

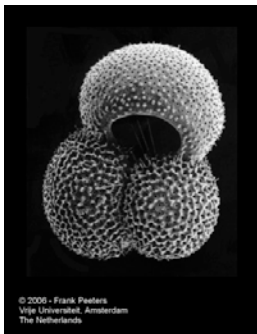
The ocean's role in climate change: temperature and more from metal proxies in carbonates

- Graham Mortyn, [USA], here since 2004
- Miquel Àngel (“Migue”) Martínez Botí, July 2009 Ph.D. (ICTA) [Spain]
- Laura Rodríguez Sanz, current Ph.D. student (ICTA) [Venezuela and Spain]
- Giorgos Kontakiotis, current Ph.D. student (University of Athens) [Greece]
- André Colonese, postdoc (IMF-CSIC) [Brazil, Italy]
- 1 completed Ph.D., 2 Ph.D.’s in progress, 3 completed MS projects

Our research on
foraminiferal trace element
geochemistry

- ocean / climate parameters,
especially temperature
- modern validation studies
- “paleo” climate reconstruction
projects

Our “workhorse” proxy
.. Mg/Ca

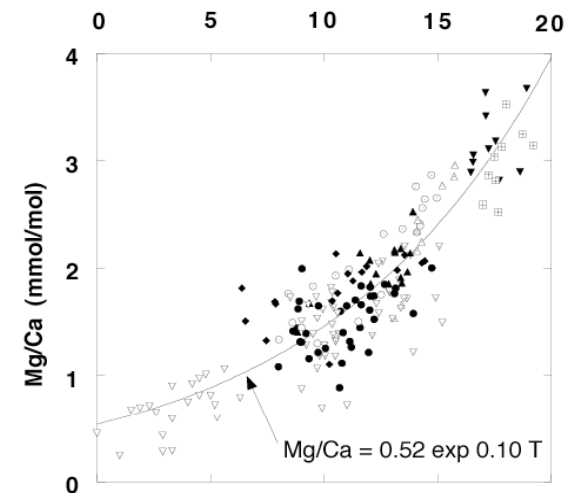


Globigerinoides ruber

Marine sediments and their microfossils



calcification temperature (°C)



○	G. bulloides (0.56)
▼	G. ruber (0.52)
⊠	G. sacculifer (0.50)
△	G. siphonifera (0.52)
▽	N. pachyderma (0.50)
◆	G. hirsuta (0.54)
●	G. inflata (0.49)
▲	G. truncatulinoides (0.54)

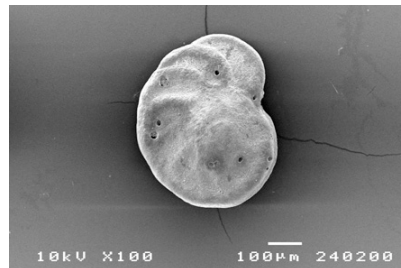
Elderfield and Ganssen, 2000.

San Lázaro Basin (SLB) is a key working area. Others include S. Atlantic, Arctic Ocean, and E. Med. All involve foraminiferal geochemistry.

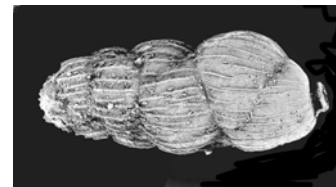
Potential MS projects:

- Multi-species deglaciation SST proxy reconstructions, range of latitudes in SE Atlantic, part of **Productivity and Carbonate Dynamics in the Southern Ocean (PROCARSO)** project
- *Globigerina bulloides* SLB record last 1.2ky (to discern role of seasonal contrast (spring-summer) in this marine climate variability)
- Baja margin benthic tracer validation (to validate Mg/Ca and Cd/Ca as tracers of NPIW T and nutrient signatures (Holocene “modern”) for eventual application to “paleo” ventilation history of NPIW under widely different boundary conditions (e.g. LGM))
- Arctic Ocean *N. pachyderma* Mg/Ca validation study from summer plankton pump samples

Planulina spp.



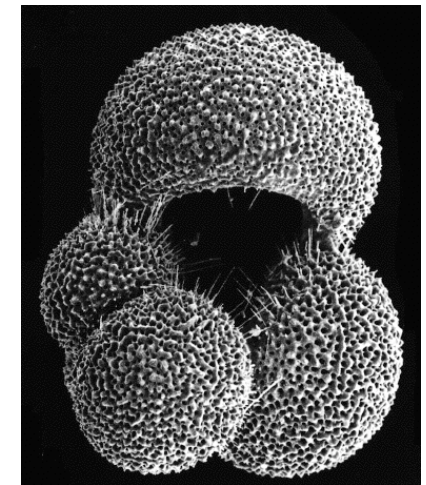
Uvigerina spp.



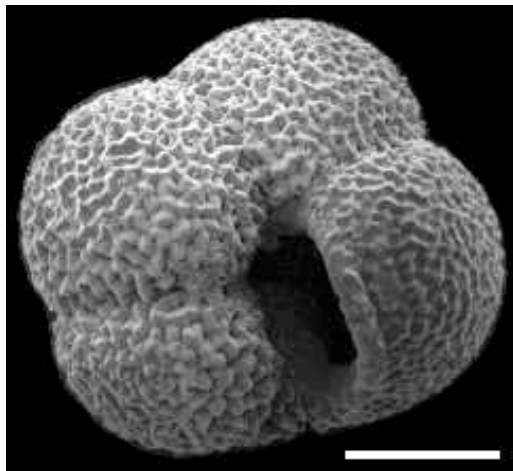
Benthic images from E. Rohling

Neogloboquadrina pachyderma (s.)
Courtesy of Byrd Polar Research Center

G. bulloides



Mortyn and Martínez-Botí, 2007



Some sample acquisition methods:

- **Plankton-tows:**

- Samples collected with nets directly from the water column
- MOCNESS, Multinets, MCN
- Environmental data available for comparison with geochemical signals



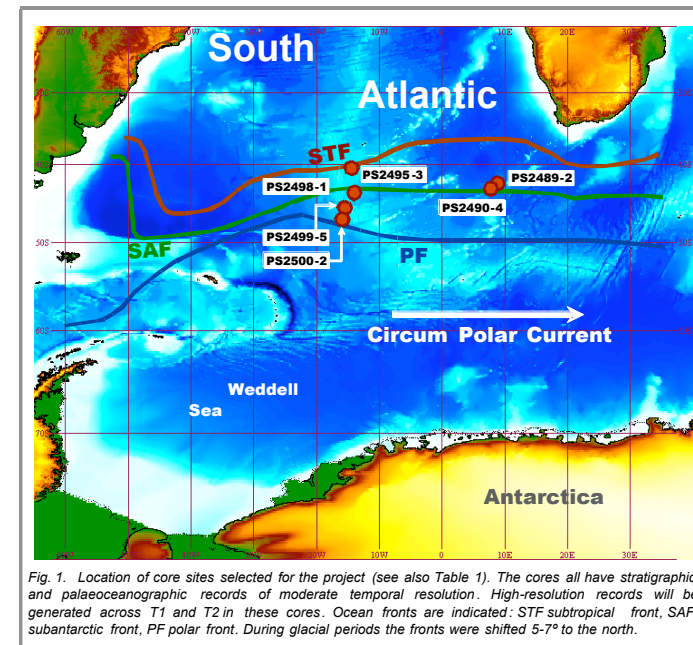
Multi-corer:

water/sediment
interface



Ocean Drilling Program (ODP)

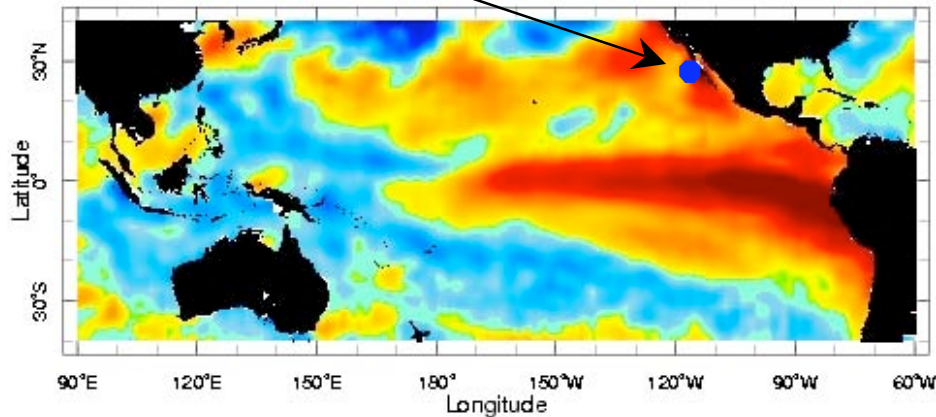
Productivity and Carbonate Dynamics in the Southern Ocean (PROCARSO) project



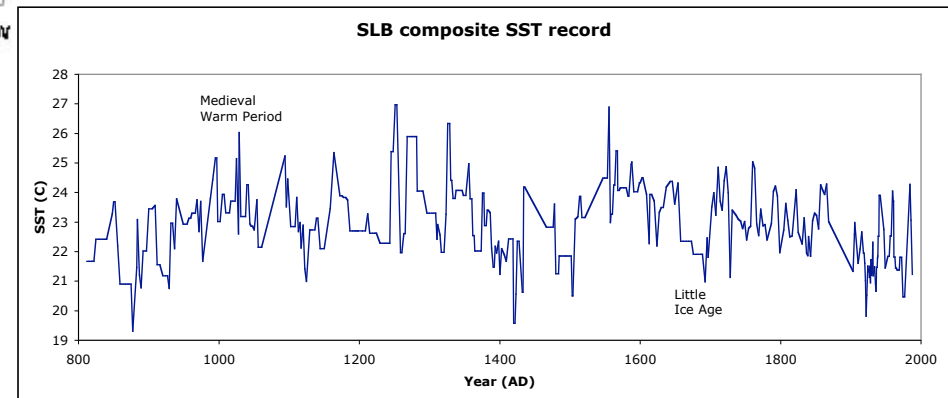
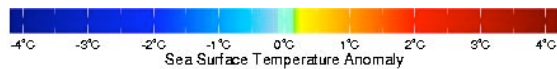
- CO₂ mysteries (cause or consequence?, missing C sink, etc.)
- S. Ocean focus (much deep C storage, potential to exchange it with atmosphere in all major ocean basin sectors that are linked here)
- Glacial terminations (“natural” global warming)
- Physical / chemical / biological property reconstructions
- Includes planktonic foraminiferal Mg/Ca (sea surface T, SST)

San Lázaro Basin (SLB) work in greater detail

San Lázaro Basin

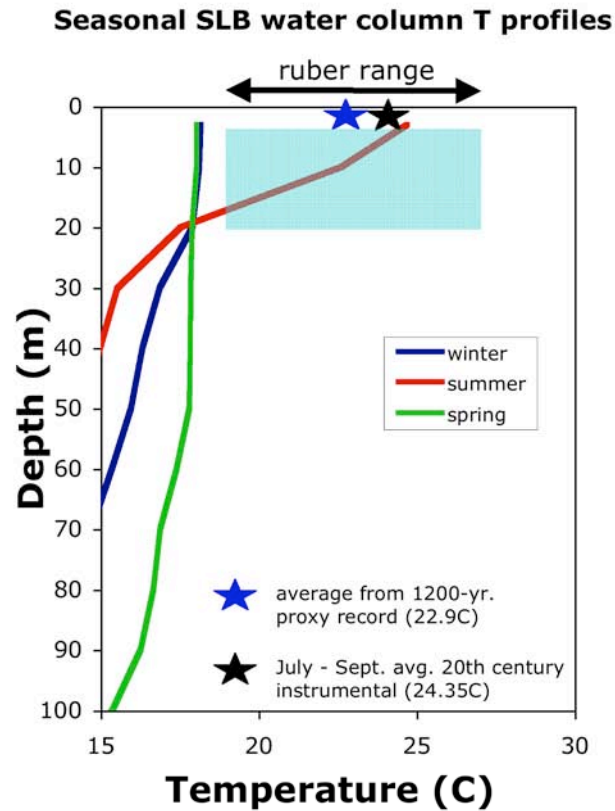


31 Aug 1997 - 6 Sep 1997

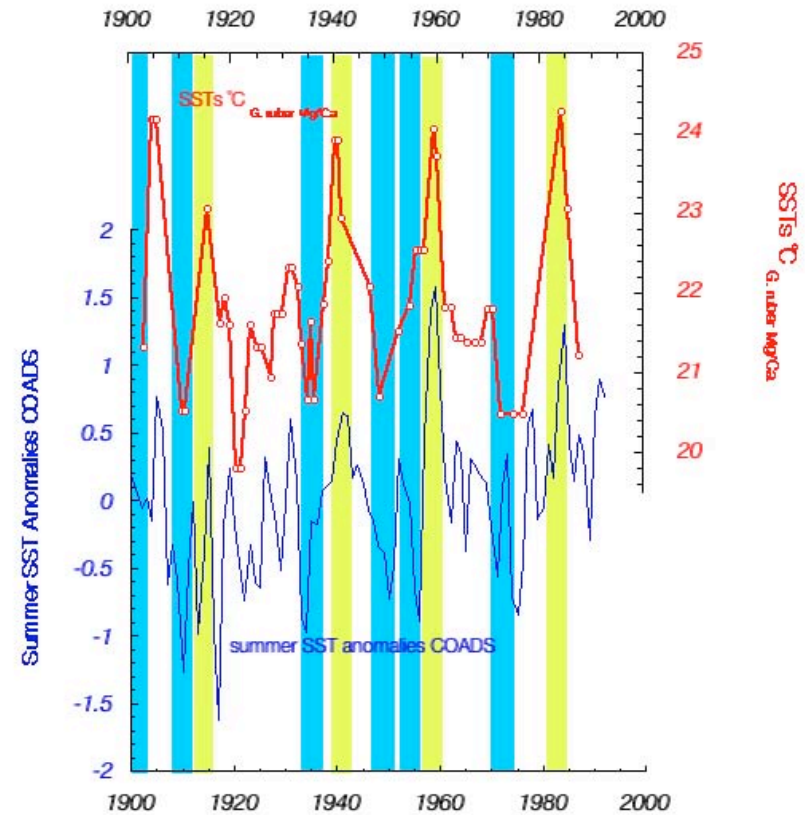


- ❖ Several key El Niño / Southern Oscillation (ENSO) (and other inter-annual / inter-decadal phenomena) successfully recorded.
- ❖ Promising proxy for SST reconstruction in critical region.
- ❖ With hi-res. reconstruction of last 1200 yr., can discern pre- vs. post-anthropogenic signature, but yet under similar climatic boundary condition (interglacial).

SLB 2-way validation that *G. ruber* Mg/Ca proxy for summer SST actually works



Water column



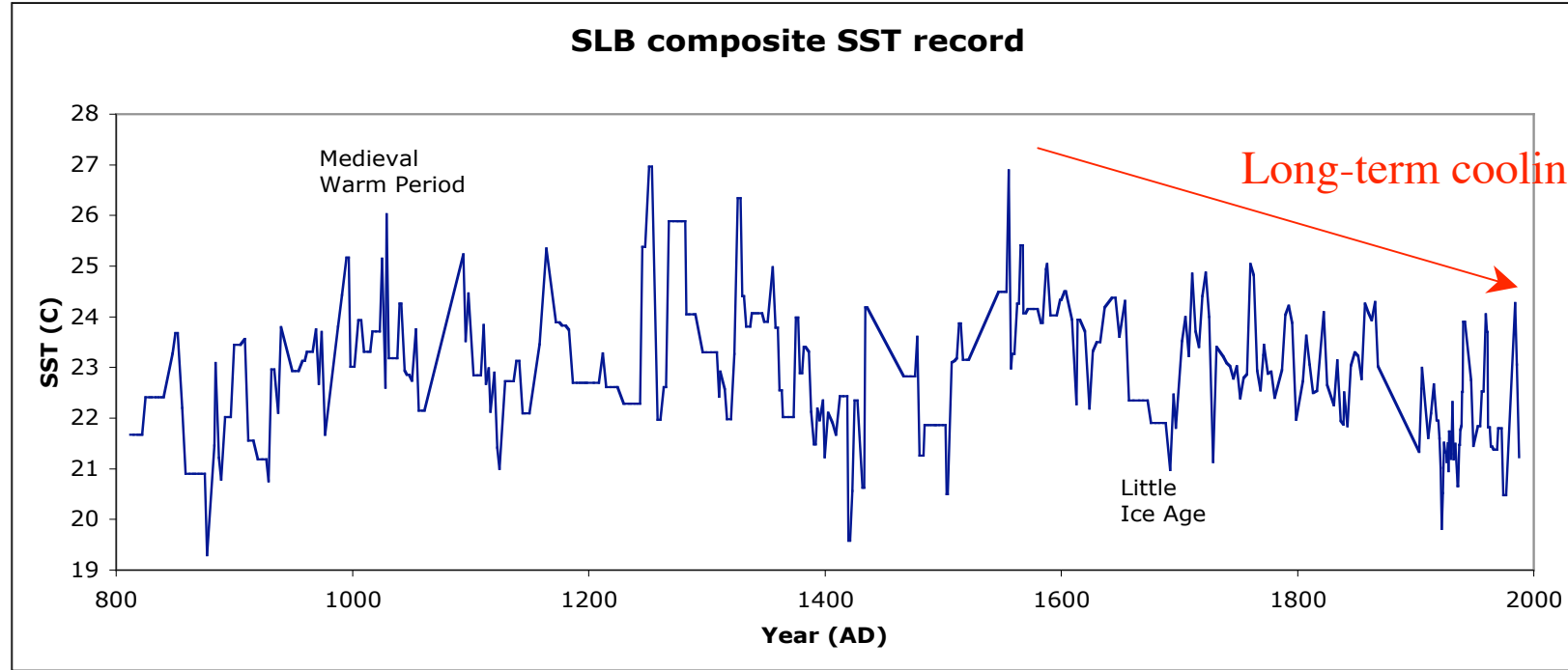
Sediments

Figure 3

Yellow Bars - ENSO
Blue Bars - La Niña

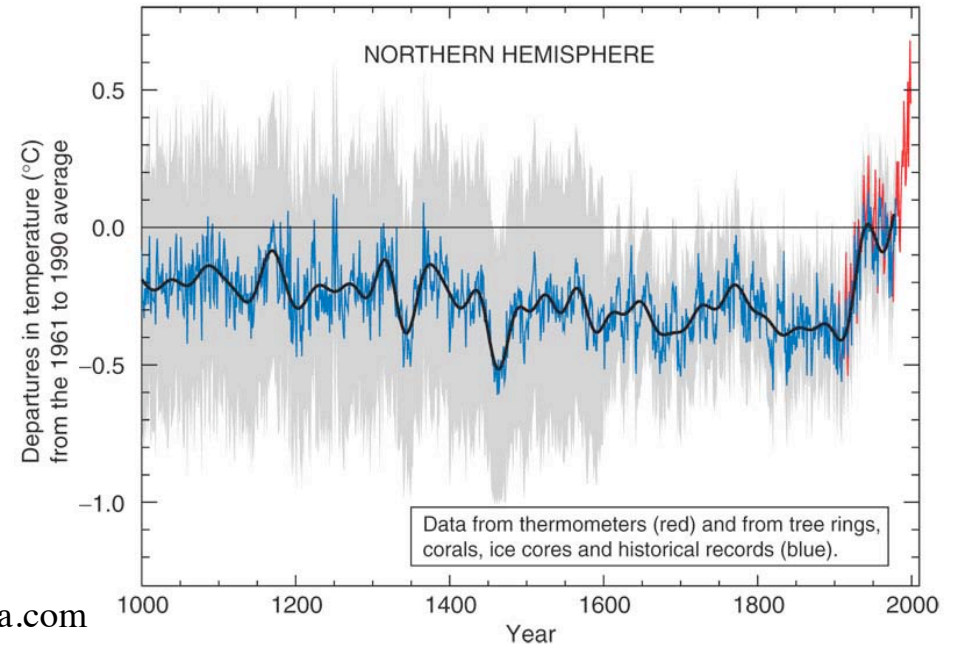
Proxy - instrument comparison for last century

The major implication of our SLB findings



Why does the ocean record not show the “blade” of the “hockey stick”??

Warmer land surface, enhanced land/sea P gradients, and wind-induced upwelling (supported by orgC data)



If interested, contact me
(graham.mortyn@uab.es)



THANK YOU!