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Effective CRS Workflow for Prestack Data Regridding, Regularization, and Depth Imaging

G. Eisenberg-Klein* (TEEC), H. Trappe (TEEC), H. Endres (TEEC) & J. Pruessmann (TEEC)

SUMMARY

The common-reflection-surface (CRS) technique provides an effective workflow for seismic data preparation and imaging in large areas of regional studies. In a case study from the North Sea, the multi-parameter stacking technique is used to combine and homogenize vintage seismic data in time domain, and to accelerate the model building cycle in depth imaging. CRS time processing may directly start from input data acquired at diverse natural binning grids, and provide the regularisation and interpolation to a uniform output grid in one
step. The regular CRS gathers show an almost complete CMP-offset
coverage and a high signal to-noise ratio, and thus enhance the resolution of prestack migration in time and depth. Depth model building departs from the CRS attributes which provide the initial model via CRS tomography, and benefits in the model update by residual moveout analysis from the enhanced signal-to-noise ratio in the prestack data.

Introduction

Regional studies of geology and lithology based on seismic data usually incorporate various 3D seismic surveys acquired in different acquisition campaigns with different geometries. Preferably, all these seismic data are included in a uniform seismic reprocessing, aiming at uniform prestack data and seamless images for interpretation. The case study presented here describes the reprocessing workflow based on the Common-Reflection-Surface (CRS) method, and applied to seismic data from the North Sea consisting of several different datasets. The CRS method is applied both in the initial task of merging data with different sizes and orientations of the binning grids into one uniform grid, and in the subsequent model building and depth imaging.

The Common-Reflection-Surface (CRS) method is a multi-parameter stacking method which provides so-called CRS wavefield attributes as stacking parameters (Jaeger et al, 2001). These CRS attributes are related to depth, dip and curvature of subsurface reflection elements, and may be inverted into a reliable velocity depth model using a tomographic approach by Duveneck (2004). The CRS method has been applied previously to regularize vintage seismic data (Gierse et al. 2010), and to derive a reliable initial velocity depth model (Gierse et al. 2009) for subsequent prestack depth migration (PreSDM). In the following, an effective CRS workflow combines the prestack data regularisation and attribute generation for model building without requiring previous vintage grid adaptations.

CRS prestack merge and data enhancement

In this case study from the North Sea four 3D seismic datasets from different vintages were combined in a prestack merge. The corresponding CRS workflow did not require any prestack rotation of seismic vintage data but incorporates all prestack data as provided. It was sufficient to define the desired uniform output grid for the CRS data regularisation which then automatically interpolated the CRS gathers at the selected bin locations in CMP and offset. The regularisation and fold balancing is illustrated by the comparison of prestack gathers before and after CRS processing in Figure 1.

The advantage of CRS regularisation and noise suppression in imaging is underlined by Figure 2 comparing prestack time migration (PreSTM) results of a former conventional processing to the CRS based results. CRS processing clearly improved the lateral and vertical resolution, despite the general finding that the initial resolution is generally higher in marine data than in land data.

a) **b)**

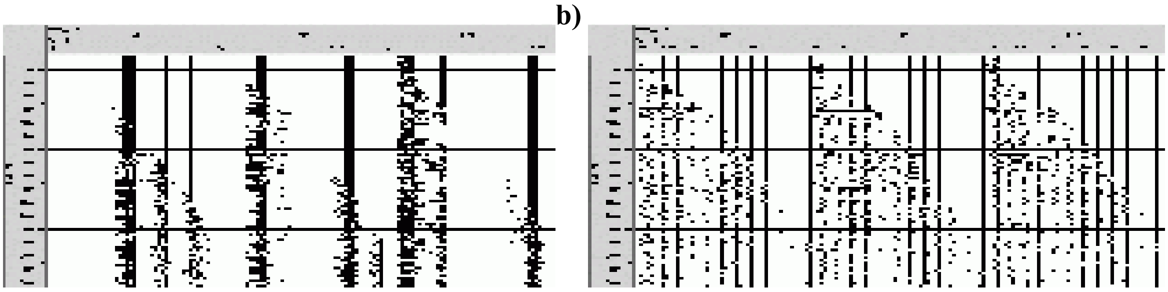

Figure 1 *Prestack gather* ***(a)*** *before and* ***(b)*** *after CRS regularisation and interpolation*

CRS depth model building

The CRS processing supported the whole process of depth model building from the initial to the final model to be used in prestack depth migration. In the first step, the CRS attributes derived as a by-product of the data merge and regularisation were used by the CRS tomography for deriving the initial velocity depth model.

The model update during iterative prestack depth migration then benefited from the improved data quality of the CRS gathers. They ensured a better determination of the residual depth moveout in the depth migrated gathers, and thus enhanced the conversion and accuracy of the model update. The final model and depth migration result are given in figure 3 for a selected inline, together with fold maps of the prestack data before and after CRS regularisation.

a) b)

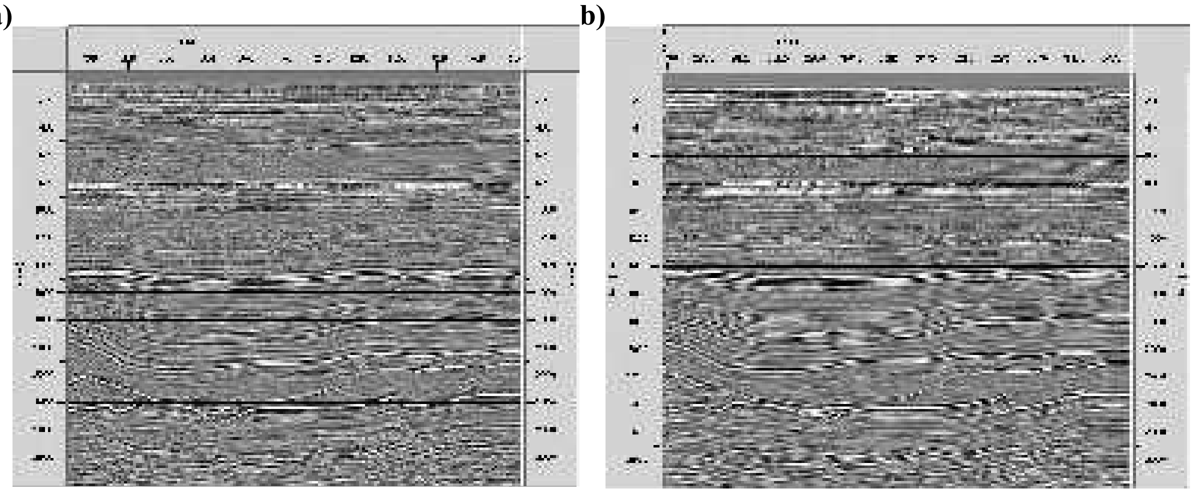

Figure 2 *Comparison of **(a)** PreSTM of former processing, and **(b)** time depth conversion of PreSDM after CRS processing*

Conclusions

In this case study, the CRS technique has proven to be an effective tool for regularizing and interpolating vintage seismic data from various input grids, and to improve the depth model building via CRS tomography and improved prestack signal-to-noise ratio in residual moveout analysis.

a) b)

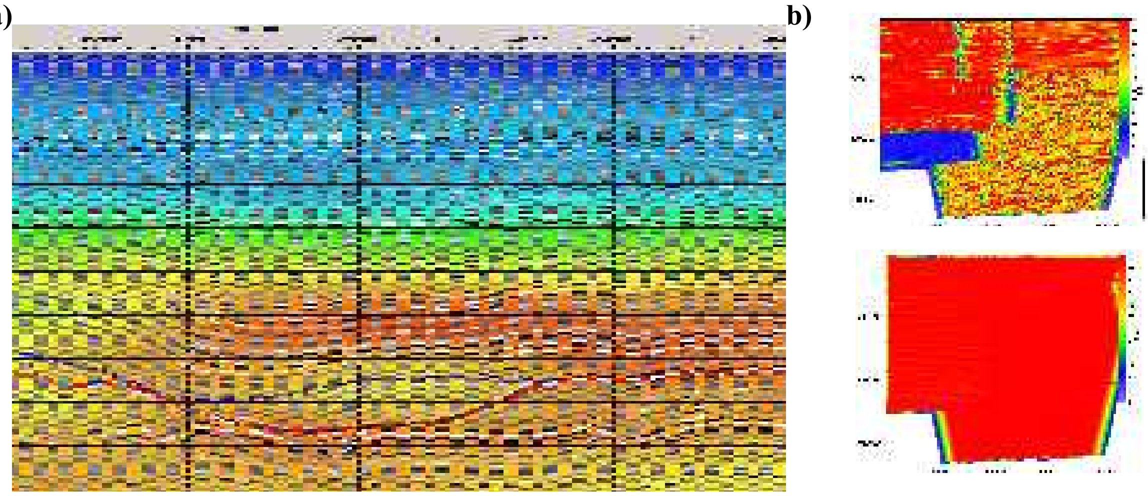

***Figure 3 (a)** PreSDM overlain by velocity depth model derived from CRS tomography (left), and **(b)** prestack fold maps before (right, top), and after (right, bottom) CRS regularisation.*

Acknowledgements

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