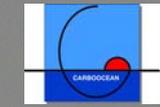


The ecological and biogeochemical role of acantharia in the Southern Ocean

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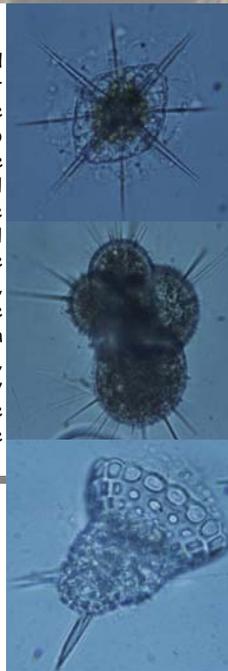
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Introduction

The study of the diversity and the function of larger protozooplankton (especially foraminifera, radiolaria and acantharia) in pelagic food webs, despite the extensive use of their mineral skeletons as proxies for palaeoceanographic reconstructions, has started only fairly recently. Process studies like iron fertilization experiments provide an ideal context to determine the role of larger protozoa as a trophic link between smaller protozooplankton and larger metazooplankton and to investigate a size fraction and group of taxa which are important for biogeochemical cycles of certain elements (Si, Ca, Ba, Sr) and palaeoceanographic studies. An important group, which comes to the fore as a biological proxy, are the acantharia. These delicate, free living, microphagic organisms form barium-enriched celestite ($Ba/Sr SO_4$) skeletons. Thus our approach was to study the response of acantharia, the water column distribution of particulate biogenic Ba, Sr and the individual acantharian skeleton Ba/Sr molar ratios during an iron-induced phytoplankton bloom (EIFEX) to determine the ecological and biogeochemical role of acantharia in the Southern Ocean.

I. Ecological importance of acantharia

By the peak of the EIFEX experiments, phytoplankton carbon stocks had increased 3fold in the deeply mixed surface layer (down to 150 m) but decreased again significantly in the final week of the experiment (see poster Assmy et al.). Acantharia, but not other protozooplankton, also showed a marked population increase in the first four weeks of the experiment inside the patch (Figs. 1A., B.), and in general their temporal response resembled the development of the phytoplankton bloom. Hence acantharia clearly have the capability to respond to enhanced biological productivity with population growth and indicating that they were actively feeding on the bloom. Compared to foraminifera and radiolaria, acantharia clearly dominated carbon stocks inside and outside the fertilized patch (Figs. 1C., D.) and estimates of the carbon fixation ability of acantharian endosymbionts (Michaels AF, 1988, Marine Biology, 97: 559-569) show that these symbionts (Fig. 1E.) could significantly contribute, at least locally, to total primary productivity. Moreover the EIFEX experiment showed that acantharia are an important food source for other microprotozoan and metazoan grazers (Figs. 1F., G.).



Conclusions

Acantharia...

- are the dominant large protozoa in the Southern Ocean
- respond to enhanced primary productivity with population growth
- are food source for other grazers
- Have a significant impact on the biogeochemical cycles of Ba and Sr

Acknowledgements

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II. Biogeochemical importance of acantharia

In the wind mixed layer (0-150m), results indicate that the particulate biogenic Ba_{xs} (Figs. 2A.-D.) and Sr (Figs. 2E.-H.) signals follow mainly phytoplankton carbon (data not shown) and acantharian stocks (Figs. 2I.-L.). Taking the high individual Ba/Sr acantharian skeleton ratios (Fig. 2O.) into account, calculations suggest that the acantharian-derived Ba could account for 96% of the upper 150 m Ba_{xs} signal, despite a rather low relation between Ba_{xs} DWA and total acantharia (Fig. 2N.). Acantharia also strongly affect the distribution of particulate biogenic Sr indicated by a particularly good relation between Sr_p and $>50 \mu m$ acantharia in surface water.

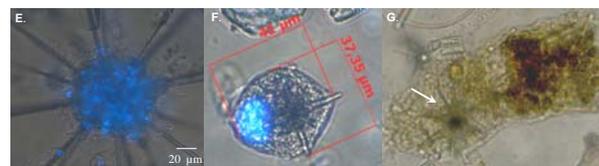
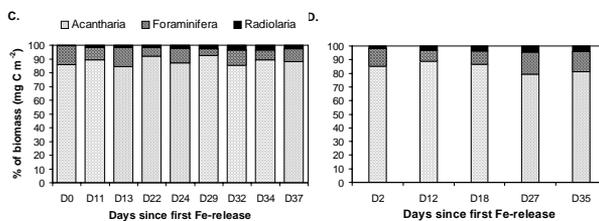
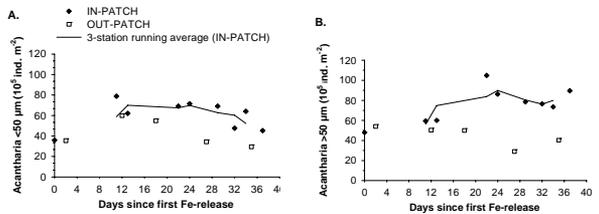


Fig. 1: Temporal development of (A.) acantharia $<50 \mu m$ and (B.) acantharia $>50 \mu m$. Percentage of carbon standing stock ($mg C m^{-2}$) inside the fertilized patch (C.) and outside the fertilized patch (D.) during EIFEX. All values integrated over 150 m mixed layer depth. (E.) Epifluorescence micrograph displaying endosymbiotic zooxanthellae inside the ectoplasma of the acantharia (*Stauracoon* spp.). (F.) Acantharia engulfed by an athecate heterotrophic dinoflagellate. (G.) Acantharian skeleton (arrow) inside a metazoan faecal pellet during EIFEX.

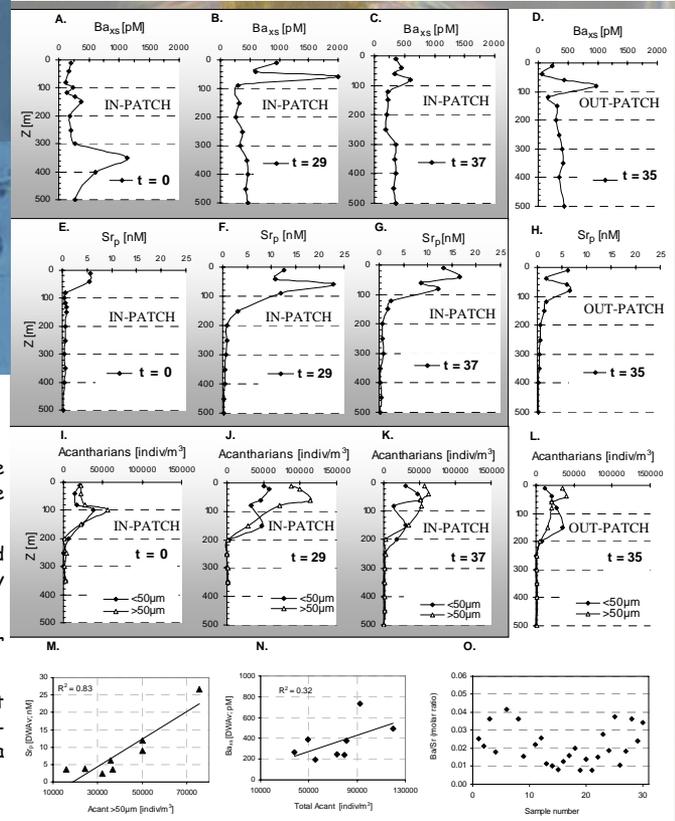


Fig. 2: Particulate biogenic Ba_{xs} profiles (pM; 0-500 m) inside (A.-C.) and outside (D.) the fertilized patch during EIFEX. Particulate Sr_p profiles (nM; 0-500 m) inside (E.-G.) and outside (H.) the fertilized patch during EIFEX. $<50 \mu m$ (full diamonds) and $>50 \mu m$ (open triangles) acantharian abundance profiles ($indiv./m^3$; 0-500 m) inside (I.-K.) and outside (L.) the fertilized patch during EIFEX. Sr_p DWA_A (Depth Weighted Average values) vs. $>50 \mu m$ acantharia (M.) and Ba_{xs} DWA, vs. total acantharia (N.) and Ba/Sr molar ratios of individual acantharia (O.) between 0-150 m during EIFEX.