Biological response to iron fertilization in the Polar Frontal Zone of the Southern Ocean (EisenEx)

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During EisenEx - the second *in situ* iron fertilization experiment conducted in HNLC (**H**igh **N**utrient **L**ow **C**hlorophyll) waters of the Southern Ocean - an iron-enriched eddy was followed over a period of three weeks in austral spring 2000. Artificial iron infusion simulates an aeolian dust input into the surface water of the open ocean and its impact on the pelagic community and the biogeochemical processes driven by changes in plankton distribution.

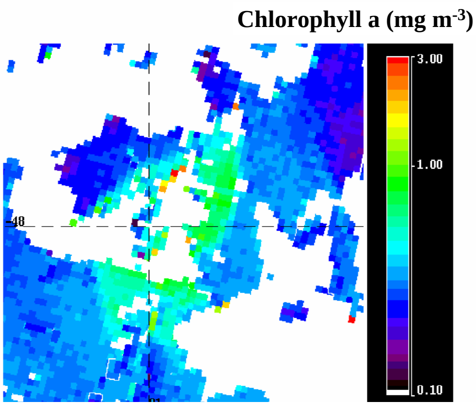

Fig. 1: Satellite picture of the chlorophyll patch.

Three weeks after the first iron release the SeaWIFS satellite picture showed an algal bloom 30 km in diameter (Fig. 1).

Diatom abundance increased 6-fold inside the fertilized patch compared to control values (Fig. 2). *Pseudonitzschia lineola* was the dominant species and accounted numerically for 51% of the diatom assemblage at the end of the experiment.

Our results confirm the stimulation of diatom growth by iron addition in the Southern Ocean.

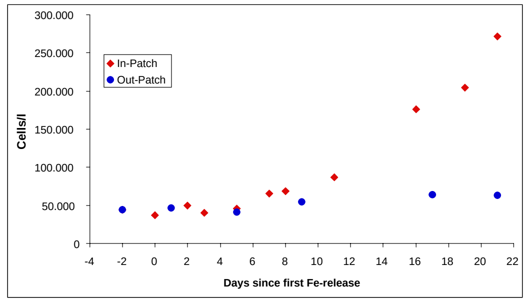

Fig. 2: Temporal development of the diatom abundance in the upper 150m in and outside the fertilized patch.

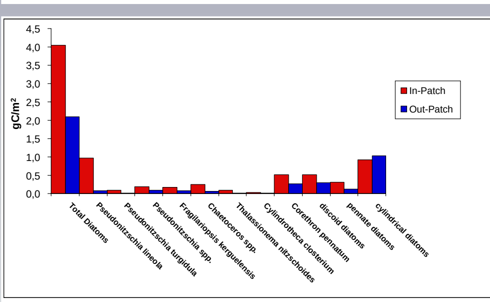

Fig. 3: Diatom standing stock at the end of the experiment integrated over 150m depth.

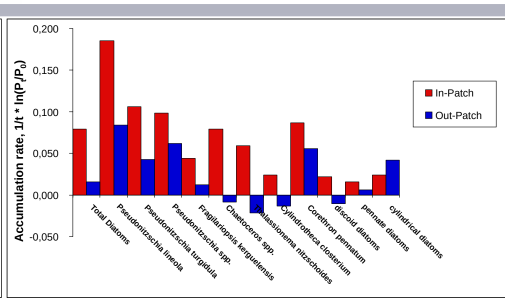

Fig. 4: *In situ* accumulation rates over the course of the experiment.

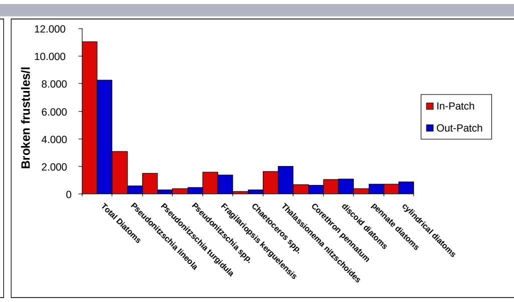

Fig. 5: Mean number of broken diatom frustules at the end of the experiment.

Inside the patch diatom standing stock was dominated by medium-sized (*Pseudonitzschia* spp., *Chaetoceros* spp. and *Fragilariopsis kerguelensis*) and large diatoms (*Corethron pennatum*, large discoid and cylindrical diatoms) whereas outside large diatoms accounted for most of the biomass build-up (Fig. 3). *In situ* accumulation rates (Fig. 4) - the balance between growth and mortality rates - are higher inside the patch, except for cylindrical diatoms. The variations in accumulation rates of different species cannot be attributed to bottom-up factors alone but are also strongly influenced by the size of the seed population and the protection against grazing. Broken diatom frustules and copepod faecal pellets (Fig. 5 and 6) are indicators for grazing pressure and their stronger increase inside the patch indicate that a large amount of the accumulated phytoplankton biomass was used by higher trophic levels. Small grazers like nauplii and copepodites showed very high abundance (Fig. 7 and 8) with *Oithona* spp. being the dominant species. Only the copepodites showed a response to the rapidly increasing food supply inside the patch and therefore could have exerted a significant grazing pressure.

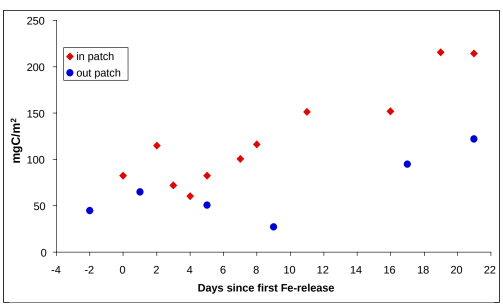

Fig. 6: Temporal development of copepod faecal pellet carbon integrated over 150m depth.

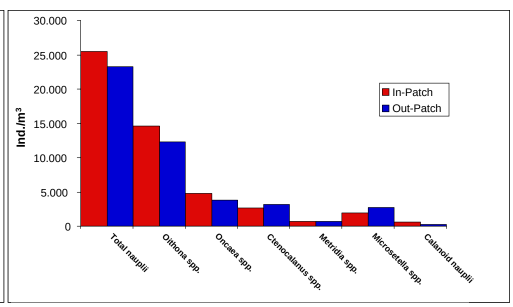

Fig. 7: Mean nauplii abundance averaged over all in and out patch CTD-stations.

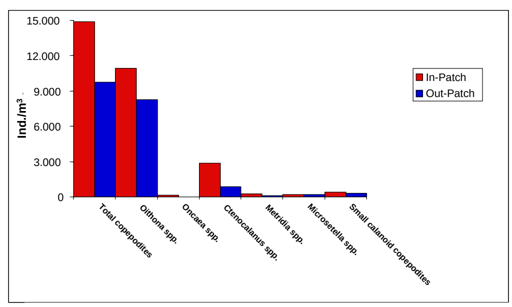

Fig. 8: Mean copepodite abundance averaged over all in and out patch CTD-stations.