Eliminating time statics from depth imaging

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Summary

Refraction and reflection statics are calculated because often the underdetermined near-surface leads to a poor image. However, these static corrections are coupled to time migration and not depth imaging.

Raytracing in depth migration has overcome many of the issues with the assumptions in time migration. Foothills datasets and other geologically complex environments compel us to look for ways to overcome these assumptions as they are violated. By merging the near-surface tomographic with the depth velocity model and calculating a model-based moveout correction for reflection statics, depth imaging can be enhanced.

Methodology

Applying static correction created derived from model-base moveout (MMO) allows for asymmetric non-hyperbolic moveout. MMO is employed using the reciprocity assumption for the relative source and receiver positions which allows a consistent method in applying the traveltimes to the respective source and receiver trace (Figure 1).

In regions of complex geologic, such as the Canadian Foothills where the Husky Structural Dataset was acquired, the tomographic approach of using diving rays generally produce a better near-surface as it is more capable of handle lateral velocity variations in the near-surface tomographic modeling process. By removing the refraction statics and merging the near surface tomographic model with the depth velocity model Will make the depth image fully dependent on depth migration.

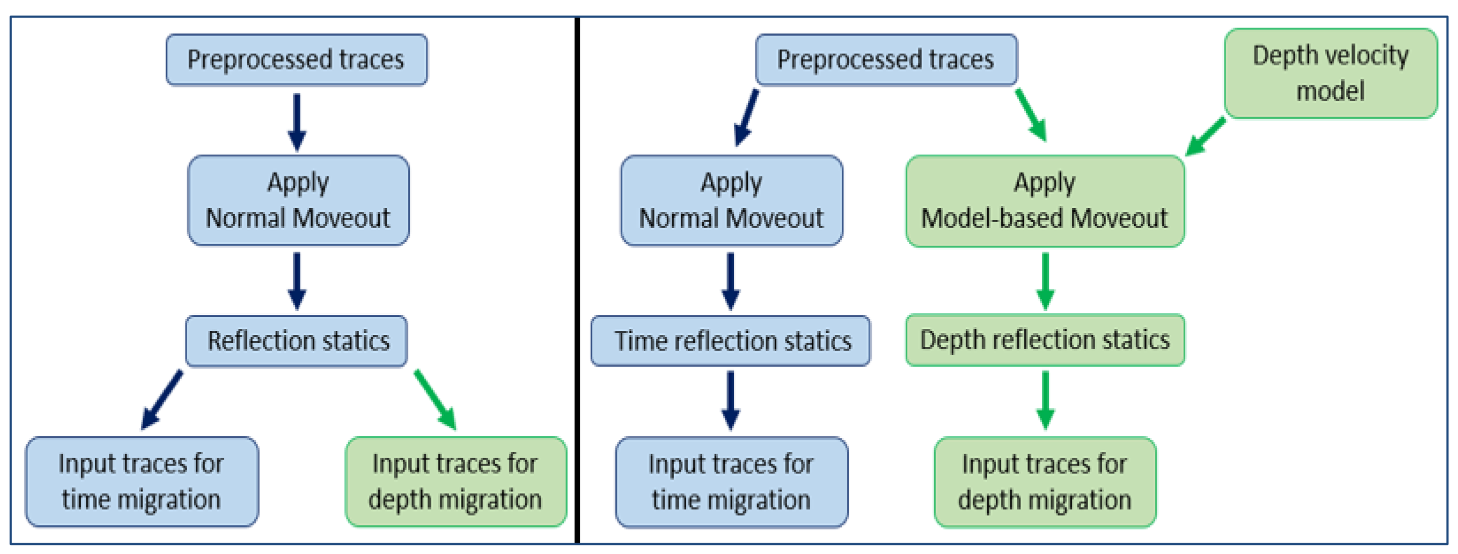

Fig 1. (Left) Conventional reflection statics. (Right) Depth specific reflection statics.

Results

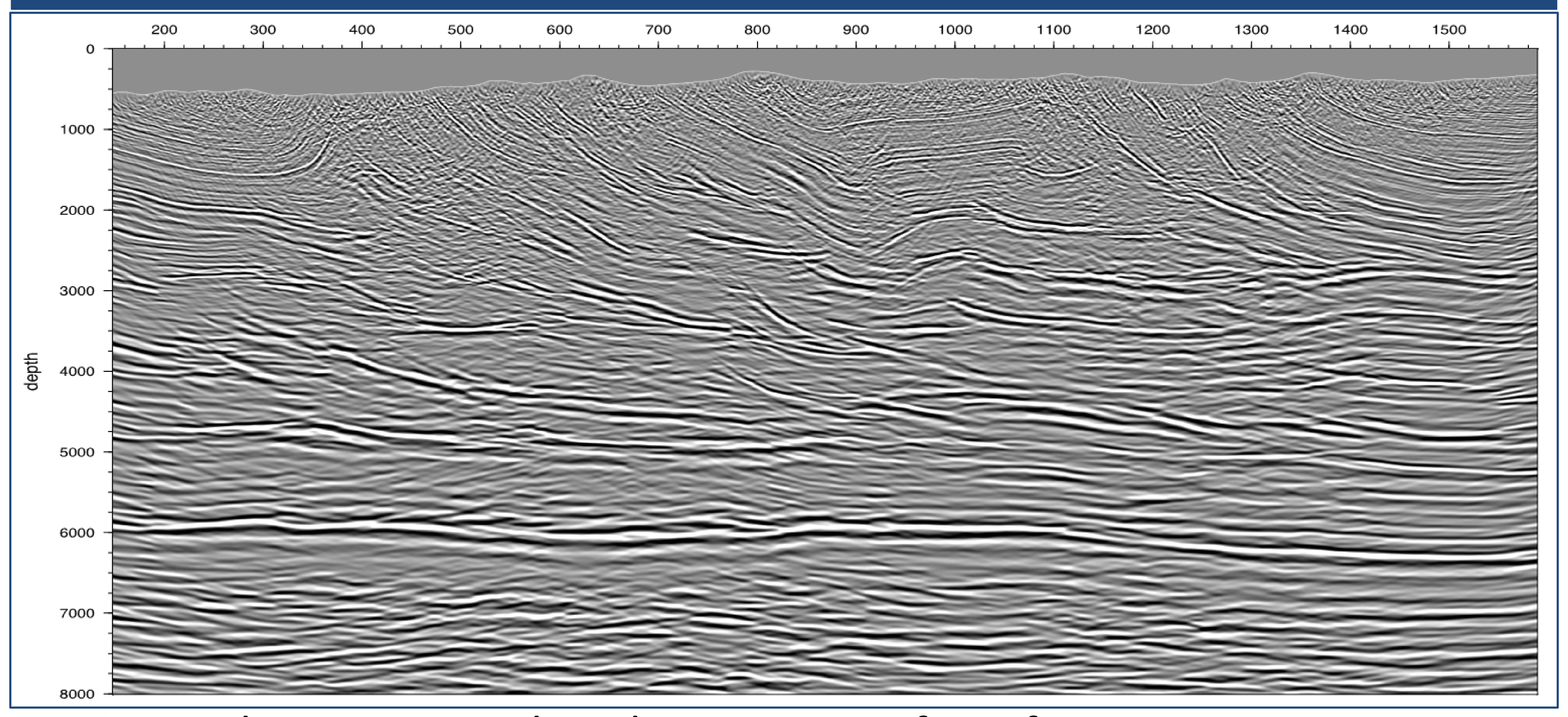

Fig 2. Depth imaging stack with time statics from figure 3.

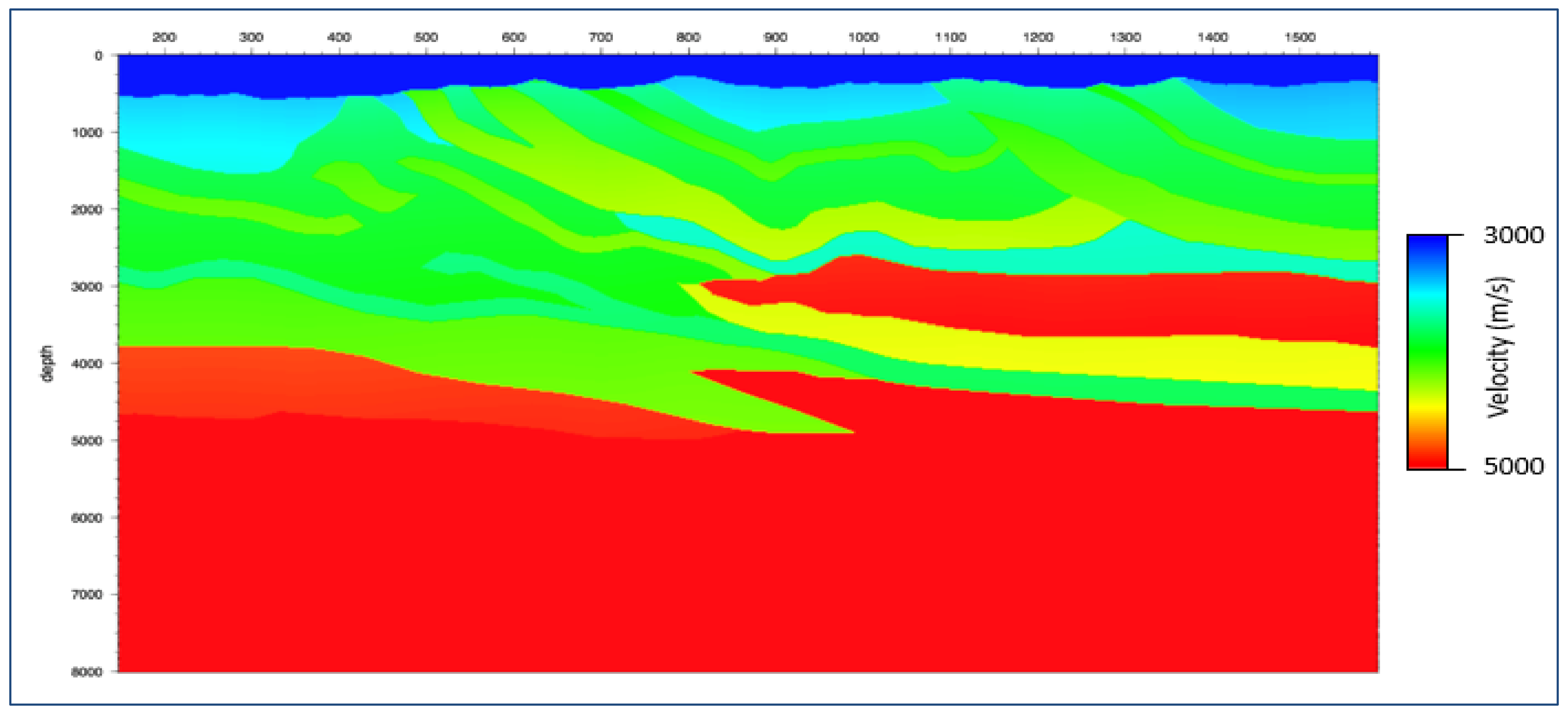

Fig 3. Depth velocity model used to create figure 2 with time statics.

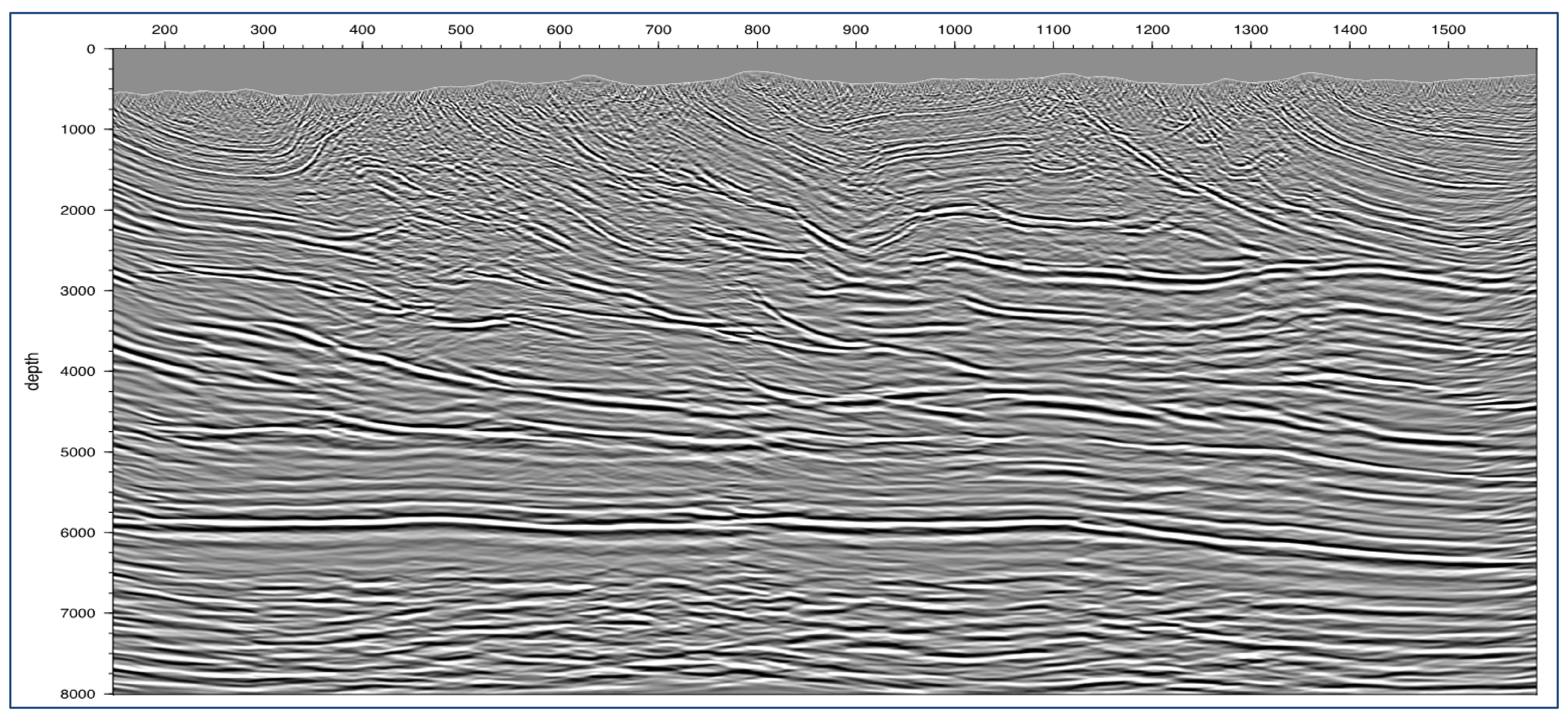

Fig 4. Depth imaging stack with depth statics from figure 5.

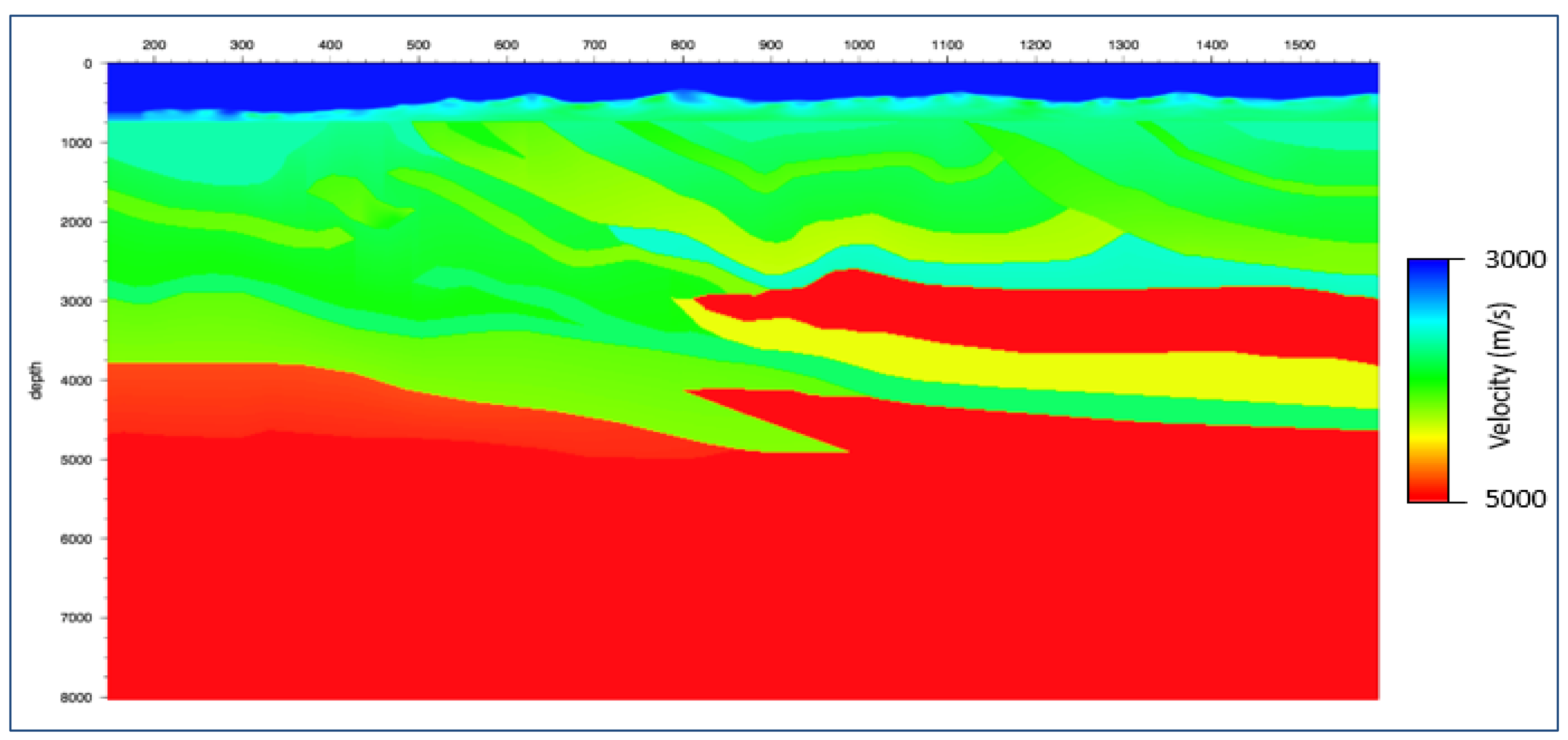

Fig 5. Depth velocity model used to create figure 4 with depth statics.

Near-Surface Comparison

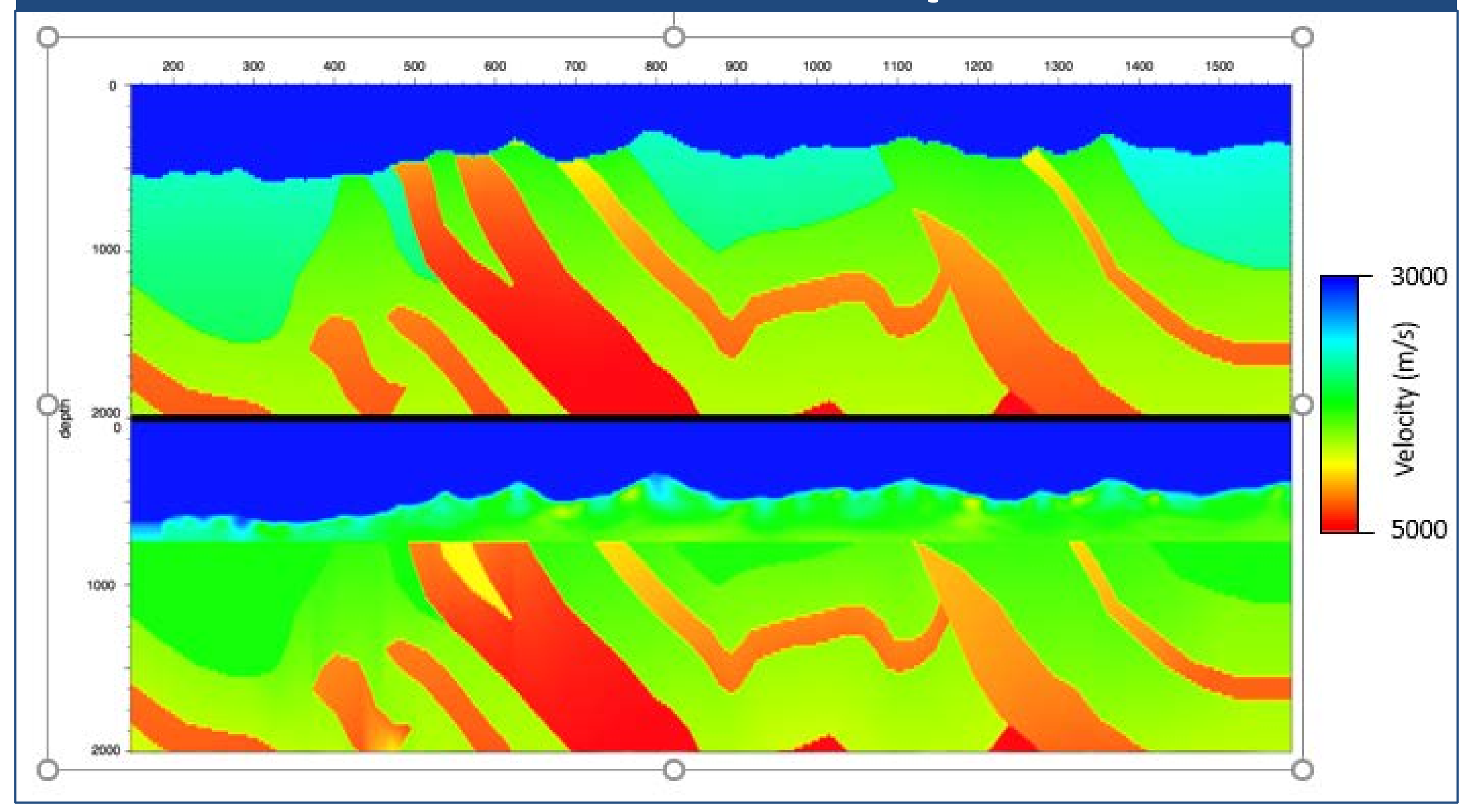

Fig 6. Near surface comparison of the velocity models in figures 3 (top) and 5 (bottom).

Conclusion

In areas of complex geology, the assumption that the moveout is near hyperbolic enough in shape to be represented by the two-term NMO equation for reflection static corrections is inappropriate for depth imaging. Applying a model-based moveout for reflection static corrections is coupled with the depth migration algorithm and provides better static solutions for depth imaging the Husky Structural Dataset. Also removing the refraction static corrections and merging the near-surface tomographic model with the depth velocity model added benefits to the coherency of the depth image. The assumption that near-surface layer has a much lower-velocity than the next layer is not suitable for the geologic complexity of foothills seismic data.

Through replacing static corrections derived for time migration with MMO reflection static corrections and merging the near-surface tomographic model with the depth velocity model the depth image is improved.

Acknowledgments

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