Validation and calibration of proxies to reconstruct past oxygenation using foraminifera: Shell Mn/Ca and porosity.

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The extent of oxygen minimum zones have been increasing since the 1960s due to ongoing climate change and eutrophication, and has led to dramatic ecological and economic consequences that will most likely be amplified in the near future. However, the timing and extent of future deoxygenation is still uncertain, since processes and feedback mechanisms involved in the formation of oxygen depleted zones are relatively unknown. The paleo-record provides the opportunity to study the processes involved in the onset and evolution of low oxygen events, leading to a better understanding of the mechanisms causing and consequences following anoxic and hypoxic events. Unfortunately, there is still a need to develop robust and reliable proxies to reconstruct past oxygenation accurately. This knowledge is crucial to predict the extent, intensity and development of low oxygen areas in the future. A number of proxies have been proposed in the last decade. The incorporation of redox sensitive element manganese in foraminiferal calcite and shell porosity has been studied as a potential proxy for paleo-oxygenation reconstructions. So far, these proxies have not been tested nor calibrated in controlled laboratory conditions. In this study we investigate the potential impacts of decreased oxygen concentration on foraminifera, including different levels like biological parameters, i.e. survival and chamber addition rate as well as shell porosity (gas exchange surface), and shell chemistry. This allows for the validation of these proposed proxies for past oxygenation, and at the same time assesses the impact of a decreasingly deoxygenated environment on the viability and success of foraminifera. Our preliminary results show that, while hypoxia negatively impacts shell growth, foraminiferal shell chemistry and porosity varies with oxygen concentration. All in all, these foraminiferal based proxies show to be a potential worthy addition to the paleo oceanographers toolbox as indicators of low oxygen conditions.

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