CHAPTER VI

CONCLUSION

The primary objective of the study is to define the lithostratigraphy of the Khao Khad Formation in the area of Khao Chan, Ban Saphanhin, Amphoe Muak-Lek, Changwat Saraburi as compared with the type section of Khao Khad Formation in Khao Khad, Amphoe Phra Phuttabat, Changwat Saraburi. Additional attempt will be made to determine the sedimentary facies and reconstruct the depositional environment of the Khao Khad Formation in the study area.

Classification and nomenclature of the lithostratigraphy

Numerous geological works have been conducted in the Saraburi area and the rocks of Permian age in the region have grouped into the Ratburi Group (Brown et al., 1951). Up to the present moment, they are called the Saraburi Group of Permian age (Bunopas, 1981) and have been subdivided into six formations, notably, Phu Phe Formation, Khao Khwang Formation, Nong Pong Formation, Pang Asok Formation, Khao Khad Formation and Sap Bon Formation (Hinthong, 1985). The Khao Khad Formation is dominated in the area, composing predominantly of limestone which is the valuable raw material for cement and construction industries. Many cement factories have quarried this formation for the cement production, crushed aggregate and ballast.

Refer to the Khao Khad Formation earlier proposed by Hinthong (1985) where the type section is located at Khao Khad, Amphoe Phra Phuttabat, Changwat Saraburi with the total thickness of 1,812 metres. The lithology of this formation is dominantly grey to dark grey limestone, argillaceous limestone, and dolomites. Nodular and bedded cherts are commonly associated and intercalated. Shale and sandstone are frequently

interbedded with limestone. Locally, marble, calcsilicate hornfels, and volcanic rocks are present. The age of Khao Khad Formation is Lower Permian (Artinskian-Kungurian).

It is apparent that the sedimentary sequences of the Khao Khad Formation in the study area at Khao Chan, are similar to those which consisting dominantly of grey to dark grey limestone, and dolomitic limestone. Nodular and bandded cherts are commonly associated and intercalated. Silt-shale are frequently interbedded between limestone beds and more abundant in the upper part of the sedimentary sequences. In the middle part, the limestone is slightly thermal metamorphosed, and volcanic rocks are present as small dikes and sills. However, the KC7 member is absent in the upper part of the type location (Figure 3.55). The age of the sedimentary sequences is marked at the lower part of the succession by the abundantly present Robustoschwagerina *sp.* indicating the Asselian age of Lower Permian (Loeblich and Tappan, 1988).

Lithostratigraphy of the Khao Khad Formation at Khao Chan area

Stratigraphiclly, the Khao Khad Formation in the study area overlies the Pang Asok Formation and conformably underlying the Sab Bon Formation with the thickness varies from 1,285 to 1,857 metres. There are seven members subdivide in ascending order as follows:

1) KC1 member is characterised by dark grey sparse biomicrite, thin- to medium-bedded algal biomicrite, and packed biomicrudite with allochems of shell fragment, foraminifera, algal fragment, intraclast and bryozoa, some dark grey chert nodule. The thickness varies from 251 to 294 metres, thinning eastwardly.

2) KC2 member is characterised by light grey to dark grey, medium-bedded sorted biosparite, crinoidal biosparite, and unsorted biosparudite with allochems of

crinoid stem, foraminifera, intraclast, and bryozoa, some dark grey chert nodule and slightly dolomitic. The thickness varies from 181 to 446 metres, thinning eastwardly.

3) KC3 member is characterised by grey to dark grey, thin–bedded, graded bedding poorly-washed intrasparudite, poorly-washed biosparite, packed biomicrite, and fossiliferous micrite with allochems of crinoidal fragment, foraminifera, intraclast, and shell fragment, and abundant reddish brown, thinly-laminated to thin-bedded silt-shale between limestone beds. The thickness varies from 20 to 81 metres, thinning eastwardly.

4) KC4 member is characterised by light grey to pinkish grey, and dark grey, thin- and thick-bedded poorly-washed biosparite, unsorted biosparite, packed intramicrite, and biomicrite with allochems of intraclast, crinoidal fragment, foraminifera, and detrital quartz, some elongated chert nodules and dolomite patches. The thickness varies from 292 to 395 metres, thinning eastwardly.

5) KC5 member is characterised by dark grey, thin- and thick-bedded packed intramicrite, and biomicrite with allochems of intraclast, crinoidal fragment, foraminifera, and detrital quartz, some elongated chert nodules, dolomite patches, and laminated silt-shale. The thickness varies from 267 to 273 metres, thinning eastwardly.

6) KC6 member is characterised by grey to dark grey, thin-bedded poorly-washed biosparite, intramicrudite, intramicrite, packed biomicrite and micrite with allochems of foraminifera, crinoidal fragment, coral fragment, intraclast, and detrital quartz associated with yellowish brown to reddish brown, thin-bedded silt-shale and silty sand. The thickness varies from 300 to 448 metres.

7) KC7 member is characterised by grey to dark grey, thin to thick-bedded, cross-lamination in the lower part, poorly-washed biosparite, and packed biomicrite with

allochems of foraminifera, crinoidal fragment, bryozoa, intraclast, and detrital quartz. The thickness varies from 300 to 365 metres, thinning eastwardly.

Depositional environments

The depositional environment of the sedimentary sequences in the study area is believed to be the shallow restricted marine, barrier bar and foreslope with some alternating of calm and storm conditions. The sub-environments concerned were intertidal and subtidal zone of restriced marine of inner shelf, subtidal and intertidal zone of inner shelf, subtidal zone of restricted marine of inner shelf, intertidal zone of barrier bar or shoal, barrier bar or shoal, and subtidal zone of outer barrier bar or foreslope. Due to the exceptionally thick sequences of sediments of this formation, it is concluded that the various subenvironments of shallow restricted marine were subject to gentle subsidence during the time of deposition. From the evidence of eastward thinning of the sedimentary successions of the Khao Khad Formation at Khao Chan area, it is believed that the paleogeography of the Permian sea in this area indicating the open marine was westwardly. This model under the present study concludes the similar paleogeography with the earlier study of Wielscowsky and Young (1985).

Chertification

The nodular and banded cherts associated with carbonate sedimentary sequences of Khao Khad Formation at Khao Chan area is believed to be the product of diagenesis where the source of silica is suggested to be from the dissolution of siliceous skeletons and siliceous minerals associated with the carbonate sediments or the migration of silica-rich interstitial pore fluids from adjacent strata. It is noted that the banded chert commonly contains some siliceous skeletal remains of sponge spicules.

Dolomitisation

The dolomitic limestone of the Khao Khad Formation at Khao Chan area have been recognised both as banded and patches dolomitic zones. It is believed to be formed during early diagenesis where the potential sources of Mg^{2+} is presumably of the sea water in the restricted marine environment and the Mg-rich interstitial pore fluid results from the transformation of high-Mg calcite to low-Mg calcite. The magnesium-rich solution seep to dolomitise the pre-existing carbonate sediments during early diagenesis under the sea floor by the mechanism of reflux model (Adams and Rhodes, 1960). The metastable high-Mg calcite is probably released the magnesium ion during the early diagenetic transformation to low-Mg calcite and cause dolomitisation of carbonate sediments in neighbouring area forming dolomite patches by the mechanism of burial stage model (Zenger, 1983).