JOURNAL OF APPLIED GEOSPATIAL INFORMATION

Vol 6 No 1 2022

http://jurnal.polibatam.ac.id/index.php/JAGI
ISSN Online: 2579-3608

Alteration Characteristics and Precious Metal Availability in Gunung Gembes & Surroundings, Jeruk Village, Pacitan Regency, East Java Province

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Received: October 15, 2021
Accepted: December 27, 2021
Published: February 11, 2022

Abstract

The research area is located in the area of Mount Gembes, Jeruk Village in Pacitan (East Java). This study aims to determine the characteristic and temperature in the formation of alteration which refers to petrography with the help of samples taken in the study area. The petrographic observations carried out were thin section observations which were then analyzed for the mineral content contained in the sample rock. After knowing the minerals contained in the sample rock, it is then entered into the mineral formation temperature diagram (White & Hedenquist, 1995). The method used in this study includes primary data in the form of geological observations such as lithology, geological structure geomorphology, environmental geology and alteration observations and combined with secondary data. Alteration observations in this study were carried out descriptively (megascopic) and subjective (microscopic). The geomorphic unit that works is of volcanic origin, with high hilly sub-units of porphyry dacite intrusion (volcanic neck). Geological structures that develop in the study area are faults, namely the left horizontal fault of Jeruk 1, the left horizontal fault of Jeruk 2 and the interpretation of the oranges right horizontal fault. Geological resources or sources found in the research area are mineral potential resources that are economical, and negative sources are in the form of mass movement of debris flow type. The Zonation and the type of alteration that developed in the research area are the clay alteration zone and silicification. The clay zone is formed at a temperature >100ºC-220ºC with a pH of 3-5 and a silicification zone is formed at a temperature>100ºC-300ºC with a pH <2 which is directly controlled by the faults found in the study site.

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Keywords: Mount Gembes, hydrothermal alteration, alteration zonation, alteration type, petrography

1. Introduction

1.1 Sub Introduction

The research area is located in the Mount Gembes area, precisely in Jeruk Village, Bandar District, Pacitan Regency, East Java. The research area has a mountainous morphology with an altitude of 900-1250 masl. Geomorphological units that developed in the research area are denuded mountain units and intrusive mountain units.

Based on the geological map of the Pacitan Sheet, the study area can be drawn for rock units of early Oligocene-Miocene age compared to the Mandalika Formation (Samodra *et al.,* 1990), and the Panggang Formation on the Ponorogo Sheet (Sampurno & Samoedra, 1997). The stratigraphy that developed in the research area is composed of andesite lava rock units, tuff, dacite intrusion, and andesite intrusion. Then due to the intrusion process by dacite rock, andesite causes the research area to allow hydrothermal alteration to occur.

Alteration is a change that occurs in the mineralogical composition of a rock caused by the action of hydrothermal solutions both physically and chemically (Guilbert, and Park, 1986). Hydrothermal solution is a liquid/fluid with a high temperature (100-500ºC) derived from the residual solution produced in the hot magma freezing process and then moves upwards by bringing metal mineral components (Bateman, 1956). The interaction between the hydrothermal fluid and the rock in its path (wall rock), will cause the primary minerals to be changed into altered minerals (alteration minerals), as well as the fluid itself (Pirajno, 1992).

2 Method

This research begins with a literature study, followed by a geological mapping of the surface. In this mapping, identification, analysis and recording of field geological data (lithology, geomorphology, geological structure, and alteration/mineralization) are carried out and rock samples are taken. In this surface geological mapping activity, identification and temporary Zonation of alteration rocks are also carried out.

From geological observations on the surface, processing of trajectory maps and observation locations, geological maps and geomorphological maps, geological structure maps, alteration and mineralization maps was carried out using Arcgis 10.5, Global Mapper 19 and Corel Draw X7 software, processing geological structure data in the form of joints using the win application. tensor and dips.

After obtaining rock samples from the field, laboratory analysis is carried out, the rock samples can be processed so that the results are obtained as thin incisions. Then the thin slices were analyzed petrographically. So that later will get results in the form of mineral content that makes up the rock.

3. Results and Discussion

The research area has a mountainous morphology with an altitude of 1020-1220 masl. The geomorphological units that developed in the research area are in the form of denuded mountain units and intrusive mountain units. Based on the geological map of the Pacitan Sheet, the study area can be drawn for rock units of early Oligocene-Miocene age compared to the Mandalika Formation (Samodra *et al.,* 1990) and the Panggang Formation on the Ponorogo Sheet (Sampurno & Samoedra, 1997).

The stratigraphy that developed in the research area is composed of andesite lava rock units, tuff, dacite intrusion, and andesite intrusion. Then due to the intrusion process by dacite rock, andesite causes the research area to allow hydrothermal alteration to occur. Data collection in the research area includes geological data (lithology, geological structure, alteration).

3.1 Research Area Lithology

In the research area, it was found that most of the rocks were the result of alteration of the original rock, namely porphyry dacite intrusion. If observed megascopically, the type of alteration in this outcrop is an argillic alteration with fresh gray-black color and weathered yellowish-brown color with an outcrop structure and massive petrography. Texture holocrystalline degree of crystallization, porphyry granularity, euhedral-subhedral mineral form, equigranular relation. The mineral composition is quartz, plagioclase, biotite, hornblende, chlorite, opaque and orthoclase. Special texture in mermekitic petrography, some places moderately-strongly altered. This unit occupies the entire research location. In general, the constituent lithology is an unofficial porphyry dacite intrusion unit that has no members**.**

3.2 Research Area Geomorphology

In general, the morphology of the study area is a geomorphic unit of volcanic origin [6]. This sub-unit has a morphography of high hills with elevations reaching 1020-1220 mdpl, a height difference of 200 mdpl, the shape of the slopes is rather steep (15°-55°), the relief of the slopes is almost wavy-mountains.

The morphogenesis that develops in this subunit is in the form of an active morphostructure characterized by intrusions, joints and faults, while the passive morphostructure is in the form of a porphyry dacite intrusion.

3.3 Geological Structure of Research Area

To solve problems regarding the shape, position, direction of the working force and the direction of its movement, the authors use the projection geometry method, especially the stereographic projection method (stereonet) and use the Dips software and use secondary data in the form of DEM interpretation to strengthen the field data and analysis results. As for naming large faults in the study area, use the name of the area through which the structure passes, moreover the location with the best geological structure condition in the research area, there were two types of faults controlling the formation of alteration, namely: (1) left slip fault (Rickard, 1972). (2) reverse left slip fault (Rickard, 1972). (3) Interpretational faults, can be seen in Figure 1.

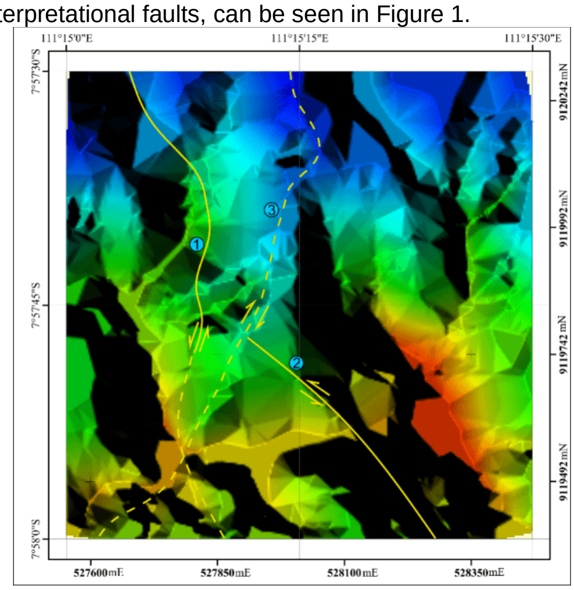

Figure 1. Geological structure maps, generated by DEM

3.4 Alteration Data Collection

Alteration data taken in the form of rock samples that have undergone an alteration process. In this study, researchers took two rock samples because they indicated the occurrence of two different types of alteration in the study area. Rock samples taken were at LP 8 with coordinates 7º57'55,2"-110º15'25,2" and on LP 9 with coordinates 7º57'58.8"-110º15'27.7". The samples that have been taken are then subjected to a petrographic incision process and an analysis of the mineral content of the sample (Fig.2). The microscope used is a polarizing microscope. The sample analysis process was carried out at the Mineral Resources Laboratory of the AKPRIND Institute of Science and Technology Yogyakarta.

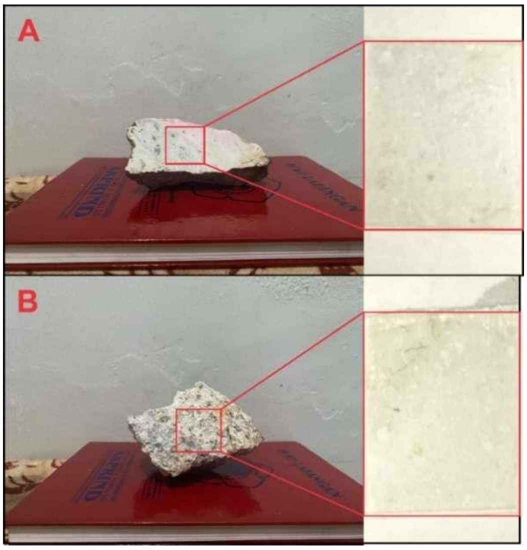

Figure 2. Rock samples A) rock samples LP 9, B) 8 LP rock sample

4. Discussion

Petrographic analysis was carried out to identify rocks, determine the presence of altered minerals in rocks, and mineral paragenesis so that rock names would be produced using igneous rock classification (Travis, 1995).

4.1 Petrography on sample LP 8

The results of petrographic analysis and field observations showed that the minerals present in this clay zone alteration were clay minerals in the form of illite and kaolinite, in some places there were minerals associated with quartz minerals in the vein (Fig. 3).

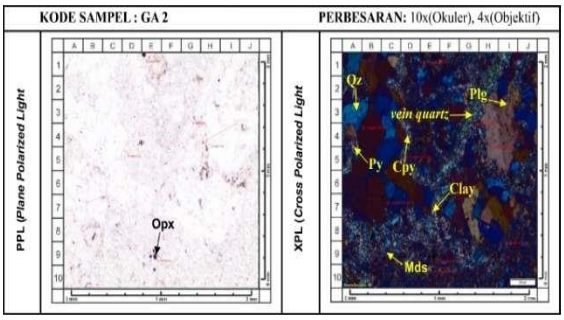

Figure 3. Appearance of sample petrographic thin section LP 8

4.2 Petrography on sample LP 9

Based on the results of observations on the incision using optical mineral analysis and petrography as well as field observations on rock samples undergoing the silicification process, it was found that the dominant mineral was quartz and secondary minerals were present (Fig.4)

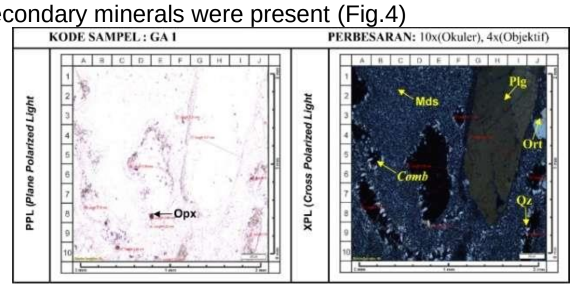

Figure 4. Appearance of sample petrographic thin section LP 9

The identifying minerals that are present in the petrographic analysis and field observations will then be included in the mineral formation temperature diagram according to Hedenquist, 1996 [9]. So that it can be seen at the temperature and pH how many types of alterations that are present in the study area are formed.

4.3 Determination of Zonation and Type Alteration

Based on the field data obtained at the research site, the compilers divide the alteration zone into 2 zones, namely the clay zone and the silification zone which can be seen in Figure 5.

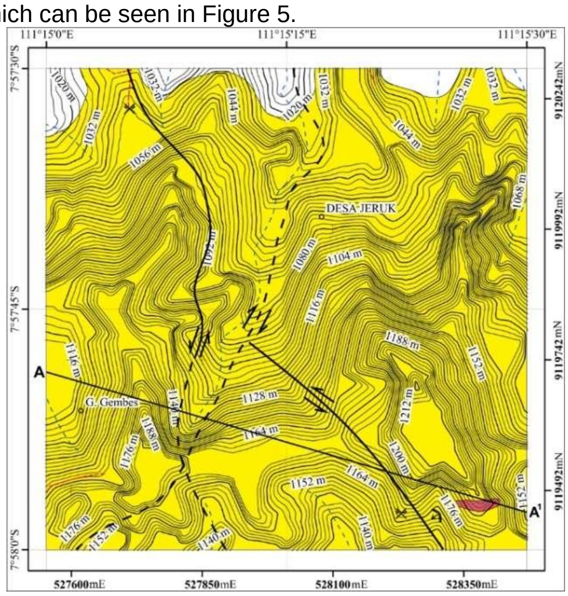

Figure 5. Map of the alteration zone of the study area, clay zone (yellow), silicified zone (red).

4.4 Clay zone

The results of petrographic analysis and field observations showed that the minerals present in this clay zone alteration are clay minerals in the form of illite and kaolinite, in some places there are pyrite minerals and chalcopyrite minerals associated with quartz minerals in the veint.

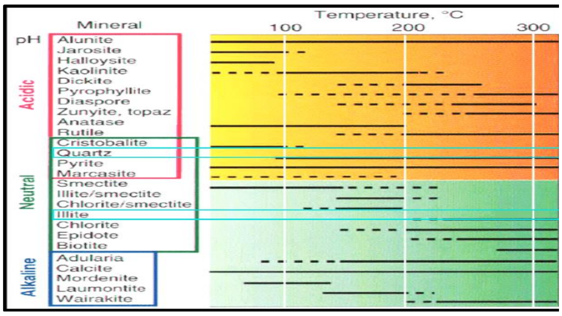

Figure 6. Diagram of mineral formation temperature in clay zone (Hedenquist and Urien, 1996[9]. With 2021 compiler modifications)

4.5 Silicification zone

The results of petrographic analysis and observations in the field showed that the minerals present in the alteration of this silicification zone were dominantly quartz minerals, the petrographic incision found pyrite minerals associated with quartz minerals. After being included in the temperature diagram (Figure 7) of mineral formation according to Hedenquist and Urien, 1996[9] which has been modified by the compilers, it is concluded that the formation of an alteration type of silicification zone occurs in the temperature range <100°-300° with pH <2 conditions (Guilbert and Park, 1986). Pyrite and Chalcopyrite, sometimes associated with gold.

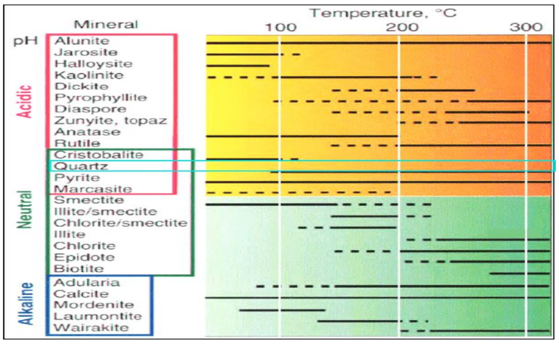

Figure 7. Diagram of mineral formation temperature in silicification zone (Hedenquist and Urien, 1996 (Hedenquist et al., 1996) With 2021 compiler modifications)

3. Conclusion

The research area has a lithology of porphyry dacite intrusion that has undergone an alteration process. The research area has a geomorphological unit of volcanic origin with high hilly sub-units of porphyry dacite intrusion (volcanic neck) (V14). The study area has a structural orientation in the form of faults, namely the Jeruk left horizontal fault of (1), Jeruk the left horizontal fault (2), and the estimated right horizontal fault (3). Alteration of the research area is divided into 2 zones, namely: clay alteration zone and silicification zone. The clay zone is formed at a temperature of >100°-220° with a pH of 3-5 and a silicification zone is formed at a temperature of <100°-300° with a pH of <2.

ACKNOWLEDGEMENT

Prefound thanks are appreciated to the Geological Engineering Department and Faculty of Teknologi Mineral, IST AKPRIND Yogyakarta for their permission and research support, and all parties involved who cannot be mentioned one by one.

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