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Potential of Metal Minerals in the Weikeri River, North Wetar, and Southwest Maluku

Subhan Arif [1]*, Nurul Dzakiya[2], Maulana Mairatu Tuheteru[3]

[1,2]Geological Engineering, Institut Sains & Teknologi AKPRIND, Kalisahak Street No 28 Yogyakarta, Indonesia
[3]Undergraduate Student in Geological Engineering, Institut Sains & Teknologi AKPRIND, Kalisahak Street No 28 Yogyakarta, Indonesia

*Corresponding author e-mail: s.arif@akprind.ac.id

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Abstract

The modern era, demand for metals as raw materials in technology continues to increase along with industrial development. Metals are used in various sectors, such as construction, automotive, electronics, and renewable energy. However, the availability of currently used metals is limited and poses challenges in terms of supply and environmental impact. To overcome these limitations, it is important to search for new metal resources. The potential for the existence of new metal deposits can be discovered through comprehensive geological research, especially in areas that have not been widely explored. One area of interest for this research is the Weikeri River, Uhak Village, Southwest Maluku. This research aims to explore the potential for metal deposition in the Weikeri River area and Uhak Village, Southwest Maluku. Using surface geological survey techniques, this research was carried out through a literature study stage and then a field geology study. Field studies are aimed at obtaining lithology, geological structure, alteration, and mineralization data. The results of field research show that the research location is composed of underwater volcanic rocks. Rock alteration conditions are dominated by the propylitic alteration type in andesite lithology, both in lava and in intrusions in the form of dikes and sills. Other alterations are argillic and silicified. The mineralization condition found was a brecciated quartz vein system. The resulting minerals found were sulfide minerals in the form of pyrite, galena, and chalcopyrite. The percentage of the presence of these minerals ranges from 1–3% on the surface.

Keywords: Geological survey, weikeri, wetar, rock, minerals.

1. Introduction

1.1 Background

The demand for metals as raw materials in technology continues to increase with the development of industry and technology in the modern era. Metals are used in various sectors, such as construction, automotive, electronics, and renewable energy. However, the availability of the metals currently in use is limited and faces challenges in terms of supply and environmental impact.

To address these limitations, it is important to seek new sources of metal resources. The potential existence of new metal ore deposits can be discovered through comprehensive geological research, especially in areas that have not been intensively explored. One of the interesting areas for such research is the Weikeri River, Uhak Village, Southwest Maluku.

Several recent studies conducted on Wetar Island discuss its tectonic conditions, such as research conducted by (Earle, 2023; Herrington et al., 2011) These two studies explain the conditions of magmatism in the arc-continent collision zone.

The Weikeri River and its surrounding areas are known to have the potential for undiscovered metal ore deposits (Sewell dan Wheatley, 1994a). Previous geological research in this region has been limited and shallow. Therefore, it is crucial to conduct further research to uncover the potential for new metal ore deposits in this location.

By conducting comprehensive geological mapping, including rock composition analysis, geological structure assessment, and mineral potential evaluation, it is hoped that we can identify the potential existence of new metal ore deposits in the Weikeri River, Uhak Village, and Southwest Maluku (Fig. 1). The results of this research will provide a better understanding of the mineral resource potential in the area and can contribute to meeting the demand for metals as technology raw materials.

1.2 Research Objectives

This research project is primarily focused on the exploration of new metal ore deposits in the Weikeri River, Uhak Village, and Southwest Maluku. The comprehensive objectives encompass creating a distribution map of potential metal ore resources, identifying various types of metal ore resources, understanding the geological characteristics and rock structures associated with these resources, and evaluating the sustainability potential of mineral resource development in the region.

The outcomes of this research will have far-reaching implications. They will furnish critical information for the mining industry and mineral resource development, particularly regarding the untapped mineral resources in the Weikeri River area. Furthermore, this study will enrich our knowledge of the geological landscape and rock structures in the research area, aiding future geological research and enhancing our general comprehension of the region. Additionally, the research findings will serve as a foundational resource, guiding mineral exploration activities and providing insights into the sustainability of mineral resource development in the region. By achieving these objectives, this research is poised to advance our understanding of untapped metal ore deposits and facilitate the sustainable development of the mining and technology sectors in the Weikeri River, Uhak Village, and Southwest Maluku.

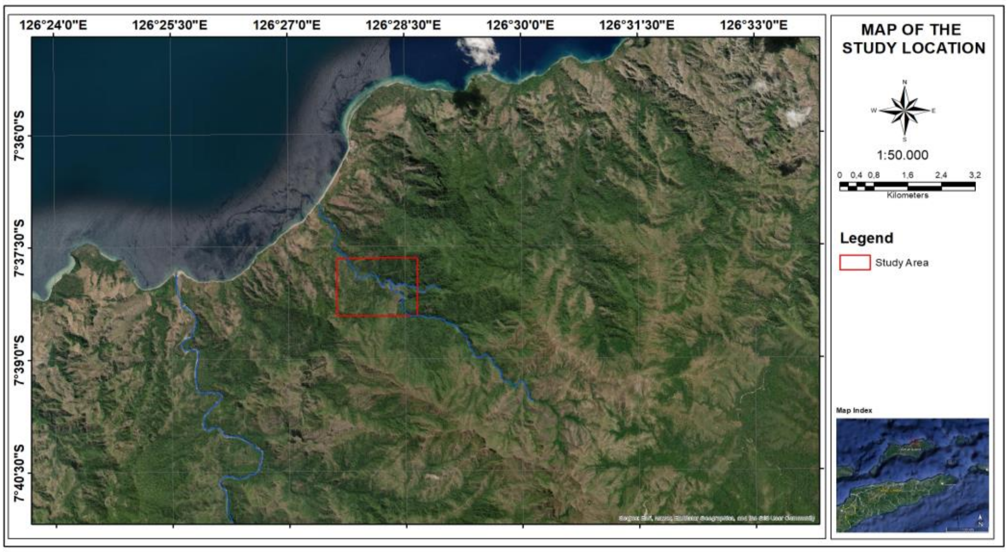

Figure 1. Map of the study location in Wetar Island

1.3 Literature Review

There has not been much research conducted on the research area in particular on Wetar Island in general. What's more, not much research related to the existence of mineralization potential has yet been published. Several researchers who have conducted research in this area and are considered related to this research topic include (Sewell and Wheatley, 1994a; 1994b), This research presents the results of exploration carried out to discover the potential existence of gold mineral deposits in Lerokis and Kali Kuning. The mining process has now been carried out. The type of deposit that has been identified is the VMS (Volcanogenic Massive Sulfide) model.

This research was the first to be conducted on Wetar Island.After this research, the next research was carried out by (Scotney, 2002; Scotney et al., 2005) with the aim of finding out the genesis of the VMS model mineralization that had previously been identified. Further research was carried out by (Male et al., 2020) to determine the type of mineralization that produces tin and copper that is present together with gold deposits.

Subsequent research conducted by (Herrington et al., 2011; Laimeheriwa, 2020; Laimeheriwa, 2015; Subarsyah and Rahardiawan, 2017) focused on efforts to identify the existence of mineralization potential on Wetar Island and its relationship to the regional tectonic system that influences it. Therefore, this research will also produce the potential for the existence of other deposits on Wetar Island, apart from those currently undergoing mining processes.

2. Methodology

A literature review of the local geological conditions is the first step in identifying possible metal minerals in a given area. The work planning process, in this case for the Weikeri River observation path, comes next. (Fig. 2).

The gathering of field data comes next. Lithology, structural geology, geomorphology, rock alteration, and mineralization conditions are the forms in which the data are collected.

Lithology data is used to determine the distribution of rocks around the research location. Geological structure data is used to identify lineament patterns and their influence on the presence of metallic minerals in the research area. Geomorphological conditions to assess the condition of the area and access to the location.

These three data points will be used to produce maps of locations for observing geological conditions and making geological maps. The geological map will be a reference in the process of working on alteration and mineralization.

Geological information gleaned from geological maps is used to create alteration and mineralization. These condition act as fundamental sources of information, offering vital details about the prevailing geological conditions in a particular region. This geological data is delicately combined with on-site alteration and mineralization data to create detailed information. Combining these datasets produces complex and nuanced maps that illustrate the complex interactions between mineral occurrences and geological features at particular observation sites.

The principal aim of these maps is to perform a comprehensive evaluation of the potential for metal minerals in the assigned research region. Through the integration of alteration and mineralization data with geological circumstances, researchers can obtain a comprehensive comprehension of the fundamental dynamics that impact the distribution of metal minerals.

In addition to helping to identify regions with abundant mineral resources, this mapping technique offers a spatial framework for prospective exploratory endeavors. For decision-makers and geologists, the alteration and mineralization are essentially priceless resources that help with resource allocation and strategic planning. This strategy makes use of geological data to provide new perspectives on the composition of the Earth, allowing for more informed assessments of metal mineral prospects in the search for sustainable resource use.

The study aimed to assess potential metal ore deposits in the Weikeri River and Uhak Village areas of Southwest Maluku. Specialized techniques and essential tools were employed in this geological investigation.

The geological hammer was pivotal for sample collection due to its robust design, enabling the retrieval of diverse geological specimens for subsequent analysis. Alongside this, the geological compass aided precise spatial determination and depiction of geological formations, contributing significantly to understanding the structural characteristics within the research region.

A loupe was used for detailed examination and analysis of minerals and rock textures. This portable magnifying instrument facilitated meticulous scrutiny of mineral composition, grain size, and rock fabric, revealing essential insights into the geological features of the obtained samples.

Hydrochloric acid (HCl) played a pivotal role in conducting experiments on rocks, particularly the acid test to determine the presence of carbonate minerals. Its acidic properties induced discernible reactions in rocks containing carbonates, such as effervescence, providing indications of carbonate presence.

The research extensively examined the geological composition to evaluate the precision of GPS technology in determining locations. The integration of GPS technology, along with other essential technologies, enabled the precise mapping of observation stations and collection sites for samples.

Each tool and material had a distinct role in systematically examining the geological composition. The geological hammer collected various rock specimens, the compass ensured precise mapping, the loupe facilitated detailed investigations, and HCl enabled preliminary assessments of carbonate presence in rock samples.

These techniques and materials contributed to a comprehensive understanding of geological features, mineral composition, and potential ore deposits in the Weikeri River and Uhak Village areas. This comprehensive insight assisted researchers in evaluating the mineral resource potential of the region.

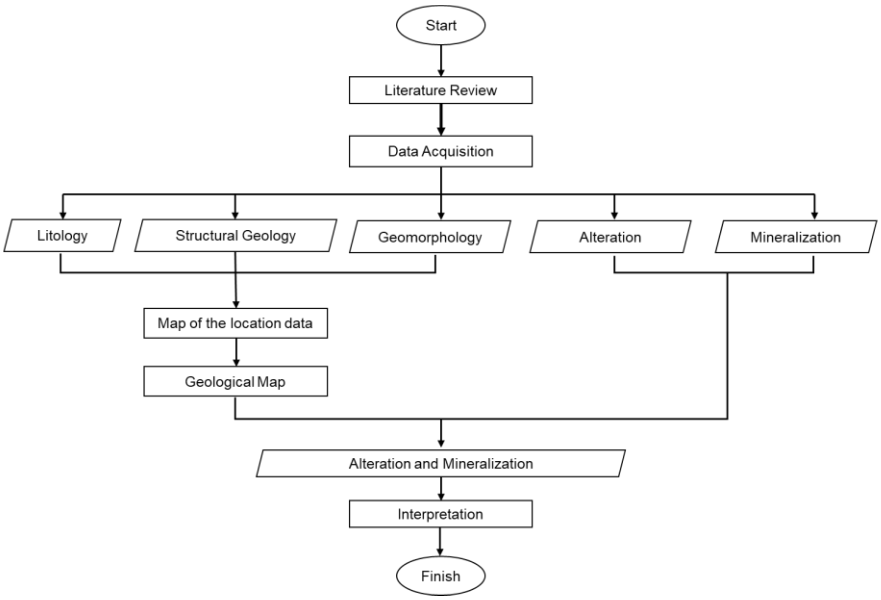

Figure 2. Data processing diagram

3. Results and Discussion

3.1 Geology

3.1.1 Morphology

The research area located in Uhak Village, part of Weikeri, has morphological characteristics formed due to volcanic processes. Morphogenically, based on field observations, the research area is part of the proximal facies of a volcanic system. This is characterized by the lithology that forms it, in the form of a dominance of coherent lava rocks with andesitic composition and intruded by sub-intrusive rocks such as sills and dykes in several locations. Morphographically, the area of investigation is a medium- to steep undulating hilly area (Fig. 3)

Figure 3. Morphology of study area

3.1.2 Lithology

The constituent rocks in the research area are par of Naumatang Fm (Fig.5). The litology of the study area are listed in order from youngest to oldest as follows; Autobreccia andesite, tuff, sub-intrusive rocks in the form of dikes and sills (Fig. 4), then coherent andesite.

Autobreccia andesite has a distribution that is not too wide, in nature, it only overlaps and covers older rocks, namely coherent andesite. This rock unit is found on the Tanisaha and Ranakorang ridges. In general, this lithology has the physical characteristics of grey to dark grey, showing the appearance of an autobreccia texture on the outside and an avanitic, vascular texture on the inside, with a major composition of glass (on the outside) and plagioclase.

Tuff is distributed locally in the investigation area, with a layer thickness of no more than three to five meters. These rocks are found on the peaks of Ranakorang Hill. The general characteristics of this rock include a grey to cream colour, massive, closed packing, good sorting, and a dominant composition of quartz, feldspar, and volcanic glass.

The sub-intrusive rocks at the investigation location are andesite dikes and sills. These rocks are found breaking through or cutting through older rocks, namely coherent andesite lava. In general, this rock has a grey to greyish green appearance, has a columnar structure, and is sometimes massive with an aphanitic texture.

Figure 4. Dike of Andesite, part of Naumatang Fm

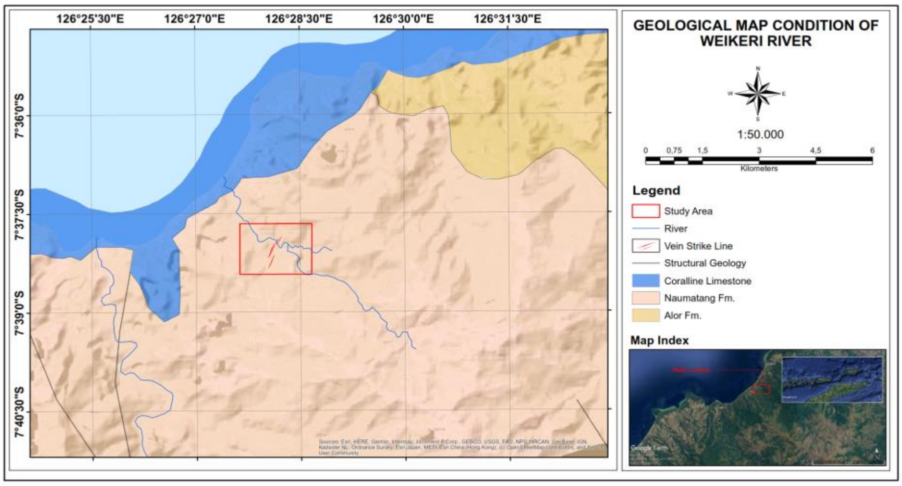

Figure 5. Geologycal map

The rock that has the most widespread distribution in the research area is Andesite coherent lava. In general, this rock has a grey to greyish green physical appearance with a massive structure, and in some locations, it shows the presence of a pillow lava structure (Fig 6), which is an indication that this rock was formed in a marine environment. The texture of the aphanitic rock, with the major composition being plagioclase and fine-sized ferromagnesian minerals. These rocks are often found intruded by andesite dikes and sills.

3.1.3 Geological Structure

The geological structure in the research area is in the form of systematic joints with a dominant direction of North Northwest–South Southeast and South Southwest–North Northeast. This dense structure is generally found in coherent lava andesite rocks. Apart from that, the normal fault structure has a general direction of north-north-south-east and a left horizontal fault structure that cuts in a southwest-northeast direction.

Figure 6. Dike of Andesite, part of Naumatang Fm

3.2 Alteration and Mineralization

The presence of mineralization in the investigation area is related to the alteration zone. Based on the characteristics of altered rocks, rock alteration in the investigation area is divided into three categories: propylitic alteration, argillic alteration, and silicification alteration. These three types of alteration are found in coherent andesite lava, andesite dike, and tuff rock units.

Propylitic alteration changes the gray andesite rock to a greenish color with the presence of characteristic minerals in the form of chlorite-carbonate. In the research area, propylitic alteration is found in the structural zone and is located in the outer zone of a vein system. This alteration is commonly found on the Tanisaha and Ranakorang hills as an alteration in the host rock. (Fig. 7)

Figure. 7. Hand samples of moderate to strong propylitic andesite

Argillic alteration is a type of alteration that changes compact and hard andesite rock into soft, white to brownish grey rock (Fig. 8). This type of alteration is characterised by the presence of clay minerals (kaolinite and montmorillonite) and silica minerals. Locally, this type of alteration is associated with structural zones in the form of clay gouges. Apart from that, there is also a location where Tanisaha appears on the edges of the vein zone.

Figure 8. A sample of weakly argillic altered andesite rocks

Silicification alteration is often found in the upper reaches of the Weikeri River and is only local, as well as on the tops of the Ranakorang hills. On the Ranakorang hill, this alteration generally causes the dacitic tuff rock to become harder and more compact due to the addition of silica elements. (Fig. 9).

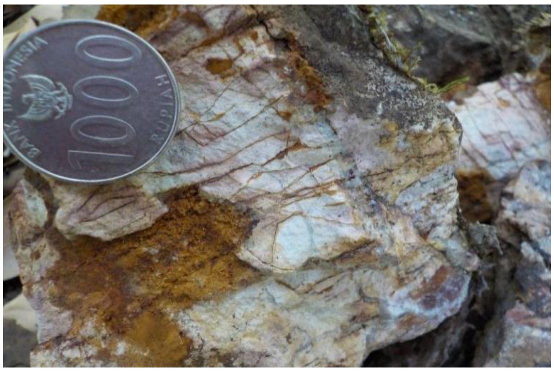

Figure 9. Samples of silicified rock

The state of mineralization in the investigation area is characterised by the presence of base metal minerals such as; chalcopyrite, galena, and sphalerite in quartz veins (Fig. 10). More intense quartz vein zones are found in the Ranakorang hill area and some in the Tanisaha hill with varying vein thicknesses, ranging from 1cm to 2 meters. The basemetal composition in the quartz veins found ranged from less than 1% to 3%.

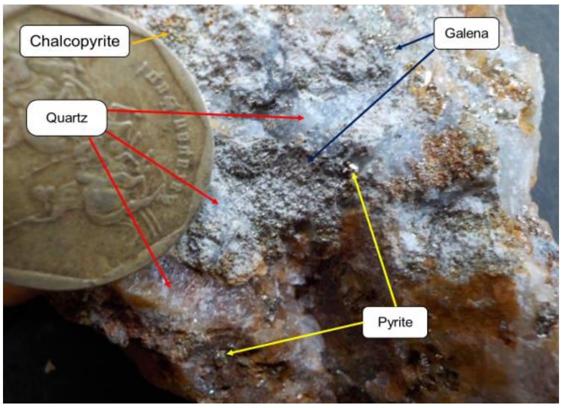

Figure 10. Sample of vein outcrop. transparent white-reddish-yellowish, massive, medium-grained crystalline, brecciated

4. Conclusion

The research site is made up of underwater volcanic rocks, according to observations made with field data. This is distinguished by the existence of pillow-shaped andesite lava outcrops.

Propylitic alteration, characterized by a brecciated vein system of mineralization, is the predominant rock alteration condition in andesite lithology. Base metal mineral ore in the form of sulfide minerals, galena, and chalcopyrite is abundant in this vein. The mineral concentration is minimal, with an approximate range of 1% to 3%.

This location cannot be considered promising because of its highly undulating morphological features and challenging access. But more research is required to determine whether alternative mineralization systems exist beneath the surface. Geophysical investigations can be used for this.

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