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Technologies & Strategies for Merging Multiple Surveys in the Gulf of Suez, Egypt

Ibrahim Mohamed [1], Mohamed Usama [1] , Ibrahim Abdallah [1], Sabry Yehia [1], Doheim Mohamed [1] , Ewida Hatem [2], Ibrahim Yousry [2], Yehia Ashraf [2]. (1) Schlumberger, Egypt. (2) GUPCO, Egypt.

Summary

This paper discusses one of the biggest challenges in the Gulf of Suez in Egypt that is merging multiple surveys prior to migration. A vast area is covered by various surveys that have to be processed and matched to make up for the differences in shooting geometries and other acquisition parameters bearing in mind also that those surveys were shot in different years.

Introduction

The project wasn't problem-free; some obstacles are faced when trying to handle the old media that the data was recorded in, fixing the navigation files, handling large gaps in the area, understanding the interpretation data provided by the client, handling the different noise and multiple levels, Ocean bottom cable (***OBC***) parallel geometry, finding the best processing sequence for each survey individually and finally building the best strategy for matching & merging those surveys.

According to initial data analysis and testing, Geosolutions new technologies were proposed to the client as solutions to the data challenges and a plan was followed to implement Interbed Multiple attenuation (***XIMP***), Multiple model subtraction in ***Curvelet*** domain, regularization of geometry through Matching Pursuit with Fourier Interpolation (***3D-MPFI&5D MPFI***), Curvelet domain residual multiple attenuation and survey matching and merging for 11 surveys (***OBC & Streamer***).

Method

According to the introduction, the following solutions were implemented to overcome all obstacles:

1- Data Initialization:

Through proper QC, we have managed to read in all data and fix the corrupted ones. Also QC that the data is correctly navigation merged.

2- Noise Attenuation:

A lot of noise attenuation were applied to the data due to the heavy noise contaminating the data due to Gulf nature.

3- Multiple attenuation

a. Modelling

This step of processing is the most important part of the sequence especially in gulf data, as the geology of the gulf is very complex, with acquisition limitation makes it a bit challenging to us to remove several types.

Surface multiple were removed by 3D GSMP in addition to water bottom multiples were removed using DWD.

Interbed multiple was the biggest challenge in this step as it was interfering with the data itself, so we proposed ***XIMP*** as a new technology to attenuate interbed multiples

b. Subtraction

This is the most challenging part in the multiple attenuation step as the multiples are interfering with the primaries, so we should give a great care to such thing, we overcome this by doing subtraction in ***Curvelet domain,*** which allows us to better separation and attacking the multiple energy only.

4- Survey Matching & Merging

As we mentioned in the beginning that this project consists of 11 surveys, all are different in everything (Acquisition geometry, acquisition parameters …etc.), So we have to match them in both amplitude and phase to be able to get one cube covering the whole surveys area which will help in imaging step to have a better imaged cube instead of image of each survey alone.

5- Regularization of geometry

Due to large gaps exist in the data due to missing data or due to rigs in this area, also due to differences between surveys and each other, we have to run regularization to the data to correct for this gaps and to compensate for this data differences. For doing this GS used its new technology known as Matching Pursuit with Fourier Interpolation **MPFI** (3D MPFI for NAZ data & 5D MPFI for WAZ data like OBC).

Results

Finally after all the previous flow, we can get the added value from all these technologies and work flows through enhanced noise and multiple attenuation, better image for one merged matched cube instead of having smaller cubes to be merged after imaging and the ultimate goal was achieved by having a volume covering the whole prospect ready for interpretation.

All these efforts were exerted so that we can have all these surveys matched with the maximum data quality to end with one huge cube that fits for interpretation purposes. Also made the data very well-conditioned for the depth imaging step.

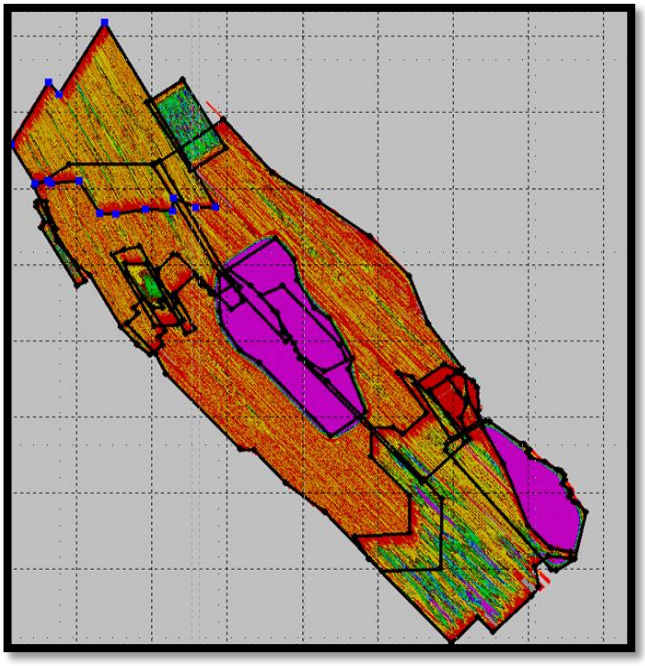

Figure 1: Fold Map for 11 surveys (Streamer & OBC)

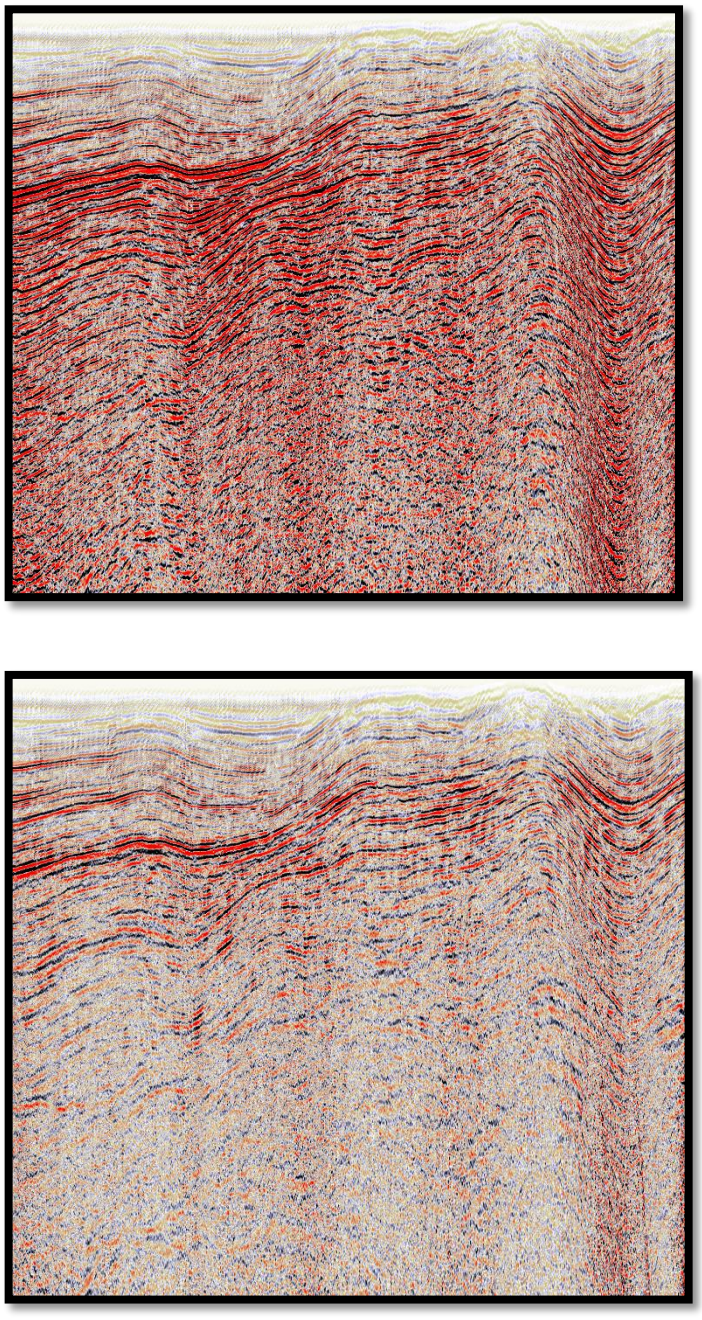

Figure 2: Stack before XIMP (top), Stack after XIMP (bottom)

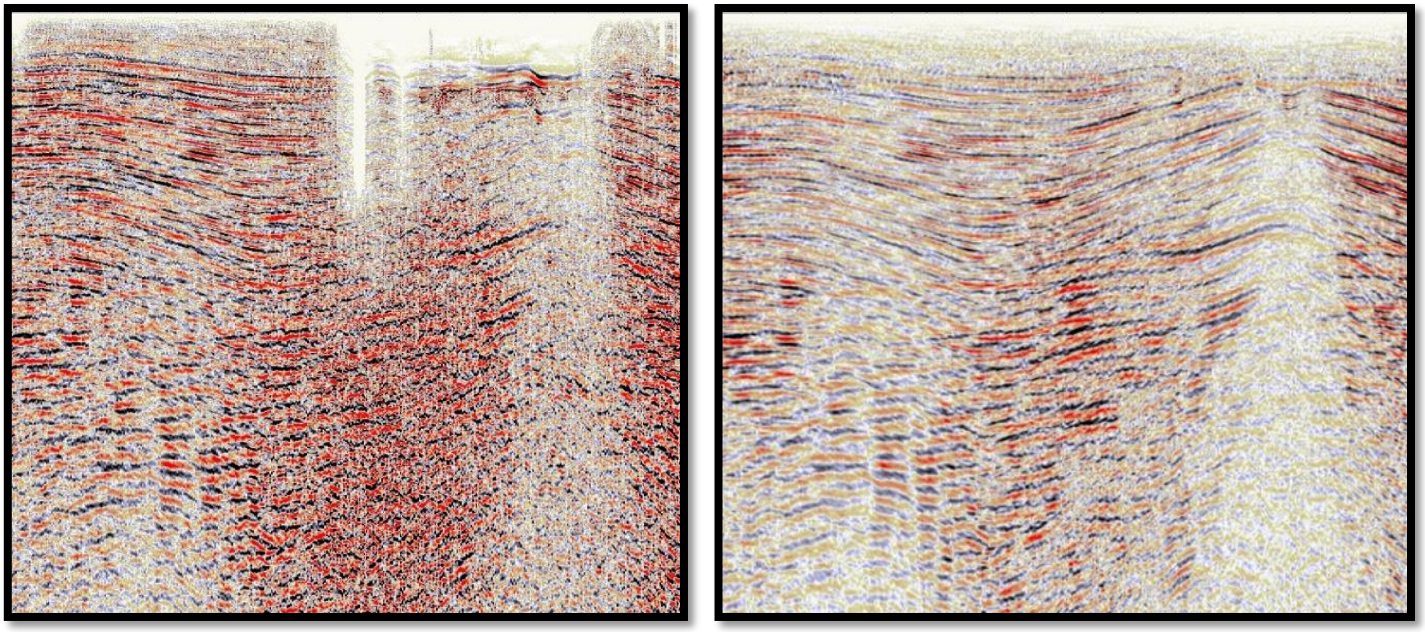

Figure 3: Stack before 5D MPFI (Left) and after 5D MPFI (Right)

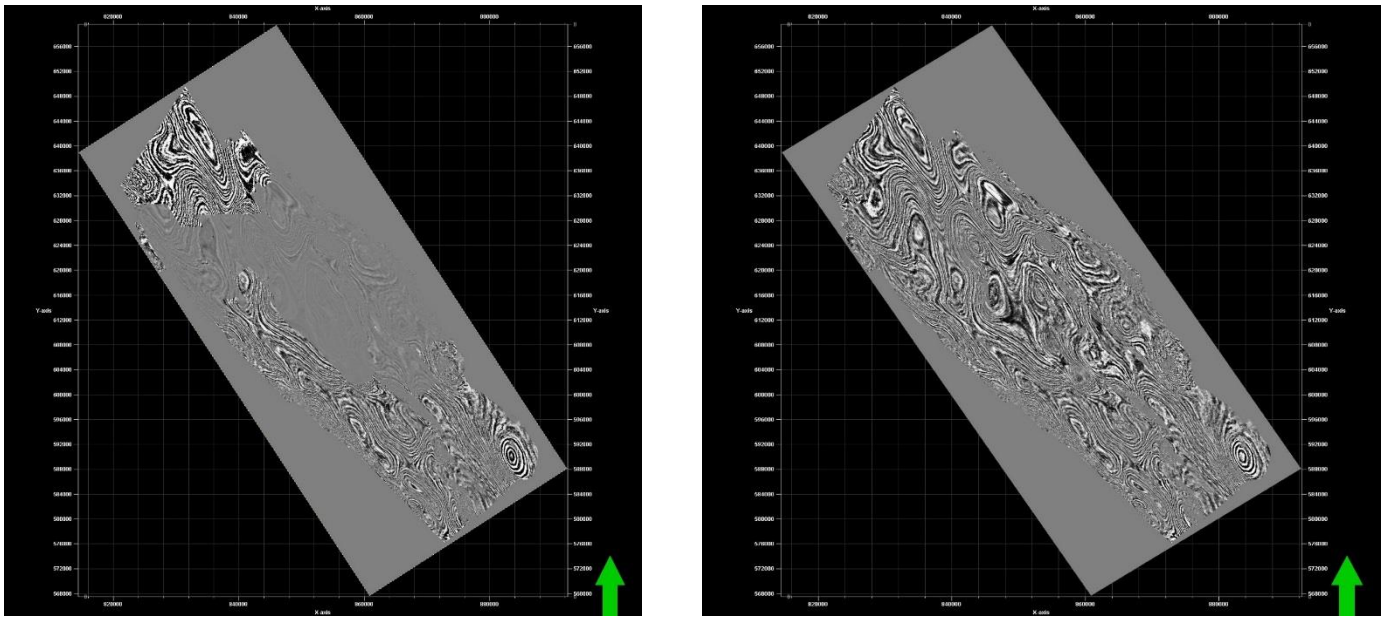

Figure 4: Time slice before survey match (Left) and after survey match (Right)

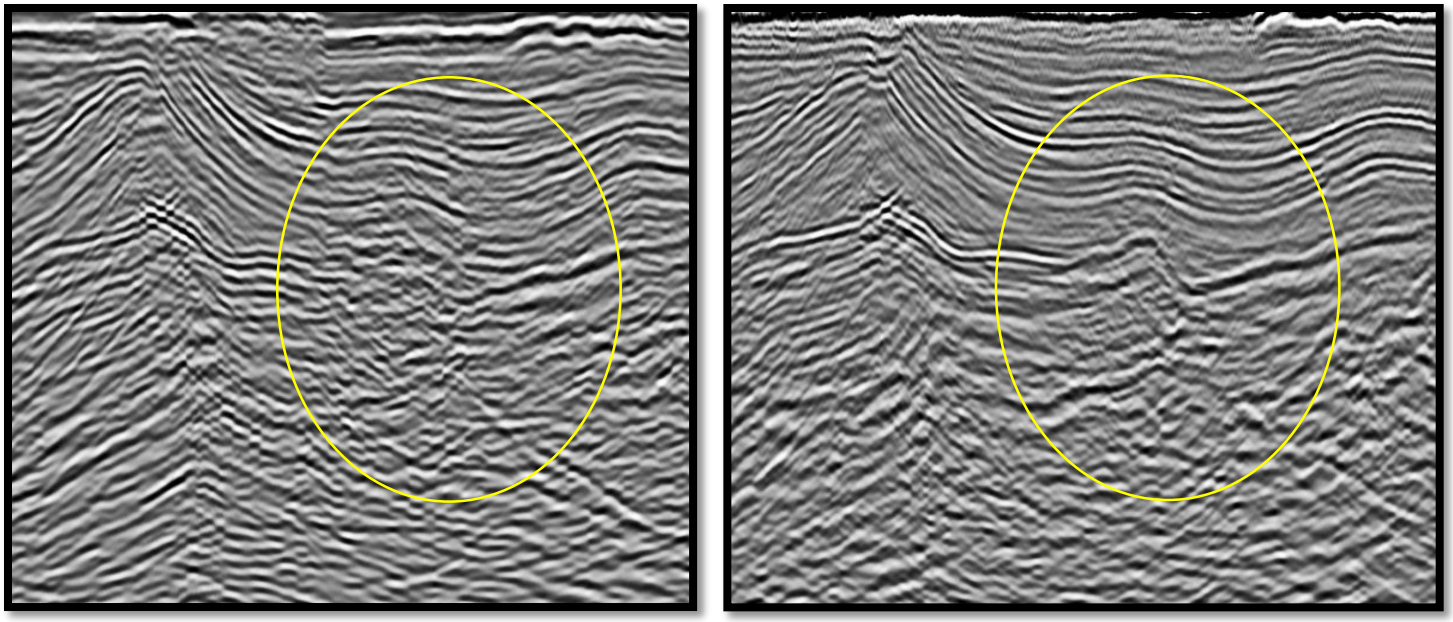

Figure 5: Comparison between Legacy (Left) and KPSTM Re-processing (Right)

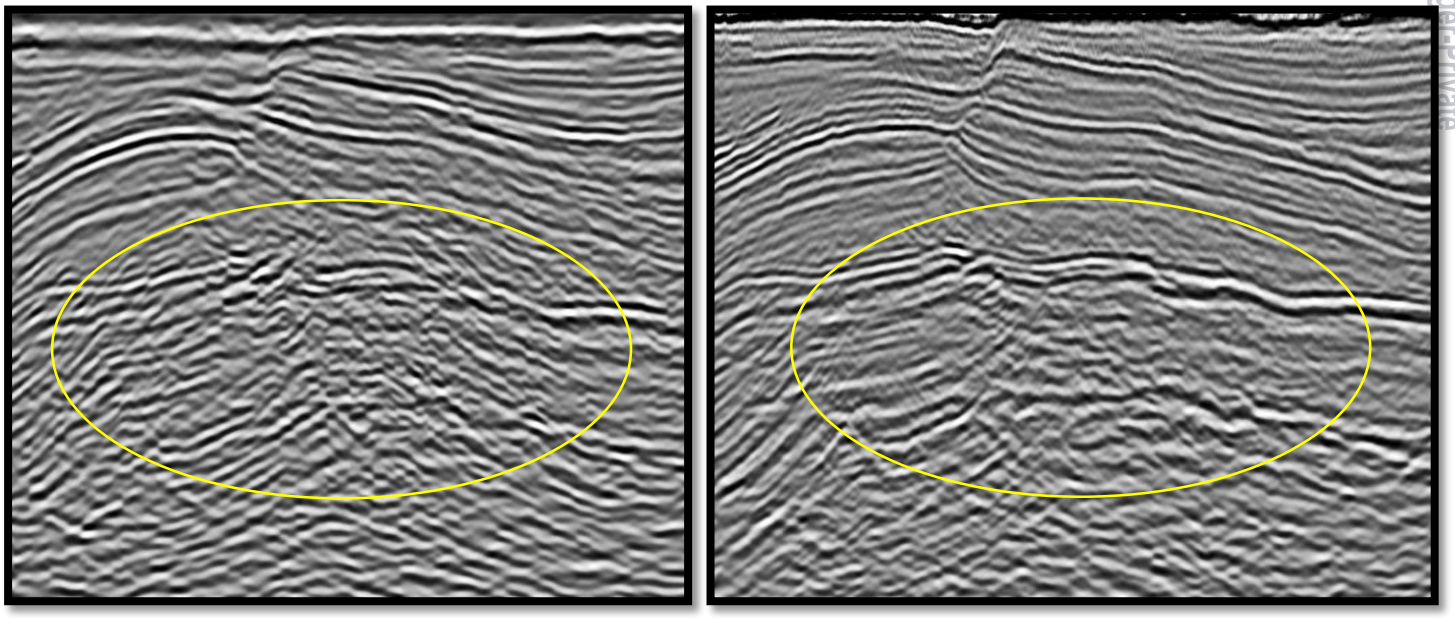

Figure 6: Comparison between Legacy (Left) and KPSTM Re-processing (Right)

Conclusion

The implementation of this new technology & workflow has shown significant improvement over the legacy volume, increasing interpretability. Also the data became more ready for depth imaging stage.

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