3d Prestack Depth Migration Of Canadian East Coast Data

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ABSTRACT

The basic ideas and theories of 3D Prestack Depth Migration (3D-PSDM) have been established for many years, however its practical use on Canadian East Coast data has been very limited; mainly due to economic reasons. The recent impressive increase of computer calculation power (especially through the use of PC clusters), has dramatically changed the situation and 3D-PSDM is now at the centre of seismic processing.

This paper will present the application of 3D-PSDM on Canadian East Coast data. We will show the significant improvement in imaging obtained using 3D-PSDM by comparing Prestack Time with Prestack Depth migrated data.

Introduction

For most geological/geophysical studies the subsurface and well information are both defined in depth, so it seems natural to think that depth imaging would always be the preferred imaging tool. However, time imaging is not only less costly, but often more robust than depth imaging. Time imaging is based on rms velocities and as a result it is relatively insensitive to small velocity errors. This insensitivity allows the time migration to produce good results in the presence of mild lateral velocity variations. As the velocity field increases in complexity, time imaging introduces unacceptable distortions and depth imaging must be used to correct for these complexities.

The main assumption of time imaging is that the velocity function is locally constant. This assumption limits the time imaging to focusing the energy; it does not correct for the lateral displacements of the seismic reflectors due to the lateral velocity variations. In the presence of strong lateral velocity variations depth imaging not only will focus the energy, but it will also shift the data laterally to the true position. This lateral shift is directly related with interval velocity variations; this means that the larger the lateral velocity variations, the larger the lateral shift and as a result, the bigger the difference between time and depth migrated sections.

Comparison between 3D-PSDM and 3D-PSTM on East Coast Canada data

The presence of salt bodies creates a sharp velocity contrast and by consequent, is a good example to demonstrate the advantage of depth over time imaging. The example that we present below is taken from offshore East Coast Canada.

Before the data was migrated in depth it was processed through a full prestack time migration flow. *Fig. 1a* presents one line after prestack time imaging and *Fig. 1b* shows the same line after prestack depth imaging. The depth migrated section has been converted from depth to time for a direct comparison.

The sections from *Fig. 1* can be divided into three major parts: the tertiary, the salt body and the sub-salt sediments. The tertiary velocities are well behaved with small lateral variations, and as a result, there is negligible difference between the time and the depth sections for the tertiary events. The result is strikingly different when we compare the base of the salt or the sub-salt sediments of *Figs. 1a and 1b*. The depth migrated section provides a greater degree of confidence, over the time migrated section, when interpreting the seismic reflectors. The depth migrated section also appears less complex. This is a result of the reflectors being correctly positioned, which allows a greater understand the geological relations between them.

One of the most important steps of depth imaging is building the correct velocity model to migrate the data. As previously stated, depth migration is very sensitive to velocity variations. Small errors in the velocity model could potentially deteriorate the quality of seismic section. This high degree of sensitivity to velocity errors can serve as a means to QC the velocity model. Moreover, the velocities can be used as interpretation attribute to guide or confirm the interpretation, especially during the picking of the base salts.

During the oral presentation, more examples will be shown illustrating the advantage of PSDM on East Coast Canada data.

Conclusion

The comparison between prestack time and prestack depth migrated sections demonstrates a significant improvement related with depth imaging. This is especially prevalent in the presence of strong lateral velocity variations as seen in the salt contact regions illustrated in *Fig. 1*.

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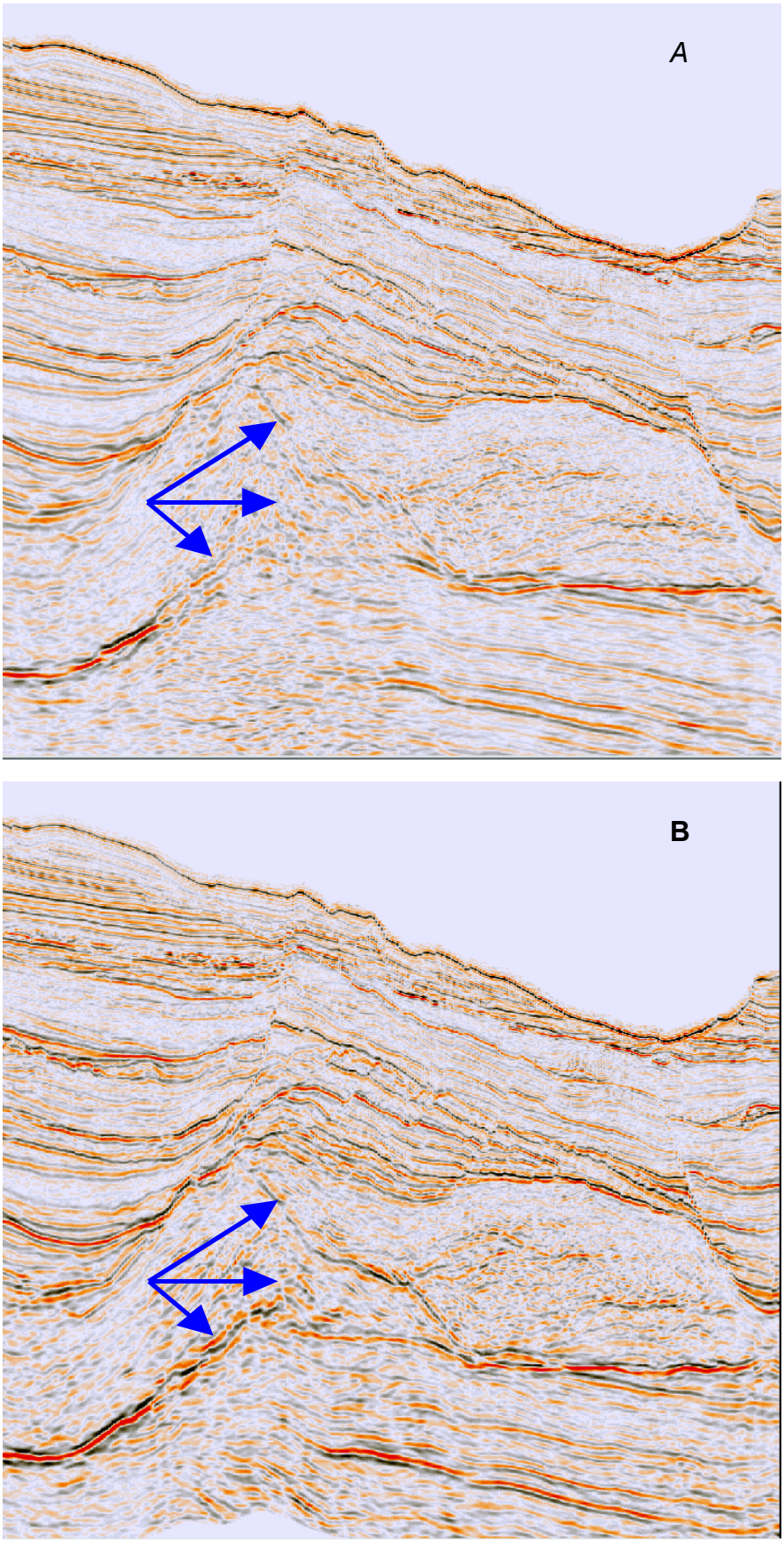

Fig. 1 Time (A) and Depth (B) migrated sections of offshore East Coast Canada Data