OBSERVATION OF LANDFORMS OF GRANITIC ROCKS IN PA NYIT BEACH IN LAUNGLON TWONSHIP, TANINTHARYI REGION

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Abstract

Many famous beaches are located at Dawei in Tanintharyi Region. Among them Pa Nyit Beach is situated in the westernmost part of Launglon Township. It is lying between Latitude 14°59′00″N to 15°02′30″N and Longitude 98°083′30″E to 98°05′30″E. It extends about 3.34 km from east to west and 5.85 km from north to south. The area covers about 19.52 square kilometers. In this area, the mountain ranges show the North-South trending. Regionally, three granite belts in the Dawei area are frontier range granite, central range granite and coastal range granite. The study area is located in the coastal range granite. Granitic rocks in the study area are hornblende biotite granodiorite, biotite granite, porphyritic biotite granite, microgranite and leucogranite. Aplite dykes and quartz and quartzofelspathic veins intruding into these rock units, especially biotite granite and microgranite. Both major and various minor landforms of granite are observed in the study area. Minor landforms are classified as weathering forms, tectonic forms and Structural forms. Observable weathering forms in the study area are blocks, boulders, exfoliation, pitting, sheet, flakes and spalls, polygonal cracks, gutter and grooves, pseudobedding and tafoni. Many of them are initiated in the surface. A-tent and orthogonal cracks are tectonic forms and they are formed by different ways of tectonic movements. Structural forms in this area are cleft, displaced blocks and split rocks, fault, joint, fracture and intrusive dykes and veins. Most of them are formed due to intrusive veins.

Keywords: Granitic, `Landforms, Pa Nyit, Launglon, Weathering, Structural, Tectonic

Introduction

Pa Nyit beach is situated in the westernmost part of Launglon Township in Tanintharyi Region. It is lying between Latitude 14°59′00″N to 15°02′30″N, Longitude 98°083′30″E to 98°05′30″E. It extends about 3.34 km from east to west and 5.85 km from north to south. The area covers about 19.52 square kilometers. (Fig 1.1) It is easily accessible by car in any season. Satellite image of the study area is shown in (Fig 1.2). Launglon area is regarded as coastal range. Many famous beaches are located along this coastal range. Almost all beaches have granitic rocks with many landforms.

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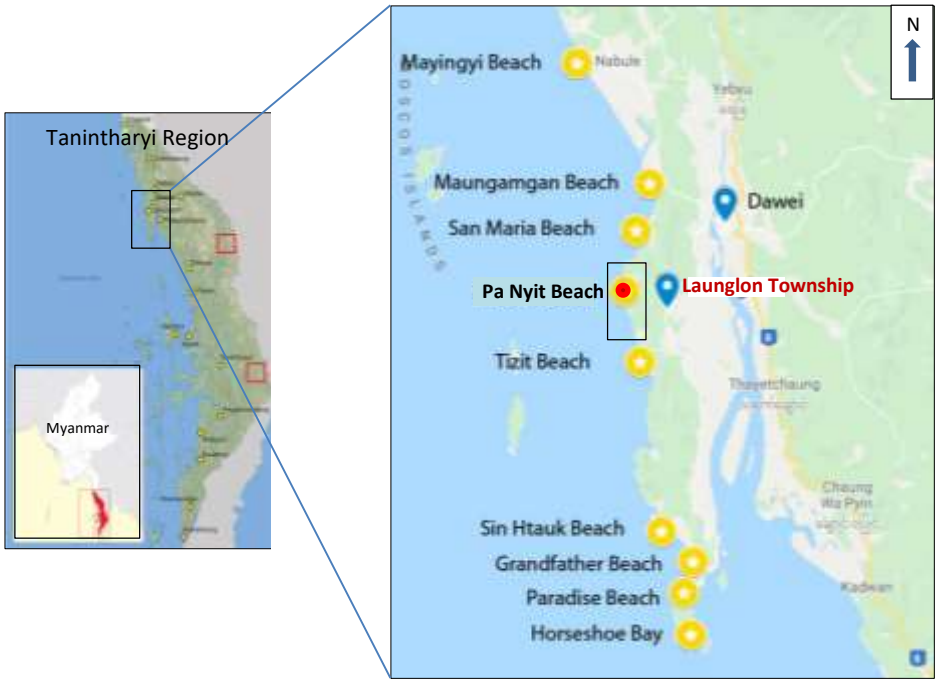

Figure 1.1 Location Map of the study area

1.1 Purpose of Study

The purposes of the investigation are to study the rock units of the investigated area and to investigate landforms of granitic rocks exposed in the study area.

1.2 Methods of Study

Before conducting the field works, literature collection and studies of previous works were performed. Aerial photographs and the satellite image were also used as an aid to delineate the lithologic boundaries and the structures of the area. Field works including systematic sampling, measurement of geological structures were carried out by using tape and compass traverse method and GPS.

Landforms of Granitic Rocks in Pa Nyit Beach

The study area is mainly composed of hornblende biotite granodiorite, biotite granite, porphyritic biotite granite, microgranite and leucogranite. Major and various minor granite landforms are observed in this area. Mainly three types of minor granite landforms in the study area are weathering forms, tectonic forms and structural forms. Interaction between bedrock and the atmosphere and hydrosphere, and especially meteoric and groundwater, leads to alteration of the rock and the formation of a regolith. Fresh granite is low in porosity and permeability, but is highly pervious by virtue of a connected series of orthogonal and sheet fractures. Granite is susceptible to weathering by moisture, leading to the formation of a regolith. The course and rate of weathering are influenced by the structure of the rock, including fractures, mineral composition, texture; especially size of the crystals and the physical, chemical and biotic nature of the invasive water. In this area, minor forms developed on granites are due primarily to weathering are blocks, boulders, exfoliation, plinths, pitting, sheet, flakes and spalls, polygonal cracks, gutter and grooves, pseudobedding and tafoni. Many of them are initiated in the surface. Tectonic forms contain A-tent, strain and rupture and orthogonal cracks. They are formed by different ways of

tectonic movements. Structural forms in this area are cleft, displaced blocks and split rocks, fault, joint, fracture and intrusive dykes and veins. Most of them are formed due to intrusive veins.

Northern part of Pa Nyit beach
(Facing 350°)

Southern part of Pa Nyit beach
(Facing 175°)

Figure 1.2 Satellite image (Fig.a) and scenic view of the study area (Fig.b&c) (Latitude 14°59′00″N to 15°02′30″N and Longitude 98°03′30″E to 98°05′30″E)

2.1 Major Landforms

2.1.1 Slopes

Smooth gently inclined slope of coastal cliffs and moderately steep slope are mostly occurred in the study area. Flared slopes are also well represented on boulders but flared slopes not found in this area.

2.2 Minor Landforms

2.2.1 Weathering forms

Observable weathering forms in the study area are blocks, boulders, exfoliation, pitting, sheet, flakes and spalls, polygonal cracks, gutter and grooves, pseudobedding and tafoni. Many of them are initiated in the surface.

Boulders and blocks - Where steeply inclined fractures or foliation are closely spaced, penitent rocks are formed, and where orthogonal systems are developed, preferential weathering along fractures leads to essentially spheroidal corestones set in a matrix of grus. When exposed, the corestones become boulders. Subsurface weathering in well-jointed granite operates preferentially along the discontinuity planes and their intersections. The transformation of the hard bedrock into a decomposed and friable regolith (grus) progresses inwards from the joints towards the core of the compartments that they individualized.

Core stones are the hard residual blocks surrounded by soft grus located in weathering mantles. Their maximum sizes are determined by the joint spacing. They tend to become progressively smaller and more rounded as weathering proceeds and may have concentric weathering layers (spheroidal weathering). Corestones may be exposed at the surface when the soft residual mass is removed selectively by erosion. The resulting boulders may be left in place or may suffer some transport. Granite boulders may also form by weathering and erosion processes guided by jointing at the surface. The boulders may reach more than 30 m in length, although the modal dimension is typically close to 1m.

Pitting - Differential weathering at the crystal scale leads to feldspars and micas being altered to clays, leaving the quartz upstanding and giving a rough or pitted surface. Pitting is widely developed in granitic rocks on the coast here it may be the combination of high temperature, and alkaline waters (sea pray) together promote rapid differential weathering on exposed surfaces.

Tafoni and hollow - The tafoni are initiated at the weathering front, presumably as a result of especially intense subsurface moisture attack. Alveolar weathering is typical of fracture planes and the weathering front and represents an early stage of weathering. Miniature hollows may form on exposed surfaces but little is known of their origin. Tafoni undoubtedly evolve at the base of boulders and sheet structures, beginning with inverted saucers and enlarging upward into the mass as a result of salt crystallization, hence the occurrence of tafoni in arid and semiarid lands and some coastal areas.

Figure 2.1 Chaotic mass of boulders and blocks of biotite granite which are fitted and polished (14°59′27″N & 98°04′36″E)

Figure 2.2 Well rounded boulder and different sizes (shingle) of biotite granite composed of released granite corestones (14°59′32″N & 98°04′30″E)

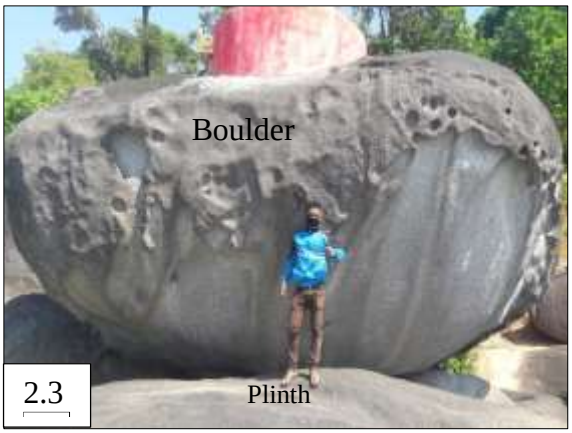

Figure 2.3 Large boulders of porphyritic biotite granite and also show boulder and plinth (14°59′45″N & 98°04′55″E)

Figure 2.4 Exfoliation features of biotite granite show concentric weathering layers, spheroidal weathering (15°00′36″N & 98°05′10″E)

Sheet, Flakes and spalls - Many exposed granite surfaces are covered, indeed essentially consist of a skin usually multilayered, of thin laminae, flakes or scale. Flakes are millimeters thick. Thicker lamellae, greater 1 cm thick, are referred to as spall plated. Both flakes and spall plates are associated with bush fires and other sources are ephemeral but intense heat.

Polygonal crack - Polygonal cracking affects spall plates on boulders and platforms and may be due to a surficial compressional stress caused by the accumulation of silica, iron oxide and manganese oxides either on exposed surfaces or at the weathering front. The cracks may be developed on as many as three successive small plates at any one site. Such patterns of cracks have been observed on corestones and on the recently exposed slopes and platforms.

Gutters and Grooves - After exposure, rudimentary gutters are deepened by running water. Abrasion is evidenced by the development of potholes. In some cases the gutters have become flask-shaped in cross section as a result of the undercutting of side walls by streams. Some gutters have exploited and follow fractures but that slope the prime determinant of the path follow by streams, and hence gutters, is demonstrated by the many places where the gutters leave fractures to follow the steepest local slope.

Pseudobedding and foliation - In some part of the world, the near surface granite is subdivided into thin slabs and attenuated lenses by fractures that run parallel or subparallel to the surface. Commonly known as Pseudobedding, it has been attributed to shear of the rock and preferential alteration along the foliation planes.

Figure 2.5 Pits occur in porphyritic biotite granite (The pits show that the vertical face on which it is located was originally horizontal.) (15°01′33″N to & 98°05′05″E)

Figure 2.6 Tafoni in porphyritic biotite granite (14°01′12″N & 98°04′55″E)

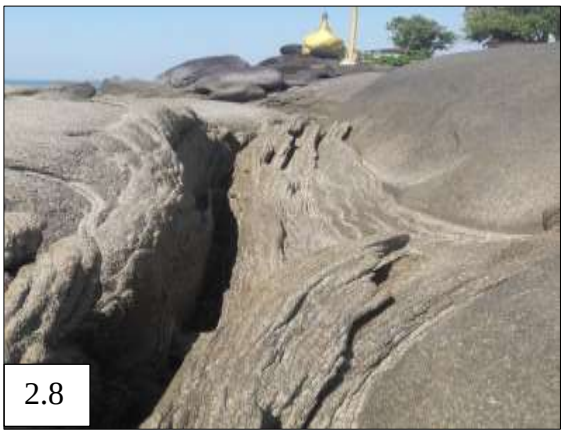

Figure 2.7 Sheeted nature of biotite granite (14°59′54″N & 98°04′42″E)

Figure 2.8 Flakes and spalls occur in porphyritic biotite granite (14°59′39″N & 98°04′50″E)

Figure 2.9 Polygonal crack occur in biotite granite (15°01′08″N & 98°01′33″)

Figure 2.10 Gutters and Grooves occur in biotite granite (14°59′37″N & 98°04′23″E)

Figure 2.11 Kluftkarren on a vertical wall occur in biotite granite (15°02′08″N & 98°05′41″E)

Figure 2.12 Pseudobedding in porphyritic biotite granite (15°01′28″N & 98°04′48″E)

2.2.2 Tectonic forms

Tectonic forms contain A-tent and orthogonal cracks. They are formed by different ways of tectonic movements.

A-tent - Tectonic processes are responsible for a small but notable suite of landforms in granite. A tent or pop-ups cannot in reason be attributed either to insolation or to erosional offloading. They involve a permanent expansion, are consistently oriented in a given area and, in some instances, have been induced by detonation of explosives. They could be due to weathering but, as they invove a small expansion, may be incomplete or incipient A-tents.

Orthogonal crack - At first sight, some patterns of cracks seem comparable to polygonal cracking, but they are orthogonal rather than pentagonal or hexagonal and give rise to chocolate blocks or tablets. They commonly occur on several parallel planes at the same site. The orthogonal cracks are interpreted as due to shearing stress on surfaces that tough during dislocation. Orthogonal cracking is also developed on the extended crests of domical structures.

Figure 2.13 A –tent occur in porphyritic biotite granite (15°02′15″N & 98°04′52″E)

Figure 2.14 Orthogornal crack occur in microgranite (15°02′25″N & 98°04′10″E)

2.2.3 Structural forms

Structural forms in this area are cleft, displaced blocks and split rocks, fault, joint, fracture and intrusive dykes and veins. Most of them are formed due to crystal strain and intrusive veins.

Cleft - Exploitation of vertical fractures leads to clefts or slots. Such exploitation of fractures and veins can, of course, take place either at the weathering front or after exposure, some depresses, some raised, depending on the relative resistance of material injected into the fractures during deformation.

Displaced blocks and split rocks - The rounded or subrounded mass of a boulder rests on the base on only a small part of the whole surface. Rounded blocks and boulders include secondary partings, gravity causes unsupported sections to fall apart, in displaced blocks or split rocks, depending on whether the two parts remain in situ or whether they tumble downslope.

Figure 2.15 Kluftkarren or clint and grike in porphyritic biotite granite. Clefts (grikes) about 15 cm deep (14°59′34″N & 98°04′34″E)

Figure 2.16 Displaced blocks and split rocks occur in biotite granite (15°02′10″N & 98°04′55″E)

Figure 2.17 Sub-rounded block with secondary fracture in biotite granite (15°02′09″N & 98°04′53″E)

Figure 2.18 Vertical joint observed in microgranite (14°59′35″N & 98°04′31″E)

Fault and Joint and fracture – Most of faults in this area are minor and which are recognized by displacement of dykes and veins. Secondary fractures and flexures are generally associated with minor faults. Joints observed in the study area shrinkage and sheet joints. Shrinkage joints are caused by tensional forces set up in rock body as a result of cooling. Sheet joint is a set of joints may develop which are more or less parallel to the surface of the ground. They probably arise as a result of the uploading of the rock mass when a cover is eroded away.

Intrusive dykes and veins - Numerous dykes and veins are found in this area. Many are weathered more rapidly than the host rock and some are still level with biotite granite surface.

Figure 2.19 Aplite veins intruding into porphyritic biotite granite (14°59′21″N & 98°04′46″E)

Figure 2.20 Intruding aplite vein is cut and displaced by microfault and also occur large fractures near the vein (15°02′13″N & 98°05′10″E)

Figure 2.21 Intruding aplite vein is apart and move down due to microfault (14°59′23″N & 98°04′49″E)

Discussion

In Pa Nyit beach, many of the landforms developed on granite, both major and minor are related to the characteristics of the rock, the composition of the penetrating water and the relative amounts of weathering and erosion. Tectonic factors are significant in a suite of forms due to the release of compressive stress. Granite outcrops will acknowledge that many curves, flakes, cracks and hollows occur in this area. Minor granite forms originate in a variety of ways, many are due to weathering, some are initiated at the weathering front, others on exposed surfaces; some evolve in response to structural weakness, others on intrinsically homogeneous surfaces; some develop and diversify after exposure, others are destroyed; some are structural and others tectonic.

Results and Conclusions

Many famous beaches are located along this coastal range. Almost all beaches have granitic rocks with many landforms. Most of granitic forms, major and minor, reflect the structure of the rock developed over eons of time from the stage of intrusion onwards. Some climatic influence on the distribution of some minor weathering forms. Many of weathering landforms are initiated in the surface and at the weathering front. Tectonic landforms are formed by different ways of tectonic movements. Most of structural landforms are formed due to crystal strain and intrusive veins. The relief developed on granite rocks may be of exogenous and endogenous origin.

Exogenous processes are directly related to the climate and contribute to the exposure of the granite rock. Flared slope do not occur in the study area but moderately steep slope occur only in this beach. In addition, it is clear that several well known minor granite forms are convergent, for they originate at different sites and evolve in different ways.

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