Validation of a new method for estimating an orthorhombic anisotropy model in the Neuquén Basin

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Abstract

Processing and analyzing seismic data acquired in the Neuquén Basin is challenging because wave propagation in anisotropic media influences velocity estimation and imaging. Describing the study area in terms of the parameters that control anisotropic wave propagation is critical for obtaining high-resolution images and integrating seismic data into geomechanical and reservoir characterization studies. The fact that the anisotropic behavior of seismic waves in the Neuquén Basin is orthorhombic magnifies this problem. However, remarkably, the signal-to-noise ratio of seismic data in the Neuquén Basin is good enough to recognize moveout patterns associated with the orthorhombic behavior. By these means, a previous study proposes a robust processing flow to estimate the seven independent parameters needed to characterize Grechka and Tsvankin's weak anisotropy orthorhombic model. Additionally, it demonstrates the usefulness of this method based on a direct modeling experiment.

We present the Kirchhoff migration results after applying these orthorhombic parameters to real seismic data acquired in the same study area. Furthermore, we migrated the seismic data considering another two experiments for comparison: an isotropic model and a vertical transverse isotropy (VTI) model. The study concludes by analyzing the impact of the three different migration strategies based on various aspects, including the residual moveout, the coherency of primary reflection events, and the distribution of amplitudes as a function of the offset and the azimuth variables.

The results demonstrate that an orthorhombic model based on seven independent and measurable parameters is preferable for explaining the moveout associated with the seismic data acquired in this area. Moreover, this work also shows the incidence of this phenomenon in terms of coherency and amplitude distribution at typical formations of interest in the basin (Quintuco and Vaca Muerta). As a final remark, more comprehensible 3D modeling should be conducted in future investigations in the Neuquén Basin to quantify the impact of the orthorhombic anisotropy on seismic images.