**GEOPHYSICS PAPER 21**

## SEISMIC IMAGING BELOW SHALLOW GAS CLOUD – A COMPARISON BETWEEN PSTM, PSDM & 4C OBC DATASETS

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Seismic data degradation due to shallow gas cloud is a common occurrence in the Malay Basin. As with many fields with large structures located in the central axis of the Malay basin, the field under study in this paper is also beset with this issue. This field, which is currently in the development stage, is a 30km long by 10km wide E-W trending elongated four way dip closure intersected by N-S & E-W striking normal faults. Two main structural culminations can be observed on the field. The major culmination lies to the eastern side of the field while a smaller one lies to the western side. The field is found to contain both oil and gas accumulation. A marine streamer 3D seismic survey was acquired over the field in 2002. The survey was acquired with an E-W line orientation.

This 3D survey data was originally processed using Pre-Stack Time Migration (PSTM) in 2002. Amplitude and frequency attenuation of reflectors were particularly severe on the two crestal culminations from approximately 800ms onwards. This problem was attributed to the presence of shallow gas and is further compounded by the presence of multiply stacked gas zones below the shallow gas. As a result, a number of key problems were inherent in the dataset, namely depth uncertainties especially at the crestal zones, fault imaging uncertainties within the gas cloud and also vertical resolution issues.

The 2002 dataset was reprocessed using Pre-Stack Depth Migration (PSDM) in 2009. The aim of this exercise was to improve seismic imaging within the gas cloud, to improve vertical resolution via increased sampling rate, to increase the signal to noise ratio via new processing technologies such as SRME & model based Q and also to reduce depth uncertainty by deriving a high resolution velocity model representative of the changes in geology. Overall, the PSDM data did demonstrate improvements in terms of reflector continuity and frequency content within the gas cloud area. Fault imaging uncertainty, even though still present, has also improved as the fault interpretation within the gas cloud was carried out with greater confidence. Depth prediction at wells based on the PSDM has also shown improvements over the PSTM based prediction. Despite these improvements, the fundamental uncertainties in the dataset remain present as they were inherent to the acquisition process itself.

Also in 2009, a 4-Component Ocean Bottom Cable (4COBC) test line was acquired over the gas cloud zone on the eastern culmination of the field. This operation was carried out to demonstrate two key points. The first was to demonstrate the feasibility of carrying out an OBC acquisition in the studied field while the second and more important point was to demonstrate the data quality improvements of the OBC data over conventional streamer data. The 4COBC test line was acquired in a N-S orientation as opposed to the E-W orientation of the streamer acquisition with the intention to undershoot the gas cloud, and thus give better imaging. Preliminary results from the 4COBC data has shown marked improvements over the streamer data on the particular test line in all imaging and structural aspects which were noted earlier. These results suggest that 4COBC seismic acquisition is feasible in this field and is probably the methodology that will give the best imaging of the field under today's technology.

In summary, this paper has demonstrated that the 2009 PSDM has managed to improve the seismic data processed via PSTM in 2002. However, the problems faced by the 2002 PSTM attributed to shallow gas cloud are still present in the 2009 PSDM dataset as they are inherent to the acquisition process. In order to break away from these problems, a 4COBC survey may be the way to go. Such a survey dataset can potentially enable the many structural & imaging issues of the seismic dataset to be resolved within the development phase of the field.

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