2D Topographic Modeling on Heat Flow Inferred from the Base of Gas Hydrate Stability Zone in the Krishna Godavari Basin

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A wide-spread bottom simulating reflector (BSR) interpreted to mark the thermally controlled base of the gas hydrate stability zone is observed over a close grid of 2D/3D multichannel seismic profiles in the Krishna Godavari (KG) Basin of the eastern continental margin of India. The seismic data reveal that gas hydrate occurs in the KG Basin at places where water depths exceed 850 m. The thickness of the gas hydrate stability zone inferred from the BSR ranges up to 250 m. A conductive model was used to determine geothermal gradients and heat flow. Ground truth for the assessment and constraints on the model were provided by down-hole measurements obtained during the National Gas Hydrate Program (NGHP) Expedition 01 at various sites in the KG Basin. Measured down-holes temperature gradient, seafloor-temperatures, sediment thermal conductivities, and P-wave velocity are utilized to generate regression functions for these parameters as function of overall water depth. In the first approach the base of gas hydrate stability is predicted from seafloor bathymetry using these regression functions and geothermal gradient and heat flow are calculated. In a second approach the observed BSR depth from the seismic profiles (measured in two-way travel time) is converted into geothermal gradient and heat flow using the same ground-truth measurements. A regional heat flow trend is observed, in which heat flow increases towards deep sea across the basin. Consistent local variations were also observed with low heat flow values over prominent topographic highs and high heat flow values over the flanks of the topographic highs. This variation may be due to focusing and defocusing effects of the topography alone, and indicates the importance of carrying out topographic corrections to heat flow in this region. However, local heat flow patterns may also be due to dynamic effects, including the displacement of isotherms by faulting and the upward migration of fluids.

Keywords: Gas hydrates; bottom simulating reflector; Krishna Godavari Basin; base of gas hydrate stability zone; heat flow; thermal modeling.