

Oil & Natural Gas Technology

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Quarterly Progress Report (April - June 2007)

Gas Hydrate Instability in the Southeastern Bering Sea

Submitted by:
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Period: April to June, 2007
NETL Manager: Robert Vagnetti
Principal Investigator: Lloyd Keigwin

Progress

Task # 7.0
Task AMS 14C Dating

We received the results from the 5 AMS samples we submitted in the last quarter. The upper two layers of authigenic carbonate from 57JPC are contemporaneous with the upper two layers of authigenic carbonate from 51JPC. We also measured the 14C/12C of samples encrusted with authigenic minerals. As we hypothesized, the samples have a lower 14C/12C than would be predicted from the chronological age of the sample, indicating that the 14C/12C of the authigenic minerals is low. We would like to collect 3 more radiocarbon dates to verify the apparent correlation we see between the cores. This will be completed during the next quarter.

Task # 8.0
Task Organic Geochemistry

Mea Cook spent 25 June to 19 July at University of Bremen working with Prof. Kai-Uwe Hinrichs to study the organic biomarkers in 51JPC and 57JPC.

After reviewing the data obtained during the previous visit, where we found elevated concentrations of archaeol, a biomarker of anaerobic methane oxidation, during the stratigraphically highest authigenic carbonate layer from 51JPC, we decided to obtain lipid data from the next layer down, in order to see whether this observation is reproducible. We also obtained lipid data from the analogous 2 events in 57JPC. We also performed ether cleavage of a time series of samples from the stratigraphically highest authigenic carbonate layer in both cores to look for evidence of carbon-13 depletion in membrane lipids.

Because the method testing and protocol development was carried out already during the previous visit, the lab work was very streamlined. In addition, Dr. Hinrichs ensured that the GC-MS and GC-IRMS were available, so Dr. Cook was able to perform measurements continuously during the entire visit. Nearly all the samples that were

prepared were analyzed. However, the GC-MS went down for repairs, so was unavailable toward the end of the visit. The few samples remaining will be analyzed by a technician in the next few weeks when the instrument is fixed.

The main result from the new lipid data is that there are not similarly high concentrations of archaeol in 57JPC or in the second authigenic carbonate layer in 51JPC as we see in the first authigenic carbonate layer in 51JPC. This is puzzling, since we would have expected to find the same pattern in all the authigenic carbonate layers. Our current hypothesis is that the lipids have degraded in the 5 years since the core was collected. Usually, sediment samples meant for lipid analysis are stored at -25 degrees C. Our cores were stored at 4 degrees C. We noticed that there was an unusually low abundance of fatty acids in our samples, which has been observed to be a consequence of degradation of organic components in sediment cores that are stored at temperatures that are too high. We do not have an explanation at the moment for why the archaeol would have been preserved in one of the layers.

We observed a significant, though slight depletion in the d13C in the constituent biphytane chains derived from membrane-lipid GDGTs from the ether cleavage reaction on samples from 57JPC. This observation is also consistent with the hypothesis that the biomarkers in the cores have undergone degradation.

Regardless, the lipid data show very clearly that the authigenic carbonates formed in association with an increased vertical flux of methane in the sediment column, even if the lipids are not always well preserved.

The last remaining piece of the puzzle that is remaining is whether the authigenic carbonates were emplaced at the seafloor. We will count the benthic foraminifera in the samples across the authigenic carbonate layers in order to see whether the abundance or taxonomic distribution of species changes. We hypothesize that if the authigenic carbonates were emplaced at the seafloor, there would have been a change in the habitat of the benthic foraminifera at the time, which may be reflected in the relative and absolute abundance of species. If the authigenic carbonate layers are emplaced, say, meters below the seafloor, then we would expect no change in the benthic foraminifer species associated with the layers.

Schedule

In the next quarter, we will prepare and submit 3 more radiocarbon dates, and we will analyze the benthic foraminifer species abundance and distribution across the authigenic carbonate layers.

Other Activities

Mea Cook will present a poster on this project at the 9th International Conference on Paleooceanography in Shanghai, China, in the first week of September.

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