

## CHAPTER 7

### CONCLUSION.

The two main purposes of this investigations are: to identify, and assessment the potential of petroleum resources in the Thai-Vietnam overlapping area, and evaluate economics of the petroleum resources of the Thai-Vietnam overlapping area. In order to achieve these goals, this thesis is divided into four main parts. The first part describes the general geology, such as, the stratigraphy and sedimentation evolution of this overlapping area. The second part concerns and describes the petroleum geology and petroleum engineering system of this overlapping area. The third part describes and assesses the potential of the undiscovered petroleum in the overlapping area. A computer program, FASPU, based on statistical and geological theories, is applied to calculate the potential of the undiscovered petroleum resources of this overlapping area. The fourth part deals with economic theories and strategies to develop this overlapping area.

Tertiary strata distribution study of the Thai-Vietnam overlapping area categorized Tertiary sediments of this area to four Units, based on the study of Polachan<sup>51</sup>, as Unit I, II, III and IV.

For its source rocks potential study, It is evident that all stratigraphic units, except upper-unit IV, which is immature with respect to the oil generation window,

have very low hydrocarbon source potentials as measured by pyrolysis. Synrift sediments (unit I, and II) and early post-rift sediments (lower-unit III) contain very low TOC (less than 0.4%), and very low QOM (between 1.3 to 1.6 mg HC/ g rock). Based on a conventional definition of hydrocarbon source rocks, these sediments can not be considered as sources rocks. Although unit III has TOC of 0.5% , it also has very low QOM (1.4 mg HC/g rock). Upper-Unit IV, on the other hand, has the highest hydrocarbon source potential with TOC content of 1.4%, and QOM of 1.4 mg HC/g rock. This unit is immature, relatively to the oil generation window.

The fact that the Pattani trough and the north Malay Basin are producing basin, it can be considered that:

- 1) either source rocks have been very effective even overall lower organic matter quality is closer than generally considered necessary;
- 2) higher quality source rocks, possibly at depths, and have not been reached by drilling, are present in the basin;
- 3) a combination of both factors.

The potential source rocks in the Pattani trough and the north Malay Basin, despite their very low oil generating potential, may represent an enormous volume of low quality source bed, which together with interbedded sandstones throughout the succession, would function as highly effective carrier beds during migration. In addition, the rapid subsidence rate and high heat flow, resulting in rapid in hydrocarbon generation, may also have facilitated creating commercial hydrocarbon accumulations.

The synrift and possibly post-rift lacustrine deposits, which widely occur in other Tertiary basins in Thailand, are believed to occur in the center of the Pattani trough as well. These lacustrine sediments may possibly be the source rocks contributing a major part of hydrocarbons to the commercial gas fields in the Thai-Vietnam overlapping area.

In addition, from the TOC and QOM distribution map in each unit, especially the unit that expected to be source rocks, unit II and III, it shows the high value of both TOC and QOM in the Thai-Vietnam overlapping area. These also indicate that there are potential source rocks in the Thai-Vietnam overlapping area.

Results of geochemical analysis from well Yala-2, Kraphong-1, Kraphong-3, Platong-1, Platong-5, Platong-8, Surat-1, Ranong-1, Kung-1, South Platong-1, Pakarang-1, Pladang-3, Insea 1, South Platong-2, Trat-1, Satun-1, Satun-2, Satun-3, Dara-1, Erawan 12-1, Erawan 12-7, Erawan 12-8, Erawan 12-9, Krut-1, Erawan K-1, Jakrawan-1, Jakrawan-2, Funan-1, Baanpot-1, Baanpot B1, 17-B-1 of Unocal Thailand and JDA as concluded in Table 4.2 are used for construction the distribution map of total organic carbon (TOC) and quality of organic matter (QOM) in each unit. From these maps, it can approximate quantity and quality of TOC and QOM of each stratigraphic within the Thai-Vietnam overlapping area as follows;

### Unit I

For the Thai-Vietnam overlapping area, TOC content is slightly high (more than 0.26 %) compared with other parts in the region. QOM of this unit in the overlapping area is also slightly high (ranges from 0.6 to 1.0 mg HC/g rock).

### Unit II

TOC content of unit II in the Thai-Vietnam overlapping area is slightly high (ranges from 0.45-0.5 %) as in unit I. While its QOM values is not high (less than 0.40 mg HC/g rock) as in unit I.

### Unit III

In the overlapping area, TOC content of this unit is slightly high (about 0.65%) as in the center of the trough. QOM values has the slightly increase toward the northeast and varies from about 0.95 to 1.10 mg HC/g rock.

### Unit IV

TOC content of this unit in the overlapping area is slightly decrease toward the southeast and varies from about 0.45 to 0.40 %. While QOM values shows an increasing trend toward the southwest, varying from about 0.95 to 1.10 mg HC/g rock.

For the assessment of undiscovered petroleum resources in this overlapping area, play type of this Thai-Vietnam overlapping area is Miocene Faulted Sand Play and it is the conceptual play because there are not wells have drilled in this area. As an evidence of previous works and the distribution maps of the possible source rock in the Pattani Trough and the north Malay basin area (Figure 4.7-4.14), source rock may extend and cover the Thai-Vietnam overlapping area. Moreover, there are many production fields around the this overlapping, such as in the north, the west and the south of this overlapping area.

The undiscovered petroleum resources assessed by FASPU program indicate that the Thai-Vietnam overlapping area may has undiscovered petroleum resources as follows;

**Oil Potential:** Although the result from FASPU indicates a very large amount of oil accumulation, 118.052-272.551 MMBBL, the level of confidence is quiet low, 5 percent to 25 percent of confidence respectively. Therefore, there is a low or no chance to hit an oil field in this overlapping area.

**Gas Potential:** The result from FASPU indicates non-associated gas potential as follows;

- at the fractile of 75<sup>th</sup>, high confidence, there is 1 gas accumulation with its size 36.659 BCF.
- at the fractile of 50<sup>th</sup>, medium confidence, there is 1 gas accumulation with its size 65.606 BCF.

- at the fractile of 25<sup>th</sup> , low confidence, there is 3 gas accumulations with their size 117.409 BCF.

- at the fractile of 5<sup>th</sup> , very low confidence, there is 6 gas accumulations with their size 271.256 BCF.

These reserves will be developed by sharing Central Processing Platform (CPP) and Floating Storage Off-loading Unit (FSO) with its adjacent field, Bongkot field. This gas reserve will be started its production on the 6th year of the work plan with production rate depend on their accumulation size.

Petroleum potential of the Thai-Vietnam overlapping area has an economics potential for developing as the results of cash flow and sensitivities analyses. Consider at an average gas price in 1997, 2.7 US\$/MMBTU, and reserve size at 37 BCF (worst case), concessionaire will get its Net Income equals 34.30 MMUS\$, and government will get its royalty and Income Tax as 5.80 and 16.56 MMUS\$ respectively. At this case , Internal Rate of Return (IRR) of the project will equal to 12.5 percent, and Profit/Investment Ratio (PIR) of this case equal to 0.78. If consider at the best case that reserve is equal to 271 BCF, concessionaire will get its Net Income equals 284.79 MMUS\$, and government will get its royalty and Income Tax as 43.35 and 284.19 MMUS\$ respectively. For this case, Internal rate of Return (IRR) of the project will equal to 21.2 percent, and Profit/Investment Ratio (PIR) of this case will equal 2.04.