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Effects of elevated CO_2 on feeding efficiency and carbon uptake by benthic foraminifera

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The progressive change of seawater chemistry through a process known as ocean acidification will have a significant impact on marine ecosystems and sediment-associated biota such as Foraminifera. Previous long- and short-term experimental studies have demonstrated that future changes in the ocean carbonate chemistry as a function of increased anthropogenic CO_2 uptake may cause morphological changes in benthic foraminiferal shell feeding structures (e.g. Khanna et al., 2013; Guamán-Guevara et al., 2018 (in review)).
In the present study, living specimens of the dominant benthic foraminiferal species Elphidium williamsoni and Haynesina germanica were collected from intertidal mudflats and exposed for 6 weeks to four different pH treatments that replicated future scenarios of high atmospheric CO_2 and low seawater pH levels. This 6-week precondition performed in an experimental recirculating seawater system under temperature-controlled conditions ensured the observation of compromised feeding structures of both live foraminiferal species before feeding experiments. Subsequent 13C-labelling experiments using live Navicula sp. as the only labelled-carbon source were carried out to estimate potential changes in carbon uptake from feeding by both live foraminiferal species.
Results revealed that E. williamsoni and H. germanica show significant differences in 13C uptake across pH treatments suggesting that foraminiferal feeding efficiency is a species-specific response that depends on both the level of alteration in feeding structures observed in each pH level and the type of food source provided during the feeding experiment (selective ingestion). In addition, the difference in the observed uptake of 13C-labelled Navicula sp. between E. williamsoni and H. germanica (i.e. one order of magnitude difference) is more likely to be a feeding strategy (food preference) associated to the quality of diatoms provided (i.e. live and small diatoms) rather than an increase in the competiveness between both foraminiferal species for the same food source.
These results suggest that E. williamsoni and H. germanica may possess a different level of sensitivity to near-future ocean acidification. Therefore, foraminiferal feeding efficiency on primary producers (e.g. diatoms), long-term ecological competitiveness, fitness and interactions between both species may be markedly different under the imminent increasing atmospheric CO_2 and declining seawater pH. This may lead to a potential shift in benthic foraminiferal community structure, with negative impacts on the energy transferred within the benthic food web, carbon cycling and total $CaCO_3$ production within mid-latitude intertidal environments.