CHAPTER 2

PHYSICAL, GEOLOGIC, AND HYDROGEOLGIC SETTING

2.1 Physical setting

Lamphun Province is locate at Chiang Mai – Lamphun Basin, both an intermountain basin. Topographic features of The Lamphun Province are classified in three types according to Land Development Department, including Flat to nearly flatland, Undulating and rolling terrace and Hills and Mountains. The Flat to nearly flatland occupies approximately 12 percent of Lamphun Province area, covering floodplains of Ping River and Mae Kuang River at Muang district, Pa Sang district and northern part of Ban Hong district, average elevation range from 200 to 400 meters above mean sea level and Lamphun City with elevation of 290.29 meters above mean sea level. The Undulating and rolling terrace occupies approximately 24 percent of Lamphun Province area, covering southwest part and southeast part of Muang district, and southern part of Ban Hong district, average elevation range from 350 to 600 meters above mean sea level. The Hills and Mountains occupies approximately 64 percent of Lamphun Province area, covers eastern part and southern part of Muang district, average elevation range from 600 to 1000 meters above mean sea level, The Mountains lie at southern part of Lamphun City, which contiguous to the great mountainous range, separating Chiang Mai Basin and Lampang Basin, in the NE-SW direction.

The Lamphun Province have two main drainage including Ping River and Mae Kuang River. The Ping River is biggest river in the area, flowing from north to south, through western part of the area and divides the area into two parts (western and eastern part). The Mae Kuang River flows southwestward, through central part of the area, while Nam Mae Thi, one of the main tributaries in northern part of area, flows northwestward, another main tributaries is Nam Mae Tip, flows to the northwest direction, then southwestward, and finally northwestward to The Mae Kuang River.

The Lamphun Province is located in the tropical area, where weather is cool in the winter. Being situated further inland away from the sea, it has the longest drought or dry season. The weather in the summer is very hot. Climate of this area is distinctly divided into 3 seasons: Hot from March to April, Rainy from May to October and Cool from November – February (considered by the local people as hot, rainy and cold seasons). The dry season is situate between the cold and the hot season, this is the longest period lasting approximately 6 months and the temperatures fluctuate somewhat between that of the two seasons.

2.2 Tectonic setting and basin geology

The Chiang Mai – Lamphun Basin is one of several intermontane graben and half-graben rift basins (Figure 2.1). The basin has a maximum width of about 45 km, a length of over 130 km, and area of about 3000 km^2. The basin is bordered on the west by the Doi Suthep-Pui Range, where the maximum elevation is 1685 m, and on the east by the Doi Lang Ka-Khun Tan range, where the maximum elevation is 1986 m. Basin elevations range from 335 m at its northern end to 280 m at its terminus in the south. The Mae Ping (Ping River) flows N-S through the basin (Fenton et al., 1997, Rhodes et al., 2005, Wattananikorn et al., 1995).

As with the other rift basins within the province, the general orientation is N-S with sinuous appearance, and it follows the structural grain produced by the compression from Late Paleozoic to Mesozoic terrain collisions. Pre-existing strike-slip faults might also have contributed to basin geometry. The basins within the province are now primarily bounded by normal faults (Fenton et al., 1997, Rhodes et al., 2005).

The basin lies within the Shan Thai block of northwest Indochina, which tectonic studies indicate extruded to the south and southeast as a result of the Indian-Asian collision that produced the Himalayan Range. While the large-scale plate tectonics in the region surrounding Thailand have been well characterized, relatively little data is available for the Northern Thailand Basin and Range Province.

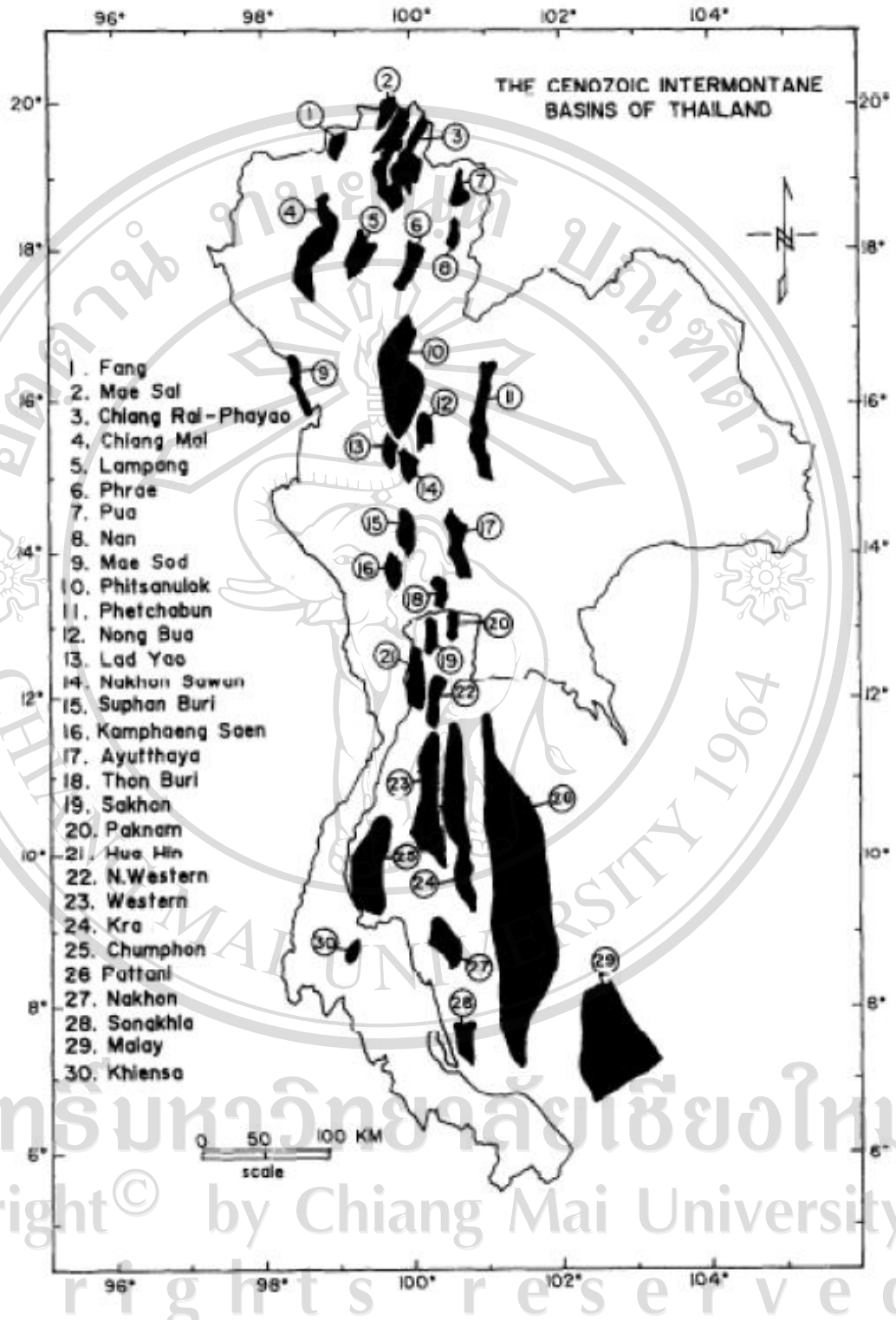

Figure 2.1 The Cenozoic intermontane basins of Thailand (Wattananikorn et al., 1995).

It can be said, however, that the history and distribution of the intraplate faults that commonly form basin boundaries are governed by distant and complex converging-plate motions, and also that northern Thailand is currently undergoing WNW to ESE extension (Peterson et al., 2007).

Rhodes et al. (2005) present arguably the most authoritative and well-supported hypothesis as to the history of the Shan Thai block, and more specifically the Chiang Mai – Lamphun Basin. The authors suggest that the basin underwent distinct phases of extension from the Late Oligocene to the Quaternary, one of which was driven by the Himalayan Orogeny, and with at least two intervening periods of basin inversion.

Support for the first period of basin inversion is provided by angular unconformities within the Mae Rim Formation on the western margin of the basin. Similarly, the second period of inversion is evidenced by folding of younger strata within the same formation, which Rhodes et al. (2005) claim may have reactivated normal faults as reverse faults. The authors, however, take great care to state that the structure and history of the Tertiary rift basins of northern Thailand is still not well known despite recent investigations. Also noted by several researchers (Fenton et al., 1997, Rhodes et al., 2005, Wattananikorn et al., 1995, Wood, 2009) is that very little non-proprietary well log data is available with which to better characterize and constrain basin stratigraphy.

With this limitation, geoscientists have had to infer the stratigraphy from outcrops located at the edges of the basin. The western margin is bounded by a low-angle normal fault where the footwall is composed of crystalline, metamorphic rocks of the Doi Suthep complex to the west and north of Chiang Mai city and the Doi Inthanon complex to the south. The basement at Mae Hia is most likely part of the Doi Suthep complex, containing gneiss and schist likely related to the underlying granite intrusion. These high grade metamorphic rocks are overlain by detached slabs of folded, relatively low-grade Paleozoic metasedimentary rocks (Rhodes et al., 2005, Wood, 2009).

Another important geologic unit located on the western margin is the Mae Rim Formation (Figure 2.2). This unit consists of fluvial and mudflow deposits, containing primarily casts from the low-grade metasedimentary rocks forming the roof of the

mountain complexes, as well as some gneissic clasts within the younger strata. The formation probably accumulated as alluvial fans along the range-front during uplift of the range (Rhodes et al., 2005).

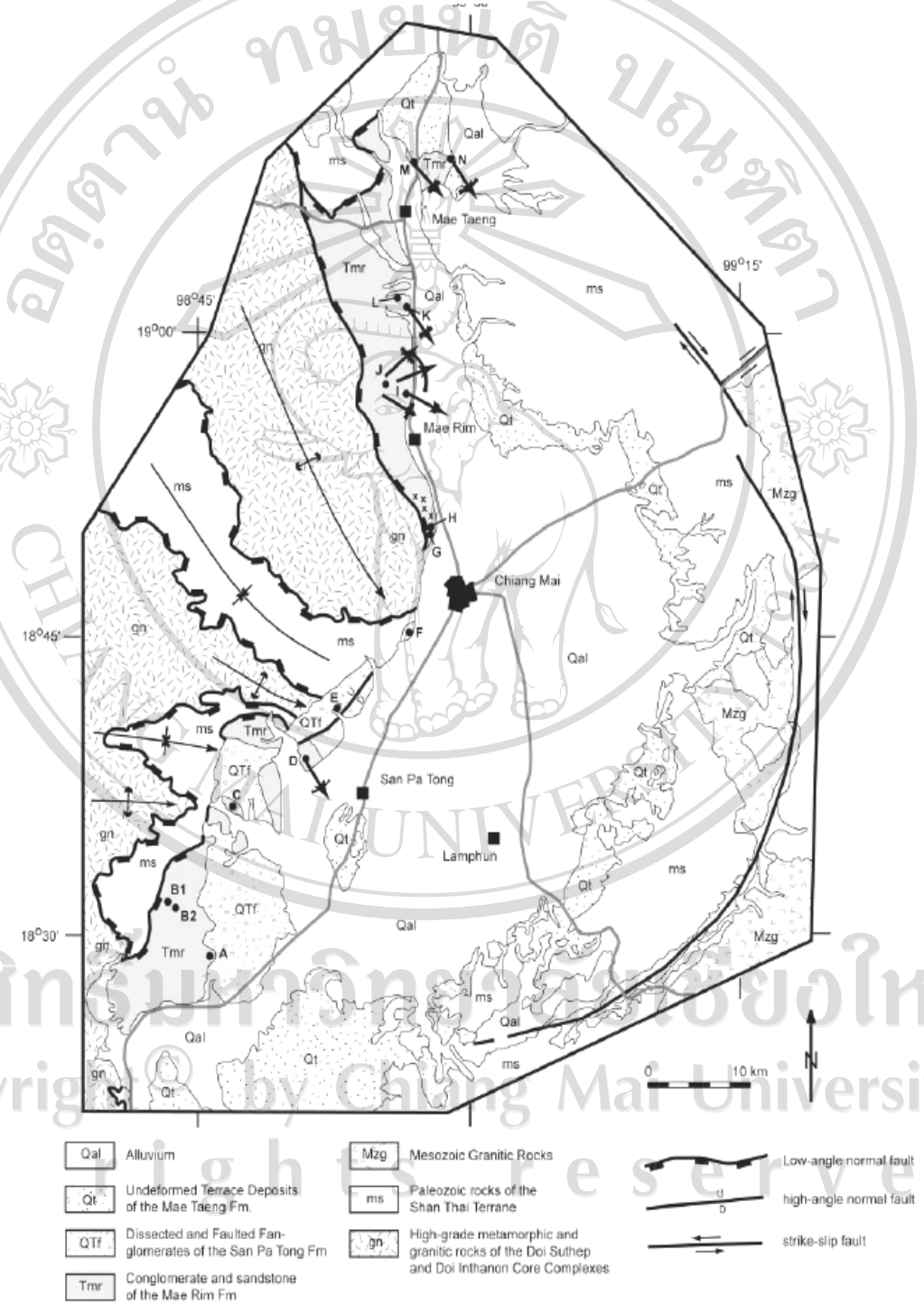

Figure 2.2 Geologic map of the Chiang Mai - Lamphun Basin (Rhodes et.al 2005).

The interior of the basin is overlain by the Quaternary river terraces and floodplain deposits governed by the Mae Ping. The upper terraces consist of sand and gravel beds, the lower terraces contain thick clay beds with lenses of sand and gravel, and the floodplain contains the previous materials with the addition of silts. It is hypothesized that the basin geometry is a complex set of half-grabens. The Quaternary alluvium sits atop the hanging wall of normal faults on the western margin, and laps sinuously onto basement rocks along the eastern margin (Rhodes et al., 2005, Wattananikorn et al., 1995, Wood, 2009).

The basement rocks to the east, known as the Shan Thai terrane, contain many of the same lithologies as those within the mountain complexes to the west, including a granite pluton and low-grade metasedimentary rocks. The terrane also contains Permian sandstone, shale, and mafic volcanics and tuffs likely erupted as a result of intraplate weakening during extension. It is likely that the Shan Thai terrain forms the basement of the Chiang Mai – Lamphun Basin (Rhodes et al., 2005, Wood, 2009).

2.3 Geologic setting

Department of Mineral Resources (2004) conducted a detailed geologic survey and constructed a groundwater map of Lamphun province. Topographically, the study area is flat and situated in a flood plain in the Cenozoic basin which is covered by unconsolidated sediment of the Quaternary age. These are consisted of low terrace deposits and alluvial deposits (Figure. 2.3). Low terrace deposits (Qtl) are distributed along eastern area. They are composed of sand, silt, clay, gravel and some parts were latteritic rocks. The sediments are of Pleistocene age. Alluvial deposits (Qa) were deposited along flood plain of the Mae Kuang River. There covered central and western portions of the area. The sediments are composed of sandy gravel, sand, silt, clay, and mud of Holocene age. The structural geology of the study area was effected by fault that lies parallel to the Mae Tha fault at the eastern part of Chiang Mai basin (Figure. 2.3). There is a major fault in the study area whose length is approximately 5 km long, lying northwest-southeast trending and north-south to northeast-southwest

trending at southern part of the area. Flow direction of Mea Kuang River is believed to be controlled by this fault.

2.4 Hydrogeology of the study area

Department of Mineral Resources (2004) mapped groundwater aquifer of Lamphun province which illustrated detailed hydrogeology of the study area. Unconsolidated sediments covering the entire study area can be divided into three aquifers as show in Figure 2.4. Young terrace sediment aquifer (Qcr) consists of gravel, sand, silt, clay being deposited along narrow terrace next to the Mae Kuang River floodplain which is consisted of thick clay with some gravel and sand pocket to thick gravel and sand beds. Groundwater is stored in the intergranular voids of gravel and sand layers. The average thickness of aquifer is 30 to 100 meters with the yield ranging from 2 to 20 m^3/hr. Colluvial sediment aquifer (Qcl) consisted of gravel, sand, clay, and rock fragments. Groundwater is stored in intergranular voids of gravel and sand deposits. The average thickness of aquifer is 15 to 20 meters with the yield ranging from 2 to 10 m^3/hr. Alluvial sediment aquifer (Qcp) consisted of gravel, sand, silt, clay being deposited along the flood plain and meandering belt of the Mae Kuang River. The average thickness of aquifer is 20 to 40 meters with the yield of more than 20 m^3/hr.

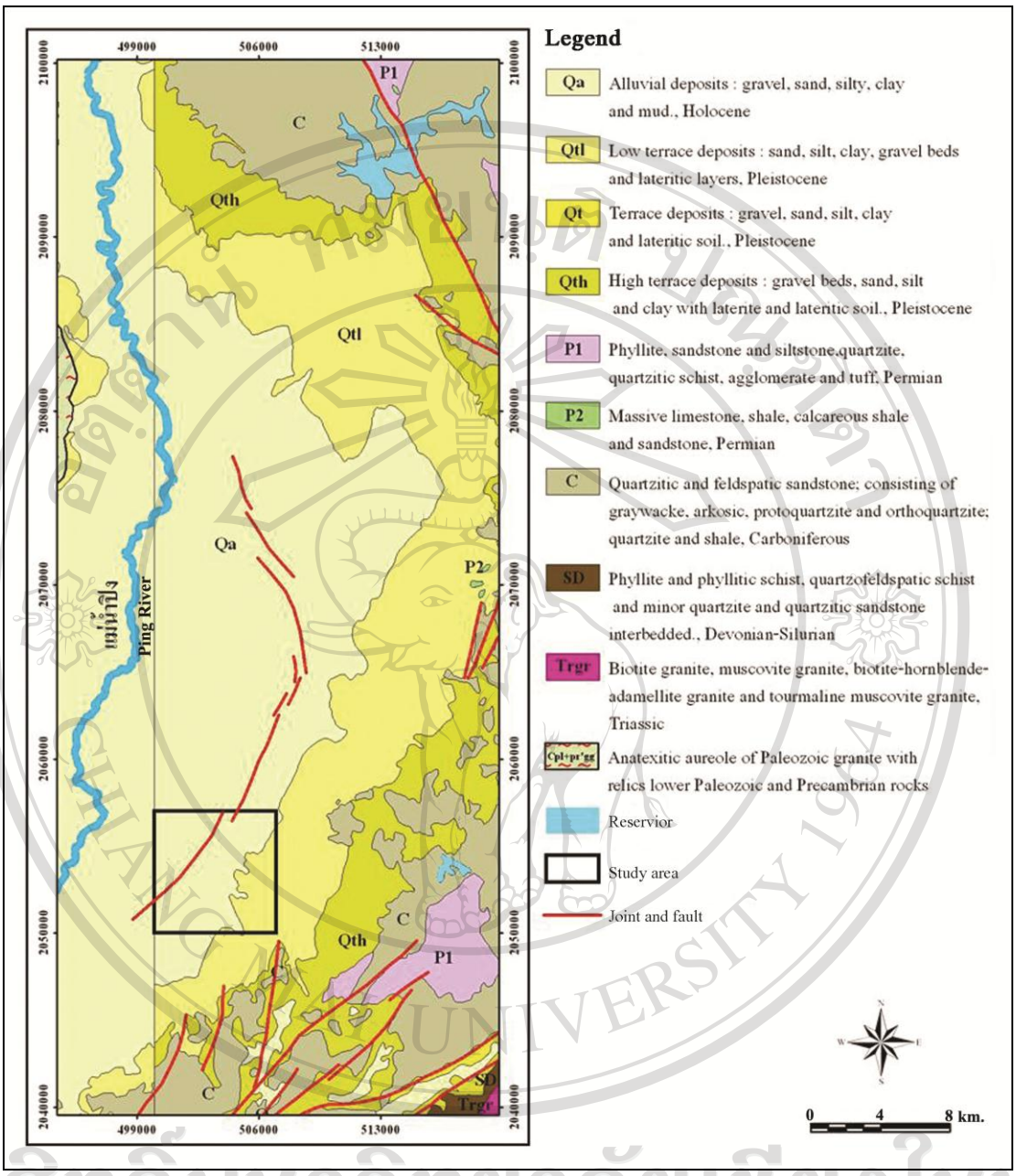

Figure 2.3 Geologic of the study area and its immediate vicinity (modified from Chiang Mai University, 2008).

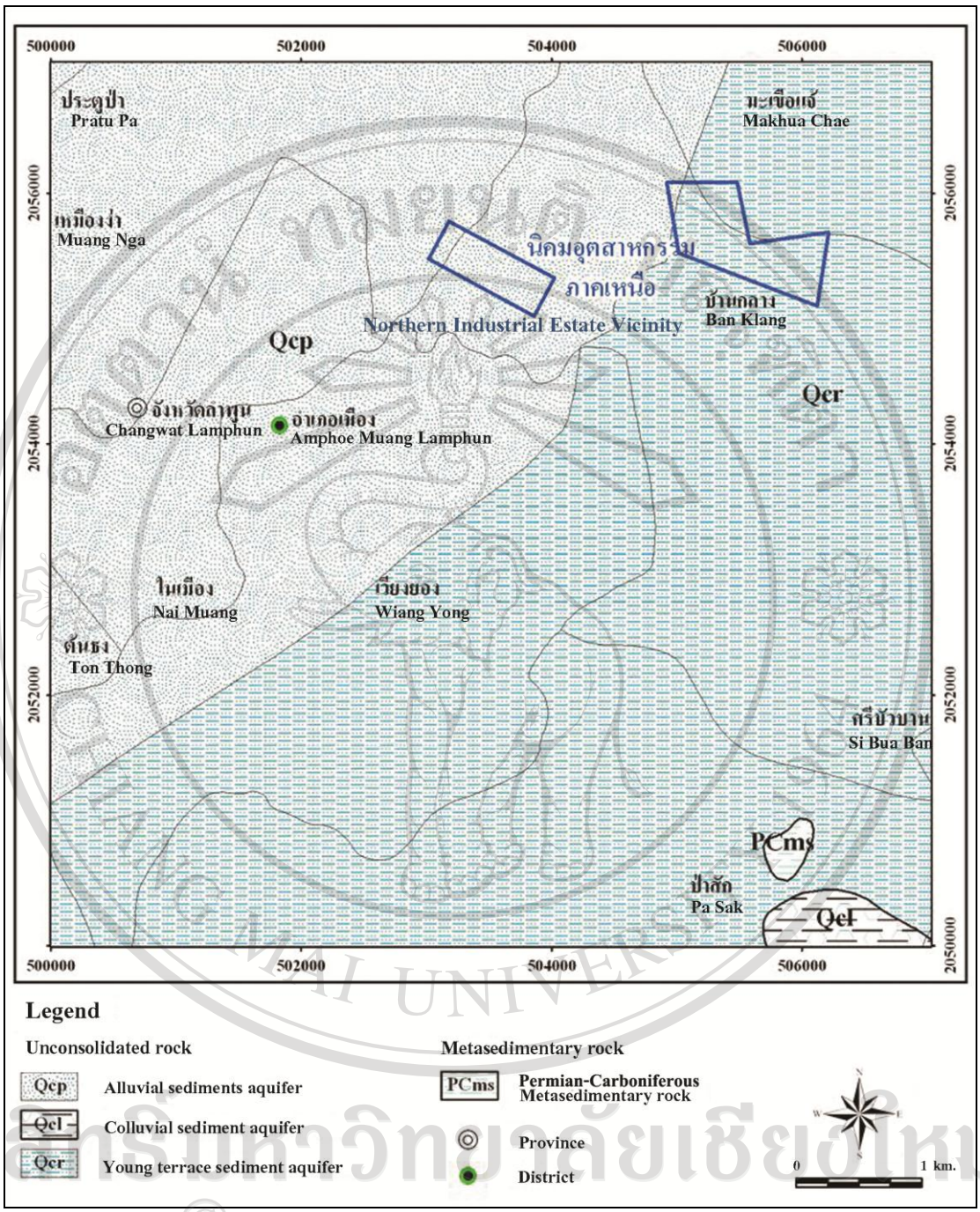

Figure 2.4 Hydrogeologic map of the study area. (modified from Department of Mineral Resources, 2004).