PETROGRAPHY OF THE NYAUNG BIN THA AREA, WAINGMAW TOWNSHIP, KACHIN STATE

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Abstract

The study area is situated in 27 Kilometers northeast of Myitkyina. The Nyaung Bin Tha area is built up of plutonic and volcanic units. The plutonic rocks exposed in the study area are peridotites, gabbro, granodiorite, and dolerite. The volcanic and volcaniclastic rocks include basalt, andesite, dacite, rhyolite and volcanic tuff. Almost all plutonic rocks are medium- to coarse-grained, and exhibit hypidiomorphic granular texture. Porphyritic textures, perthitic texture and myrmekitic textures are also recognized in these rocks. Ocellar texture is also observed in the samples taken from dolerite dyke. Plagioclase feldspar shows conspicuous zoning and twinning. Pyroxenes, in gabbro, occur as phenocrysts and display sector-zoned and each sector show oscillatory zoning. In basalt it shows resorbed and embayed texture, coroner or keleptic rim. Chloritization, seritization, epidotization and serpentinization are common hydrothermal alteration occurred in the study area.

Keywords: Petrography, Hypidiomorphic granular, Porphyritic, Zoning and Twinning

Introduction

The study area is situated in Waingmaw Township, Myitkyina District, Kachin State. It is located about 27 Kilometers northeast of Myitkyina. This area is bounded by north Latitude 25° 30' to 25° 35' 30" and East longitude 97° 30' to 97° 35'. This area falls in the UTM map sheet of 2597-10. It extends about 4.6 km long and 4.3 km wide. It covers approximately 20 square kilometer of fairly rugged terrain. It can be easily reached by car or motorcycle from Myitkyina. Location map of the study area is shown in figure (1).

Purposes of research work

Previous workers researched regionally on geology, mineral occurrences, geochemistry and geochronology of the igneous rocks around Myitkyina area. There is no detail research on mineralogical, petrological and geochemical characteristics and geological map. So, the present research mainly focuses on petrography and geological map of the study area.

Methods of study

The (50) representative rock samples were made by thin section. Detailed mineralogical characters, texture feature and other petrographical criteria of representative rock sample were systematically studied under petrographic microscope.

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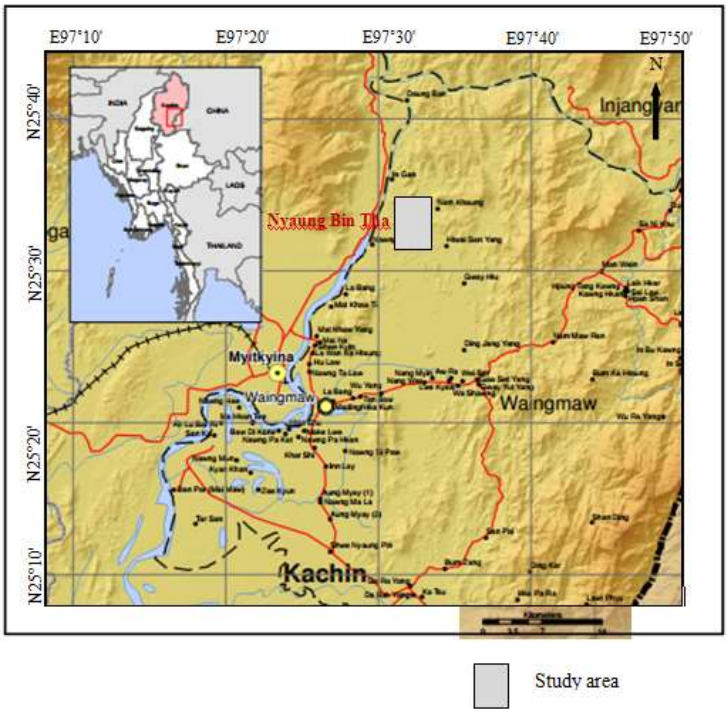

Figure 1 Location map of the Nyaung Bin Tha area

Geology of the study area

The present area lies between the Shan Plateau in the east and the Central Lowlands in the west. It is mountainuous and rugged terrains and cover with fairly dense vegetation. The study area is mainly composed of igneous rocks include both plutonic and volcanic rocks. The plutonic rocks are peridotites, gabbro, granodiorite and dolerite. The volcanic rocks are basalt, andesite, dacite, rhyolite and volcanic tuff. Clegg (1941) regarded that peridotites, diorites and gabbro in the Katha and Myitkyina Districts associated with lava and tuffs as a result of Post Cretaceous to Early Eocene igneous activity. Using K/Ar dating method, UNDP project in which determination on hornblende from a pegmatite gabbro veins within a serpentine boulder at Ma-U Chaung area indicates 158 ± 20 my which is Middle Jurassic (Mitchell *et.al*, 1979). The study area is a part of Tagaung-Myitkyina Belt of Upper Ayeyarwady Province. So the age of volcanic rocks such as dacite and rhyolite in the study area may be possibly Mesozoic to Tertiary (Mitchell et al., 1978). Based on zircon U-Pb ages (ca. 173–171 Ma) are similar to ages previously reported for different lithologies (e.g., andesitic basalt, leucogabbro, and plagiogranite) of the Myitkyina ophiolite, i.e., 176–166 Ma (Yang et al., 2012), and slightly older than the radiolaria age (i.e., Late Jurassic) of cherts at the confluence of the Mayhka and Malikha area was determined as Jurassic by Mg Mg (Maung et al., 2014). Therefore, the Myitkyina ophiolite was formed during the Middle Jurassic (Liu et al., 2016a). According to previous works and field observations, the rock sequences of the study area are shown in Table (1).

Table 1 Rock sequences of the Nyaung Bin Tha area

Sedimentary Unit		
	Alluvium	Quaternary
	^^^^^^^^^^^^^^^^^^^^	
Igneous Unit		
Volcanic rocks	Volcanic tuff	Late Cretaceous to Early Eocene
Volcanic rocks	Rhyolite	Late Cretaceous to Early Eocene
Volcanic rocks	Dacite	Late Cretaceous to Early Eocene
Volcanic rocks	Andesite	Jurassic
Volcanic rocks	Basalt	Jurassic
Dyke rocks	Dolerite	Jurassic
Plutonic rocks	Granodiorite	Jurassic
Plutonic rocks	Gabbro	Jurassic
Plutonic rocks	Peridotites	Jurassic

Distribution of the Petrographic Units

Peridotites are found in the eastern bank of the Ayeyarwady River. Gabbro can be observed in the northwestern part of the study area. Gabbro associated with volcanic tuff. Granodiorite can be found as a bold massive, predominant plutonic unit in the study area. Two-third of the study area is made up of granodiorite. Gold bearing quartz vein are found in granodiorite host rock. This unit can be found in the northern, eastern and southeastern part of the study area. Dolerite intruded as dyke into gabbro unit along the Nam Phu Hka Chaung sections. Dacite is the second most abundant unit in the study area and they are commonly exposed along the Pun Gre Hka Chaung. Basalt exposures are found along Nam Hkawng Hka Chaung section. Most of the basalt shows pillow structure piled one upon another and displays exfoliation. Xenoliths of granodiorite can be observed in the basalt body in the northern part of Nawng Mon village. So, basalt is younger than granodiorite. Rhyolite is well exposed in the northwestern part of the study area. Layerings of lava flow are common features of this rock unit. Good exposures are generally best seen at the stream section. The rest part of the study area is covered by alluvium. The geological map of the study area is shown in figure (2).

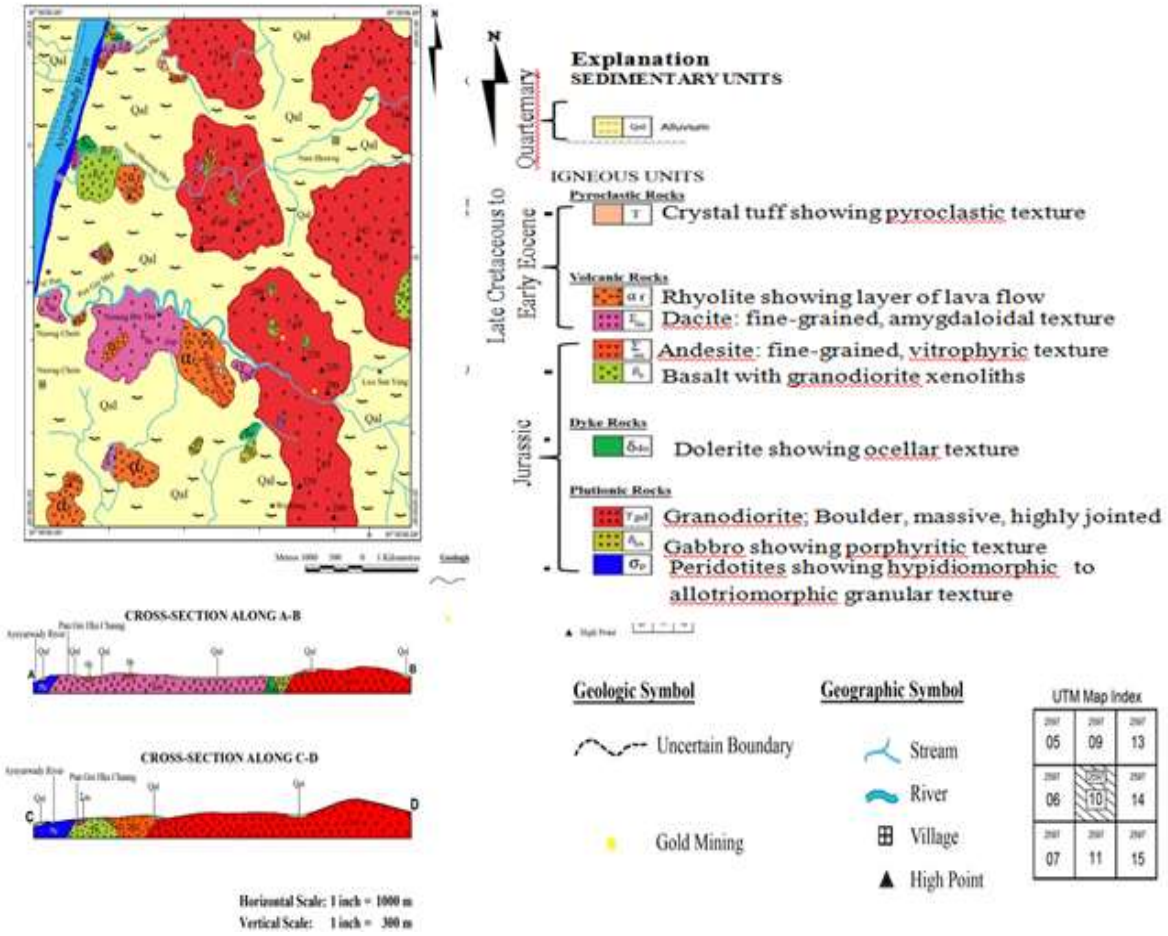

Figure 2 Geological map of the Nyaung Bin Tha area

Petrography

Plutonic Rocks

Peridotites

The rock is medium-grained, hypidiomorphic to allotriomorphic granular texture (Fig.3). The essential minerals are olivine (65%), orthopyroxene (11%) and clinopyroxene (9%) with minor amount of hornblende and biotite (10%). Chromite, iron ores and plagioclase (5%) are accessories minerals. Olivine is the chief constituent minerals in this rock. Olivine grains occur as granular form and average grain size is about 0.5 mm. It is also found as inclusion in enstatite. A few orthopyroxene occurs as subhedral to anhedral grains of more than 1mm in size. It shows lamella structure. Clinopyroxene occurs as grains and as short prismatic form. Chromite ore occurs as disseminated grains with varying sizes.

Gabbro

This rock is medium- to coarse- rocks with a hypidiomorphic granular texture. It essentially contains plagioclase (60%), pyroxene (25%), hornblende (10%) with minor amount of olivine (3%). Magnetite, apatite (2%) is present as accessories. Plagioclase occurs as subhedral to euhedral form and its size ranges from 1 mm to 3 mm. They commonly show polysynthetic twin, combination of Carlsbad and albite twin and display conspicuous zoning (Fig.4). Pyroxene occurs as large phenocryst shows sector-zoned and each sector displays oscillatory zoning (Fig.5). The

size ranges from 1 mm to 3 mm. Along the boundaries of some crystals, they are altered to chlorite. Hornblende occurs as subhedral to anhedral form and occasionally, typical hornblende cleavages are observed. Some hornblende is entirely enclosed in the plagioclase phenocryst. A few olivines interstitially replaces between plagioclase.

Granodiorite

Hornblende-biotite granodiorite

It is medium- to coarse-grained and shows hypidiomorphic granular texture. This rock is essentially composed of plagioclase (48%), orthoclase (20%), quartz (23%) with minor amount of hornblende and biotite (5%). Apatite, zircon and magnetite (2%) occur as accessories. Plagioclase is the most common mineral in this rock. The composition of plagioclase ranges (An_{11-17}) albite to oligoclase. Plagioclase is mostly euhedral in form and coarser grain than others. Their grain size varies from 1.5 mm to 2 mm in length. Plagioclase is partly or completely altered to sericite or saussurite and some altered to epidote. Quartz and alkali feldspar are less abundant than plagioclase. Alkalifeldspar occurs as anhedral to subhedral grains and most of them are perthitic orthoclase. String perthite are also found (Fig.6). Quartz occurs as anhedral crystal and displayed consertal texture in quartz-rich portion (Fig.7). Two types of hornblende, consisting of the brown and green hornblende are found in the hornblende biotite granodiorite Hornblende occurs as long prismatic crystal, strong pleochroism from yellowish green to dark brown and the size range from 0.2 mm to 2 mm in length. Magnetite and quartz enclosed within the hornblende minerals, giving to the poikilitic texture (Fig.8). In some thin section, hornblende altered to chlorite (Fig.9). Biotite occurs as subhedral form and shows strong pleochroism from yellowish to dark brown. Their size ranges from 0.5 mm to 2 mm in length. Some biotite altered to chlorite along the cleavage plane. Olivine occur as anhedral to subhedral crystal, the maximum grain size reach up 0.5 mm. Marginal parts of the olivine altered to serpentine mineral (chrysotile) due to hydrothermal alteration (Fig.10).

Biotite granodiorite

This rock is essentially composed of quartz (25%), plagioclase (50%), orthoclase (20%) and biotite (5%). Magnetite found as accessory minerals. The rock shows hypidiomorphic granular texture. Quartz appears mostly as anhedral crystals. The grain size ranges from 0.1mm to 0.5mm in diameter. Plagioclase displays subhedral to anhedral form. Some plagioclase crystal shows carlsbad twin or polysynthetic twinning. Orthoclase feldspar occurs as anhedral to subhedral and the grains size ranges from 0.1 mm to 0.5 mm. Biotite is the chief constituents minerals in this rock. Biotite occurs as subhedral, flaky form and their size ranges from 0.5 mm to 2 mm in length. It exhibits pleochroism from dark-reddish brown to light brown. In some thin section, partial replacement of hornblende by biotite is also observed (Fig.11). Magnetite and apatite are present. Magnetite totally inclusion in the cleave plane of the biotite flake.

Leucogranodiorite

The leucogranodiorite occurs as light coloured, fine-grained rocks, consisting mainly of plagioclase (36%), orthoclase (30%), quartz (24%) with minor amount of biotite and hornblende (8%). Apatite, magnetite, chlorite (2%) occur as accessories. Quartz occurs in alternating bands of medium grained prismatic crystals, fine, and extremely fine mosaic textured quartz (indicating very rapid deposition), along with intervals of colloform chalcedony, which has now recrystallised to fine quartz (Fig.12). The intergrowth of quartz with plagioclase may be seen as myrmekitic texture in this rock (Fig.13). Orthoclase feldspar occurs as cloudy appearance. Hornblene occurs as brown

crystal. Plagioclase display subhedral to anhedral form and sometime prismatic form. In some thin section, it shows polysynthetic twinning is also observed. Biotite occurs as irregular flakes and magnetite occurs as inclusion in other minerals particularly in feldspar.

Dolerite

It is composed essentially of olivine (5%), plagioclase (25%), augite (15%) hornblende (2%). Other fine-grained minerals also occur in the groundmass (53%). Dolerite shows ocellar texture (Fig.14). Each ocellus shows small spheroidal or ovoid form and olive-green colour of ocellus is olivine and shows zoning (the rim is more or less complete veneer of tiny magnetite crystals). The remainder of each ocellus comprises clear zeolites, turbid or very-fined grained zeolites. Kaersutite (black hornblende containing titanium) occurs as slender prisms, much more abundant than grains of augite and oxides. Plagioclase occurs as microlites in the fine-grained groundmass. The groundmass includes magnetite and other opaque minerals. Interstitial quartz and orthoclase are also observed in the matrix. Augite occurs in some thin section.

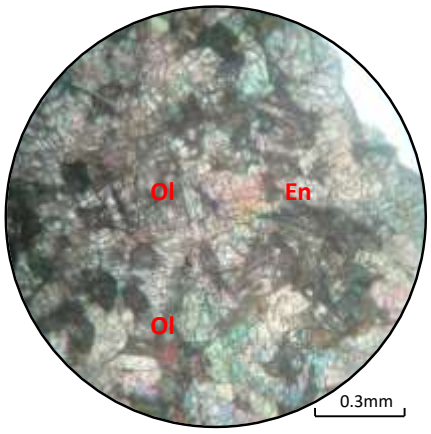

Figure 3 Hypidiomorphic to allotriomorphic granular texture in peridotites, between XN

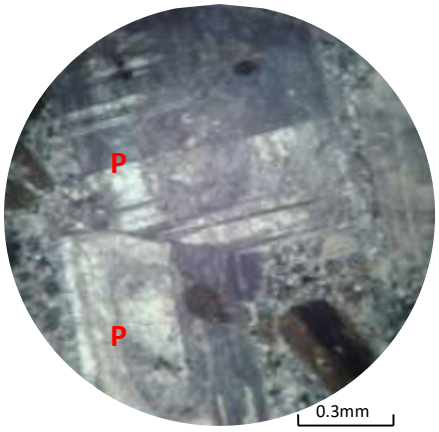

Figure 4 Zoned plagioclase twinned on the Carlsbad law in gabbro , between XN

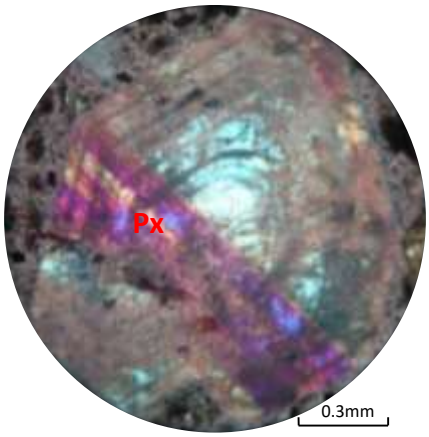

Figure 5 Sector-zoned and each sector displays oscillatory zoning of pyroxene in gabbro, between XN

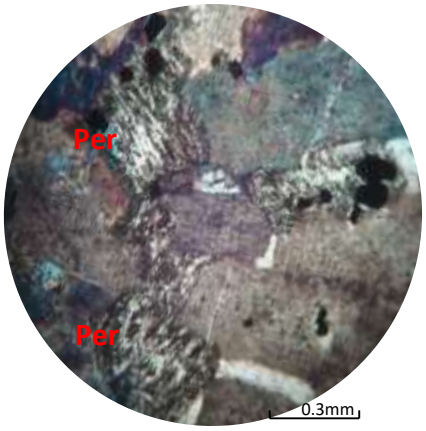

Figure 6 String perthite in hornblende biotite granodiorite, between XN

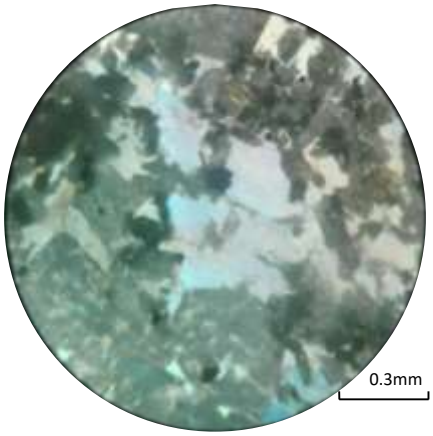

Figure 7 Consertal texture in hornblende - biotite granodiorite, between XN

Figure 8 Poikilitic texture of brown hornblende in the hornblende biotite granodiorite, between XN

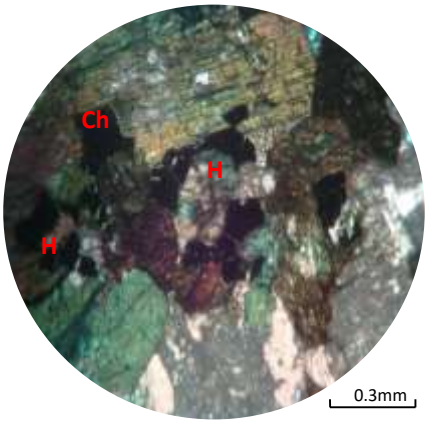

Figure 9 Hornblende altered to chlorite in hornblende biotite granodiorite, between XN

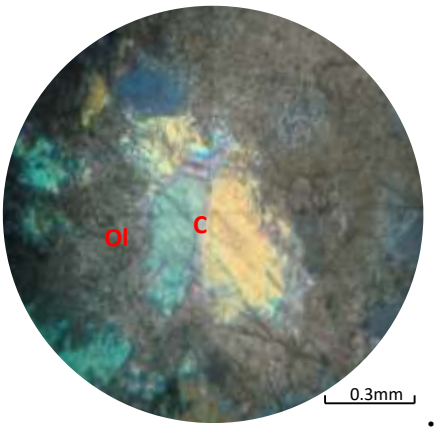

Figure 10 Marginal parts of the olivine altered to serpentine mineral (chrysotile) in hornblende biotite granodiorite, between XN

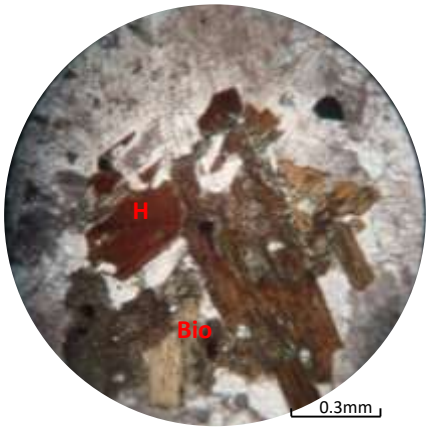

Figure 11 Partial replacement of hornblende by biotite in biotite granodiorite, between XN

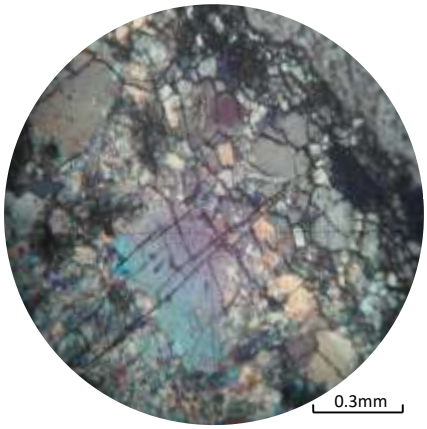

Figure 12 Alternating bands of medium grained prismatic crystals, fine, and extremely fine mosaic textured quartz (indicating very rapid deposition), between XN

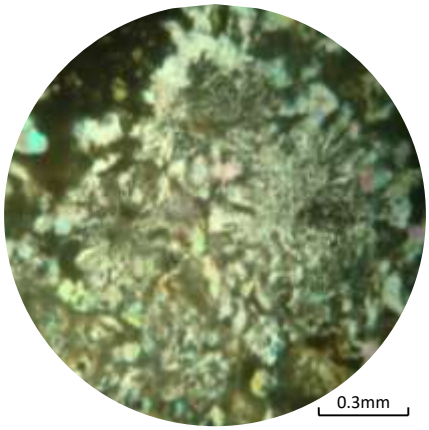

Figure 13 Myrmekitic texture in leucogranodiorite, between XN

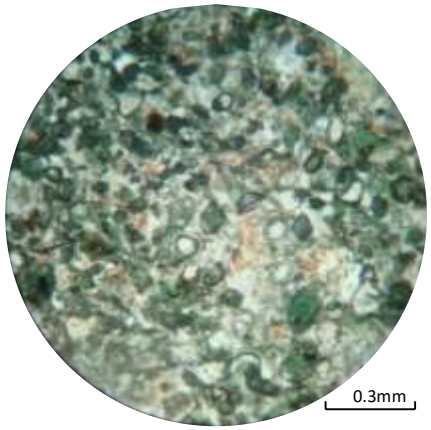

Figure 14 Ocellar texture of dolerite, between XN

Volcanic rocks

Olivine basalt

The olivine basalt is essentially composed of plagioclase (55%), olivine (25%), pyroxene (15%) and minor amount of magnetite and apatite (5%). Phenocrysts of olivine, pyroxene are set in the groundmass. This rock display porphyritic textures. The groundmass is composed of plagioclase microlite with subordinate amount of granular olivine, pyroxene, magnetite, apatite and volcanic glass occurring as intergranular or interstitial matrix. Phenocrysts of olivine and pyroxene are of various sizes and they are fairly abundant. The main constituent mineral plagioclase is present as microlites and sometimes it is found as small amounts of phenocrysts. The matrix is chiefly composed of plagioclase microlites. Plagioclase shows sieve texture due to replacement of abundant inclusions (Fig.15). The grain size ranges from 0.1 mm to 0.3 mm. In some thin section, plagioclase feldspar shows conspicuous zoning are also noted. Some Olivine is also observed in two generations; as large phenocrysts and as small granules within the matrix. The former occurs as subhedral to euhedral prismatic form with the size ranges form 0.2 mm to 1.5 mm. Typical shape of olivine crystal shows irregular cracks and slightly alteration along cracks. In some thin section, olivine phenocrysts shows reaction rims of iddengsite (Fig.16). Pyroxene occurs as subhedral in form and their size ranges from 0.5 mm to 2.5 mm. Some pyroxene phenocrysts shows corona texture or keleptic rim (Fig.17). In some thin section, resorbed crystal of pyroxene commonly have rounded corners or embayed (Fig.18). Granules of magnetite are mostly occupying interstitial spaces in the groundmass. Minute apatite are also observed in the groundmass.

Xenoliths of granodiorite

This rocks exhibits holocrystalline, hypidiomorphic granular texture (Fig.19) and is composed essentially of plagioclase (45%), alkalifeldspar (25%), quartz (23%), biotite and hornblende (5%). Sphene, apatite, zircon and magnetite (2%) are constituted as accessories. Plagioclase is mostly euhedral in form and the size ranges from 0.5 mm to 1.3 mm. It displayed polysynthetic twinning. Some plagioclase altered to sericite. Orthoclase shows simple twin with subhedral form and the size ranges from 0.5 mm to 1 mm. Microline occurs as minor amount and shows cross-hatch twinning. Quartz occurs as anhedral crystal, high β form and the maximium grain size exceed 0.5 mm. Hornblende occurs as brown colour, euhedral crystal. The grain size varies from 0.1 mm to 0.5 mm in length. Biotite occurs as brownish flakes and their size ranges from 0.1mm to 0.5 mm in length. Tiny sphene, zircon and magnetite are present as accessories.

Andesite

This rock composed of plagioclase (50%), olivine (5%), pyroxene (3%) and hornblende (2%) with quartz, alkali-feldspar and dark glass (40%) in the groundmass. The rock varies in texture from intergranular to porphyritic. Plagioclase occurs as both phenocrysts and lath-shaped in the groundmass. Plagioclase phenocrysts are typically enclosed in a pilotaxitic groundmass of small plagioclase laths set in glass. Their grain size ranges from 0.5 mm to 2 mm. It exhibits well penetration twinning. Olivine occurs as anhedral granules occupying the space between feldspar laths. Pyroxene and hornblende are usually anhedral granules in the groundmass. Quartz, alkali-feldspar, magnetite are present in the groundmass in subordinate amounts. The inclusion such as mafic minerals, magnetite and glass are enclosed within plagioclase crystals.

Dacite

Dacite are mainly composed of phenocrysts of plagioclase (20%), quartz (15%), orthoclase or sanidine (8%), pyroxene, hornblende or biotite (7%) and other fine-grained mineral in the groundmass (50%). Plagioclase ranges in composition from labradorite to oligoclase. The main constituent mineral plagioclase is present as microlites and sometimes it is found as small amount of phenocrysts. The matrix is chiefly composed of plagioclase microlites. Plagioclase phenocrysts are generally euhedral to subhedral in form ranging in size from 0.1 mm to 0.5 mm in diameter. Most of the plagioclase shows well penetration twinning. In some thin section, zeolite, quartz filled up in the vesicles and showing amygdaloidal texture (Fig.20). Biotite occurs as small flakes, brown to deep brown color. Its grain size is less than 0.1 mm in diameter. It is usually altered to chlorite. The groundmass is composed of microlites of plagioclase, orthoclase and quartz. Minor accessories minerals are pyrite and iron ores in this rock.

Figure 15 Sieve texture in cumulophric cluster of plagioclase phenocryst in olivine basalt, between XN

Figure 16 Alteration of olivine to "iddingsite" in olivine basalt, between XN

Rhyolite

It is mainly composed of quartz (28%), orthoclase (20%) plagioclase (5%), biotite (3%) and other fine-grained minerals in the groundmass (44%). It shows hypocrystalline texture. Quartz is usually present as small grains, suture contact and undulatory extinction. Orthoclase occurs as subhedral to anhedral grains and shows simple twin. Plagioclase feldspar occur as euhedral to subhedral crystal and cloudy appearance. Brown biotite may be present in lesser amount.

Volcanic Tuff

The rock is composed of crystal of feldspar, small amount of quartz crystal, lithic fragments and volcanic glass in fine-grained matrix. It exhibits pyroclastic texture. The most common minerals are feldspar. Most of feldspar crystals show simple and polysynthetic twinning. Some of the lithic fragments contain opaque iron ore and abundant opaque volcanic glass. Quartz is accidental because it derived from surrounding rocks.

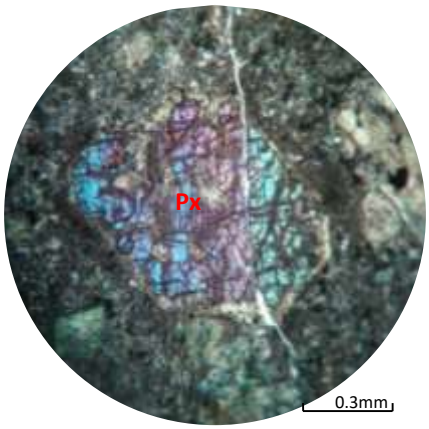

Figure 17 Resorbed texture of pyroxene in olivine basalt, between XN

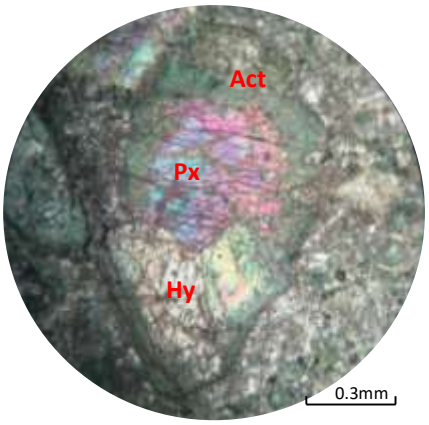

Figure 18 Corona or kelyphitic rim of pyroxene in olivine basalt, between XN

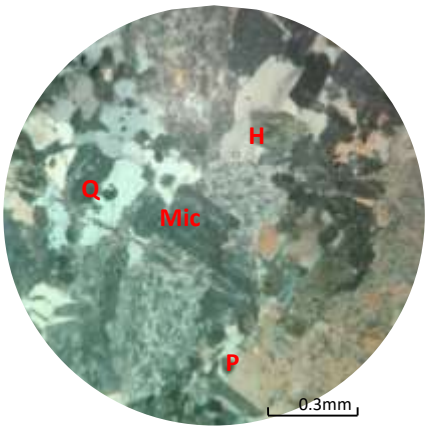

Figure 19 Hypidiomorphic granular texture in xenoliths of microgranodiorite between XN

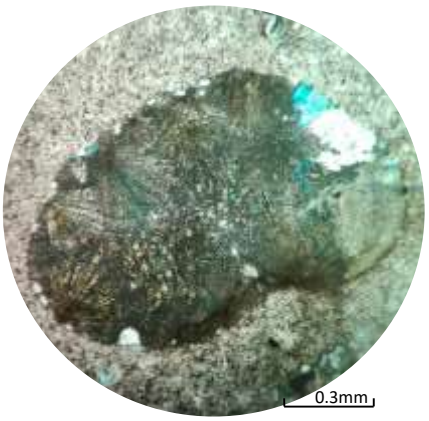

Figure 20 Zeolite, quartz filled up in the vesicles, showing amygdaloidal texture in dacite, between XN

Results

A geological map of the virgin area (Nyaung Bin Tha Area, Myitkyina District, Kachin State) was also attempted (Fig.2). According to the field observation and petrographic criteria, almost all plutonic rocks show medium to coarse-grained, hypidiomorphic granular texture. Porphyritic textures are also recognized in these rocks. Plagioclase feldspar shows conspicuous zoning and twinning. Pyroxene shows resorbed and embayed texture, coroner or keleptic rim. Myrmekites are regarded as the products of a subsolidus reaction. Concentric zoning represents magmatic differentiation processes within the magma. Being affected by the hydrothermal alterations (Chloritization, seritization, epidotization, zeolization and serpentinization) it should be considered as a result of crystallization from wet magma. Gold bearing quartz vein are observed

in granodiorite host rock. Pyroxene and hornblende are most abundant in the study area. Thus, the sources of granodiorite rocks of the study area may be regarded as I-type nature.

Discussion

According to previous works and field observations, the ages of the plutonic rocks and volcanic rocks (basalt and andesite) is regarded as Jurassic. The age of volcanic rocks (dacite, rhyolite and tuff) might be Late Cretaceous to Early Eocene.

Conclusion

According to the field observation and petrographic criteria, almost all plutonic rocks show medium to coarse-grained, hypidiomorphic granular texture. Porphyritic textures are also recognized in these rocks. The presence of perthitic orthoclase in the hornblende-biotite granodiorite rocks suggest that these rocks are of subsolvus types and crystallized at the temperature of less than 700°C.

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