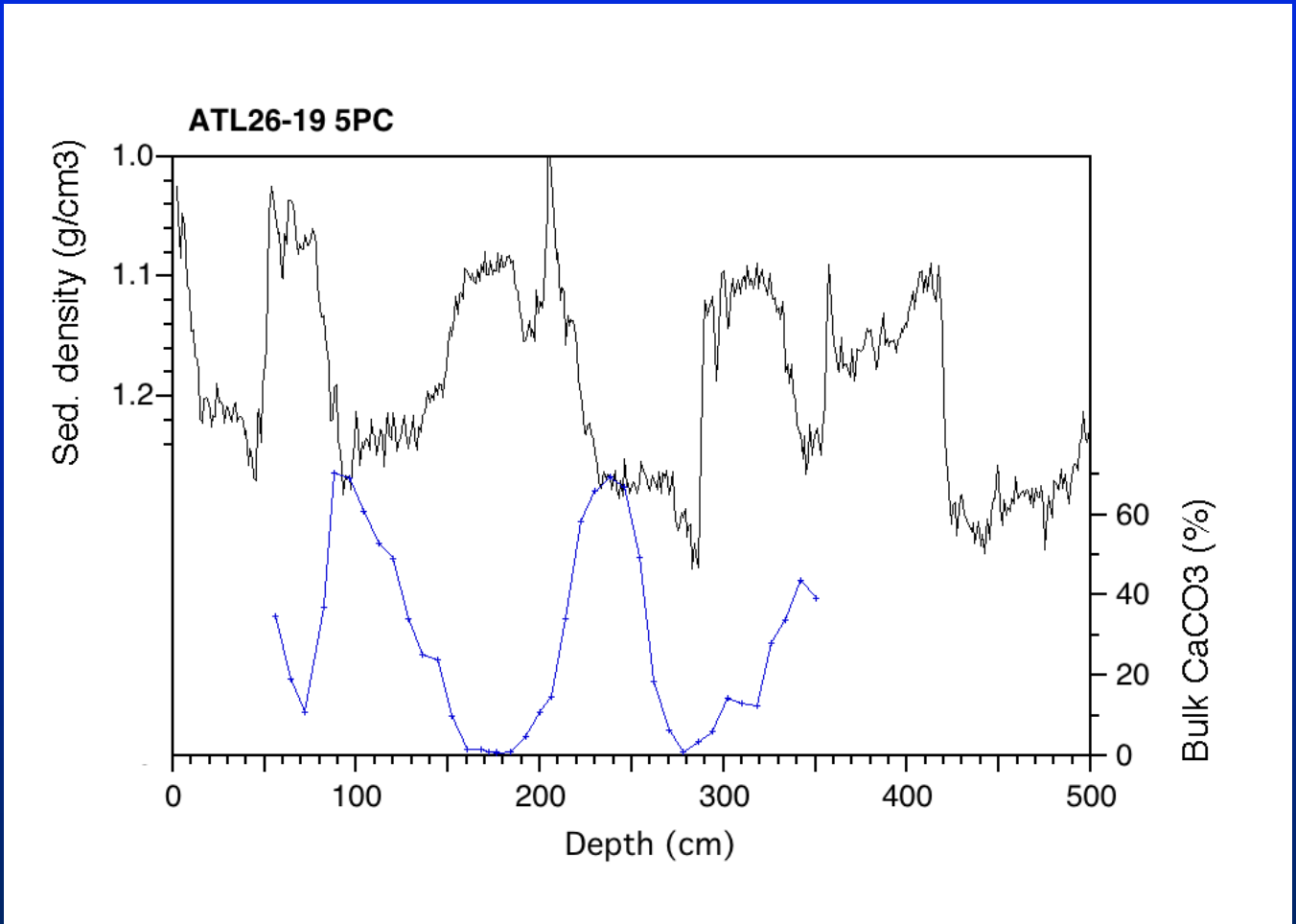
K. Costa et al., shipboard



K. Costa et al., shipboard

New $CaCO_3$ content data from SeaVOICE core

(suggests substantial burial during each glaciation)

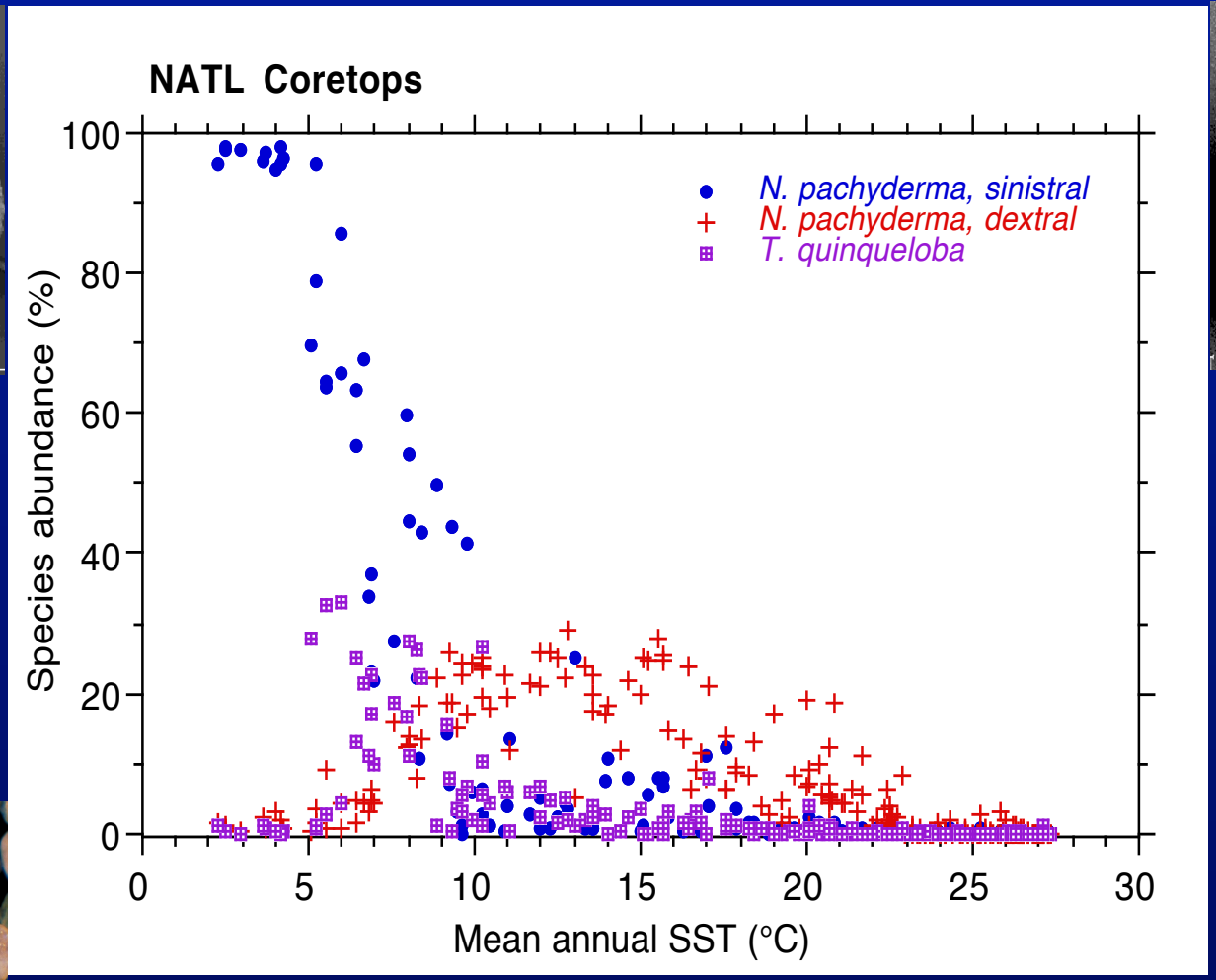


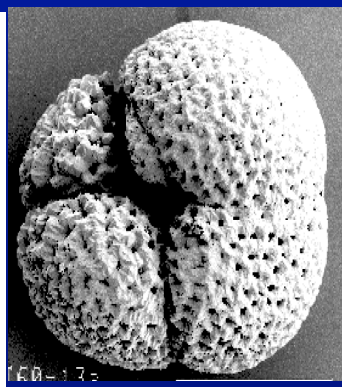
Luis et al., unpub.

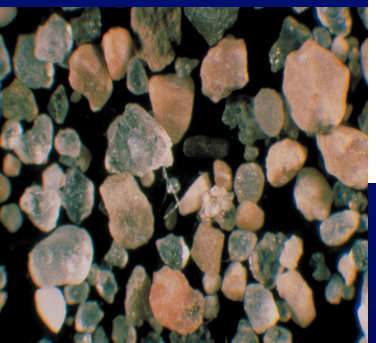
Sea-surface indicators: Foraminifera and IRD

High density intervals in JdF cores have polar forams and IRD

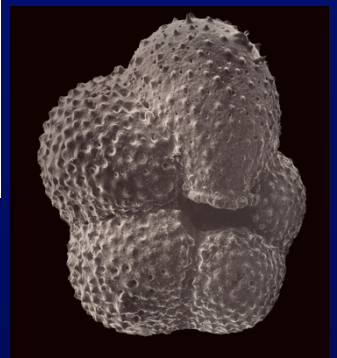
N. pachy., sininstral, polar foram.







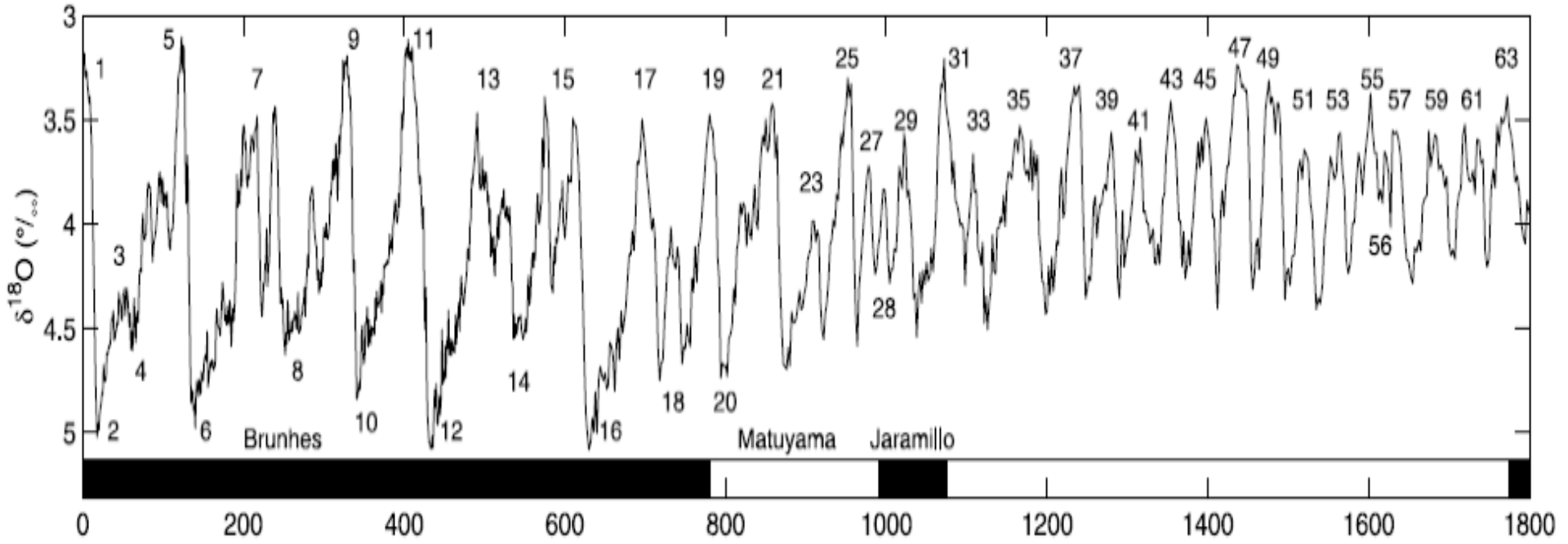
Iceberg-rafted debris (IRD)



Oxygen isotopes provide a global stratigraphy to compare events.
Climate cycles identified as marine isotope stages (MIS).
The even # MIS are glacial intervals, odd MIS are interglacial intervals.

Warmer/Less Ice

Global Stack



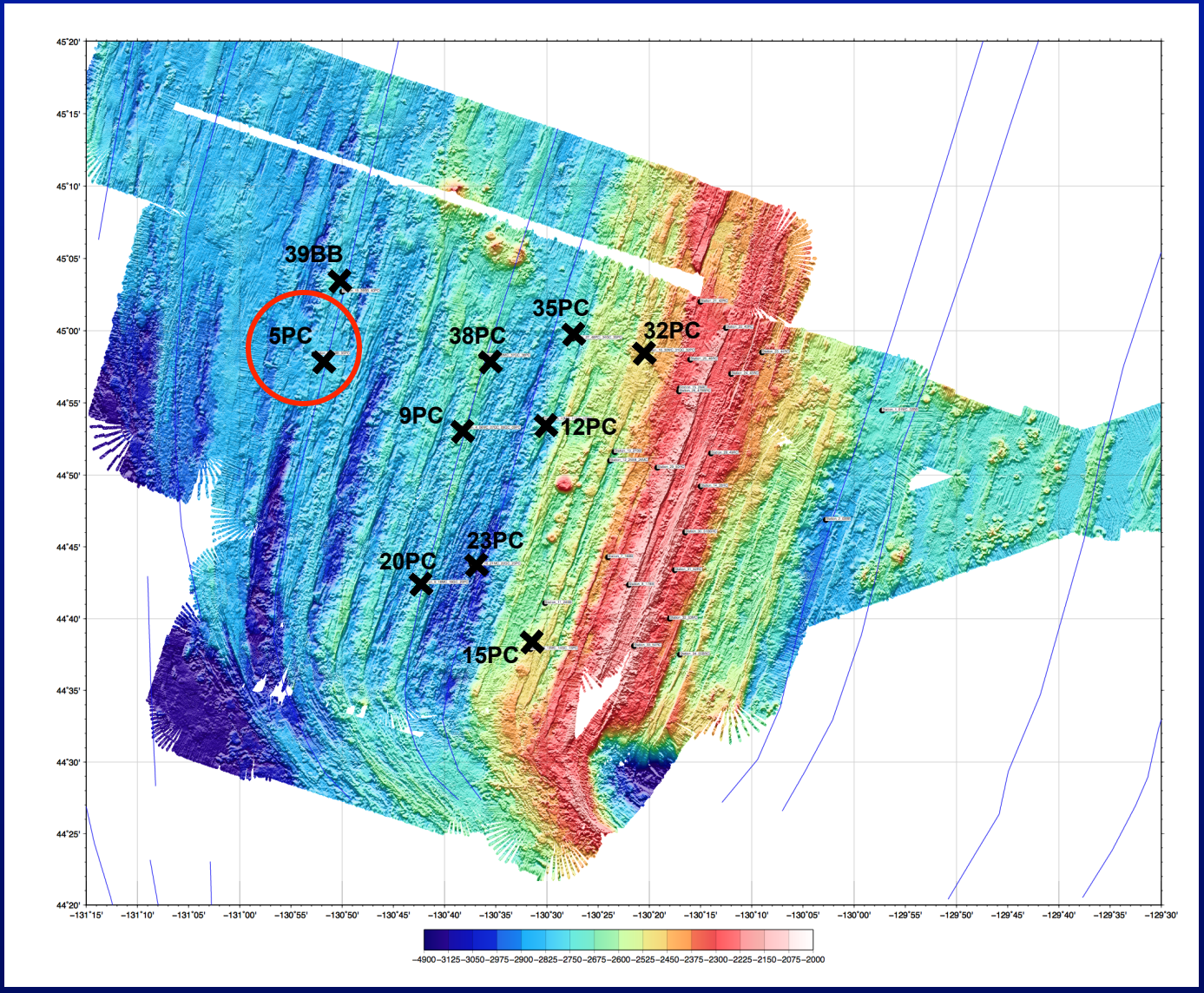
Colder/More Ice

Lisiecki and Raymo, 2005

Benthic (bottom-dwelling) foraminifera genus *Uvigerina* selected for $\delta^{18}O$ analyses

Cushman Foundation

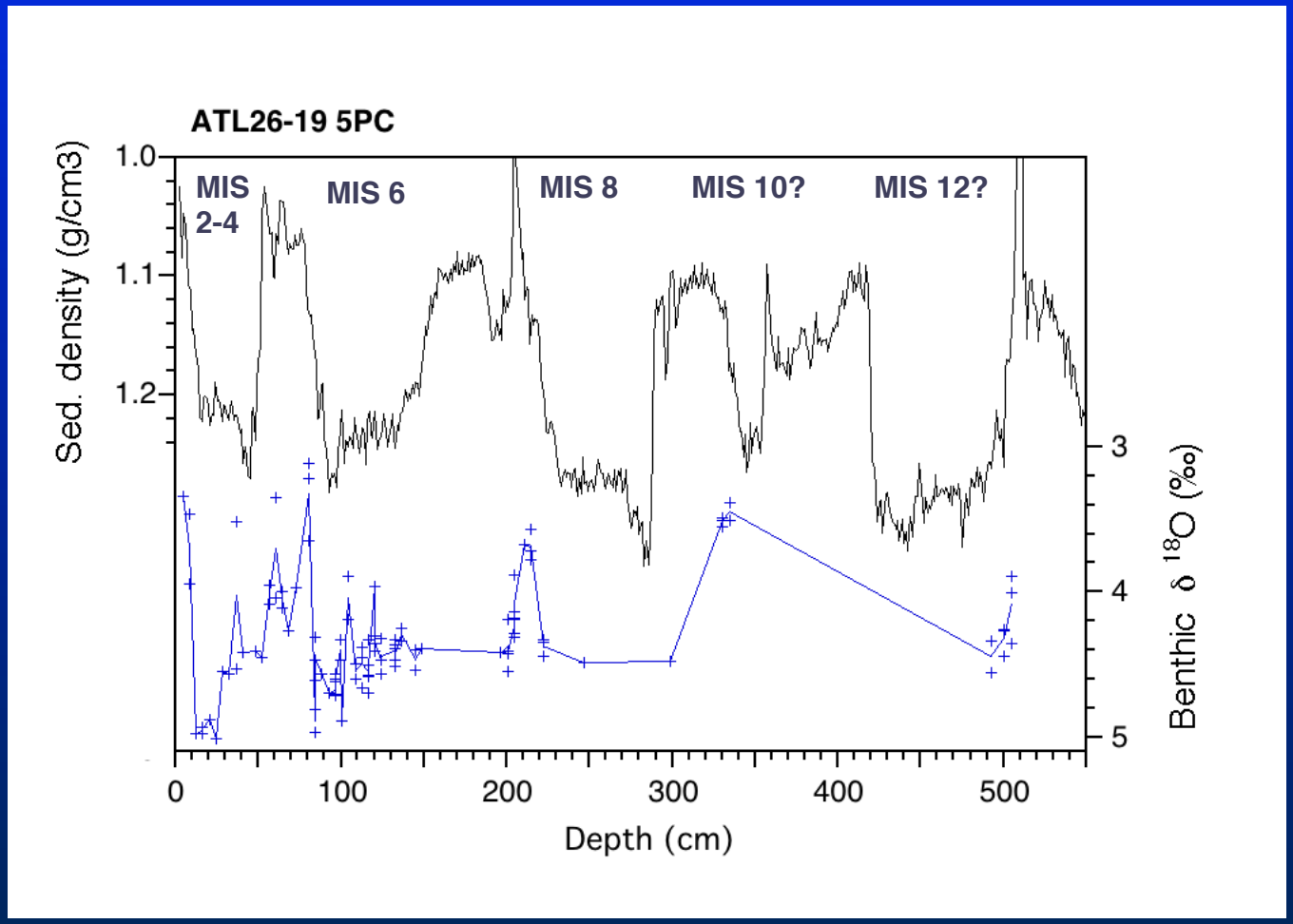
5pc: piston core with long section on oldest crust



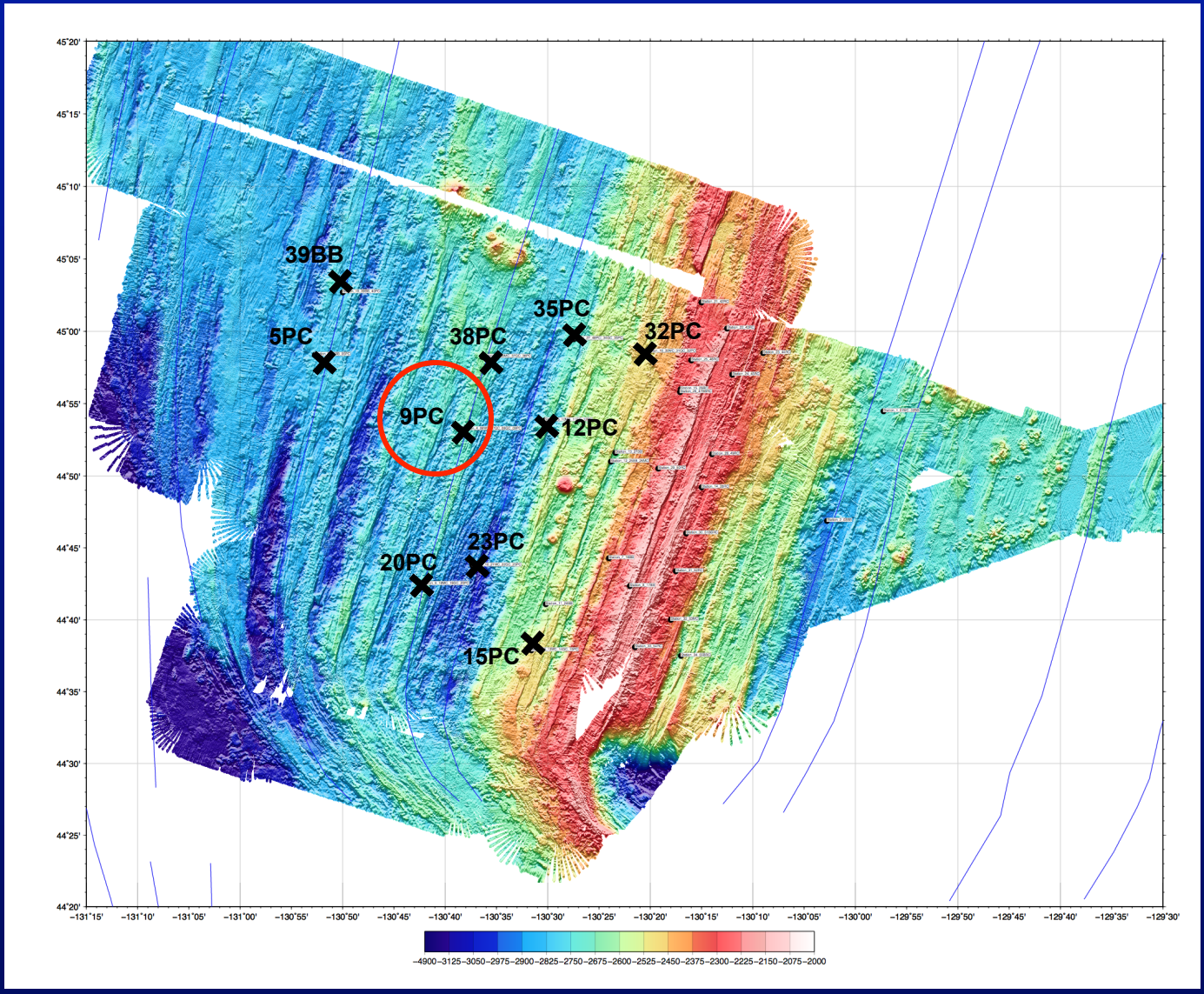
Basemap courtesy of Boulahanis, Gibson and Carbotte

Benthic foraminifera $\delta^{18}O$

High density intervals have high (glacial) $\delta^{18}O$



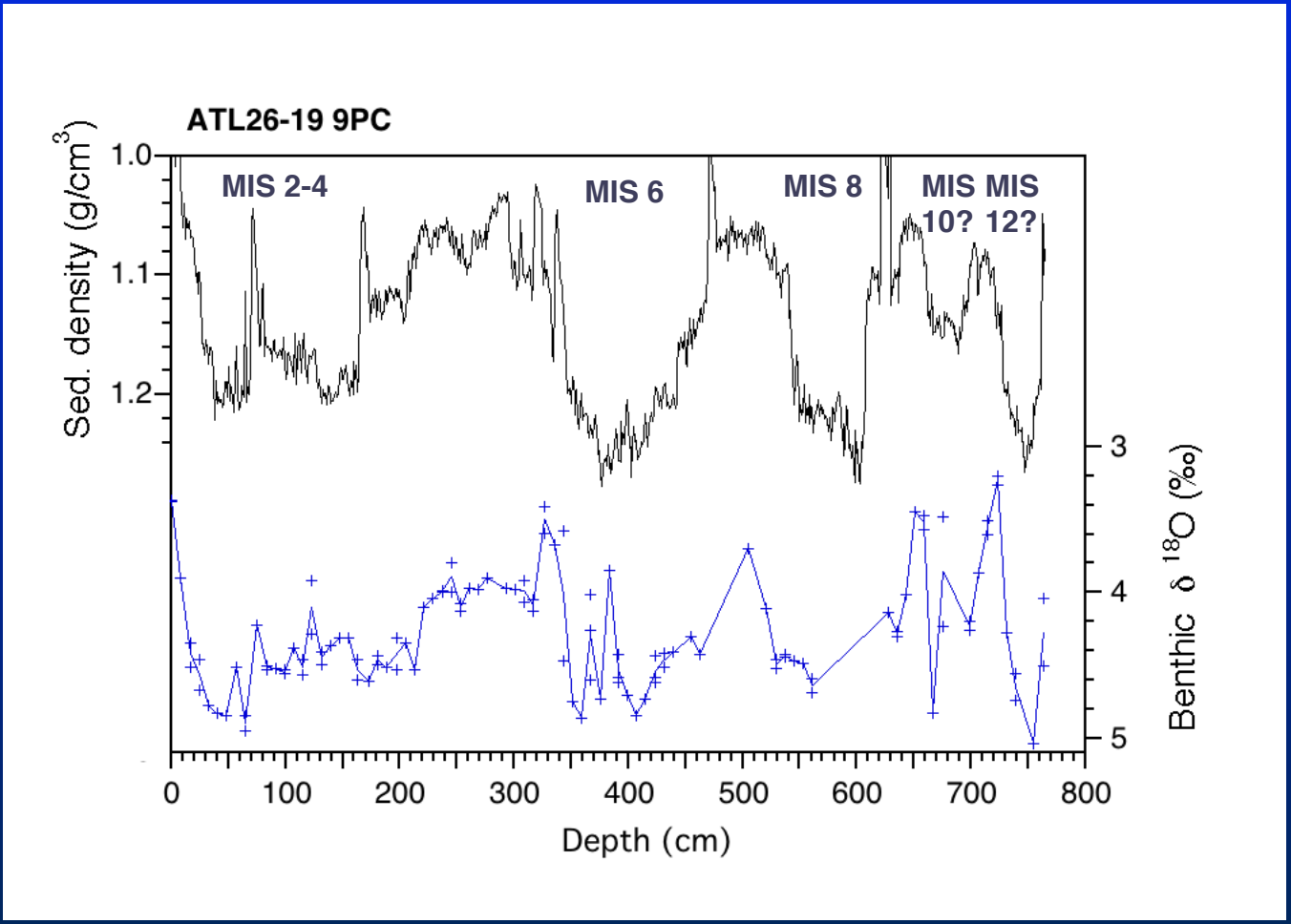
9pc: highest accumulation rate, longest section



Basemap courtesy of Boulahanis, Gibson and Carbotte

Benthic foraminifera $\delta^{18}O$

High density intervals have high (glacial) $\delta^{18}O$ - sed. rate varies



Summary

SeaVOICE cores have identifiable glacial cycles

High density intervals represent glaciations

$CaCO_3$ is present nearly throughout, varies widely

Accumulation rates range from ~1cm/ka to ~3cm/ka

Many sediment sections extending to ~300 ka

Several sediment sections extend to ~500-800 ka