

Equivalent formation strength of gas hydrates bearing zone

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Gas hydrate-bearing layers are normally identified by a basement simulating reflector (BSR) or well logging because of their high acoustic- and electric impedance compared to surrounding formations. These gas hydrate characteristics can also result in contrasting in-situ formation strengths. Here, we describe gas hydrate-bearing layers based on equivalent strength (EST) in the exploration borehole of the Indian National Gas Hydrate Program (NGHP) Expedition 02. For Site NGHP-02-23, a representative site, the EST shows a constant trend of ~2 MPa, with some strong peaks in the 0–271.4 meter-below-seafloor (mbsf) interval, and a sudden increase up to 4 MPa above the BSR depth (271.4–290.0 mbsf). Below the BSR, the EST stays at ~2 MPa to the bottom of the hole (378 mbsf). Comparing the EST with logging data and a core sample description suggests that the EST depth profiles reflect the formation lithology and gas hydrate content. The EST increases in the sand-rich layer and gas hydrate-bearing zone. In the lower gas hydrate zone in particular, the EST curve shows the same approximate trend with that of P-wave velocity and resistivity measured during downhole logging. These results suggest that the EST, as a proxy for in-situ formation strength, can indicate the location and extent of the gas hydrate layer as well as borehole logging. Although the EST was calculated after drilling, utilizing the recorded surface drilling parameter in this study, the EST can be acquired during drilling using real-time drilling parameters. In addition, the EST only requires drilling performance parameters without any additional tools or measurements, making it a simplified and economical tool for the exploration for gas hydrates.

Keywords: Gas hydrate, Equivalent strength, Drilling parameters