Azimuthal Residual Velocity Analysis in Offset Vector for WAZ Imaging

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Wide azimuth acquisition provides full azimuthal illumination of the subsurface structures for a more accurate image. Additionally, analysing azimuthal variations of the seismic response may offer information on fracture orientation. To meet both objectives, it is essential that the wide azimuth character of the data is preserved throughout the processing sequences in order to get full benefit of true 3D algorithms. In this perspective, the use of the offset vector binning concept on dense wide azimuth datasets is advantageous as it preserves offset and azimuth information even after migration.

The offset vector binning uses the same cartesian system as the acquisition geometry and hence ensures an optimum distribution of seismic traces in each Common Offset Vector (COV) volume. Conventional sectoring approach using polar coordinate system provides cubes with holes and over folds, which requires an offset and azimuth interpolation process with careful fold compensation.

In our azimuthal processing sequence, pre-stack migration is achieved independently for each COV volume. The proposed azimuthal residual velocity analysis method is based on semblance optimisation computed within the 3D CIGs. Starting from the NMO elliptical model, the residual parabolic NMO correction is derived in a cartesian coordinate system. We define three variables Q, R and S which describe the residual travel-time function. The isotropic part is represented by Q and anisotropic components are represented by R and S.

Through our WAZ land data case study, we demonstrate that a velocity analysis algorithm that simultaneously takes into account all azimuths is less sensitive to the noise than independent 2D analysis within azimuthal sectors. The spectacular imaging improvement we are seeing after azimuthal residual move-out validates the accuracy of the extracted azimuthal parameters. The correlation that we observe between azimuthal corrections and structural dip and spatial RMS velocity variations suggests that the apparent structural anisotropy would be predominant in the azimuthal kinematic effect. Whatever the causes, structural or intrinsic anisotropy, the correct azimuthal travel-times compensation is an essential prerequisite for a better structural image and/or for any azimuthal amplitude analysis such as fracture characterization studies. Acknowledgements We are particularly grateful to Sonatrach, Cepsa and Total for the permission to publish the field data example.