Please fill in the name of the event you are preparing this abstract for.	International Petroleum Technology Conference
Please fill in your 5-digit IPTC manuscript number and IPTC Control number.	IPTC-19519-MS 19IPTC-P-2603-IPTC
Please fill in your abstract title.	Advanced Azimuthal AVA Inversion: Case Study from Saudi Arabia

Please fill in your author name(s) and company affiliation.

Given Name	Surname	Company
Ayman	Suleiman	Saudi Aramco
Nizare El	Yadari	Saudi Aramco

Abstract

Objectives/Scope: To get a detailed description of fractures and stresses, the use of seismic data has been widely used in industry to infer information about anisotropy, particularly through the interpretation of azimuthal AVA analyses and inversions. A case study from Saudi Arabia is presented to address some of the issues of the complexity of azimuthal anisotropy, and demonstrate how it can help with eliminating uncertainties in interpreting seismic anisotropy attributes in terms of fractures and stresses.

Methods, Procedures, Process: An advanced azimuthal AVA inversion workflow has been determined based on the existing well established isotropic AVA inversion. Using the Rüger reflectivity equation, the elastic parameters used in pre-stack inversion for each azimuth sector are linked with the fracture orientation. The well tie and the wavelet estimation are performed at every well location and for each angle-azimuth sector stack. For a reliable elastic inversion, the starting model is produced using all available wells with the help of seismic horizon guided 3D interpolation. In addition to the conventional inverted elastic parameters, volumes of anisotropic magnitude and fracture orientations are also obtained.

Results, Observations, Conclusions: The advanced workflow is applied to an onshore field from Saudi Arabia in a area that contained image log interpretations and walkaway VSP studies. The PSTM seismic data, seismic interpreted horizons, well log data and borehole seismic data were all integrated in the seismic inversion workflow to produce acoustic impedance, VP-VS ratio and density volumes as well as the anisotropy gradient and direction. The quality of the inversion result is validated based on the comparison with well log data. As common to all inversions, the results of this modified workflow depends on the quality of input data. However, special processing and imaging techniques are carried out to account for the HTI effect on seismic amplitude. In addition, a residual azimuthal flattening after PSTM is performed to ensure stability of the azimuthal AVA inversion. To demonstrate the robustness of this workflow, the anisotropy results are firstly compared with the results from an azimuthal AVA analysis, then benchmarked with results from walkaway VSP shear wave splitting analysis and finally validated with the existing geological models including the FMI logs. The inverted volume pattern and magnitude match both log interpretation and VSP analysis and have similar orientation and low magnitude.

Novel/Additive Information: An advanced azimuthal AVA inversion workflow is introduced as a new approach to quantitative stress and fracture characterization which can be used in reservoir simulation to enable the interpretation of the fluid flow and to facilitate oil recovery and production. Unlike the azimuthal AVA analysis that suffers from noise, this workflow closes the loop between well log data and inversion results using existing established forward modeling and inversion tools.