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Physical Properties of Sediment Related to Gas Hydrate in the Northern Gulf of Mexico

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Eighteen giant piston cores, up to 38-m long, were recovered during July 2002 to determine the distribution of gas hydrate in widely different

geologic environments of the Northern Gulf of Mexico. Physical properties, including electrical resistivity, three different shear strengths, P-wave velocity, and thermal conductivity were measured on split and whole-round cores at sea. Water content, grain density, and related properties are being determined in a shore-based laboratory from shipboard-acquired subsamples. These physical property data are important for two primary reasons: (1) to relate the presence of gas hydrate to the natural host sediment; and (2) to correlate with shallow seismic reflection records so they can be interpreted more accurately within and below the depth of coring. Preliminary results indicate that porosity and water content typically decrease rapidly to a subbottom depth of about 8 to 9 m, but then decrease at a much lower rate to the base of the core - often 30 or more mbsf. Although higher water contents are measured in the sediments that were recovered in association with gas hydrates, they are probably an artifact of post-sampling hydrate dissociation rather than an in-situ characteristic. The hydrate recovered during the cruise, was present either as particles distributed throughout the sediment or as massive chunks that filled the entire 10-cm diameter of the core liner. The sediments immediately adjacent to the recovered gas hydrates are visually similar to surrounding sediments, and thus primary lithologic differences do not appear to control the distribution of these gas hydrates. Vane shear strength measurements correlate better to subbottom depth than to water content. The strength values typically increase from less than 10 kPa near the seafloor to as much as 80 to 90 kPa at the base of some cores. Electrical resistivity appears to be related to water content (and probably porewater salinity) since a break in slope with depth is often recorded in the upper 8 to 15 m of sediment. Electrical resistivity typically increases from about 0.4 to 0.5 ohm-m near the top of many cores, to about 0.7 ohm-m near the base of the deeper recovered sediment. These values are typical for clay-rich fine-grained sediment with high water content. Although the amount of gas hydrate in the natural environment is enormous, little is known about its distribution in sea-floor sediment or even exactly how it forms. A goal of this cruise was to find evidence for the existence of gas hydrate away from obvious seafloor gas-hydrate mounds and at depth in the sediment. This international, multi-discipline coring cruise was conducted jointly by the Institut Polaire Francais, Paul-Emile Victor (IPEV) and the USGS aboard the 120-m-long French research vessel, Marion Dufresne. Partial funding was provided by the U.S. Dept. of Energy and considerable at-sea help was provided by an international group of about 40 scientists under the IMAGES (International Marine Past Global Changes Study) and PAGE (Paleoceanography of the Atlantic and Geochemistry) programs.

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