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Pteropods under the impact of ocean acidification and warming: a novel approach of calcification rate measurements in pre-winter *Limacina helicina* and effects on overwintering *L. helicina* and *L. retroversa*

Jan Büdenbender, Silke Lischka, Kai G. Schulz, and Ulf Riebesell

Leibniz-Institute of Marine Sciences (IFM-GEOMAR) Düsternbrooker Weg 20, Kiel, Germany
(jbuedenbender@ifm-geomar.de)

The increase in atmospheric CO_2 concentrations caused by anthropogenic activities could lead to aragonite (polymorph of calcium carbonate) sub-saturation in parts of the Arctic surface ocean by 2020 if emissions follow business as usual scenarios. Most pronounced effects are expected to take place during winter-time. Sub-saturated water was shown to negatively impact a variety of marine calcifying organisms. The polar calcifying pteropod *Limacina helicina* can contribute up to 20% of the Arctic zooplankton biomass at times and has a key function in the Arctic epipelagic food web. The temperate-boreal sibling species *L. retroversa* is frequently introduced to Arctic regions with Atlantic water masses. Both species contribute significantly to vertical carbon flux. In September/October 2009 and in January/February 2010 incubation experiments were carried out in Ny Ålesund/Svalbard at three temperatures (3, 5 and 8˚C) and four pCO_2 levels (180, 400, 750 and 1150 ppm) with durations of 29 and 9 days, respectively. In the 2009 experiment we used a novel approach of a ^{13}C stable isotope incubation for measuring pteropod calcification rates. First results show that ^{13}C concentrations varied in the total particulate carbon (TPC) of the organism but stayed constant in the particulate organic carbon (POC). From mass-balance calculations the variation in the TP^{13}C concentrations result from ^{13}C concentration changes of the particulate inorganic carbon (PIC) and/or changing PIC/POC ratios. The first is most likely affected by different calcification rates whereas the second could be additionally affected by changing respiration rates in response to the applied treatments. Our results show trends of ^{13}C enrichment in organisms with increasing temperature and with decreasing pCO_2 levels, suggesting a positive temperature and a negative CO_2 effect on pteropod calcification rates. To investigate species-specific differences, in winter 2010 (January/February) temperature and CO_2 perturbation experiments were carried out with *Limacina helicina* and *L. retroversa* both occurring in Kongsfjord/Svalbard. Preliminary results reveal growth cessation in winter (with respect to absolute shell size) of both, *Limacina helicina* and *L. retroversa*. However, the Atlantic-type *L. retroversa* seemed to be more sensitive to high pCO_2 conditions with respect to mortality and shell degradation as compared to its polar relative *L. helicina*.