

Moveout analysis of wide-azimuth data in the presence of lateral velocity variation

Authors: Mamoru Takanashi and Ilya Tsvankin, Center for Wave Phenomena,
Colorado School of Mines

Abstract (as excerpted from *Geophysics*, 2012, v. 77, no. 3, pp. U49-U62)

Moveout analysis of wide-azimuth reflection data seldom takes into account lateral velocity variations on the scale of spreadlength. However, velocity lenses (such as channels and reefs) in the overburden can cause significant, laterally-varying errors in the moveout parameters and distortions in data interpretation.

Here, we present an analytic expression for the normal-moveout (NMO) ellipse in stratified media with lateral velocity variation. The contribution of lateral heterogeneity (LH) is controlled by the second derivatives of the interval vertical travelttime with respect to the horizontal coordinates, along with the depth and thickness of the LH layer. This equation provides a quick estimate of the influence of velocity lenses and can be used to substantially mitigate the lens-induced distortions in the effective and interval NMO ellipses. To account for velocity lenses in nonhyperbolic moveout inversion of wide-azimuth data, we propose a prestack correction algorithm that involves computation of the lens-induced travelttime distortion for each recorded trace. The overburden is assumed to be composed of horizontal layers (one of which contains the lens), but the target interval can be laterally heterogeneous with dipping or curved interfaces. Synthetic tests for horizontally layered models confirm that our algorithm accurately removes lens-related azimuthally varying travelttime shifts and errors in the moveout parameters. The developed methods should increase the robustness of seismic processing of wide-azimuth surveys, especially those acquired for fracture-characterization purposes.