3-D Amplitude vs. Offset Analysis for Gas Hydrate Identification in the Northern Gulf of Mexico: MC 118 (Woolsey Mound)

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Abstract

The northern Gulf of Mexico has been a significant target area for the study of gas hydrates that have been discovered in shallow sediments with water bottom exceeding 900 m. Due to the complexity of the geology, occurrence of chemosynthetic communities, and associated hydrate vent activity, the Mississippi Canyon Lease Block 118 (MC118) was chosen by the Gulf of Mexico Hydrates Research Consortium as a multi-sensor, multi-discipline sea-floor observatory for gas hydrate research. Woolsey Mound at MC118 is a one-kilometer diameter hydrate/carbonate complex where gas hydrates were first observed at the seafloor. Subsequently, the subsurface evidence for gas hydrates has been confirmed by coring and 3D seismic reflection data. Previous studies that incorporated the use of 3D seismic data and well logs, generated a structural and stratigraphic framework for the thermogenic hydrate system within the Mississippi Canyon area (MC118) of the Gulf of Mexico (GOM). The complex geology of MC-118 is primarily characterized by allochthonous salt movement similar to other hydrocarbon systems in the Gulf of Mexico. The hydrate mound is associated with a salt diaper through an array of shallow crestal faults which are considered as migration pathways for the hydrocarbon rick fluids. Most common seismic indications of gas hydrate presence are bottom simulating reflector (BSR), relatively high P- and S- wave velocities, seismic blanking, and amplitude vs. offset (AVO) effects. AVO effects result from the presence of free gas that may be trapped by the overlying hydrate formation, which is the origin of the classical form of BSR. As a result of the complex salt distribution and shallow fault

systems that inhibit free gas trapping, the GOM is not primarily characterized with regionally extensive BSRs. However, the shallow subsurface of the GOM, particularly the MC118, show evidence of “bright spots”. These shallow “bright spots”, in the absence of regionally extensive BSRs, may mark the bottom of the gas hydrate stability zone. The overarching hypothesis of this work is that the shallow “bright spots” (<200 mbsf) identified on the seismic data mark the base of the gas hydrate stability field and, therefore, exhibit Amplitude Variation with Offset (AVO) effects due to free gas trapped underneath the hydrate charged sediment. We will perform AVO analysis over the area of hydrocarbon vents at Woolsey Mound in order to test this hypothesis and find out which of the vents were active at the time the seismic dataset was collected.