ANALYSIS OF GRAIN SIZE AND MINERALOGY OF HEAVY MINERAL GRAINS IN PALANGKA RAYA AREA, CENTRAL KALIMANTAN PROVINCE

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ABSTRACT

The Palangka Raya area is situated on the island of Borneo, specifically within the Central Kalimantan province. The study area is composed of a lithological sequence comprising fine-coarse quartz sandstone and cross-layered conglomerate, with components in the form of malleable and granitic rocks from the Dahor Formation (TQd) and alluvium deposits. This sequence has the potential for heavy mineral deposits associated with sedimentary sands. This study aimed to calculate and identification of grain size and heavy minerals content distribution within the investigated area. The research was conducted using a combination of grain size analysis and grain mineralogy analysis on six mesh numbers. The results of grain size analysis indicated that majority of samples exhibit grain sizes within the mesh numbers -10+18 and -60+140. The results of grain mineralogy analysis revealed the presence of heavy minerals, including cassiterite, hematite, biotite, chalcopyrite, zircon, rutile, ilmenite, garnet, amphibole, and staurolite. Heavy mineral variations were observed on mesh numbers -60+140 and <140. These minerals are believed to have originated from metamorphic rocks, S-type granitic rocks, and I-type granitic rocks.

Keywords: grain counting, grain fraction, quartz sandstone, source rock

INTRODUCTION

The occurrence of mineral deposits in a given area is subject to the influence of geological conditions closely related to the specific formation process and mode of deposition. Kalimantan Island is one of Indonesia's islands with a rich geological heritage, including a significant concentration of heavy minerals. In Central Kalimantan, the potential for heavy mineral deposits is particularly pronounced in Palangka Raya City, where granitic and tonalite rock fragments from the Schwaner Mountains have been transported and deposited. These rocks are typically associated with quartz sand and other heavy minerals, including rutile, hematite, and magnetite (D. Z. Herman, 2007). The Schwaner Mountains are composed of metamorphic rocks, namely the Pinoh metamorphics, which consist of sericite mudstone, biotite mica schist, quartzite, metasilite, and metapelites of Permian-Carboniferous age. During the Early Cretaceous period, these metamorphic rocks were intruded by tonalite or granitoid rocks, collectively known as the Sepauk tonalite (Soetopo, 2016).

It is hypothesized that during the Mesozoic-Tertiary Period, the northern part of the Schwaner Mountains underwent a significant geological transformation, marked by the intrusion of igneous rocks, including dacitic and granitic, into the region's crust. The sedimentary deposition that occurred during this period probably continued until the Pliocene, with an increase in the coarse size component that produced products in the form of sand deposits with rich content of quartz skeletal conglomerates, quartz and zircon clay inserts, and sandstone pebbles whose source originated from the northeast, as evidenced by the characteristics of the cross-cutting layers (D. Z. Herman, 2007). In accordance with the regional geology (Figure 1), the study area is identified as belonging to the Dahor Formation (Tqd) and Alluvium Deposits (Qa). The Dahor Formation is composed of a gradation of quartz sandstones and cross-bedded conglomerates, interbedded with layers of malleable and granitic rocks. The Alluvium Deposits are comprised of gravel, quartz sand, and boulders derived from malleable rock components, exhibiting a granite and quartzite composition.

Heavy mineral sands are typically defined as concentrations of heavy minerals found in alluvial environments, such as coastal or riverine systems. The study area in the Palangka Raya area, which the Central Kalimantan Arc crosses, contains about 10% of the gold reserves, and in the northeastern part of the arc, gold occurs with cassiterite in greisen and skarn near granidiorite intrusions. In addition, mesothermal veins have been

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found in the Gunung Mas area north of the Palangka Raya area (Carlile & Mitchell, 1994). These rocks could be an important source of economically valuable heavy minerals. These minerals can be derived from igneous and metamorphic rocks that have undergone significant weathering and subsequent transport by riverine and marine processes, ultimately forming economic mineral deposits with high market value. As defined by Tonggiroh (2020), a mineral must meet several criteria in order to be classified as a heavy mineral. These include a density value exceeding that of silica (>2.56 g/cm³), a capacity to withstand fluctuations in weathering, and resilience to transportation, abrasion, and concentrated processes.

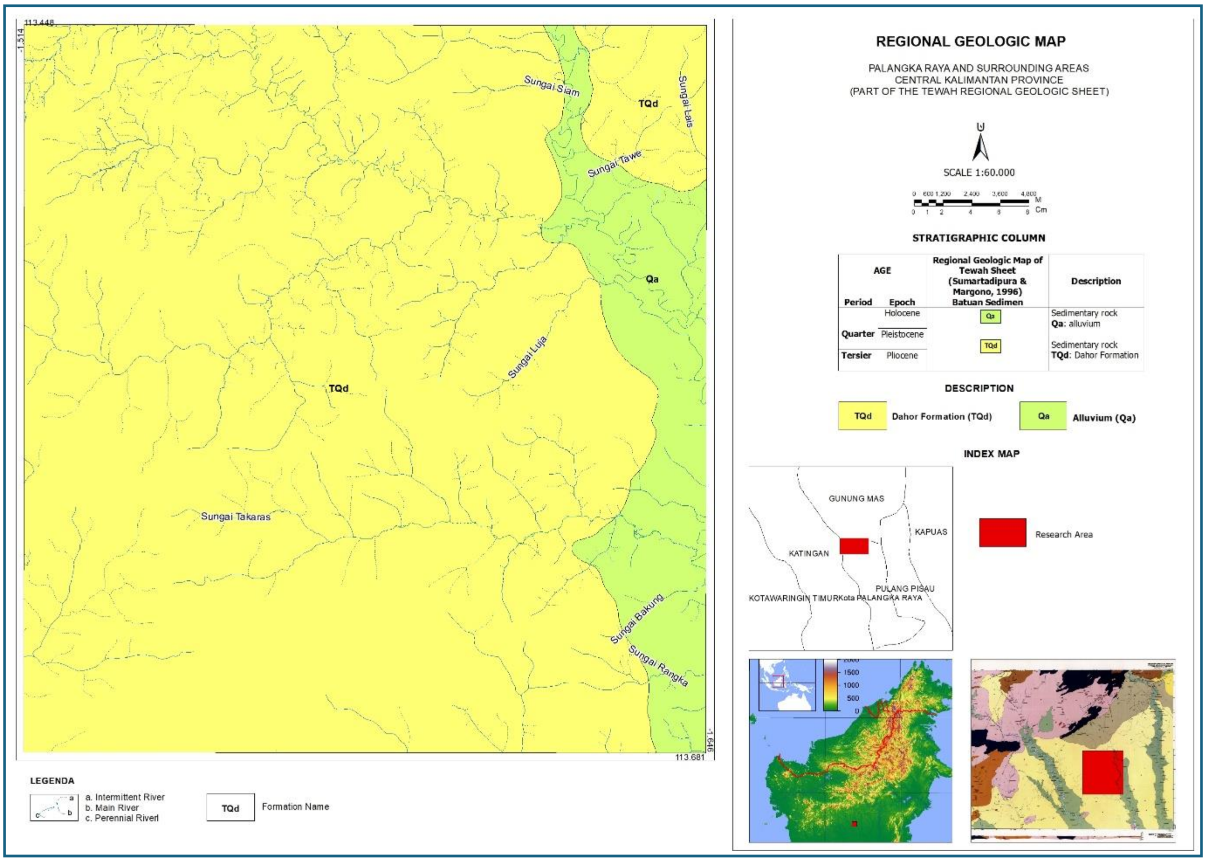

Figure 1. Modified Regional Geologic Map of Tewah Sheet (Sumartadipura & Margono, 1996)

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The heavy mineral composition of a rock can be used to infer its type of origin or the environment in which it was deposited. As posited by Setijadji et al. (2014), the presence of heavy minerals such as cassiterite, ilmenite, alanite, and monazite can serve to characterize S-type granite source rocks. In type-I granite source rocks, the presence of magnetite, pyrite, chalcopyrite, and molybdenite minerals can be expected. In metamorphic source rocks, minerals such as

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rutile, staurolite, and epidote are likely to be identified.

RESEARCH METHOD

The data were obtained from the field in the form of sedimentary sand, which was then analyzed in the laboratory. The laboratory analysis included grain size analysis and grain mineralogy analysis (grain counting). Six meshes were utilized for both analyses: +10, -10+18, -18+35, -60+140, and <140. Each fraction was expressed as a percentage of the total weight, and a bar chart was constructed to illustrate the distribution of heavy minerals in the sedimentary sand samples. (1) grain mineralogy analysis was conducted to determine the mineral composition of the sample by calculating the weight total (wt%).

$$Wt\% = \frac{total\ weight\ of\ fraction\ A}{weight\ of\ all\ total\ fractions\ x\ \%weight\ of\ fractions}$$

(1)

Description:

- % weight of fractions $= \frac{weight\ of\ mineral\ A}{total\ weight}$ x100
- Weight mineral A = average mineral grain A x ρA

RESULT AND DISCUSSION

An item size analysis was conducted with the objective of determining the distribution of grain size in each sample. The analysis was conducted on four samples. The results of grain size analysis indicated that majority of samples exhibit grain sizes predominantly distributed within the mesh numbers -10+18 and -60+140 (Figure 2).

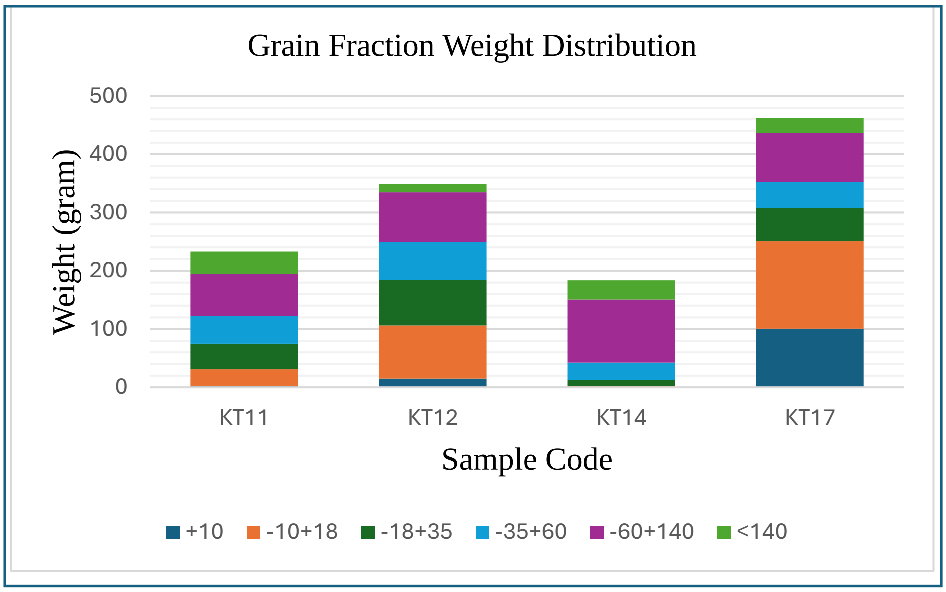

Figure 2. Fraction Weight Distribution Diagram

Meanwhile, the mineralogical analysis of grains revealed that the mineral composition of the samples is dominated by quartz minerals, followed by lithics, feldspar minerals, cassiterite, hematite, biotite, chalcopyrite, zircon, rutile, ilmenite, garnet, and staurolite (Figure 3).

The mineral cassiterite is the dominant constituent in sample KT11 (Figure 3(a)). Furthermore, other heavy minerals, including biotite, zircon, hematite,

chalcopyrite, as well as rutile and ilmenite minerals, are present in minor quantities. These heavy mineral variations are predominantly observed on mesh -60+140 and mesh <140. Conversely, no heavy minerals were identified on mesh -10+18 and -35+60.

In sample KT12 (Figure 3(b)), the dominant minerals are chalcopyrite, cassiterite, ilmenite, hematite, rutile, biotite, and a small amount of garnet and staurolite. These heavy mineral variations are predominantly found on mesh -60+140, while there are no heavy mineral contents on mesh +10 and -10+18.

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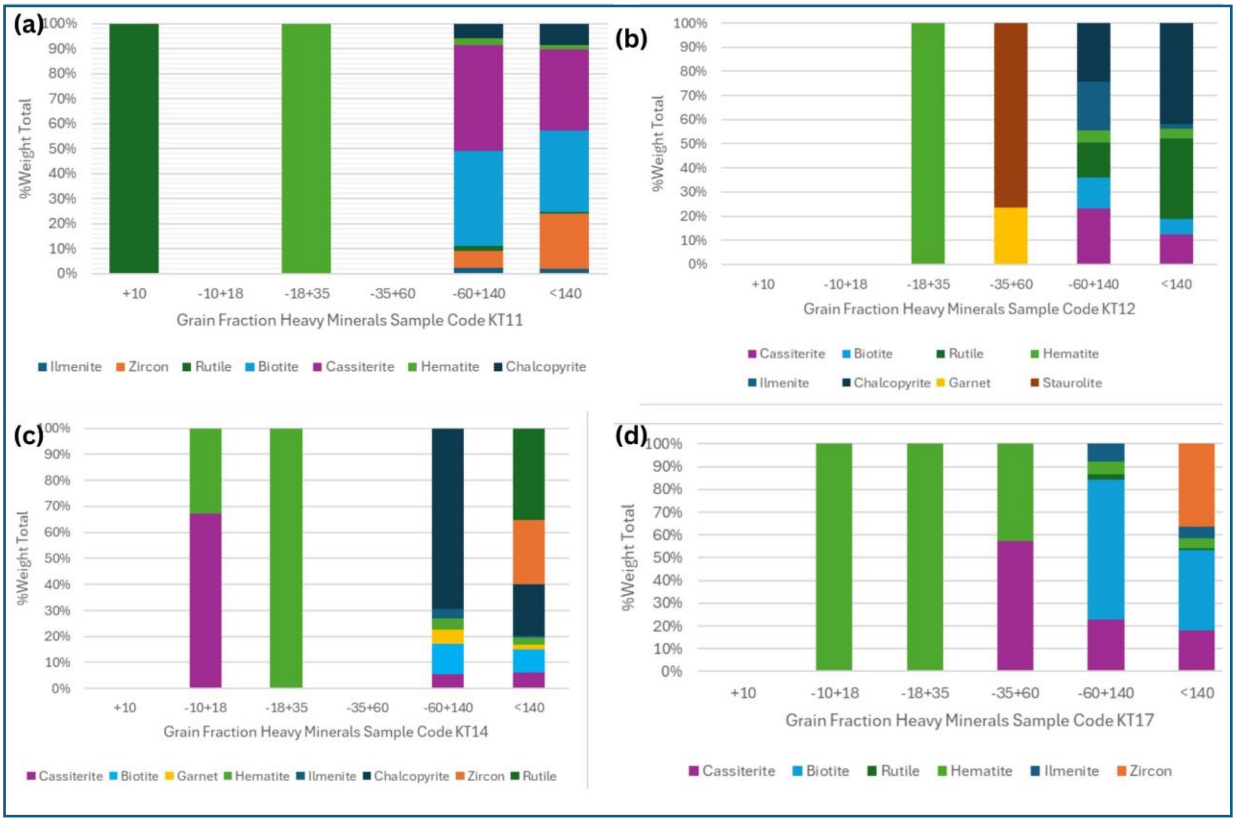

Figure 3. Heavy Minerals Distribution Diagram

The heavy mineral composition of sample code KT14 (Figure 3(c)) is dominated by the presence of chalcopyrite, rutile, zircon, hematite, cassiterite, biotite, with small amounts of garnet and ilmenite. These heavy mineral variations are predominantly observed on mesh -60+140 and mesh <140, whereas no heavy mineral contents are evident on mesh +10 and -35+60.

The sample KT17 (Figure 3(d)) is predominantly composed of heavy minerals, including hematite, cassiterite, biotite, zircon, and minor amounts of ilmenite and rutile. These heavy mineral variations are predominantly present on mesh sizes ranging from -60+140 to <140, with no heavy mineral content observed on mesh size +10.

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The overall variation of heavy minerals in the mesh is high, with a range of 60+140 and a mesh size of less than 140. The most prevalent heavy minerals are cassiterite,

hematite, biotite, chalcopyrite, zircon, rutile, and ilmenite, with garnet and staurolite minerals present in very low concentrations. Figure 4 illustrates the comprehensive heavy mineral composition of each sample, expressed as a percentage of the total weight.

With these different heavy minerals compositions, it can be inferred that the minerals come from different source rocks

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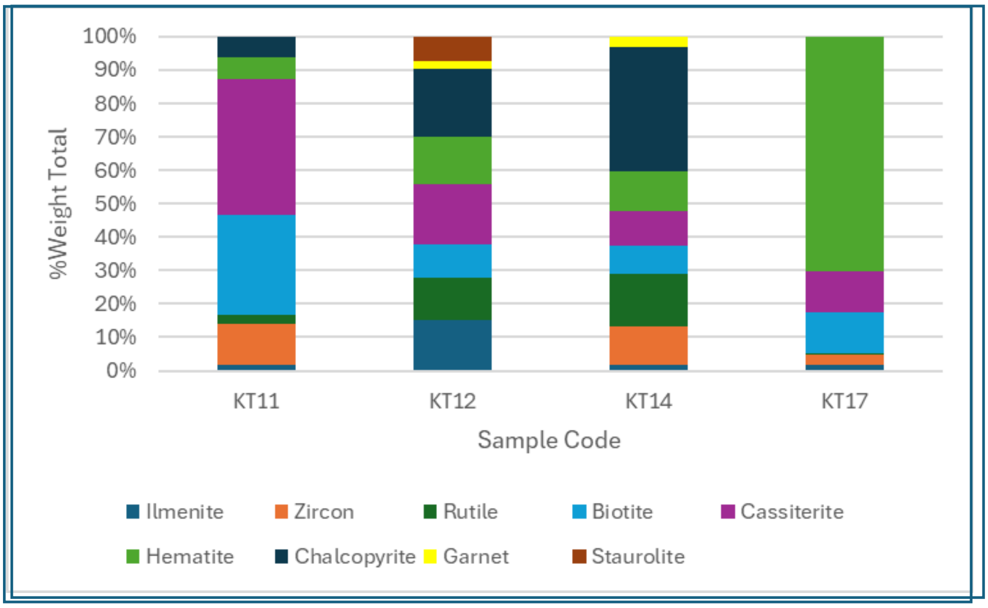

Figure 4. Heavy Minerals Composition Diagram of Each Sample

Sedimentary sand deposits in this study area, located in Palangka Raya, Central Kalimantan, indicate that the source rocks of the sedimentary sand are of different types. The presence of cassiterite and ilmenite minerals may come from S-type granitic rocks, and the presence of chalcopyrite and biotite minerals may come from type I granitic rocks. While the presence of rutile and staurolite minerals can be sourced from metamorphic rocks. The igneous rocks of the area are from the Sepauk tonalite, while the metamorphic rocks are from the Pinoh metamorphism, both of which are from the Schwaner mountain range to the northwest of the study area (Setijadji et al., 2014).

With different source rock types, as well as the distribution of mineral variations which are mostly found on mesh -60+140 and <140 which causes the grain size of heavy minerals to be very fine, may also indicate the presence of heavy minerals. The grain size of heavy minerals is very fine, which may also indicate the presence of a long and distant transportation process in this area.

CONCLUSION

Based on the results of grain size and grain mineralogy research that has been conducted in the Palangka Raya area regarding the characteristics of heavy minerals, it can be concluded that the composition of heavy minerals varies, ranging from the minerals cassiterite, hematite, biotite, chalcopyrite, zircon, rutile, ilmenite, garnet and staurolite. These minerals are often used in everyday industry. These heavy mineral variations are found in mesh numbers -60+140 and <140 with very fine grain sizes. The source rocks of these minerals can come from metamorphic rocks, type S granitic rocks, and type I granitic rocks.

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