The distribution and petrography characteristics of material eruption in the south of Rawa Danau, Banten Province

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Abstract. Banten is an area that has geological uniqueness, particularly in Rawa Danau on the North side. The research area is a young volcanic complex surrounded by several mountains such as Mount Aseupan, Parakasak, and Karang in Serang district in Banten province. The Rawa Danau consists of swamp and lake, which is located inside an estimated Pliocene-Pleistocene caldera as the result of the ancient volcanic eruption. Based on the previous study the lithology of the lake was fine-grained fluvial sediment and swamp deposit with volcanic material. The aim of this study is to reconstruct the behaviour of the eruption in the research area and to know the area affected by the eruption using petrography analysis. The research area is dominated by pyroclastic such as breccia, tuff, and andesite in the form of lava flow and basalt that originate from M. Parakasak, M. Aseupan, and M. Karang. The mineral contents of the igneous rocks are plagioclase, pyroxene, and opaque with the microlith plagioclase as the groundmass. The degree of plagioclase extinction angle was used to differentiate between andesite rock and basalt rock. Andesite rock has more acidic plagioclase than basalt rock. The texture of andesite rock is trachytic implied that the geometry is a lava flow. The basalt rock has porphyritic texture and becomes the part of the caldera wall of Mount Parakasak.

Keywords: Rawa danau, trachytic, porphyritic, caldera, lava flow, parakasak

1. Introduction
The study area is in the South of Rawa Danau, Serang district, Banten province that has geomorphological uniqueness with the existence of the volcanic lake in the centre of the area (figure 1) [1]. The volcanic lake is a depression that filled up by young sediment materials that originate from surrounded volcanic. This volcanic lake was assumed as a caldera as the result of the immense eruption that occurred on Pliocene-Pleistocene. Hence, the distribution of the eruption materials and its process is interesting to research. Petrography analysis is used in this study to determine the content, texture, and the interconnected of grains. Those parameters can explain the process of the formation of rocks [2].

The aim of this study is to determine the distribution of eruption products in the research area. The previous study in Krakatau explains that crystallization of plagioclase, pyroxene, and Fe-Ti oxide can identify the type of its magma as the result of Krakatau eruption that has erupted in 1883 [3, 4]. The eruption chronology could be known by using petrography analysis and reinforced with geochemical data [5]. However, this study does not use the geochemical method.
2. Data and method

2.1. Field observation
The fieldwork was conducted in Padarincang sub-district and Ciomas sub-district, Serang district, Banten. Remote sensing survey was done to know structure lineament, the distribution of pyroclastics, and type of lithology before geological mapping began. The geological mapping comprises approximately 144 km$^2$ of the study area. Then, geological mapping was conducted to know pyroclastic distribution exactly in the study area and to obtain a hand specimen from the outcrop directly. 100 samples and 12 geological structure data have been obtained.

2.2. Laboratory method
Megascopic rock description was aimed to identify the characteristics of rock such as colour, texture, and structure. Thin section was analyzed using a polarized microscope with the 25 times of magnification, this analysis comprised of determining the mineral content, a specific texture of rocks, and the angle of plagioclase extinction (figure 2).

![Method flowchart](image)

**Figure 2.** Method flowchart
3. Results and discussion
The result of geological mapping shows that study area is dominated by pyroclastic materials such as tuffaceous breccia, tuff, andesite in the form of the lava flow, and basalt as the result of the volcanic eruption. The eruption products were generated from Mount Aseupan, Mount Parakasak and Mount Karang (figure 3). The distribution of eruption material was dominated by pyroclastic material such as tuffaceous breccia and tuff. Those mountains released material with almost the same characteristics, so that breccia rocks are difficult to distinguish. The breccia rock has a volcanic rock as a fragment with the ash tuff as a matrix. Satellite imagery data is used to see the area coverage of each mountain and include groups of tuffaceous breccia based on the region of each mountain.

There are seven rock units scattered in the study area, namely Mount Aseupan tuffaceous breccia, volcano deposit, Mount Parakasak lava flow, Mount Parakasak tuffaceous breccia, basalt, Mount Karang breccias, and Mount Karang lava flow. The rocks are scattered from regions with lowland to high hills geomorphology (figure 4).

![Figure 3](image1.png)

**Figure 3.** The outcrops produced by volcano eruptions, (a) tuffaceous breccia, (b) basalt rock and (c) lava flow.

![Figure 4](image2.png)

**Figure 4.** The distribution of eruption material in Padarincang sub-district and Ciomas sub-district, Serang district, Banten.
On the lowland area with an altitude of 50–150 m above sea level is dominated by deposit of the volcano that occupies around 5% of the study area. It accumulates in the South-west of the study area. The formation of the deposit caused by weathering processes around.

Around 15% in the South-west of the study area is occupied by tuffaceous breccia, tuff and basalt rock with the sheeting joint structure (figure 5). All those rocks are the material eruption of Mount Aseupan that distributed on the low hills to High hills with an altitude of 125–750 m.

The eruption products of Mount Parakasak occupy mostly in the centre of the study area that spread from the South to the North. The rocks such as tuffaceous breccia and tuff dominate in around 45% of the study area, it is in low hills to the high hills area with an altitude of 150–600 m.

The lava flow pattern flows from the area with the altitude 500 m to the area with an altitude of 112.5 m it covers around 7% of the study area. The source of flow came from the South to the North and East to the North. In the Northern part exposed basaltic rocks which occupy about 3% of the study area. Basalt rock occupies an area with an altitude of 150–225 m with low hill geomorphology to hills.

The breccia tuff lapilli cover around 20% on the East area. It is an eruption material of Mount Karang, it spread from low hills area to the hills area with an altitude of 150–225 m and the lava flow of Mount Karang covers around 5% of the study area, the orientation of flow is from Southeast to the Northwest seen based on larger contour values to smaller ones (figure 4). It occupies the area with an altitude of 775–162.5 m.

Those mountains also emit lava flows but there are no outcrops in the Aseupan Mountain which form a flow pattern, but there is a basalt rock outcrop with a sheeting joint structure (figure 5) which indicates a flow during its formation, supported by petrographic data which shows the trachytic texture reinforces the fact that Mount Aseupan also emits lava flow (figure 6).

The difference is seen in the colour of the rock, where basalt rocks have a darker colour than andesite rocks. The differences in rock types in the lava flow produced by the three mountains are due to different types of magma. The flow of lava produced by Mount Aseupan is relatively more alkaline than the lava produced by Mount Parakasak and Mount Karang saw from the type of plagioclase which has a greater extinction angle. Mount Parakasak and Mount Karang lava are intermediate, so the lava flows on both mountains are andesite rocks.

The thin section of Andesite rock of Mount Parakasak shows the groundmass is a 70% of microlite of plagioclase, blackish grey, low relief mineral. The crystal fragment consist of 15% of plagioclase with the size of 1 mm, gray colour, angular shape of mineral with the medium relief,

Figure 5. Sheeting joint structure of the basalt rock.
twin type is Carlsbad-albite with the angle of plagioclase extinction is 32° which show the type of plagioclase is labradorite (An-55), 10 % of pyroxene with the size of 0.2 mm, yellowish-brown colour, angular shape of crystal, medium relief and do not show a pleochroism, 5 % of opaque with the size of 0.1 mm, subangular crystal, black colour. The texture is trachytic that show the lineament of the microlith plagioclase (figure 6).

In the part of the caldera wall, the rock type is basalt rock that consists of 60 % of microlith plagioclase as a groundmass, grey to black colour, low relief, subhedral of crystal shape. 20 % of plagioclase, grey colour, low relief, subhedral crystal, twin type is Carlsbad-albite, type of plagioclase is labradorite (An-60), 15 % of pyroxene yellowish brown colour, medium relief, subhedral crystal. 5 % of opaque black colour, spread unevenly some are associated with pyroxene. The texture is porphyritic (figure 7).

The thin section of basalt rock of Mount Aseupan shows the groundmass is a 65 % of microlite of plagioclase, blackish grey, low relief mineral. The crystal fragment consist of 20 % of plagioclase with the size of 0.5–1 mm, grey colour, angular crystal with the medium relief, twin type is Carlsbad-albite with the angle of plagioclase extinction is 45° which show the type of plagioclase is bytownite (An-75), 10 % of pyroxene with the size of 0.2 mm, yellowish-brown colour, sub-angular shape of crystal, medium relief and do not show a pleochroism, 5 % of opaque with the size of 0.1 mm, subangular crystal, black colour. The trachytic texture implied the flow process. The thin section of Mount Karang’s lava flow shows that consists of 50 % of microlith plagioclase as a groundmass, grey to black colour, low relief, subhedral crystal. 28 % of plagioclase, grey colour, low relief, subhedral crystal, twin type is Carlsbad-albite, type of plagioclase is andesine (An-40), 16 % of pyroxene reddish brown colour, medium relief, subhedral crystal. 6 % of opaque black colour. The trachytic texture forms an orientation of microlith plagioclase as a groundmass (figure 6).

The thin section analysis shows that there are two types of volcanic rocks that formed in the study area. The minerals composition of volcanic rock is intermediate plagioclase, pyroxene, and opaque with the trachytic texture was defined as andesite rock in the form of the lava flow that originated from Mount Parakasak and Mount Karang. The volcanic rocks with minerals composition are basalt plagioclase, pyroxene, and opaque minerals with the porphyritic texture were defined as basalt rocks as a part of Mount Parakasak’s caldera.

![Figure 6. Thin section of mount Parakasak eruption products with the mineral content Plagioclase (Pg), Pyroxene (Px), Opaque (Op), and Microlite Plagioclase as a groundmass. (a) Trachytic texture of andesite rocks in the form of lava flow, and (b) Porphyritic texture of basalt rock as a part of the caldera wall of mount Parakasak.](image)
Figure 7. Thin section of Mount Karang and Mount Aseupan eruption products with the mineral content Plagioclase (Pg), Pyroxene (Px), Opaque (Op), and Microlite Plagioclase as a groundmass. (a) Trachytic texture of basalt rock originated from Mount Aseupan, and (b) Trachytic texture of andesite rock originated from Mount Karang.

4. Conclusion
The distribution of eruption material in the study area was dominated by Mount Parakasak products which were 7% of lava flow, 45% of tuffaceous breccia, and 3% of basalt rock occupied the central part that spread from South to North and also from the West to the East bordering with Mount Aseupan eruption product that is 15% of tuffaceous breccia in the West and Southwest and the Mount Karang product that are 20% of breccia rock and 5% of lava flow in the East of study area. Mineral content in lava rock of those mountains are plagioclase, pyroxene, and opaque minerals, the difference lies in the type of plagioclase. Mount Aseupan has bytownite (An-75) plagioclase which tends to be more alkaline compared to labradorite (An-55) plagioclase of Mount Parakasak and andesine (An-40) plagioclase of Mount Karang which are intermediate. The basalt rock of Mount Parakasak has an alkaline type of plagioclase labradorite (An-60) which is part of the Mount Parakasak caldera wall.

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