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Seawater Mg/Ca variability during the Middle Miocene Climate Optimum
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ド・ノーイエ レナート [1*], van Dijk IEY[1], 豊福 高志 [3], Sluijs A[2], Reichart GJ[1]
Lennart Jan de Nooijer[1*], IEY van Dijk[1], Takashi Toyofuku[3], A Sluijs[2], GJ Reichart[1]

[1]NIOZ, [2] ユトレヒト大学, [3] 海洋研究開発機構
[1]Royal NIOZ, [2]Utrecht University, [3]JAMSTEC

Variability in seawater [Ca2+] and [Mg2+] over timescales >1 Ma challenges the use of foraminiferal Mg/Ca as a temperature proxy. Since temperature and seawater Mg/Ca both determine foraminiferal Mg/Ca, reconstructed temperatures need to be corrected for past seawater Mg/Ca when applied to long timescales. Currently, such corrections are based on models with a low temporal resolution and relatively large uncertainty in past seawater Mg/Ca. Moreover, when applying correction factors it is assumed that the sensitivity of the Mg/Ca-temperature calibration is not affected by seawater Mg/Ca. To quantify the combined impact of seawater Mg/Ca and temperature on foraminiferal Mg/Ca, we conducted a set of culturing experiments in which these parameters were manipulated independently. The combined effect of seawater Mg/Ca and temperature on calcite Mg/Ca in a hyaline (Elphidium crispum) and a miliolid (Quinqueloculina sp.) species was determined by laser ablation-ICP-MS.

The dependencies of calcite Mg/Ca on these two parameters for both species were used to reconstruct seawater Mg/Ca over the Middle Miocene Climatic Optimum (MMCO) from the Equatorial Pacific using IODP core 1338. Using the different Mg-incorporation mechanisms of hyaline and miliollid foraminifera reveals that seawater Mg/Ca for this interval is on average different and more variable than previous studies suggested. The accompanying deep sea temperatures for this interval are on average lower than previously reported. This new reconstruction also shows that variability in seawater Mg/Ca warrants high resolution reconstructions when correcting temperatures based on foraminiferal Mg/Ca.

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