8th Biennial International Conference
& Exposition on Petroleum Geophysics

"HYDERABAD 2010"

P-155

Prestack Time Migration and its effect on the identification of BSR in western coast of India

Sanjeev Kumar*, Satyavani, N., Sain, K.
National Geophysical Research Institute, (CSIR), Hyderabad

Summary

Gas hydrates are ice like crystals structure of water molecules and hydrocarbons formed under the favorable conditions. In gas hydrates crystals mainly methane gas is trapped within a framework of cages of water. Gas hydrates are mainly found in shallow sediments of outer continental margins and permafrost regions. Oceanic occurrences of gas hydrates are inferred mainly on the basis of appearance of bottom simulating reflector (BSR) in the seismic section, that coincides with the base of gas hydrate stability field (low temperature and high pressure). To delineate the gas hydrates deposits, we should be able to see the clear seismic image which is obtained after proper processing of seismic section. Often we don't see the image clearly if proper migration is not done especially in case of dipping reflector. Now a days we use prestack migration instead of poststack migration as it works trace to trace to shift the energy to its true position. In this paper we discuss the Prestack Time Migration and its effect on the identification of BSR in western coast of India

Introduction

With the ever growing demand of energy, the earth's store of conventional hydrocarbon will no longer be able to supply adequate energy to its growing economics and population. After that, unfamiliar but kindred hydrocarbons called hydrates may play a role of significant sources of energy. A suite of method exists for the identification and quantification of gas-hydrates (Sain et al. 2000, Vohat et al., 2003, Satyavani et al., 2003; Das et al., 2004; Ghosh et al., 2006; Ojha et al., 2007; Shanker, 2007; Ojha et al., 2008; Sain et al., 2008; Satyavani et al., 2008; Shanker, 2008; Ghosh et al., 2008; Shanker, 2009; Sain et al., 2009) Considerable amount of gas hydrates deposits are expected in Kerala-Konkan basin, Krishna-Godawari basin, Mahanadi and Andaman Sea, offshore India.
Here we present results from a seismic line in Kerala-Konkan basin delineating probable gas hydrates deposits. 2D seismic data acquired by GAIL, Delhi has been processed at NGRI

Methodology

The purpose of seismic data processing (Robinson and Coruth, 1998; Yilmaz, 2001) is to convert the information recorded in the fields into a form that can be used for geological interpretation. The main objective of processing is to enhance the signal to noise ratio. Seismic data used here, is having 96 channels, 25 m shot-receiver interval and maximum 48 CDP foldage. We have used the ProMAX (Landmark, 1998), the commercial seismic data processing software. CDP gather after geometry merging has noisy traces and direct arrivals (Figure 1), preliminary processing includes trace killing and muting of direct arrival and refracted rays. Then to recover the loss of amplitude, spherical divergence correction was applied. To enhance the temporal resolution, zero phase spiking deconvolution was used. Velocity analysis and normal move out (NMO) correction have been carried out iteratively followed by stack. Here even we have flat reflector still prestack Kirchhoff`s time migration giving better results in comparison to the results of post-stack time migration. Results of pre-stack (Figure: 3) and post-stack time migrations (Figure: 4) have been compared for better understanding and interpretation. Processing steps followed are shown in figure 2.

Research Scholar, Room no. 103, Fractal Group, Main building, National Geophysical Research Institute, Uppal Road, Hyderabad, 500606 Email: sanjeevbadgotra@gmail.com

Results

Major results of seismic data processing of 2D line in western coast of India are given as:-

- Deconvolution makes the BSR unclear in this seismic data which suggests deconvolution may not be applicable to this data set with dominant frequency of ~35 Hz (Figures: 5 and 6).

- Pre-stack Kirchhoff`s time migration shows better results than that of the post-stack migration and shows clear opposite polarity BSR event with respect to the seafloor reflection (Figures: 3 and 4).

Conclusions

The most efficient tool for identification of gas hydrates deposits is seismic reflection method by identifying the BSR on seismic section based on polarity reversal with respect to the seafloor reflection, velocity inversion. But to obtain useful information from the seismic section a good processing technique is required so that a clear seismic image can be generated. It was found that prestack time migration has produced an improved structural image of BSR and base of free gas saturated sediments. Further, pre-stack time migration can also delineate features like faults and fractures that can act as paths for upward migration of fluids from below the BSR

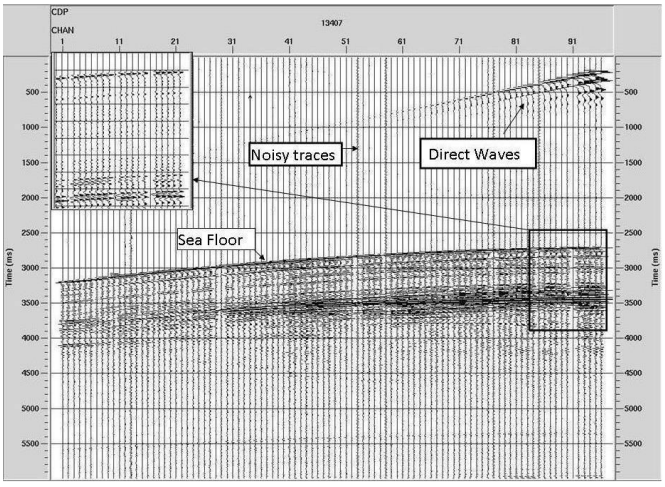

Figure 1:- CDP gather after geometry merging showing noisy traces and direct waves.

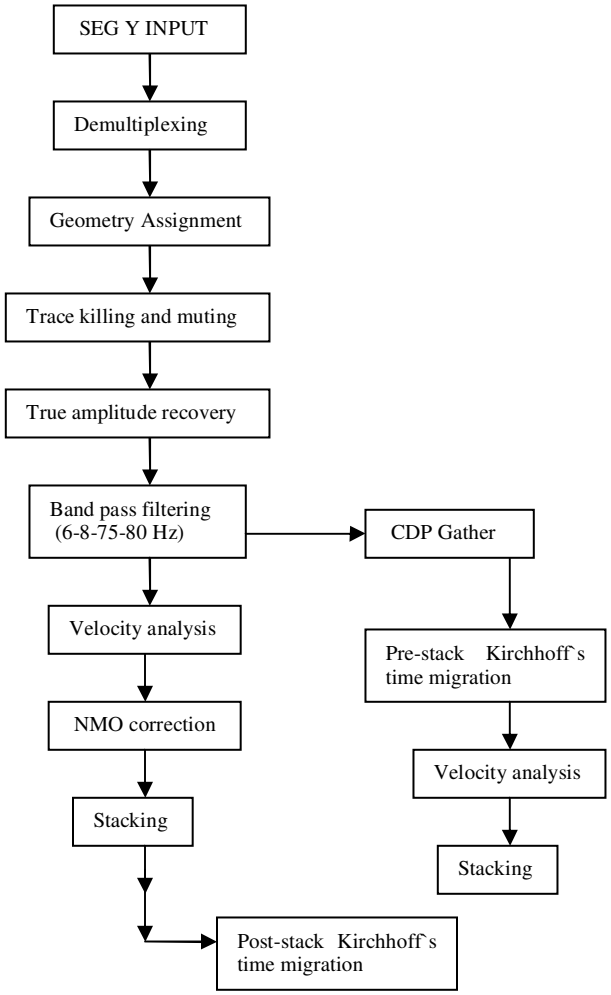

Figure 2: Description of flowchart here

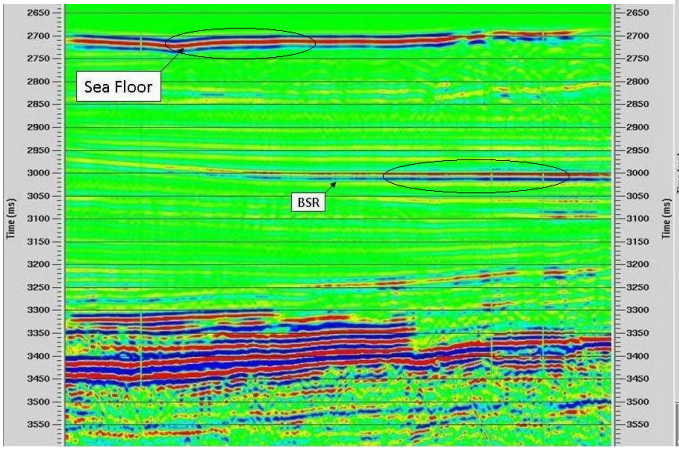

Figure 3:- Pre-stack Kirchhoff`s time migration showing clear reverse polarities of BSR appearing at 3000 msec. (Vohat, et al., 2003; Ojha et al., 2007; Shanker et al., 2009; Sain et al. ,2009) and seafloor at 2700 msec..

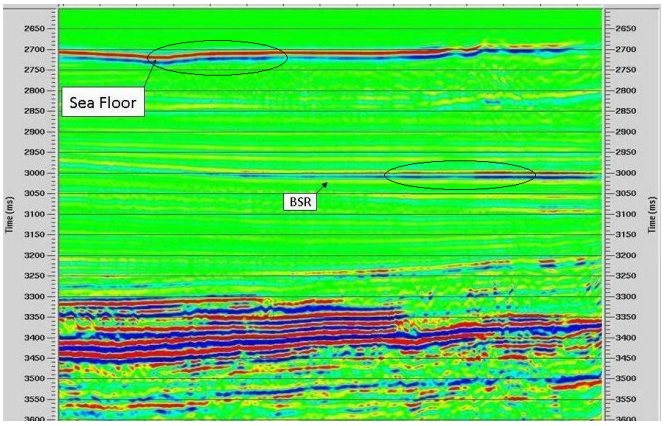

Figure 4:- Post-stack Kirchhoff`s time migration showing loss of energy. Polarities of seafloor and BSR are not so clear.

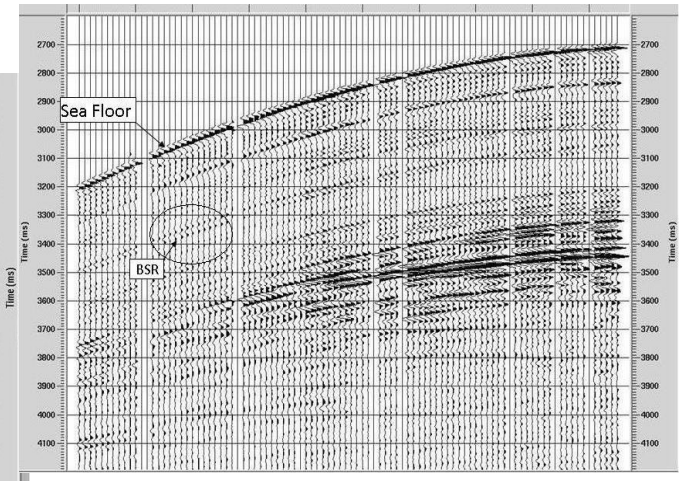

Figure 5:- Good polarity reversal appearing at 3050 msec. to the sea floor at 2700 msec. which is due to presence of BSR (Vohat, et al., 2003; Ojha et al., 2007; Shanker et al., 2009; Sain et al., 2009) before deconvolution, shown by circle

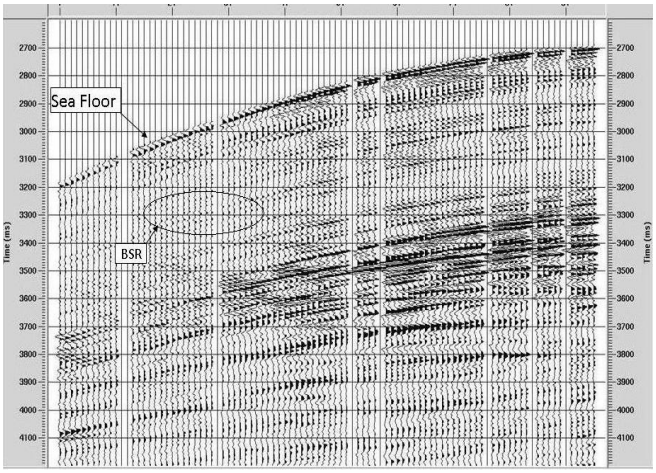

Figure 6:- Unclear polarity reversal appearing at 3050 msec. to the sea floor at 2700 msec. after deconvolution, shown by circle.

References

- Sain, K., Minshull, T.A., Singh, S.C., &. Hobbs, R.W, 2000. Evidence for a thick free-gas layer beneath the bottom-simulating reflector in the Makran accretionary prism, *Marine Geology*, 164, 3-12.
- Vohat, P., Sain K & Thakur, N.K, 2003 (a). Heat flow and geothermal gradient from BSR: a case study, *Current Science,* 85, 1263-1266.
- Satyavani, N., Thakur, N.K., Shankar, U., Reddi, S.I., Sridhar A.R., Rao P.P., Sain K.& Khanna R., 2003 (b). Indicators of gas hydrates: role of velocity and amplitude, *Current Science,* 85, 1360-1363.
- Das, R.K. Sain, K. & Thakur, N.K., 2004. Overpressure detection from seismic AVO response: an application to gas hydrates, *Current Science,* 86, 985-990.
- Ghosh, R., Ojha, M., Sain, K. & Thakur, N.K, 2006. Physical parameters of hydrated sediments estimated from marine seismic reflection data: a case study, *Current Science*, 90, 1421-1430.
- Ojha, M. & Sain, K., 2007. Seismic velocities and quantification of gas hydrates from AVA modeling in the western continental margin of India, *Marine Geophysical Researches*, 28,101-107.
- Shankar, U. & Sain, K., 2007. Specific character of the bottom simulating reflectors near mud diapirs: Western margin of India, *Current Science*, 93, 997-1002.
- Ojha, M. & Sain, K., 2008. Appraisal of gas hydrates/free-gas from V_P/V_S ratio in the Makran accretionary prism, Marine & Petroleum Geology, 25, 637-644.
- Sain, K. & Gupta, H. K., 2008. Gas hydrates: Indian scenario, *Journal of Geol. Soc. of India*, 72, 299-311.
- Shankar, U., Ojha, M., Sain K., Khanna, R.K., Sudhakar, M. & Tyagi, A., 2008. Seafloor geophysical study in search of gas hydrates/gas related evidences in the deep waters of the western continental margin of India, *Journal of Geol. Soc. of India*, 72, 547-555.
- Satyavani, N., Sain, K., Lall, Malcolm, &. Kumar, B.J.P, 2008. Seismic attribute study for gas hydrates in the Andaman offshore, India, Marine Geophysical Researches, 29, 167-175.
- Ghosh, R.& Sain, K.&, 2008. Effective medium modeling to assess gas hydrate and free gas evident from the velocity structure in the Makran accretionary prism, *Marine Geophysical Researches*, 29, 267–274.
- Shankar, U. & Sain, K., 2009. Heat flow variation from bottom simulating reflector in the Kerala-Konkan basin of the western continental margin of India, *Indian Journal of Marine Sciences*, 38, 110-115.
- Sain, K., Singh, A.K.,. Thakur, N.K & Khanna, R. K, 2009. Seismic quality factor observations for gas-hydrate-bearing sediments on western margins of India, *Marine Geophysical Researches*, in press, DOI 10.1007/s11001-009-9073-1.
- Promax 2D Advanced Techniques Training Manual, Landmark Graphics Corporation, 1998.
- Robinson E.S.& Coruh C. (1998), Basic exploration Geophysics, John Wiley & Sons Inc., USA
- Yilmaz O. (2001), Seismic Data Analysis, vol-1 (Text) SEG