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Impact of vital effects and carbonate chemistry on δ13C in benthic foraminifera: model sensitivity experiments

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The proxy δ13C as derived from benthic foraminifera shells is widely used by palaeoceanographers to reconstruct the geometry of past water masses. The biogeochemical processes involved in forming the benthic foraminiferal δ13C signal, however, have not been fully understood yet and a sound mechanistic description is still lacking.
We are using a reaction-diffusion model for calcification developed by Wolf-Gladrow et al. (1999) and Zeebe et al. (1999) in order to quantify the effects that different physical, chemical and biological parameters have on the δ13C value of an idealised benthic foraminiferal shell.
The results indicate that temperature, δ13C_DIC, respiration rate, foraminiferal size, and pH have a significant impact on foraminiferal δ13C, which exceeds the typically accepted measurement error range of 0.2 permil. In contrast, salinity, pressure, and calcification rate have only a limited influence. In a case study we show how these effects can influence the interpretation of benthic foraminiferal δ13C.
Our study underlines the importance of understanding the biological and chemical processes in forming the δ13C signal in foraminiferal shells, and calls for further laboratory and in-situ measurements in order to test the model results.