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Petrogenesis of Andesitic Rocks In Sumalata, North Gorontalo

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ABSTRACT

Sumalata area locates in North Gorontalo or northern coast of North Arm Sulawesi. This area is rich in natural resources. One of those is a gold mine, which is managed by society. The area is covered by Miocene to Pliocene andesite and tuffs. Andesitic rocks are members of Diorite Boliohuto Formation. This study was conducted to determine petrogenesis of andesitic rocks. The research method used is field observations. The samples were analyzed by petrographic analysis. Field observations shows andesitic rocks consisted of andesite and quartz andesite. Most of the mineral are presence as opaque minerals such as pyrite and chalcopyrite. Petrographic analyses of 20 samples indicte four types of rocks namely andesite, trachyte, latite and quartz latite. Those rocks are formed by alkaline-intermediate magma. The differences of these rocks are their compositions of plagioclase, K-feldspar and quartz. In addition, the secondary minerals are chlorite, sericite, carbonates and opaque minerals. The presence of minerals supposedly due to the alteration of primary minerals such as pyroxene and plagioclase. This can occur if there is a process of alteration and metal mineralization.

Keywords: Sumalata, Petrogenesis, Andesitic rocks

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1. INTRODUCTION

Sumalata area located in North Gorontalo district, Gorontalo Province, or geologically located in North Arm of Sulawesi. The regional geologic setting of study area can be divided into three groups of rocks in general; sedimentary rock, volcanic rock, and intrusive rock groups [1]. The geological structure features in this area is fractures, folds and faults. Horizontal faults predominantly trending northwest-southeast and a few trending northeast-southwest. The study area are located in the Eastern part of North Arm Sulawesi, which is a volcanic arc formed by double subduction, namely North Sulawesi subduction lane in the Northern part and Sangihe subduction lane in the East and South part of North Arm Sulawesi [2].

Based on the regional geologi [7] Lokodidi Formation (*TQls*) composed of conglomerate, sandstone, conglomeratic sandstone, black shale and tuffaceous sandstone - Pleistocene. Dolokapa Formation (*Tmd*) is an old sedimentary rocks (Miocene), composed of wake sandstone, siltstone, claystone, and conglomerate. Pinogu volcanics (*TQpv*) composed of agglomerates, tuffs, and intermediate to alkaline lava - Upper Pliocene to Pleistocene.

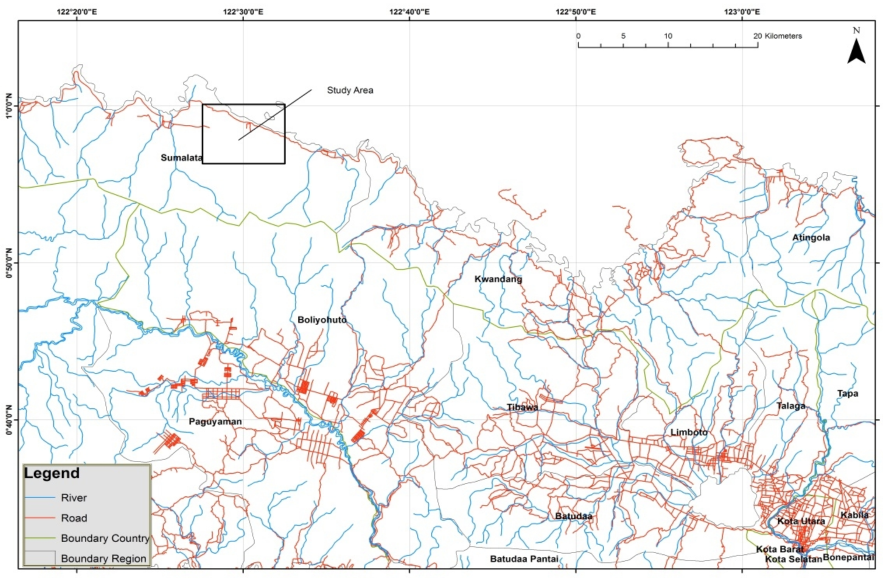

Figure 1. The map of study area. Sumalata District, North Gorontalo.

Wobudu Breccia (*Tpwv*) composed of volcanic breccia, agglomerate, tuff, lapilli tuff and intermediate to alkaline lava - Pliocene. Diorite Boliohuto (*Tmbo*) this unit intruding Miocene Dolokapa Formation, composed of diorite and granodiorite, in some places basalt dikes are found [Figure 5].

This study focused on the dioritic rocks, in particular research on Diorite Boliohuto (*Tmbo*) composed of diorite and granodiorite, and Wobudu Breccia (*Tpwv*) are also composed of intermediate to alkaline lavas. Petrographic observations are necessary to distinguish mineralogy of dioritic rocks in Sumalata area.

2. METHOD

The method used in this study is a megascopic rocks descripting in the field and with the emphasis on petrographic observations. The geological field observation was carried out by taking a fresh rock samples with hand specimen. Sampling locations are plotted onto base map using GPS. Selected rock samples are require for making thin sections. Samples were cut and polished up to 0,03 mm thickness and observed with a polarizing microscope.

3. RESULTS

The morphology of the study area is characterized by hills located at the foot of Mohenti Mountain, East Sumalata District. Most of the areas are accessible by foot. The rocks covered this area are intermediate to alkaline igneous rocks. In general, the minerals are altered, such as pyrite, chalcopyrite, malachite, and hematite. Calcite and quartz veins are found in several places. The rock types are andesite and andesite porphyry. These rocks are underlain by Miocene tuff volcanic rocks. Andesite and tuff breccia is a member of Wobudu formation.

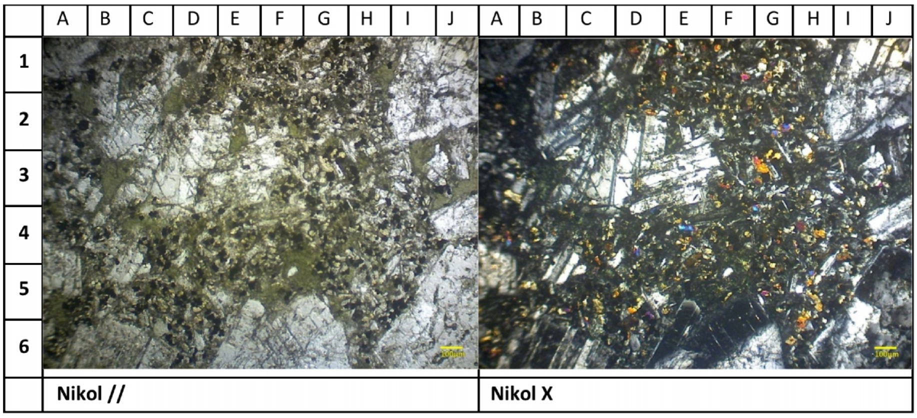

Figure 2. Microscopic appearance of mineral compositions of andesite with plagioclase and ground mass with secondary minerals such as klorite and cerisite

In Kelapa Dua and Padengo encountered weathered andesite outcrops and spheroidal weathering. Oxide minerals indicated by reddish and dark brown color. Based on petrological observation, andesite is found in gray to greenish color, hypocrystalline - holohyaline, porphyro aphanitic - aphanitic, in-equigranular hornblende as phenocrysts and massive, carbonate and quartz veins are also contained.

Based on petrographic observations, andesitic rocks in this study area can be divided into andesite, trachyte, latite and quartz latite, which has form of intermediate – alkaline igneous rock. The differences of these andesitic rocks are in composition of plagioclase, orthoclase and quartz.

Andesite has a dominant plagioclase mineral compared to trachyte. Meanwhile, latite and quartz latite only differ in composition of quartz mineral where quartz latite increased more than 5 percent quartz. The four rocks are derived from the same andesitic magma. Andesite samples were observed at PHP 06 and PHP 2.2 is transparent to brownish color, minerals size in PHP 2.2 are larger, subhedral to anhedral, interference color gray-brown to black, hypocrystalline texture, phanero porphyritic, in-equigranular, the primary mineral consist of plagioclase and masses. The secondary minerals consist of hornblende, sericite, clay minerals, and opaque in PHP 06, while at PHP 2.2 consists of pyroxene, chlorite, sericite, and opaque minerals.

Trachyte samples were observed in station 5.1 are transparent to brownish color, mineral size <10µm-520m, mineral forms subhedral to anhedral, interference color gray-brown to black, hypocrystalline texture, phanero porphyritic, in-equigranular, the primary mineral consist of feldspar and masses. Secondary minerals consist of carbonate, sericite, clay, and opaque minerals. It is found 25,9-30µm sized vein filled by carbonate minerals. At station 5.2 find transparent to brownish colored, mineral size <10µm-1330µm, subhedral to anhedral, porphyritic-trachytic texture, composed of phenocryst alkali feldspar and plagioclase. Secondary minerals consist of sericite and

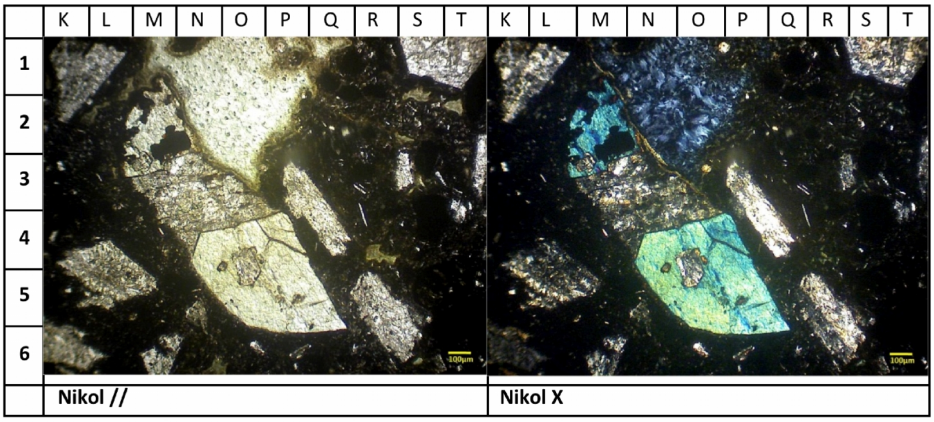

Figure 3. Trachyte appearance under the microscope with a porphyritic-trachytic texture composition of major minerals alkali feldspar and plagioclase that form the structure of the flow with clay minerals and chlorite as secondary minerals

opaque minerals. At Station PHP 04 the mineral size is <10µm-599µm, has subhedral to anhedral form, hypocrystalline texture, phanero porphyritic and in-equigranular. Mineral composition consists of plagioclase and ground-masses, and secondary minerals consist of clays, sericite, and opaque minerals.

Latite samples observed in station C.51 has brownish to black color, mineral size ranges <10µm-1200µm, subhedral to anhedral form, subhedral texture. The mineral composes of plagioclase and pyroxene. The rock alteration is about 30% to form secondary mineral consisting of carbonates, epidote, chlorite, sericite, clays, and opaque minerals.

Quartz latite samples observed in station H1.01 are strongly altered, transparent to brown color, mineral size ranges <10µm-646,4µm, subhedral to anhedral, porphyritic texture, dominated by alkali feldspar mineral and glass. Secondary minerals consist of quartz, alunite, pyrophyllite, clays, and opaque minerals.

4. DISCUSSION

Petrogenesis of andesitic rocks in study area can be divided into two types (i.e phaneritic igneous and volcanic rocks). Both rock types are distinguished by its formation. Andesite is the dominant rock cropping out in this study area. Generally it has phanero-porphyritic texture, is formed as a hypobisal body where plagioclase as its phenocryst within pyroxene matrix. These rocks contain secondary minerals such as chlorite, sericite and opaque minerals (metals). These minerals are thought to be present due to interaction of remaining solution to alter plagioclase and pyroxene into chlorite and sericite. Meanwhile, opaque minerals observed macroscopically in the form of pyrite and magnetite. The alteration of plagioclase and pyroxene into chlorite and sericite resulting in increasing composition of quartz in the rock. Furthermore in several places exposes latite and quartz latite. Meanwhile, trachyte formed from porphyro-aphanitic molten rock and is dominantly composed by K-feldspar. Trachyte,

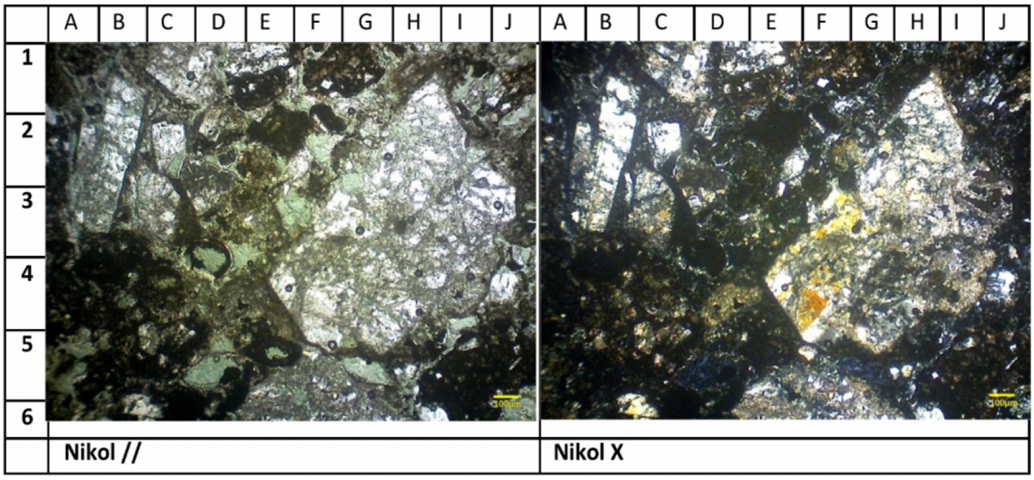

Figure 4. Latite appearance under the microscope with the composition of the main minerals pyroxene and plagioclase that form the structure of the flow of the mineral epidote, sericite, chlorite and clay minerals as secondary

Figure 5. Andesite sample (Station 5.1) shows porphyritic texture

Figure 6. Morphological view of Padengo area shows high weathering cropping out andesite rocks.

latite and quartz latite are found in several andesite outcrops in Padengo, Lasambo and Kelapa Dua. These rocks are difficult to distinguish on macroscopic observation. The process of alteration and mineralization is the main reason of variety of andesitic rocks in the study area.

5. CONCLUSIONS

Intermediate rocks become common constituent of rocks in Sumalata area, dominated by andesite, and in some places encountered trachyte and latite with increased silica content. This process supposedly due to alteration and mineralization occurrences in andesite. This is proven by alteration products of chlorite, sericite, carbonates, silica content and opaque which is a kind of metallic minerals.

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