



## CHAPTER IX

### CONCLUSION

The Sirikit crude oils from the Phitsanulok basin have been characterized of their geochemical correlation on the basis of their biomarker characteristics and stable carbon isotope ratios. The geochemical evaluation of source, depositional environment, maturity and degree of biodegradation were objectives of this study. Crude oil samples representative the Sirikit oils were collected from different subunit reservoirs in the same field. Characteristics of all the oils examined demonstrated no significant distinction between oils from different subreservoirs. Based on the presence of biomarkers and stable carbon isotopes, it has been proposed that the Sirikit crude oils from the Phitsanulok Basin have a typical characteristic signatures of their basin source materials and burial history.

The biomarkers present in the oils of this basin were characteristic of a highly oxic depositional environment with high Pr/Ph ratios in all the oil samples. A shallow, short-lived large lake characterized the original depositional environment for this basin. The major source materials for the Sirikit oils were mixtures of organic debris from algae, bacteria and

terrigenous higher plants. The algal contribution to the organic material of the source rock was inferred by the predominance of  $n\text{-C}_{15}$  and  $n\text{-C}_{17}$  of  $n$ -alkanes. The bacterial contribution was suggested by a high concentration of hopanes in all samples. The presence of sesquiterpanes and diterpanes, in a significant concentrations in almost all the suspected samples, confirmed a contribution of terrigenous higher plant to source rocks of the oils. This interpretation was supported from previously published geological information of the Sirikit oilfield and the Phitsanulok basin (KNOX and WAKEFIELD, 1983; FLINTS et al., 1988). Anomalous carbon isotope distributions in a Sofer type plot suggested these samples had marine (non-waxy) rather than terrigenous (waxy), characteristics. This anomalous phenomena may be explained by the presence of a significant algal contribution to the source materials rather than the higher plants. However, the hopane/sterane ratios of the oils samples in this study show relatively high values. The low sterane content may possibly be explained with reference to the oxic environment. It is possible that the organisms in this environment possessed alternative cell-wall rigidifier constituents rather than the typical sterols (MELLO et al., 1988). Another proposal for the very low sterane/hopane ratios may be related to the specific type of algae in the environment which did not contain very high concentration of sterols. 8,14-Secohopanes present

in all oil samples in this study might be derived from the degradation of hopanes by microbial activity in early stage of diagenesis. No significant concentration of tricyclic and tetracyclic terpanes could be seen in these oils as that there is no evidence to support the original marine source materials contributing to this environment.

The relative immaturity of the Sirikit oils parameters based on ratios of  $22S/22R17\alpha(H), 21\beta(H)-C_{31}$  hopanes,  $20S/20S+20R 14\alpha(H), 17\alpha(H)-C_{29}$  steranes,  $\alpha\alpha/\alpha\alpha + \beta\beta -C_{29}$  steranes and various aromatic was manifested in the maturity. The isomer ratios of  $C_{29}$  steranes of these oils were relatively low and moretane/hopane ratios were rather high compared to the general ratio values of crude oils. The maturity characteristics of these oils were in agreement with those previously observed for the Tertiary crude oils by GRANTHAM (1986). This investigation is supportive of the kinetic studies of isomerization processes of biomarkers with respect to source and heating rates constrain the rate of isomerization by STRANCHAN et al. (1988, 1989). Based on basinal characteristic, the geological setting of the Phitsanulok Basin arising from the regionally extensive strike-slip faults might have caused a rapid burial of the sediments during deposition. High heating rates and/or the type of organic source materials could affect changes in the of reaction rates of these isomerization reactions. Since time and temperature both affect the thermodynamic equilibrium of the reaction,

incompletely isomerization processes might result from changes in one of the variables. Variation in the source rocks with respect to contribution from coal sources, or mixed coal particles, or shales can also affect the different changes of activation energy in these isomerization reaction. The anomalously low values for the C<sub>29</sub> sterane isomers ratios and high moretane/hopane ratios in the Sirikit crude oils might arise from one or both of these effects, namely source and heating rate.

There was also no evidence of non thermal alteration, such as water washing or biodegradation to the Sirikit crude oils. However, catalytic clay reactions were also observed by the presence of diasteranes, but only in insignificant concentrations.

In summary, the geochemical characteristics of all the Sirikit oil samples from the Phitsanulok Basin indicated no significant difference in their sources, depositional environment, maturity and degree of biodegradation as compared to those oils derived from the different subunit reservoirs. All these crude oils were generated from the same source rocks of their environment. The burial history of the basin might be the main factor that influenced the maturity of these oils. Some typical biomarker characteristics in these oils were probably dependent upon the unique characteristics of the basin, such as the local type of organic source materials, heating rate and subsidence history which also effected presumably the style of



sedimentation. Therefore, the more one knows about the organic source materials and the effects of subsidence and heating upon the geochemical characteristics of the oils in this basin, the more one may truly understand the variations in geochemical characteristics of these Sirikit crude oils through time and space.