Subsurface Structure and Stratigraphy of a Transient, Fault-Controlled Thermogenic Hydrate System at MC-118, Gulf of Mexico

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Analysis of 3-D seismic reflection data and integration with industry well logs reveals the subsurface structural and stratigraphic architecture of a thermogenic hydrate system in the Mississippi Canyon area (MC-118) of the Gulf of Mexico. Like many hydrocarbon systems in the Gulf of Mexico, MC-118 is dominated by the presence and periodic movement of allochthonous salt within the sedimentary section. The deeply-rooted northwestern flank of the salt body appears to tap depths suitable for hydrocarbon maturation, while the steep flanks of the salt body provide migration pathways for deep basin fluids. A radiating crestal fault structure above the salt creates a delivery system to the shallow subsurface and venting at the seafloor.

Development of seafloor hydrate/carbonate mounds shows a close spatial association with three shallow crestal faults, and suggests a temporal evolution of venting activity and mound creation. Such spatial and temporal transience may be the result of periodic formation and dissociation of hydrate in the vicinity of these shallow faults. Seismic bright spots appear throughout the 3-D volume, suggesting the abundant presence of free gas within the system. While some of these bright spots show evidence for either structural or stratigraphic trapping elements, the shallowest ones (~100-150 m) may be an expression of free gas at the base of the hydrate stability zone above the salt body.

Stratigraphic relationships indicate that the most recent period of salt mobilization was probably during the Late Pliocene, and subsequent Pleistocene time was characterized by relatively uniform, quiescent sedimentation over the mound site. Such relationships suggest that the hydrate system at MC-118 may be a geologically young feature.