Study of mineral properties in granite rocks Ujung Karang village, South Aceh

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Abstract. Granite rock is a non-metallic rock, one of which is located in Ujung Karang Village, South Aceh Regency, this rock has a high commercial value, but depends on the type and color that is owned. So to find out need to do a basic study of these rocks. The purpose of this study was to obtain preliminary information on the constituent minerals and dominant colors that appeared in the granite rocks of Ujung Karang Village. This research method uses X-ray fluorescence (XRF) and Scanning Electron Microscopy (SEM) techniques. The test results showed that 17 dominant mineral phases were identified, while others were minor phases. The largest mineral phase is in the SiO2 compound at 63.6%, while the smallest mineral phase is in the ZnO compound at 0.01%. While the surface morphological observations obtained 46.49wt% O elemental bases, then 28.60wt% Si elemental bases, and 09.57wt% basic element Al, besides these elements, there are also other elements namely 05.65wt% O basic elements, 04.68wt% Na basic elements %, the element Fe is as broad as 03.72wt%, and Mg is as basic as 01.71wt%. The surface morphology in these rock samples is irregular with varying grain sizes. Visually visible colors are dark and white, and it can be assumed that the elements contained in the granite are predominantly Si or Silica elements.

1. Introduction

Granite rocks are intrusive igneous rocks that have different constituent minerals and are highly colored. Granite rocks are formed from the process of bonding with the composition of quartz and feldspar minerals, while other minerals in small quantities such as biotite, muscovite, hornblende, and pyroxene [1] [2] [3]. Granite rocks are widely used for household purposes as building materials and ornamental houses, while in the industrial field are used as pembutan ceramics, decorative stones, floors, wall ornaments and so on [4] [5], therefore in its use it is necessary to know the constituent minerals in detail.

Based on the results of a study conducted by the Center for Geological Resources in 2006, there is a potential distribution of granite rocks in South Aceh Regency, one of which is in Ujong Karang Village, Sawang District with a resource reserve of 100,000,000 tons [6]. Some previous studies have found that there are quartz minerals (SiO2) in Ujong Karang granite rocks with a very dominant diffraction pattern followed by other mineral phases [2]. Previous studies only used one method, namely X-Ray diffraction (XRD), so the kanena in this study was carried out with two other methods namely X-Ray Fluorescence (XRF) and Scanning Electron Microscopy (SEM) aims to obtain percentages in minerals while using SEM-EDX to see the surface morphological structure and
elements contained in rocks. So the expected results of these three methods can strengthen scientific arguments on the Ujung Karang granite rocks.

2. Materials and methods

2.1. Rocks sampling
The granite rock samples were taken from Ujung Karang Village, Sawang District, South Aceh Regency. Rock samples taken are small chunks using a geological hammer.

![Granite rocks in Ujung Karang Village, South Aceh.](image1)

**Figure 1.** Granite rocks in Ujung Karang Village, South Aceh.

2.2. Preparation sample
The sample preparation is the stage of preparing a sample in the form of small granules (powder) which is carried out using a pestle and mortar.

![Finished sample.](image2)

**Figure 2.** Finished sample.

2.3. Sample testing
Rock samples were tested using X-Ray Fluorescence and Scanning Electron Microscopy Energy Dispersive X-ray Spectroscopy (SEM-EDX) methods at the Central and Mineral Central Laboratory, Department of Natural Sciences, State University of Malang. In conducting laboratory tests the X-Ray Fluorescence method uses Bragg's law equation and then analyzed with a qualitative approach [9].

\[2d \sin \theta = n \lambda\]  

(1)

Where:
3. Results and discussion

3.1. X-Ray fluorescence in the sample

The based on the test results using X-Ray Fluorescence on granite rock samples taken from Lhok Pawoh Village, Sawang District, South Aceh Regency, there are 17 mineral phases that appear predominantly SiO$_2$ minerals with a percentage of 63.6%, followed by the mineral phase Al$_2$O$_3$ as a percentage the second dominant is 13%, and the third is Fe$_2$O$_3$ mineral phase with a percentage of 8.33%, and then followed by other mineral phases as minor phases. The difference in mineral content and the percentage of a mineral depends on the geological process that is influenced by the process of dissolving other minerals and hydrothermal changes during its journey from the bowels of the earth through the surface of the earth due to tectonic or volcanic events [7].

The mineral phase that emerged was based on the results of the X-Ray Fluorescence test in the sample of Ujung Karang Village granite rocks, namely:

| No | Compound | Concentration Unit (%) |
|----|----------|------------------------|
| 1  | SiO$_2$  | 63.6                   |
| 2  | Al$_2$O$_3$ | 13                     |
| 3  | K$_2$O   | 8.33                   |
| 4  | Fe$_2$O$_3$ | 6.56                   |
| 5  | CaO      | 5.12                   |
| 6  | P$_2$O$_5$ | 1.4                    |
| 7  | TiO$_2$  | 1.19                   |
| 8  | SrO      | 0.26                   |
| 9  | MnO      | 0.21                   |
| 10 | BaO      | 0.2                    |
| 11 | Eu$_2$O$_3$ | 0.2                    |
| 12 | Rb$_2$O  | 0.11                   |
| 13 | Re$_2$O$_7$ | 0.08                   |
| 14 | V$_2$O$_5$ | 0.02                   |
| 15 | ZnO      | 0.01                   |
| 16 | CuO      | 0.045                  |
| 17 | Cr$_2$O$_3$ | 0.039               |

3.2. Scanning electron microscopy test of the sample

SEM test results on the sample of Ujung Karang Village granite rocks can be seen as shown in Figure 3, with each scale of 500μm and 100μm.
Figure 3. Morphology of minerals from sample Ujung Karang Village. (a) Magnification 150x, (b) Magnification 1000x.

Table 2. EDX data of minerals from sample magnification 150x.

| Element | Wt% | At % |
|---------|-----|------|
| OK      | 46.18 | 60.97 |
| NaK     | 04.60 | 04.22 |
| AlK     | 10.45 | 08.18 |
| SiK     | 29.14 | 21.91 |
| KK      | 06.42 | 03.47 |
| TiK     | 00.53 | 00.23 |
| FeK     | 02.68 | 01.01 |

Matrix Correction ZAF

Table 3. EDX data of minerals from sample magnification 1000x

| Element | Wt% | At % |
|---------|-----|------|
| OK      | 50.55 | 63.99 |
| NaK     | 03.83 | 03.43 |
| AlK     | 06.93 | 05.28 |
| SiK     | 31.54 | 23.10 |
| KK      | 03.62 | 01.91 |
| FeK     | 03.52 | 01.30 |

Matrix Correction ZAF

In the Figure 3, shows the results of micro observations, surface morphology in rock samples in Ujung Karang Village is irregular with varying grain sizes. Visually visible colors are dark and white.
Dominant colors that appear are white, it can be assumed that the elements contained in the rock are dominant O and Si elements. Then the EDX analysis results provide information about the mineral composition in granite rocks. From the results of the characterization note that in Figure 3 (a) the highest elemental concentration is O with 46.18 wt%, Si 29.14 wt%, and followed by other elements. Thus it is assumed that rock samples contain silica minerals (SiO$_2$), this is supported by the appearance of surface morphology in the form of amorphous or pilikristal. While in Figure 3 (b) the surface morphology is visually brighter and clearly dominated by white color, this is influenced by the Si element which has a high concentration of 31.54 wt% and the O element of 50.55 Wt%. The SEM-EDX diffraction pattern can be seen in the Figure below.

![Figure 4](image4.png)

**Figure 4.** Pola difraksi SEM-EDX magnification 150x.

![Figure 5](image5.png)

**Figure 5.** Pola difraksi SEM-EDX magnification 1000x.

The SEM-EDX diffraction pattern in Figure 4 and Figure 5 states that the highest peak is the dominant Si element, followed by the O element and Al element, it is almost certain that the composition of the constituent elements in the Ujung Karang Village granite rock samples is white and gray. Then the gray granite has an average density of 2.72 g/cm$^3$ and an average longitudinal wave velocity of around 4800 m/s [10].
4. Conclusions
The based on X-Ray Fluorescence analysis in the granite rock samples in Ujung Karang Village, it shows that 63.6% of SiO₂ (silica) and Al₂O₃ (Aluminum Oxide) minerals are 13%. This result is in accordance with SEM-EDX analysis that the dominar elements that appear are O and Si elements, so it can be concluded that the Ujung Karang village granite rocks contain silica and alumina minerals with white and grayish color.

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