

Identification of Elemental Content and Rock Types in West Lampung Regency

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Abstract : Rock is a constituent of the earth's crust from a collection of minerals that harden due to natural processes. Rocks formed from volcanic eruption materials in each place have different characteristics in distribution patterns, types of minerals and the content of elements contained therein. These rocks contain elements that form magnetic minerals. However, in rocks in West Lampung Regency the elemental content in the rocks has not been identified. This study aims to determine the composition of rock-forming elements and rock types found in West Lampung Regency. The elemental content in rocks can be identified using X-Ray Fluorescence (XRF) and determine rock types using SiO₂ and K₂O diagrams. The results of the analysis using XRF show that Si (Silica) is the most dominant element found in 4 rocks in Lampung Regency. West. In addition, the elements found in rocks in West Lampung are Al, Si, K, Ca, Fe, P, Cl, Ti, Mn, Ni, Cu, Zn, Ga, As, Rb, Sr, Y, Zr, Ag, In, Eu, and Pb, from the content of these elements there are elements that form magnetic minerals, namely Fe and Ti, with rock types of Foidite and Decite.

Keywords : Rock, Elemental Composition, Rock Type, XRF

Introduction

Sumatra has about 30 active volcanoes that affect environment. This activities indicates the presence of lava under the earth's surface, which is a source of rock and forms rock structures on the earth's surface due to the eruption process [1]. Volcanic eruptions produce volcanic materials such as rocks, volcanic ash. Volcanic ash which is scattered in all directions according to the direction of the wind, the material falls and settles in a place, where the sediment has different characteristics in the pattern of distribution of the type of material and the content of the elements contained in it. Due to differences in the temperature of the earth's surface, magma freezes to form rock [2]. West Lampung Regency is an area traversed by magmatic pathways that produce a series of volcanoes so that they have rock potential as a result of geological activity.

Rocks are constituents of the earth's crust consisting of hardened minerals that occur due to natural processes such as freezing [3]. Most rocks are a mixture of minerals, organic matter, and volcanic materials [4]. In these rocks there are minerals, namely chemical elements in certain ratios, where the atoms in them are arranged following a systematic pattern [5]. Silica (Si) is an element in rock that can determine the type of rock in an area. Rocks contain many minerals, one of which is magnetic minerals.

Magnetic minerals are minerals with high magnetic properties. Magnetic minerals are actually naturally available in rocks, and soil [6]. Magnetic minerals have three properties, namely, diamagnetic, paramagnetic, and ferromagnetic [1][7]. Magnetic mineral elements have various shapes, sizes and forms of minerals that can provide clues about the conditions of an environment [8]. Magnetic minerals are formed from the elements. However, the content of rock-forming elements, especially in West Lampung Regency, has not been identified.

The elemental composition of rocks can be seen using X-ray Fluorescence (XRF). The XRF method is a technique that can analyze the elements in a mineral and can be used to determine the concentration of elements based on wavelengths [8]. Samples measured using XRF can be powder, solid,

or liquid [9] [5]. This study aims to determine the content of rock elements using X-Ray Fluorescence and rock types using SiO_2 and K_2O diagrams in West Lampung Regency.

Materials and Methods

Sampling

Sampling was carried out in West Lampung Regency. The sample taken is rock with coordinates $4^\circ 57' 45.11''\text{S}$ $104^\circ 3' 0.43''\text{E}$, $4^\circ 57' 45.11''\text{S}$ $104^\circ 3' 0.43''\text{E}$, $5^\circ 0' 47.27''\text{S}$ $104^\circ 2' 28.54''\text{E}$, $5^\circ 1' 24.42''\text{S}$ $104^\circ 17' 15.72''\text{E}$. The sampling process begins with determining the coordinates, looking at outcrops and observing rocks that meet the characteristics of volcanic rocks, and samples that are possible to be taken are immediately taken using a hammer.

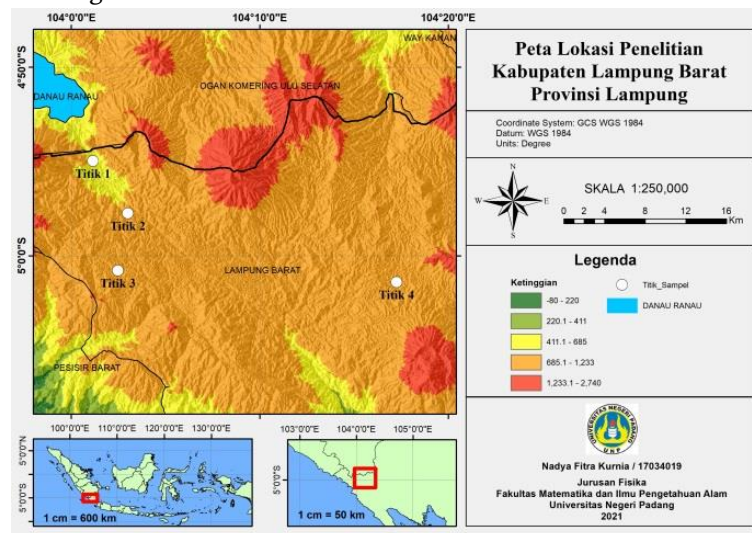


Figure 1. Sampling Locations in West Lampung Regency

Preparation and Determination of Sample Elemental Composition

The sample preparation process starts from smoothing and storing the sample in a holder so that it is not contaminated, then the mass of the sample is measured. The next step is to see the composition of the elements contained in the rock and the type of rock using X-Ray Fluorescence (XRF).

XRF is a non-destructive technique that can be used to identify the element Berillium (Be) to Uranium (U). The results obtained are grouped into three parts, namely, elements (elements), Geology (natural compounds), Oxides (chemical compounds containing at least one oxygen atom and one other element). Furthermore, from the Oxide content of Silica (SiO_2) and Potassium (K_2O) elements, the rock types were obtained using the TAS diagram (Figure 2).

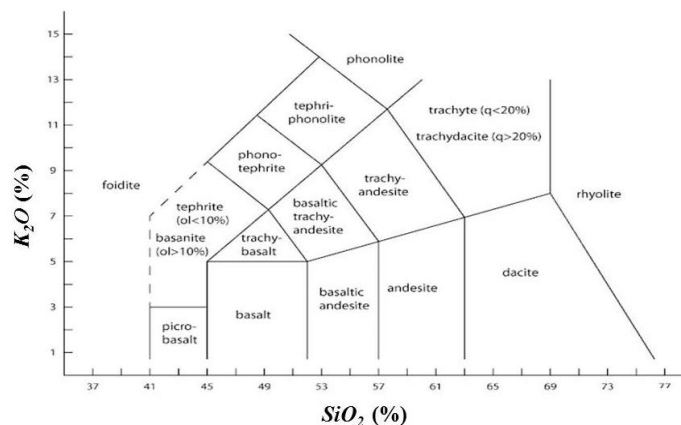


Figure 2. Diagram of SiO_2 vs K_2O [10]

Result and Discussion Elemental Composition

The results obtained from measurements using X-Ray Fluorescence Spectrometry (XRF) on rock samples in West Lampung Regency in the form of rock samples that became the focus of this study were SSU 19-07, SSU 19-08, SSU 19-09, SSU 19-10. The elements contained in each sample can be seen in **Table 1**.

Table 1. Compound Composition of Oxides

Oxide	West Lampung Regency Rock			
	19-07	19-08	19-09	19-10
Al ₂ O ₃	13.833	9.657	9.349	14.247
SiO ₂	38.78	69.398	71.389	68.082
P ₂ O ₅	3.196	3.772	3.694	3.665
K ₂ O	2.677	7.504	8.362	6.486
CaO	15.657	5.154	3.798	2.83
TiO ₂	2.786	0.575	0.375	0.472
V ₂ O ₅	0.076	0	0	0
MnO	0.332	0.136	0.13	0.179
Fe ₂ O ₃	21.386	3.025	2.126	3.141
NiO	0.004	0.011	0.005	0.004
CuO	0.039	0.006	0.005	0.014
ZnO	0.05	0.004	0.005	0.006
Ga ₂ O ₃	0.013	0.043	0.045	0.005
As ₂ O ₃	0.003	0.079	0.051	0.053
Rb ₂ O	0.032	0.004	0.004	0.045
SrO	0.204	0.035	0.041	0.005
Y ₂ O ₃	0.012	0.358	0.431	0.046
ZrO ₂	0.08	0.149	0.15	0.369
Ag ₂ O	0.413	0	0	0
In ₂ O ₃	0.188	0.037	0.023	0.042
Eu ₂ O ₃	0.182	0	0	0
IrO ₂	0	0.004	0.003	0.005
PbO	0.009	0.005	0.006	0.007
Cl	0.048	0.044	0.005	0.117
Re	0.002	0	0.001	0.001

Table 1 shows the results of the main rock compounds in West Lampung Regency. The dominant compounds in each sample are Al₂O₃, SiO₂, P₂O₅, K₂O, CaO, TiO₂, Fe₂O₃. SiO₂ compound is the compound with the highest content ranging from 38.78% - 71.389%. The content of Al₂O₃ ranged from 9.349% - 14.247%; P₂O₅ ranged from 3.196% - 3.772%; K₂O ranged from 2.677% - 8.362%; CaO (2.83% -15.657%), TiO₂ (0.472% - 2.786%) and Fe₂O₃ (2.126% - 21.386%). From these values, this rock is classified as volcanic rock, where volcanic rock has a characteristic composition of SiO₂ (48.29%-58.34%), Al₂O₃ (12.49%-17.18%), TiO₂ (0.49%-0.81%) and P₂O₅ ranged from 0.20%-0.41% [11].

Elemental Content in each Sample

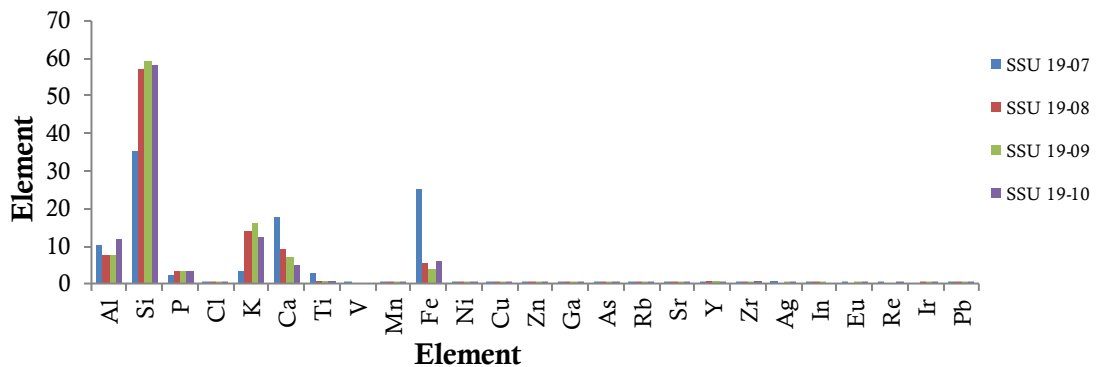


Figure 3. Elemental Content of Each Sample

The comparison of the elements contained in each rock sample in West Lampung Regency can be seen in **Figure 3**. From the measurement results, the most common elements found in rocks in West Lampung Regency are Si (35.352%-59.414%), Ca (5.09%-17.983%), Al (7.547%-7.799%), Fe (4.039%-25.284%), P (2.524%-3.51%), K (3.509%-16.015%), Ti (0.595%-2.755%). The rock-forming elements in West Lampung Regency are Al, Si, P, Cl, K, Ca, Ti, V, Mn, Fe, Ni, Ga, As, Rb, Sr, Y, Zr, Ag, In, Eu, Pb. The composition of the elements that make up the magnetic minerals are Fe and Ti. These rocks include volcanic rocks. The elemental composition of these rocks is the same as the volcanic rocks of Mount Galama and Mount Talang with elemental compositions of Si, Ca, Al, Fe, K, M, with a presentation of ferrum (Fe) 9.952% and Silica (Si) 49.233% [12].

Determination of Rock Type

Rocks are materials that contain one or more solid minerals. Rock types in West Lampung Regency can be determined using the following SiO_2 vs K_2O diagram:

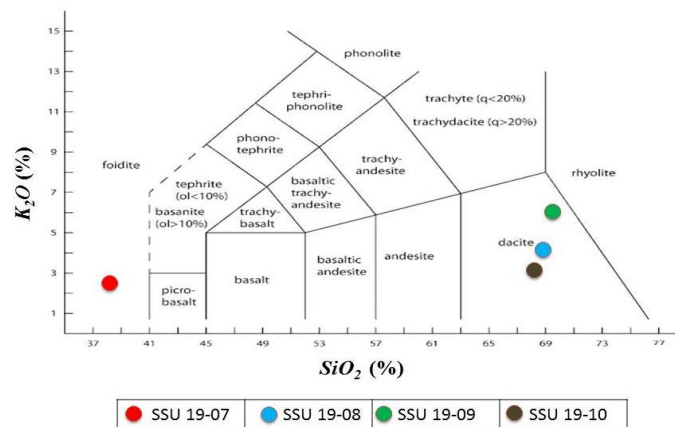


Figure 4. Diagram of Determining the Type of Origin of Rocks in Sample Based on Content SiO_2 and K_2O

Figure 4 shows the percentage of SiO_2 which ranged from 38.78% - 71.389% and K_2O ranged from 2.677% - 8.362%. Rock types can be determined using chemical content, namely by looking at the Silica and Potassium possessed by a material [13]. Potassium (K_2O) has a value that is not to low. However, the elemental content of Silica (SiO_2) is high. Based on the elements of K_2O and SiO_2 the rock types in Lampung Regency are Foidite, and Dacite. This can also be seen in volcanic rocks in the Amplas River, Mamuju which are composed of Ponolite, Foidite and Foid-Syenite [14]. The rocks of Mount Wungkal, Godeon, Yogyakarta have rock types consisting of Andesite, Dacitic, to Decite. [15]. So from this information it can be seen that the three regions have different rock types.

Conclusion

Based on the results of discussion on rock samples in West Lampung Regency, it was concluded that there were elements Al, Si, K, Fe, P, Cl, Ti, Mn, Ni, Cu, Zn, Ga, As, Rb, Sr, Y, Zr, Ag, In, Eu, Pb. The most dominant elements found in West Lampung Regency are Si and Fe with a range of 35,352% - 59,414% and 4.039% - 25.284%. The composition of the Oxides compound is Al_2O_3 , SiO_2 , P_2O_5 , K_2O , CaO , TiO , Fe_2O_3 , with rock types of Foidite and Decite .

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