Characteristics of quaternary volcanic rocks based on petrographic analysis in Belandang Area, Ulu Ogan, Ogan Komering Ulu

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Abstract. Administratively the research area located in Belandang, Ogan Komering Ulu District, South Sumatra Province. The astronomical located at coordinates 04 04' 6.9" - 04 07' 54.2" LS - 103 45' 15.1" - 103 49' 1.4" BT. The research area included in the territory of the Bukit Barisan formed on the Late Oligocene-Early Miocene and controlled by Semangko Fault Northwest-Southeast oriented accompanied by an increase in the rate of volcanic activity. Then in the Plio-Pleistocene compression and removal process occurs that causes volcanism, so that at the end of the deposition of South Sumatra Basin filled by volcanic materials. The research area is dominated by volcanic deposits consisting of, Andesite Lava, Lapilli Tuff Unit, and Agglomerates. The method used is the petrographic analysis of the 9 rock samples were considered to represent the extent of the study area, consisting of 2 samples of Andesite, 1 sample of Lapilli Tuff, and 6 samples of Agglomerate. The results are show that volcanic rocks in the study area has undergone a change that is characterized by the presence of alteration minerals such as Carbonates, Chlorite, Sericite, Quartz and Clay minerals. The presence of alteration minerals indicate that the volcanic rocks in the study area belongs to the type of alteration Phyllic and Outer/Sub Propyllitic. Based on lithological characteristics, the research area enter into the Central and Proximal Facies.

1. Introduction
Indonesia is a country that is surrounded by active volcanoes that appear at the edges of the Pacific Ocean or commonly called the "Ring of Fire on Pacific Rims". This is caused by the activity of the subduction of four tectonic plates, in addition to the Pacific Ocean, also occurred in the Asian Plate, Australian Plate and the Indian Ocean plate. In the Southern and Eastern Indonesia, there is a volcanic belt that runs along the island of Sumatra, Java, Nusa Tenggara, Maluku and Sulawesi. Thus, this condition causes Indonesia has a high potential occurrence of volcanic eruption activity. Caused by volcanic activity resulted in the release of the contents of the bowels of the earth to the surface of the earth in the form of fragmental straight from magma in the form of pyroclastic material (Schmid, 1981).

Volcanic rocks are rocks deposited from volcanic activity, either directly or indirectly. Directly interpreted as the result of the eruption of frozen and precipitated in situ, while not directly explain that the rock has been deformed and overhaul. Volcanic activity is intended as a process of eruption or discharge of magma from the earth to the surface through a crater/caldera in various forms and activities. Volcanic rocks are grouped into coherent lava and volcaniclastic rock.
In landscapes, volcanoes divided into 4 zones in the description referred to as facies consists of, peaks, slopes, feet, and the plains surrounding it. This division was later developed by the Vessel and Davies (1981) and Bogie and Mackenzie (1998) in Bronto (2006) into 4 facies, namely Central facies, Proximal facies, Medial facies and Distal facies.

This study aims to determine the characteristics of Quaternary volcanic rocks based on its microscopic appearance, structure, texture and mineral composition. The appearance of names obtained from rock, rock formation temperature, the influence of hydrothermal alteration, and the deposited process, then correlated to the division of zones or facies as the accumulation of volcanic rock.

2. The Scope Of The Research Area

Administratively the research area located in Belandang, Ogan Komering Ulu District. Astronomically located at coordinates 04, 04 '6.9" - 04 07' 54.2" LS - 103 45' 15.1" (Figure 1). On the south side outside the study area there are hilltops caldera formed by explosive volcanic eruptions and is indicated as the source of volcanic material spread in the study area (Figure 2). The spread of volcanic material occupies 85% of the research area are scattered in the Northwest-Southeast. With the dominance of volcanic material, the authors are interested to discuss in more detail about the characteristics of the volcanic rocks in the study area based on the microscopic appearance to determine the structure, texture, and composition of the minerals contained therein. So, from the appearance can identify the source, the temperature of the formation, and the genesis of volcanic rocks in the study area. This research was conducted by geological mapping scale of 1: 25,000 and an area of 49 km².

![Figure 1. Research Area](image-url)
3. Data and Method

The method used is based on field geological mapping include field orientation, recording field data and field data collection on the open track. The observations made on the outcrop, in the form of rocks, megascopically characteristics, outcrop profile, and measurements of the position of the bedding, then grouped into rock units so that the results of field mapping method is embodied in geological map with a scale of 1: 25.000.

Then, taking rock samples are considered representative for subsequent laboratory analysis is done using a polarization microscope Olympus CX23 brands in the Laboratory of Dynamic Geology and Petrology Department of Geological Engineering University of Sriwijaya. Prior to the analysis under the microscope, first performed in the manufacture of thin section Geo-Services Laboratory Obsidian rock samples of which have been based on the distribution of volcanic materials that represent each side of the study area for further petrographic analysis. The locations were taken as rock samples for petrography analysis divided into nine locations, among others LP 3 (PET-01), LP 12 (PET-02), LP 24 (PET-06), LP 28 (PET-07), LP 32 (PET-05), LP 40 (PET-20), LP 68 (PET-08), LP 86 (PET-03), and LP 107 (PET-04).

Direct field observation method is useful to know the characteristics of volcanic rocks megascopically covering, rock types and outcrop dimensions. While microscopic observation is done to be able to see the appearance of the structure, texture, and composition of the minerals contained in the rocks. The result, can determine the type and name of rock, rock formation temperature, the influence of hydrothermal alteration, and the genesis of its formation, as well as its relation to the distribution of volcanic facies in the study area.
4. Result and Discussion

Volcanic rocks in the study area is divided into two types of rocks, namely Extrusive rocks and Pyroclastic rocks. Field observations conducted to determine the appearance megascopically include, color, structure, texture, compactness, and mineral composition. On the Extrusive rock indicated Andesite shows the characteristics of the gray-black, texture porphyritic, hypocristaline, equigranular, structured vesicular and columnar joints, the appearance of extrusion with the mineral composition composed of plagioclas, hornblende, biotite, quartz, orthoclase, mineral ore, and clay minerals. The appearance of these rocks show a pattern more like lava flows and almost all lithologies exposed at the edge of the river. Then the field observation of the pyroclastic rocks the study area is divided into two lithologies, namely Lapilli Tuff and Agglomerates. In Lapilli Tuff rocks showing the characteristics of grayish color, open container, compactness rather soft and easily crushed, 2mm grain size, sorting good, massive structure, mineral composition consisting of quartz, tuff, andesitic, pyrite, and is composed of a matrix ash. While on the rocks Agglomerates have a common characteristic colored dark gray, massive structure, sorting bad, pack open, compactness hard until slightly soft, mineral composition consists of fragments of tuff, andesite, quartz, feldspar, iron oxides and clay minerals (Figure 3).

![Figure 3](image-url)

Figure 3. Megascopically observation of Volcanic Rocks in research area

After the observation of the field, then do sampling considered representative represent research areas for the next observed under a microscope comprising, 2 extrusive rock samples and 7 samples pyroclastic rocks. Andesite is divided into 2 samples, 1 sample Lapilli Tuff and 6 samples of Agglomerates. Andesite rocks on the sample LP 12 (PET-02) and LP 32 (PET-05) microscopically show color index leucocratic rock, subhedral-euhedral crystal shape, the granularity equigranular,
allotriomorfik granular, crystal size of 0.1-0.2 mm, with a mineral composition comprising plagioclase, pyroxene, biotite, quartz, feldspar, opaque minerals and clay minerals. Andesite paragenesis shows Pilotaxitic texture, which microlites plagioclase form a flow pattern that tends to subparalel, is due to slow flow pattern or flow of viscous lava. Symptoms of zoning in plagioclase formed as a result of changes in temperature, composition, and the pressure to be identifier that phenocrysts and basic mass rich in sodium (sodium-rich plagioclase). Most mineral incision experienced changes characterized by the presence of sericite minerals which generally change the mineral plagioclase, then comes feldspar types sanidin, secondary quartz and chlorite alteration characterize the rock experienced a kind of phyllic (Corbett and Leach, 1998).

In Lapilli Tuff rock samples LP 40 (PET-20) microscopically show color index leucocratic rock, subhedral-anhedral crystal shape, the granularity inequigranular, allotriomorfik granular, crystalline size of 0.1-5 mm, with mineral composition consists of quartz, pyroxene, pumice, plagioclase, glass and mineral clay. Petrogenesis of Lapilli Tuff shows that where phenocrysts vitrovirik texture and mass are essentially composed of glass. The rocks did not show any effect of alteration.

Then the appearance petrographic samples of rocks Agglomerates LP 3 (PET-01) LP 86 (PET-03), LP 28 (PET-04), LP 24 (PET-06), LP 107 (PET-07), LP 68 (PET-08), has a color index leucocratic rock, subhedral-anhedral crystal shape, the granularity equigranular-inequigranular, hipidiomorfik granular, crystal size of 0.1-0.5 mm, with mineral composition composed of plagioclase and microlite plagioclase, quartz, glass, lithic dominated by some show texture pumice tuff, opaque minerals and clay minerals. Petrogenesis of Agglomerates rocks show that texture intergrowth pilotaxitic where there are patterns indicating phase alignment crystallized minerals in mineral transport. On incision showed that primary volcanic/piroklas formed first have experienced changes into secondary mineral such as chlorite, illite, sericite, quartz secondary and carbonate characterize the rock has undergone changes with the intensity of a weak to moderate with the type of alteration Outer/Sub Propylitic (Corbett and Leach, 1998).

In (Figure 4) is the result of petrographic observation of all samples of volcanic rocks in the study area showing the rock has undergone alteration intensity of weak to moderate alteration (Morrison, 1997), except Lapilli Tuff samples that did not show any effect of alteration. Generally rock samples showed weak level of class changes, <25% of the total presence of secondary minerals, while the moderate level change indicates the presence of secondary minerals 25-75% of the total number of constituent mineral rocks. Volcanic rocks in the study area showing different variations of the mineral composition (Table 1).
Figure 4. Microscopically observation of Volcanic Rocks in research area

Table 1. Percentage Composition of minerals contained in the volcanic rocks of research areas based on petrographic analysis

| LP | Plg | Qz | Fsp | Px | Bio | Lithik | Glass | Opaque Mineral | Clay Mineral | Intensity | Rock Name | Alteration |
|----|-----|----|-----|----|-----|--------|-------|---------------|--------------|-----------|-----------|------------|
| 3  | 15% | 5% | -   | -  | -   | 28%    | 15%   | 2%            | 35%          | Medium    | Agglomerates | Outer/Sub Prophyllitic Phyllic |
| 12 | 75% | 4% | 9%  | 3% | -   | -     | 1%    | 4%            | Low Andesite Lava | Low | Agglomerates | Outer/Sub Prophyllitic Phyllic |
| 24 | 6%  | 4% | -   | -  | -   | 48%    | 17%   | 5%            | Low Agglomerates | Low | Agglomerates | Outer/Sub Prophyllitic Phyllic |
| 28 | 18% | 7% | 3%  | -  | -   | 34%    | 12%   | 3%            | Medium Agglomerates | Medium | Agglomerates | Outer/Sub Prophyllitic Phyllic |
| 32 | 65% | 12%| 2%  | 5% | 4%  | -      | -     | 8%            | Low Andesite Lava | Low | Agglomerates | Outer/Sub Prophyllitic Phyllic |
| 40 | 10% | 17%| -   | 2  | -   | 10%    | 51%   | 3%            | Low Glassy Tuff | Medium | Agglomerates | Outer/Sub Prophyllitic Phyllic |
| 68 | 14% | 4% | -   | -  | -   | 46%    | 8%    | 2%            | Medium Agglomerates | Medium | Agglomerates | Outer/Sub Prophyllitic Phyllic |
| 86 | 7%  | 2% | -   | -  | -   | 40%    | 13%   | 4%            | Medium Agglomerates | Medium | Agglomerates | Outer/Sub Prophyllitic Phyllic |
| 107| 15% | 4% | -   | -  | -   | 42%    | 9%    | 3%            | Medium Agglomerates | Medium | Agglomerates | Outer/Sub Prophyllitic Phyllic |
Based on megascopic and microscopic observations data shows that the study area is composed of Andesite Lava, Lapilli Tuff, and Agglomerates. Then correlated to the volcanic facies models Bogie and Mackenzie (1998). So the research areas included in the Central facies to Proximal facies based on lithologic characteristics in it (Figure 5).

![Figure 5. Distribution of Facies Volcano (Bogie dan Mackenzie, 1998 in Bronto, 2006)](image)

**Conclusions**

Based on megascopic observations in the field and microscopic observations in the laboratory showed that the volcanic rocks in the study area is composed of Andesite rocks and pyroclastic rocks, namely Lapilli Tuff and Agglomerates. Then the microscopic observation of both types of these rocks shows that the study area is composed of Andesite Lava, Glassy Tuff, and Agglomerates altered the mineral composition of rocks constituent has experienced changes, characterized by the presence of carbonate minerals, chlorite, sericite, illite, and quartz. On Andesite rocks are categorized in phyllic alteration zones due to the presence of sericite minerals (generally changes plagioclase), feldspar, quartz and chlorite. While in the pyroclastic rocks consisting of Lapilli Tuff lithology showed no significant alteration influence, while at the lithology Agglomerates are categorized into the alteration zone Outer/Sub Prophylitic. Characterized by the presence of alteration minerals identifier that is, carbonate, chlorite, illite, and quartz secondary visible across a thin slice agglomerates. Based on lithology characteristics in the research area included in the Central Facies and Proximal Facies.

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References
[1] Bronto S 2006 Fasies gunung api dan aplikasinya Jurnal Geologi Indonesia Vol 1 No. 2 J 59-71
[2] Bogie I and Mackenzie K M 1998 The application of a volcanic facies models to an andesitic stratovolcano hosted geothermal system at Wayang Windu, Java, Indonesia Proceedings of 20th NZ Geothermal Workshop 265-276
[3] Corbett G J and Leach T M 1996 Southwest Pacific Rim Gold-Copper Systems: Structure, Alteration, and Mineralization (Auckland: CMS New Zealand Ltd)
[4] Morrison K 1997 Important Hydrothermal and their Significance (New Zealand)
[5] Schmid R 1981 Descriptive nomenclature and classification of pyroclastic deposits and fragment: recommendation of the IUGS Subcommission on systematics of igneous rock Geology (Zurich)