The Origin of the Hydrate Filled Fractured Zone in the DOE/Chevron Hydrate JIP Walker Ridge 313 Wells

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The DOE/Chevron JIP hydrate drilling program drilled 7 LWD wells in April and May, 2009, at three sites in the Gulf of Mexico, two of which (the "G" and "H") were in Walker Ridge block 313. The primary targets of these wells were seismically identified Pleistocene sands ~2700 feet below the seafloor (fbsf). Both wells encountered high hydrate saturations in the primary target layers. A largely unanticipated discovery in both wells was a ~500 ft thick stratally bound, fine-grained unit containing pervasive hydrate-filled fractures located at ~ 600 fbsf. State-of-the art LWD data indicate that this unit has elevated resistivities, as was found in the nearby WR 313 #001 well. The LWD data reveal no increase in seismic velocities within the unit though. From a petroleum systems perspective, these observations lead to two questions: Why did fracturing and hydrate formation affect this stratigraphic unit but not lithologically similar units above and below? What was the source of methane charge for the hydrate system?
End member models for the strata-bound hydrate-bearing fractures depend on whether the fractures predated the gas hydrate or whether hydrate growth and/or associated gas migration contributed to opening the fractures. In the first case, the fractures, confined to a single stratigraphic unit would result if slight variations in the lithology and/or pore pressure characteristics, form during regional uplift of the units in response to salt uplift to the east. Charge to this zone would then be by a combination of vertical diffusion, in situ methane generation, and possible lateral migration. A competing model is that fractures and the associated gas hydrates formed as a consequence of gas invasion into this layer, with the gas fed into the layer along very thin, permeable silt and sand beds. A potential gas source for large-scale gas-driven fractures is an extensive gas chimney associated with a prominent sea-floor seep complex in WR 269 and 270.

Preliminary analysis of the gas hydrate saturations in the JIP wells and the WR 313 #001 well shows a positive correlation between saturation estimates and the strength of the seismic amplitude response from the top of the unit. A more comprehensive attribute analysis of the entire zone over the region around this site may further explain the relationship of hydrate occurrence and concentration to the gas migration processes at the WR 313 site.