

Ant XXV/3 – LOHAFEX

Data report 3

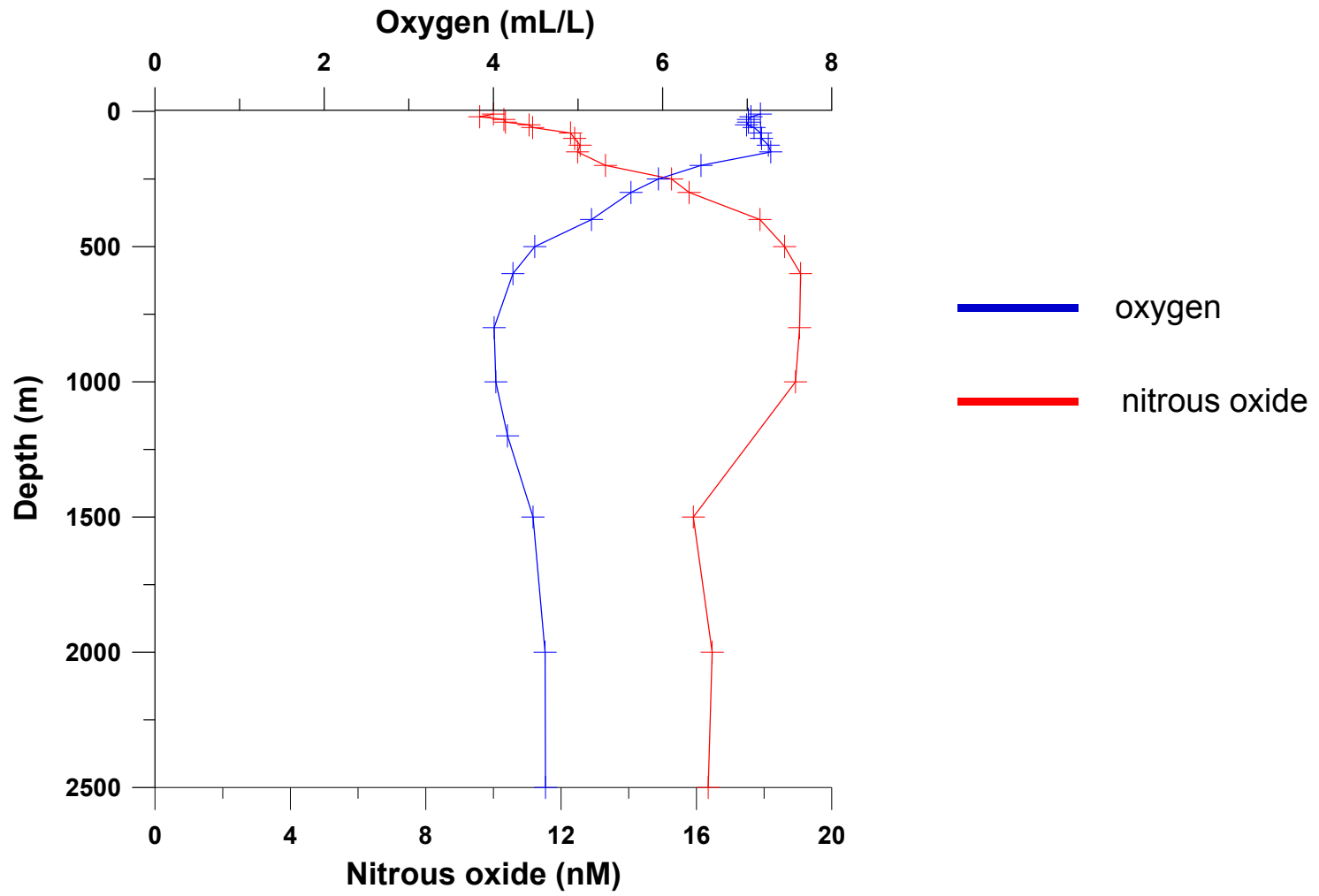
9th February 2009

The previous data reports presented observations and data on biological and nutrient conditions in the area prior to and immediately following fertilization on 27 and 28 January 2009 in an area located in the centre of the eddy determined from altimeter images and current fields measured with the ADCP. The patch has since moved north and then east due to transport by inertial oscillation (a surprising, hence interesting result) and entrainment in the geostrophic flow field respectively. Subsequently it moved south and is currently moving west within the eddy core. Chlorophyll concentrations increased from 0.7 to 1.4 mg Chl m⁻³, declined slightly due to deep mixing by a storm and are rising again. Photosynthetic efficiency in the patch is high and increasing.

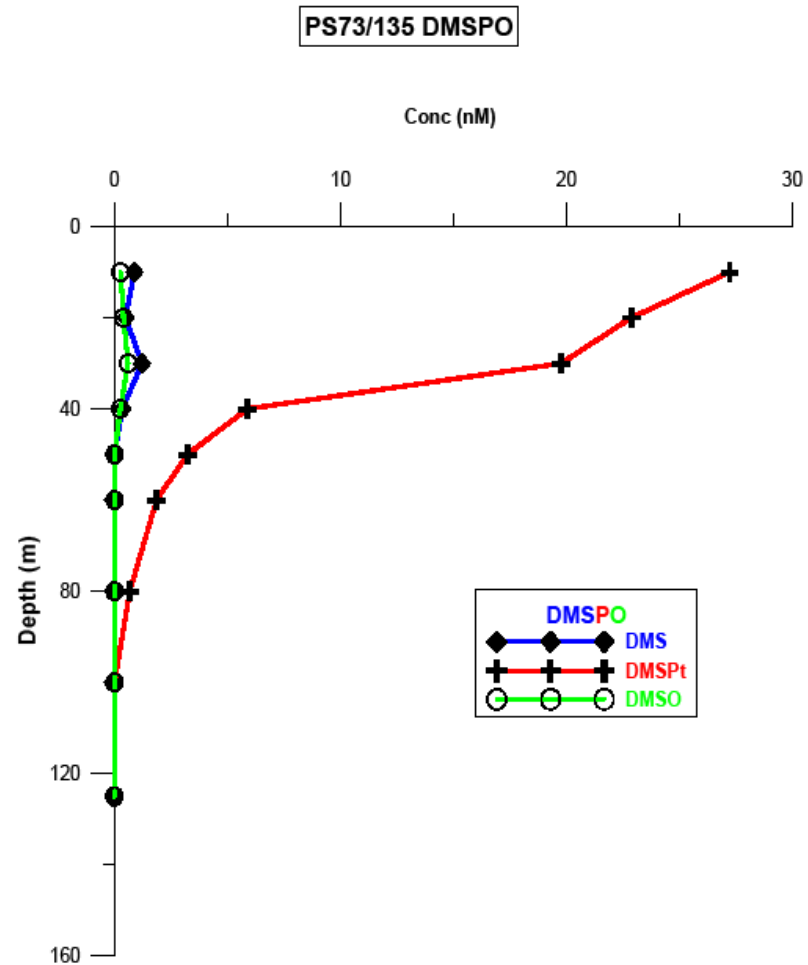
In this report we present data on gases: nitrous oxide in relation to oxygen, DMS in relation to DMSP, halocarbons and ²³⁴Thorium profiles that indicate previous particle losses from the surface layer.

Nitrous oxide and methane

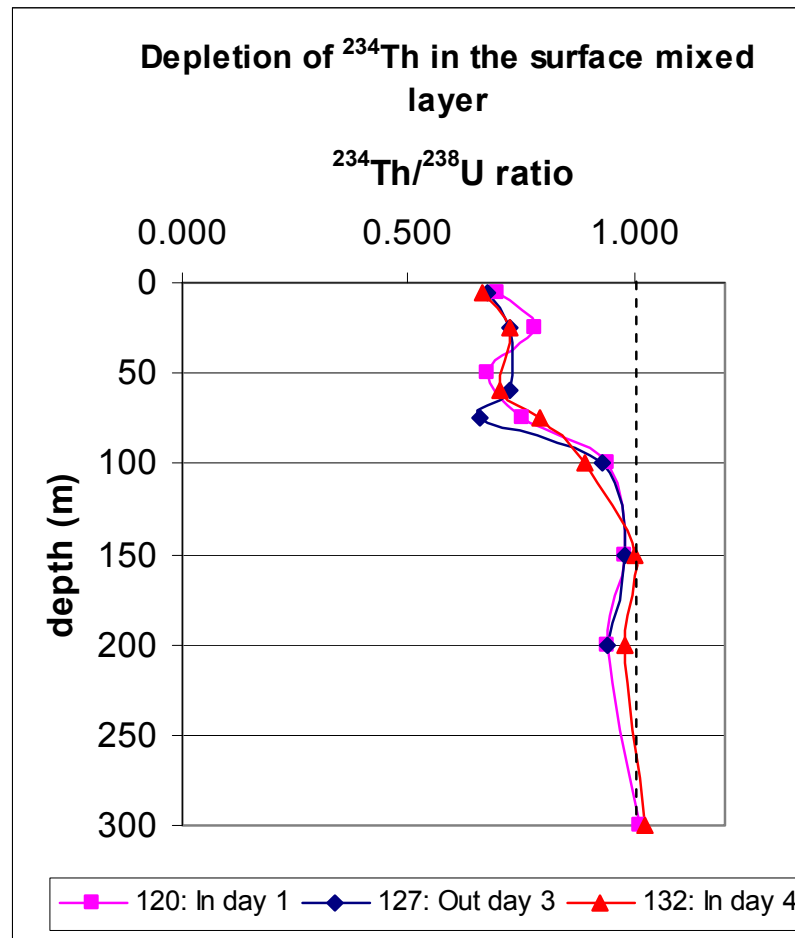
Nitrous oxide (N₂O) is a potent greenhouse gas that also contributes to stratospheric ozone depletion. N₂O is produced naturally by bacteria as an intermediate during redox transformations of nitrogen in seawater. In oxic seawater, nitrification is the dominant process of N₂O production. This is reflected by the fact that the depth profile of N₂O is an almost mirror image of the dissolved oxygen profile. The yield of N₂O during nitrification is almost constant until the oxygen levels fall below about 0.5 mL/L, after which N₂O production is greatly enhanced. It is feared that ocean iron fertilization on a large scale may lead to an increase in N₂O emissions from the oceans. This gas is therefore being measured on a routine basis during LOHAFEX. The pre-fertilization profile of N₂O, presented on the next page, is typical of the region with surface concentration close to equilibrium and the mid-depth maximum in N₂O coinciding with the oxygen minimum. As the oxygen concentration at our experimental site remains above 4 mL/L even at the minimum, and the small scale experiment such as LOHAFEX is not likely to produce any detectable change in oxygen distribution, the changes in N₂O are also expected to be within the natural variability. The data being collected by us will allow us to test this hypothesis. The same applies for methane, another greenhouse gas, the samples for which are being preserved for analysis in the shore laboratory.



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DMSP is the precursor molecule of DMS and is produced largely by the algal group known as haptophytes. Its concentrations doubled in the first few days following fertilization and is continuing to increase. However, concentrations of the gas DMS, which is released to the atmosphere where it increases cloud albedo thereby causing cooling, has not shown a similar increase yet.

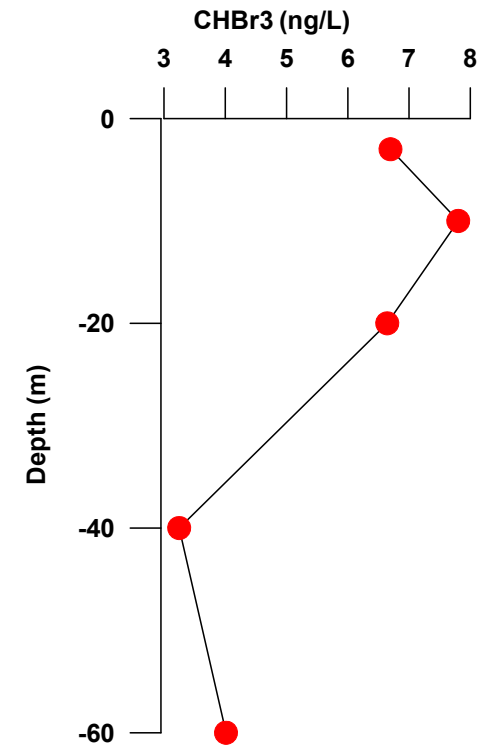
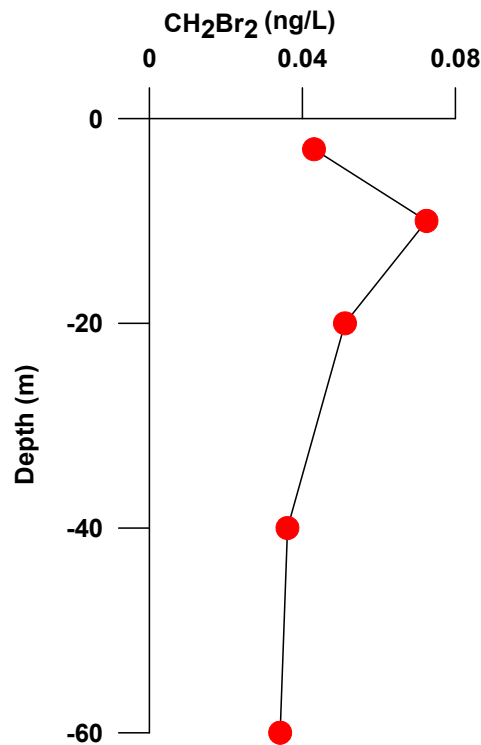
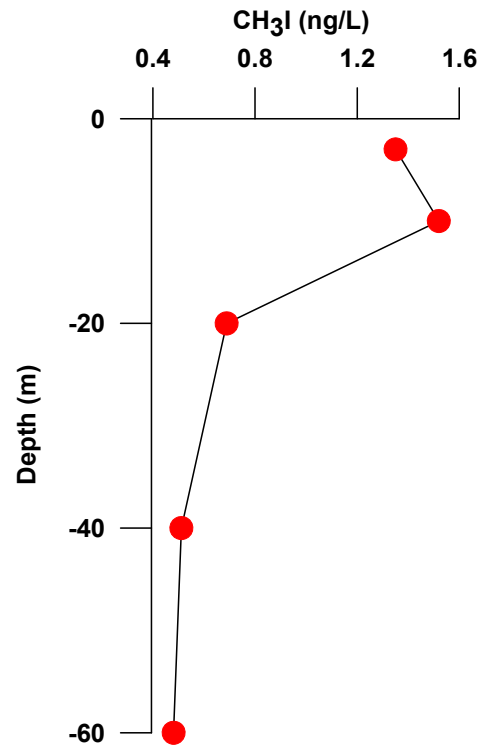


At the start of our experiment, the natural radionuclide ^{234}Th is depleted in the surface mixed layer with respect to its mother nuclide ^{238}U . This implies that within the past approx. 2 months (just over 2 half lives of ^{234}Th) an export of particles from the surface water has occurred. This means that, as we had expected from the low nutrient data, our experiment takes place in a region where an algal bloom has already taken place and resulted in a downward particle flux. In this respect our experiment is similar to EIFEX but different from EISENEX which started earlier in the season. At the start of EISENEX, ^{234}Th was near equilibrium with its parent ^{238}U , i.e. the $^{234}\text{Th}/^{238}\text{U}$ ratio was close to equilibrium at all depths.

Data are preliminary as chemical yield determinations will be carried out in the home laboratories.

Halocarbon Profiles

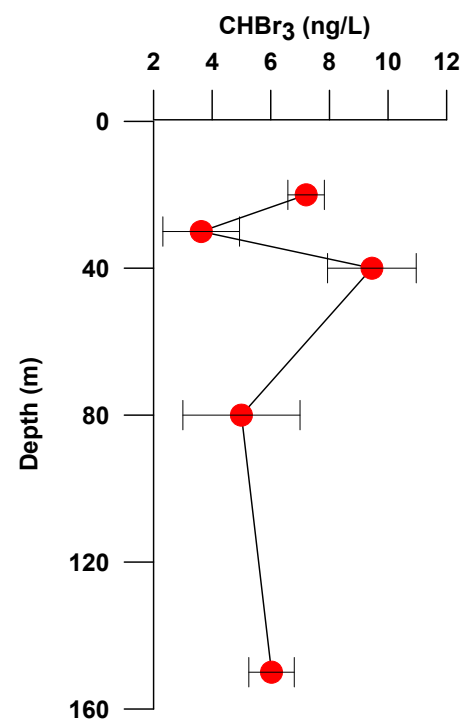
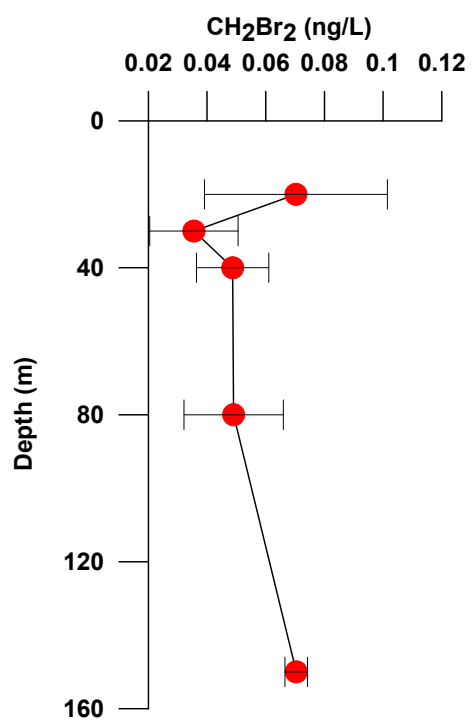
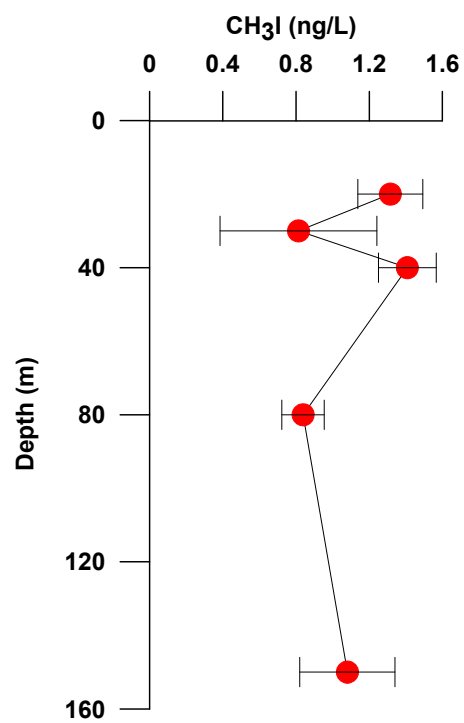
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Halocarbons are volatile gases believed to be produced by phytoplankton and can contribute to stratospheric ozone breakdown. The concentrations are in the same range as reported previously from the Southern Ocean. We are closely monitoring these gases and the others shown in subsequent slides.

Halocarbon Profiles

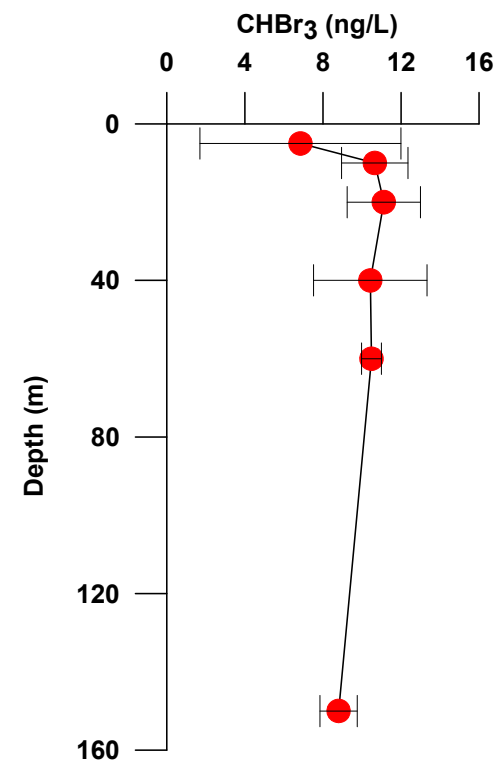
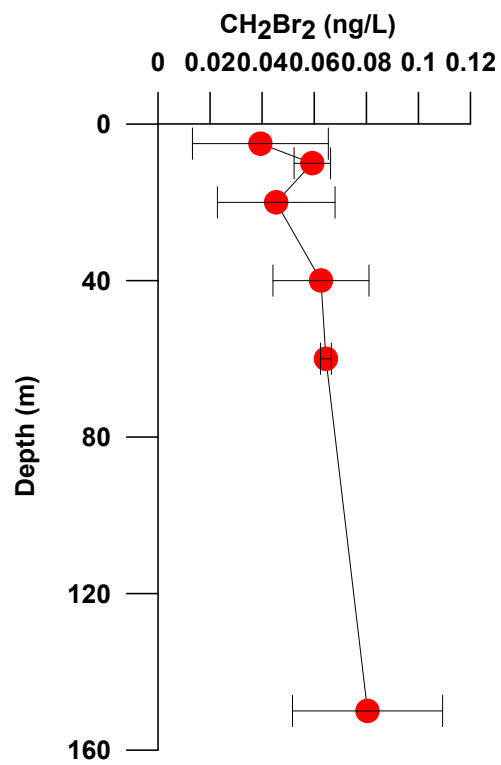
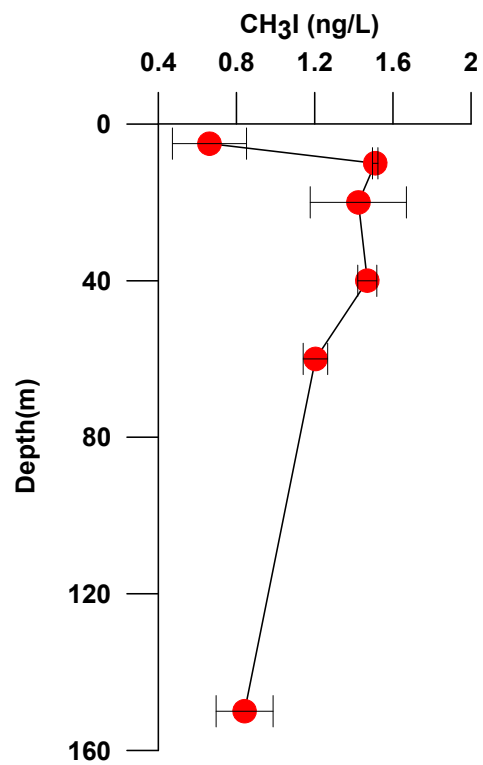
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Halocarbon Profiles

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