

In situ stress determination by ASR and DSCA methods with oriented cores from Yufutsu oil and gas field, Japan

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Abstract

ASR (Anelastic Strain Recovery) method and DSCA (Differential Strain Curve Analysis) method for measuring in situ stress were applied to the Yufutsu oil and gas field, Hokkaido, Japan by using an oriented core which was retrieved from a depth of about 4,187 m. The Yufutsu oil and gas field has an oil/gas reservoir with natural fractures at depths of 3,900-4,800 m. The rock is granite. Four and five specimens were taken for the ASR method and the DSCA method, respectively. Unfortunately, in situ stress measurement by the DSCA method was not successful since the specimens contain many fractures. In the ASR method, from the data of the anelastic normal strains measured with 16 strain gauges in nine independent directions, principal stress directions were determined. The results were in agreement with the orientation of the maximum principal stress estimated from borehole breakouts observed in the well. Based on two assumptions that (i) the rock stress in the vertical direction is equal to the overburden stress and (ii) the ratio of the anelastic strain recovery compliance of shear deformation mode to that of volumetric deformation mode is equal to 2, the values of the three principal stresses were determined. The values of the minimum principal stress determined in this study were in agreement with those determined by leak-off tests conducted at the same field. Thus, the result obtained in this study gave the in situ stress at the maximum depth in Japan. Therefore, it can be said that the ASR method can be used for directly determining the directions and magnitude of principal in situ stresses for isotropic rock at great depth.