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Objective Oriented Reprocessing of 3D data - A Case Study of Cambay Basin

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Summary

The 3D seismic data pertaining to study area located in Cambay-Tarapur tectonic block of Cambay basin. Reprocessing was taken up for object oriented processing for bringing out improved image of subsurface, so that further studies could be carried out for the delineation of middle pay sands of Eocene and Olpad reservoirs. To validate our processing results we have carried out attributes analysis on both the datasets and it was observed that the reprocessed data shows appreciable improvement in term of continuity and resolution of the subsurface features.

Introduction

The area is geographically located in Khambat taluka district Anand, Gujarat. The seismic data was acquired during the year 2011-12 was of good quality. The reprocessing was carried out with an objective to get a better image of the subsurface features, so that the data can be used for AVO and Inversion studies.

General Geology and Stratigraphy

The study area falls in south western rising flanks of Tarapur depression **Fig-1.** A number of other oil and gas fields, viz. Dholka, Cambay, Mahi and Kathana are located on the periclinal part of the rising flank of Tarapur depression. The producing pays in rising flanks of Tarapur depression are Dholka Lower(DLP) & Middle pays (DMP), EP-IV, EP-I, EP-II, OS-II and Miocene Basal Sand (MBS).

The Cambay-Tarapur block is well differentiated at Trap Level into a number of horsts and grabens. The study area, Akholjuni, is a paleo high. The Olpad formation lies over the Deccan Trap and consists of mostly Trap derivatives and deposited from the basin margin. Older and Younger Cambay Shale can be differentiated in this area by the presence of Neck Marker. EP-I and EP-II are in Tarapur formation. Electro log correlation show that EP-II and EPIV units are present throughout the area. Commercial hydrocarbons are being produced from MBS formation in Akhlojuni field.

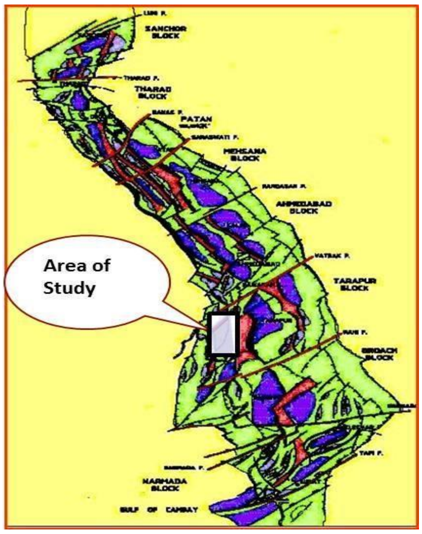

Fig 1: Tectonic map of the Cambay Basin showing study area

Stratigraphy of the area

In the present field hydrocarbon accumulations are mainly contained in MBS Pay developed in the basal part of Babaguru formation. EP-II pay is also oil bearing in few wells, whereas EP-III and EP-IV have given only oil indication in few wells drilled in this field. Thick oil shows / indications have also been observed in Olpad and Trap intervals. MBS sand is considered to be deposited by

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meandering distributary channels. These sands were often reworked by tides.

Eocene pays in this area consist of fine grained sands and siltstones deposited in low energy shelf environment. Olpad formation consists of trap derived clastics representing coalesced alluvial fans for which source material was provided by longitudinal asymmetric horst blocks. Hydrocarbon entrapment in all the pay sands in this area is strati-structural.

Data Acquisition

The seismic survey is employed using the common depth point method and used asymmetrical split spread geometry as shown in base map figure 2. Each shot gather record is composed of 180 channels with 250m shot line interval, 250m receiver line interval and with a number of 12 receiver lines. The field parameters were finally decided with the shot interval of 25m and group interval of 25m is opted. The above configuration results into 54 fold coverage as shown in figure 3. The I/O system-IV (Scorpion) was employed with a sample rate 2msec, record length 7Sec.

Data Processing

In the present study, the processing sequence was used to fulfill the objective of reprocessing.

Processing flow:

Processing sequence

- Format Conversion
- Geometry Merging
- Geometrical Spreading Correction
- Pre-filter
- Denoise
- Surface Consistent Amplitude Correction
- Surface Consistent Deconvolution
- Decon Velocity Analysis
- 3D Residual Statics – Two Pass
- Residual Velocity Analysis Two Pass
- PreSTM on Target Lines
- Migration Velocity Analysis
- Final PreSTM
- Post stack processing

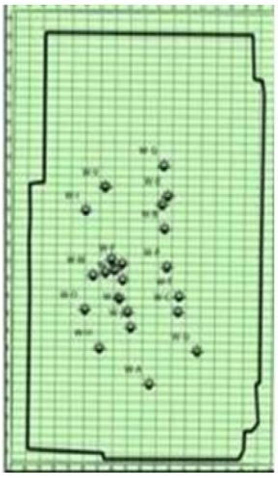

Fig 2: Base map

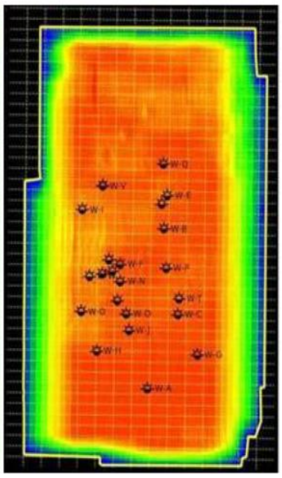

Fig 3: Fold map

The main steps followed in reprocessing the data are listed as below:

- Denoise of data was done by using different noise attenuation techniques for removal of spikes using auto editing, removal of ground roll, high-burst noise, linear noise as shown in **Fig-4** to **Fig-8**.
- Different tests were done for geometrical spreading correction; finally T 2 scaling was applied on the data to fulfill the AVO criteria.
- Different tests were carried out with different parameters for Surface consistent amplitude scaling; Deconvolution, Surface consistent residual statics and optimum parameters were opted finally.
- Two pass closed grid (200mx200m) residual velocity analysis was done and residual stack time slice was shown in **Fig-8**.
- Migration velocity analysis was done on target lines in a close grid (200mx200m). Iterative refinement of the velocity field was done to get final velocity field calibrated with the VSP velocities.
- Different tests were carried out for finalization of migration aperture and the optimum aperture along with final velocity field were used for final run of Prestack migration using Kirchhoff's principle.
- In post stack processing, random noise attenuation was also done for bring standout of reflection events clearly and the results of the reprocessed migrated volume are shown in **Fig-9** to **Fig-12**.

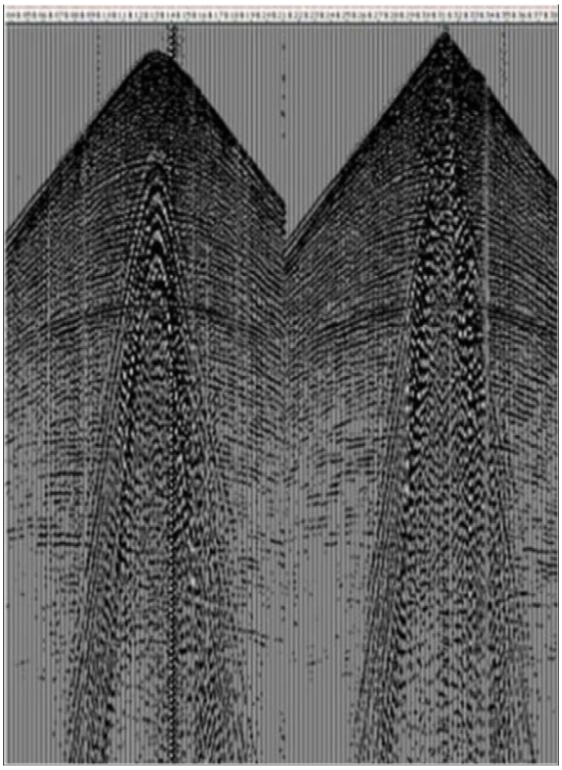

Fig 4: Raw record

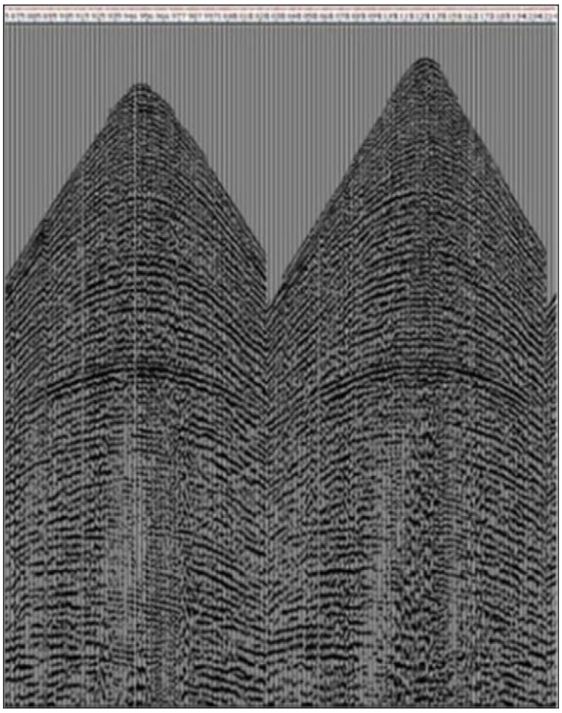

Fig 5: Denoise record

Efforts taken during reprocessing

- We have stressed more during preprocessing to eliminating different types of noise primary ground rolls in raw records. The Fig-4 and Fig-5 clearly shows the quality of denoise record.
- At each step of processing we generated time slices i.e. from brute stack, denoise stack and residual stack volume to see the stepwise improvement in data, as shown from Fig-6 and Fig-8.
- Imaging quality of reprocessed data shown from Fig-9 to Fig-12 clearly shows much better continuity, standout of events, fault plane resolution and subsurface structural delineation has been brought in much better way.
- More emphasis was laid in velocity model building and refinement during all pass i.e. from decon to final migration velocities, since velocity plays crucial role in imaging subsurface features.

Fig 6: Time Slice (Brute stack)

Fig 7: Time slice (Denoise stack)

Fig 8: Time Slice (Residual stack)

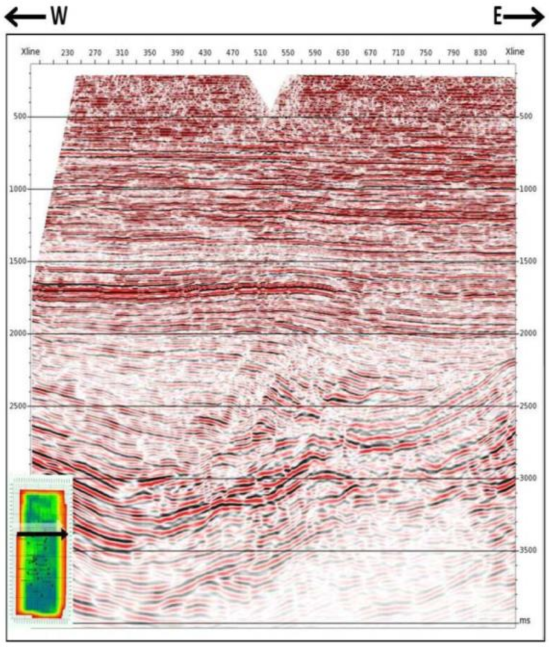

Fig 9: Reprocessed PreSTM stack Inline-AA

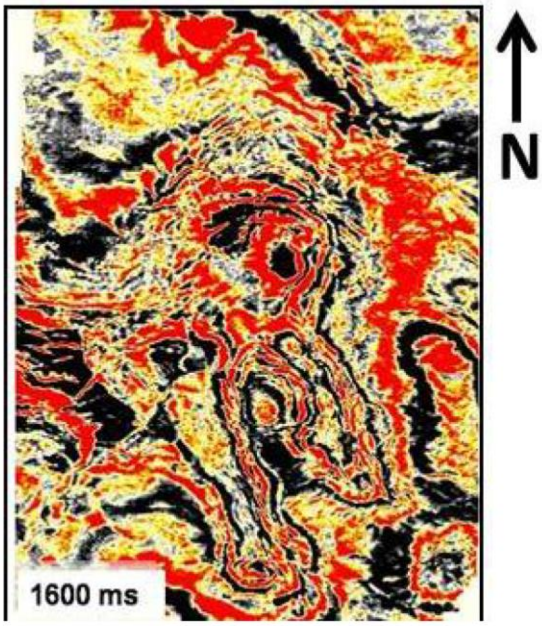

Fig 11: Time slice (Reprocessed PreSTM stack)

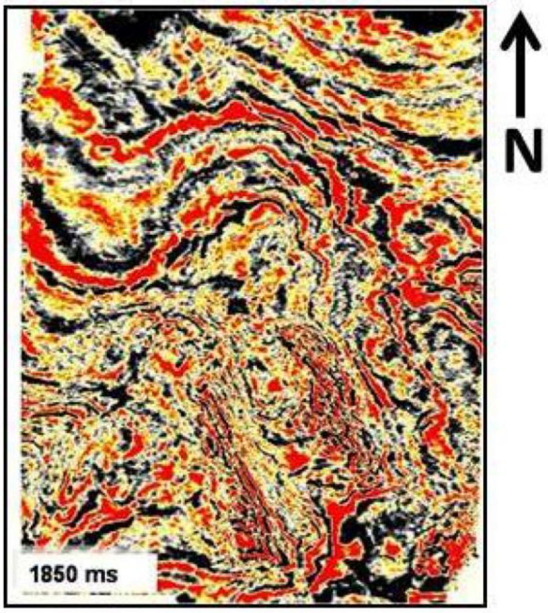

Fig 12: Time slice (Reprocessed PreSTM stack)

Comparison of earlier and reprocessed data

Results of reprocessed PreSTM stack data shows remarkable improvement in image quality and comparison of earlier and reprocessed data along few inline, xline and time slices are shown in Fig-13 to Fig-18.

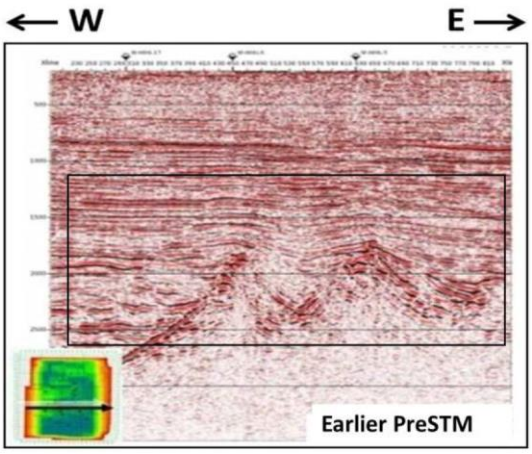

Fig 13: Earlier PreSTM stack Inline-CC

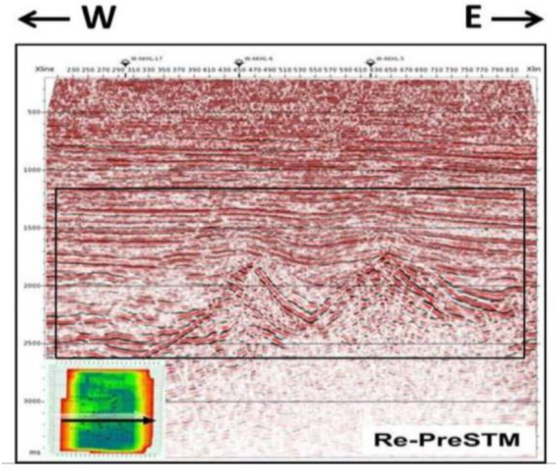

Fig 14: Reprocessed PreSTM Stack Inline-CC

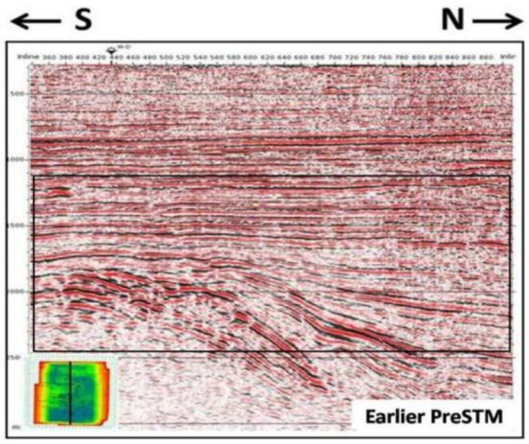

Fig 15: Earlier PreSTM stack Xline-DD

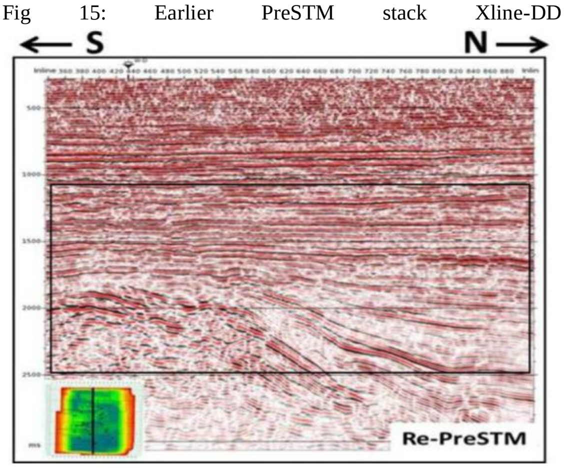

Fig 16: Reprocessed PreSTM stack Xline-DD

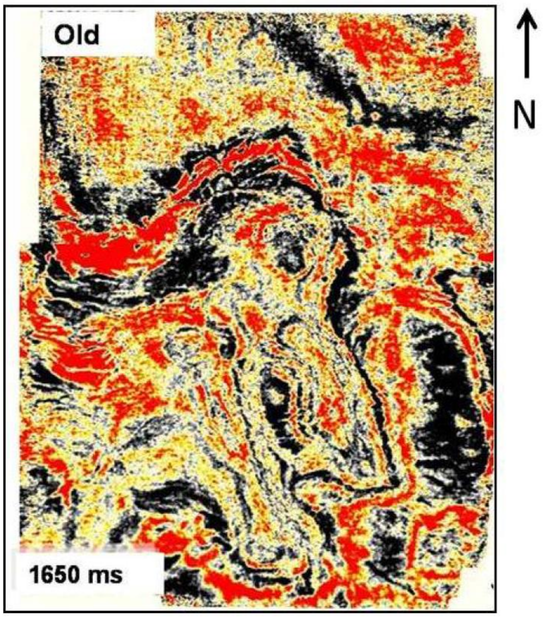

Fig 17: Time slice (Earlier PreSTM)

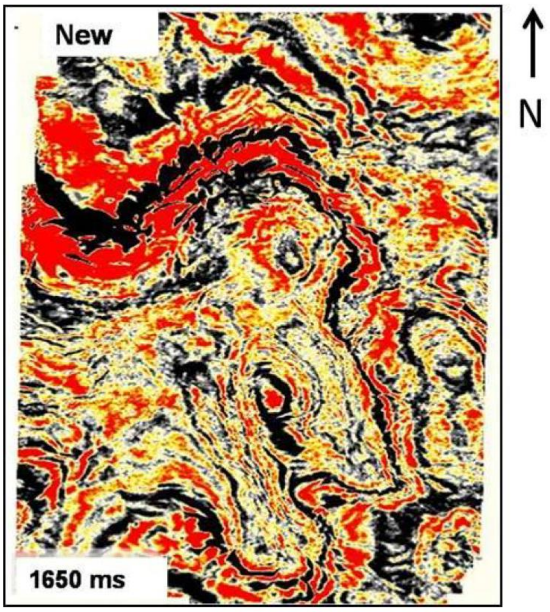

Fig 18: Time slice (Reprocessed PreSTM)

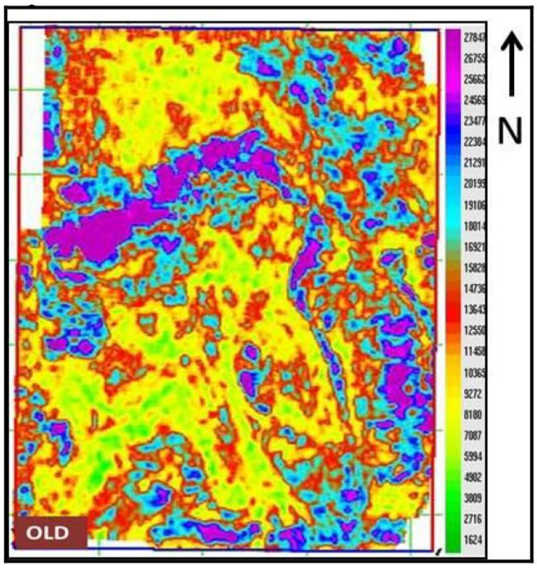

Fig 19: Amplitude envelope (Earlier PreSTM)

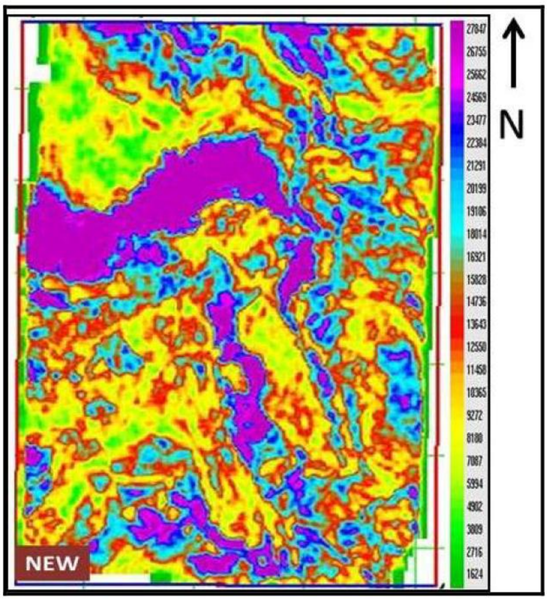

Fig 20: Amplitude envelope (Reprocessed PreSTM)

Attribute analysis on reprocessed data

In the present study seismic attribute analysis was also carried out on the reprocessed data for validating the final outputs.

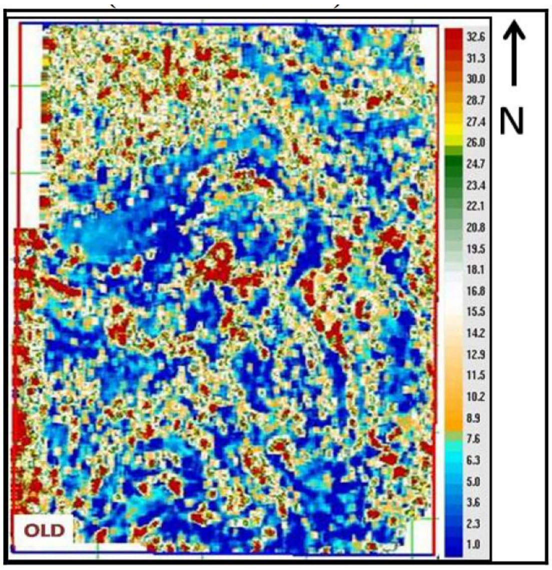

Fig 21: Instantaneous frequency (Earlier PreSTM)

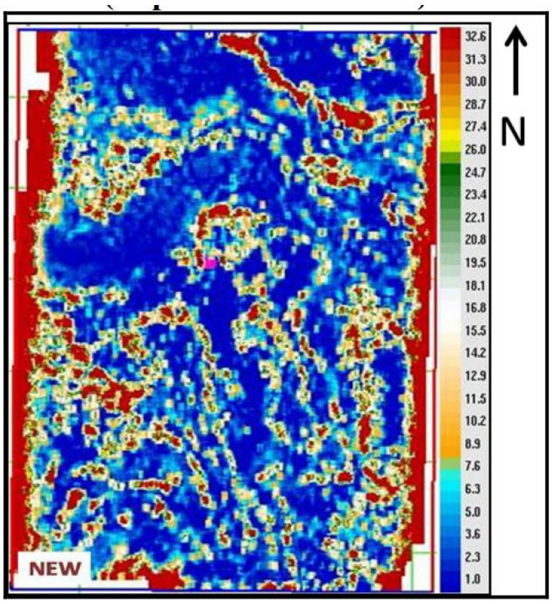

Fig 22: Instantaneous frequency (Reprocessed PreSTM)

The main objectives of the attribute study are to provide accurate and detailed information to the interpreter on structural, stratigraphic and lithological parameters of the seismic prospect.

Comparison of the attributes analysis carried out on earlier and reprocessed PreSTM volumes are shown here. The different attributes volumes were generated i.e. amplitude envelope, instantaneous frequency and instantaneous phase. From these volumes time slices at

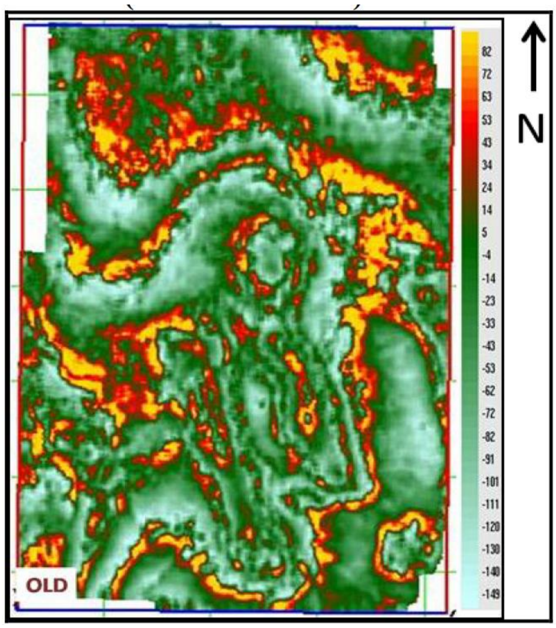

Fig 23: Instantaneous Phase (Earlier PreSTM)

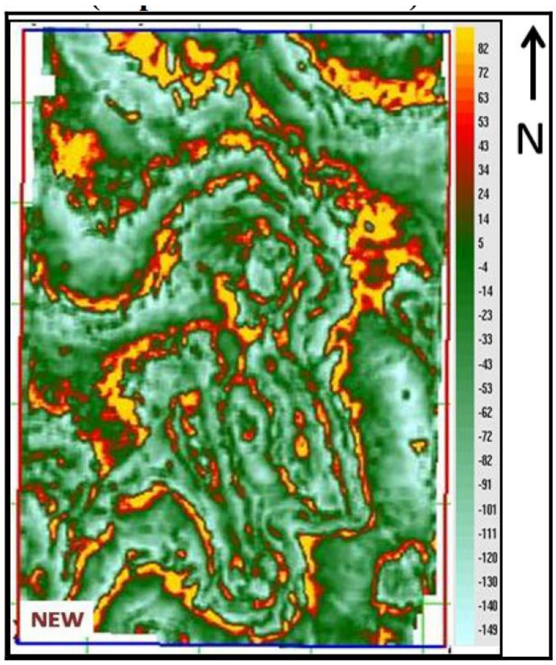

Fig 24: Instantaneous Phase (Reprocessed PreSTM)

a 1650ms time level were produced as shown in the **Fig-19** to **Fig-24** clearly shows that the slices of reflection strength, instantaneous phase, instantaneous frequency of reprocessed attributes volumes contain the more geological information and these could be helped to detect the reservoir anomaly

Conclusions

The reprocessing was carried out mainly for AVO Inversion studies, so we have laid emphasis more during pre- processing stages for attenuating different noises and secondly we have also stressed more on velocity analysis, since velocity analysis plays a vital role in imaging the subsurface features.

To validate our results, attribute analysis carried on reprocessed volume shows a much better picture of the subsurface as compared on earlier data.

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References

Unpublished reports of ONGC on 3D Survey under SIG 490, 2011-12.

Unpublished internal reports of ONGC.

O Z Yilmaz. Seismic Data Analysis,

JACK BOUSKA, Double vision for interpreters: Case histories showing the value of dual processing for 3-D surveys-Leading Edge.

N.B: The views expressed in the paper are solely of the authors and not necessarily of the organization in which they are working.