Quantifying Gas Hydrate Deposits and Implications for Petroleum Systems and Secondary Target and Seal Assessment in Large Biogenic Gas Plays

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Abstract

Some of the most promising gas hydrate targets are associated with strong biogenic gas systems such as in New Zealand, Myanmar, and Colombia, where gas hydrates are in close proximity to, and may seal potential secondary commercial drilling targets. The association of high saturation gas hydrate prospects and strong biogenic gas systems should not be surprising. Large gas hydrate deposits, except along thin chimneys, tend to not be distributed broadly from the base of the gas hydrate stability zone to the seafloor, they tend to accumulate at the base of gas hydrate stability if there is porous and permeable reservoir. Gas hydrates are commonly seen where there are large biogenic gas systems such as deepwater Gulf of Mexico, Colombia, Trinidad & Tobago, Israel, East coast of India, Myanmar, Vietnam, Indonesia, and Papua New Guinea. Conventional (produced by conventional means) biogenic gas systems are young systems. With the right conditions, economic accumulations of biogenic gas may form in less than 100,000 years Provided that the sediments have sufficient organic matter, temperature is then the principle control on methane generation. What is generated and can accumulate in biogenic gas reservoir sediments is gas production by mesophile bacteria within a temperature window between 13° and 50° C with peak generation between 35° and 45°C. The discovery curve for deepwater conventional biogenic gas reserves has accelerated over the last 20 years with approximately 100 Tcf of gas reserves developed in that time (MacGregor, 2018). Gas hydrates

appear, in some local settings, to help concentrate conventional biogenic gas deposits. “Hoteling” of biogenic gas as gas hydrate has been discussed as a free gas concentration mechanism at Camden Hills in Mississippi Canyon 348 in the Gulf of Mexico and at the multi-Tcf Shwe gas field offshore Myanmar. Gas hydrates are also unstable and are subject to stripping from any undersaturated fluids passing by a gas hydrate deposit. High saturation gas hydrates that are found at the base of gas hydrate stability tend to form from an active and vigorous biogenic gas expulsion from the basin. If conventional gas deposits were trapped first as gas hydrate, it implies that the gas hydrates had local lithologic seals and that the seal was key to preservation of the gas as the gas and seal were buried. The presence of gas hydrates in conventional biogenic gas plays indicates that there is an active flux of methane through the near seafloor sediments and can inform potential gas targets that are proximal to the gas hydrate system. Quantifying gas hydrate deposits can be done by modification of exploration methods for conventional oil and gas. These techniques, plus other seismic thin bed responses that can be isolated with seismic attributes such as envelope derivatives, can be used to quantify gas hydrate presence, thickness, and saturations.