CHAPTER III

METHODOLOGY

The methods used in this study were divided into four main steps which consisted of preparation stage, field investigation, laboratory studies, and final evaluation including report preparation.

3.1 Preparation Stage

3.1.1 All the previous works conducted in the study and neighboring areas were firstly reviewed.

3.1.2 Regional geology and geological structures were studied using the existing map and data together with remote sensing media.

3.1.3 General literature reviews on geology of Permian rocks embracing the stratigraphy, sedimentology, sedimentary petrography and diagenesis were also undertaken as background knowledge for further detailed discussion.

3.2 Field Investigation

3.2.1 Reconnaissance field surveys on the geological setting of Changwat Saraburi and neighboring area including the study area were carried out in order to obtain the better geological framework for future detailed study.

3.2.2 Detailed field surveys were essentially the detailed measurement of stratigraphic rock sections. The measured sections were undertaken along three routes in the vicinity of Khao Kheio (so called "Khao Khad area"), Khao Chan and along Pak Chong – Khao Yai highway. The traverses were made in the direction approximately perpendicular to the regional and local strike direction with the total length of 28,603 meters. The measurement was conducted in accordance with the standard procedure described by Compton (1962) which was essentially aimed at obtaining the megascopic information regarding the sedimentary sequence, lithology, thickness, fossils, sedimentary structures, bedding attitudes, etc. In addition, rock specimens from the measured section were collected whenever necessary for detailed petrographic studies. Altogether there are 312 sampling locations and 536 rock samples.

3.3 Laboratory Works

3.3.1 Petrography

3.3.1.1 All collected rock specimens were slab-cut and polished for megascopic observation of sedimentological features by necked eyes and low power magnification microscope.

3.3.1.2 The rock specimens were prepared as standard thin-sections which were also stained with the potassium ferricyanide and Alizarin Red S solution following standard procedures of Hutchison (1974). The thin-sections were studied under a polarizing microscope for carbonate mineral identification of various types of grain components and cements as well as their

textural and compositional variations. The information was used to classify and designate the proper rock name based on Grabau (1903) and Folk (1959, 1962).

3.3.1.3 Some important specimens were selected and prepared as polished thin-sections for the examination of phase variation of different diagenetic fabrics using a cathodoluminoscope, Cilt CCL8200, attached onto a microscope at the Gem and Jewelry Institute of Thailand. The cathodoluminoscope was run at accelerating voltage between 12.3 to 21.8 kV and current between 310 to 611 μA with automatic adjustments. There are totally 47 selected samples examined.

3.3.1.4 Fossils in rocks were studied and identified in order to gain the relative age and used as key bed for stratigraphic correlation. They were also useful for the interpretation of depositional environment.

3.3.2 Chemical Analyses

3.3.2.1 The major, minor and trace element compositions of various grain components and cements were analyzed using a JEOL electron probe micro analyzer (EPMA), Model JXA-8100 super probe, at the Department of Geology, Faculty of Sciences, Chulalongkorn University. Standards used for calibration of the microprobe are wallastonite for Ca and Si, enstatite, pyrophanite, fayanite, barite, albite, potash-feldspar and strontium barium niobate for Mg, Mn, Fe, Ba, Na, K and

Sr, respectively. The analyses were carried out at acceleration voltage of 15.0 kV, probe current of about 2.2×10^{-8} A and beam diameter of 1-5 μms. The results were automatic correction by JEOL software.

3.3.2.2 Carbon and oxygen isotopic analyses were carried out on 69 powder carbonate samples of various diagenetic fabrics and 21 samples of whole rocks. They were carefully drilled by small-dental drilling bits. The isotopic determination was analyzed using the Finnigan MAT Deltaplus isotope ratio mass spectrometer at the Institute of Earth Sciences, University of Graz, Austria. The sample powders with equivalent 0.1 to 0.3 mg carbonate content were loaded into individual glass vials and reacted with 10 % H_3PO_4 at 70°C for 4 minutes on the Finnigan Kiel II device for extracted CO_2 gas. The CO_2 was analyzed on line with the Finnigan MAT Deltaplus isotope ratio mass spectrometer. The standard of NBS 18 and laboratory's standard (Soelk marble, Styria) were routinely analyzed and could be reproduced within errors. Reproducibility of replicate measurements was better than 0.1 (1 sigma) for both $\delta^{18}O$ and $\delta^{13}C$. The results of both $\delta^{18}O$ and $\delta^{13}C$ values were reported relative to the Peedee belemnite of the Peedee Formation (Upper Cretaceous) of South Carolina.

3.4 Evaluation and Report Preparation

3.4.1 The sedimentary facies and the lithostratigraphy of the Khao Khad Formation were established.

3.4.2 Depositional environment of each facies was interpreted.

3.4.3 The physical and chemical changes through diagenetic history were synthesized.

3.4.4 The paleogeography and the depositional environment of the Khao Khad Formation were reconstructed.

3.4.5 Final preparation of thesis and manuscripts for publication in scientific journals have been carried out.