A new model for biomineralization and trace-element signatures of foraminifera tests

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The Mg/Ca ratio of foraminifera calcium-carbonate tests is used as proxy for seawater temperature and widely applied to reconstruct global paleo-climatic changes. However, the mechanisms involved in the carbonate biomineralization process are poorly understood. The current paradigm holds that calcium ions for the test are supplied primarily by endocytosis of seawater. Here, we combine confocal-laser scanning-microscopy observations of a membrane-impermeable fluorescent marker in living benthic species Ammonia tepida with dynamic 44Ca-labeling and NanoSIMS isotopic imaging of its test. We infer that Ca for the test in A. tepida is supplied primarily via trans-membrane transport, but that a small component of passively transported (e.g. by endocytosis) seawater to the site of biomineralzation plays a key role in defining the trace-element composition of the test. Our model accounts for the full range of observed Mg/Ca and Sr/Ca benthic foraminifera test compositions and predicts the effect of changing seawater Mg/Ca ratio.

Re-Os-PGE constraints on the evolution of backarc oceanic mantle

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Our direct understanding of the evolution of oceanic mantle during backarc extension is limited to exposures of abyssal peridotite and ophiolites. Few direct comparisons of ophiolite and backarc peridotite have been made due to the small number of documented exposures and limited in situ samples from backarc settings. Here we report Re-Os and PGE data for backarc abyssal peridotites from the Godzilla Megamullion (GM), a massive ~9000 km^2 oceanic core complex located in the Parece Vela Basin (Philippine Sea). The distal portion of GM records early, magmatically productive extension marked by moderately depleted spinel peridotites. This transitions into a less melt-productive medial region characterized by more fertile peridotite. The proximal region represents the most recently exhumed portion of the megamullion. Isotopically, the regions are indistinguishable, with whole rock $^{187}Os/^{188}Os$ = 0.1174-0.1704. Elevated $^{187}Os/^{188}Os$ values correlate with MgO loss, suggesting the influence of sea floor weathering. While spinel grains in proximal samples record high TiO_2 and Cr# indicative of melt-rock interaction, PGE abundances are not strongly affected; distal samples record stronger depletions in Pt-Ru-Pd the than proximal samples, consistent with higher degrees of melt extraction. In all samples, Re abundances are low (2-107 ppt) and are positively correlated with TiO_2 abundances in spinel, suggesting that Re is mildly influenced by melt-rock interaction. However, $^{187}Os/^{188}Os$ ratios are not correlated with Re concentration, demonstrating that modest Re addition occurred recently. As a whole, the $^{187}Os/^{188}Os$ data suggest that the backarc oceanic mantle in this region did not experience significant ancient melt depletion. Instead, the geochemical and isotopic signatures of the GM were generated during backarc extenstion associated with the Izu-Bonin-Mariana subduction zone.

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