CHAPTER III

ROCK SAMPLES

This chapter describes geological of selective area and sample preparation for Phra Wihan siltstone, Phu Phan conglomeratic sandstone and bedded sandstone.

3.1 Sample collecting and geological area

Samples have been collected from Northeast part of Thailand. Geological strata in this area is mostly comprised with Mesozoic red bed sedimentary rocks. Mainly composed of conglomeratic, sandstone, siltstone, mudstone, and shale. Somes of the strata have interlayers of rock salt and potash, which likely found across south China, Laos, and other countries nearby (Zhou et al., 2019; Song et al., 2017). In Thailand, Two basins are identified to have these strata, known as Khorat and Sakon-Nakhon basins. From recent studies, both basins tend to have good geological correlation with less of hiatus (Charusiri, Imsamut, Zhonghai, Ampaiwan, & Xu, 2006; Racey, 2009). Before Triassic-Jurassic tectonic genesis, some researchers believed that these basins used to coexist as one. After the event, Phu Phan ranges were uplifted and separated both apart (Veeravinantanakul, Kanjanapayont, Sangsompong, Hasebe, & Charusiri, 2018). Khorat basin is known as one of a complete Mesozoic red bedded series. The series of formation, comprise with Nam Phong, Phu Kradung, Phra Wihan, Sao khua, Phu Phan, Khok Kruat, Maha Sarakham and Phu Tok formations. These formations deposited upward, respectively. This study will be focused on sedimentary rocks in Khorat basin, especially at the West edge.

The selected samples are from slope embankment and road cut in Nakhon Ratchasima and Chaiyaphum provinces, coordinate zone 47N locate at 101°68’11” E /

15°56’35” N and 101°52’30” / E 14°40’15” N. The samples included with the upper part Phra Wihan sandstone (PWSS) and conglomeratic sandstone (PPCS) and bedded sandstone (PPSS) from the lower part of Phu Phan formation. Selective areas and northeastern railway lines (State Railway of Thailand [SRT], 2020) are shown in Figure 3.1 with geological formations of the Khorat group (Department of Mineral Resources [DMR], 2018).

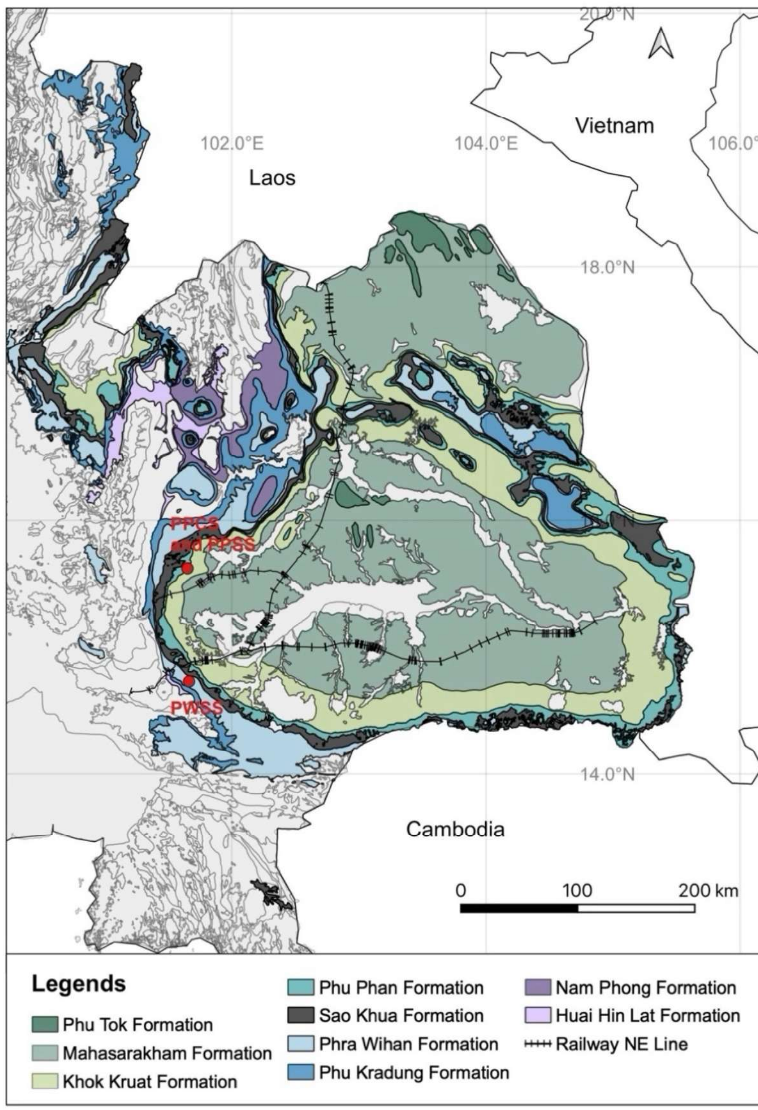

Figure 3.1 Geological map of sample collecting area (modified from DMR, 2018; SRT, 2020).

3.2 Sample preparation

Rock specimens of Phra Wihan sandstone (PWSS), Phu Phan conglomeratic sandstone (PPCS) and Phu Phan bedded sandstone (PPSS) are cut to obtain cubical blocks with dimensions of 27.5×27.5×27.5, 25.0×25.0×25.0, and 29.5×29.5×29.5 mm^3, respectively. Twenty cubical specimens have been prepared for each rock type. The specimens are remained smooth surface with discrepancy of grinding ± 0.5 mm in each axis. Ten specimens are used for dry slake durability index test, and the rest for wet testing. The combined dry weight of ten specimens is about 500±50 g, following ASTM D4644-16 standard. The specimens are prepared with bedding planes parallel to one of the specimen side. Figure 3.2 shows representative of initial specimens in each rock types and Figure 3.3 shows specimens of PPCS using under dry testing. The average density of PWSS is 2.35 g/cc and 2.67 g/cc and 2.53 g/cc for PPCS and PPSS. The density is determined in accordance with ASTM D2763-21 standard test method.

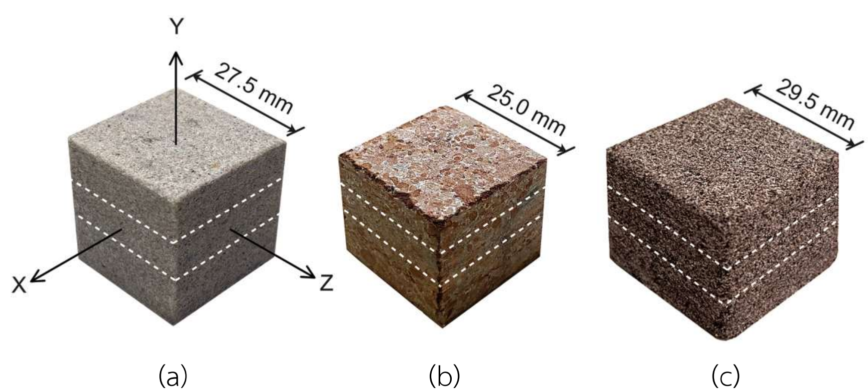

Figure 3.2 Representative of specimens at initial condition of PWSS (a), PPCS (b), and PPSS (c) with dimensions. Dash lines show alignment of bedding planes.

Figure 3.3 Examples of PPCS specimens prepared for dry testing.

3.3 Mineralogical and petrographic examination

This section includes the result of mineralogical and petrographic analysis at initial condition. The mineral compositions of rocks are obtained from X-ray diffraction (XRD), analyze based on the Rietveld refinement method as specified by ASTM E3294-22 standard. The samples are prepared with sizes less than 0.42 mm. (mesh no. 40). The sizes are prepared such that to provide more prospect of X-ray beam to contact with the surface. The sample is contained in sample holder (Figure 3.4) and tested with Rigaku smart lab X-ray diffractometer by using Cu-Kα tube (1.5418 Å) with 0.5 sec/step. The specified interest two theta are ranging from 5-80 degrees. The results of mineral compositions at initial conditions are shown in Table 3.2.

Petrographic examination provides more accuracy to identify mineral compositions within rocks. The results of both tests will be correlated to classify as if they are grains, matrix or cementing materials. The samples are prepared normal to mirror plate and grinding until the sample thickness is 0.3±0.05 mm. The result shows in Figure 3.5 represented the image of cross polarized light and closed up image of specimens. The images show that PWSS specimen has a grain contacts with siliceous cementing. PPCS specimen shows matrix supported of quartz and some of calcite minerals with lithic fragments and calcrete feature. For PPSS specimen, ferrous oxide appear to be a cementation of quartz, feldspars, and other mineral grains.

Table 3.1 Mineral compositions of samples before testing.

Mineral compositions		Weight percent (%)		
		PWSS	PPCS	PPSS
Quartz		78.58	14.13	60.60
Plagioclase feldspars		1.99	6.81	5.93
K-feldspars		3.00	2.86	0.74
Mica	Biotite (Mg-Fe)	1.89	2.31	0.26
	Muscovite (K)	0.97	0.45	2.21
Clays minerals	illite	0.64	5.36	1.30
	Kaolinite	5.74	2.37	1.70
	Montmorillonite	0.58	0.61	0.31
Chlorite		4.32	2.01	9.22
Calcite		0.23	58.28	11.32
Dolomite		0.00	0.77	0.80
Gypsum		0.81	1.97	2.54
Siderite		0.00	0.29	0.36
Goethite		0.00	0.00	0.68
Hematite		0.22	1.86	1.54

(a) (b) (c)

Figure 3.4 Sample preperation for XRD analysis of PWSS (a), PPCS (b) and PPSS (c).

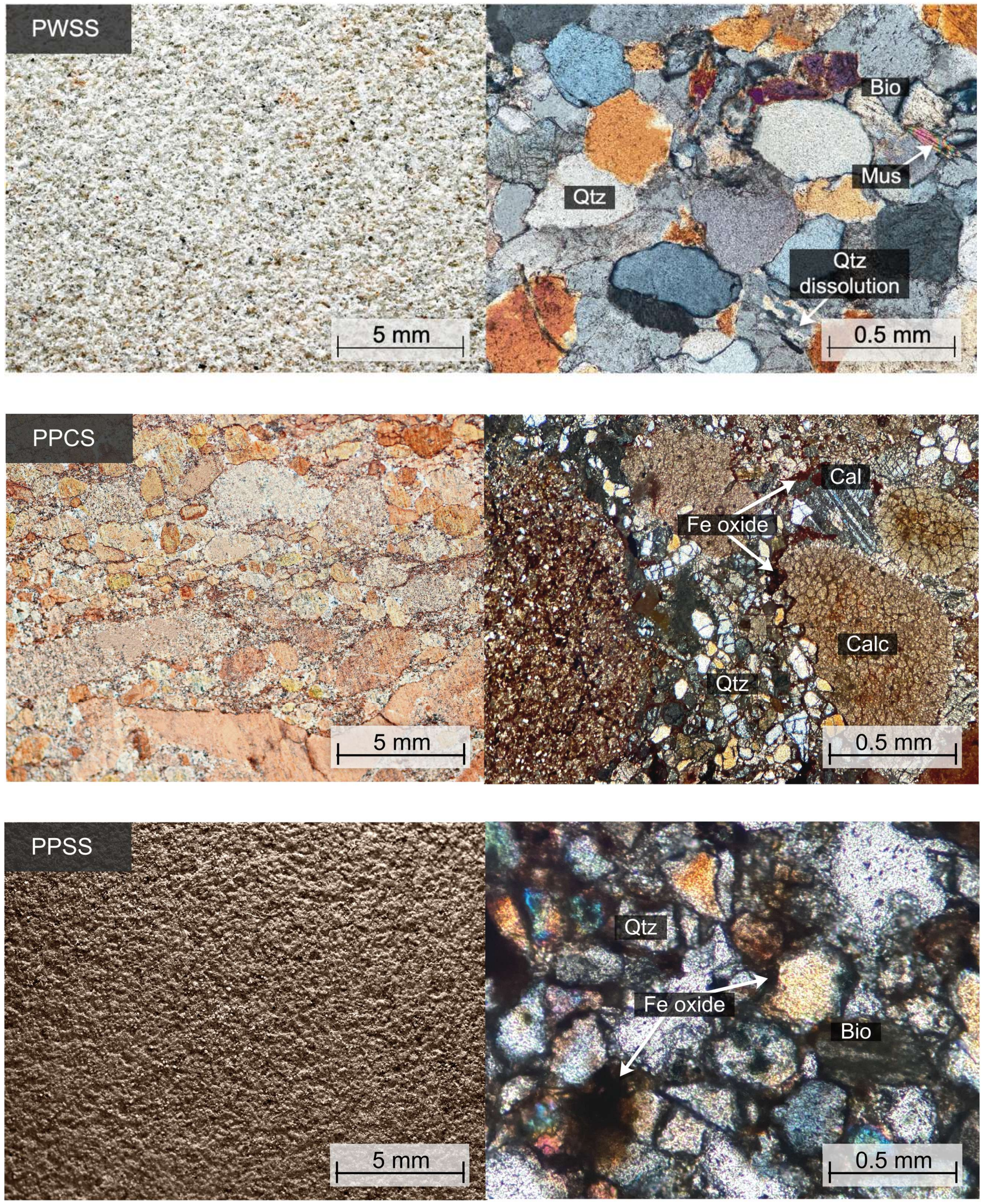

Figure 3.5 Closed-up images of specimens (right) and petrographic images under cross polarized light (left) of PWSS, PPCS and PPSS. Quartz (Qtz), Calcite (Cal), Calcrete (Calc), Muscovite (Mus) and Biotite (Bio).