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GEOLOGY

A geologic record of methane consumption associated with methane gas hydrates at Blake Ridge region (continental rise, offshore southeastern United States).

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Geochemical signals locked within sedimentary rocks are a record of earth processes. Sulfide minerals (elemental sulfur, iron monosulfides, and pyrite) are formed within marine sediments by several different geochemical processes mediated by microbes. Investigating the concentration and sulfur isotopic composition ($\delta^{34}\text{S}$) of sulfide minerals gives clues about the relative importance of these competing geochemical processes.

Marine sediments of the Blake Ridge (offshore South Carolina and Georgia) contain sulfide minerals that point to anaerobic methane oxidation (AMO) as an important diagenetic process both today and in the recent geological past (Miocene). At the present-day methane-sulfate interface, upward-diffusing methane is consumed by reaction with downward-diffusing sulfate, producing a geochemical environment that promotes the authigenic precipitation of sulfide minerals. These sulfide minerals, mainly pyrite, are enriched in the heavy isotope of sulfur (^{34}S), whereas sulfides higher in the sulfate reduction zone contain more ^{32}S . This result is consistent with larger fluxes of methane in the region being produced by methane gas hydrate deposits.

The sedimentary record back to the Late Miocene (~6.2 Ma) shows that changing depositional conditions seems to progressively favor sulfate reduction over AMO. Sulfide mineral amounts change from baseline values of 0.2 weight percent to 0.4 to 0.6 wt %. Baseline values of $\delta^{34}\text{S}$ also increase from -45‰ to -30‰ . Geochemical conditions today favor AMO whereas conditions in the past responded to loading of sedimentary organic matter – conditions necessary to produce the amount of methane gas hydrates within the Blake Ridge region.

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