East Coast Canada:
So How Difficult Could a 3D PreSDM Be?

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Summary

Two 3D marine projects totaling 1800 km2 were recently processed through 3D SRME (Surface Related Multiple Elimination) and PreSDM to address the raypath distortions and multiples generated by a very rugose waterbottom (Figure 1). The zones of interest were better imaged with respect to the previous PreSTM sequence. The existence of strong lateral velocity variations just below the rugose waterbottom was one of the big challenges for Velocity Model Building (VMB). The R&D department worked closely with us to to meet these challenges.

Introduction

These projects were acquired with new technology in the Atlantic Margin (East Coast Canada). Concurrent with the ongoing original processing (a flow incorporating 2D SRME), a re-processing was initiated to introduce 3D SRME and the latest PreSDM technology. Without the removal of the extremely strong diffracted multiples, it would be difficult to resolve the details needed at VMB stage…

3D PreSDM

To meet deadline commitments, our Velocity Model Building was started using the original, processed gathers while the data was still being processed through the 3D SRME flow. When that final data became available, it was used in the subsequent iterations of the VMB stages. This proved to be a sticking point, since, until the background multiple "noise" was removed, it was a bit difficult to resolve the velocity details (figures 3 and 4).

Initially, a "smooth model"-building approach was chosen (i.e., what's commonly known as global grid tomography). It was quickly decided that a "hybrid" model-building approach should be adopted. This combines the resolution of the global approach with the downward-continuation of the older layered methodology. Here, once the VM was finalized down to the Tertiary boundary, the model was frozen above that boundary, and new tomographic updates addressed the velocities below. This methodology was also used to update everything below the Base Cretaceous.

After each iteration, the data was converted back to time to be compared with the previous result (and previous PreSTM). The road forward was a bit rough. Thanks (!) to the R&D staff who worked diligently with us on this, we were able to achieve quite a nice result. The extreme amount of near surface velocity variation, coupled with the rugose waterbottom, required several modifications to our velocity inversion engine (Figure 2 shows an incomplete update resultant from the early runs).

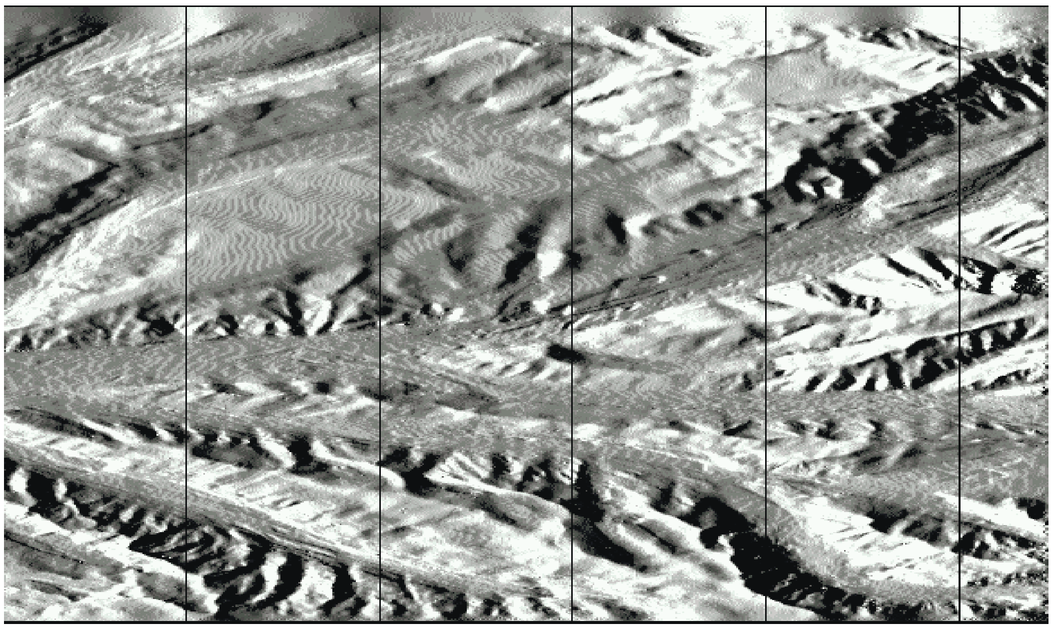

Figure 1. The problem: Waterbottom topography of one of the surveys:
-A very complex surface to try to image through!

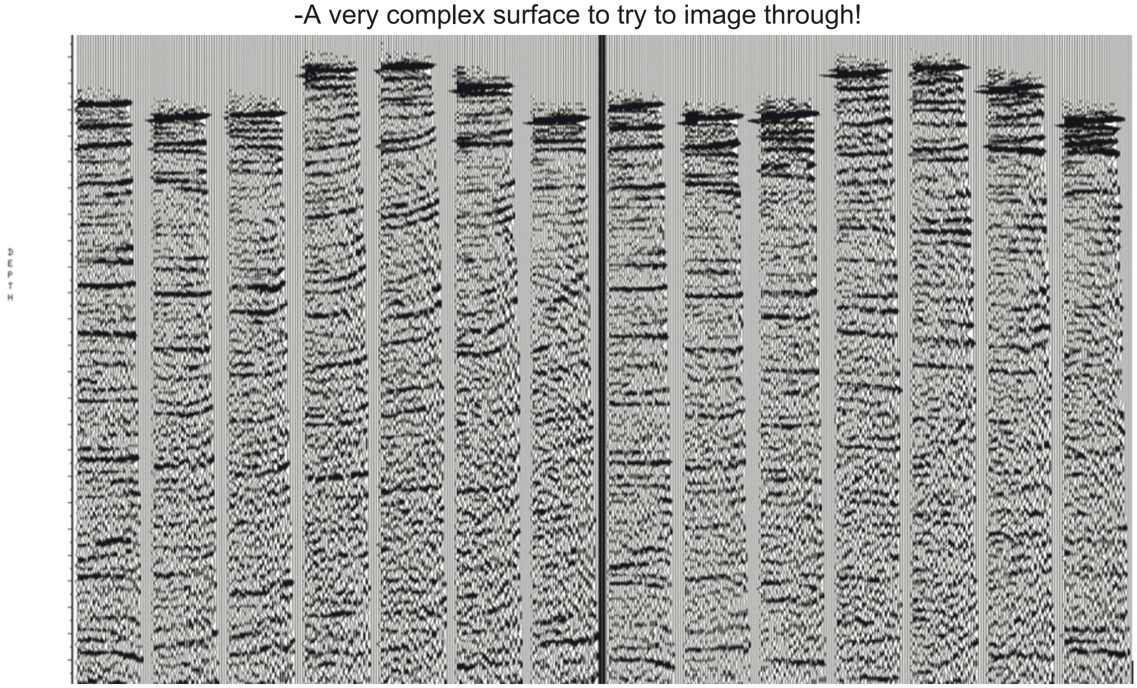

Figure 2. PreSDM Gathers after Iteration-1 (LHS) vs after iteration-2 (RHS)
-Note how quickly the velocities (and the residual moveout) vary across the line.

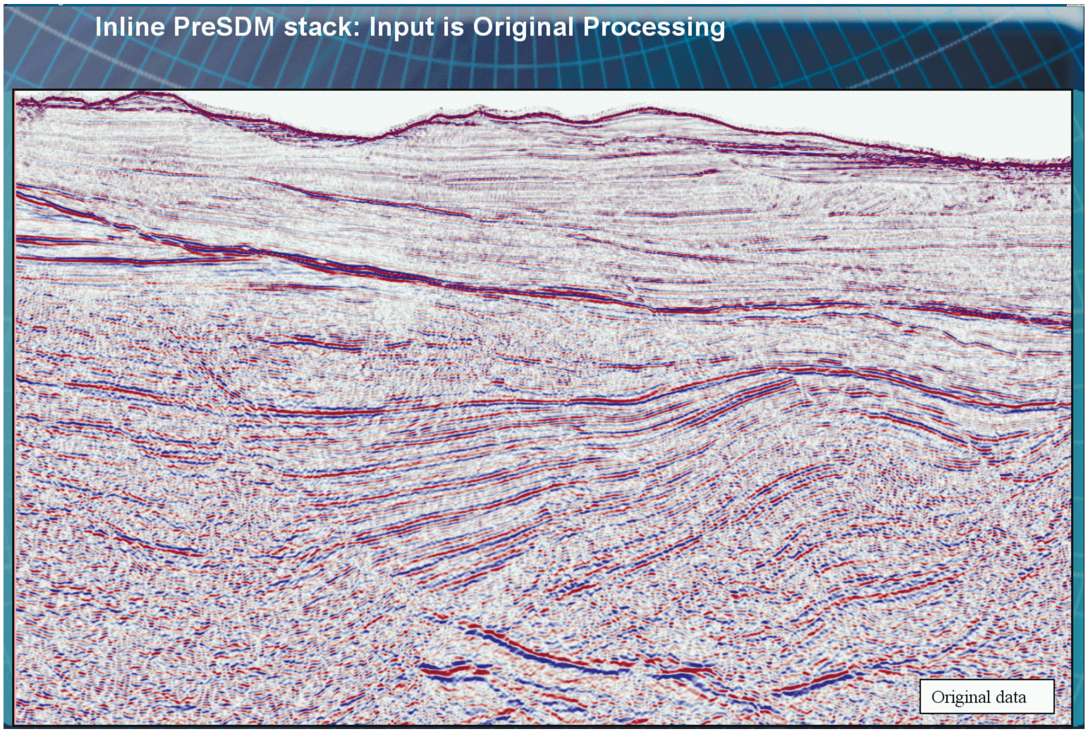

Figure 3. PreSDM using original gathers as input

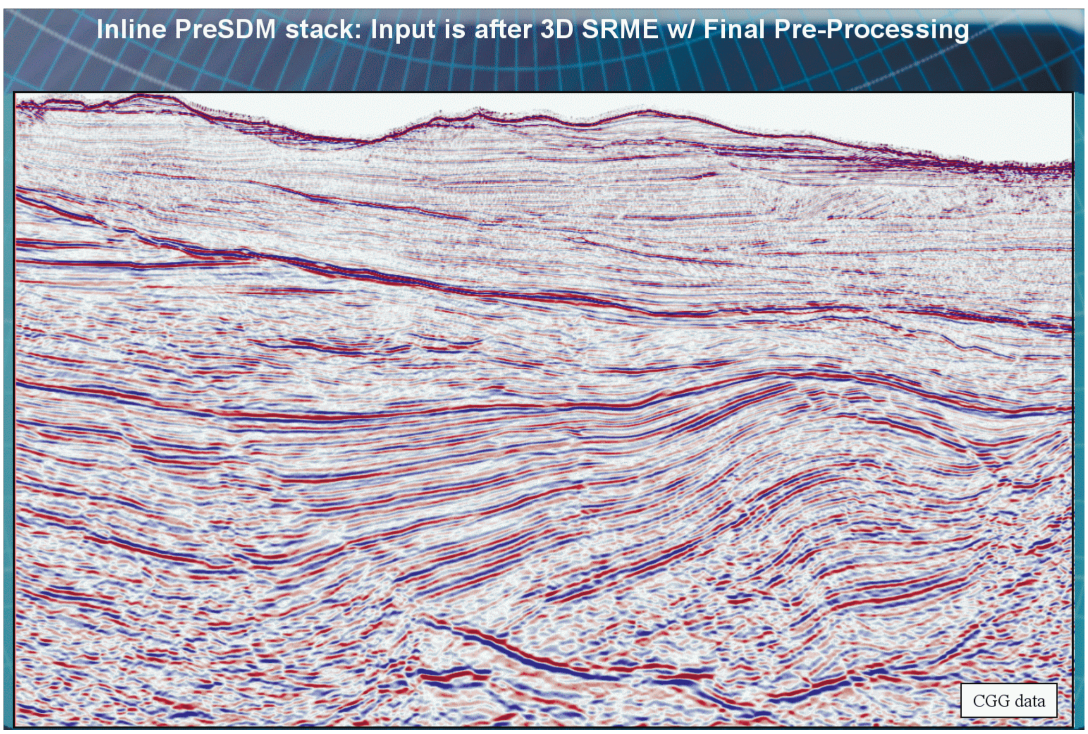

Figure 4. PreSDM using final demultipled gathers as input

Discussions and Conclusions

A rather complicated volume of data was processed successfully from demultiple through PreSDM. A rather new (and machine-intensive) demultiple methodology (3D SRME) was complemented by a new (to Calgary) hybrid PreSDM methodology. –And the extreme velocity variations of the geology required some new updates to our inversion software as well. This required a bit of patience and perseverance from *all* of the people involved with the project.

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