Quaternary volcanostratigraphy setting in Rawa Danau Caldera, Banten Province

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Abstract. The volcano complex in the Rawa Danau of Banten Province or called the Dano Volcano has an association with the eruption of the Krakatoa volcano, observed from the direction of the ridge lineament. The Dano volcanic eruptions occurred during the Holocene period, causing the accumulation of volcanic material deposits into the northern part of Banten Province. This research area is covering five mountains which are Mount Parakasak, Mount Marikangen, Mount Tukung-Gede, and Mount Karang (sorted from the oldest to the youngest). Field mapping method we use in accordance with previous research and literature studies, as well as the results of the analysis in the form of the senses and geomorphology, stratigraphy, geological structure, and petrography to conclude volcanic facies in the Rawa Danau and surrounding areas. The results of the study showed that there were 4 volcanic facies around the Dano Volcano area. The central facies comprise of dome of Mount Parakasak with steep morphology while the proximal facies with andesitic lava. The structural geology feature formed from sheeting joints in the Southwest-Northeast direction with azimuth of N15° E/44° and tectonic fractures with Northwest-Southeast direction with azimuth N135° E/70° with steep morphology. The medial facies is tuffs and tuff breccias with gentle slope morphology, and the distal facies only have mud deposit, clay lithology with flat morphology. Rawa Danau in this study is located in the distal zone which consists of swamp deposits resulting from the destruction of the surrounding volcanic material.

Keywords: Rawa danau, volcanic facies, volcanic complex

1. Introduction
Rawa Danau is a caldera of the Danau complex volcano that is located in Serang District, Banten Province, shown in figure 1. Stratigraphic analysis reveals that eruptions in the Danau complex volcano area began from Pliocene until Pleistocene. Danau Volcano has two eruption periods, the last eruption occurred about 1 million years ago with an explosive eruption causing the Danau Volcano caldera to collapse, then the center of the caldera filled with sediment deposits resulting from destruction of volcanic eruptions [1, 2].

This eruption from Dano Volcano produced the morphology of hills and mountains around the caldera [2]. These mountains are type B volcanoes whose eruption has not occurred after 1600, but there are still indications of the incident eruptions such as solfatara/fumarole field, it is shown by the presence of hot springs and geothermal field development planning in the Batukuwung area from Mount Parakasak [3, 4]. The mountains are composed of eruption products from the volcano, hence the
deposition process or stratigraphy of this volcano can be sorted. This deposition is sorted by analysis of volcanic facies in the form of central, proximal, medial, and distal. Each facies has its own characteristics for the type of the lithology. In the central facies it was characterized by siliceous dome, vent breccia, agglomerate, and intrusive. In the proximal facies of the rock that characterizes it was lava, tuff breccia, and lapilli tuff. Medial facies were characterized by tuff and lava rocks, while in distal facies that were located far from the top of the volcano are characterized by lacustrine siltstone, conglomerate, and interbedded sandstone and tuff which are the result of other rock debris [2, 5, 6].

Research in the Rawo Dano area is still rare, especially for volcanic facies research. Therefore, the research was carried out using field observation methods to obtain data on rock distribution, geomorphology, and geological structure, as well as laboratory analysis in the form of petrography to find out the mineral composition and texture in rocks in more detail [6, 7].

This study aims to determine the order of the deposition of Danau volcanoes after the eruption which occurred with the determination of volcanic facies.

2. Methodology

The method used in this study are primary data and secondary data. Primary data can be obtained from the results of mapping conducted (field observation) around Rawa Danau and laboratory, then secondary data obtained from literature reviews and previous researchers.

2.1. Field observation

The method used in this study are primary data and secondary data. Primary data can be obtained from the results of mapping conducted around Rawa Danau and secondary data obtained from literature reviews and previous researchers (figure 2). In this study, the analysis method of the data obtained using sensory analysis and geomorphology for the landscape of the study area which could determine volcanic facies from central to distal. Sensory and geomorphological analysis were carried out by looking at the landscape appearance of the overall satellite imagery of the Rawa Danau area and through the morphography, morphometry as well as morphogenetic aspects of the study area [5, 6].

While stratigraphic analysis was carried out to determine the type of lithology and its sedimentation sequence so that the zone will be known from the place where the lithology was found. This analysis was done by geological mapping in the research area followed by determining the type of rock and

![Figure 1. The location of the research area of Rawa Dano, Serang Regency, Banten Province. Geographically located at 6°4'4.07"S to 6°17'11.72"S and 106°1'21.88"E to 105°54'48.69"E.](image)
identifying the age of the rock with the literature study in the form of regional geology and previous research. Geological structure analysis was done by analyzing the strike and dip of the rock, and by looking at the pattern of the ridge of the mountain complex around the Rawa Danau area [5, 6].

2.2. Laboratory analysis
Petrographic analysis was done by analyzing rock samples which had been thinly sliced and observed with a polarization microscope to identify the types of minerals and its characteristics so that detailed rock types were known. This analysis was used to determine mineral composition and particular texture of rocks [7, 8].

3. Results and discussion
Based on the data found in the field, there are four volcanic facies that can be analyzed by geomorphology, stratigraphy, geological structure, and petrography from four mountain objects around Rawa Danau which can be seen in figure 2b. In the central zone of morphology, it appears in the form of steep high hills with an altitude of 700–950 meters above sea level with a radial pattern that forms a sharp V valley, shown in figure 3a. This central zone is characterized by dome of mount Parakasak which can be seen in figure 3b, with the Holocene age based on the regional geology map of Serang and Anyer [9, 10].

Figure 2. (a) Rocks distribution of field observation, and (b) Distribution of volcanic facies based on the distribution of rocks in the research area.
The proximal zone has a steep hill high morphology with an altitude of 400–925 meters above sea level forming blunt U to be a sharp V with radial flow patterns and dendrigo-parallel, shown in figure 4a. The lithology that covers this area consist of Pliocene to Holocene andesitic lava, breccia tuff, agglomerate, and tuff lapilli based on the regional geology map of Anyer and Serang regional. This age range is derived from 5 mountain rocks which are the object of research and andesite from the old Danau Volcano which is still exposed. The rocks found around this proximal zone have encountered weathering. The structure found in this zone is a sheeting joint which is the result of cooling magma. The orientation of this sheeting joint is Southwest-Northeast with a slope of N15° E/44°. Also found a tectonic structure in the form of shear joint with a slope of N135° E/70° and this structure oriented Northwest–Southeast, which is similar to the direction of the ridge alignment.

This shear joint is found in the southern part of Rawa Danau which is on the Mount Parakasak. From petrographic analysis, special texture is obtained in the form of porphyritic and mineral types in the form of plagioclase, pyroxene, amphibole, biotite, and opaque. Plagioclase found in this zone have sorts of andesine to labradorite type. Petrography analysis which can be seen in figure 4b.

The medial zone has a sloping hilly morphology with an altitude of 87.5–200 meters above sea level forming a sharp U valley with dendritic flow patterns, shown in figure 5a. The lithology that dominates this zone is tuff and andesite resulting from debris which has an early Pleistocene age range to the late Pleistocene based on the regional geology map of Anyer and Serang.

Figure 3. (a) Central facies in Mount Parakasak, south of Rawa Danau, and (b) Dome of Mount Parakasak.

Figure 4. (a) Proximal Facies with rocks distribution in Rawa Danau, (b) Thin section of lava Mount Karang (left) and Mount Tukung Gede (right), composed of plagioclase (Pg), pyroxene (Px), microlite plagioclase (MPg), opaque (Op), and biotite (Bi).
This tuff came from Dano Volcano, which emitted fine material which was then deposited throughout the Rawa Danau area. The structure was found in the form of shear joint with a Northwest-Southeast and Northeast-Southwest direction with a slope of N168° E/76° and N250° E/85°. The petrographic results obtained in the form of glass and phenocrysts are in the form of plagioclase, feldspar, quartz, pyroxene, biotite, and opaque minerals. Plagioclase were found to have labradorite types. Petrography analysis which can be seen in figure 5b.

The distal zone has a lowland morphology with an altitude of 50–87.5 meters above sea level with an anastomotic river flow pattern which is a river flow in the swamp, shown in figure 6. Lithology in this distal zone is in the form of sedimentary deposits, namely mud, sand, silt which are the result of volcanic rock fragments around it. Based on the regional geology map of Anyer and Serang the age of these deposits is the late Holocene.

The result of research in the distal part of this swamp sediment by drilling, it consisted of clay, woody peat, ash, and soil with a late Glacial age range to late Holocene [1]. So, it can be concluded that the age of this distal zone is late Pleistocene to late Holocene. The structure in this distal region is difficult to find because it is a swamp deposit and has experienced intense weathering and erosion. Petrographic analysis also cannot be done because rocks are not well consolidated so they cannot be analyzed microscopically.

![Figure 5.](image)
4. Conclusion

Facies Volcanoes in the Rawa Danau area are divided into 4 zones, the central zone which is characterized by dome of mount Parakasak with the Holocene age and altitude of 700–950 meters above sea level. The proximal zone consists of tuff breccias, agglomerates, tuff lapilli, and andesitic lava which have a volcanic fractured with Southwest-Northeast direction and tectonic fractured with Northwest-Southeast direction, proximal zone have an altitude of 400–925 meters above sea level. The age range of this proximal zone are late Pliocene to early Holocene. The medial zone has tuff lithology and andesitic debris with an early Pleistocene age range to late Pleistocene and there is a shear joint with a Northwest-Southeast and Southwest-Northeast direction, medial zone has an altitude of 87.5–200 meters above sea level. The distal zone is a part of the swamp with mud, clay, ash and peat lithology which has a late Pleistocene to late Holocene age and have an altitude of 50–87.5 meters above sea level.

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