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Anisotropic parameter using core plugs and full-wave sonic logs

Jang, S.H.[1], Hwang, S.H.[2] and Kim, T.Y.[3]

[1]KIGAM, 124 Gwahang-no, Yuseong-gu, Daejeon, Korea, Republic, 34132, shjang@kigam.re.kr
[2]KIGAM, 124 Gwahang-no, Yuseong-gu, Daejeon, Korea, Republic, 34132, hwangse@kigam.re.kr
[3]UST, 217 Gajung-no, Yuseong-gu, Daejeon, Korea, Republic, 34113, tykim@ust.ac.kr

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Anisotropic parameters such as Thomsen's parameters alpha, epsilon [1], and Akhalifah-Tsvankin's anisotropic parameter eta [2] are most important parameters for reservoir characterization and processing seismic reflection data from anisotropic media. In order to get information on the anisotropic parameters three methods are mainly used: full-wave sonic logs [3], cylindrical core plugs with three directions [4], and nonhyperbolic semblance analysis to reflection seismic data with multicomponent and multi-azimuth [5]. One of them, laboratory measurement of the core plugs is important to understand anisotropy of the rock material itself. For the calculation of anisotropic parameters, we used core plugs and full-wave sonic logs. Ultra sonic pulse transmission without confining pressure was used for the measurement velocities of the core plugs. Since the anisotropic parameters depend on the elastic moduli of an ideal transverse isotropic medium, it needs P, SH and SV velocities from the minimum of three different directions. We took multiple core plugs from different angles, which are perpendicular, parallel and 45 degree to the material's layering. It assumes that the perpendicular and parallel directions align with the principal anisotropic axes. We measured compressional and two shear wave speeds (SH and SV) using in-house core measurement system. The measured velocities are used to obtain the full suite of elastic constants for the samples under the assumption of vertical transversely isotropic symmetry (VTI) [1]. In the case of anisotropic parameters from logging data, we used full-wave sonic log data and anisotropy was calculated using Backus averaging [6]. Due to the Backus averaging, we can replace thin-layering media with more homogeneous medium. Through the relationship between Thomsen's anisotropic parameters and Backus quantities, we calculated anisotropic parameters in VTI media from P, S and density log data. The anisotropic parameters from logging data are possible to be used to discriminate lithofacies, since these show difference of petrophysical properties. The anisotropic parameters in the study area are 0.12 of epsilon, 0.06 of delta and 0.05 of gamma from full-wave sonic logs. From core plugs those are 0.002 of epsilon, 0.001 of delta and 0.002 of gamma. The results show that this area is weekly anisotropic. For the further study it needs to analyze the differences between sonic logs and measured values from core plugs.

References:

[1] Thomsen L (1986) Geophysics 51: 1954-1966
[2] Alkhalifah T and Tsvankin I (1995) Geophysics 60:1550-1566
[3] Liner C and Fei T (2006) Geophysics 71:D183-D190
[4] Wang Z (2002) Geophysics 67:1423-1440
[5] Mahomoudian F et al. (2002) SEG Tech Exp Abs 1-6
[6] Backus G (1962) J Geophy Res 67:4427-4440