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SELECTIVE UPTAKE OF RARE EARTH ELEMENTS IN MARINE SYSTEMS AS AN INDICATION OF AND CONTROL ON AEROBIC BACTERIAL METHANOTROPHY

Abstract

Unicellular methanotrophs constitute a widespread, polyphyletic group of organisms that oxidize methane to assimilate carbon and obtain energy. Despite their prevalence in most described environmental niches, including in areas of interest as terrestrial homologs for proposed extraterrestrial environments such as geothermal hot springs and hydrothermal vent systems, methanotrophs have only recently garnered widespread attention. In particular, recent research has found that light rare earth elements (REEs) are required for the catalytic activity of the common xoxF isoform of methanol dehydrogenase in the aerobic methanotrophy pathway. The previously described methanol dehydrogenase, mxa-MeDH, uses a calcium ion for catalysis. Though rare earth elements exist in picomolar concentrations in the ocean, the gene for this isoform seems to be maintained in marine methanotrophs, pointing to a possible terrestrial origin for aerobic methanotrophy.

In this work, we will present data from a short time-series in the oligotrophic Sargasso Sea. This time-series will build on previous research to describe the rare earth element distribution in the mid-latitude North Atlantic Ocean, the distribution of dissolved methane and nitrous oxide, and the prevalence of molecular markers for aerobic methanotrophy in the water column. A primary objective of these cruises is to isolate a pelagic aerobic methanotroph in order to characterize the environmental conditions that regulate use of each isoform of methanol hydrogenase. Furthermore, we aim to determine if aerobic methanotrophs have a reproducible and identifiable signal of selective uptake of light rare earth elements as compared to heavier REEs that could be applied as an indicator of past aerobic methanotrophy in the geologic record. A biologically induced negative anomaly in light rare earth elements may also have applications as a biomarker that would be identifiable remotely by simple mass spectrometry techniques.