International Journal of Multidisciplinary Research and Publications
ISSN (Online): 2581-6187

Determination of Volcanic Zone Distribution Based on Petrographic Analysis in Rumpin Area, West Java

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Abstract**—*The increasing population growth leads to higher demand for building materials, on of them is andesite, whose demand in Indonesia is rising. The Rumpin area has significant andesite potential, and its quality is quite good. This makes Rumpin an important consideration due to its potential and resources, as well as its strategic location bordering South Tangerang City, Banten. Therefore, the management of natural resources, the environment, and regional development activities must focus on preserving their functions and capabilities. Consequently, development activities will not trigger disasters, and development sites must be located in areas that are safe from disasters. This research was conducted to determine the volcanic distribution zone in the research area using geological mapping and petrographic methods. The necessary parameters include slope, rock samples, and land use, as well as supporting field data in the form of morphology photos, slope angles, and lithology. The results of this study provide information on the zonation of volcanic or andesite distribution in the Rumpin area.*

Keywords**—*Rumpin, andesite, volcanic, mapping, distribution zone.*

I. Introduction

The Rumpin area is very strategic, as it borders the city of South Tangerang and Banten. Topographically, the Rumpin area has many springs that function as reservoirs or water catchment areas and can be utilized for agriculture and aquaculture. Additionally, the Rumpin area has tourism potential, offering beautiful natural scenery and several historically valuable sites. Furthermore, Rumpin has natural resource potential in the form of the best andesite rock in Indonesia. Holcim and Waskita are among the mineral companies that have explored the Rumpin area.

Bogor Regency, particularly Rumpin Sub-district, boasts abundant natural resources with potential to be developed into leading regional products. These resources must be continuously developed to establish them as competitive commodities at local, regional, national, and even international levels.

II. Regional Geology

Regional Stratigraphy

The Regional Geology of the Bogor sheet is generally composed of volcanic rocks, intrusive rocks, and constituent rocks of the Bogor zone and constituent rocks of the southern mountain zone in the form of Tertiary sedimentary rocks. The following are the constituent rock units of the Bogor sheet arranged from youngest to oldest.

A. *Surface Sediment*

- Alluvial (Qa): This unit consists of clay, silt, gravel, and cobbles, primarily river deposits that include sand and gravel deposited along the coast of Pelabuhanratu Bay.
- Alluvial Fan (Qav): Consists of siltstones, sandstones, gravels and pebbles of Quaternary volcanic rocks re-deposited as an alluvial fan.

B. *Bogor Zones*

- Tuff and Breccia (Tmtb): This unit comprises pumice tuff, andesite-stratified tuff breccia, tuffaceous sandstone, tuffaceous clay containing eroded wood and plant remains, and cross-bedded sandstone structures.
- Bojongmanik Formation (Tmb): This unit consists of sandstone, pumice tuff, marl containing mollusks, limestone, claystone with bituminous clays and lignite seams, and resinous remains. It is estimated to be 550 meters thick. Fossils found in the mudstone include plankton, indicating a Middle Miocene age. This formation is correlated with the Subang Formation in the Subang area.
- Limestone Member of the Bojongmanik Formation (Tmbl): This unit consists of limestone containing mollusks. It occurs in the form of lenses within the Bojongmanik Formation, which is of Middle Miocene age.
- Breccia Member of Cantayan Formation (Tmcb): This unit consists of polymict breccia with fragments of andesite-basalt and coral limestone. The overlying sandstone layers are 1,700 meters thick. The member is overlain by the Bojongmanik Formation and overlies the Klapanunggal Formation. Its age is Middle Miocene.
- Klapanunggal Formation (Tmk): This unit primarily consists of dense reef limestone containing large foraminifera and other fossils such as mollusks and echinoderms. It is believed to be equivalent in age to the Lengkong and Bojonglopang formations in the southern mountainous zone, which are Early Miocene in age. The Klapanunggal Formation overlies the Jatiluhur Formation, and its thickness reaches up to 500 meters in the eastern part of the sheet.
- Jatiluhur Formation (Tmj): This unit consists of sandstone and clay shale with intercalations of quartz sandstone, which becomes finer-grained towards the

Cahyaningratri Prima Riyandhani, Himmes Fitra Yuda, Ameda Putra Mandalawangi, and Murni Sulastri, "Determination of Volcanic Zone Distribution Based on Petrographic Analysis in Rumpin Area, West Java," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 3, pp. 1-4, 2024.

International Journal of Multidisciplinary Research and Publications
ISSN (Online): 2581-6187

east. The upper part of the formation interfingers with the Klapanunggal Formation and dates to the Early Miocene period.

C. Volcano

- Lava of Endut Volcano - Prabakti (Qvep): Composed of hornblende andesite containing oligoclase, andesine, hypersthene, and hornblende minerals.
- Mount Salak Volcanic Rocks: consists of lava flows, basal andesite with pyroxine (Qvsl); lahars, tuffaceous breccias and lapilli, composed of basal andesite, weathered (Qvsb); passive claystone tuff (Qvst).
- Mount Pangrango Volcanic Rocks: younger deposits, lava, andesite (Qvpy) and older deposits, lava and andesite basalt with oligoclase-andesin, labradorite, olivine, pyroxine and hornblende (Qvpo).
- Mount Gede volcanic rocks: consists of the youngest lava flows (Qvgy); tuffaceous breccia and lava, andesite with oligoclase-andesin, pyroxine and hornblende abundance, trachy texture, generally weathered (Qvg); basal andesite lava flows (Qvgl); basal lava flows of Mount Gegerbentang (Qvba); breccias and lavas of Mount Kencana and Mount Limo (Qvk).
- Old Volcanic Rocks: Unconfined Volcanic Rocks (Qvu); breccias and lava flows, mainly andesite. Volcanic Breccia (Qvb); andesite-basalt breccia, locally agglomerate, weathered. Lava volcano (Qvl); lava flows in Bogor area composed of basalt with labradorite, pyroxine and hornblende. In the Palabuhanratu area, there is andesite and oligoclase-andesine and hornblende.
- Tuff (Qvt); pumice tuff
- Volcanic Material (Tpv); breccias, claystone tuff breccias, lava flows and tuffaceous sandstones. Generally, poorly layered, conglomerate composed of andesite and basalt. This unit is well exposed in the Cianjur sheet and is thought to be Plio-Plistocene in age and overlies unconformably older sedimentary rocks.
- Volcanic Material (Tpb); breccias, lava flows, tuffaceous sandstones and conglomerates with andesite-basalt fabric.

D. Intrusive Rocks

The intrusive rocks found in the Bogor sheet are; andesite (a) with mineral composition of oligoclase-andesin, augite, hyperstenes and hornblende which forms plug and dike; dacite (da) exposed in the northwest corner area; quartz diorite (qd) in the northwest corner area; andesite hornblende (ha) in the southeast corner area; porphyry diorite (dp) is a dike along the Cicareuh river (Fig. 1).

III. METHOD

Field observations and geological mapping were conducted specifically in the Rumpin and surrounding areas to collect geological field data, which includes geomorphology and lithology descriptions. The important geomorphological parameters include slope, rock samples, and land use, as well as supporting data in the form of morphological photographs and lithologic slope angles. To identify the geological units of volcanic areas, it is necessary to pay attention to the relationship between geomorphological features and lithological units. Rock samples were taken from andesite and tuff, the two rock types selected. Rock samples were prepared in the form of thin sections with a thickness of 1 mm to represent each volcanic rock location found in the field. For optimal analysis results, rock samples must be fresh and minimally weathered. Petrographic analysis was conducted by observing the thin sections under a polarizing microscope to determine the mineralogical composition and texture of the rocks.

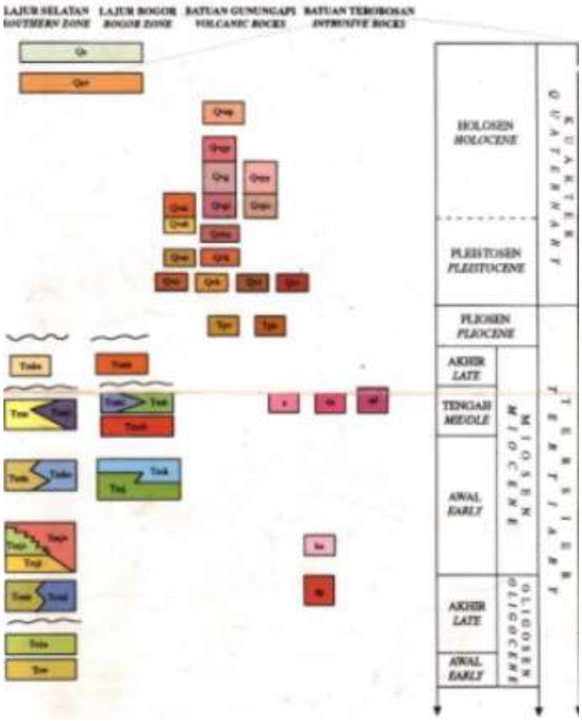

Fig. 1. Regional Geological Map of Bogor Sheet

IV. RESULT AND DISCUSSION

Based on their texture, igneous rocks can be categorized into plutonic and volcanic igneous rocks. The difference between the two can be observed in the size of the minerals that compose the rock. Plutonic igneous rocks generally formed from the slow cooling of magma, resulting in relatively large constituent minerals. Meanwhile, volcanic igneous rocks formed from the rapid cooling of magma, resulting in smaller constituent minerals.

One of the most widely needed examples of volcanic igneous rock is andesite. Andesite is a mining commodity used for various purposes, such as building foundations, road paving, bridge construction, and river gabions. Andesite that is abundant and located near construction projects will be economically valuable to mine. In utilizing rock resources like andesite, an exploration stage is required before mining activities are carried out.

A. Geomorphology of the Rumpin Area

The morphology of the Rumpin area can be classified into four units: lowland, plain, low hills, and hilly geomorphological units (Fig. 2). These varied units cover the research area, including the fluviatile sedimentary plain unit (Fig. 3). Field observations show that the research area has undulating hills and depression zones in the hilly areas.

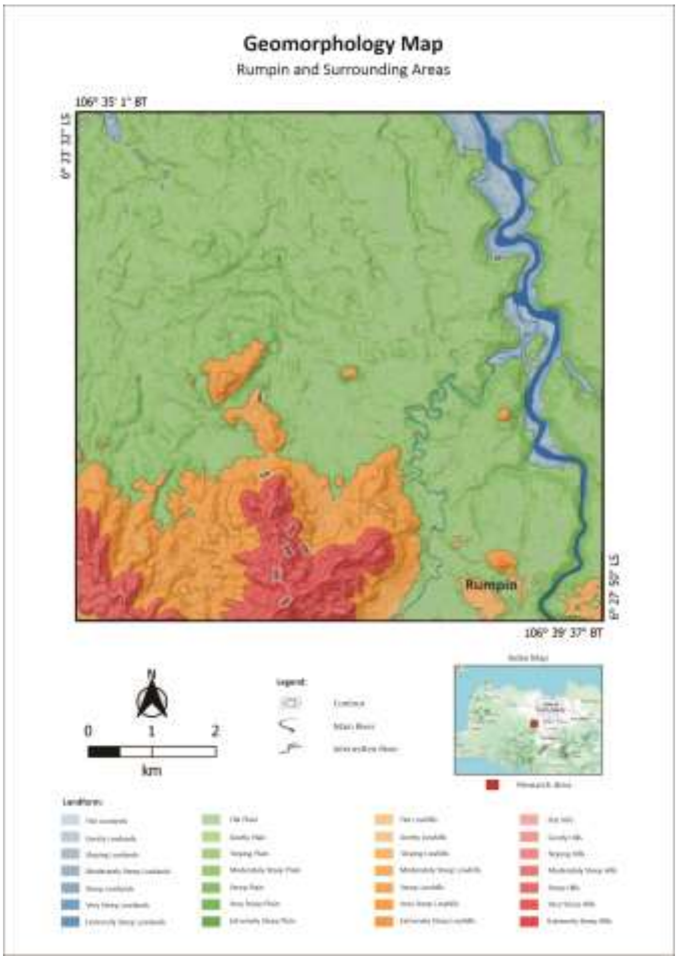

Fig. 2. Geomorphological Map


Fig. 3. Geomorphology of the Research Area

B. Volcanic Zones

Based on the observation of outcrops of volcanic zone distribution in the Rumpin area, a thin section petrographic analysis was conducted. From the results of this analysis, rock types can be determined based on parameters such as texture, composition, and mineral variation (Fig. 4).

Fig. 4. Tuff Outcrops (a) and Andesite Outcrops (b)

Andesite

The analytical results show that the sample is brown-white in light-polarized light (PPL) and dark gray in light-polarized light (XPL). It has porphyritic phaneritic granularity, with crystal sizes ranging from 0.3 to 1.3 mm, microphenocrysts from 0.1 to 0.3 mm, and a ground mass of less than 0.1 to 0.3 mm. The fabric is inequigranular, with hypocrystalline crystallinity and euhedral to anhedral crystal shapes, as well as hypidiomorphic mineral shapes. The phenocryst composition (60%) is predominantly plagioclase, while all mafic minerals (amphibole, pyroxene) have been converted to chlorite and clay minerals. The ground mass (40%) is rich in plagioclase microlites. In this section, 40% of the minerals have been converted to chlorite and clay minerals, including altered phenocrysts of amphibole, pyroxene, and plagioclase, as well as the ground mass (Fig. 5).

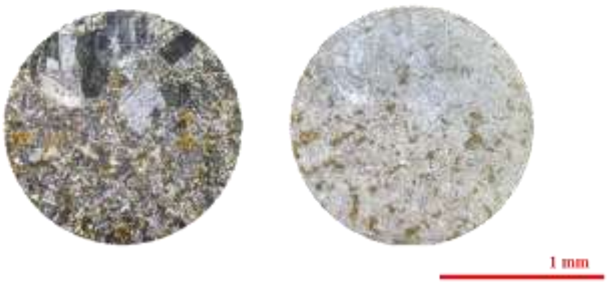

Fig. 5. Thin section of Porphyry Andesite

Tuff

The fresh color of the sample is light grey, while the weathered color is brownish orange to green grey. The texture is predominantly fine to coarse ash, angular to rounded, with medium sorting and a closed fabric. The rock is hard. The composition includes feldspar, oxidized mafic minerals, vitrics, lithic fragments (pumice), and chlorite. Zeolite/quartz is also present (Fig. 6).

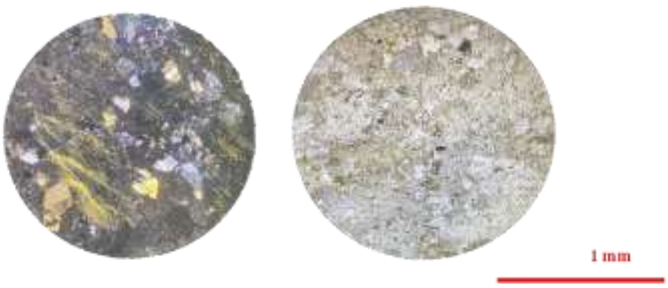

Fig. 6. Thin Section of Faneritic Tuff

V. Conclusion

Based on research on the outcrop of the volcanic zone distribution in the Rumpin area, we observed two rock samples, each of which was analyzed through two thin sections for petrographic analysis. The analysis results show that andesite is characterized by porphyritic-faneritic granularity, with plagioclase as the main component of the phenocrysts (60%) and the ground mass (40%) rich in plagioclase microlites. On the other hand, coarse tuff has a fine-coarse dust texture with lithic fragments (pumice) and chlorite, and it contains zeolite/quartz. The information obtained from these two rock types provides important insights into the environment and history of geological formations in the Rumpin area. Therefore, it is crucial for natural resource and environmental management activities, as well as regional development, to prioritize the preservation of their functions and capabilities to mitigate potential disaster risks stemming from development activities.

Acknowledgment

We would like to thank the Dean of the Faculty of Earth and Energy for providing support to us in this research, as well as to those who helped with this research.

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