Partitioning Environmental Controls on Benthic Foraminifera Elemental Composition: Implications for Paleo-Temperature Reconstruction

WEIFU GUO[1], DELIA OPPO[1], KUO-FANG HUANG[2], JIMIN YU[3]

[1]Woods Hole Oceanographic Institution, Woods Hole, MA
[2]Institute of Earch Sciences, Academia Sinica, Taipei, Taiwan
[3]Australian National University, Canberra, Australia

Elemental composition of benthic foraminifera tests reflects the physicochemical condition of the seawater in which foraminifera live. This forms the basis of many paleoclimate and paleoceanography proxies. Particularly, Mg/Ca and Mg/Li ratios of benthic foraminifera tests (e.g. *Uvigerina, C. pachyderma, H. elegans)* have shown great potential for reconstructing subsurface ocean temperature in the past. However, multiple lines of evidence suggest factors other than temperature, e.g. ΔCO_3 (a representation of seawater saturation state), also affect the incorporation of Mg and Li into foraminifera tests. This complicates the interpretation of these paleo-temperature proxies. The fact that paleo-oceans may have different T-ΔCO_3 relations from the modern ocean on which these proxies are calibrated further hinders their applications.

Here we present new Mg/Ca, Li/Ca and Mg/Li data of core-top *Uvigerina* and *C. pachyderma* samples from the Demerara Rise, where seawater T and ΔCO_3 deviate from the typical positive correlations in the modern ocean and thus allow better partitioning of their respective effects on these elemental ratios. Further, we develop a numerical model simulating the incorporation of Mg and Li into benthic foraminifera tests, based on physicochemical principles. This model takes into account both the seawater micro-environment adjacent to foraminifera tests and the regulation of the calcifying fluid chemistry by foraminifera. It enables us to quantitatively evaluate the controls of different seawater parameters (e.g. T, pH, DIC, ΔCO_3) on the incorporation of Mg and Li into benthic foraminifera tests. We optimize the model parameters based on our new data from the Demerara Rise and other published and unpublished core-top datasets, and use it to predict Mg/Ca and Li/Ca ratios of benthic foraminifera in the paleo-oceans. The comparison of these model predictions with down-core observations, as well as the implications of our model for other foraminiferal elemental proxies (e.g. B/Ca, U/Ca), will be discussed.