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Interpretation: Tomographic velocity analysis and wave-equation depth migration in an overthrust terrain: A case study from the Tuha Basin, China

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Although the structures associated with overthrust terrains form important targets in many basins, accurately imaging remains challenging. Steep dips and strong lateral velocity variations associated with these complex structures require prestack depth migration instead of simpler time migration. The associated rough topography, coupled with older, more indurated, and thus high-velocity rocks near or outcropping at the surface often lead to seismic data that suffer from severe statics problems, strong head waves, and backscattered energy from the shallow section, giving rise to a low signal-to-noise ratio that increases the difficulties in building an accurate velocity model for subsequent depth migration. We applied a multidomain cascaded noise attenuation workflow to suppress much of the linear noise. Strong lateral velocity variations occur not only at depth but near the surface as well, distorting the reflections and degrading all deeper images. Conventional elevation corrections followed by refraction statics methods fail in these areas due to poor data quality and the absence of a continuous refracting surface. Although a seismically derived tomographic solution provides an improved image, constraining the solution to the near-surface depth-domain interval velocities measured along the surface outcrop data provides further improvement. Although a one-way wave-equation migration algorithm accounts for the strong lateral velocity variations and complicated structures at depth, modifying the algorithm to account for lateral variation in illumination caused by the irregular topography significantly improves the image, preserving the subsurface amplitude variations. We believe that our step-by-step workflow of addressing the data quality, velocity model building, and seismic imaging developed for the Tuha Basin of China can be applied to other overthrust plays in other parts of the world.

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