PAPER • **OPEN ACCESS**

Petrography of The Main Range Granite Characterization in Titiwangsa Rest Stop, Perak, Malaysia

To cite this article: Joshua William *et al* 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **1102** 012021

IOP Conf. Series: Earth and Environmental Science 1102 (2022) 012021 doi:10.1088/1755-1315/1102/1/012021

Petrography of The Main Range Granite Characterization in Titiwangsa Rest Stop, Perak, Malaysia

Joshua William[1], Elvaene James[1*], Zuhaira Muhammad Zaini[1], Mohammad Muqtada Ali Khan[1], Hafzan Eva Mansor[1], Zaitul Zahira Ghazali[1], Oluwatoyin Akinola[2] and Angela Vidda Chuwat[3]

[1] Department of Geoscience, Faculty of Earth Science, University Malaysia Kelantan Jeli Campus, 17600 Jeli, Kelantan, Malaysia
[2]Department of Geology, Ekiti State University, Ado-Ekiti, Nigeria
[3]Geomapping Technology Sdh Bhd, Bangi, Selangor
*E-mail: elvaene@umk.edu.my

Abstract: The area of research is located in between the Titiwangsa Rest Stop, Perak allocated along the Gerik-Jeli highway, approximately $25km$ in area. The objective of this research is to remodify a geological map with a scale of 1:25,000 and to determine the petrological aspects of the metamorphic mineral assemblages around the study area. One of the methods used during the initial of this research is primarily on previous research and literature review. The geological mapping technique such as traversing was applied to map the allocated study area and rock samples are collected from three different outcrops that are exposed around the area as well. Moreover, the samples are then sent to a lab to undergo microscopic and petrographic analysis of the rocks' compositions by producing thin sections to determine the mineral assemblages which surround the area on Titiwangsa Rest Stop, Perak. The rocks that can be identified around the area include igneous and metamorphic rocks such as biotite granite, gneiss, and mica-schist. The area of research which extends from the Titiwangsa Rest Stop towards the Gerik-Jeli highway is located directly on the Bentong-Raub suture zone. The depositional setting hypothesized in the area is a marine depositional coastal environment which includes a transition of a lower grade metamorphic rock towards a higher-grade metamorphic rock.

1. Introduction

Granite is classified as an intrusive igneous rock originating beneath a pluton or a volcanic region on the surface of the Earth. A granite rock will be commonly used in manufacturing and construction processes in a consumer's life as it has a dense silica content on the rock itself. Moreover, this type of felsic rock has a 77% percentage of silica, and this rock can be categorized into its types based on the crystallization rate. Such granitic-based rocks include leucogranites and many more. The classification of the granite rocks created by Chappel and White (1974) suggests the development of I-type granite and S-type granite. This classification signifies the composition of the granitoid composition and the felsic magma recrystallization. Peninsular Malaysia contains one of the largest granitic batholiths, specifically at the Western Belt Terrane of Peninsular Malaysia. To add to the context, S-type granites can be found occurring in the Triassic-Central Range of Peninsular Malaysia. Hence, the Main Range has a dominant biotite-granite rock mineral and characterizes the tin provinces around the area. Based on the focused study area, the granitic embodiment has a transitional zone consisting of granite till a high-grade metamorphism foliated gneiss. Several modified contacts can be identified from the study area consisting of gneiss, mica-schist, granite, and sediments. The lithology of the granite covers approximately 65% of the study area.

The objective of this research is to update a scaled geological map according to the study area in a ratio of 1:25,000. Moreover, this research is to investigate the Main Range granite characterization throughout the study area. The research is also to analyse the petrographical aspects of the plutonic and metamorphic rocks in the research area.

2. Literature Review

2.1 Geological Settings

Focused on the research made by Hutchison (1978), 90% of the igneous compositions are made up of granitic bodies in Peninsular Malaysia. They are formed into extended belts from the coast of Thailand to Southern Malaysia. The belts are extended into the Western, Eastern and Mid-Range Province, separated by the Bentong-Raub Suture (Hutchinson & Taylor,1978; Beckinsale, 1979; Cobbing et al., 1986). The Main Range Granite covers the whole of Peninsular Malaysia, and it has more silica content than the other Ranges. The two distinct types of granitic bodies in Peninsular Malaysia, S-Types, and I-type granite, were formed by tectonic collision and crystallization from meta igneous rocks. The Tertiary Tectonic Event, which formed Peninsular Malaysia, affected the granitic intrusion to crystallize from batholiths and secondary minerals such as K-Feldspar and biotite around 251-254 million years ago. The Tiang schist occupies a north-south trending belt whose western margin is in contact with the eastern margin of the Main Range Granite (Malaysian Thai Working Group,2012).

The Main Range Granite compromises large batholiths along the Bentong-Raub suture abundantly. Porphyritic microgranite has a dominant value in the Main Range Granite, tin-mineralized granite. These granitic rocks are found in large areas of plutons of granites. Hutchinson (1978) also concluded that S-type granites contain a nomenclature of K-feldspar, quartz, plagioclase, and biotite as abundant minerals (Bowden et al., 1984). Biotite usually can be found in mafic clasts along with granoblastic dominance of quartz and plagioclase in granitic crystallized igneous rocks making up 25% of the rock's volume. These S-type based crustal melts mostly dominate in the north of Peninsular Malaysia as they are in the initial area of the Bentong-Raub suture (Bowden et al., 1984). The Main Range granite is primarily directed through the effects of an uplift process between tectonic plates and the orogenic granitic trends (De La Roche et al., 1980).

Based on the research made by Wong (1974), the Main Range Granite intrudes suture zone rocks more extensively. Metasedimentary rocks in the West- Coast highway in Gerik have a higher grade of metamorphism in this south. The grade metamorphism ranges from upper greenschist to lower amphibolite facies. Mohd Raji (1990) also detailed the area by describing several different metamorphic facies such as muscovite-quartz schist and biotite-hornblende dominated gneiss biotite-hornblende schist. Moreover, he suggested that gold mineralization occurs in quartz veins within the muscovite quartz-schist. Biotite gneiss extends on the east of Kampung Batu Melintang; meanwhile, gneiss foliation derived from Kemahang Granite intrudes towards the Northern edge of Taku Schist. This occurrence is due to the argon outgassing during the Cretaceous tectonic event near the Peninsula of Malaysia. However, it is doubtful whether biotite gneiss has a bearing age of rocks originating from Bentong- Raub suture. Main Range Granites are more concentrated in the Potassium-Calcium alkali field (Hutchinson,1984).

The area is located between a latitude of 55 $°35'48''N$ and the longitude of $101° 30' 5''E$, with a 25 km^2area span. Based on the hypothesis of several researchers, the rocks of the area are dominated by plutonic and metamorphic rocks, whereby include a transition of a lower grade to higher-grade metamorphism. The depositional area can also be classified as a marine depositional coastal environment. The area's surroundings contain jagged hills, a forest reserve (Amanjaya forest reserve) and a highway rest stop at the border between Gerik and Jeli. Landslides can also be seen in the study area, including soil slumps and slides.

3. Materials and Methods

Several materials are used in this research study based on completing the methods planned. A geological hammer is used to split and break a portion of an outcrop to obtain a hand sample. A compass (Brunton Compass) was used to obtain an outcrop's strike and dip measurements. Third, a GPS (Geographic Positioning System) is a satellite-based navigation system that consists of three main components: a space satellite, ground monitoring stations, and GPS receivers. GPS devices offer latitude and longitude data, and some need altitude calculations.

The method of this study was executed in several different steps, which include a preliminary study, fieldwork research, data collection and petrographically analysis. Preliminary research was done to obtain the lithology of the study area, and fieldwork traverse mapping was done throughout the Gerik-Jeli highway. The significance of the method used was to locate the type of lithology rock units in several separate locations along the highway route and to determine the nature of the type of rocks embedded in outcrops throughout the area of interest. The outcrops were remarked on their texture, colour, structural analogy, and foliation. The dip and strike measurements were obtained from those outcrops discovered to obtain the lithology and the extension of the rock minerals throughout the area. Rock samples were taken from the outcrop for further petrographically analysis.

In data collection, rock specimens were collected from the outcrops that were believed to be a part of the Main Range Granite located in the Eastern Belt on the East-West highway between Kelantan and Perak. Those rock specimens obtained were then sliced into smaller pieces, inserted into thin sections, and interpreted in terms of the mineral compositions and textures. Petrography analysis was done to illustrate the rocks' geological history based on the minerals' characteristics in the thin section.

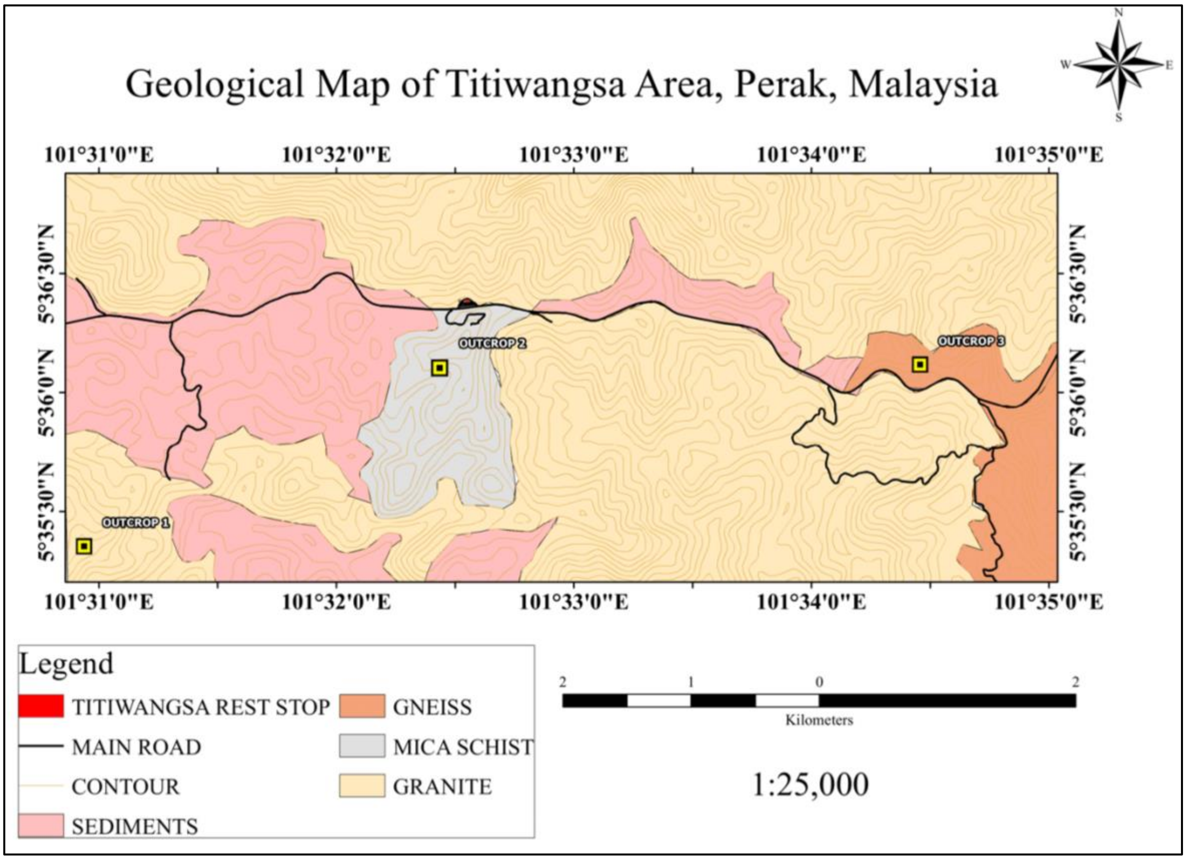

Figure 1. The geological map of the study area

4. Locality

Few exposed outcrops were discovered along the Titiwangsa area highway route (Fig. 2). A partially weathered biotite granite porphyry outcrop was found near the Amanjaya forest reserve (location: 5°35′48″N and 101°30′5″E) (Fig. 2a). Based on the hand specimen, biotite accumulations can be seen are embedded in the coarse-grained fresh sample of biotite granite rock sample (location: 5°36′48″N and 101°32′33″E) (Fig. 2b). Mica schist outcrop was found opposite the Titiwangsa Rest Stop (location: 5°36′3″N and 101°34′59″E) (Fig. 2c) and most of the rocks showing deformation (Fig. 2d). A gneiss outcrop was found along the highway route with a transition of a slightly foliated schist outcrop (location: 5°36′3″N and 101°34′59″E) (Fig. 2e). An intrusion of aplite can be seen which intruded the gneiss (Fig. 2f).

Figure 2. The figure shows the hand specimen and the outcrops that was discovered along the Titiwangsa area highway route. **a)** A partially weathered biotite granite porphyry outcrop was found near the Amanjaya forest reserve (location: 5°35′48″N and 101°30′5″E). **b)** Presence of biotite accumulations are embedded in the coarse-grained fresh sample of biotite granite rock sample (location: 5°36′48″N and 101°32′33″E). **c)** A mica-schist outcrop was found opposite the Titiwangsa Rest Stop (location: 5°36′3″N and 101°34′59″E). **d)** Presence of a deformation fresh- dark grey samples of mica schist taken from the outcrop as a hand specimen. **e)** A gneiss outcrop was found along the highway route with a transition of a slightly foliated schist outcrop (location: 5°36′3″N and 101°34′59″E). **f)** Aplite, quartz veins intruded the gneiss.

IOP Conf. Series: Earth and Environmental Science 1102 (2022) 012021 doi:10.1088/1755-1315/1102/1/012021

5. Results

Based on the thin sections show a photomicrograph of igneous rock samples along the Gerik-Jeli highway. All samples are abundant with a metamorphosed quartz mineral (Figure 3). Sample J1 contains quartz mineral metamorphosizing in the thin section (Fig. 3a). Quartz shows first-order colour from greyish to milky white, wavy extinction and low relief. Another section of sample J1 shows the presence of a bluish chloride in the middle of a twinned orthoclase (Fig. 3b). Sample J1 shows the presence of biotite being dominant around quartz grains with a high colour birefringence (Fig. 3c). Sample J2 contains several presences of muscovite and characteristics such as inclusions and exsolution (perthite) can be seen in the alkali feldspar phenocryst (Fig. 3d). Sample J2 exhibits twinning with a phenocryst characteristic (Fig. 3d). Sample J2 also has an Albite Twinning seeping besides the presence of biotite and muscovite (Fig. 3df).

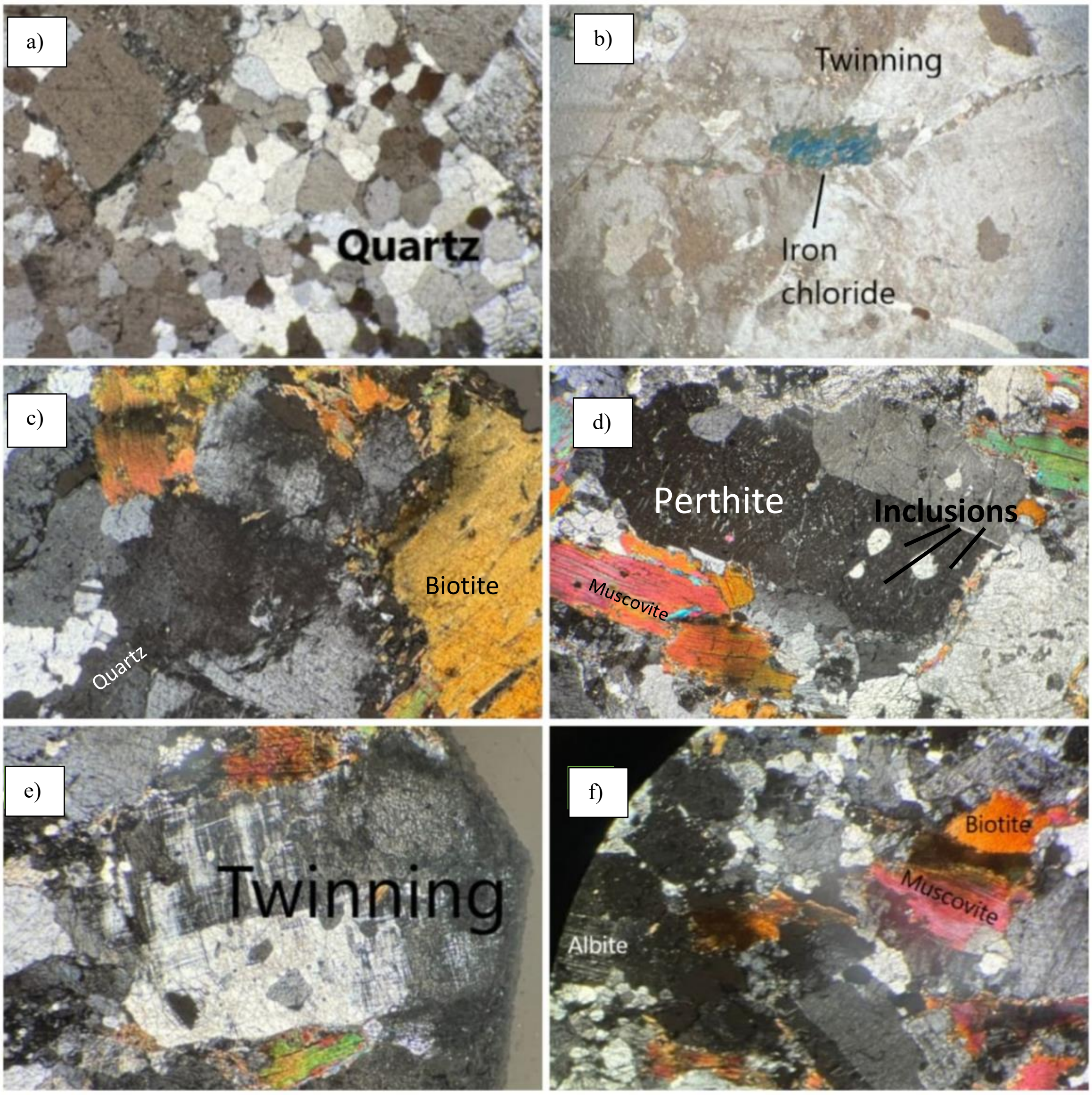

Figure 3. The thin section of igneous rock samples along the Gerik-Jeli highway. (**a**) Sample J1 contains quartz mineral metamorphosizing in the thin section (**b**) Another section of sample J1 shows the presence of a bluish iron chloride in the middle of a twinned orthoclase (**c**) Sample J1 shows the presence of biotite crystals being dominant around quartz grains with a high colour birefringence (**d**) Sample J2 contains several presences of muscovite and characteristics such as inclusions and exsolution (perthite) can be seen in the alkali feldspar phenocryst (**e**) Sample J2 exhibits twinning with phenocryst characteristics. (**f**) Sample J2 also has an Albite Twinning seeping besides the presence of biotite and muscovite.

IOP Conf. Series: Earth and Environmental Science 1102 (2022) 012021 doi:10.1088/1755-1315/1102/1/012021

6. Discussion

Based on the results of the petrographically analysis, the igneous intrusive granitic bodies intrude the existing country rocks that can be found in the Main Range Granite in the Western Belt of Malaysia. In terms of the rock's textural aspects, the interlocking feature of the minerals further suggests that slow crystallization forms a perfect crystal form. Foliations or crenulations in thin sections which bring to a metamorphic origin could not be clearly seen. However, the Mid-Range Granite, which extends to the East-Coast highway, includes a transition from granitic igneous rock to a high-grade metamorphic rock such as gneiss, hence stating that the identified igneous rock has a slight metamorphism trait. This can be proved by the quartz recrystallization that can be observed in the thin sections.

This area is in Peninsular Malaysia, situated nearby the collision of two tectonic terranes, Sibumasu in the West and Chanthaburi terrane in the East of Southeast Asia; disjointed by the Bentong-Raub suture. The area of Gerik-Jeli, in general, has an abundance of meta-igneous melt sources, and this is due to the tectonic processes that occur in Central Belt in Peninsular Malaysia.

In terms of the tectonic occurrences in the study area, intrusion of metasediments, Z-type granites, and I-type granites, occurred due to the spreading of Mesotethys ridge around the Palaeozoic era. This process had caused continental subduction in the Sibumasu plate terrane, which forms Bentong-Raub suture zones and slab breakoffs.

In the Titiwangsa area, based on the lithology of the map given, the granites intruded consist of biotite- muscovite granite. Late-stage magmatic structures such as sizeable pegmatitic potassium feldspar are common in the pluton of the study area. The occurrence of biotite-muscovite granite proves the partial (dehydration) melting of crustal rocks of the Sibumasu and Indochina tectonic terrane and the presence of meta supra crustal rocks in the area.

7.Conclusion

This paper utilizes the geological analogy and the petrographical characteristics of the Titiwangsa area relating to the Main Range Granite from the Bentong- Raub Suture located in the Western Belt of Malaysia. Primary field descriptions of outcrops were conducted at three outcrops relating to the mentioned Main Range Granite to understand the geological history of the area of interest. Plus, the observed lithology and facies around the area are biotite-granite, mica-schist, and gneiss. Textural aspects indicate that the granitic rocks are categorized as S-type granite originating from the Bentong-Raub Suture.

References

[1] Cobbing E J 1987 A comparison of the Andean Batholith in Peru with granites from the South-East Asian Tin Belt. *Proceedings of the Ussher Society* **6** 423–430.
[2] Cobbing E J, Mallick, D I J, Pitfield P E J, Teoh, L H 1986 The granites of the Southeast Asia Tin Belt. *Journal of the Geological Society London* **143** 537–550.
[3] Cobbing E J, Pittsfield, P E J , Darbyshire, D P F, Mallick D I J 1992 The granites of the South-East Asian tin belt. Overseas Memoir, 10. British Geological Survey.
[4] Ghani A A 2009. Plutonism. In C.S. Hutchison & D.N.K. Tan (Eds.). Geology of Peninsula Malaysia. *Geological Society of Malaysia*, pp. 211-234.
[5] Hutchison C S and Tan D N 2009 Geology of Peninsular Malaysia. Kuala Lumpur: Geological Society of Malaysia.
[6] Khoo T T and Lim S 1983 Nature of the contact between the Taku shist and adjacent rocks in the Manek Urai area, Kelantan, and its implications. *Geological Society of Malaysia*, 139-158.
[7] Lech M E and Trewin C L 2013 Weathering, erosion, landforms, and regolith. Australia: Geoscience Australia