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Detection and Appraisal of Gas Hydrates: Indian Scenario

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Gas hydrates, found in shallow sediments of permafrost and outer continental margins, are crystalline form of methane and water. The carbon within global gas hydrates is estimated two times the carbon contained in world-wide fossil fuels. It is also predicted that 15% recovery of gas hydrates can meet the global energy requirement for the next 200 years. Several parameters like bathymetry, seafloor temperature, sediment thickness, rate of sedimentation and total organic carbon content indicate very good prospect of gas hydrates in the vast offshore regions of India. Methane stored in the form of gas hydrates within the Indian exclusive economic zone is estimated to be few hundred times the country's conventional gas reserve. India produces less than one-third of her oil requirement and gas hydrates provide great hopes as a viable source of energy in the 21st century. Thus identification and quantitative assessment of gas hydrates are very important. By scrutiny and reanalysis of available surface seismic data, signatures of gas hydrates have been found out in the Kerala-Konkan and Saurashtra basins in the western margin, and Krishna-Godavari, Mahanadi and Andaman regions in the eastern margin of India by mapping the bottom simulating reflector or BSR based on its characteristic features. In fact, the coring and drilling in 2006 by the Indian National Gas Hydrate Program have established the ground truth in the eastern margin. It has become all the more important now to identify further prospective regions with or without BSR; demarcate the lateral/areal extent of gas hydrate-bearing sediments and evaluate their resource potential in both margins of India. We have developed various approaches based on seismic traveltime tomography; waveform inversion; amplitude versus offset (AVO) modeling; AVO attributes; seismic attributes and rock physics modeling for the detection, delineation and quantification of gas-hydrates. The blanking, reflection strength, instantaneous frequency and attenuation (Q-1) attributes are found very useful for the identification of gas hydrates in areas where BSR is not clearly observed on seismic section. These attributes can also be used to ascertain whether a BSR is related to gas hydrates. Since seismic velocity of pure gas hydrates is much higher than that host sediments, hydrates-bearing sediments exhibit higher velocities than normal oceanic sediments, whereas underlying free-gas laden sediments have considerably low P-wave velocity. Thus traveltime tomography of large offset multi channel seismic (MCS) or ocean bottom seismic (OBS) data can delineate the extent of gas hydrates and free-gas bearing sediments. Estimating accurate velocities by full-waveform inversion or AVO modeling followed by rock physics modeling has been an efficient tool for appraisal of gas hydrates and free-gas. Examples of these approaches to the Indian data sets will be presented in this paper.

Key words: BSR, Gas hydrates, delineation, appraisal, approaches