Carbon and nitrogen budgets and respiration rates of selected foraminifera of the Gullmar Fjord in Sweden

**Julia Wukovits**¹, Nicolaas Glock², Johanna Nachbagauer¹, Petra Heinz¹, Wolfgang Wanek³, Margarete Watzka³, and Alexandra-Sophie Roy⁴

¹Institute of Paleontology, Vienna, Austria, University of Vienna, Austria
²GEOMAR, Helmholtz-Zentrum für Ozeanforschung Kiel, Germany
³Center of Microbiology Environmental System Science, Department of Microbiology and Ecosystem Science, University of Vienna, Austria
⁴Institut für Allgemeine Mikrobiologie, Christian-Albrechts-Universität zu Kiel, Germany

Benthic foraminifera are highly abundant, ubiquitous marine protists, with many species feeding on microalgae or phytodetritus. Knowledge about carbon and nitrogen budgets and metabolic activities of benthic foraminifera can help to increase our understanding about their ecology and their role in aquatic biogeochemistry at the sediment-water interface. This can further increase their application as proxies for environmental changes. Shifts in the benthic foraminiferal communities of the Swedish Gullmars Fjord document the shift from well oxygenated bottom waters to seasonal hypoxia at its deepest location the Alsbäck Deep (125 m), during the last century.

So far there are only investigations available relating foraminiferal community composition with increased primary productivity and resulting hypoxia in this Fjord. In contrast, studies about the species-specific feeding ecology or food derived foraminiferal carbon and nitrogen fluxes are scarce.

Therefore, laboratory feeding experiments and respiration rate measurements were carried out with *Bulimina marginata*, *Cassidulina laevigata* and *Globobulima turgida*, abundant foraminifera in such environments, collected in August 2017.

Experiments were conducted to evaluate the carbon and nitrogen intake and turnover of dual (¹³C and ¹⁵N) isotope labelled *Phaeodactylum tricornutum* detritus; detritus of a common diatom in the Gullmar Fjord. For the feeding experiments, foraminifera were incubated at 9.1°C in the dark, in sterile filtered seawater at ambient oxygen concentrations. The foraminifera were fed for a period of 24 hours and subsequently incubated without food for another 24 hours. After each incubation cycle, foraminiferal respiration rates were measured. The individuals were analyzed via Elemental Analyzer-Isotope Ratio Mass Spectroscopy to evaluate ¹³C/¹²C and ¹⁵N/¹⁴N ratios and their bulk content of organic carbon and nitrogen.

Additionally, we present carbon and nitrogen to volume ratios for the foraminifera *B. marginata*,...
C. laevigata, G. turgida, G. auriculata and Nonionella turgida, as derived from elemental analysis and light microscopy imaging.

The results show, that B. marginata, an opportunistic species associated with high fluxes of organic matter, had the highest rate of specific carbon and nitrogen intake and turnover. Cassidulina laevigata, a species that co-occurs with fresh phytodetritus and does not tolerate very low oxygen concentrations, showed lower carbon and nitrogen intake rates. Globobulima turgida, a denitrifying infaunal species that thrives under hypoxia, showed the lowest specific carbon and nitrogen intake and turnover rates. Respiration rates of all species did not depend on incubation with or without a food source. The foraminifera showed similar carbon and nitrogen densities per test volume across all species.

Overall this study helps to improve the knowledge on the nutritional ecology of the investigated species, demonstrating the close relation between feeding/metabolic rates and their environmental niche and highlighting the need to introduce foraminiferal data in future marine carbon and nitrogen flux models.