Revisiting the S-wave Splitting Anisotropic Characterization Workflow: An ApproachBased on the Splitting Intensity Analysis and Inversion

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Abstract

Introduction

In azimuthally anisotropic media, S-waves polarize into a fast wave (S1) parallel to the fractures and a slow wave (S2) perpendicular to them. If the split S-waves encounter a layer where the principal directions change, they will split again. In this case, a layer stripping procedure is required to unravel deeper anisotropy directions. Errors occurring in the shallow might propagate to deeper layers. We show a different approach that consists of inverting interval values of splitting intensity (SI) without the need of layer stripping and makes S-wave splitting analysis simpler. SI is robust with respect to structural variations and facilitates estimating key anisotropic properties within a geological formation by analysing the differences of SI measured at the top and bottom of a geological sequence. This new workflow has been successfully applied to seabed and land PS data.

Splitting intensity analysis and inversion

In the case of a stack of *n* weakly horizontal transverse anisotropic layers, SI varies with azimuth φ according to $SI_n (\varphi)=\sum_i \delta t_i \sin 2(\varphi - \varphi_i$ (1) where δt_i is time delays between S1 and S2 and φ_i is the azimuth of S1 for the i^{th} layer. SI represents the lag between the sum and the difference of the radial and transverse components and it is then inverted to obtain a model of splitting parameters varying with time or depth (Boiero and Bagaini, 2019).

Application to multicomponent data

Results from seabed data shown by Boiero and Bagaini (2019) are comparable to previous production results, but the SI method is faster to apply and is easier to QC. In this case, the SI inversion confirmed the presence of a major anisotropic layer in the overburden. In the land example shown by Johns (2018), the SI inversion approach deployment revealed a detailed set of horizon-based interval attributes that described the subtle anisotropic behavior of the Sprayberry formation in the Permian Basin from the NE Midland 3C survey area. The sum of the individual SI responses correlated closely with the single-layer Alford rotation result (Alford, 1986) and provided further confidence in attribute integrity.