CHAPTER 4

DISCUSSION AND CONCLUSION

4.1 Discussion

The method of this study is quite new and challenging in petroleum exploration and development. Seismic data are a complex response of subsurface geology. The best development drilling program for a petroleum reservoir depends on how well the reservoir characteristics are known, particularly porosity, permeability, and reservoir facies distribution. Integration of well log data and three-dimensional seismic data to predict and map porosity using the method of multi-attribute analysis is being more widely used in recent years. Hampson-Russell® software programs were used here for seismic attribute analysis and porosity mapping of the northern part of the Pattani basin in the Gulf of Thailand, where petroleum exploration and production operation have been active..

This study started with correlating well logs with seismic data. Wavelet extraction was an important step in the process of well log correlation. Both seismic and well log data were used to create a better average wavelet. The total correlation between well log and seismic data was 0.30, which is a poor correlation. Extraction of a better wavelet and use of check-shot data may improve this correlation coefficient in the future studies. The STRATA® program was used to create an acoustic impedance volume. A model-based inversion method gave the best inversion result. In order to perform acoustic impedance inversion, the initial background model was developed by picking three continuous horizons in the seismic data volume. The inversion was then applied within the range of these three horizons, which cover the zone of interest. The acoustic impedance inversion results showed some low impedance anomalies

(Figures 3.17 and 3.18). These low impedance anomalies might be related to some channel sandstone beds or be fault-bounded lithology differences.

The EMERGE® program was used, with its multi-attribute regression capabilities, for attribute analysis. Acoustic impedance, which is related to porosity, was used as an external attribute in the EMERGE® program to predict porosity. The multi-attribute analysis result showed (Figure 3.23) that six attributes would give the best porosity prediction. Among these six attributes, the inversion result, which is acoustic impedance, is the best single attribute to use. The prediction cross-correlation was 74 percent when six attributes were used and its average porosity error was 1.89 percent. The validation error cross-correlation was 65 percent. These correlation coefficients are quite acceptable. However, more careful well correlation and better wavelet generation might improve the results.

Several time slices from the predicted porosity volume were generated. These were interpreted to relate porosity distribution to some geological features. These interpretations did not consider the absolute values of predicted porosity. Rather, only the relative porosity distribution was interpreted. The interpreted porosity maps have distribution patterns that can be related to fluvial sandstone channel systems. Several authors have written about the non-marine sedimentary successions in the rift basins in Thailand. The sandstone beds of these non-marine sequences are immature and were deposited by small and weak river systems in fluvial and lacustrine deltaic environments. These sandstone sequences possess good porosity at shallow depths of less than 2,500 meters. Since porosity degradation becomes significant with increasing depth, below 2,500 meters there is a problem with reservoir quality (Pradidtan and Dook, 1992).

4.2 Conclusions

The method of porosity prediction and mapping through multi-attribute analysis is applicable in the study area. It might also be useful in the other parts of the Pattani basin. The multi-linear attribute analysis technique for seismic attribute analysis is a useful tool in this process.

The acoustic impedance is the best single attribute to predict porosity. The combination of other attributes with the acoustic impedance inversion gives a better correlation in predicting porosity from seismic data. Well log correlation to seismic data is an important step in performing attribute analysis.

Porosity maps in the study area indicate higher porosity trends related to some possible channel sandstone layers. These interpreted channels are oriented north-south and have a pattern of meandering/braided rivers. These channels were probably controlled by some north-south oriented normal faults related to basin forming processes. Porosity distribution in the basin was also likely to be controlled in some degree by the lithology variations associated with faults.

The porosity maps generated may be useful in understanding the sandstone geometry and the lateral distribution pattern of porosity in sandstone layers in the study area. The results could also be useful in planning development of petroleum fields in the area. The higher porosity zones at different time slices could be the possible development drilling points, however, the structural map of the study area need to be considered as well.