Simulation of Wide Azimuth Data: A processing effort using vintage seismic data

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Summary

Subsurface illumination is determined by the acquisition geometry. The maximization of subsurface coverage through wide azimuth survey presents new challenges. This paper attempts to blend two vintage seismic data volumes to achieve the wide azimuth coverage facilitated by the acquisition geometries which were orthogonal to each other.

Introduction

Seismic data has an important role in petroleum exploration. To meet the exploration challenges, It is common to reprocess the old available data with latest techniques and reinterpret the outputs to meet the ever changing exploration objectives. However, on many occasions, in spite of the best efforts, the results may not be sufficient enough to meet the specific requirements which are vital to the exploration process. The data may have inherent deficiencies in terms of a) temporal and spatial resolution b) signal to noise ratio c) fold d) offset and azimuth distribution e) record length or target depth.

These deficiencies can be overcome by reacquisition. Modern acquisition systems can effectively address many of the above mentioned problems. The practice is to acquire data with suitable acquisition geometry to meet the new exploration objective and to process and provide a new data set for interpretation.

Here we discuss a case of 3D reacquisition and processing in an area in KG-PG Basin, east coast of India. The acquisition parameters of the old (Survey A) and new (Survey B) are given in table1.

The receiver lines and shot lines of survey A & survey B are perpendicular to each other as shown in Fig.1 & Fig.2 respectively. The azimuth and offset distribution of survey A & survey B are shown in Fig.3 & Fig.4 respectively. The surveys are complimentary to each other and their combined result looks like a wide azimuth survey Fig5. Similarly their combined offset distribution provides well-populated bins consisting of all the offsets Fig6, Fig.7 & Fig8.

The objective of old survey was shallower (Time: 1500-2500 ms & in Depth 1800-3600 mts) and the objective of new survey is to map deeper targets (Time: 1000-4000 ms and in Depth : 2000-5300 mts). The far offsets of these surveys are accordingly optimized. A close look at the acquisition geometries of the surveys reveal that the two surveys are complementary to each other and practically non redundant. Therefore, a third data set can be produced by suitably combining A and B with increased fold and rich in offset (Fig.9) and azimuth distribution (Fig.5). For the purpose of this study, we have restricted the offset of new survey up to 4160 mts (Fig.6).

Parameters	Survey A (2004)	Survey B (2009)
Template	Symmetric Split Spread	Symmetric Split Spread
No. of RL's	6	7
Receiver Line Interval(m)	280	320
Shot Line Interval(m)	560	680
No. of Channels/ RL	168	340
Total Active Channels	1008	2380
Near / Far Offsets (m)	20/4160	84/7506
Fold (Nominal) (Inline x Crossline)	36 (6X6)	70 (10 x7)
Bin Size	20X20	20x20
Record length	5 sec	8 sec
Instrument	UL_408	UL_408
Receiver Line orientation	EEN-WWS	NNW-SSE
Shot Line orientation	NNW-SSE	EEN-WWS

Table1. Acquisition Parameters for Survey A & Survey B

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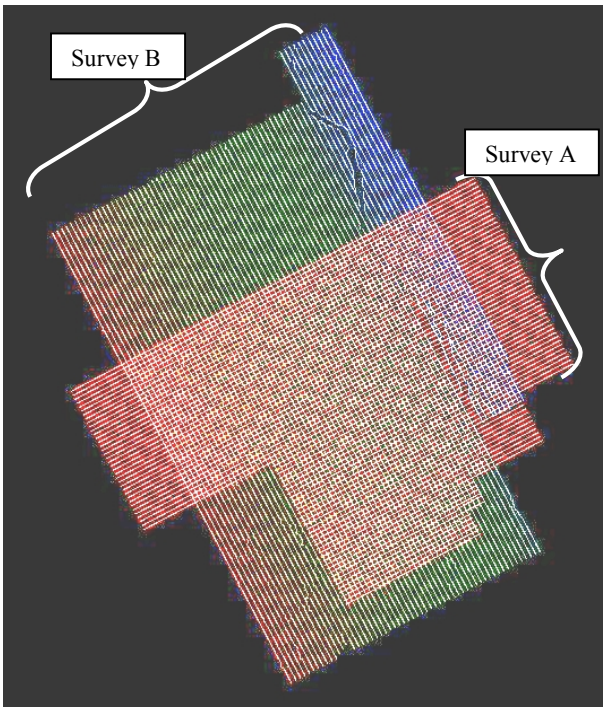

Fig1. Receiver lines for Survey A & Survey B

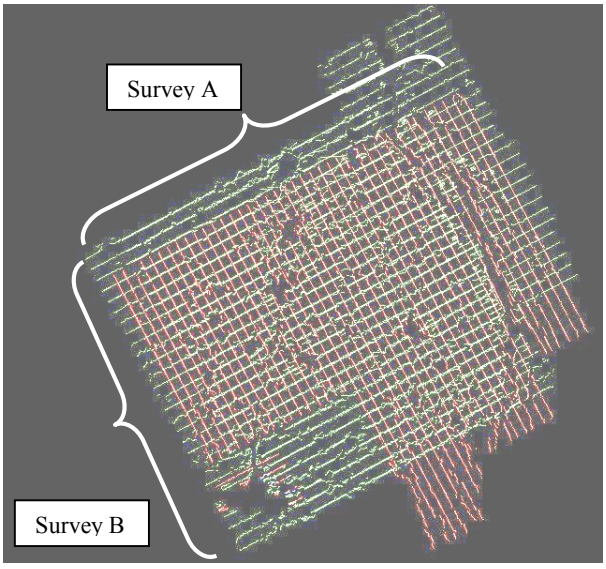

Fig2. Shot lines for Survey A & Survey B

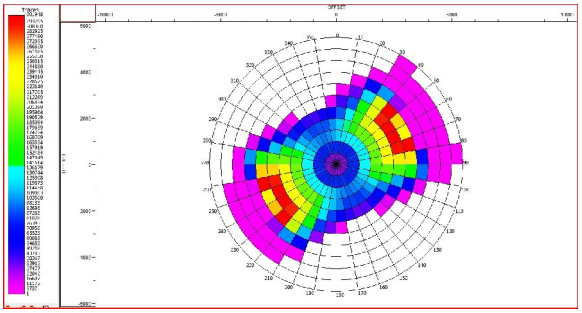

Fig3. Azimuth distribution for Survey A

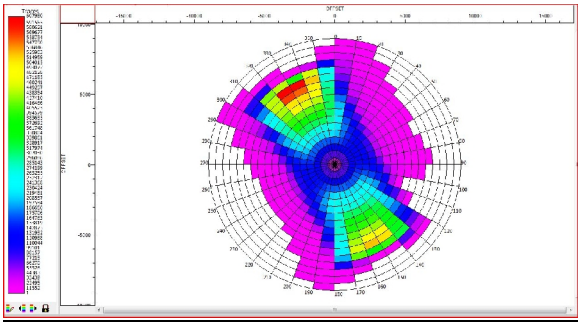

Fig4. Azimuth distribution for Survey B

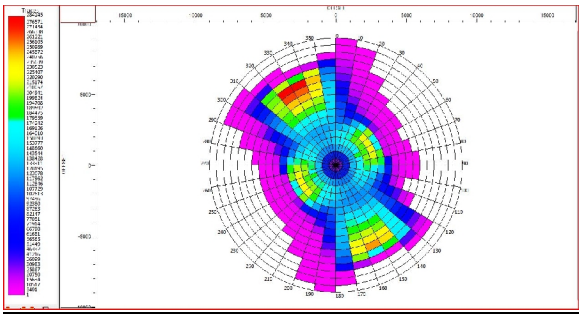

Fig5.Combined Azimuth distribution of Survey A & Survey B with full available offset of both surveys

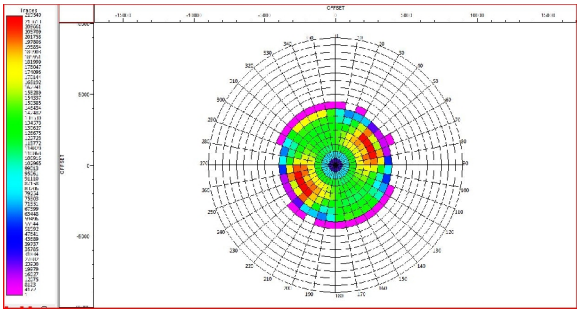

Fig6.Combined Azimuth distribution of Survey A & Survey B with restricted Offset of 4160 mts

Fig7. Offset distribution for Survey A

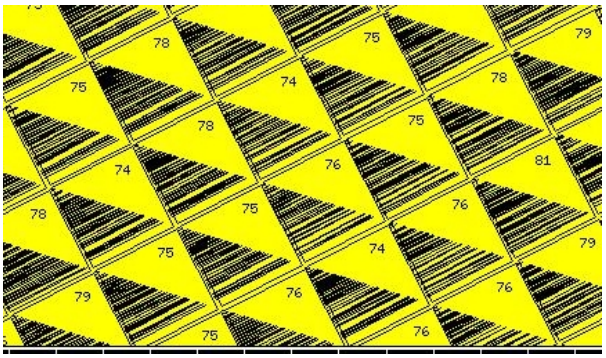

Fig8. Offset distribution for Survey B

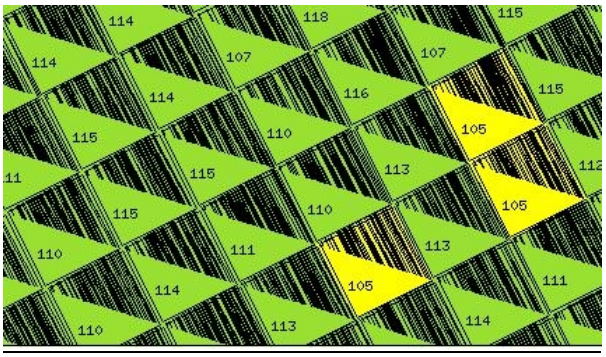

Fig9.Combined Offset distribution of Survey A & Survey B

Data Processing

Three PSTM stack volumes were produced with identical processing parameters wherever required. Generalized processing sequence is given in the flow chart as given below. However, azimuth dependent processing would be attempted on this combined data set in order to test the efficacy of wide azimuth data.

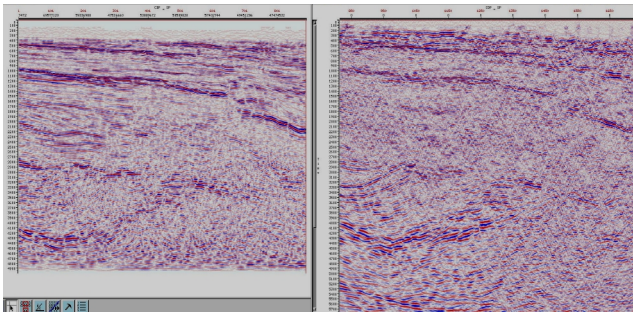
Fig10. Processed Section of Survey A & Survey B

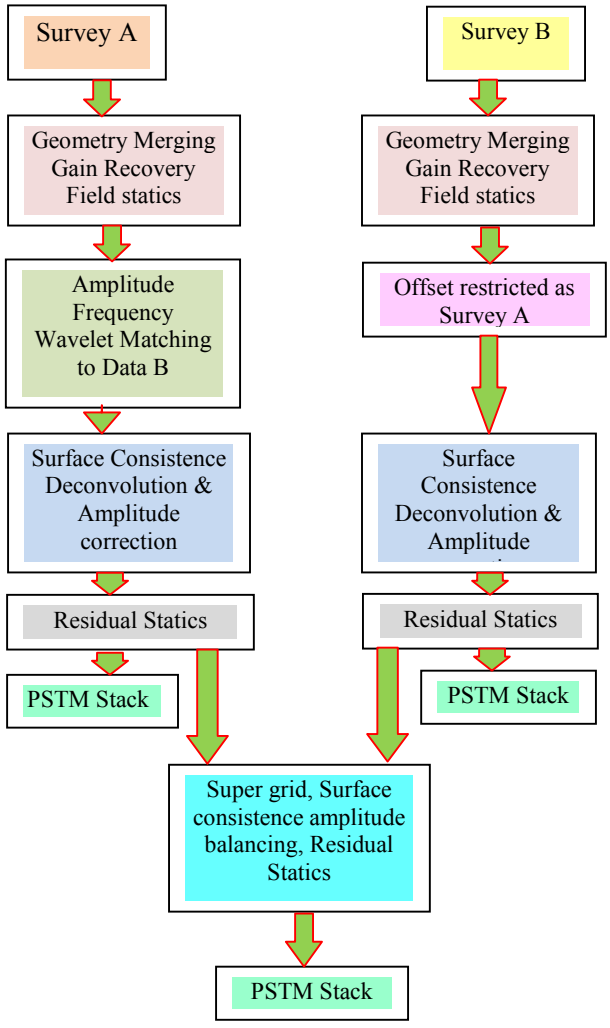

Fig.11 Processing Sequence flow chart for Survey A, Survey B & Super grid

Representative sections from the output are shown below.

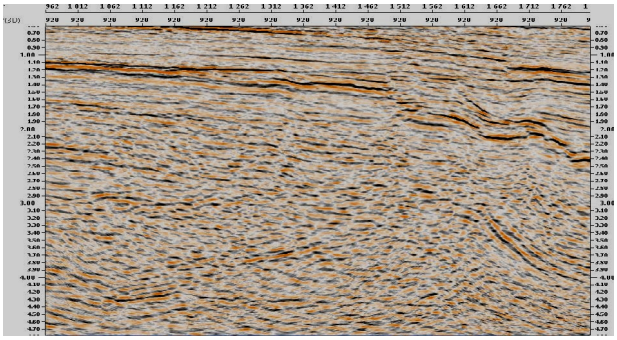

Fig12. Processed Section of Survey A (IL 920)

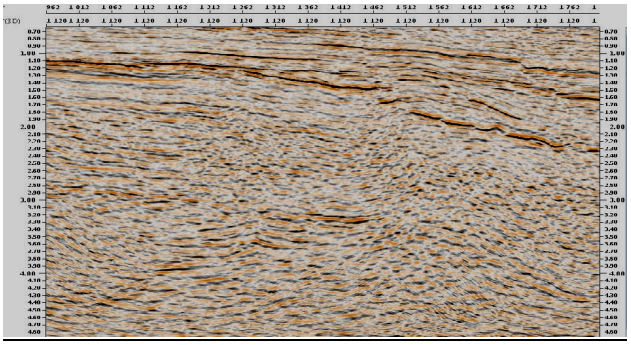

Fig15. Processed Section of Survey A (IL1120)

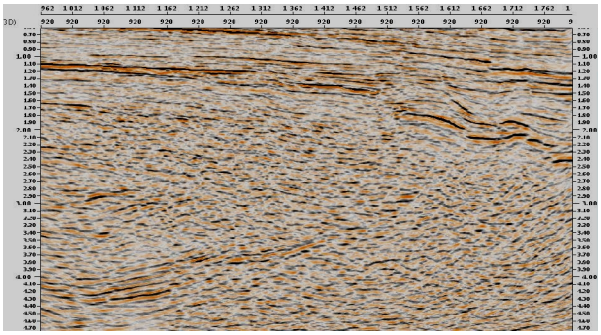

Fig13. Processed Section of Survey B (IL920)

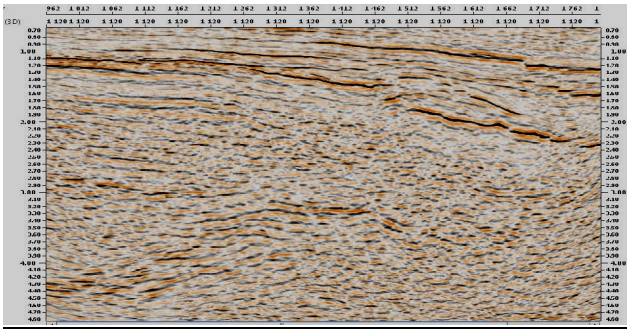

Fig16. Processed Section of Survey B (IL1120)

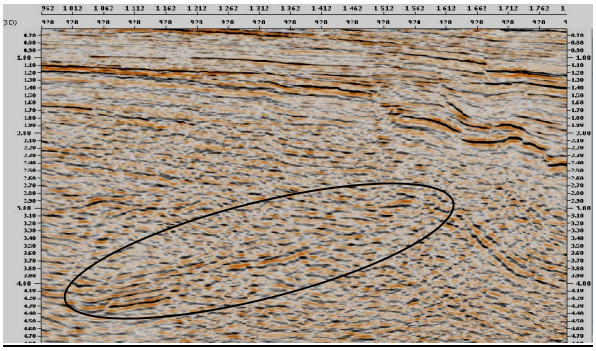

Fig14. Processed Section of Super grid (IL920)

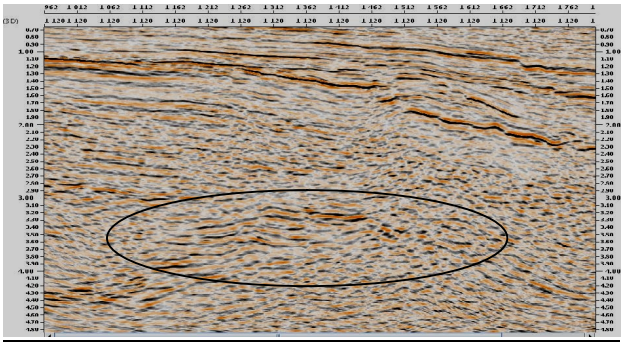

Fig17. Processed Section of Super grid (IL1120)

Conclusion:

Combining the two 3D data sets, available in the area especially with orthogonal to each other, can produce a new data set which is superior to both (Fig.14 and Fig.17).

The combined volume is superior in terms of fold, offset and azimuth distribution. It may also allow us to do azimuth dependent attribute studies, which can be very difficult to attempt on individual volumes due to low fold in any azimuth sector.

Reference

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