Geochemical proxy calibration along the Indonesian Throughflow (ITF) pathway.

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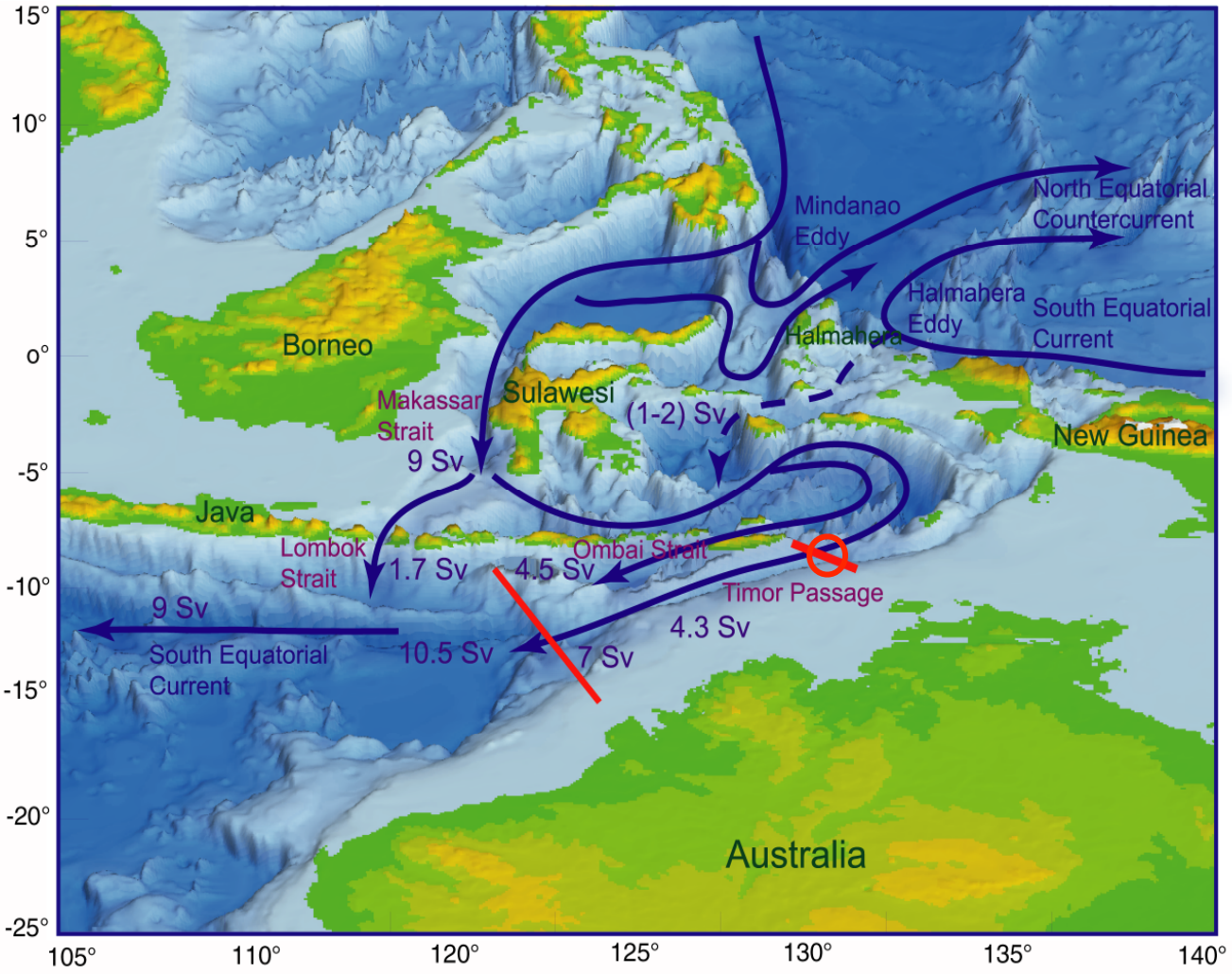
Summary

- Introduction
- Stable isotopes
- Mg/Ca Palaeothermometry
- XRF core scanning
- Discussion
- Future work

Core 18471-2



(Kuhnt et al., 2004)

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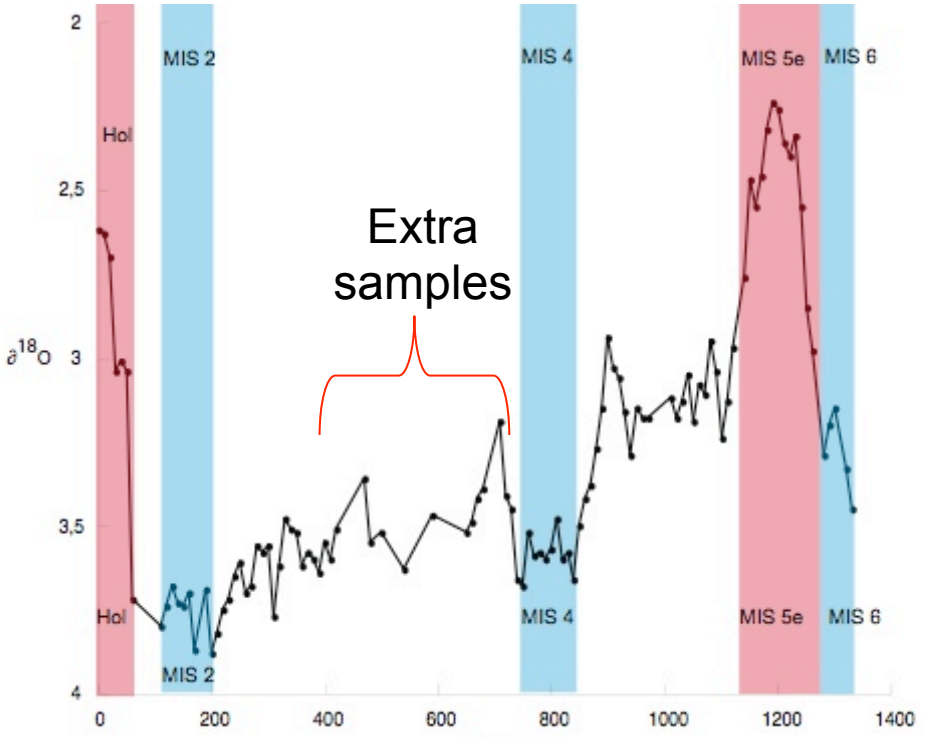
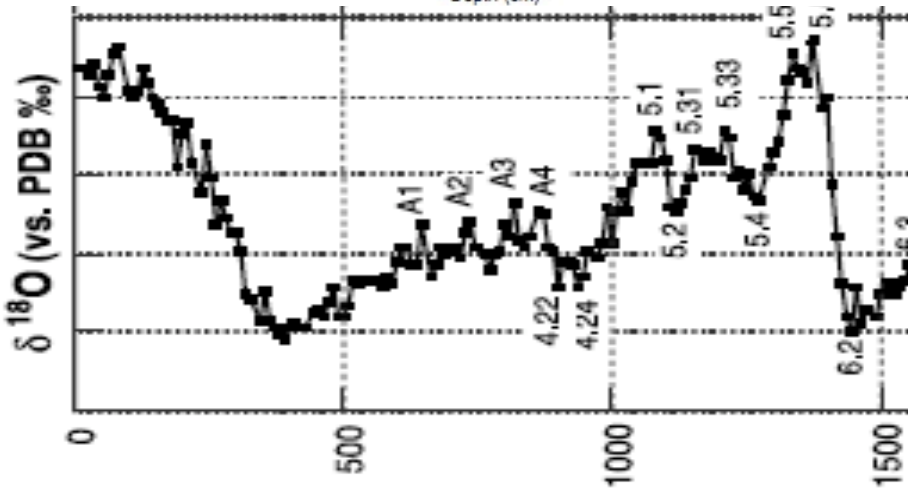
Using BENTHIC FORAMINIFERA as proxies for temperature and changes in the water masses, we can investigate the “real” thermocline flow, going deeper than previous works have done:

1. How does the thermocline flow change with time?
2. What are the implications of its variability on the climate?
3. Is the NW Australian river runoff recorded in the core?
4. Do climate changes in NW Australia affect the thermocline flow? How?

Stable Isotopes





(Holbourn *et al.*, 2005)

$\delta^{18}O$ values range between 2.24 - 3.88 ‰.

SO18471-2 water depth: 485 m

SO18471-2 location: 129°58.983'E/9°21.987'S

MD01-2378 water depth:1783 m

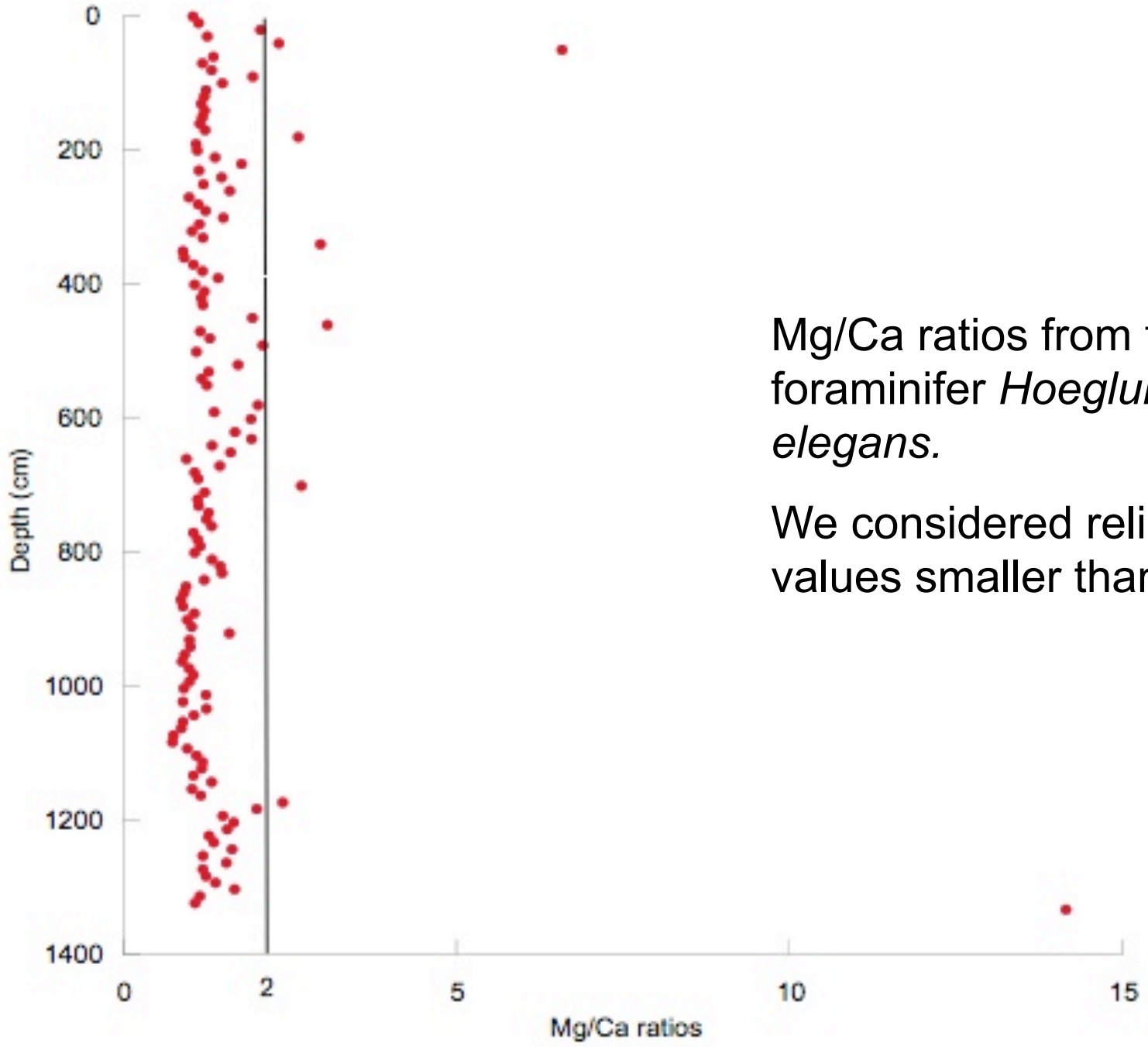
MD01-2378 location: 121°47.27'E/13°04.95'S northwestern margin of the Scott Plateau in the Timor Sea.

Mg/Ca Palaeothermometry

Mg/Ca palaeothermometry

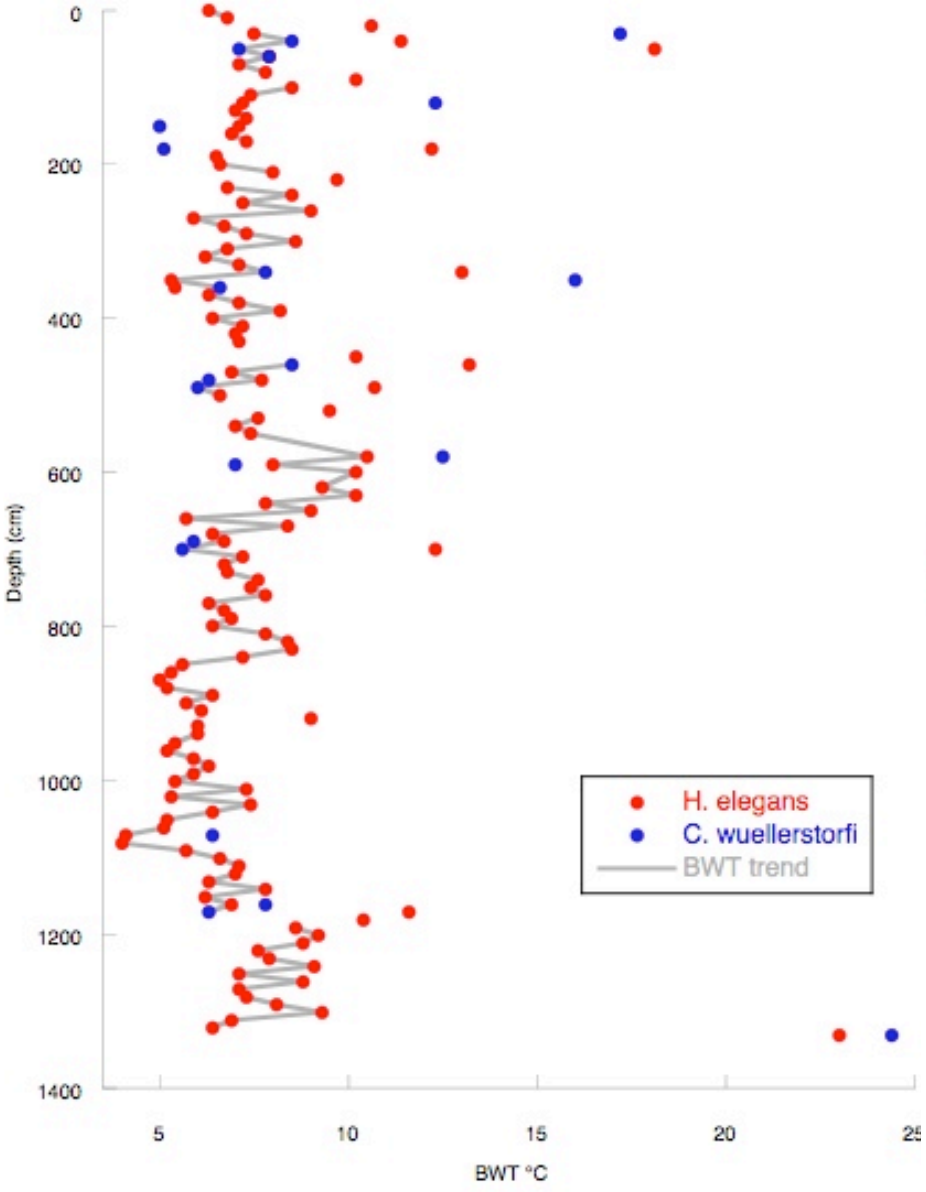
It is a well accepted method to estimate temperature from planktonic foraminifera tests.

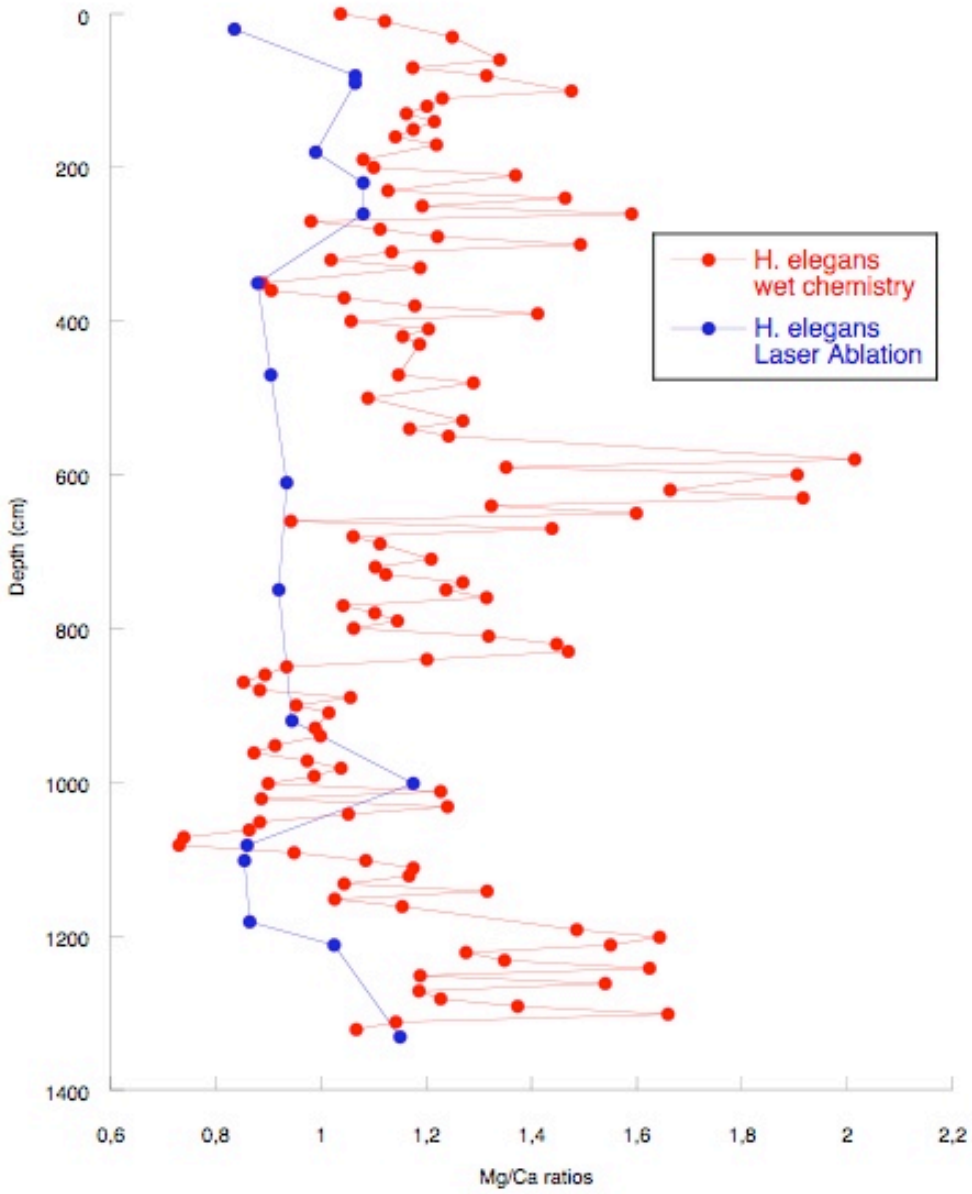
Its application to benthic foraminifera is still relatively new because of the small difference in temperature recorded by benthic foraminifera.

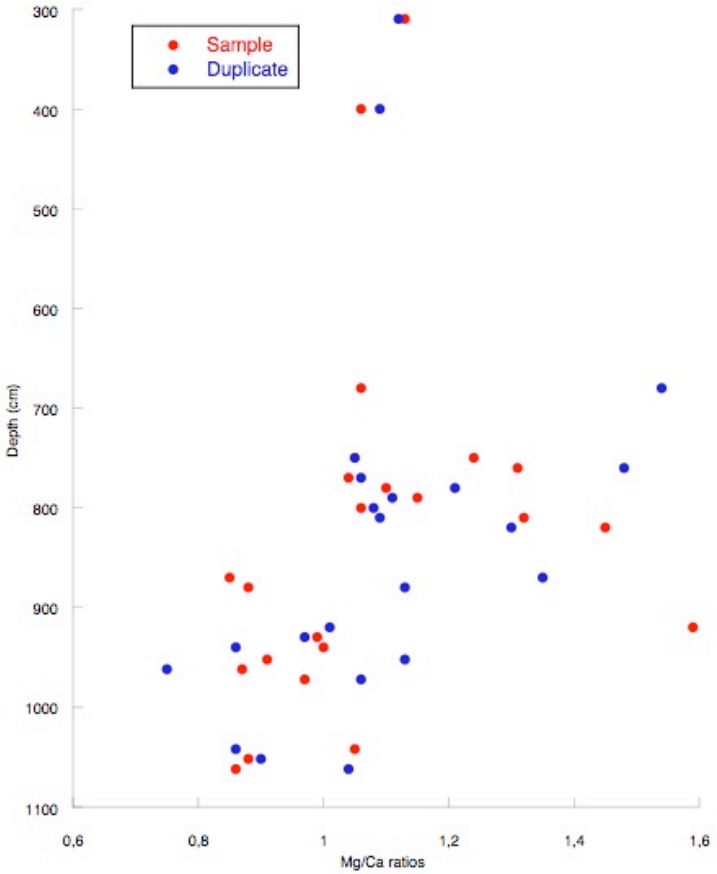


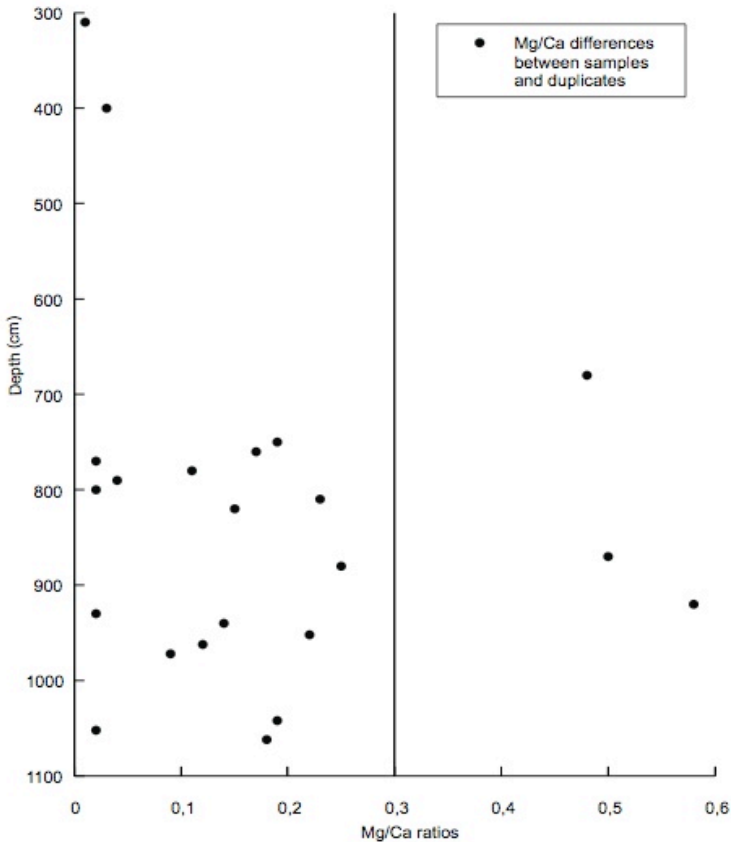
Mg/Ca ratios from the benthic foraminifer *Hoeglundina elegans.*

We considered reliable all the values smaller than 2.


Depth (cm)
0
200
400
600
800
1000
1200
1400
5
10
15
20
25
BWT °C
H. elegans
C. wuellerstorfi
BWT trend

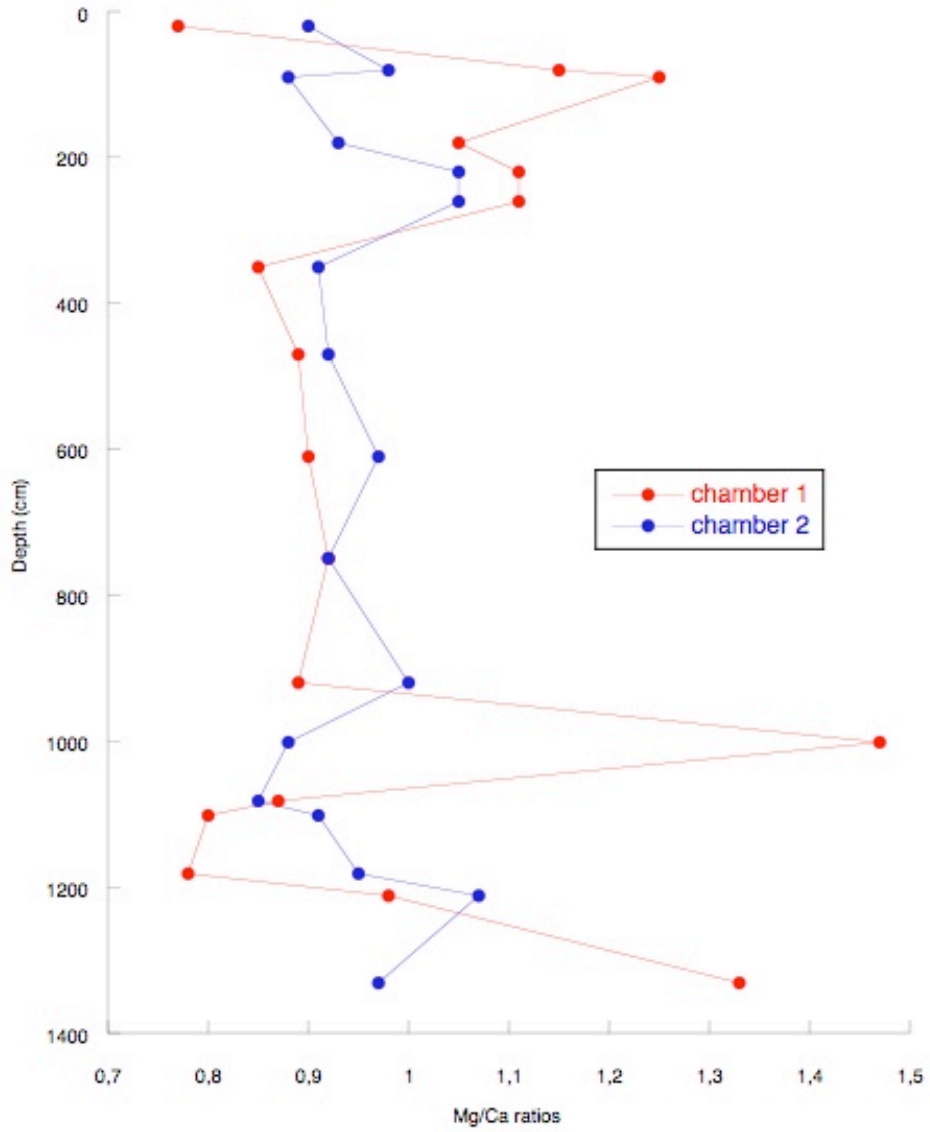

Depth (cm)
0
200
400
600
800
1000
1200
1400
0,6
0,8
1
1,2
1,4
1,6
1,8
2
2,2
Mg/Ca ratios
H. elegans wet chemistry
H. elegans Laser Ablation

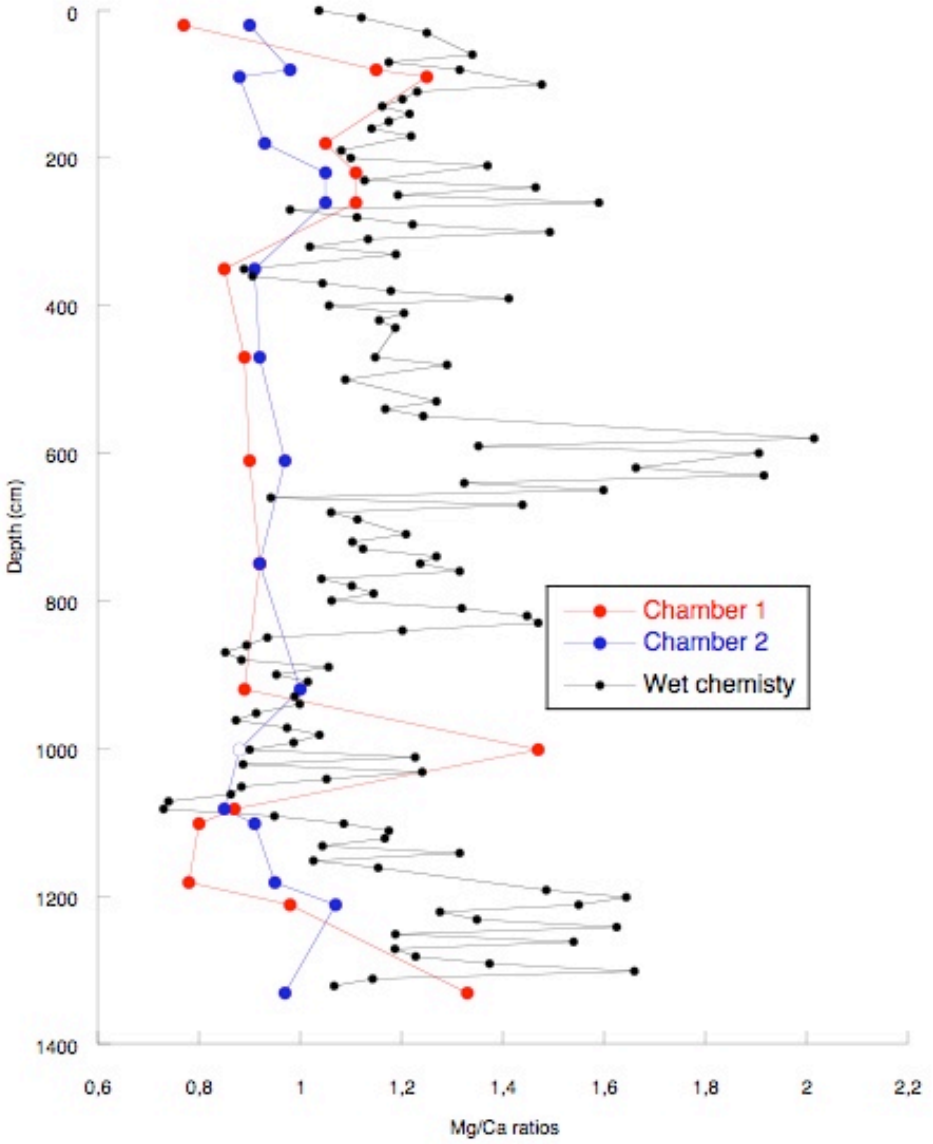


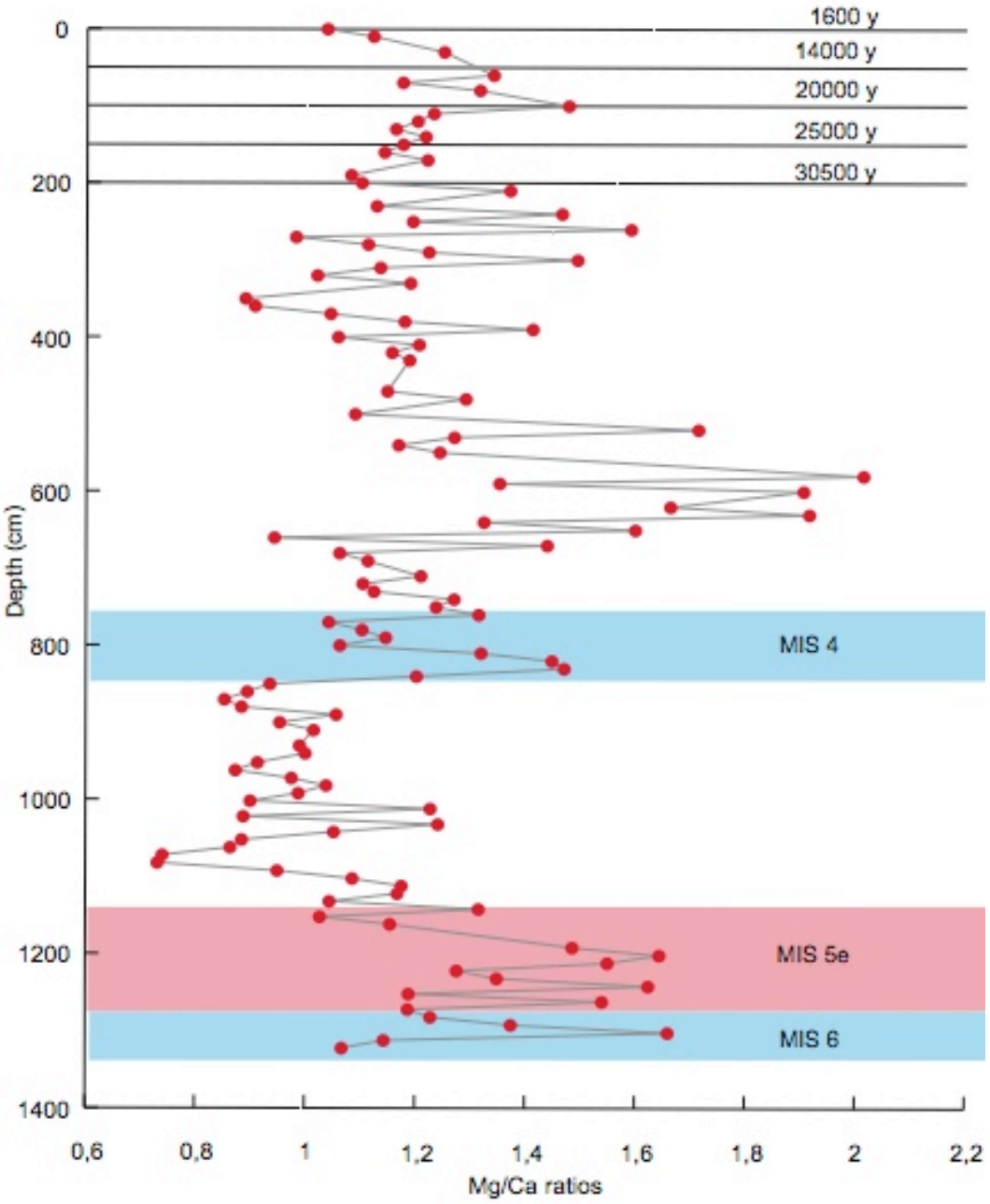


Reproducibility of the wet chemistry samples

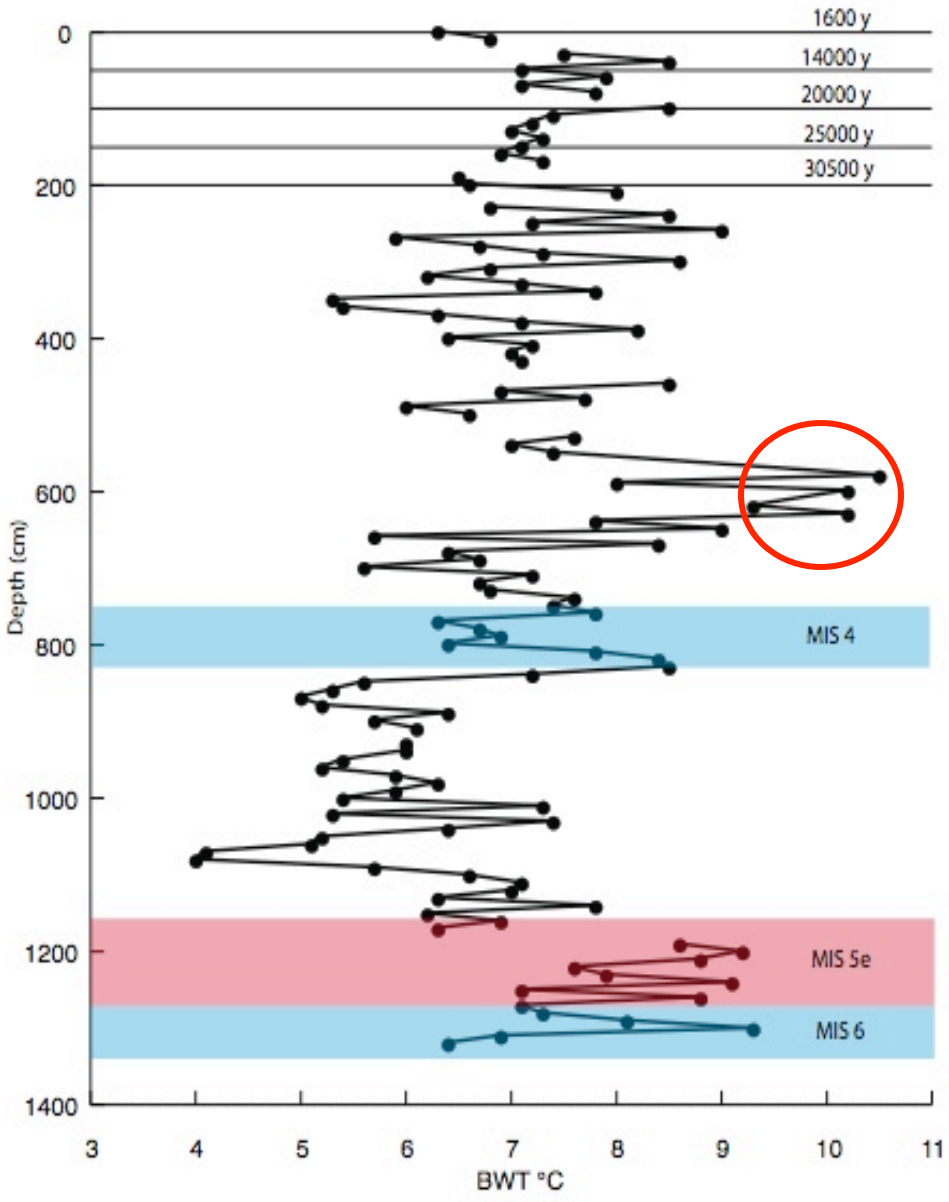
	Difference
Minimum	0,01
Maximum	0,57999998
Sum	3,76
Points	22
Mean	0,17090909
Median	0,145
RMS	0,23306261
Std Deviation	0,16218476
Variance	0,0263039
Std Error	0,03457791
Skewness	1,2634506
Kurtosis	0,77947975


0
200
400
600
800
1000
1200
1400
Depth (cm)
0,7
0,8
0,9
1
1,1
1,2
1,3
1,4
1,5
Mg/Ca ratios
chamber 1
chamber 2


0
200
400
600
800
1000
1200
1400
Depth (cm)
0,6
0,8
1
1,2
1,4
1,6
1,8
2
2,2
Mg/Ca ratios
Chamber 1
Chamber 2
Wet chemisty



Mg/Ca ratios from *H. elegans* range from 0.73 and 2.01 mmol/mol.



WorldOceanAtlas (129,5°E/8,5°N)	Surface T [°C]	400m T [°C]	500m T [°C]
Sep.05	28,91	8,00	7,27
Oct 2005	29,28	8,35	7,20
Season incl Sept 05	29	7,98	7,17
Season incl Oct 2005	29,05	7,85	7,12
Annual	28,84	7,86	7,11

Core water depth: 485 m

Core location:

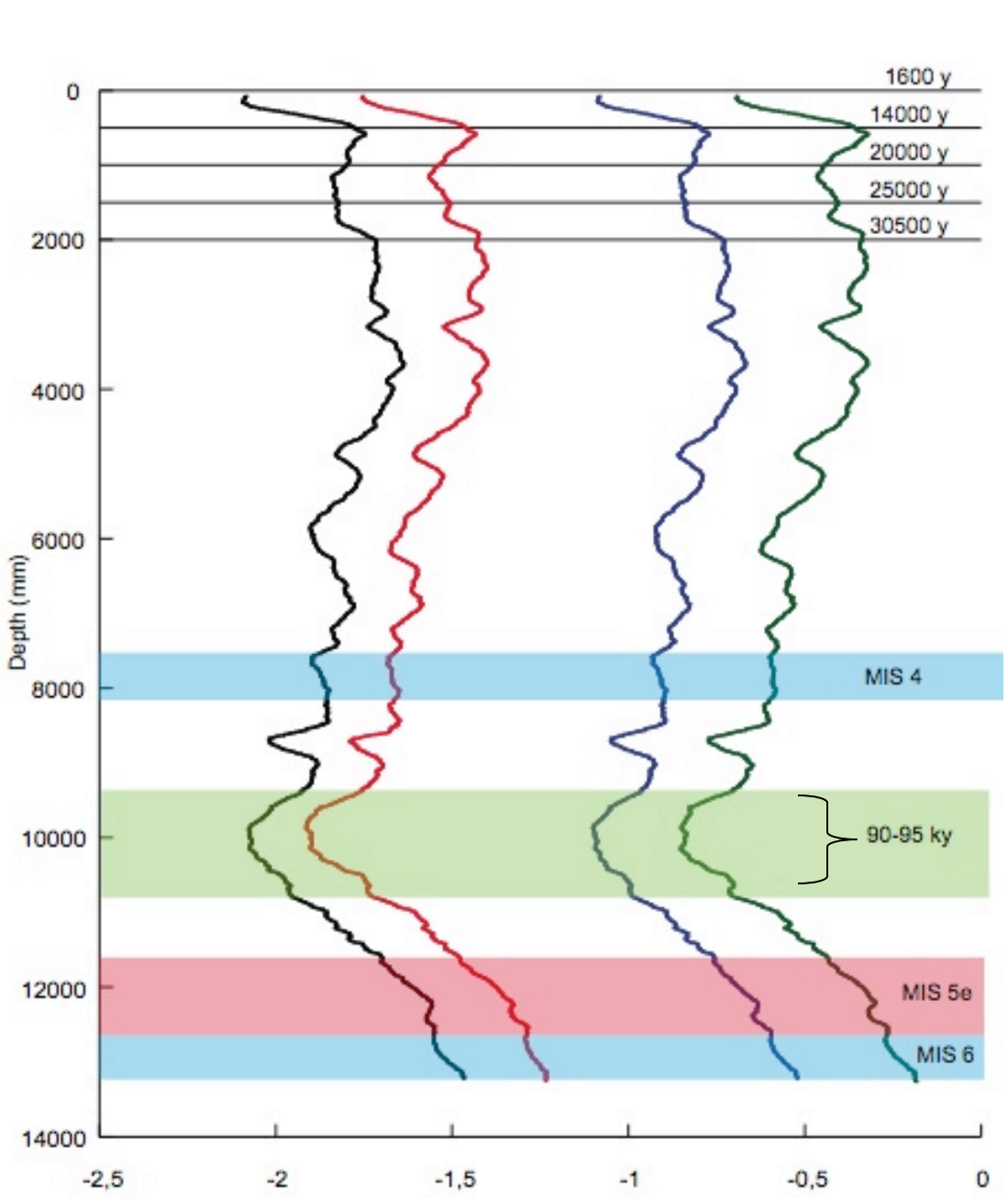
129°58.983'E/9°21.987'S

BWT range: 4°C - 10.5°C

BWT=LN[(Mg/Ca)/0.3894]/0.1564

(Fhlaithearta *et al.*, 2010)

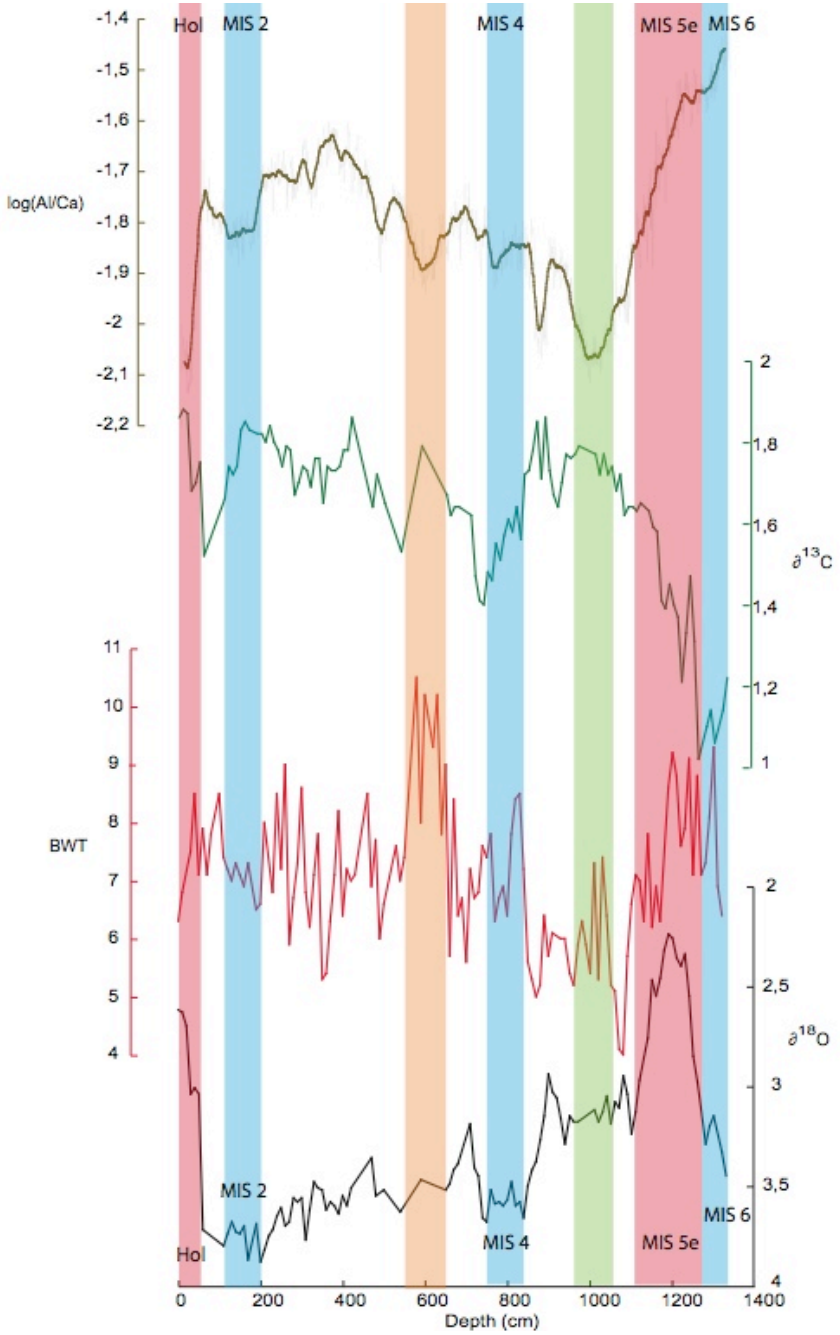
XRF core scanning



Terrigenous input

Data from other cores (not yet published) suggest that this is a regional minimum and it has been dated to be 90-95 ky BP.

Discussion



Green shading ⟶ Regional minimum in terrigenous input between 90 and 95 ky BP.

↓

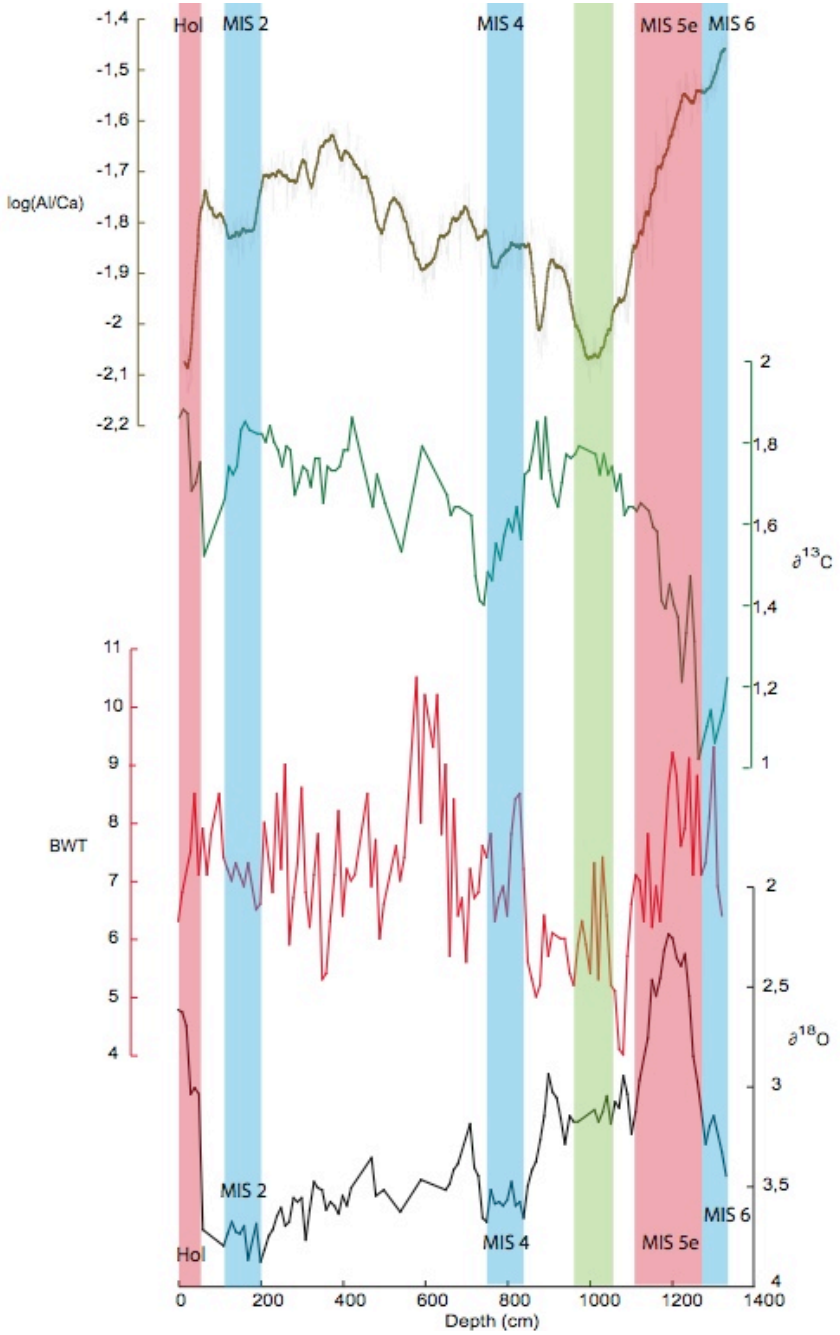
Carpentaria Lake or dry period?

Orange shading ⟶ Peak in BWT at 600 cm.

↓

Increase in salinity and drop in sea level: stop of the ITF?
Is it related with Heinrich event?

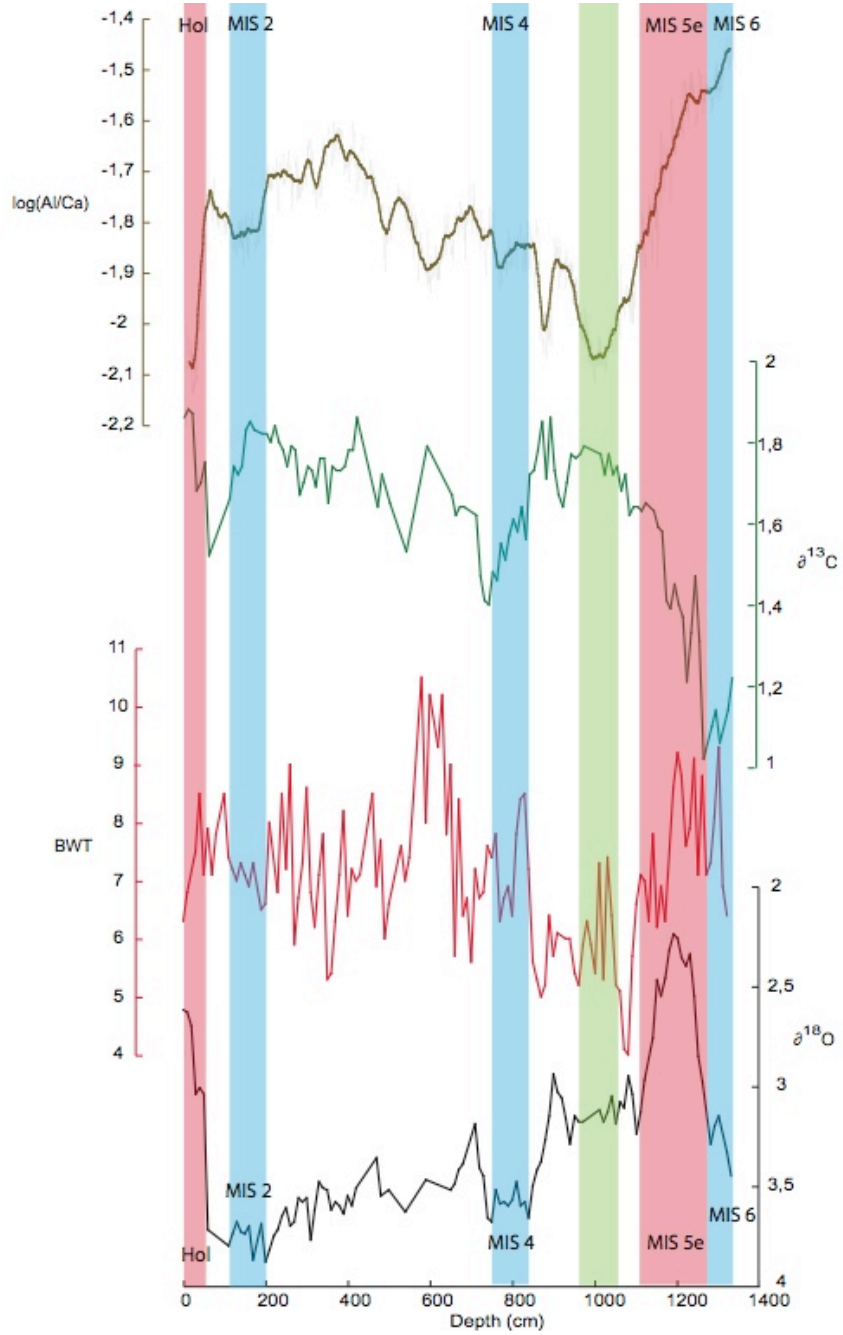
From Google Earth



Carpentaria Lake/Gulf and runoff from Northwest Australia.

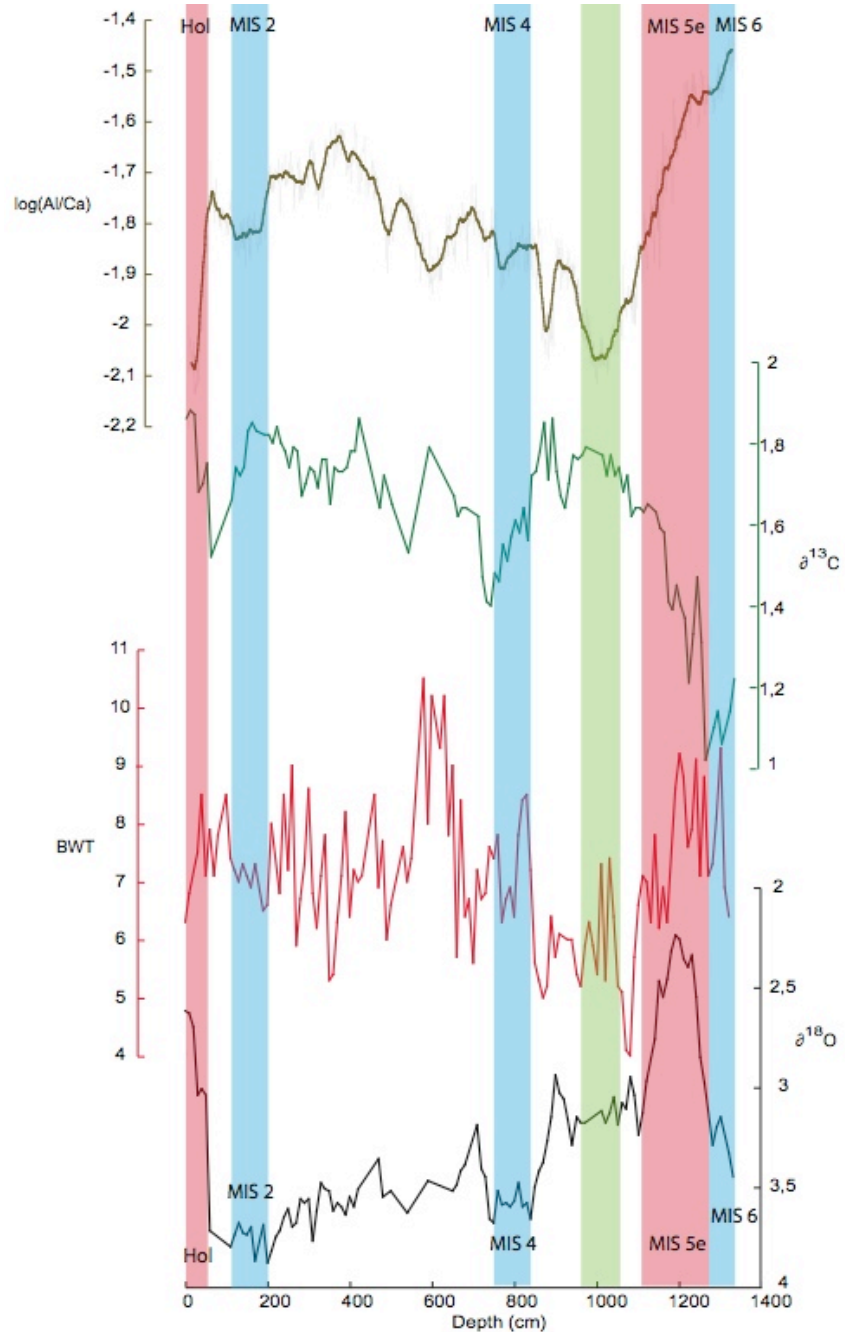
When lacustrine conditions were active, the Carpentaria Lake contributed to the terrigenous input in the Timor Sea.

When marine conditions prevailed, this flow of terrigenous input was shut off, probably causing the minimum in the terrigenous input detected in our record.



MIS 5.c (103-93 ky BP)

The Carpentaria area was a shallow marine environment, distal from fluvial influence. The sea level was well above the Arafura Sill (Arafura Sill is 53 m below present sea level). (Reeves *et al.,* 2007 and 2008).



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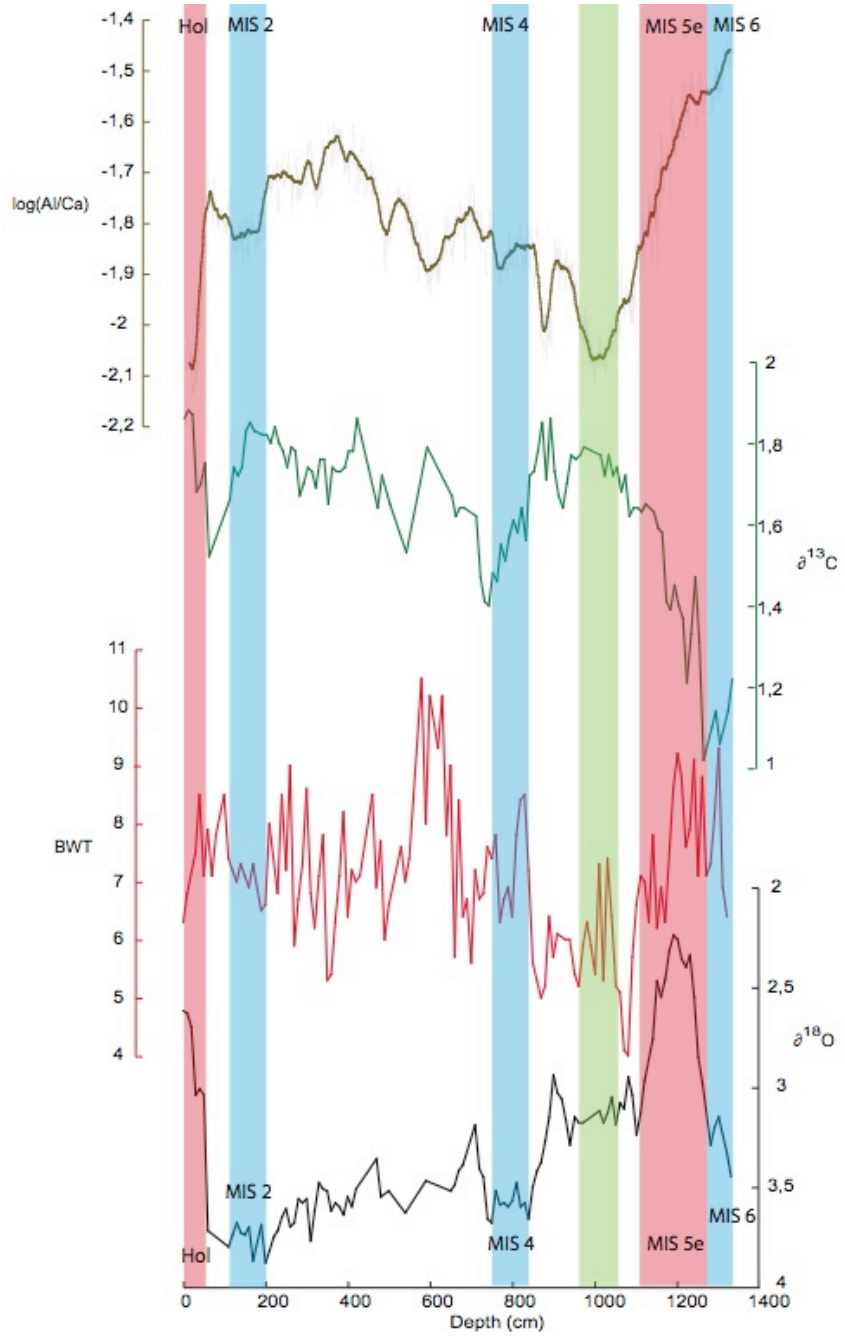
MIS 5.b (93-85 ky BP)

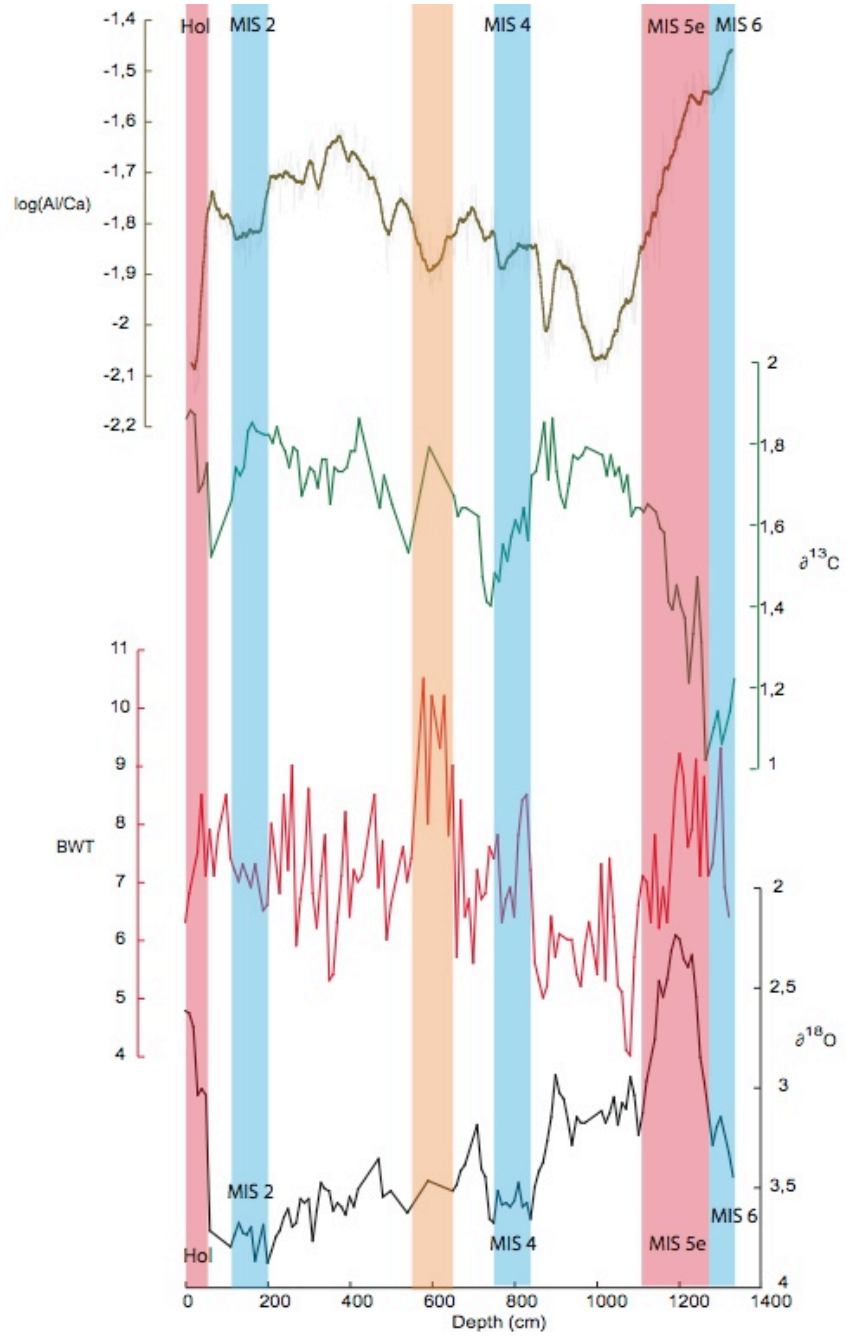
The Carpentaria area was restricted to a lagoonal environment exposed to stagnation and drying. At this stage the sea level dropped and the Arafura Sill was probably exposed, further restricting the communication between the two basins. (Reeves *et al.,* 2007 and 2008).



Dried period: local or global?

Monsoon activity may be an explanation for this minimum in terrigenous input, being responsible for a decrease in the amount of precipitation in the area.

Was the climate dry also in Southeast Africa? Was a global dry period?



Peak in BWT: 10.5°C at 600 cm.

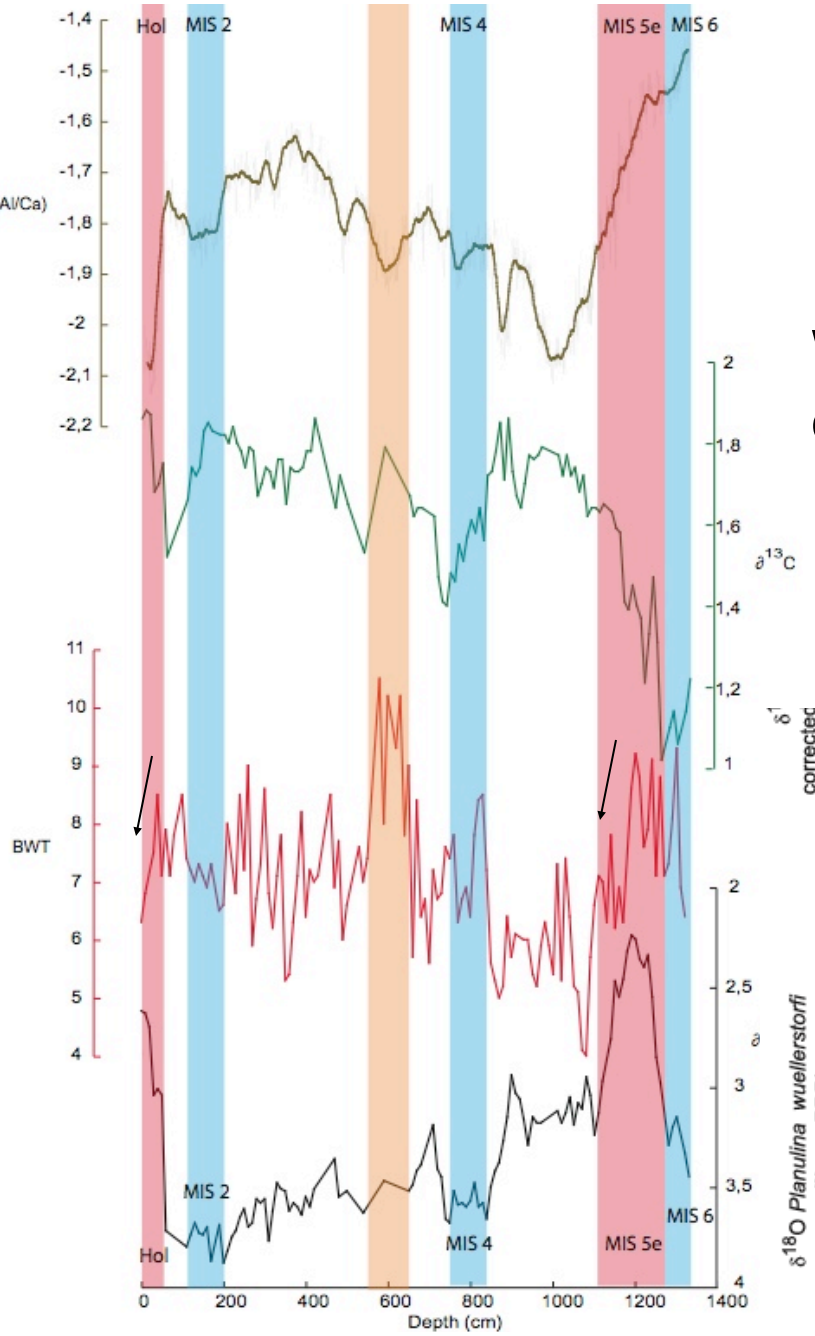
Did increased salinity and dropped sea level cause an interruption of the ITF with consequent warmer and saltier thermocline flow?

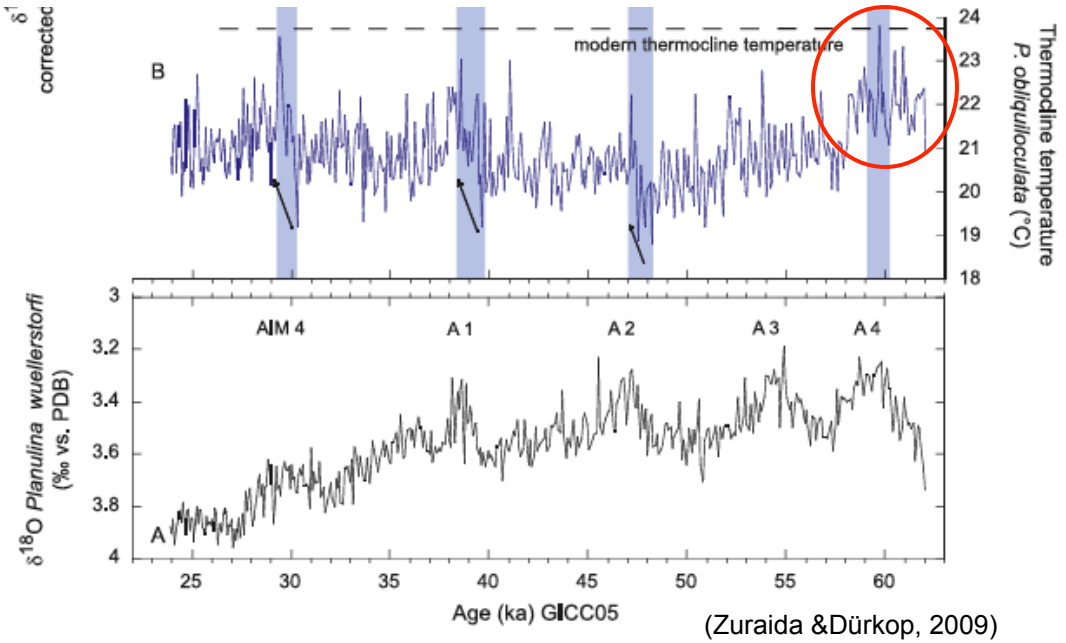
$\delta^{18}O$ curve is mainly temperature driven, but in correspondence of the BWT peak is mainly salinity driven.

ITF was reduced during glacial periods, (Xu *et al.*, 2008 and 2010) but why is it reduced/cut off at this stage?

Peak in BWT: 10.5°C at 600 cm.

Is it related to Heinrich events?
Why don't we see a signal in the oxygen record?





(Zuraida &Dürkop, 2009)

Future work

- Focus on the warm interval between 400 and 700 cm. Is it real?
- Run more $\delta^{18}O$ and Mg/Ca ratios measurements (Laser Ablation and Wet chemistry) to better resolve this interval.
- Student over for a one month internship.
- Write an abstract for poster session at the AGU 2012.
- Start working with the top cores retrieved during the oceanographic cruise SO217 (Makassar - Singapore) in order to provide a new regional calibration for benthic foraminifera.
- Write (a) paper(s).

Questions?