The rock physics model of methane hydrate-bearing sediments

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It is well known that methane hydrate exists in sediments at deepwater over 500m or under arctic permafrost in the nature. Helgerud (2001) proposed the following four models such as cement model, coating model, matrix-support model and pore-filling model as methane hydrate-bearing rock physics models.

Helgerud (2001) and Hato et al. (2006) clarified the relationships between P-wave velocity (Vp), S-wave velocity (Vs), P- and S- wave velocity ratio (Vp/Vs) and the methane hydrate saturation (Smh) on those models. Hato et al. (2006) inferred that methane hydrate-bearing sediments at the MITI Exploratory Test Wells 'Nankai Trough' would belong to the matrix support type from the analysis of Vp, Vs, Vp/Vs and Smh. However, some differences from the model and real well sonic data are recognized on Vp, Vs and Vp/Vs.

First step in this study, we evaluated the effect of clay volume with change to the P-wave velocity on matrix-support rock physics model. By the results, it is suggested that, the more clay volume increases, the more Vp and Vs decrease and Vp/Vs increases.

In the eastern Nankai Trough, it was inferred that clay content estimated from the logging and core data of wells was approximately 50 or 60 %. By our interpretations, the Vp, Vs and Vp/Vs values correspond to values of 50 or 60 % clay content on matrix-support model.

In Mackenzie Delta in Canada, it was inferred that clay content from the logging and core data of wells was approximately 10 %. The Vp, Vs and Vp/Vs values correspond to values of 10 % clay content on matrix-support model.

Therefore it is expected that methane hydrate saturation delineate from Vp, Vs and Vp/Vs on assumption that methane hydrate-bearing sediments are correspondent to matrix-support model. These results could apply to delineate methane hydrate saturation or concentration from Vp, Vs or Ip, Is, or Vp/Vs by the seismic data.

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