

VSP-driven Model Building for Converted Waves Processing

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Abstract

Subsurface imaging with seismic converted wave provides insights into the reservoir fracture behavior and fluid content. Vertical seismic profiling (VSP) data is acquired using three component receivers which offers the capability of recording converted waves from routinely acquired zero-offset VSP data and correct velocity information for both P and S waves can be directly obtained. The P and S waves velocities information can be used as an aide to the processing of surface seismic converted waves data. We propose to use VSP data to estimate the velocity for converted waves, from P to S waves, in an area of interest. Each VSP data would provide one velocity function. Geostatistical methods combine all of the available velocity functions in the area to build 3D P, S and converted wave velocity models in the area of interest. We picked converted waves velocity functions from 15 marine wells distributed across multiple oil fields in Saudi Arabia. The picked velocity functions are then combined with information about structural interpretation in the area to build 3D P, S and converted waves velocity models. These models are then used to generate P and converted waves seismic images in the area. The image results showed enhanced continuity for both shallow and deep events in comparison to images created using conventional surface seismic velocity models. To validate our results, we used VSP P and PS corridor stacks, which contains only primary seismic events, to perform seismic to well tie. The seismic to well tie showed good agreements between the primary events in the corridor stack and the surface seismic images, thus demonstrating that VSP driven models have assisted with obtaining accurate surface seismic images, especially at the zone of interest. This proposed method is a practical and fast strategy of estimating converted waves velocities that can be used directly in surface seismic imaging.