

# Acidification Experiment in the Southern Ocean

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Increasing concentrations of carbon dioxide concentrations reduce ocean pH and carbonate ion concentrations, and hence the levels of calcium carbonate saturation. Southern ocean surface waters are projected to exhibit undersaturation with regard to aragonite for CO<sub>2</sub> concentrations higher than 600 ppm, a level exceeded during the second half of the century in most of the SRES scenarios<sup>1</sup>. Experimental findings so far indicates that pteropods, one of the potential key marine organisms, will have difficulty maintaining their external calcium carbonate skeletons when exposed to undersaturated conditions<sup>2</sup>.

The goals of our study:

1. to understand of Southern ocean Thecosomata pteropods life history and population dynamics coupled with oceanographic and climatological factors
2. to determine the effect of ocean acidification on vulnerability of Thecosomata pteropods in regard to Southern Ocean carbonate chemistry models
3. through use of models try to predict the impact of their vulnerability to wider ecological community

## Pteropods in the Southern Ocean

### • Species composition

Two holoplanktonic opisthobranch orders, commonly referred as Pteropods, constitute shelled pteropods belonging to the Order Thecosomata, and unshelled Order Gymnosomata.

Southern Ocean host subspecies and formae within Thecosomata that are not present anywhere else. These include: *Limacina retroversa australis*, *Limacina helicina antarctica*, and *Clio pyramidata*<sup>3</sup>.

### • Pteropod distribution

Though there is still a considerable lack of knowledge of Southern Ocean pteropod ecology, data are showing that pteropods seem to be much more abundant than previously realized. High abundances are seasonal phenomenon and constitute to the importance of pteropods in food web. Thecosomes pteropods are also important for transferring carbon downwards, mostly through aragonite shell production<sup>4</sup>. Additionally, they affect the rain ratio and influence the pCO<sub>2</sub> of surface waters via calcification and dissolution.

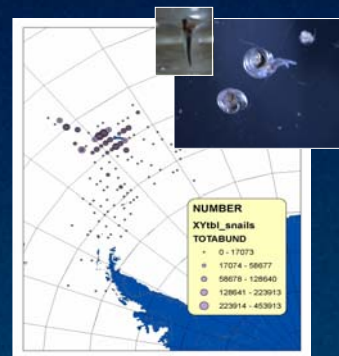


Figure 1: Pteropod distribution in the Southern Ocean

## Southern Ocean Models

Modelling ocean-carbon cycles for the years 2050 and 2100 under the IS92a "business-as-usual" suggested that some polar surface waters will become aragonite undersaturated at ~ two times the preindustrial level of 280 p.p.m.v and that only within next 50 years. By the year 2100, as atmospheric CO<sub>2</sub> will have reached 788 p.p.m.v. under IS92a scenario, the Southern Ocean surface waters aragonite concentration are expected to fall below  $55 \pm 5 \mu\text{mol kg}^{-1}$ , which is 18 % below the threshold where aragonite becomes undersaturated<sup>2</sup>.

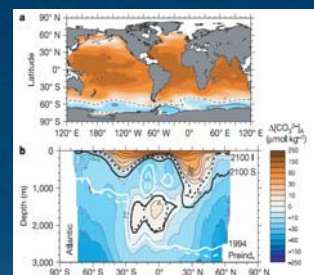


Figure 2: The aragonite saturation state in the year 2100 as indicated by carbonate concentration<sup>2</sup>

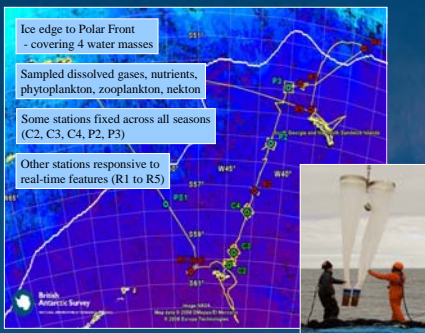


Figure 3: Proposed track of JCR177

## Experimental work onboard JCR177

Towed Bongo nets and vertical sampling techniques were deployed to catch pteropods. Both, adult and juvenile pteropods were used in the experimental set up. The animals were incubated for 4.8 and 12 days in the sea water with increasing gas concentration (385 ppm, 500 ppm, 750 ppm and 1200 ppm). Experiment was coupled with biochemical analysis of the water (TA, pH, pCO<sub>2</sub>, temperature, salinity). Samples were either frozen or stored in the ethanol for subsequent analysis back in the UK..

## REFERENCES

- <sup>1</sup>Meehl et al., 2007: Global Climate Projections. In: Climate Change 2007: The Physical science basis. Contribution of working group to the fourth assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK
- <sup>2</sup>Orr et al., 2005: Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. Nature 437
- <sup>3</sup>Lalli & Gilmor, 1989: Pelagic snails: the biology of holoplanktonic gastropod molluscs
- <sup>4</sup>Fabry, 1989: Shell growth rates of pteropod and heteropod molluscs and aragonite production in the open ocean: implication for the marine carbonate system.

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