ลักษณะเฉพาะของแหล่งแร่ "เฟลด์สปาร์เขาถ้ำ" และความสัมพันธ์กับหินภูเขาไฟในบริเวณข้างเคียง อำเภอสระโบสถ์ จังหวัดลพบุรี

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CHARACTERISTICS OF KHAO THAM FELDSPARS AND THEIR VOLCANIC ASSOCIATION

AMPHOE SRABOT, CHANGWAT LOPBURI

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Senior Project Advisor

CHARACTERISTIC OF KHAO THAM FELDSPAR AND THEIR VOLCANIC ASSOCIATION, AMPHOE SRABOT, CHANGWAT LOPBURI

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Abstract

Khao Tham volcanics is a part of Lam Narai volcanic field, located 7 kilometers north of Amphoe Srabot, Changwat Lopburi. This project is aimed to study petrography, geochemistry and mineral chemistry for classification and correlation of volcanic rocks in the study area. Based on petrographic characteristics, Khao Tham volcanic rocks can be classified into 6 types, i.e., rhyolites, vitrophyric rhyolites, rhyolitic tuff, andesites, perlitic pitchstones and devitrified perlites. Rhyolites consist of microcrystalline feldspar and tridymite with vitrophyric groundmass. Smaller amounts of microcrystalline feldspar and tridymite are found in vitrophyric rhyolites. Andesites consist mostly of microcrystalline feldspar and biotite. Rhyolitic tuff is composed mainly of vitrophyric ash groundmass. Perlitic pitchstones show perlitic cracks and vitrophyric texture. Spherulitic texture is found in devitrified perlites. Feldspar found in these rocks are classified based on mineral chemistry as sanidine. Geochemically, Khao Tham volcanic rocks contain similar major and minor oxides ranging within ranges of 68-78 wt% SiO_2, 13-15 wt% Al_2O_3, 3-5 wt% K_2O, 0.1-5 wt% Na_2O. However, the lesser amounts of Fe_2O_3 and TiO_2 of fine-grained rhyolites indicate that this rock type provides good quality feldspar appropriate for industry. In addition, mineral chemical analyses also indicate that Khao Tham volcanic rocks contain mainly alkali feldspar, particular Sanidine.

Keywords : Khao Tham; feldspar; Rhyolite; Lam Narai; volcanic

ลักษณะเฉพาะของแหล่งแร่เฟลด์สปาร์เขาถ้ำ และความสัมพันธ์กับหินภูเขาไฟในบริเวณข้างเคียง อำเภอสระโบสถ์ จังหวัดลพบุรี

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บทคัดย่อ

หินภูเขาไฟบริเวณเขาถ้ำเป็นส่วนหนึ่งของพื้นที่หินภูเขาไฟลำนารายณ์ ตั้งอยู่ห่างจากอำเภอสระโบสถ์ จังหวัดลพบุรีไปทางทิศเหนือเป็นระยะทางประมาณ 7 กิโลเมตร ซึ่งโครงงานวิจัยนี้ได้ทำการศึกษาศิลาวรรณา ธรณีเคมี และเคมีแร่ของหินเพื่อทำการจำแนกและหาความสัมพันธ์ระหว่างหินบริเวณแหล่งแร่เฟลด์สปาร์เขาถ้ำและหินภูเขาไฟข้างเคียงภายในพื้นที่ศึกษา จากการศึกษาศิลาวรรณาทำให้สามารถแบ่งหินในพื้นที่ศึกษาออกได้เป็น 6 กลุ่ม คือ rhyolites, vitrophyric rhyolites, rhyolitic tuff , andesites , perlitic pitchstones และ devitrified perlites หินกลุ่ม rhyolites พบผลึกขนาดเล็กของแร่เฟลด์สปาร์และทริดิไมท์ในเนื้อพื้นเนื้อแก้ว ในขณะที่กลุ่ม vitrophyric rhyolites มีปริมาณผลึกแร่เล็กน้อยและมีเนื้อแก้วมาก ส่วน rhyolitic tuff จะพบลักษณะของเนื้อแก้วและเถ้าภูเขาไฟ ในกลุ่มของ andesite พบผลึกแร่ขนาดเล็กของเฟลด์สปาร์และไบโอไทต์ นอกจากนี้ในกลุ่มของ perlitic pitchstone พบเนื้อแก้วในปริมาณมากกับผลึกแร่เล็กน้อยทั้งยังแสดงลักษณะของ perlitic crack ส่วน devitrified perlite แสดง spherulitic texture อย่างชัดเจน โดยแร่องค์ประกอบหลักของหินภูเขาไฟเขาถ้ำคือ เฟลด์สปาร์และทริดิไมต์ ซึ่งผลจากการศึกษาเคมีแร่ของหินในพื้นที่ทำให้ทราบว่าส่วนใหญ่เป็นแอลคาไลน์เฟลด์สปาร์พวกซานิดีน และจากการศึกษาธรณีเคมีพบว่าหินภูเขาไฟบริเวณเขาถ้ำในแต่ละกลุ่มมีปริมาณธาตุองค์ประกอบหลักและธาตุองค์ประกอบรองในปริมาณที่ใกล้เคียงกัน ประกอบด้วย 68-78 wt% SiO_2, 13-15 wt% Al_2O_3, 3-5 wt% K_2O, 0.1-5 wt% Na_2O.แต่ด้วยปริมาณของ Fe_2O_3 และ TiO_2 ซึ่งพบว่ามีปริมาณน้อยมากในกลุ่มของ rhyolites และปริมาณผลึกเฟลด์สปาร์ขนาดเล็กจำนวนมากทำให้หินในกลุ่มนี้มีคุณภาพดีพอจะนำไปใช้ในอุตสาหกรรมได้ ดังนั้นจะพบว่าหินกลุ่มต่างๆในพื้นที่นั้นมีองค์ประกอบทางเคมีที่ใกล้เคียงกันแต่ด้วยลักษณะการปะทุและเย็นตัวของลาวาที่ต่างกันจากการระเบิดหลายครั้งทำให้เกิดหินที่มีลักษณะต่างกันรวมทั้งแหล่งแร่เฟลด์สปาร์เขาถ้ำด้วย

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Chapter I
Introduction

1.1 General Statement

The Lam Narai volcanic field consists of various types of Late Tertiary Volcanics covering an area between Changwat Lopburi and Changwat Phetchabun, in central Thailand, approximately 1,200 km^2 (Jungyusuk and Suriyachai, 1987). Khao Tham Volcanics are parts of the central Lam Narai volcanic field located about 7 km north of Amphoe Srabot, Changwat Lopburi. It is useful for domestic industries especially feldspars, one of the main material in ceramics industries that is a large industry of Thailand.

Normally, most of feldspars used in domestic industries are mined from felsic plutonic rocks which give coarse-grained feldspars that is easy for mineral separation and also easy for quality control. However, Khao Tham feldspar, which is one of the active feldspar mines, is associated with volcanic rocks, particularly rhyolite (Jungyusuk, 1995). As mentioned above, the characteristics of Khao Tham feldspars are worthy known. Therefore, this study is initiated to focus on petrology and geochemistry of volcanic rocks in this area.

1.2 Hypothesis

Khao Tham feldspars in Amphoe Srabot Changwat Lopburi are altered from volcanic glass or other country rocks that contain different compositions.

1.3 Objectives

The main objective of this study is to investigate petrographical and geochemical characteristics of Khao Tham feldspars and relationship of volcanic rocks in the study area.

1.4 Scope of Work

The research is aimed for study petrography, geochemistry and mineral chemistry of Khao Tham feldspars and related volcanic rocks in Amphoe Srabot, Changwat Lopburi.

1.5 Location and Accessibility

The study area is located in Amphoe Srabot, Changwat Lopburi, central Thailand. Its is close to Saraburi, Sing Buri, Ang Thong, Nakhon Sawan, Nakhon Ratchasima, Chaiyaphum and Phetchabun (Fig. 1.1). The area lies on Topographic map scale 1: 50000 of L7017, sheet 5139 I & 5139 I (Ban Maha Pho & Ban Phaniat) of the Royal Thai Survey Department (Fig. 1.2). It is bounded by latitudes between 15° 14' N and 15° 16' N, longtitude between 100° 52'E and 100° 54' E

The study area is accessible via the Bangkok - Saraburi - Baan Dee Lang - Baan Wang Plerng route which is about 173 kilometers. Subsequently, moving northward to Amphoe Srabot is taken via motorway no. 3326 for approximate 16 kilometers. After passing Amphoe Srabot about 1 kilometer, we turn right northward to Baan Khok Charoen about 9 kilometers before reaching Baan Maha Pho. Local road along a small canal is taken about 2 kilometers to Khao Tham. Total distance from Bangkok is approximately 205 kilometers.

Fig.1.1 Tourist map of Lop Buri showing main routes accessible to the study area (Tourism Authority of Thailand)

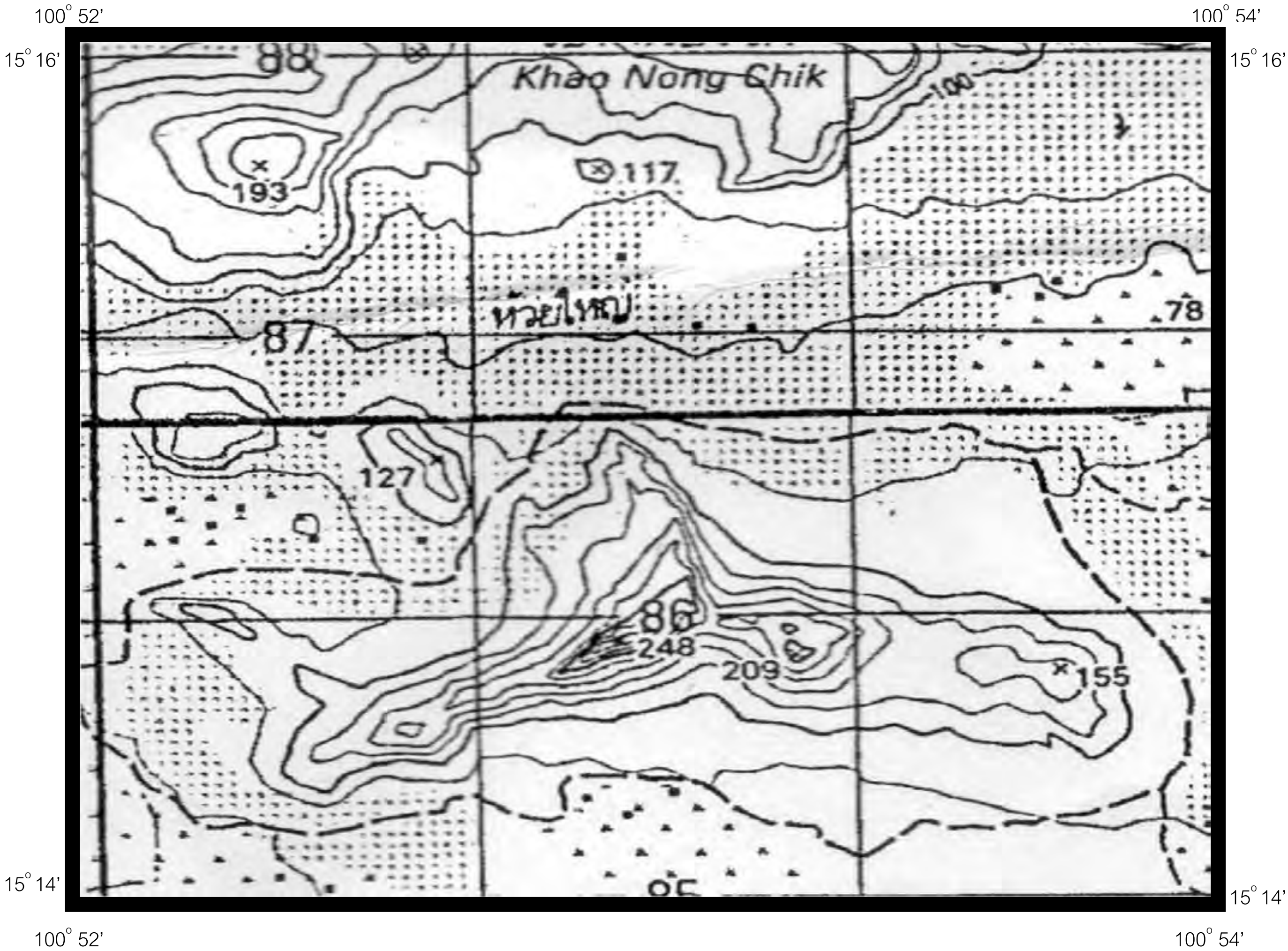


Fig 1.2 Topographic map of the study area,scale 1:50,000, serie L7017, sheet 5139 I (Ban Maha Pho) and 5139 II (Ban Phaniat) (The Royal Thai Survey Department).

1.6 Methodology

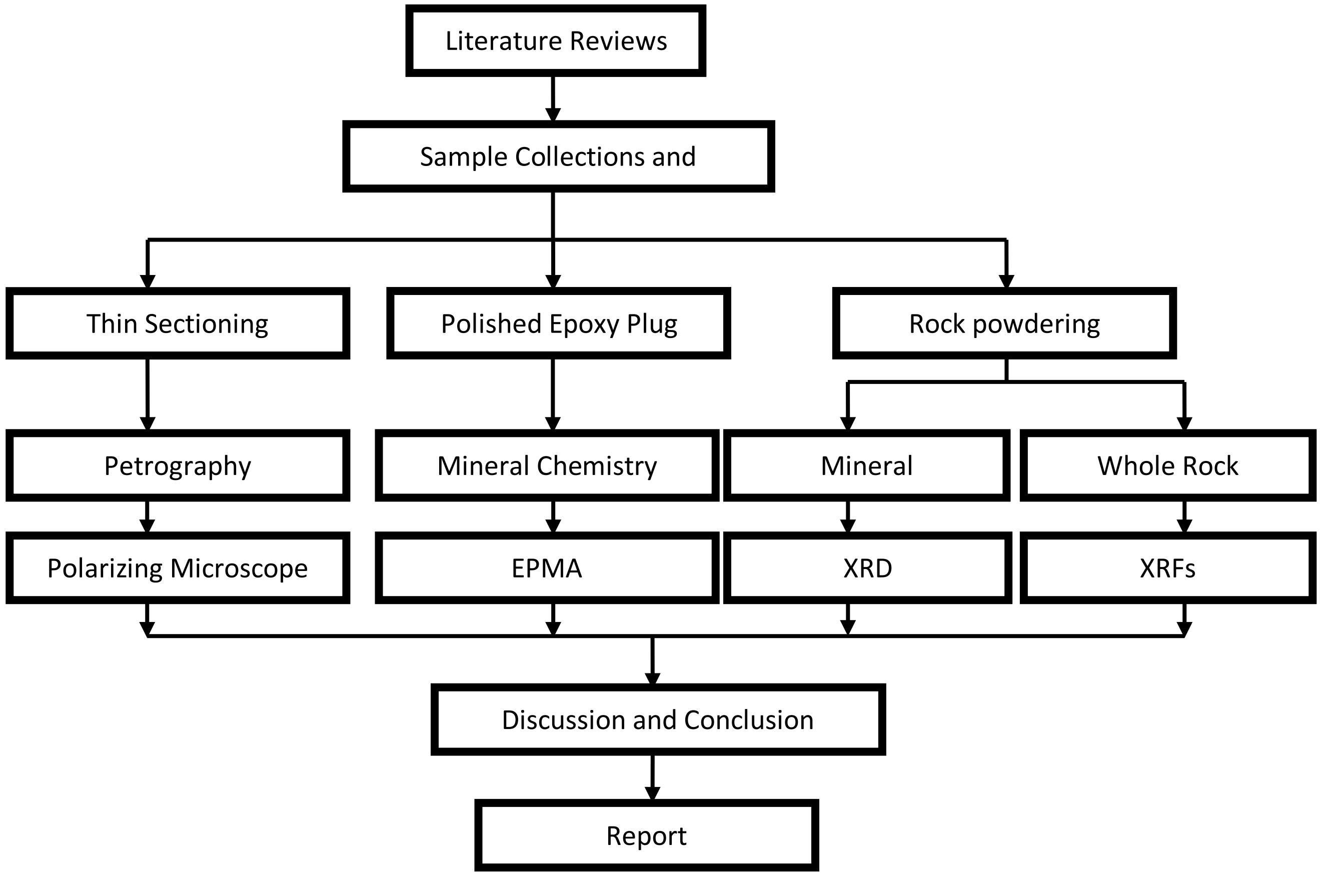


Fig. 1.3 Schematic diagram showing steps of work during this project.

Steps of work under this research project are summarized in form of flowchart diagram as shown in Fig. 1.3. They are composed of 8 steps. Details of each step are reported below.

1. Literature reviews were taken place initially to collect information related to his research project including geologic setting in the study area and adjacency as well as similar research from other places. This step could lead to basic knowledge and guidelines for the research project.

2. The geological data of the study area were acquired by field investigation and the rock samples were collected for studying physical property, petrography and geochemistry.

3. Petrography description was carried out using a polarizing microscope to identify rock-forming minerals and their textures which can help to classified simply group of rocks.

4. Mineral assemblages were additionally identified using XRD because all of rocks sample in study area are volcanic rocks which are hardly identified under microscope.

5. Whole-rock geochemistry was analyzed using a X-Ray Fluorescence Spectrometer (XRF), Model Bruker AXS S4 PIONEER. Analytical condition was set at 220/380 v, 50 Hz, 8 kvA which internal standards and rock standards were used for calibration prior to report wt% oxides of major and minor compositions. The whole-rock analysis can be use to indicate chemical composition of Khao Tham feldspar and associated volcanic rocks in study area.

6. Mineral chemistry of all significant assemblages were subsequently analyzed using an Electron Probe Micro-Analyzer (EPMA), model JEOL JXA-8100 and analytical condition was set at 15kV with about 2nA measuring time of each elements. Pure oxides and mineral standards was selected for calibration before automatic ZAF correction and reported as % oxides. Mineral chemistry of feldspars in rocks sample was then used to identify feldspars.

7. Discussions on specific aspects including characteristics and chemical compositions of Khao Tham feldspar and other volcanic rocks nearby area and their relationship were then carried out.

8. Finally, all data gained from the stud were reported herein.

CHAPTER 2: GENERAL GREOLOGY

Regional geology

Detailed Geology

Sample Locality

Chapter II
General Geology

2.1 Regional Geology

From the study of Jungyusuk and Khositanont (1992), Lopburi area is located between 100°45'E – 101°15'E and 15°00'N-15°30'N(fig. 2.1) covering topographic maps of Ban Phaniate(5139 I), Amphoe Chai Badan(5239 III), Ban MahaPho(5139 I) and Amphoe Sri Thep(5239 IV). Rocks in the area are mainly sedimentary and igneous rocks. Metamorphic rocks occur in minor amounts along the contacts between sedimentary and igneous rocks. Sedimentary rocks in this area are Permian shale, sandstone and limestone and Mesozoic non-marine clastic sedimentary sequence of the Khorat Group which covers a large area in the eastern part of this region.

Volcanic rocks are distributed along a north-south trend covering approximately 1,200 square kilometers which filed relationships relative to the other rock units are poorly established (Fig.2.1). They occur as lava flows and dikes associated with pyroclastic deposits. The associated plutonic rocks are granite and exposed sporadically as small shallow intrusive bodies. Jungyusuk and Suriyashai(1987) proposed that volcanic rocks in this area are named as the Lam Narai Volcanic Formation. The volcanic rocks vary in composition from mafic to felsic. The intermediate volcanic rocks, which are overlain by rhyolite, pyroclastic rocks and basalt, are believed to be the oldest rocks of the Lam Narai Volcanic Formation (Jungyusuk and Suriyashai, 1987). The rhyolitic rocks are characterized by massive rhyolite, pitchstone perlite and associated pyroclastic rocks. It is believed that basalt which overlies rhyolite, trachyandesite, andesite and unconsolidated Quaternary beds are the youngest volcanic rocks in this area. The basalt also occurs as dikes cutting though the volcanic rocks and Quaternary sedimentary beds.

Trachyandesite and andesite expose in the central and northwestern parts of the Lop Buri area. The andesitic rocks in the northern part on the Lop Buri area represent a volcanic sequence comprising vesicular basaltic andesite and trachyandesite porphyry at the base, and pyroclastic deposits, rhyolite vitrophyre and rhyolite on the top part. The andesitic rocks range from grayish green, reddish brown to grayish black in color with very fine-grained to porphyritic texture. The eruption of intermediate lava locally produced blocky jointed lava lobes and scoriaceous lava rubble (Aa flow). This lava flow is surrounded by a thick and irregular layer of autobrecciated rock. The autobrecciated layer indicated the steep flow fronts of andesitic lava (Cas and Wright, 1987). The lava flow is overlain by glassy layers, which are dense, black in color with microphenocrysts of plagioclase and pyroxene set in glassy groundmass. This rock is the chilled surface of the andesitic lava. Trachyandesite consists mainly of sanidine, plagioclase and clinopyroxene with good flow alignment. The overlying pyroclastic rock is a lithic lapilli tuff. The pyroclastic rock contains varying size rock fragments (2 to 15 centimeters) including scoriaceous basaltic andesite, andesite, trachyandesite, pumice and acidic glassy rock. Large rock fragments of andesitic rock (approximately 10x20 centimeters) are also found in the pyroclastic deposit. Andesite porphyry occurs in the central part of Lop Buri area. The andesitic lavas are overlain by pyroclastic deposits and rhyolite. The rocks contain 10-30% of plagioclase phenocrysts, 5-10% of clinopyroxene and a small amount of hornblende phenocrysts embedded in a microcrystalline to glassy groundmass. The relationship of the andesitic rocks to the more basic and associated acidic rocks suggests that several volcanic episodes occurred in this area. An andesitic rock was determined by paleomagnetic data to be approximately of Late Tertiary to Quaternary age (P.Vella, pers.comm.).

Rhyolite lavas of Lam Narai Volcanic Formation cover an area of approximately 300 square kilometers. The rhyolite in this area is usually associated with pyroclastic deposits. A variety of lithologies and textural features of the rhyolite can be distinguished. The rocks include massive rhyolite, glassy breccias, pitchstone perlite and pyroclastic deposits. The eruption of acidic volcanic materials locally produced a layered structure characterize by layered of pyroclastic rock at the bottom, overlain by glassy layers with massive rhyolite layers on the top.

Generally, the pyroclastic deposits are poorly sorted with high particle concentrations characteristic of pyroclastic flow deposits. The deposits are composed of more than one flow unit. Each flow units is regarded as the deposit of a single pyroclastic flow. In this area, there are two main types of pyroclastic unit; lithic lapilli and ash-flow tuffs. Surge deposits are also found associated with pyroclastic flow deposits. The pyroclastic flow units are composed of lithic and pumice clasts at the bottom with an upper fine-ash layer(20 centimeters to 2 meters thick).The lithic lapilly layers are composed mainly of variable size(2 to 20 millimeters) and concentration rock fragments(vesicular trachyandesites, pumices, glassy rocks and rhyolites) in ash matrix. Figure 2.2 is a schematic diagram showing the textural elements of the pyroclastic eruption.

Glassy rock (perlite) of rhyolitic composition is always found associated with pyroclastic flow deposits and rhyolite. It overlies pyroclastic flow units and forms thick foliated layers as chilled glassy carapace rhyolite lava and as glassy brecciated beds with varying thickness from 10 to 20 meters. A large amount of glassy rock ejected amongst the pyroclastic deposits indicates that while the rhyolite lava was developing, explosive eruptions may have continued (Cas and Wright, 1987). The rocks are variable in color from light green, green to black. Some glassy rocks show flow layers defined by black and light green flow banding. These glassy layer are usually folded. Contraction features in this glassy rock are characterized by a perlitic texture indicating high-water content glassy groundmass. The phenocrysts are plagioclase and biotite. Due to a dull, pitchy luster, flat fracture perlitic structure and chemical composition, this glassy rock is considered to be pitchstone perlite.

Rhyolite lava occurs as both domes and mesas. The rhyolite commonly shows low-angle or horizontal flow layers overlying pyroclastic flow units and glassy beds. Generally, rhyolite is found overlying trachyandesite and basalt. It is in places found underlying basalt.

Basalt occurs as lava flows covering most of the low level areas (approximately 700 square kilometers). It occurs as both layer and rubble flows. The basalt flows overlie and underlie the rhyolite in the central part of Lop Buri area. Some basaltic lava is extruded onto rhyolite along fault zones. In some areas, the basalt flow over Quaternary gravel beds. Base on stratigraphic relations, the basaltic lava may have erupted in several episodes (Fig 2.2.).

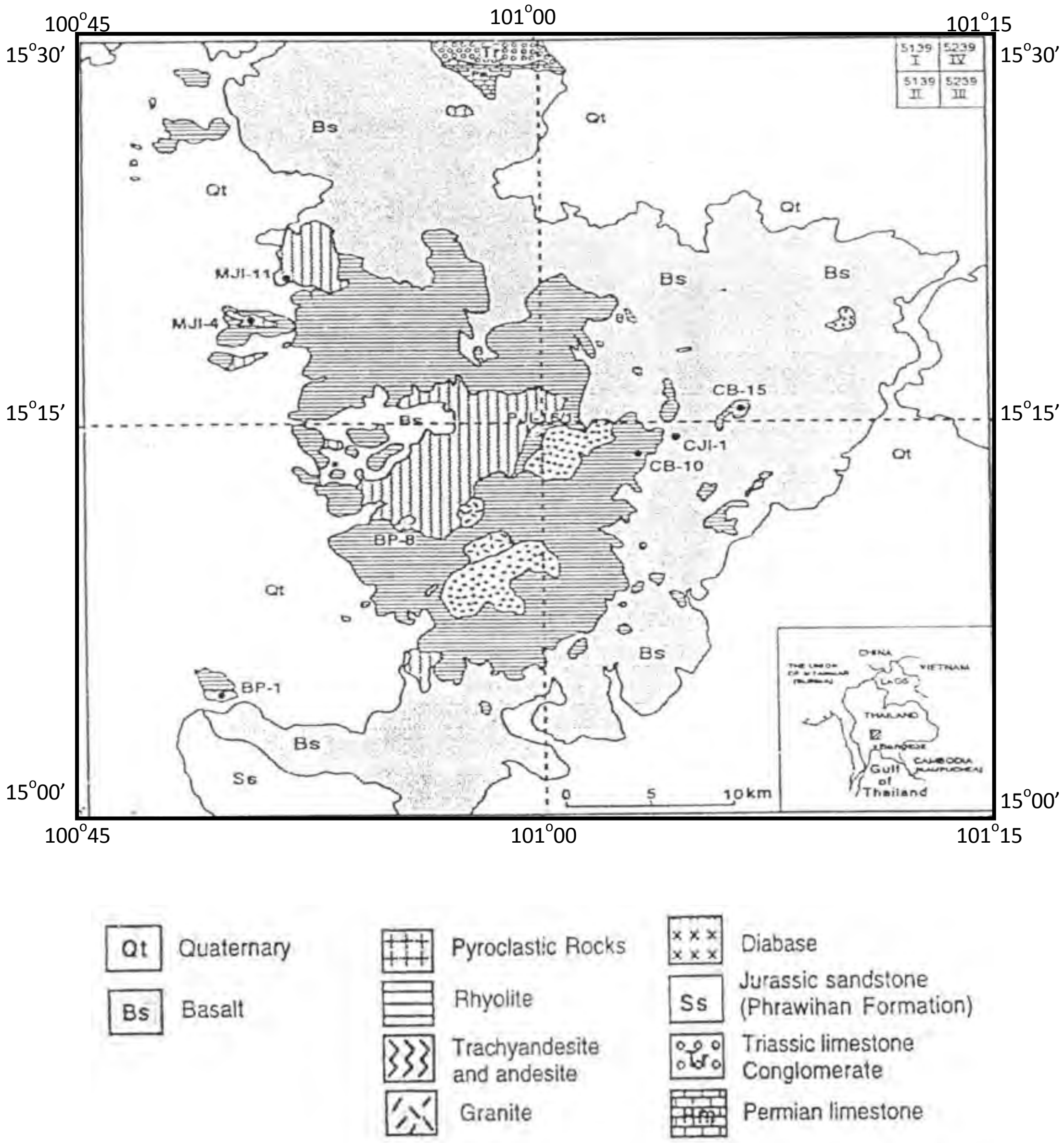


Fig. 2.1 Geological map of the Lop Buri area showing the distribution of rock types. Dashed lines represent topographic map sheet (scale 1:50,000) show at right top corner.

(Jungyusuk and Khositanont, 1992).

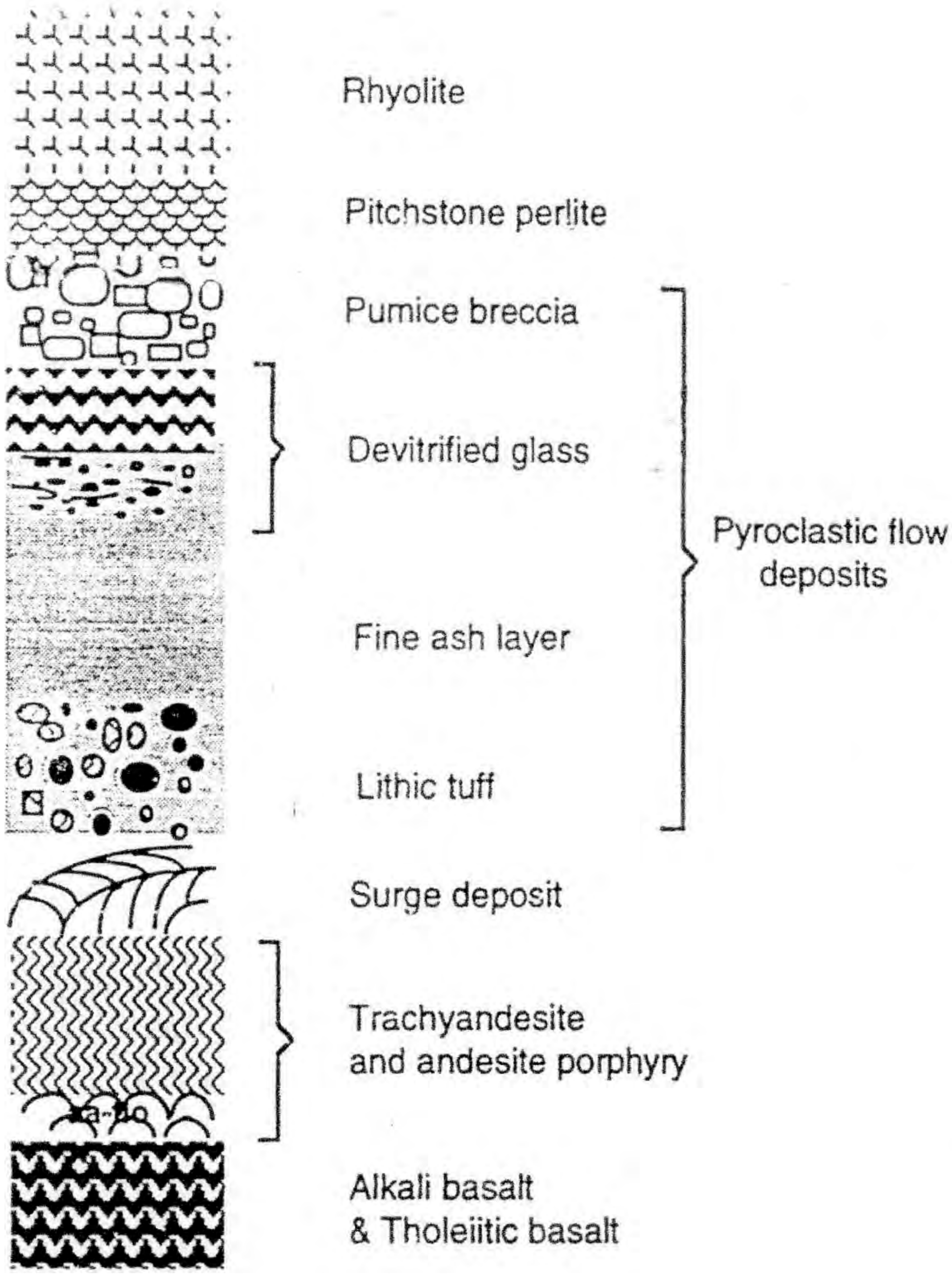


Fig.2.2 Idealized section of a Lop Buri volcanic sequence. The stratigraphic sequence presented is not drawn to scale. (Jungyusuk and Khositanont, 1992).

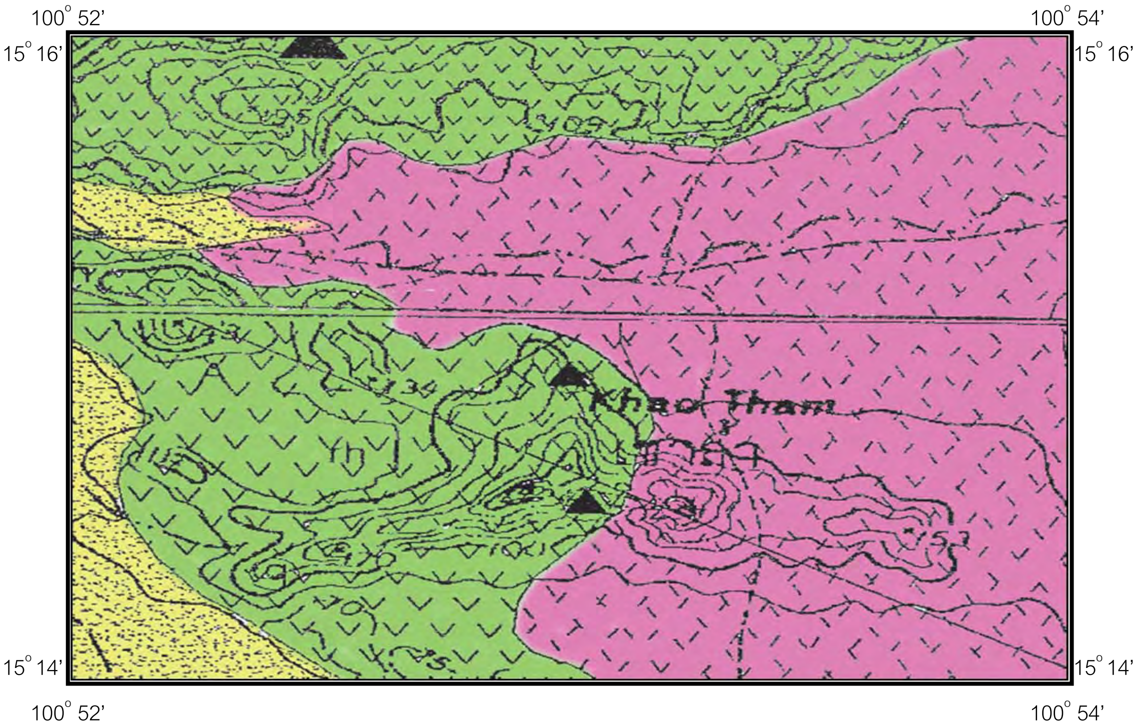
2.2 Detailed Geology

The study area is situated in Lam Narai Volcanic Formation (Jungyusuk, 1993) which is located approximately 7 kilometers north of Amphoe Srabot, Changwat Lop Buri. It is mainly occupied by volcanic rocks including rhyolite and basaltic andesite. Topography of the area displays ring structure that may indicate a part of remaining old crater. Major rhyolitic rocks in this area are purplish red rhyolite porphyry. Phenocrysts are composed mainly of feldspar and biotite founded in fine- to very fine-grained glassy groundmass. Rhyolites found in the area occurred as thin layers of lava flow (Fig.2.3).

Khao Tham is a small hill covering an area approximately 10,000 square meters with about35 meters high above mean sea level. Khao Tham features like eclipse-shape and contain mainly fine-grained tridymite - feldspar rocks. Their appearances are similar to siltstone. They have light weight. Flow layers are commonly observed and vary in thickness and colors. The tridymite – feldspar rocks can be divided into two types including white tridymite-feldspar rock occurring in the southern part and reddish white generally exposing in the northern part.

2.3 Sample Locality

Figs. 2.2 and 2.3 show the sample locations in Amphoe Srabot, Changwat Lop Buri. Topographic map scale 1:50,00, series L7017, sheet 5139 I (King Amphoe Khok Chareon) and 5139 II(Ban Phaniat) are the main map sheets. Sample collection was taken place in 13 stations (Fig.2.4).



หินชั้นและหินแปร
SEDIMENTARY AND METAMORPHIC ROCKS

ตะกอนตะพัก : กรวด ทราย ทรายแป้ง ดินเหนียว และคราบหินปูน
Terrace deposits : sands, silts, clays, and calcareous tufa.

หินอัคนี
IGNEOUS ROCKS

หินบะซอลต์ สีเทาดำถึงสีดำ เป็นรูพรุน และเป็นฟองมักมีแร่โอปอลฝังอยู่
Basalt, dark gray to black, vesicular and amygdaloidal which generally filled with opal.

หินอัลคาไลด์ไรโอไลต์ถึงหินไรโอไลต์ ส่วนใหญ่เป็นลาวาหลาก สีแดงแกมเทาถึงสีมารูน เนื้อละเอียด เนื้อเป็นดอกบางส่วน ไหลทับชั้นหินเนื้อแก้ว และหินชิ้นภูเขาไฟ
Alkali rhyolite to rhyolite mainly lava flows, grayish red to maroon, fine grained, porphyritic texture; some parts flow over glassy beds and pyroclastic flow (nonwelded tuff).

Fig. 2.3 Geologic map of the study area from map scale 1:50,000, sheet 5139 I (Ban Maha Pho) and 5139 II (Ban Phaniat) (Department of Mineral Resources, 1993).

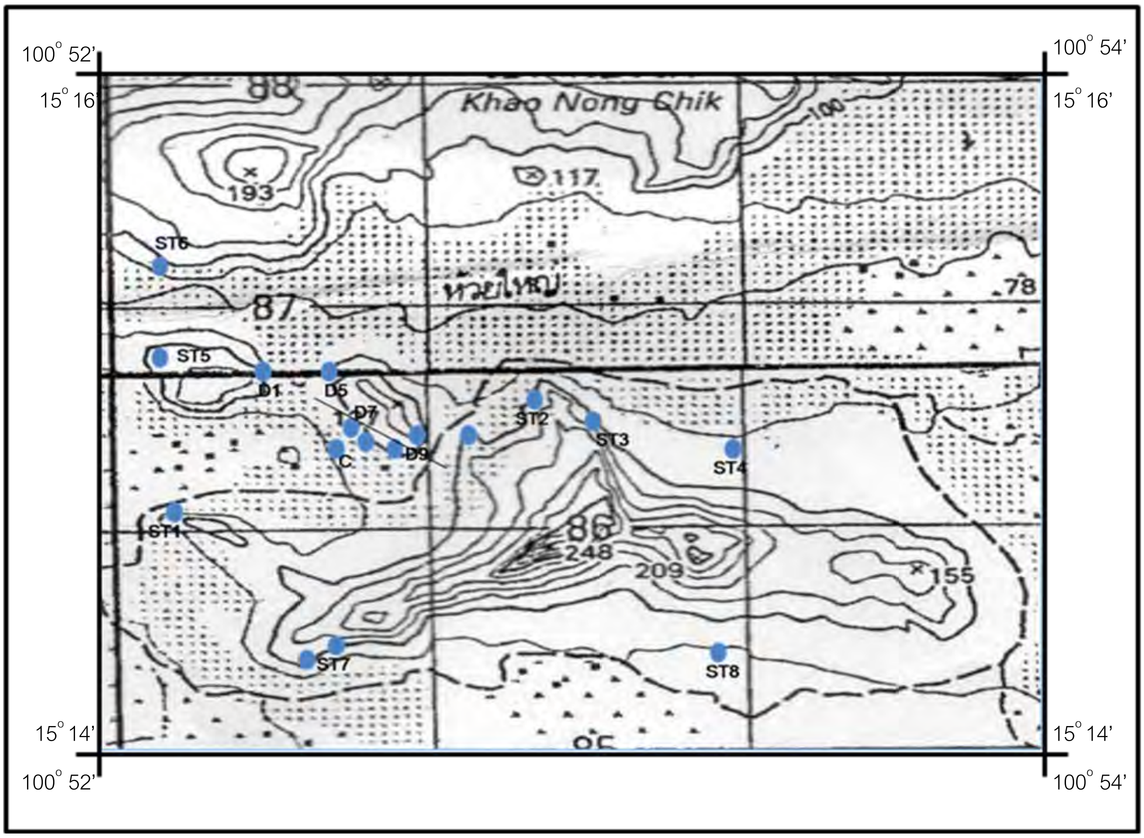


Fig. 2.4 Topographic map of the study area showing sample locations, topographic map scale 1:25,000, sheet 5139 I – Ban maha Pho and 5139 II-Ban Phaniat (modified from the Royal Thai Survey Department.)

a

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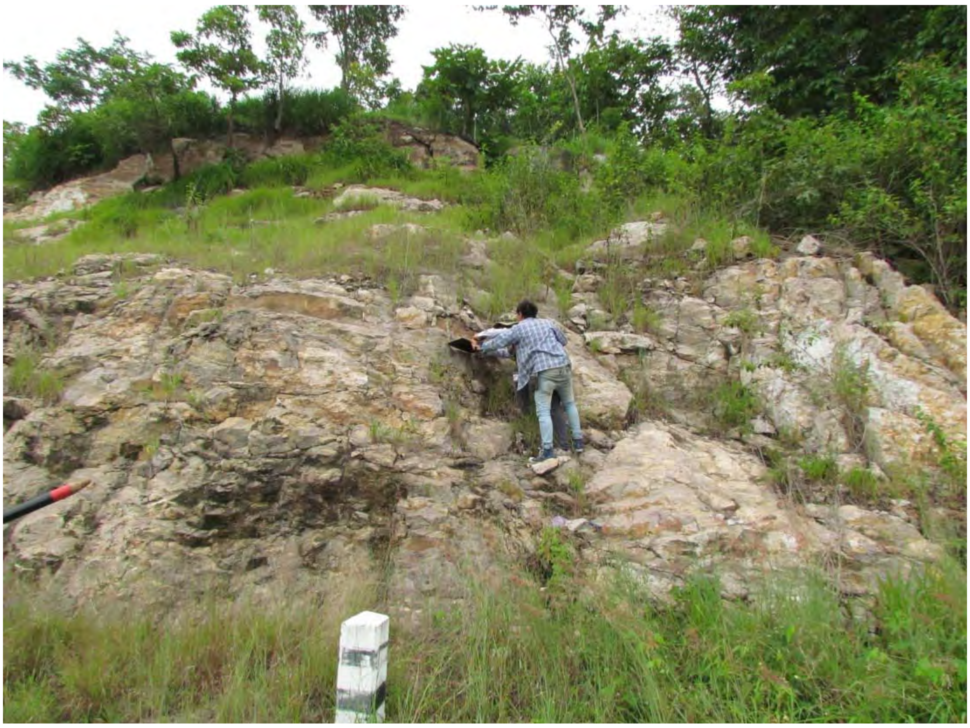


h

i

j

Fig.2.5 Outcrops of rock samples in each locality within the study area of Amphoe Srabot, Changwat Lop Buri.

CHAPTER 3: RESULTS

Petrography

Mineral Assemblage

Whole-Rock Analysis

Mineral Chemistry

Chapter III
Results

3.1 Petrography

Rock specimens collected from the study area can be divided, base on color, macroscopic feature and microscopic texture, into 6 groups including rhyolites, vitrophyric rhyolites, rhyolitic tuff, andesites, perlitic pitchstones and devitrified perlites. Thirty representative samples were prepared as thin sections for petrographic description under a polarizing microscope. Details of each group are reported below.

Rhyolites (Khao Tham): is characterized by white dense very fine-grained rocks which contain subhedral microcrystal with vitrophyric groundmass. Feldspar (up to 60%) appears to be the main compositions whereas trydimite is rarely found situated in glassy groundmass (Fig.3.1).

Vitrophyric rhyolite: is purplish gray, very fine-grained rocks which contain small amount of subhedral microcrystals embedded in vitrophyric groundmass. Mineral composition is similar to the former group. Feldspar also appears to be the main composition (av.30-40%) and trydimite contains about 5-10% (Fig.3.2).

Rhyolitic tuff: is purple to brown, fine-grained volcanic clastics which display vitrophyric ash and glassy groundmass texture (Fig.3.3).

Andesite: is mostly greenish gray rock. They are characterized by dense fine-grained rocks (0.1-0.5 mm. across). Anhedral-subhedral microcrystals of plagioclase and biotite are found as the main composition situated within glassy groundmass showing microporphyritic texture (Fig.3.4).

Perlitic pitchstone: is a glassy rock with greenish gray color. These rocks usually display perlitic cracks and flow bands under polarizing microscope. Their phenocrysts are mainly plagioclase and biotite. These rocks usually show dull surface, pitchy luster, flat fracture, perlitic crack which is consequently grouped as perlitic pitchstone (Fig.3.5).

Devitrified perlite: is characterized by redish gray matrix with white spot and usually show spherulitic texture. Phenocrysts are composed of plagioclase and quartz (Fig.3.6).

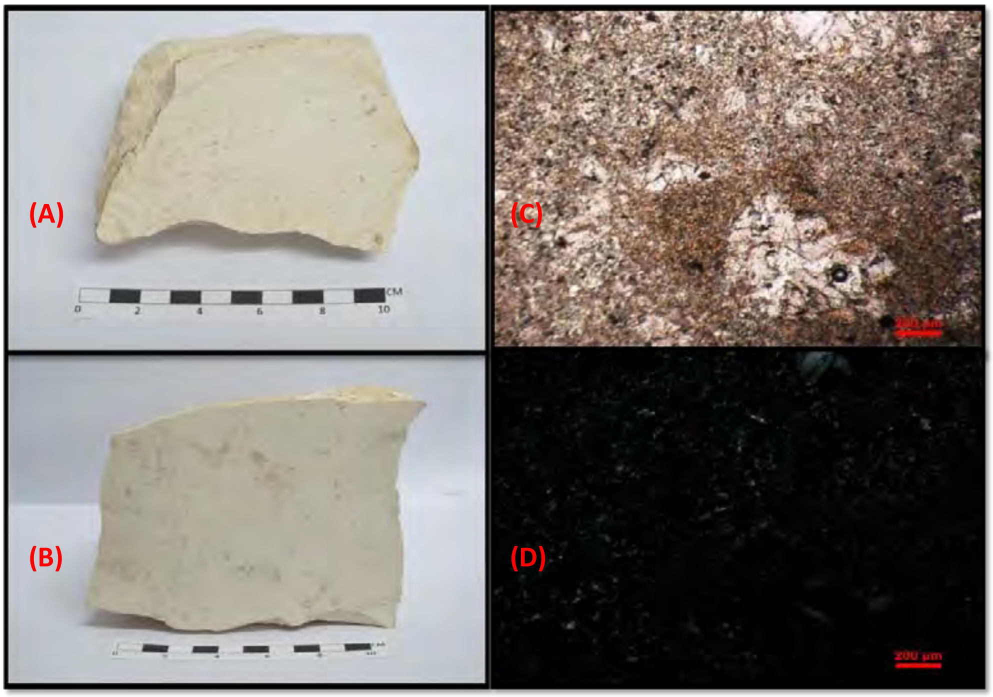


Fig. 3.1 (A) and (B) rhyolite specimens; (C; PPL) and (D; XPL) photomicrographs showing microcrystalline feldspar and tridymite embedded within glassy groundmass.

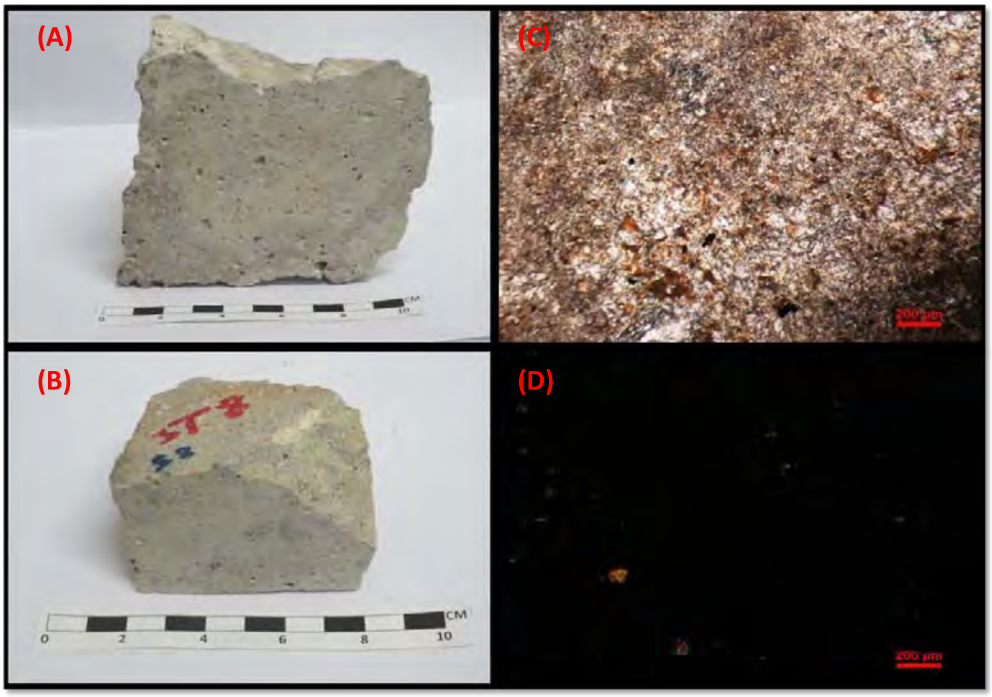


Fig. 3.2 (A) and (B) specimens of purplish grey rhyolite; (C; PPL) and (D; XPL) photomicrographs showing vitrophyric texture of small amount of microcrystals in glassy groundmass.

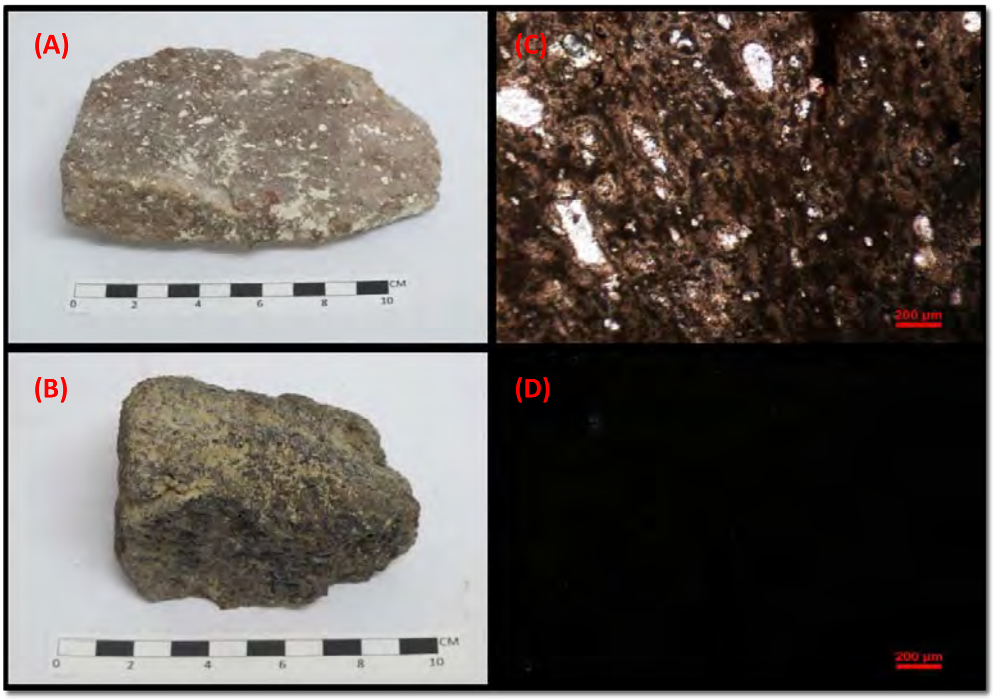


Fig. 3.3 (A) and (B) A specimens of rhyolitic tuff; (C; PPL) and (D; XPL) photomicrographs of rhyolitic tuff showing vitrophyric ash and glassy groundmass.

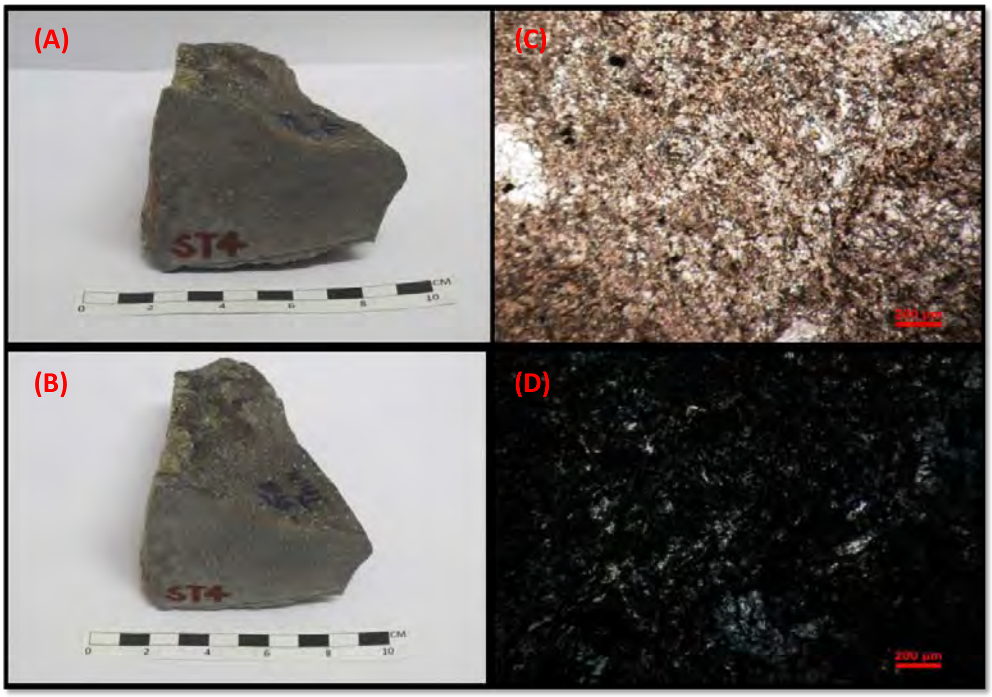


Fig. 3.4 (A) and (B) specimens of andesite showing greenish black with fine-grained texture; (C; PPL) and (D; XPL) photomicrographs showing microcrystalline of plagioclase and biotite in glassy groundmass.

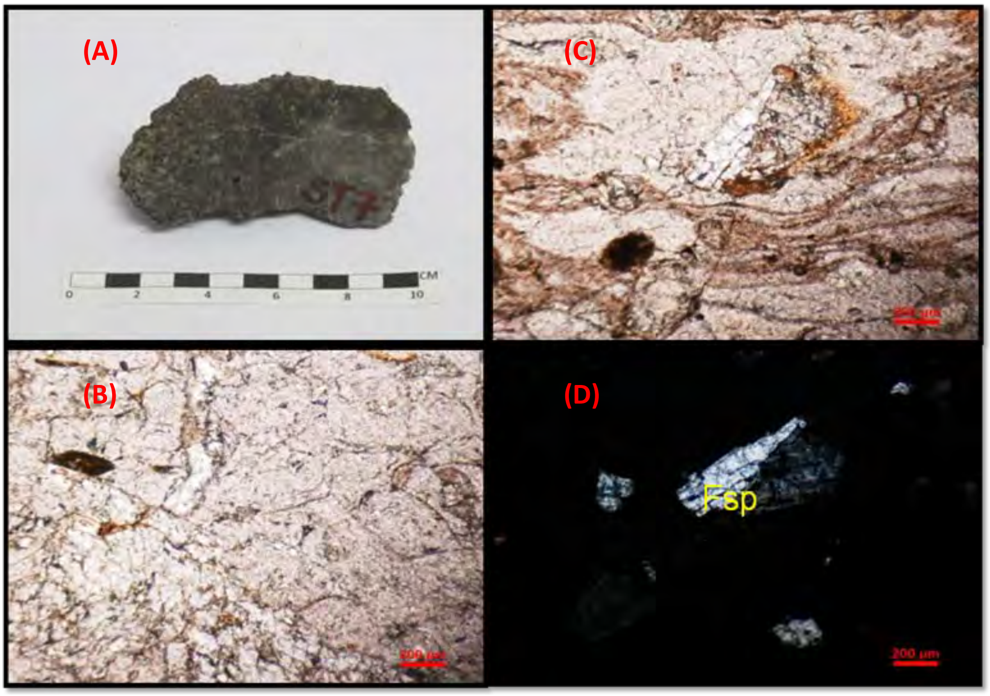


Fig. 3.5 (A) A specimen of perlitic pitchstone showing greenish gray color with glassy texture; (B; PPL) and(C; PPL) photomicrographs displaying perlitic cracks and flow texture in perlitic pitchstone; (D; XPL) photomicrograph of pitchstone showing vitrophyric texture.

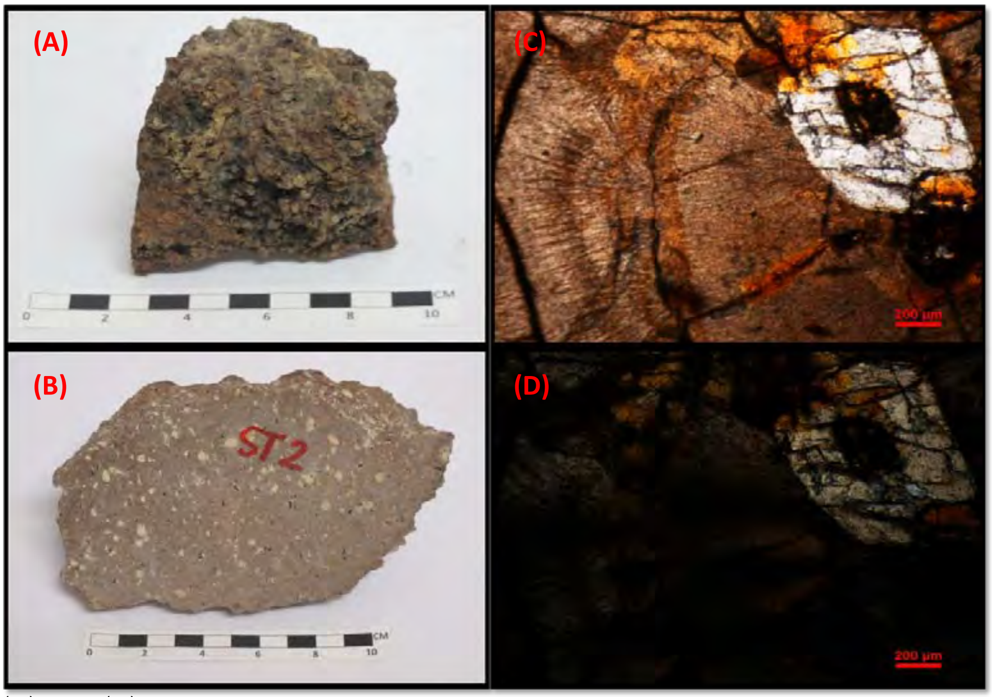
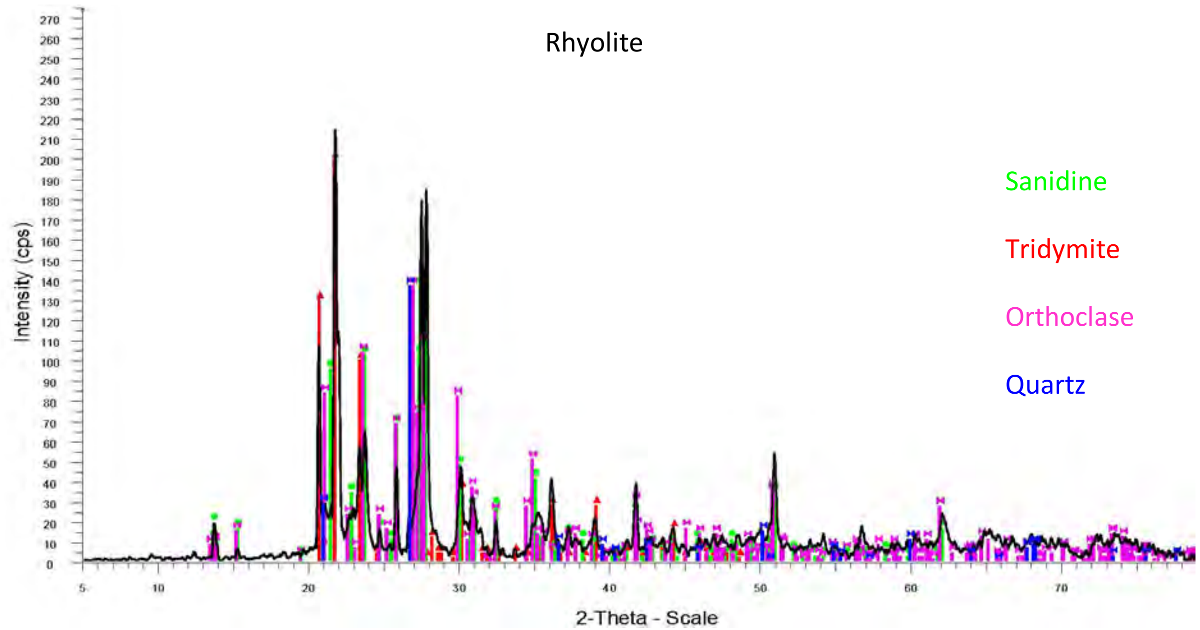


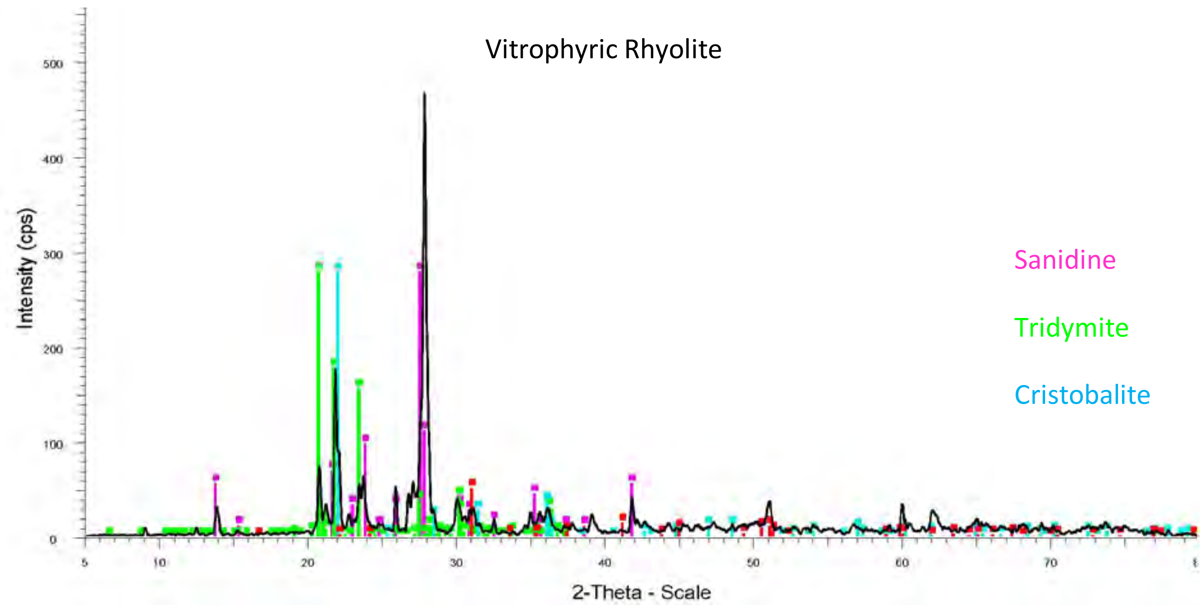
Fig. 3.6 (A) and (B) specimens of devitrified perlite showing redish gray color with white spot; (C; PPL) and (D; XPL) photomicrographs showing spherulitic texture.

3.2 Mineral Assemblage

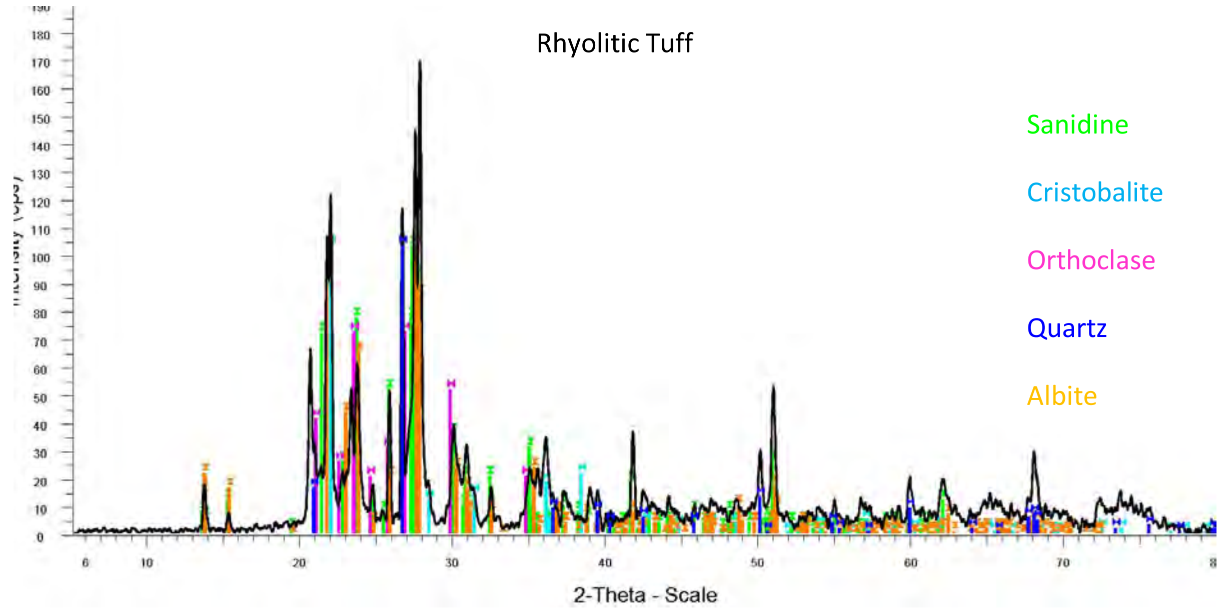
Mineral assemblages of rock samples were additionally identified using powdered samples and X-Ray Diffractometer (XRD). The analytical results indicate that most rock samples mainly contain sanidine feldspar and tridymite as displayed in Fig. 3.7 below.



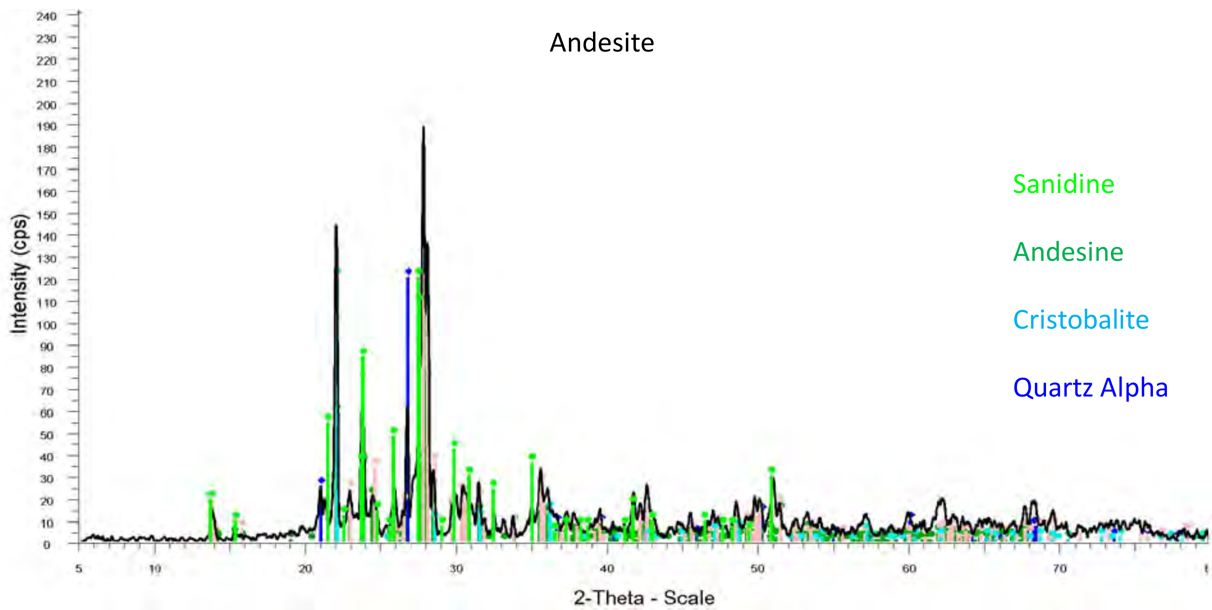
a



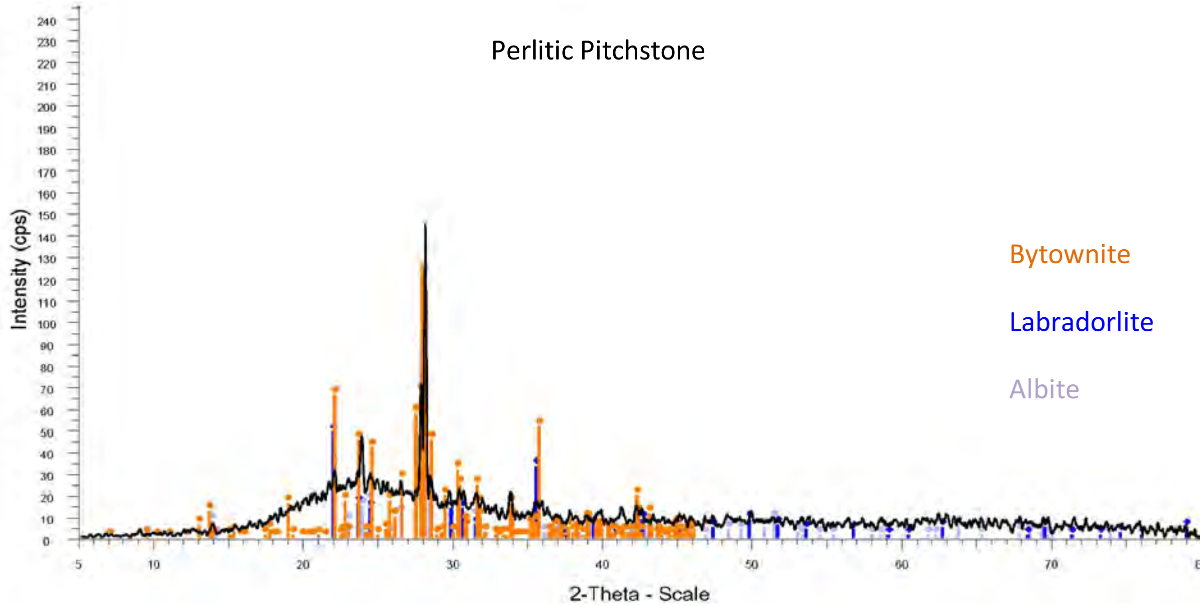
b


Rhyolitic Tuff
Sanidine
Cristobalite
Orthoclase
Quartz
Albite
2-Theta - Scale

c


Andesite
Sanidine
Andesine
Cristobalite
Quartz Alpha
Intensity (cps)
2-Theta - Scale

d



e

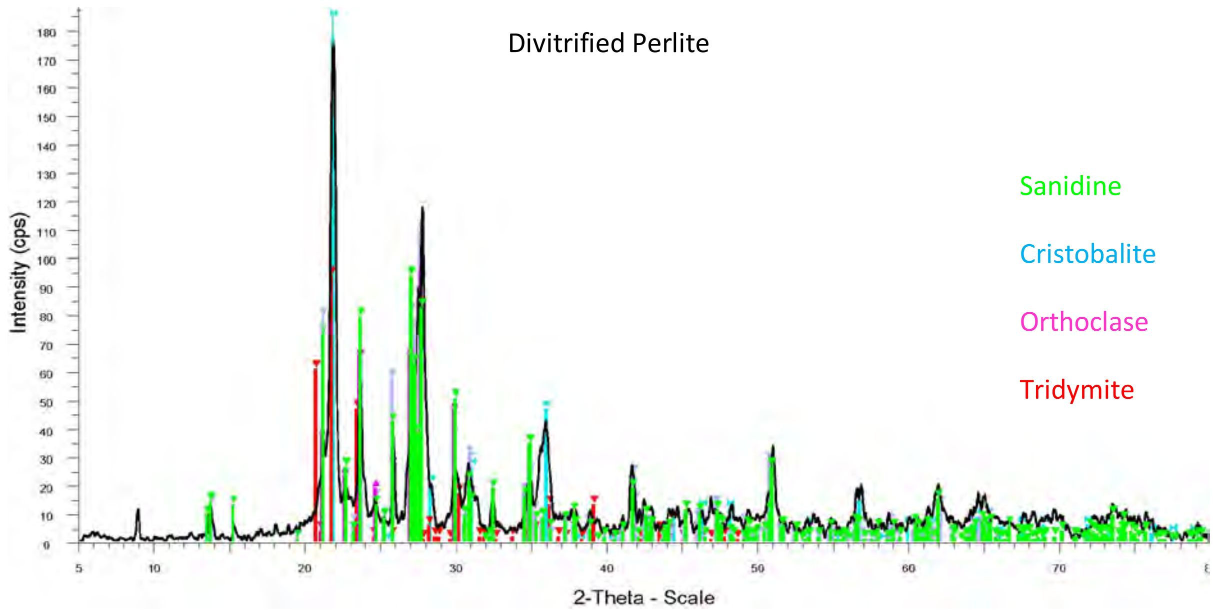


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Fig.3.7 Representative XRD patterns of all rock types under this study; sanidine and tridymite appear to be the most crucial phases among the others including glassy matrix as observed by hump feature.

3.3 Whole-Rock Geochemistry

All of rocks samples collected from the study area in Amphoe Srabot, Changwat Lopburi were milled as powder samples and analyzed for major and minor oxides using X-ray fluorescence (XRF) spectrometer. Their whole-rock chemical analyses are summarized in Table.3.1. Major and minor oxides of these volcanic rocks are quite similar in all groups. In general, they contain 66.63-78.36% SiO_2, 11.71-14.55% Al_2O_3, 0.12-5.18% K_2O , 0.79-4.04% Na_2O, 0.21-2.48%CaO, 0.2-0.96% MgO, 0.19-3.95% Fe_2O_3, 0.11-0.81% TiO_2, 0.12-0.20% P_2O_5, 0.01-0.03 MnO. Variation diagrams plotting between SiO_2 versus other oxides are shown in Fig.3.8. Based on these plots, they seem to have compositions closely related to each other.

Table.3.1 Whole-rock analyses of rock samples using XRF technique.

	Rhyolite						Vitrophyric Rhyolite						Rhyolitic Tuff		Andest	Div-Perlite		Per-Pit
	C1	C3	C5	RT	LP	D7	ST1	ST3	ST5	ST6	ST8	D1	D5	D12	ST4	ST2	D9	ST7
SiO2	76.58	77.30	76.37	77.08	76.24	78.36	74.23	75.92	73.05	74.33	75.20	74.47	70.54	68.59	66.63	73.67	74.97	70.05
Al2O3	13.08	13.11	13.18	12.64	12.80	11.71	13.61	12.79	13.12	13.90	13.47	14.05	14.55	13.26	14.49	13.12	13.23	12.85
CaO	0.22	0.21	0.21	0.22	0.23	0.21	0.27	0.24	0.27	0.27	0.30	0.55	0.39	0.83	2.48	0.42	0.43	0.89
MgO	0.20	0.20	0.20	0.20	0.28	0.20	0.32	0.52	0.28	0.20	0.20	0.43	0.44	0.35	0.96	0.64	0.56	0.45
Fe2O3	bdl	bdl	bdl	bdl	0.22	0.19	0.77	1.07	0.57	0.69	0.77	1.08	1.26	1.08	3.95	0.92	0.58	1.11
K2O	4.51	4.63	0.12	4.60	4.68	4.27	4.84	4.43	4.80	4.62	4.57	4.43	4.39	4.77	3.40	5.08	5.03	4.81
Na2O	3.82	3.82	0.24	3.74	3.40	3.51	2.89	2.55	3.14	3.10	0.79	3.49	2.39	2.56	4.04	2.81	2.73	2.51
TiO2	0.13	0.13	bdl	0.13	0.17	0.11	0.24	0.25	0.21	0.22	0.23	0.31	0.31	0.28	0.81	0.30	0.27	0.27
P2O5	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.20	0.12	0.12	0.12
MnO2	bdl	bdl	bdl	bdl	bdl	bdl	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.02	0.02	0.01	0.01	0.03
LOI	1.15	1.13	0.73	0.60	1.10	1.26	2.81	4.05	1.62	1.45	1.53	1.65	3.50	3.41	4.02	1.95	1.78	3.97
TOTAL	99.17	99.92	90.91	99.06	99.23	99.93	100.11	101.93	97.18	98.91	97.19	100.58	97.90	95.27	100.99	99.04	99.72	97.05
Quartz	0.61	0.61	1.23	0.62	0.63	0.69	0.64	0.72	0.60	0.63	0.87	0.59	0.64	0.56	0.40	0.61	0.64	0.58
Orthoclas	0.48	0.49	0.01	0.49	0.50	0.45	0.51	0.47	0.51	0.49	0.49	0.47	0.47	0.51	0.36	0.54	0.53	0.51
Albite	0.62	0.62	0.04	0.60	0.55	0.57	0.47	0.41	0.51	0.50	0.13	0.56	0.39	0.41	0.65	0.45	0.44	0.40
Anorthite	0.01	-	-	0.01	0.01	-	0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.06	0.20	0.02	0.02	0.07
Corundum	0.04	0.03	0.25	0.03	0.04	0.02	0.07	0.07	0.05	0.07	0.14	0.05	0.11	0.05	-	0.05	0.05	0.04
Hyperstine	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.01	0.01	0.01	0.02	0.02	0.02	0.05	0.03	0.03	0.02
Ilmenite	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hematite	-	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.05	0.01	0.01	0.01
Apatite	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01	-	-	-
Rutile	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01	-	-	-
Plg is An	0.90	0.70	10.70	0.90	1.20	0.80	2.10	1.70	1.90	2.00	9.00	5.80	5.10	12.70	23.30	4.90	5.20	13.90

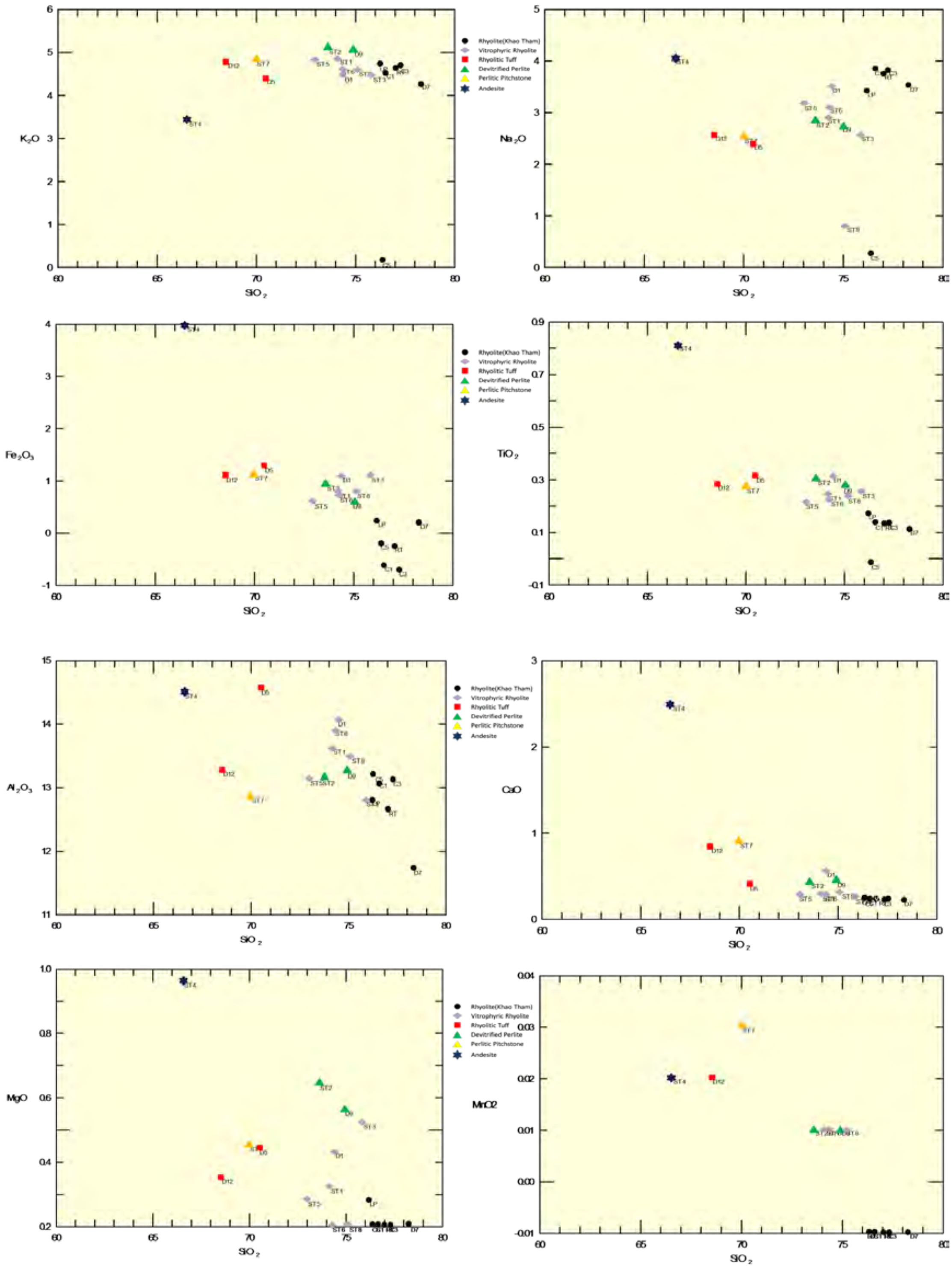

Fig.3.8 Harker's Variation diagram plotting between SiO_2 against other oxides of volcanic rock samples in study area.

3.4 Mineral Chemistry

EPMA analyses of a few crucial minerals were selected and presented in Table 3.2. Feldspar, the main composition of the study volcanic rocks, shows high contents of SiO_2 Na_2O and K_2O(Table 3.2) with average atomic proportions of 3.0-56.2% Na^+, 7.4-94.1% K^+,0.6-60-?% Ca^{2+}. They fall within the range of alkaline feldspar, sanidine (Fig. 3.9). However, a few samples of ST4 and ST7-2 yielded An_{50-70} within labradorite range.

Table.3.2 Representative EPMA analyses of feldspar in volcanic rocks collected from the study area, Amphoe Srabot, Changwat Lopburi.

	Rhyolite	Vitrophyric Rhyolite						Andesite	Div-perlite	Perlitic pitchstone	
	C1	ST1	ST3	ST5-1	ST5-2	ST6	ST8	ST4	ST2	ST7-1	ST7-2
SiO2	67.46	65.42	65.80	65.60	67.82	66.40	67.66	59.85	65.27	64.59	60.68
TiO2	0.00	0.02	0.04	0.05	0.03	0.03	0.02	0.04	0.05	0.19	0.01
Al2O3	18.29	19.60	20.41	19.51	18.45	18.56	18.70	22.63	19.53	18.62	20.85
FeO	0.04	0.09	0.17	0.14	0.16	0.17	0.17	0.30	0.25	0.81	0.25
MnO	0.02	0.00	0.02	0.01	0.02	-	0.00	-	0.00	0.02	0.02
MgO	0.02	0.01	-	0.00	0.01	-	0.00	0.02	0.01	0.13	0.00
CaO	0.11	0.43	0.47	0.50	0.43	0.49	0.44	11.13	0.15	0.47	11.77
Na2O	5.45	5.96	5.40	4.14	3.46	5.51	5.49	3.28	5.36	0.36	3.69
K2O	7.37	6.69	7.44	8.21	8.31	7.04	7.48	1.15	7.46	15.04	1.53
P2O5	0.15	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.01
Total	98.89	98.22	99.73	98.15	98.70	98.22	99.97	98.42	98.09	100.26	98.81
Base on 8O											
Si	3.029	2.968	2.951	2.981	3.055	3.015	3.016	2.722	2.974	2.973	2.763
Ti	0.009	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.002	0.007	0.001
Al	0.968	1.048	1.079	1.045	0.980	0.994	0.983	1.213	1.049	1.010	1.119
Fe2+	0.001	0.004	0.006	0.005	0.006	0.006	0.007	0.011	0.010	0.031	0.009
Mn	0.001	0.008	0.001	0.000	0.001	-	0.011	-	0.004	0.001	0.001
Mg	0.001	0.001	-	0.008	0.001	-	0.004	0.001	0.001	0.009	0.002
Ca	0.005	0.021	0.022	0.024	0.021	0.024	0.021	0.542	0.007	0.023	0.574
Na	0.474	0.524	0.469	0.364	0.302	0.485	0.474	0.289	0.473	0.032	0.325
K	0.422	0.387	0.426	0.476	0.478	0.408	0.425	0.067	0.434	0.883	0.089
P	0.006	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.001	0.001	0.000
Total	4.917	4.962	4.955	4.910	4.844	4.933	4.941	4.848	4.953	4.971	4.883
% Ca	0.6	2.2	2.4	2.8	2.6	2.6	2.3	60.3	0.8	2.5	58.1
% Na	52.6	56.2	51.2	42.2	37.7	52.9	51.5	32.2	51.8	3.4	32.9
% K	46.8	41.5	46.4	55.1	59.7	44.5	46.2	7.4	47.4	94.1	9.0

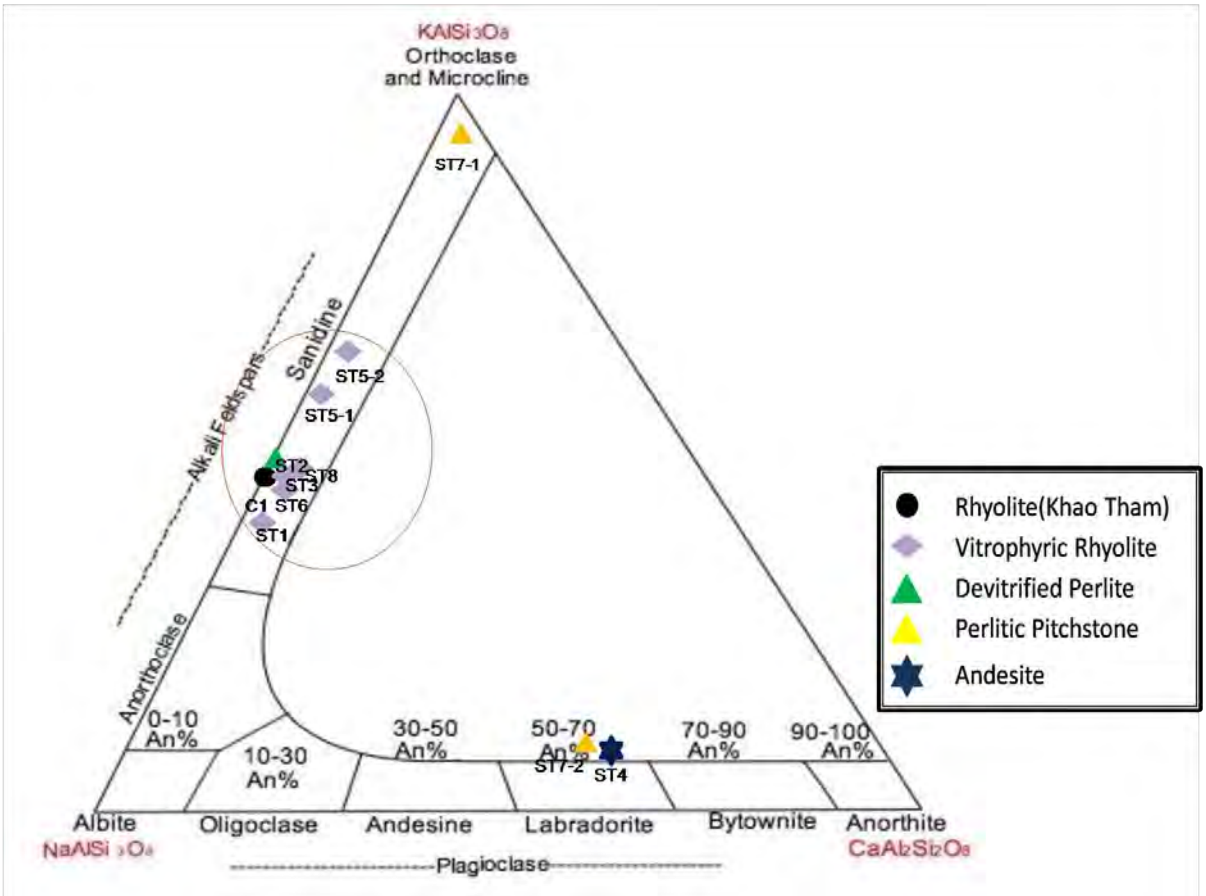

Fig.3.9 Atomic Na-K-Ca of feldspar in volcanic rocks collected from the study area, Amphoe Srabot, Changwat Lopburi.

CHAPTER4: DISCUSSION AND CONCLUSIONS

Petrogenesis

Characteristic of Khao Tham Feldspar

Conclusions

Chapter IV
Discussion and Conclusions

4.1 Petrogenesis

Volcanic rocks from the study area, Amphoe Srabot, Changwat Lop Buri, can be divided into rhyolites, vitrophyric rhyolites, rhyolitic tuff, andesites, perlitic pitchstones and devitrified perlites groups; however, they yield closely similar in mineral assemblage, mineral chemistry and whole-rock composition excepted andesites which rather have a different composition from each other. The main rock forming minerals include feldspar and silica minerals which vary in specific types such as labradorite and sanidine feldspar, tridymite or cristobalite. Their textures and mineral assemblages indicate felsic volcanic rock.

Geologic setting of the study area displays various types of volcanic rock which particularly appear to be related in several episodes of eruption (Jungyusuk and Khositanont, 1992).

Based on whole-rock geochemical analyses, volcanic rock samples in each group mostly have composition similar to rhyolite. Moreover, a few sample of ST7, D6 and D12 have composition similar to dacite-rhyolite; sample ST4 is closely to dacite and trachydacite. They are clearly presented by plotting between total alkali versus SiO_2 (TAS) diagram (LeBas et al.,1986 in Fig.4.1). However, all of the rock samples have a close composition but it can be divided, based on textural and mineralogical features, into four groups such as: 1. Rhyolites; 2. vitrophyric rhyolites and devitrified perlites; 3. perlitic pitchstones and rhyolitic tuff; 4. andesites (see Figs. 4.2 to 4.4).

Based on mineral chemistry analyses, most of feldspar compositions yielded alkali feldspar range, particularly sanidine that occurred typically in felsic volcanic rock. However, in some samples such as ST7-2 and ST4, composition of feldspar is nearly to labradorite (Fig.4.3). In case of ST4, feldspar occurred as phenocryst and whole-rock composition indicate intermediate volcanic rock. These feldspar phenocrysts are labradorite, commonly. However, sample no. ST7-2t is suggested that feldspar occurred generally as xenocryst because their whole-rock composition is felsic composition. Thus, it can be indicated that the felsic lava may pick up labradorite grained from the lower part, probably basaltic andesit) (Jungyusuk, 1987) prior to eruption.

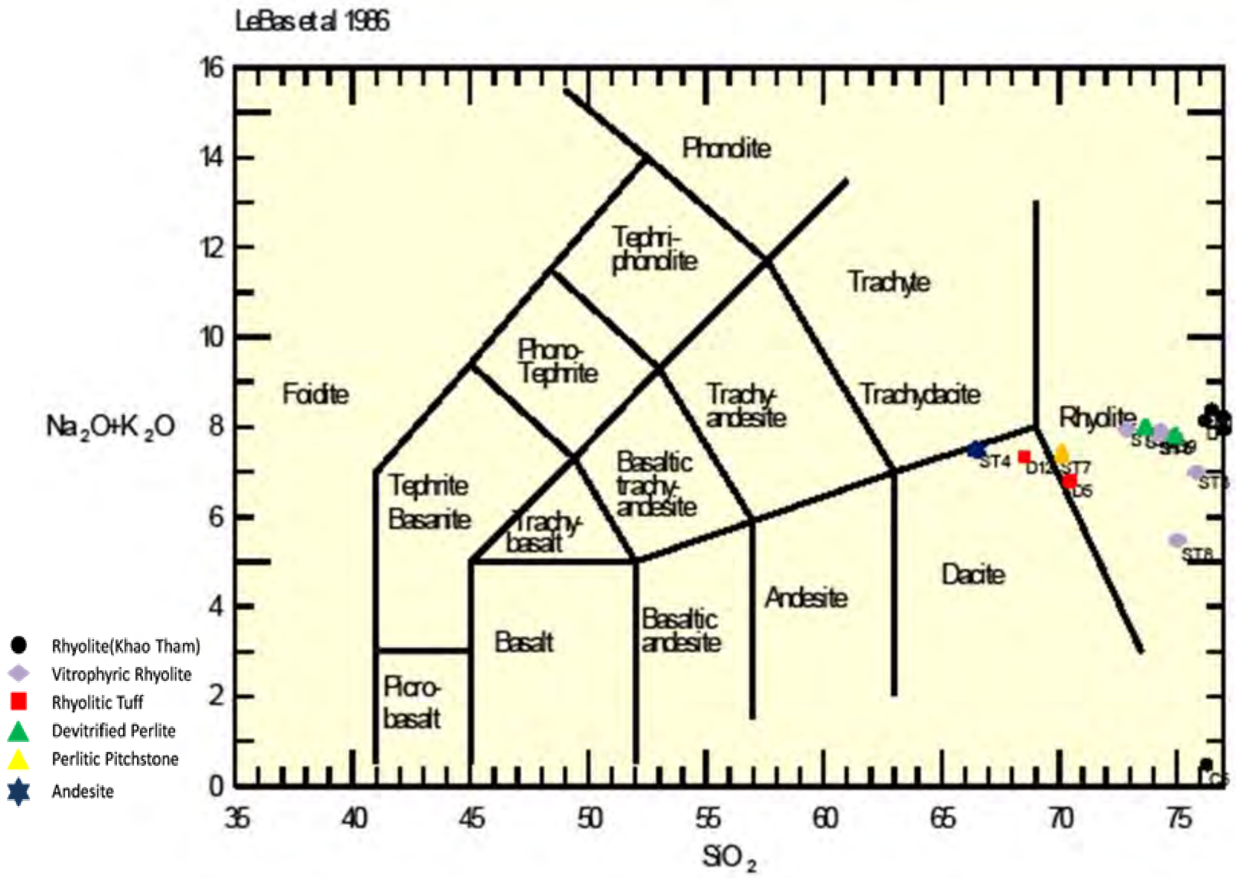

Fig.4.1 Total alkali vs. SiO_2 (TAS) diagram showing compositions of volcanic rock samples are mostly plotted within field of rhyolite and some in dacite field (LeBas et al., 1986).

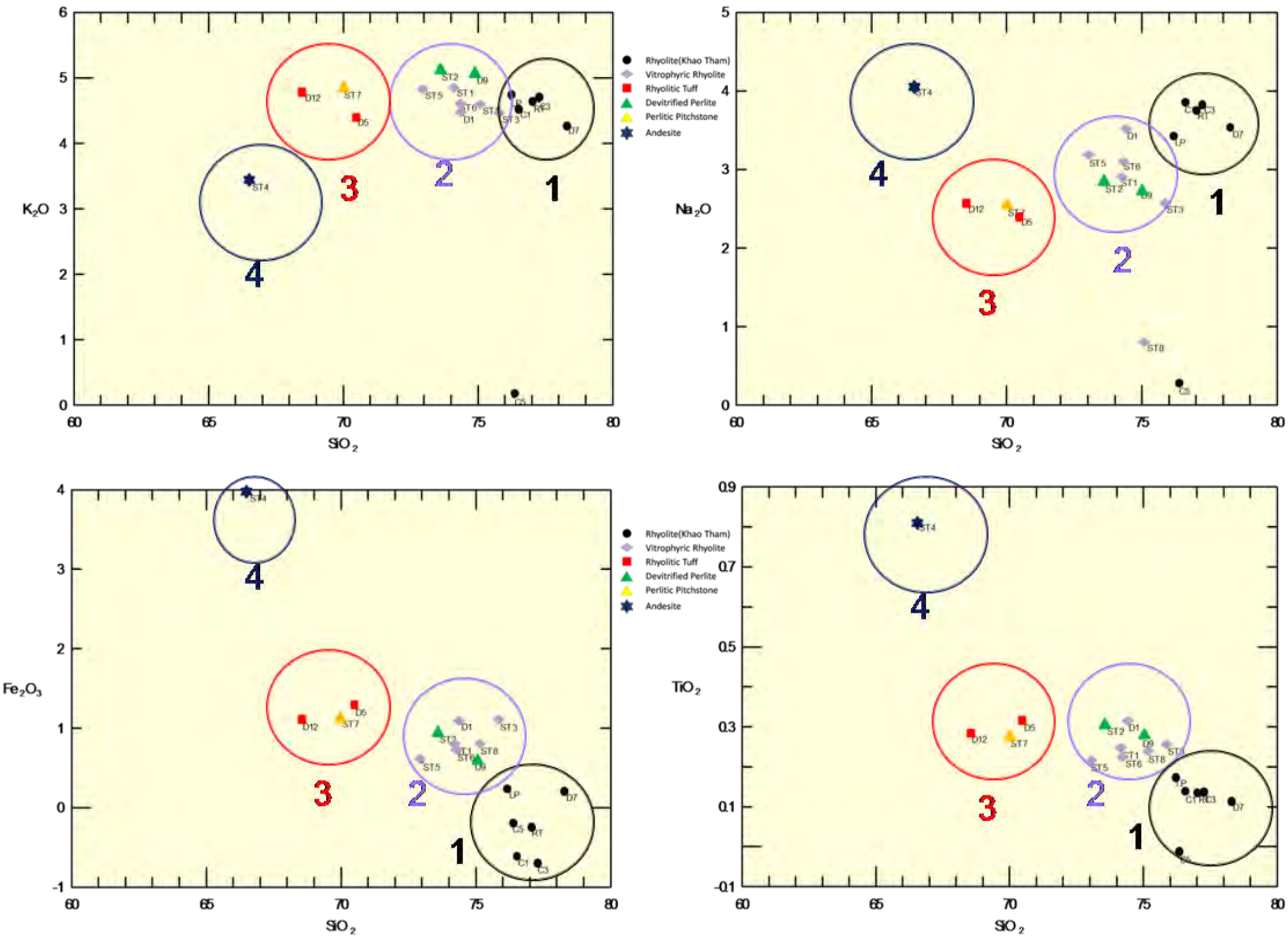

Fig.4.2 Harker's Variation diagram plotting between SiO_2 against some crucial oxides of volcanic rock samples that can be divided into four groups.

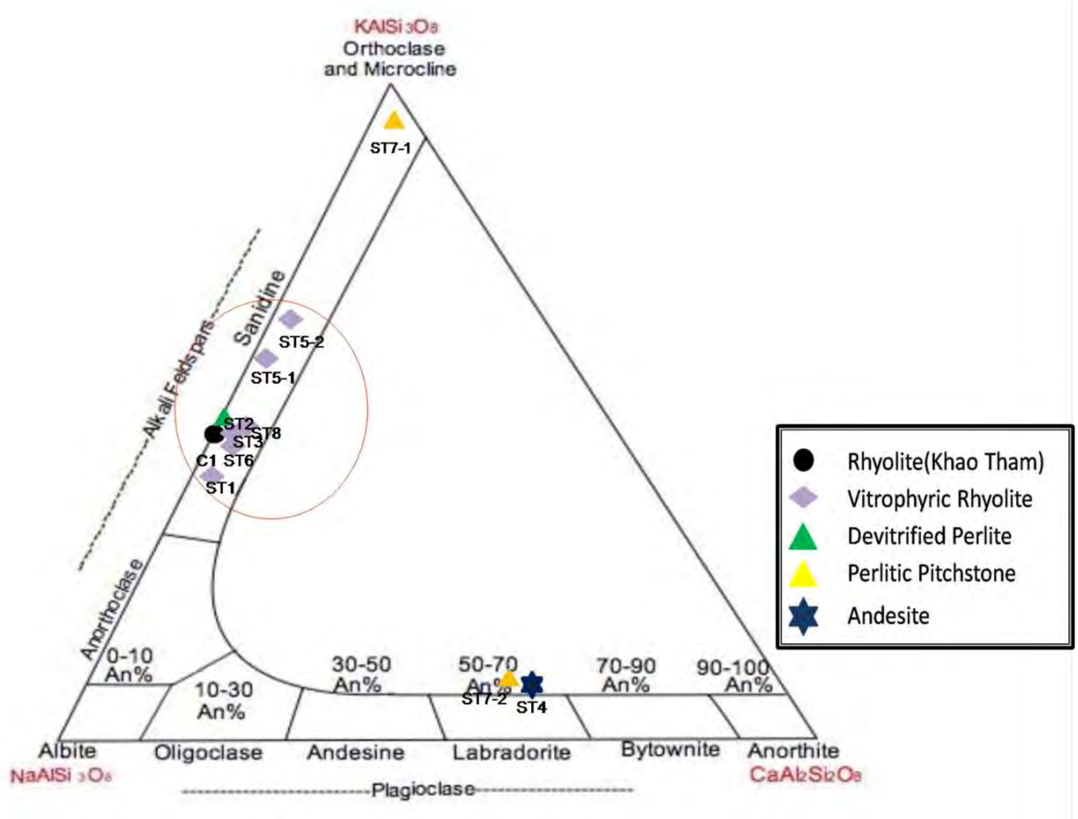

Fig.4.3 Atomic Na-K-Ca of feldspar in volcanic rocks of Amphoe Srabot, Changwat Lopburi.

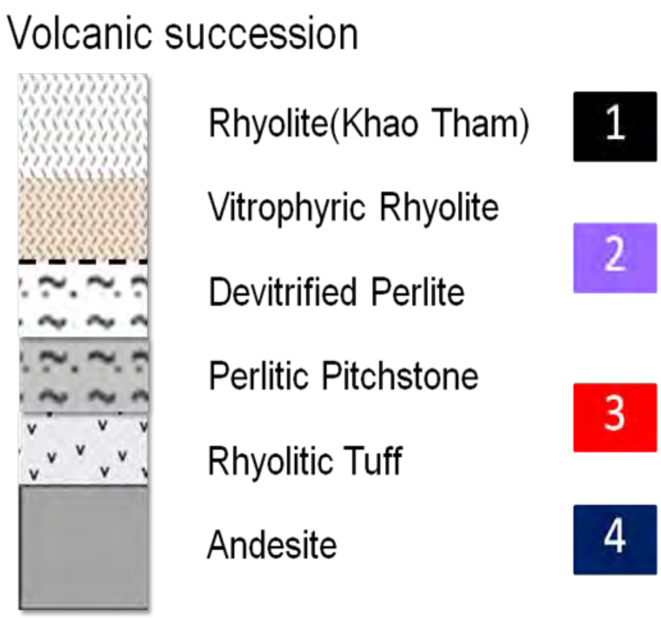

Fig.4.4 A model of volcanic succession in the study area, Amphoe Srabot, Changwat Lop Buri.

4.2 Characteristic of Khao Tham Feldspar

Among similarities of mineral assemblage, mineral chemistry and whole-rock composition, rhyolites at Khao Tham may have a characteristic which is different from the adjacent volcanic rocks in the study area. Consequently, it made them to be suitable for mining.

Rhyolites at Khao Tham are characterized by white dense very fine-grained rocks which contain a lot of subhedral microcrystals embedded in glassy groundmass, vitrophyric texture. The main rock-forming minerals include sanidine feldspar and tridymite. Their textures and mineral assemblages indicate felsic volcanic rock. It is really hard to separate minerals; however, Khao Tham rhyolites contain a lot of feldspar microlites in comparison with the other volcanic rocks in this area. Khao Tham rhyolites are more suitable for feldspar mine.

Based on whole-rock geochemical analyses, Khao Tham rhyolites also show a high silica oxide (76-79% SiO_2). From this property, Khao Tham Rhyolite will be more vicious and taking more time to cool down, so it would have a time for feldspar crystallization. Although, all of the rock samples under this study have similar compositions, Khao Tham rhyolite have lower contents of Fe_2O_3 and TiO_2 (Fig. 4.5) which is good quality required for ceramics industry.

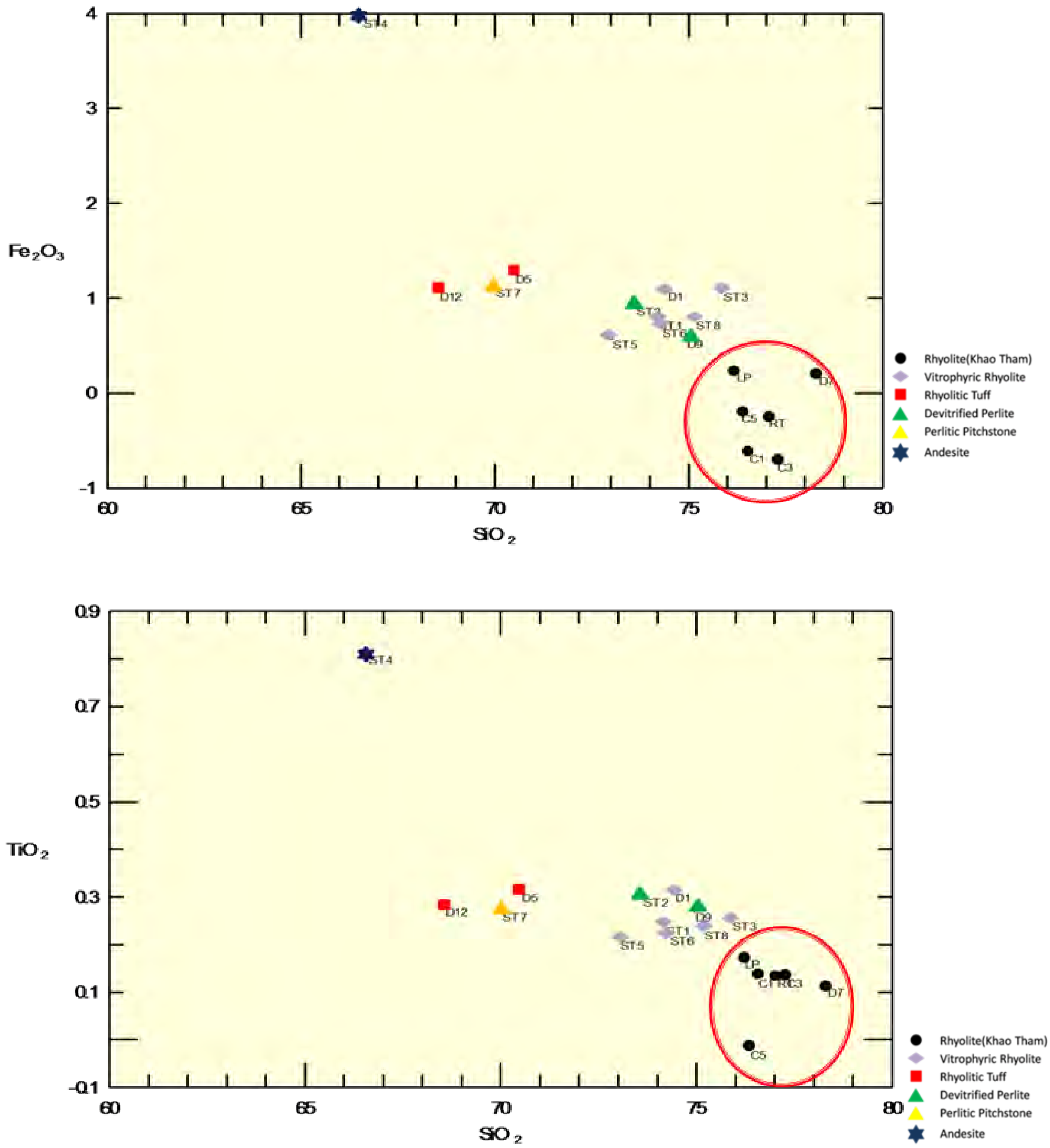

Fig.4.5 Variation diagrams plotting between SiO_2 against Fe_2O_3 and TiO_2 of volcanic rock samples in the study area. Khao Tham rhyolite (black spot) displays significantly low contents of Fe_2O_3 and TiO_2 that are suitable for feldspar mine.

4.3 Conclusions

Khao Tham rhyolites and the adjacent volcanic rocks in the study area may be from the same magma chamber which has several episodes of eruption. Because of different condition such as cooling rate and gas pressure, chemical compositions and types of eruptions were varied and yielded various types of volcanic rocks in this area. Consequently, Khao Tham rhyolites have color, texture and mineral composition different from other volcanic rocks in the study area. Its properties are most suitable of be mining.

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