

Geological Characteristics of Tra Duoc Mountain, Kien Giang Province, Vietnam

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-----ABSTRACT-----

Tra Duoc Mountain in Binh Tri Commune, Kien Luong District, Kien Giang Province, Vietnam, is classified in the Nha Trang Formation (Knt), with the main composition including rhyolite, trachyrhyolite and their tuff, more than 100 m thick. The research results have determined the geological characteristics of the rock; The silicate chemical analysis showed that the rock belongs to the acid eruption group with the content of $Na_2O > K_2O$. The quality of stone meets the requirements of the standard stone used as a common building material.

KEYWORDS: rock, geological features, building materials

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I. INTRODUCTION

The study area covers an area of 14.2 ha, including the middle part of Tra Duoc Mountain in Binh Tri commune, Kien Luong district, Kien Giang province, about 8 km south of Kien Luong town, far from Rach Gia city is about 70 km to the northwest. The area is in the shape of a convex polygon, about 1,000 m long, 380 m wide at its widest. The results of geological research and minerals search [2] show that in the vicinity of the studied area, stratigraphic units such as: Hon Chong Formation (D-C1hc), Nha Trang Formation (Knt), Quaternary sediments (Middle Pleistocene sediments, Hau Giang Formation QIV2hg)... Particularly, Tra Duoc Mountain is classified into the Nha Trang Formation (Knt), which main components are rhyolite, trachyrhyolite and their tuff, more than 100 m thick.

II. RESEARCH METHOD

2.1. Basis for choosing exploration method:

Tra Duoc Mountain has an elevation from +5m to +107m (mountain peak). The object of study is acid eruption rock with a wide distribution area; the rock thickness is much thicker than that of the studied rock. Due to the specific characteristics of the study area with a many side concave polygon, the research network is selected as follows:

- Distance of probe lines: 200 – 250m
- Distance of exploration works on lines: 150 - 220m

To determine the thickness of the cover layer and rock thickness, rock composition and physical properties, and sample bedrock, exploration methods are used:

- Measuring and drawing topographic maps at 1:2000 scale.
- Rotary boring for sampling combined with geological routes.

2.2. Exploratory methods:

Establishment of a geological map of 1/2000 scale:

The goal of this work is to measure and draw the geological boundaries for the calculation of rock reserves and for the preparation of an environmental impact assessment report later. Due to the characteristics that the entire study object is an acid eruption rock, which is almost completely covered by weathering materials, the geological route along the lines is not suitable. In order to delineate geological formations, it is necessary to conduct routes according to the boundaries of exposed rock areas, combining documents of exploration boreholes. The geological survey process uses man-made outcrops, dug holes, and water wells to collect geological data and descriptions.

Drilling work:

Exploration drilling works are used for the following purposes: determining stratigraphic thickness, taking samples to analyze rock quality, detecting the possibility of rock changes in depth, due to weathering and tectonics. Drilling holes are arranged on the route from the foot of the mountain to upslope with a slope of 20 - 250, mainly mixed wood forests and people's gardens, so the type of drilling machine chosen here is the Chinese XJ.100 Drill.

Volume: 10 holes drilled with total drilling length: 87.6 m. Of which, drilling in soft soil is 75.7 m; drilled in hard rock 11.9 m.

Sampling work:

- The petrographic sample: Samples were taken with a size of 3x6x9 cm, evenly distributed over the study area and by depth. The sample was sent for processing and analysis at the Center for Analysis and Experimentation, South Vietnam Geological Mapping Division.

Total number of samples: 10 samples; petrographic analysis of 5 samples, in which background photos of petrographic structures were taken: 5 samples.

- Semi-quantitative spectral sample: Collected in the form of lumps at the exploration works, evenly distributed over the research area and exploration depth, in order to evaluate the percentage by mass of trace elements to detect the possibility of containing rare elements.

Total number of samples: 5 samples. Place of analysis: Center for Analysis and Experimentation, South Vietnam Geological Mapping Division.

- Silicate chemistry sample: Samples are taken in the form of lumps or spots, evenly distributed over the exploration area and rocks, usually taken at the same location as the mechanical sample. This type of sample is intended to determine the chemical composition of rocks, especially the possibility of containing harmful components such as SO₃.

Total number of samples: 5 samples; sent for analysis of 3 samples. Place of analysis: Center for Analysis and Experimentation, South Vietnam Geological Mapping Division, requires analysis of 14 indicators: SiO₂, TiO₂, Al₂O₃, Fe₂O₃, FeO, MnO, MgO, CaO, Na₂O, K₂O, P₂O₅, LOI (Loss on ignition), SO₃, H₂O.

Mechanical sample:

Samples are taken from research works; Samples are evenly distributed over the exploration area and evenly distributed according to the depth of holes.

Total number of samples: 5 samples; sent for analysis: 3 samples. Place of analysis: Center for Analysis and Experimentation, South Vietnam Geological Mapping Division. Requirements to analyze the following criteria: specific gravity, density, water absorption, natural compression resistance, saturated compression resistance, porosity, water absorption, softening coefficient, internal friction angle, cohesion force.

III. RESEARCH RESULTS

3.1 Geological features

In the study area, there is only one type of rock and is distributed throughout the area, which is acid eruption rock, which is classified in the Nha Trang Formation [2]. On the exploration area, the rock is completely covered by the surface weathering zone of the bedrock. The thickness of the cover horizon varies from 2.5 to 9.5 m, with an average of 6.5 m. From the drilling documents, the boundary of fresh rock mass is very clear, the unfinished weathering zone is very thin and is included in the cover.

3.2 Features of petrology - mineralogy

The petrographic characteristics of acid eruption rocks of Nha Trang Formation includes dacites, rhyodacites, rhyolites and their tuff [2]. Under the microscope, the rock has block structure, flow structure, fragmental texture, aphanocrystalline texture; microgranular mesostasis, grey-green, bluish-gray to dark gray. The stone has small grains, pinkish-white gray or greenish-gray color, phenocryst on a fine-grained mesostasis.

The analysis results of the petrographic samples show that the mineral composition of the rock is as shown in Table 1.

Table 1. Analytical results of petrographic samples

Mineral	Content (%)		
	Lowest value	Highest value	Average value
Phenocryst and coarse-grained in tuff	30 - 34	27 - 30	32
Plagioclase	18 - 21	12 - 14	17
Quartz	11 - 13	3 - 4	6 - 8
Tuff	6 - 9	1 - 2	4 - 5
Transformed colored minerals	8 - 12	3	5 - 7

Potassium feldspar	8 - 11	4 - 6	8
Mesostasis	66 - 70	73 - 70	68
Quartz, feldspar, silica, transformed colored mineral, chlorite, zoisite, carbonate	68 - 71	60 - 63	65
Apatite, cericite, carbonate...	1	Little	Little
Ore minerals, iron oxides	1	Little	Little

Phenocryst:

Plagioclase: rectangular or prismatic plate, size varies from 1-2 mm to 0.5 - 0.8 mm; the surface is broken, cracked and patchy due to strong sericitization and chloritization. Plagioclase has a polymorphic twin, sometimes with a mottled structure.

Coarse-grained in tuff:

Coarse-grained in tuff includes crystal and rock debris, angular, sharp, varying in size from 0.2 to 2.5 mm, commonly from 0.5 to 0.7 mm. The mineral composition of debris includes plagioclase, feldspar, quartz. Plagioclase are plate, prismatic, broken, corroded, mostly sericitized, carbonated from weak to quite strong. Quartz has a gray interference color, in some places the form of a cluster of grains. Colored minerals are short plates, most of which are completely chloritated and carbonated. In addition, there are intermediate eruption rock fragments, angular granite debris.

Mesostasis:

The mesostasis is a collection of micro-particles associated with debris, including feldspar, color-modified minerals, chlorite, zoisite, carbonate, quartz... alternating to form a dense background block that is difficult to distinguish.

Ore has no definite shape, black, not transparent, sparsely scattered.

Some pictures of the petrographic messtasis texture of rock samples below.

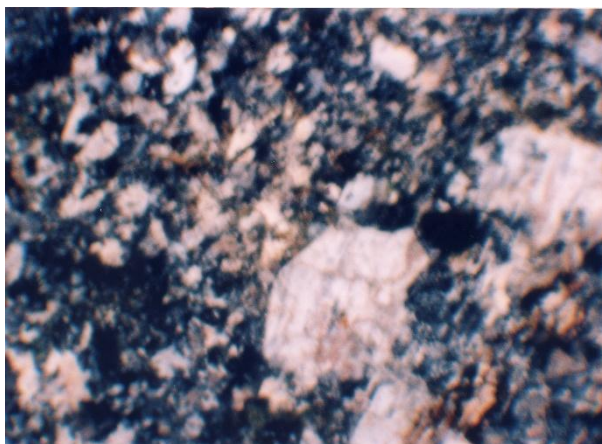


Figure 1. Sample LK 4-1



Figure 2. Sample LK 5-2

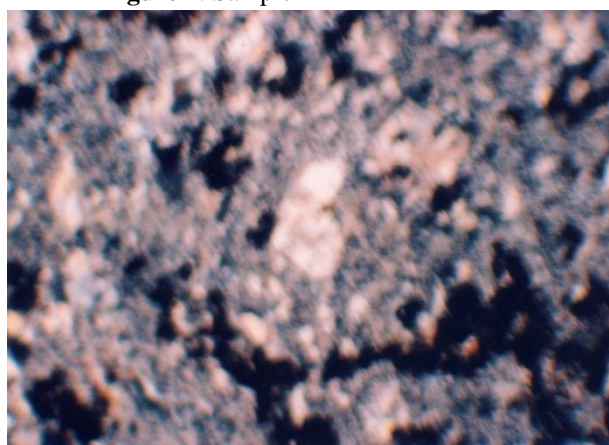


Figure 3. Sample LK 8-1

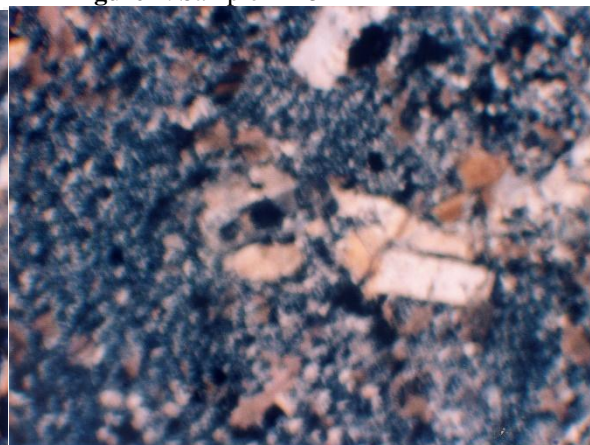


Figure 4. Sample LK 9-2

3.3 Features of geochemical - mineralization

Chemical composition:

Table 2. Analytical results of silicate chemical samples

Oxide composition	Content (%)		
	Lowest value	Highest value	Average value
SiO ₂	74.00	48.16	66.61
TiO ₂	1.67	0.29	0.55
Al ₂ O ₃	16.99	8.71	12.76
Fe ₂ O ₃	3.23	0.20	0.88
FeO	9.03	4.10	5.59
MnO	0.10	0.40	0.07
MgO	6.66	0.47	1.89
CaO	4.46	0.99	2.28
Na ₂ O	4.94	2.19	3.68
K ₂ O	3.62	0.81	2.09
P ₂ O ₅	0.20	0.02	0.07
LOI	4.36	0.81	2.45
Σ	99.97	98.08	98.92
SO ₃	0.84	0.02	0.33
H ₂ O	0.48	0.10	0.28

The results of the above silicate chemical analysis show that the rock belongs to the group of acid eruptions, with the content of Na₂O>K₂O. Comparing the chemical composition of the erupting rock in the area with the average chemical composition of the rock according to Deli [1], similarities with acid eruptions can be seen. The analyzed rock samples did not contain harmful components such as SO₃.

Related Mineralization:

+ Semi-quantitative spectroscopy results: According to the results of analysis of semi-quantitative spectroscopic samples, the percentages of elements are shown in Table 3.

Table 3. Analytical results of semi-quantitative spectral samples

Elements	Content (%)		
	Lowest value	Highest value	Average value
Al	>10	>10	>10
Si	>10	>10	>10
Mg	1	0.7	0.9
Ca	0.8	0.5	0.68
Ba	0.015	0.01	0.011
Fe	5	4	4.8
V	0.01	0.005	0.0078
Mn	0.05	0.03	0.042
Ti	0.5	0.5	0.5
Ni	0.003	0.002	0.0024
Cr	0.01	0.003	0.0052
Mo	0.001	0.0003	0.00044

Elements	Content (%)		
	Lowest value	Highest value	Average value
Sn	0.0015	0.0007	0.00092
As	0.02	0.01	0.012
Bi	0.002	0.0002	0.00082
Cu	0.005	0.004	0.0048
Ag	0.0001	0.0005	0.00012
Pb	0.02	0.01	0.015
Zn	0.01	0.005	0.0064
Ga	0.002	0.002	0.002
Be	0.0002	0.0002	0.0002
Nb	0.001	0.001	0.001
Zr	0.015	0.01	0.013
Na	3	1	2.1
La	0.003	-	0.003
Y	0.003	0.003	0.003
Yb	0.0003	0.0003	0.0003
Sc	0.0005	0.0005	0.0005

This result compares with the Clarke content of the elements of the Vernasky classification, the content of trace elements is often lower or approximately equal to the average Clarke content of the earth's crust, so it can be seen that there is no concentration and enrichment of elements in rocks in the study area.

Other related minerals:

For the intermediate to acid eruption rocks of the Kreta age from the South Central to the South of Vietnam, there are no accompanying mineralizations anywhere [3]. Mineral petrographic studies under polarizing microscope show that the chloritization and cericization transformation processes are almost unrelated to ore formation.

3.4 Mechanical properties

The results of physical and mechanical properties of rock are determined through the criteria as shown in Table 4.

Table 4. Analytical results of physico-mechanical samples

Mechanical indicators	Results		
	Lowest value	Highest value	Average value
Volumetric weight (g/cm ³)	2.7	2.68	2.69
Density (g/cm ³)	2.73	2.71	2.72
Porosity (%)	1.11	0.74	0.98
Saturated water absorption (%)	0.3	0.08	0.20
Solidity coefficient	10.64	10.47	10.22
Softening coefficient	0.94	0.90	0.92
Natural compressive strength (kg/cm ²)	1,238	1,086	1,183
Saturated compressive strength (kg/cm ²)	1,164	974	1,086
Natural tensile strength (kg/cm ²)	185	152	169.67
Saturated tensile strength (kg/cm ²)	173	142	160.00
Natural adhesive force (kg/cm ²)	325	277	306.00
Saturation cohesive force (kg/cm ²)	300	251	283.00
Natural friction angle	36 ⁰	34 ⁰	35 ⁰
Saturated friction angle	35 ⁰ 50	33 ⁰ 50	34 ⁰ 50

Thus, compared with the physical and mechanical criteria of building stone for magmatic rock, the rock in the study area completely meets and exceeds the norm compared to Vietnam's standard for construction stone.

3.5 Radioactivity of the rock

The results of analysis of radiation intensity samples in the laboratory showed that: Radioactivity ranges from 5 to 9 ppm. Radiation intensity from 42 to 80 pulses/min. This result shows that the rock in the mine has low natural radioactive activity, does not affect the environment and is not toxic to users.

IV. CONCLUSIONS

Report on research results on rock from Tra Duoc mountain, Binh Tri commune, Kien Luong district, Kien Giang province, which is carried out on the basis of conventional construction quarry research technology currently being applied in a number of mines in the region. and according to the current regulations of the Department of Geology and Minerals of Vietnam.

As a result of the study, the following main tasks were accomplished:

- Measuring and drawing the topography of Tra Duoc mountain, scale 1/2000, area 0.15 km².
- Establish a regional geological map of 1:2,000 scale on an area of 0.15 km².
- The quality of stone meets the requirements compared to the standard stone used as a common building material. In the rock, there is no mineralization, the content of useful minerals in the rock is very low, no industrial value.

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