Low Resolution Examination of Cool-Water Carbonate Foraminifera around Tasmania during the Pleistocene (ODP LEG 189, SITE 1168)

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Abstract

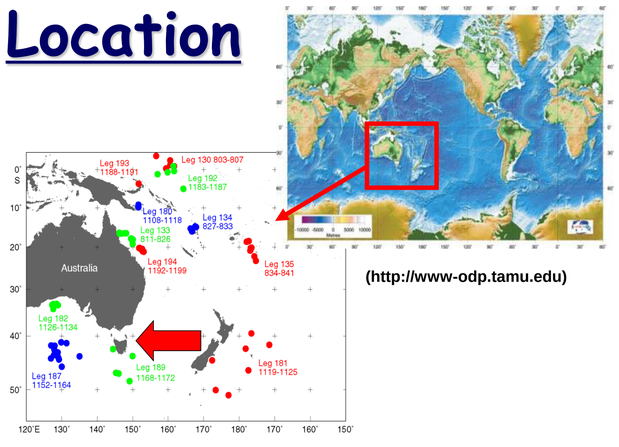
Benthic foraminifera from nine sediment samples recovered during Ocean Drilling Program (ODP) Leg 189: The Tasman Gateway were examined to determine how changing Southern Ocean conditions affect benthic foraminiferal populations. All samples come from Site 1168 situated 70km from the coast of Tasmania on the western continental slope (2463 m below the surface) and are spaced at roughly 150,000 years apart. Identifications of benthic foraminifera were done with a dissecting microscope and several reference books. Foraminifera were correlated with environmental proxy data obtained from Brughmans (2003) (total organic carbon, carbonate, siliciclastics, coarse fractions, chlorin, barium, aluminum, iron, and titanium) and The Scientific Shipboard Party (2001) (density, magnetic susceptibility, and lightness).

The data demonstrates that benthic foraminifera responded to large-scale changes in the ocean surface waters caused by the movement of the subtropical convergence during glacial and interglacial periods. Genera such as *Uvigerina*, *Cibicidoides*, *Cibicides*, and *Notoralia* tend to be more successful during glacial periods when there is greater abundance of wind-blown terrigenous metals delivered to the ocean; whereas genera *Pyrgo* and species *Epistominella elegans* and *Hansenisca soldanii* seem to thrive under interglacial conditions when there is higher productivity in the surface waters. This research also adds to the growing knowledge base of cool-water carbonate environments and provides further evidence of a mid-Pleistocene extinction event affecting the genus *Siphondosaria* and others.

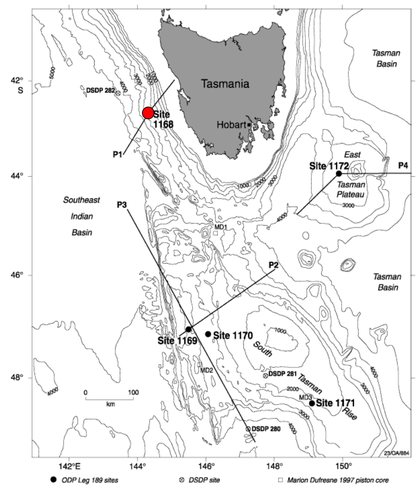
Objectives

- To assess the benthic paleocommunity (mostly through the benthic foraminifers) during glacial and interglacial periods.
- To add to the growing wealth of information on cool-water carbonate environments
- To assess the likelihood of gravity flows at site.

Location



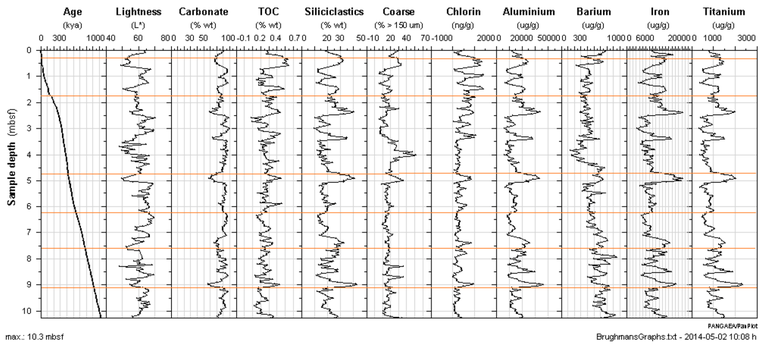
(http://www-odp.tamu.edu)



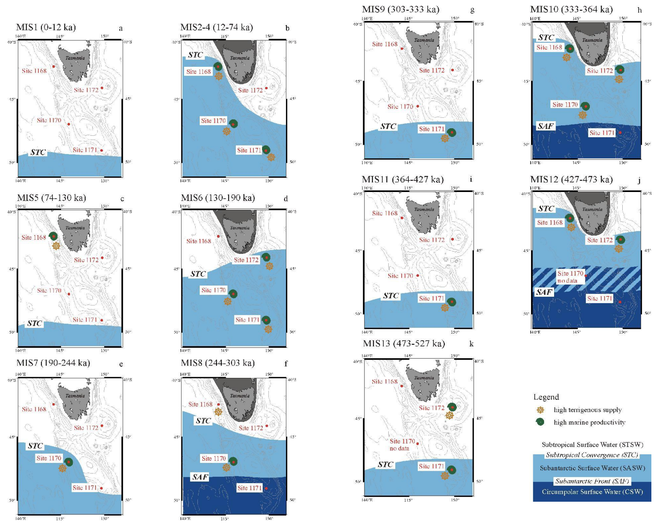
Location of Site 1168. The dots represent Sites of the Ocean Drilling Program; the large red arrow points to Tasmania.

(Shipboard Scientific Party, 2001. ODP Leg 189 Initial Reports)

Previous Work – Brughmans (2003)



(Above) High resolution sediment analysis. Orange lines indicate location of samples in this project.



(Above)The change in ocean current location resulting from glacial (even numbered MIS) versus interglacial (odd numbered MIS) periods.

Bio-lithogenic Grain Abundance (Johnson, unpublished)

(Right) Table showing relative abundances of different types of grains in the samples (benthic forams, planktonic forams, mollusk shells, ostracode valves, echinoderm spines, quartz, carbonate, fish material, bryozoans, opaque minerals, spicules, and pteropods). 0 = absent, 1 = very rare, 2 = occasional, 3 = common, 4 = abundant. Approximate ages are listed under the sample column. These are derived from using sedimentation rates from the site report (Shipboard scientific party, 2001) and N. Brughmans' oxygen isotope data (2003).

Depth (mbsf)	Benthic foraminifera	Planktonic foraminifera	Shells	Ostracods	Echinoderm Spines	Quartz	Fish material	Bryozoan fragments
0.28	3	4	1	1	1	1	1	1
1.78	3	4	1	2	2	0	0	2
3.28	3	4	0	1	1	0	0	0
4.78	4	4	1	2	2	0	0	3
6.28	2	3	1	1	1	1	0	3
7.58	3	4	1	1	1	1	1	3
9.08	2	3	1	0	1	0	0	1
10.58	3	4	1	1	1	1	1	3
12.08	4	4	1	1	1	0	1	3
13.58	3	4	1	2	2	0	0	2
15.08	3	4	1	2	2	0	1	2

Methods

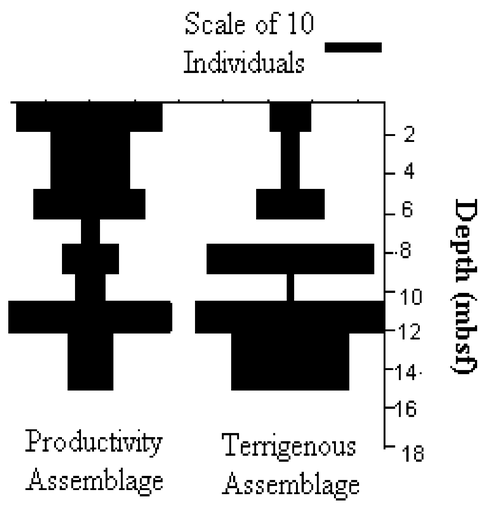
- Samples were weighed, washed, wet-sieved at 63 µm, and dried.
- Each sample was dry-sieved at numerous gravel-, and sand-size fractions.
- The individual size-fractions were weighed and catalogued.
- Gravel- and sand-size fractions were microscopically evaluated, and photomicrographs were taken.
- Results were graphed and analyzed statistically.
- Samples were picked for biogenic material.
- Biogenic material was glued onto microslides and identified.

Epistominella elegans

Foraminifera Correlations & Assemblages:

	Al	Fe	Ti	*Cibicid-oides spp.*	*Cibicides spp.*	*Uvigerina spp.*	*Siphond-osaria spp.*	*A. globosus*	*N. clathrata*
Cibicid-oides spp.	0.225	0.340	0.329						
Cibicides spp.	0.642	0.712	0.736	0.430					
Uvigerina spp.	0.217	0.320	0.305	0.514	0.428				
Siphond-osaria spp.	0.652	0.643	0.667	0.634	0.773	0.771			
A. globosus	0.751	0.690	0.737	0.344	0.623	0.638	0.735		
N. clathrata	0.336	0.385	0.376	0.848	0.597	0.759	0.838	0.623	
M. barleeanus	0.194	0.281	0.233	0.469	0.315	0.697	0.647	0.164	0.661

(Above) Table of correlation coefficients between Al, Fe, Ti, ***Cibicidoides spp., Cibicides spp., Uvigerina spp. Siphondosaria spp., A. globosus, N. clathrata***, and ***M. Barleeanus***. Yellow is used to highlight the correlations between these groups and terrigenous sediment, leading them to be clustered into an assemblage.

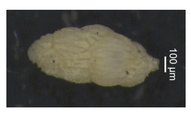


(Above) Stratigraphic records of the absolute abundance of two assemblage groups compared to depth. "Terrigenous Assemblage" contains ***Uvigerina spp.***, ***Cibicidoides spp.***, ***Cibicides spp.***, ***A. globosus***, ***N. clathrata***, ***M. barleeanus***, and ***Siphondosaria spp***. "Productivity Assemblage" contains ***Pyrgo spp.***, ***E. elegans***, and ***H. soldanii.***

Siphondosaria lepidula

	Lightness	Carbonate	TOC	Coarse Fraction	Chlorin
Pyrgo spp.	-0.7017	-0.60088	0.73297	0.36679	0.6763
E. elegans	-0.51088	-0.58868	0.80818	0.90829	0.4054
H. soldanii	-0.49768	-0.052818	0.79156	0.4848	0.7042

(Above) Table of correlation coefficients between lightness, carbonate, TOC, siliciclastics, coarse fractions, chlorin, ***Pyrgo spp., E. elegans, and H. soldanii***. Green is used to highlight the correlations between these groups and surface productivity proxies, leading them to be clustered into an assemblage.



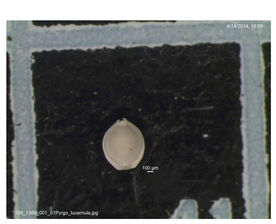
Uvigerina peregrina

Conclusions

(1)Benthic communities are affected by global climate changes.

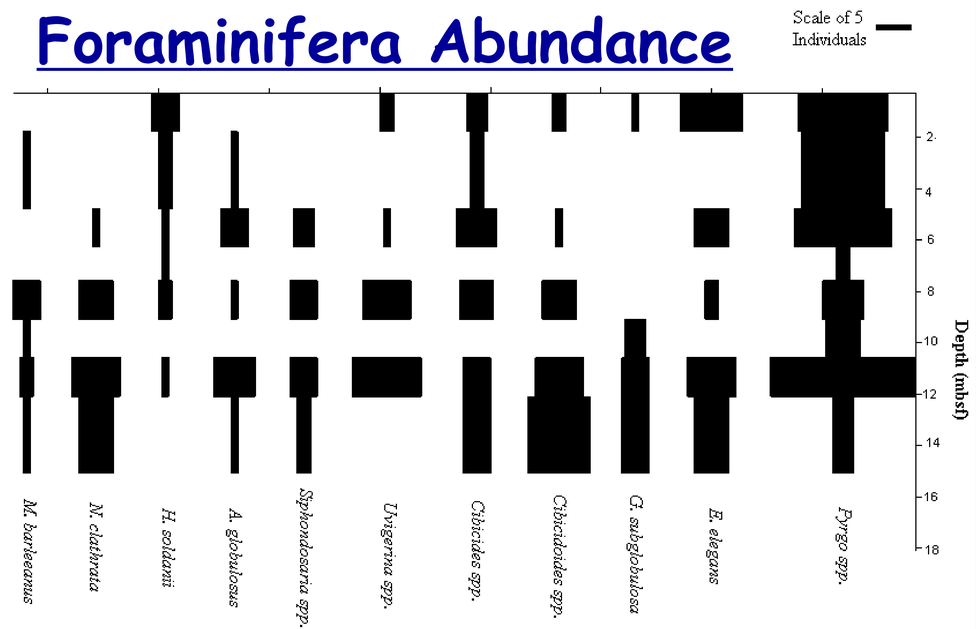
(2)The absence of coral fragments and other data support that the site is a cool-water carbonate (heterozoan) setting.

(3)Gravity flows probably did, occasionally, impact the benthic community.



Pyrgo lucernula

Foraminifera Abundance



(Above) Stratigraphic records of the absolute abundance of the most abundant species and genus groups compared to depth.

Species	Depth (mbsf)	Absolute Abundance 0.28	1.78	4.78	6.28	7.58	9.08	10.58	12.08	15.08
L. filiformis		0	0	0	0	0	0	1	0	0
*E. orientalis**		1	0	0	0	0	3	4	4	0
H. lingulata		0	0	1	0	0	0	0	0	0
N. clathrata		0	0	1	0	5	0	7	5	0

(Above) Absolute abundance of potential shallow water foraminifera by depth. *Some of the species identified as ***Globocassidulina subglobosa*** may actually be ***Evolvocassidulina orientalis***.

Next Steps

1) Request more samples. The resolution of this study is very low--~150ky gaps between samples.
2) Compare to material from more pelagic settings: Site 1171&1172.
3) Include pelagic foraminifera in analysis

Selected References + Acknowledgments

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