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DEPTH IMAGING VELOCITY ESTIMATION CASE HISTORY IN A CHALLENGING AREA OF CALIFORNIA

Two major issues that give rise to seismic imaging challenges in California are near-surface propagation effects and complex velocity structure. In this case history, which exhibits both challenges, a deep target has been imaged by a 50,000' seismic line with offsets to 20,000'. The topographic relief is about 800'. The imaging target is about 20,000' deep under a faulted anticline. The main imaging problem is a low-velocity-zone at the top of the anticline that lets little energy penetrate vertically and severely distorts the raypaths of non-vertically traveling energy. This setting poses a particular challenge to depth imaging because of the sensitivity velocity model errors. Dipmeter readings from a borehole to about 12,000' provide some quality control of the deeper sections of the image.

In order to build a reliable velocity model for prestack depth migration, we employed two different approaches of iterative migration velocity analysis: (1) a layer-based vertical update based on Dix's equation that proceeds from the surface downward, freezing the model in shallower layers when a satisfactory solution has been reached, and (2) a whole-model tomographic update which is constrained by dip steering filters obtained from analyzing the slopes present in the image. The tomographic method eliminates the need for manual reflector picking by automatically selecting back projection points based on dip coherency and semblance strength. The layer stripping and tomographic approaches complement each other, as the Dix update performs better in the shallow section, whereas the tomographic update works better for the deeper parts of the model.