Bombana Gold Hunt: Geomorphology, Geology & Land Use Changes

Dipo Caesario[1], Musri Ma'waleda[2], Bigharta Bekti Susetyo[3], Muhammad Ikhwan Bagus[4]
{caesariodipo@fis.unp.ac.id[1]; musrimawaledageologi@gmail.com[2]; bighartabekti@fis.unp.ac.id[3]; ikhwanmuhammad@student.unp.ac.id[4]}

[1,3,4] Department of Geography, Faculty of Social Science, Universitas Negeri Padang, Padang, Indonesia.
[2]Department of Geology, Hasanuddin University, Makassar, Indonesia.

Abstract: The research area is located at Poleang and Toburi village, Eastern Poleang District, Bombana Regency, Southeast Sulawesi Province. The Research area is part of the East Sulawesi Zone. Geomorphology of the research area consists of four units: Mountains Complex, Homoklin Hills, Karts Hills, and Alluvial Plain. Shape of the river valley in the study area is so complex, resembling the ``V" and "U" shape, with relatively straight and rectangular patterns of river flow. Stratigraphic of the research area consists of four lithological units, from old to young are: Complex Metamorphic Rocks (Cretaceous) equivalent with the Complex Pompangeo, Conglomerate-Sandstone Unit (Middle Miocene) equivalent with the Langkowala formation, Limestone Unit (Late Miocene) is equivalent with Eemoiko Formation and Alluvial Deposition Unit (Recent) equivalent with Alluvium deposits. Metamorphic rock in the complex unit consists of chlorite schist, mica schist, glaucophane schist, marble and milonit. Geological structures that are found in the research area consists of three major faults, two left strike slip fault (Amitopa faults and Tahite fault) trending west-northwest, located in the north and south of research area which cut the three existing units, as well as a thrust fault that east-west trending wich cut Complex Metamorphic Rocks. The presence of quartz-like cross cut foliation vein in metamorphic rock associated with economic minerals, such as: gold, cinnabar, & antimony. These minerals have caused a great gold hunt phenomenon in Bombana Regency from 2010 until 2022. Supervised classification from landsat 8 imagery are used to get a development of these illegitimate mining activities and their effect on Poleang's land use changes.

Keywords: Bombana, Facies of Metamorphic Rock, Illegitimate Gold Exploitation, Land Use Changes.

1 Introduction

Bombana Regency is located in Sulawesi Tenggara Province, or at the southeast part of Celebes Island precisely. Bombana regency has 2 metamorphic complex basement ranges, in the north part as known as Mekongga Mountains Range and Rumbia Mountains Range in the southern part. This metamorphic basement consists of schist, quartzite, slate and marble, that is locally intruded by younger rock that is found along the west coast of the southeast arm (Surono, 1994; 2005). Boulder's of pink granite are found in several locations as rock fragments in the Sulawesi Molasa (Aziz, 1986; Surono, 1994). This indicates that this granite is also present as bedrock in the Southeast Arm of Sulawesi (Surono, 1994; 2005).

ICGEO 2022, November 19-20, Padang, Indonesia

DOI 10.4108/eai.19-11-2022.2332159

Helmers et al. (1989) described the metamorphic rocks found in the Mekongga Mountains around Kolaka and the Rumbia Mountains in Bombana as mica-graphite and quartzite-mica schist and a few marble intercalations which were intruded by metabasic schistose. Metabasic is very rare in the Mekongga Mountains but very common in the Rumbia Mountains. Metabasic generally shows relict igneous rock texture with augite rim by, titanite, pumpelite, chlorite and some glaucophane. A number of examples of metamorphic rocks from Lasolo, Mendoke and Rumbia in the Southeast Arm, have been studied by de Roever (1956) who referred to them as the older amphibolite epidote facies and the younger glaucophane schist facies. The older metamorphisms events are related to burial, while the younger metamorphisms are caused by large-scale overthrusting, possibly when Southeast Sulawesi and the Buton microcontinent collided in the late Oligocene (Surono, 1994; 2005). Hamilton (1979) argues that the age of the blue schist metamorphic rock in Central Sulawesi is Cretaceous or Paleocene because the metamorphic rock is covered with Mesozoic sedimentary rock which has undergone strong deformation and was overlain by peridotite.

In 2008, a “gold hunt” occurred in these regions that brought a lot of mining companies to explore these areas. Gold deposit was found locally as a “placer” in the loose clastic sediment at the narrow valley between Rumbia Mountains in the south part, and Mendoke Mountains in the north part. In general, the lithology at these areas is dominated by pre-tersiers metamorphic rocks, which is known as Pompangeo Metamorphic Complex formation (Simandjuntak, 1993). This study was proposed, to get the development and land use changes that were caused by the mining activity from geology and geomorphic aspects in this past decade.

2. Methods

The research area is a protected forest area of the Rumbia Mountains which is located about 30 km west of Kasipute Village. Geographically the boundaries of the study area are 4°43'09.4"-4°43'09.8" South Latitude and 121°46'15.9"-121°49'27.8" East Longitude, with an area of around 37 km^2. Administratively, the research area is in Toburi Village and Rau-Rau Village, East Poleang District, Bombana Regency, Southeast Sulawesi Province. The research area can be reached in about 1 day from Padang City by air transportation to Kendari City then about 6 hours by land transportation to Kasipute Village.

The method used in this study is observing topographic and geomorphological features, which are then followed by collecting geological data related to the mining activity problem to be analyzed, including determining the location of data collection and collecting lithology data which includes determining the lithology of the research area. As well as collection of geological and structural data. The grouping of the data was carried out based on similarity in nature and lithological characteristics of the data obtained in the field. Then do the processing of geological data to generate geological maps. In addition, petrographic analysis was also carried out with thin sections. Then a supervised classification method using the maximum likelihood algorithm, in the analysis of land cover in Bombana Regency, it was divided into 2 land cover classifications, namely (1) mining land cover and (2) non-mining land cover, which were carried out in year 2013 and 2022, using a Landsat 8 imagery In 2013 and Landsat 9 imagery in 2022 (Figure 1).

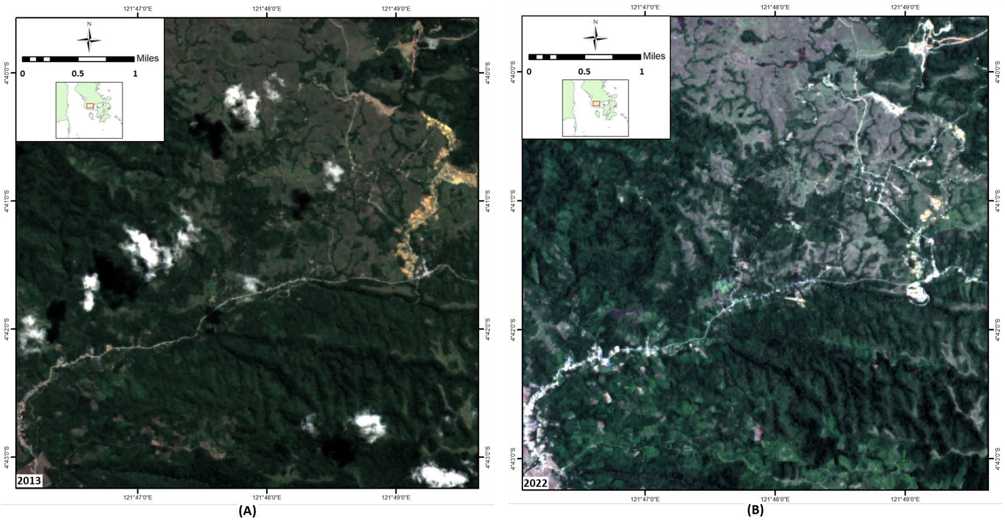

Fig. 1. (A) Landsat-8 images of Poleang Area in 2013 & (B) Landsat-9 images of Poleang Area in 2022.

3. Result

Geomorphology study in these areas was processed by DEMs (Digital Elevation Model) interpretation, Landsat 8's satellite imagery, and field observation. From morphology gesture identification bombana regency is dominated by dense contour (30 to 410 m above sea level) that formed mountains, valleys and isolated hills. The river patterns are elongated from east to west then change to north east to south west at the lower relief. At the lower relief, La Rau river, the lowest topography reaches at the La Rau River and the highest elevation is at the peak of Mount Rumbia.

The study area consists of four main rivers namely the Tahite River, Amitopa River, La Ea River and La Rau River. The rivers in the study area show a rectangular flow pattern (Figure 2) which may be influenced by geological structures in the form of faults or fractures formed in various types of rocks. Around the Rau-Rau area, there is the Tahite River, which has a north-south flow direction in the upper part, then changing direction to southeast-northwest in the downstream part. This change in the direction of the Tahite River flow is likely influenced by the Tahite Fault. Then the Tahite River changes direction again to become northeast-southwest trend starting from Bukit Karang and joins with the La Rau River which flows relatively east-west at the scrape slope of Mount Rumbia. The La Rau River, which has an east-west trend, is thought to be the boundary between the relatively soft lithology around the Rau-Rau area and the relatively harder lithology on Mount Rumbia. Around Mount Rumbia there are several rivers namely, the Amitopa River has an east-west direction downstream and changes to southeast-northwest around the Amitopa Waterfall and then joins the La Rau River which flows east-west around the scrape slope of Mount Rumbia. In general, the rivers in the Rumbia mountain area are influenced by structures in the form of faults and joints.

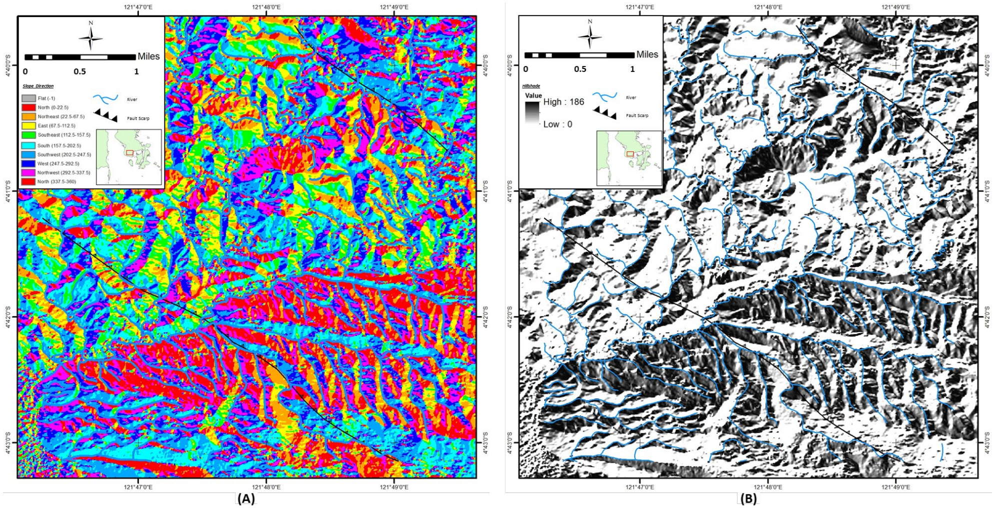

Fig. 2. (A) Slope Direction map & (B) River Pattern & Shaded Relief map of Poleang Area using DEMNAS image to create geomorphological unit map.

The rivers in the study area have very diverse flow directions, there are three flow directions namely north-south, east-west, and southeast-northwest. These rivers are interpreted as rivers with obsequent genetic types, namely rivers that have a flow direction in the same direction as the slope of the rock layers or cut through the strike. In general, the rivers in the study area are characterized by steep slopes and a "V" shape of river valleys and a few "U" shaped valleys. River sedimentation is very dominant and almost always covers the bedrock on the river bed so that in some places, outcrops are very difficult to find. Illegitimate Gold mining activities around these rivers also affect the shape of the river. Based on the characteristics of the river above, it can be concluded that the stages of river erosion in the study area are in the juvenile-adult erosion stage.

Based on observations from topographic maps, DEM and observations in the field, the geomorphological units in the study area can be divided into 4 units with reference to Lobeck's classification (1939), namely classification based on morphological form, as well as genetic type or the processes that cause these morphological formations. Table 1 shows the geomorphological units in the study area that consist of complex mountain units, homoclinal hill units, karts hill units, and alluvial plain units.

Table 1. Geomorphological units in the study area near Poleang area

Geomorphological Unit	Area Coverage	Special Features	Geomorphic Stage	Rock	Placer Gold Deposits
Complex Mountains Unit	47%	Rectangular river pattern, regular slope direction	Young	Metamorphic Rock	Good

Homoclinal Hill Units	30%	Irregular slope direction	Mature	Sandstone & Conglomerate	Bad
Karts Hill Units	13%	Isolated hill	Mature	Limestone	Bad
Alluvial Plain Units	10%	Wide river plain	Mature	Loose Sediment (Boulder to Granule)	Good

The Complex Mountains Unit occupies 47% of the study area, has a surface elevation between 36-400 meters above sea level in the study area, with a maximum altitude of the Rumbia Mountains of around 1089 meters above sea level. It is characterized by a dense and elongated contour pattern from east to west and is relatively resistant and rough. The slope is gentle to very steep. Rivers are generally in the young to mature stages characterized by the formation of a "V" river valley, the formation of relatively straight river channels and rectangular and parallel river flow patterns. This unit enters the young to mature geomorphic stage, the constituent lithology is in the form of metamorphic rocks.

The Homoclinal Hill units occupy 30% of the study area, and have a surface elevation between 36-190 meters above sea level in the study area. Characterized by a pattern of densely sparse contours, undulating hills that are relatively resistant and rough. The slope of the slope is gentle to steep. Rivers are generally in the mature stage characterized by the formation of a "U" river valley, the formation of a relatively straight river channel. Exogenous processes that affect the form of weathering, upstream erosion, vertical erosion, lateral erosion, and slope erosion. This unit enters the mature geomorphic stage. The constituent lithology is in the form of conglomerate rocks and sandstones.

Karts Hill Unit occupy 13% of the study area, and have a surface elevation of between 60-150 meters above sea level in the study area. Characterized by a pattern of densely sparse contours, undulating hills that are relatively resistant and rough. The slope of the slope is gentle. The river is generally in the mature stage characterized by the formation of a "U" river valley. This unit enters the mature geomorphic stage. The constituent lithology is limestone.

Alluvial Plain Units occupy 10% of the study area, and have a surface elevation of between 70-100 meters above sea level in the study area. Characterized by a tenuous contour pattern, in the form of undulating plains. The slope is very gentle. The river is generally in the mature stage characterized by the formation of a "U" river valley, the formation of a relatively winding river channel. Exogenous processes that affect the form of upstream erosion, lateral erosion, slope erosion, and sediment deposition. This unit enters the mature geomorphic stage. The constituent lithology is in the form of chunks of metamorphic rock and loose sedimentary rock.

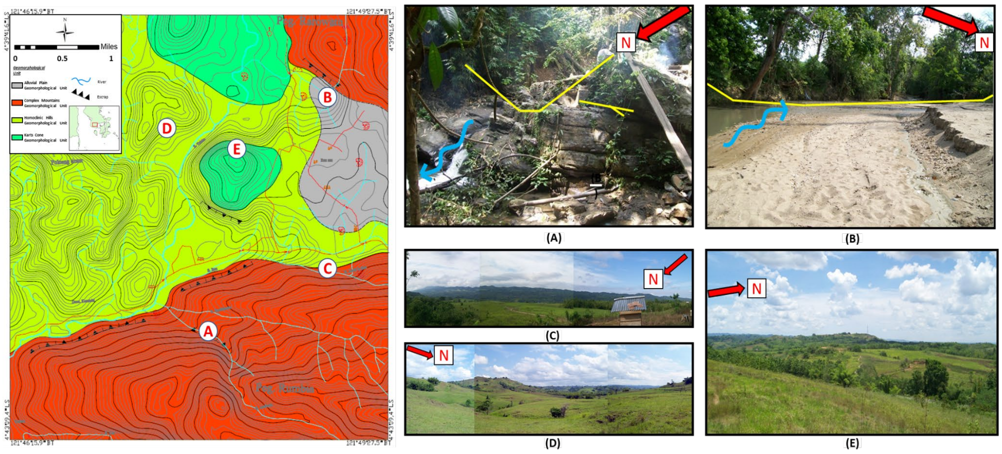

Fig. 3. Geomorphology Map of study area (A) Amitopa River in the shape of a “V” valley, (B) “U" shaped valley of the Tahite River, (C) Complex mountain morphology that extends from east to west, (D) The morphology of the homoclinal hills around the Poleang area, & (E) Isolated hill morphology.

An unofficial lithostratigraphic naming system was used to discussing the stratigraphy of the research area, based on physical characteristics of the rock and the lithology observed in the field by looking at the type of lithology and uniformity as well as the stratigraphic relationship with the rock units below and above it. Based on the analysis of the relationship between the position of the rocks in the study area. Then the stratigraphy of the study area, from old to young is as follows: (1). Metamorphic Rock Complex Unit, (2). Conglomerate-Sandstone Unit, (3). Limestone Unit, (4). Alluvial Sediment Unit (Figure 4).

The Metamorphic Rock Complex Unit occupies 44% of the total area of the study area on the geological map this unit is colored light purple. This unit is located in the south to slightly north of the study area. This unit spreads lengthwise from west to east with a very random east-west foliation trend, N60°E-N125°E and N250°E-N305°E and the slope of the layer trending north and south with very varying angles, ranging from 15°-80°. This unit is well exposed in the Rumbia Mountains area of Kasipute Town, Toburi Village, Rarowatu Village, Mount Mendoke, and Watumohai Forest Park. The chlorite schist lithology has a formation resembling a minor intrusion but the orientation of chlorite and quartz minerals has been observed. It is exposed on both the Tahite and La Rau rivers. Mica schists are found in almost all of the study area with exposed minor folding structures in both the La Rau River, Tahite River, and Mount Rarowatu. Glaucophane schist can be found in the Amitopa River. Marble is only found in the north of the study area, namely in the upper part of the Tahite River. Based on the similarity of the lithology of this Metamorphic Rock Complex Unit, this unit can be equated with the Pompangeo Metamorphic Complex Formation (Simandjuntak, 1993) which is estimated to be Pre-Tertiary or Cretaceous (Hamilton, 1979) to the Oligocene (Hall, 2001).

Based on observations in the field, the lithological characteristics of the chlorite schist group megacosphicly are light green-dark green, do not show any luster, foliation, diverse grains (heteroblastic) with very fine-coarse grain sizes (0.1mm-1mm), very fine schistosic texture are present, the grains consist of very abundant chlorite minerals and some quartz and mafic minerals, which are scattered in rocks with less composition. Microscopically, this rock consists of chlorite-quartz-muscovite schist ±garnet, with minor lawsonite, actinolite, plagioclase, zoisite, clinozoisite, muscovite, garnet, sphene, calcite, and stilpnomelane.

Megacosphicly mica schist has the following characteristics, light gray in color, glassy luster, foliation, uniform grains (homeoblastic) with fine-coarse grain size (0.1mm-1mm), has an excellent schistosic texture, grains consist of the very abundant mica mineral has flattening with foliation and in several places there are scattered quartz minerals following the foliation. Sometimes there is also the formation of a heteroblastic texture, namely lepigranulobalstic. There is also crenulation or minor folding. Microscopically, this rock consists of muscovite-quartz-chlorite schist ± garnet, with minor plagioclase, sphene, and calcite.

The glaucophane schist has the following characteristics, bluish green in color, does not show any luster, foliation, the grains are diverse (heteroblastic) with fine-coarse grain size (0.1mm-1mm), has an excellent schistose texture, the grains consist of minerals chlorite, glaucophane and some places there are quartz minerals that form a nemagranulobalstic texture. Microscopically, this rock consists of glaucophane-quartz schist ±garnet, with minor biotite, muscovite, actinolite, and lawsonite.

Megascopically, marble has the following characteristics: bluish-gray, glassy luster, has uniform grain foliation (homeoblastic) with fine-coarse grain size (0.1mm-0.5mm), bad schistose texture, grains consist of minerals calcite and quartz. Microscopically, this rock consists of the minerals calcite, quartz and muscovite.

This Conglomerate-sandstone unit, the lithology that makes up this unit in general, is conglomerate, sandstone, clay-inserted sandstone, and claystone. Megascopically the conglomerate has characteristics, brown in color, slightly weathered, is a polymict conglomerate of gravel fragments (2mm-5cm), consisting of rock fragments, quartzite, mica schist, within a coarse sand matrix (<2mm), non-carbonate cement, rounded to subrounded grains, good porosity, brittle, slightly poor sorting of minerals: oxide minerals. Sandstone has the characteristics of brown-yellowish color, medium grain size-coarse sand (0.5mm-1mm), poor sorting, good porosity, rounded grain shape, within a clay mineral matrix & non-carbonate cement. Claystone has the characteristics of a brown color with very uniform and very fine grains. Based on the results of microfossil analysis of this claystone, containing benthic foraminifera fossils, it was found that the depositional environment ranged from the littoral range which was characterized by the presence of *Pyrgo Denticulata*, *Rotalia Sp*., and *Textularia Folicea*. This unit's relative age is N9-N14 or early-miocene early Miocene (based on Blow classification, 1969), which is equated with the Middle Miocene Langkowala Formation (Simandjuntak et al., 1993).

The Limestone Unit is the youngest rock unit exposed in the study area, this unit consists of rudstone bioclastic limestone and reef limestone. Based on the results of microfossil analysis of a limestone sample, it is found that the relative age of this limestone unit is N15-N17 or Middle Miocene-Late Miocene (based on Blow's classification, 1969), which is equivalent to the Eemoiko Formation (Simandjuntak, 1993) so that it can be concluded that this Limestone Unit is Late Miocene in age.

The Alluvial Sediment Unit consists of sediments from recent rivers in the study area. The Alluvial Sediment Unit is composed of unconsolidated river deposits. This deposit is composed of polymic components ranging in size from clay size to boulder size. The boulder that makes up this unit consists of schist, quartzite, limestone, and mud. Another feature is the presence of placer gold deposits measuring ±0.1mm.

The nature of the fault movement is determined from the analysis of river lineaments in the study area, slope direction from satellite images, and lineaments of topographic maps coupled with kinematic and dynamic analysis of accompanying structures obtained from the field. Regionally, the eastern part of Sulawesi Island is a very diverse tectonic product, the result of interactions with the West Sulawesi terrain, East Sulawesi terrain, the Banggai-Sula

Microcontinent, and the Buton Microcontinent, from subduction to collision activity that started from pre-tertiary to recent (Figure 4).

The Tahite Fault is a fault that extends in a southeast-northwest direction following the Tahite River valley which experiences a very extreme deflection. Determination of the name and movement of this fault is based on data in the form of brecciation and joints in chlorite schist metamorphic rocks. Based on joint, brecciation and river straightness analysis, the fault plane position was N105°E/77°SW, netslip 5°/N282°E, and pitch 5° with main stress 1°/N79°E. This fault is a lateral strike-slip fault. The Amitopa Fault is a fault that extends in a northwestern direction following the Amitopa River valley which experiences a very extreme bend in the Amitopa Falls area. Determination of the name and movement of this fault is based on data in the form of brecciation and joints in chlorite schist. Based on joint, brecciation and river straightness analysis, the position of the fault plane was N295°E/49°NE, netslip 22°/N95°E, and pitch 31° with main stress 25°/N229°E. This fault is interpreted to cut bedrock in the form of metamorphic rock and tertiary sedimentary rock.

The metamorphic process is influenced by the composition of the original rock, conditions of pressure and temperature (P&T), and fluid conditions. Based on the original rock composition, the metamorphic rocks in the study area are dominated by groups of alkaline igneous rocks and carbonate rocks. Based on the mineralogical composition and type of protolith, the study area can be divided into two metamorphic rock facies in general, namely the blueschist facies and the greenschist facies, based on Raymond (2007). Metamorphic rock in the research area can be divided into four zones based on the appearance of the identifying minerals and the rock of origin, namely: (1). Chlorite-Zoisite zone with alkaline igneous protolith, (2). Actinolite-oligoclase zone with alkaline igneous protolith, (3). Glaucophane zone with alkaline igneous protolith, (4). Marble Zone with carbonate rock protolith (Figure 4).

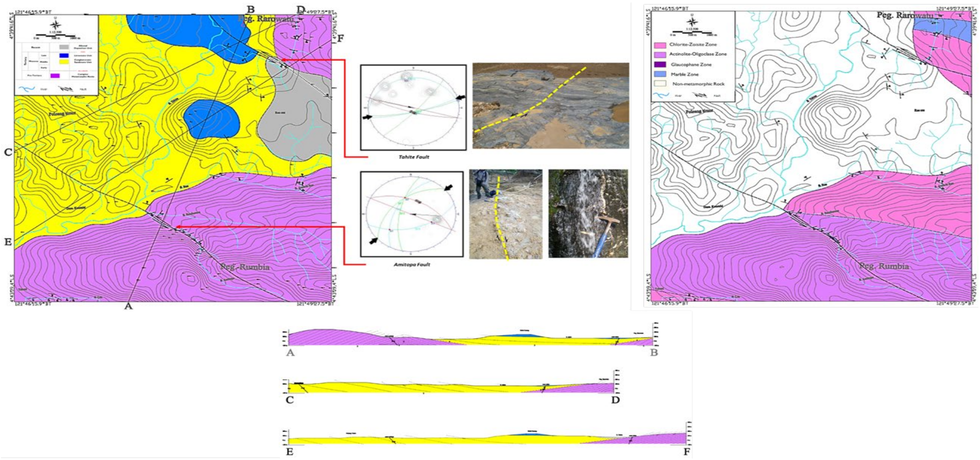

Fig. 4. (left) Geological Map and (right) Metamorphic Facies Map of study area.

Greenschist facies with alkaline igneous rock protolith of Chlorite-Zoisite Zone, is represented by chlorite-quartz-zoisite-garnet schist with minor muscovite, clinozoisite, stilpnomelane, sphene, plagioclase, almandine garnet, calcite, and opaque minerals, which are characterized by the appearance of green chlorite, brown to colorless zoisite and the almandin group garnet which is pink in color with high relief. This rock exhibits schistosic, semi-schistosic and porphyroblastic textures, quartz is present as a polygonal mineral. Greenschist facies with alkaline igneous rock protolith or Actinolite-Oligoclase Zone, is represented by chlorite-quartz-zoisite-garnet schist rocks, with minor actinolite, oligoclase, lawsonite, clinozoisite, muscovite, sphene, almandine garnet, and opaque mineral, which is characterized by the appearance of actinolite that are green in color, colorless to brown lawsonite, and oligoclase. This rock exhibits schistosic, semi-schistosic and porphyroblastic textures, quartz is present as a polygonal mineral. Important minerals present are actinolite, lawsonite and plagioclase (oligoclase).

Greenschist facies with carbonate rocks protolith or Marble Zone, is represented by marble rocks which are characterized by the appearance of very abundant calcite. These rocks show a semi-schistosic to granulitic texture, quartz is present as a minor mineral together with muscovite to form a bad foliation (Figure 5).

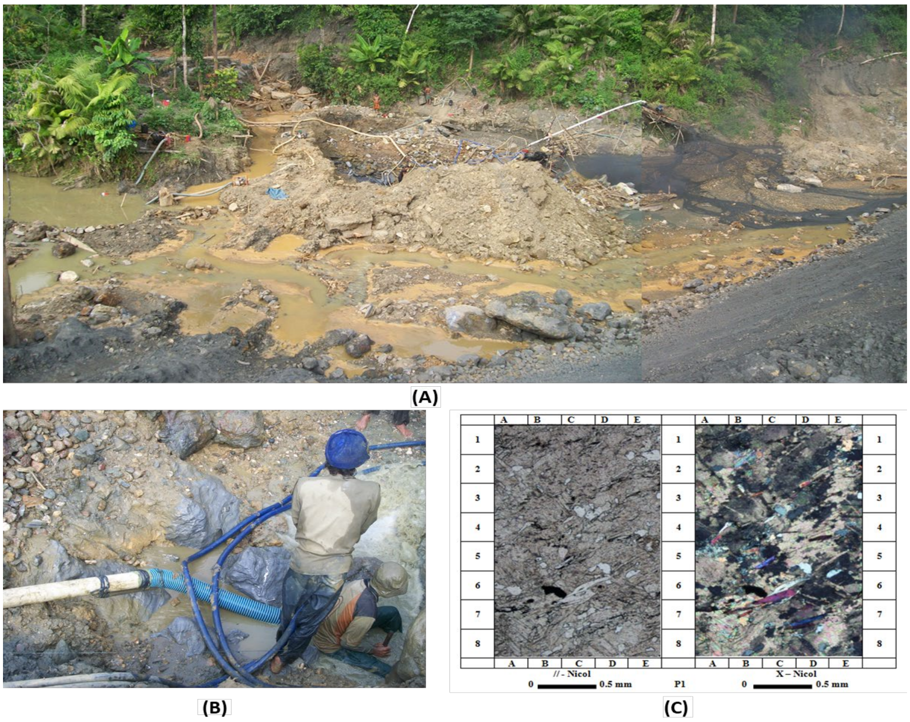

Fig. 5. (A) Illegitimate gold's mining activities at upstream part of northern Tahite River using traditional mining approach, to get material from sedimentary placer that is overlaying above basement that consist of, (B) Marble zone metamorphic unit, that showing <1 cm thick whitish-Quartz veins. (D) Thin section of marble that shows foliated trend of quartz, calcite, & opaque minerals.

Blueschist facies with alkaline igneous rock protolith or Glaucophane Zone, is represented by quartz-muscovite-glaucophane (±biotite) schist, characterized by the appearance of violet-blue glaucophane. This rock exhibits a porphyroblastic texture. Quartz occurs as a polygonal shaped mineral, and the brown biotite is present showing pleochroism effect (Figure 6).

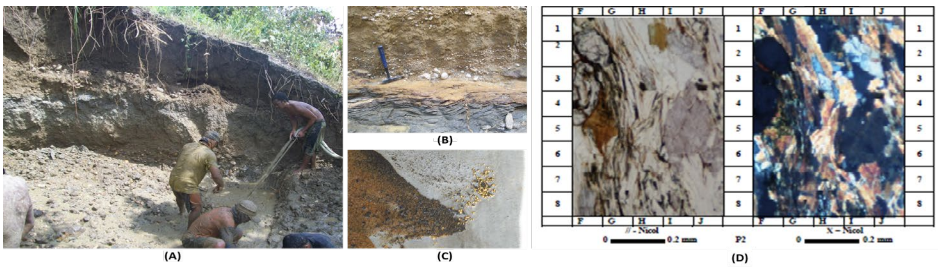

Fig. 6. (A) Illegitimate gold's mining activities at downstream part of southern Tahite River near Rumbia Mountains using traditional mining approach, to get material from sedimentary placer that is overlaying above basement that consist of, (B) Glaucophane zone metamorphic unit, that showing 1 cm thick oxidized whitish-Quartz veins that perpendicular from foliation trend, that produce (C) Placer gold deposits (yellowish), Antimony (dark gray) and fe-oxide or cinnabar (?) (reddish). (D) Thin section of glaucophane unit that shows foliated oxidized garnet and glaucophane.

Musri et. al (2022) suggest, the partial melting in the lower crust, is very likely to occur in the event of subduction, or collisions due to thickening of the crust and therefore hydrothermal solution supplied to the wall rock, and which caused the hydrothermal alteration and deposition of sulfide mineralization in the Rumbia schist Complex, Mendoke Mountains, and very possible in the Mekongga Complex in the Northern part of the Southeast arm of Sulawesi. This metamorphic rock act as a host rock that eroded and produce produce the paleoplacer/placer (as a secondary) gold grains hosted by Langkowala formation in Bombana, SE Sulawesi are evidently derived from massive, crystalline, partly brecciated, sigmoidal, sheared and segmented, laminated gold-bearing quartz±calcite veins/reefs with thickness from 2 cm to 2 m hosted by Pompangeo Metamorphic Complex Formation (PMCF). The PMC particularly consists of mica schist (dominant rock type), phyllite and metasediment (commonly metasandstone and marble) (Idrus et. al., 2012).

To process land cover classification on pixel-based landsat 8 and 9 multispectral images, a training sample is needed to carry out digital image processing through the Supervised Classification method with the maximum likelihood algorithm. The results of the image processing are in the form of land cover maps with classification classes of mining land and non-mining land in Bombana Regency in 2013 and 2022 (Figure 7). Table. 2 shows the development of the area of illegitimate mining land in 2013 and 2022, there was an increase in land change of 30.55 hectares due to illegal mining activity in this past decade.

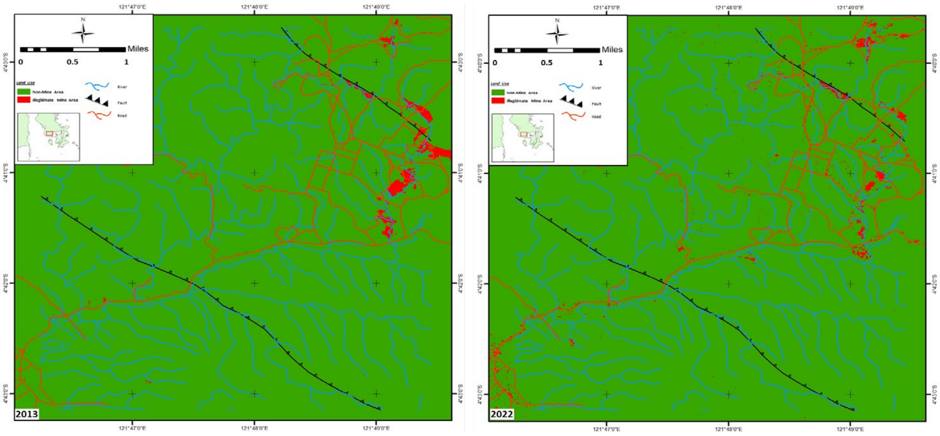

Fig. 7. Comparison maps land use changes of illegitimate mining area (red) and non-mining areas (green) from 2013 and 2022 using Supervised Classification analysis for the two years show changes in the trend of the exploitation target area which was previously centered on alluvial deposits around the Tahite fault in the north part, now heading south with the target of thin alluvium deposits covering facies metamorphic rocks. actinolite-oligoclase on the slopes of the Rumbia Mountain

Table 2. Development of land use from illegal mine aspects from 2013 to 2022 near Poleang area.

Year	Illegitimate Gold Exploitation Area (Hectare)
2013	190.03
2022	220.58

Fig. 8. Illegal mining which exploits irregularly in the Poleang Area (without the correct geological exploration concept), causing some damage to public facilities, especially public roads and the “newest” gold hunt trend has change in 2022 due to hunt the host rock using “rat hole”, not targeting a placer deposit anymore in the northern part.

Even though 15.2 % growth of the area has been changed to illegal mines, the pattern has been changed at the north part of Tahite River. This anomaly occurs, because illegitimate miners have changed the trend and the method of gold mining exploitation/exploration that used an open mine approach before, has changed to a tunnel system, or as familiar as “rat hole”. But in other hands, the knowledge of a “good placer exploration” methods is very little owned by these illegal miners, who use the dig-produce-abandone method. This transformation methods resulting in a lot of excavation holes that are left behind, because they are affected by the less volume or the thin placer deposits. This effect can be seen in the south downstream area of the Tahite River, which shows a spreading pattern in past decade, compared to 2013 which is more centralized near Tahite fault zone. This haphazard exploration/exploitation activity resulted in the destruction of many public facilities, especially public roads and bridges (Figure 8).

4 Conclusion

Based on the results of field observations, laboratory analysis, literature review, it can be concluded that: The geomorphology of the study area consists of a Complex Mountain Unit, a Homoclinal Hills Unit, a Karts Hills Unit and an Alluvial Plains Unit with a rectangular river flow pattern with young-adult geomorphic stages. The stratigraphy of the study area from old to young consists of: (1) Complex Metamorphic Rocks, (2) Conglomerate-Sandstone Units, (3) Limestone Units, and (4) Alluvial Sediment Units. The geological structure of the study area consists of 2 horizontal faults, namely: (1) Amitopa strike slip Fault, (2) Tahite strike slip Fault. The Metamorphic Rock Complex Unit consists of two facies, namely the greenschist facies and the blueschist facies with basic igneous and carbonate rocks of origin, which can be divided into 4 zones, namely: (1) Chlorite-Zoisite Zone, (2) Actinolite-Oligoclase Zone , (3) Glaucophane Zone, and (4) Marble Zone. This complex is thought to originate from the part of the oceanic crust associated with subduction zones (melange). The main source of illegitimate gold exploration was changes from 2013 to 2022, previously targeted the placer deposit at thick alluvial deposit near tahiti fault in the northern part, move to thin placer deposit overlaying actinolite-oligoclase zone in the southern part near Rumbia Mountain, these changes have led to the growth of illegal mining areas in the Poleang area by 15%.

Reference

[1] Aziz, S. (1986). Konglomerat Berfragmen Granitoid P. Manui. Geosurvey Newsletter, 20 Mei. Page. 92.

[2] Blow, W.H. (1969). Late Middle Miocene to Recent Planktonic Foraminiferal Biostratigraphy. Proceedings First International Conference on Planktonic Microfossil. Geneva. Page. 119-442.

[3] De Roever, W.P. (1956). Some Additional Data On The Crystalline Schists Of The Rumbia And Mendoke Mountains, Southeast Celebes, Verh. K. ned.geol.-mijnb. Genoot, XVI. Page. 385-393.

[4] Hall, R. (2001). Extension During Late Neogene Collision In East Indonesia And New Guinea. Journal of the Virtual Explorer. Page 4.

[5] Hamilton, W. B., (1979), Tectonics of The Indonesian Region. USGS Prof. Paper 1078. Page. 345.

[6] Helmers, H., Sopaheluwakan, J., Nila, E.S. dan Tjokrosapoetro. (1989). Blueschist Evolution In Southeast Sulawesi, Indonesia. Netherlands Journal of Sea Research, 24, (213). Page. 373-381.

[7] Idrus, A., Sukmandaru, F., Warmada, I. W., Nur, I., Meyer, F. M. (2012). The Metamorphic Rock-Hosted Gold Mineralization At Bombana, Southeast Sulawesi: A New Exploration Target in Indonesia. Proceedings Of The Sulawesi Mineral Resources 2011 Seminar MGEI-IAGI 28-29 November 2011. Manado, North Sulawesi, Indonesia.

[8] Lobeck, A. K. (1939) Geomorphology, An Introduction To The Study Of Landscapes. McGraw-Hill Book Company, Inc. New York and London. Page. 613-646.

[9] Mawaleda, M., Umar, H., Forster, M., Suparka, E., Abdullah, S. I., & Basuki, N. I. (2022). Geochronology And Metamorphic Rocks Evolution Of Rumbia Mountains, Southeast Arm Of Sulawesi, Indonesia, Syntax Literate, Vol. 7, Special Issue No. 1, January 2022.

[10] Raymond, Loren A. (2007). The Study of Igneous, Sedimentary and Metamorphic Rocks - 2nd Edition. Page. 213-305.

[11] Simandjuntak, T.O., Surono & Sukido. (1993). Peta Geologi 1:250.000 Lembar Kolaka, Sulawesi, P3G, Bandung.

[12] Surono (1994) Stratigraphy Of The Southeast Sulawesi Continental Terrane, Eastern Indonesia, Journal of Geology and Mineral Resources, No. 31, IV. Page 12.

[13] Surono (2005). Geology of Southeast Sulawesi, Journal of Geological Resources, Special Publication.