BIOGEOCHEMICAL REACTION RATES IN THE K-G BASIN OFFSHORE INDIA: INSIGHTS INTO CARBON CYCLING IN GAS HYDRATE-BEARING SEDIMENTS

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Abstract

In marine continental margin sediments, methane as a dissolved or gas phase, and in gas hydrates constitutes an important part of the global carbon cycle. The distribution and concentration of these methane phases, however, vary at different margins and tectonic environments. The focus of this study is to constrain the biogeochemical and hydrological processes responsible for this variability. Profiles of dissolved chemical constituents can be used to quantify net rates of microbial and diagenetic reactions such as POC degradation via sulfate reduction and methanogenesis, CO\(_2\) and CH\(_4\) production, AOM, and CaCO\(_3\) precipitation/dissolution. We use a numerical transport-reaction model, driven by pore fluid chemical data and sediment physical properties, to identify and quantify the rates of these co-occurring reactions at nine sites drilled in the Krishna-Godavari (K-G) basin offshore southeast India.

Gas hydrate concentrations vary considerably in the K-G basin from disseminated to massive along faults and fractures. Results show that sulfate reduction rates are lowest at sites with disseminated gas hydrate and highest at sites containing massive gas hydrates, whereas in situ methane production rates are highest at the disseminated sites and lowest at the sites with massive gas hydrates suggesting a deep methane source and intense AOM at sites with significant quantities of gas hydrate. DIC and alkalinity profiles indicate that most to all of the CO\(_2\) produced during methanogenesis is neutralized and converted to HCO\(_3^-\) by silicate weathering. A significant portion of the alkalinity generated is then sequestered as CaCO\(_3\). These preliminary results highlight many important processes occurring in the K-G basin. The numerical analysis of alkalinity, Ca/Mg, and Cl profiles, in progress, will provide critical information on the evolution and distribution of gas hydrate deposits in the K-G basin, and the role silicate weathering in gas hydrate-bearing sediments plays in the marine carbon cycle.

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