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Sub -Basalt Imaging - A Processing Effort

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Summary

A few profiles from Kerala Konkan (KK) Basin have been processed,where the sedimentary section is overlain by Basalts and a model based approach to analyse long offset data has proved that the image of sub basalt targets can be improved with the use of reflections contained in the wide angle wave field. The comparison has also been made with the vintage data. The thrust of the processing had been to make the imaging helpful for understanding the structural disposition of the area in the Kerala-Konkan Basin of India.

Keywords*: Kerala Konkan Basin, Long offset, Velocity model, Multiple Attenuation, Pre-stack Time Migration*

Introduction

The Evolution of western margin in general and Kerala Konkan basin in particular relates to continental break-up of Western Gondwana land and Madagascar plate. During Late Triassic/Jurassic period and subsequent rifting during Cretaceous to Paleocene time within which the Basin witnessed widespread volcanic episodes. Thus the Basalt covers the large area of sedimentary sequence of a very high hydrocarbon potential and more or less remains unexplored. The main reason remains, understanding the architecture of the Basin due to poor imaging below Basalt. An attempt has been made to improve imaging by addressing the problems through specialized work flow.

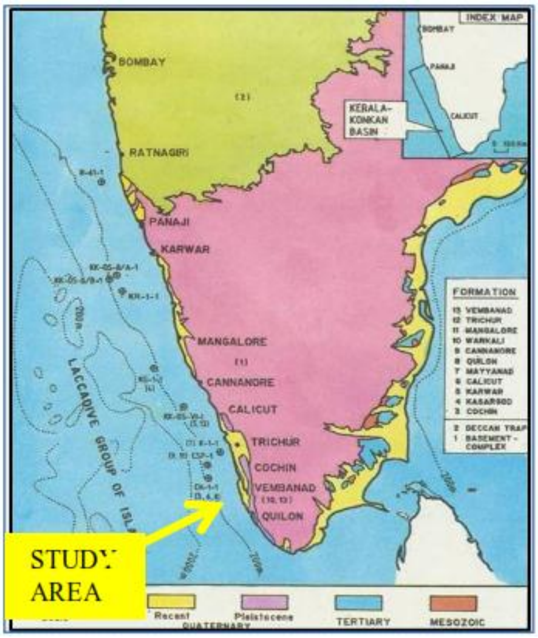

Figure 1: Kerala Konkan Basin

Geological setup

Kerala-Konkan offshore Basin forms the southern part of the western continental margin of India and extends from Goa in the north to Cape Comorin in the south (Figure 1). It is bounded in the east by Peninsular India. Westward it extends to Arabian Abyssal plain. The

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Basin developed series of linear rifts majority of which are aligned in NNW- SSE direction. Early rift and post rift phases contain more than 5 km of Cretaceous to Recent sediments. Post-rift mature sediments with sufficient organic carbon content are present in the Basin. Drilling results and adsorbed gas anomalies confirm generation of hydrocarbons in a well approximately 70 kms away from the study area in the Basin. The tectonic element of the Basin is shown in Figure 2

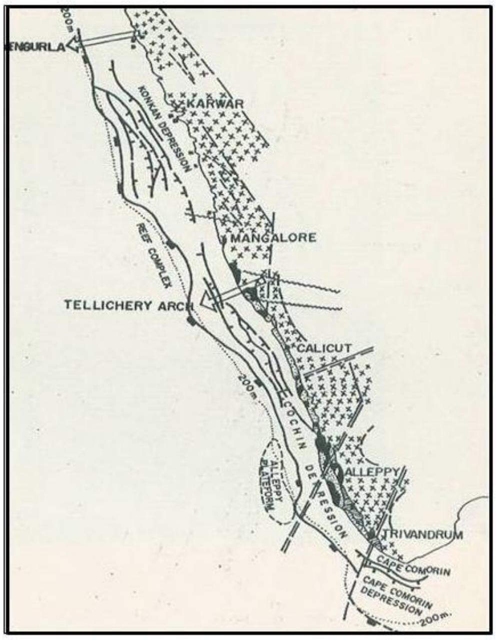

Figure 2: Tectonic Set-up

The deposition started with continental environment, changed gradually to paralic and finally to pulsating marine conditions, punctuated by basic lava flows (Deccan Trap) in the terminal stages towards the end of Cretaceous and Early Paleocene. Towards the end of the early rift phase, most of the rift related grabens and horsts, located in the deeper parts were covered up with sediments and the continental margin became less intricately differentiated.

During Late Cretaceous to Paleocene, the Basin experienced the marine transgression during which sandstones and clay were deposited. The Paleocene was a hiatus and then during Late Palaeocene marine transgression again took place resulting in deposition of Kasargod formation. Early Eocene was the post rift period where carbonates were deposited. Early Oligocene was the period when strong transgression took place extending up toon land coastal area. The carbonate deposition was widespread except on margins where sands and clays were deposited. From late Oligocene to Early Miocene a continuous eustatic changes took place and the deposition of carbonate and sandstone can be observed under the fluctuating marginal marine to continental environment towards the Basin margin. During the end of m id Miocene severe tectonic activity occurred and there the carbonate deposition ended giving way to clastics. The generalized stratigraphy of the Basin is shown in Figure-3.

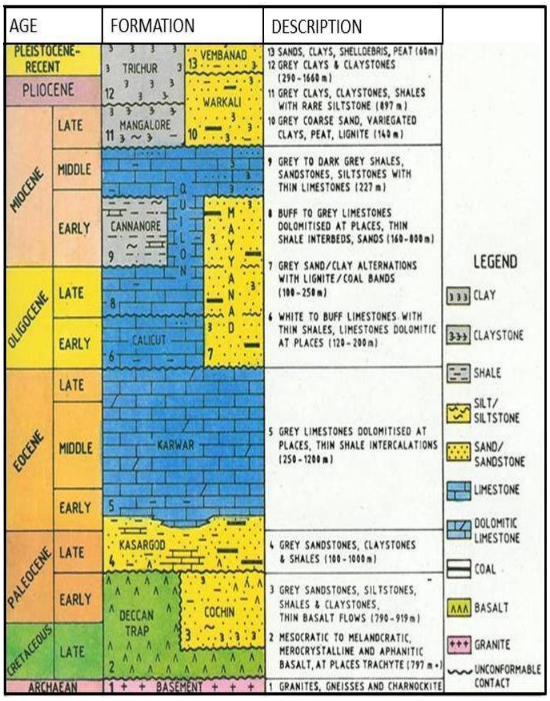

Figure 3: Generalised Stratigraph y of the KK Basin

Analysis of Data

The processing flow for the Long offset data having 960 channels of 12.5m and 50m as Group and shot interval respectively making an offset of 12000m is tabulated in table 1.After re-sampling and Geometry merging (Figure- 4), the precondition ing of data required the attenuation of linear and refracted noises preserving the information in the wide angle cone. The application of dip filter has been used to accomplish the job (Figure-5). The other major issue was to identify and attenuate the different types of multiple infecting the data particularly when seismic character gets distorted after application of NMO. To start with, Different order water bottom multiple was removed from the data. Here the multiple was modelled and subtracted from the data as it was easier to assume the water bottom velocity. At this step it was important to preserve the water bottom amplitude intact (Figure-6). A comparision of gathers thereafter is shown (Figure-7). After this the inter-bedded multiples generated from the heterogeneity of basalt was suppressed. At this step the conventional processing gave a better result because of limitation of frequency range used for parabolic Radon transform. H igh resolution Velocity analysis was thereafter carried out from the constant velocity migration cube as it is more accurate in the sense that the horizon velocity picked could be verified simultaneously with Vertical semblance on cube .

Table 1: Processing Work Flow

RAW DATA
RESAMPLING GEOMETRY MERGING
PRECONDITIONING
SIGNAL PROCESSING
WATER BOTTOM DEMULTIPLE
VELOCITY CUBE GENERATION & PICKING
PSTM
VELOCITY UPDATION AS PER GEO_MODEL
PSTM
RADON DEMULTIPLE ON PSTM GATHERS
MUTING & STACK
POST STACK PROCESSING

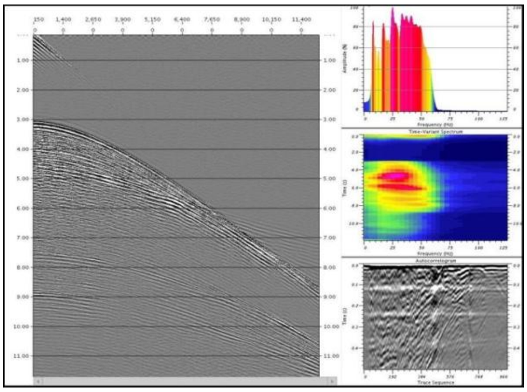

Figure 4: Raw Gather after Geometry Merging

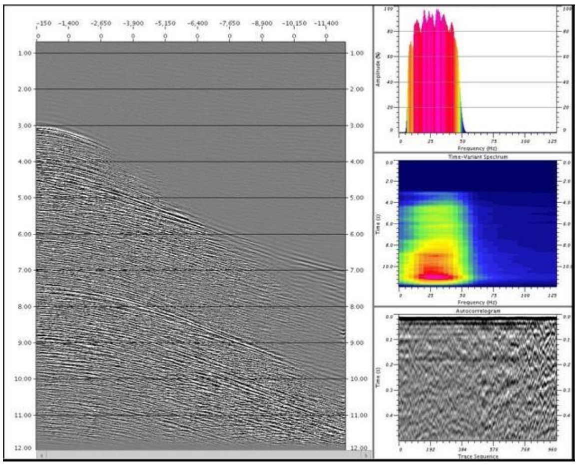

Figure 5: Conditioned Gather

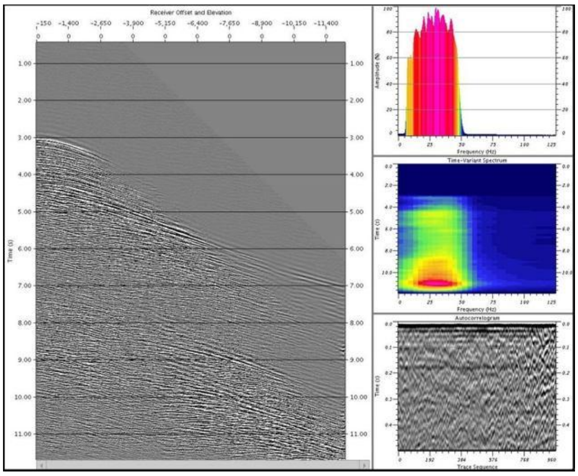

Figure 6: Gather showing attenuated water bottom multiple with far offsets intact.

The velocity model obtained through picking semblances on the constant velocity migrated stacks along horizons and their vertical counterpart, was used for first pass migration of the data. The model thereafter was modified as per the geologic model and the final model is shown on right. (Figure-8).

Bending Ray algorithm of PRESTACK TIME MIGRATION which uses Interval velocity in time for ray tracing has been used to take care of the reflections below Basalt. The PSTM stack so generated has been shown in below. It can be seen that there are strong multiple masking the primary amplitudes (Figure-9). which has been removed by radon filter thus bringing out the sub basalt image clearly. (Figure-10 & 11).

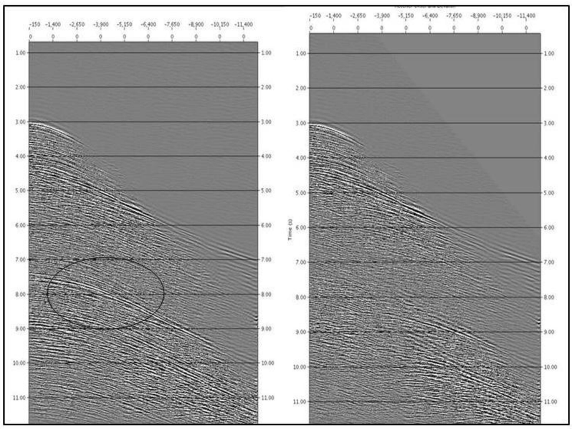

Figure 7: Comparison of gathers showing attenuated water bottom multiple(right panel)

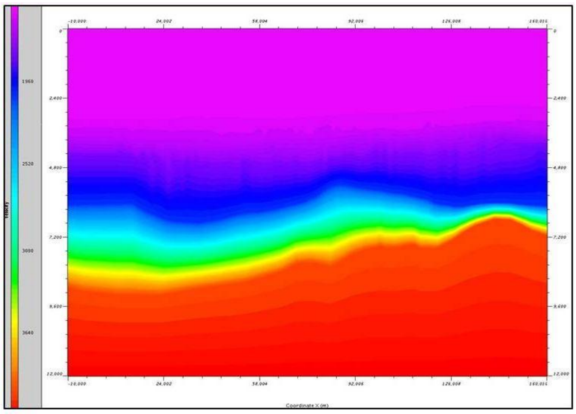

Figure 8: Final Velocity Model

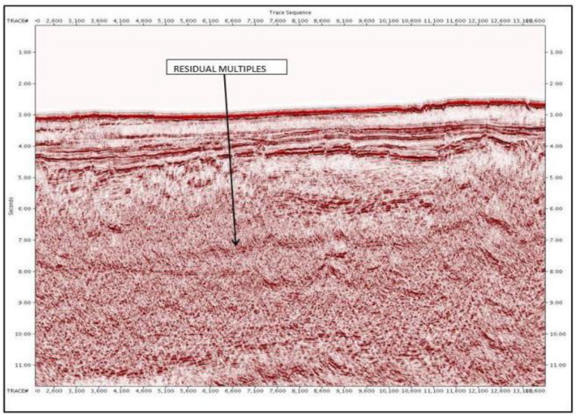

Figure-9 : PSTM stack(Intermediate)

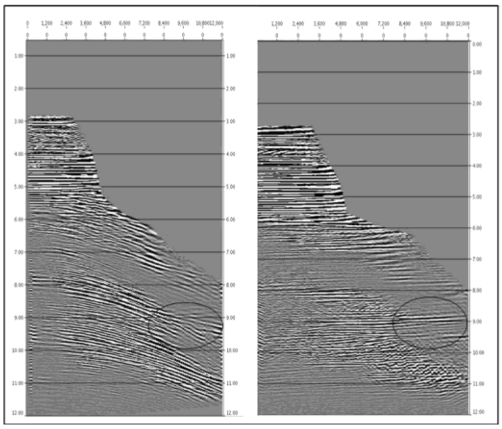

Figure 10: Raw PSTM gather(left) final PSTM gather(right)

The final PSTM stack thus generated has been shown below in Figure-11 with the vintage data Figure-12

Conclusions

Altogether several lines have been processed through the strategy discussed above and the data could be improved through the workflow taking care of by a) preserving far offset b)multiple attenuation at various stages c) Velocity model generation on Migrated Stack cube and d) selection of Migration Algorithm. The flow cannot be generalized for all categories of long offset data sets, however we were able to improve the Sub Basalt Imaging significantly in this area of KK Basin. Hopefully this will help the interpreters make the Basinal model in a more definitive way. There are other avenues still to be explored like PRESTACK DEPTH MIGRATION on this dataset.

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Views expressed in this paper are that of authors only and may not necessarily be of ONGC.

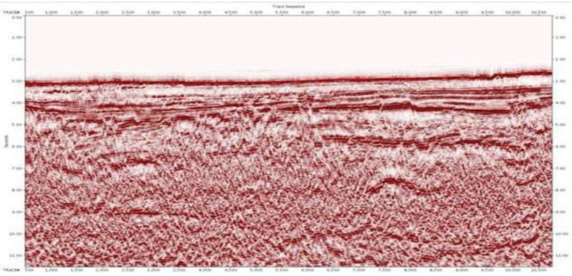

Figure 11: Final PSTM stack

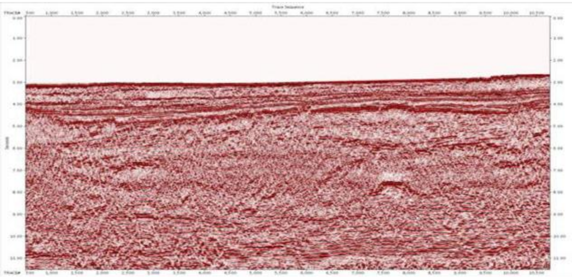

Figure 12: Vintage PSTM stack

References

Dhananjay Kumar, Ravi Bastia and Debajyoti Guha (First Break 2004), Prospect hunting below Deccan Basalt: Imaging challenges and solutions.

J. Shah etal (71st EAGE conference and exposition, Amsterdam): Hydrocarbon in Sub basalt sediments-Basin modelling of Kerala-Konkan Basin Offshore, West India.

Sujata Venkatraman: Imaging through Deccan Basalt-New lessons from INDIA SPAN II, Geohorizons, Vol 15, No.1, June 2010.

Jan Ove Hansen etal 2001 Western Geco Norway & Schlumberger Stavanger Research NorwayAnalysis of Long Offset Sub-Basalt data using model based processing.

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