Geophysical Research Abstracts, Vol. 9, 04236, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04236

Abundance of gas hydrates in the northern Cascadia Margin – Results from pressure core analysis during IODP Expedition 311

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Integrated Ocean Drilling Program (IODP) Expedition 311 established for the first time a transect of deep drill holes on the northern Cascadia margin to study the evolution of gas hydrates over the entire gas hydrate stability field of an accretionary complex (Riedel et al., 2006). In addition to four up to 300 meter deep transect sites, a fifth site was drilled within an active cold vent. Expedition 311 complements previous gas hydrate studies along the Cascadia accretionary complex (DSDP Leg 18, ODP Legs 146 and 204) by extending the aperture of the sampled transect and introducing new tools to systematically quantify the gas hydrate content of the sediments. Downhole logging while drilling and measurement while drilling provided guidance for subsequent coring and special tool deployments. Infrared imaging of the recovered core was used to quickly identify gas hydrate in the core for direct subsampling and standard coring was interspersed with pressure core sampler runs, i.e. with autoclave techniques that aim to retrieve samples under in situ pressure for onboard experiments and shore-based studies.

Because conventional cores tend to release large volumes of gas during recovery from ocean depth, pressure core sampling is essential for the quantification of gas hydrates. Expedition 311 carried out an intensive pressure coring program: A total of 20 suc-

cessfully retrieved pressure cores were used to determine gas hydrate quantity, using degassing experiments and mass balance calculations, and gas hydrate distribution, using nondestructive measurement of the physical properties of the cores at in situ pressures. The employed methods included X-ray imaging that shows the overall structure of the core and gas hydrate within them, measurement of P-wave velocity on undisturbed gas hydrate–bearing sediments that provides acoustic parameters valuable for analysis of seismic data, and continuous gamma-ray density measurements during degassing experiments that allow to monitor gas hydrate dissociation and gas evolution in the slowly depressurized cores.

Among the most significant findings of the expedition was the occurrence of up to 20-m-thick sand-rich turbidite intervals with gas hydrate concentrations exceeding locally 50% of the pore-space. These anomalous gas hydrate intervals occur at unexpectedly shallow depths of 50 to 120 meters below seafloor. This finding contrasts previous models of gas hydrate formation in accretionary complexes, which predicted gas hydrate to be more concentrated near the base of the gas hydrate stability zone. In pressure cores retrieved from the latter depth interval (188 to 246 meters below seafloor) gas hydrate and free gas filled in general $<$3% of the pore space. Overall, the gas hydrate appears to be mainly concentrated in coarse-grained turbidite sand layers, which has not been previously documented along the northern Cascadia margin (Riedel et al., 2006).

References:

Riedel, M., Collett, T.S., Malone, M.J., and the Expedition 311 Scientists, 2006. *Proc. IODP,* 311: Washington, DC (Integrated Ocean Drilling Program Management International, Inc.). doi:10.2204/iodp.proc.311.2006