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# Characteristics of Lateritic Nickel Mineralization In Mid Part of Madang and Serakaman Areas, Sebuku Island, South Kalimantan

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**Abstract.** The research was conducted in Madang and Serakaman Tengah area, Sebuku Island Subdistrict, Kotabaru Regency, South Kalimantan Province which is one of the nickel potential areas in Indonesia. The aim of this research is to know the characteristic and distribution of laterite nickel mineralization. The rocks present in the study area are serpentinized dunite, serpentinized harzburgite, gabbro, silicified gabbro, tuff, and basalt. Methods used in this research were surface geological mapping, rock observation and sampling from outcrop and drill core representing each laterite horizon from limonite horizon to bedrock. Laboratory analysis consist of X-Ray Fluorescene (XRF) analysis is used to determine the abundance of certain chemical elements and compound which characterized the mineralization stage zonation in the laterite profile. The laterite deposite in the study area can be divided based on physical and chemical properties into four zones; red limonite, yellow limonite, saprolite, and bedrock. Saprolite is dominated by a group of hydrocylicic minerals (serpentine) so it can be predicted that the laterite types are developing laterite oxide and laterite silicate types.

## 1 INTRODUCTION.

Indonesia is one of the largest nickel producer countries in the world (Geomagz, 2013). In 2016, nickel reserves in Indonesia are estimated to reach 221 million tons derived from laterite nickel and nickel sulphide (Databoks, 2016). Most of the nickel produced in Indonesia is nickel laterite.

One of the areas that have the potential for lateritic nickel deposits is Sebuku Island, Kotabaru Regency, South Kalimantan. The nickel mining exploration activity in this area is owned by PT. Sebuku Iron Lateritic Ores (PT.SILO). This research was conducted on Madang and Serakaman Tengah area which is under exploration to know the existence of lateritic nickel in the area. The aim of this research is to know the characteristic of laterite nickel mineralization.

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## 2 RESEARCH METHODS

The methodology used is by surface mapping and description of drilling well samples representing each laterite horizon ranging from limonite horizon to bedrock. X-Ray Fluorescene (XRF) analysis is used to determine of elements content found in the laterite profile.

## 3 RESULT AND DISCUSSION

### 3.1 Lithology

The lithology of the study area can be divided into 6 units, namely serpentinized dunite unit, serpentinized harzburgite unit, gabbro unit, silicified gabbro unit, tuff unit, and basalt unit.

#### *3.1.1 Serpentinized dunite unit*

Rocks generally have fractures filled with serpentine minerals, in some locations found in massive. Rocks have dominated by a weak magnetic level. Physically, serpentinized dunite have minerals composition of olivine, piroxene, and serpentine with dominated of olivine > 90%. The rocks have average chemical composition of MgO 37.08%, $SiO_2$ 40.13%, $Cr_2O_3$ 0.39%, Ni 0.41%, and Co 0.01%. Has a dispersal area 30% of the research area.

#### *3.1.2 Serpentinized harzburgite unit*

Rocks generally have fractures filled with serpentine minerals. These rocks have minerals composition of olivine, piroxene with dominated orthopiroksen, brucite and serpentine. The rocks have an average chemical composition of MgO 34.94%, $SiO_2$ 40.28%, $Cr_2O_3$ 0,33%, Ni 0.4%, and Co 0.00%. These rocks have weak magnetism. Has a dispersal area 25% of the research area.

#### *3.1.3 Gabbro unit*

This rock has a composition of dominated of plagioclas, piroxene, and a little bit of olivine. The rocks have an average chemical composition of MgO 14.91%, $SiO_2$ 49.34%, $Cr_2O_3$ 0.39%, Ni 0.11%, and Co 0.01%. Rocks have magnitude ranges from weak to moderate. Magnetism is interpreted because of the presence of magnetite minerals that are present on some spots of rock. Has a dispersal area 5% of the research area.

#### *3.1.4 Silicified gabbro unit*

Rock has a texture of holocrystalline, fine-grained, porfiritic, and subhedral. This rock has a composition of mineral dominant silica minerals such as quartz caused by silicified. Other minerals are plagioclase, pyroxene, slightly olivine. The rocks have an average chemical composition of MgO 5.03%, $SiO_2$ 59.28%, $Cr_2O_3$ 0.00%, Ni 0.00%, and Co 0.00%. These rocks have a weak magnetism. Has a dispersal area 10% of the research area.

#### *3.1.5 Basalt Unit*

These rocks are generally found in have weathered level III to IV. Has a texture holocrystalline, fine-grain, having afanitic granularity, with anhedral crystal form. These rocks have a composition in the form of the dominated plagioclase, pyroxene, and olivine. The rocks have an average chemical composition MgO 31.77%, 45.05% $SiO_2$, 0.15% $Cr_2O_3$, 0.10% Ni, and Co 0.00%. In the basalt weatherized was also found gibbsite and hematite. Has a dispersal area 5% of the research area.

#### *3.1.6 Tuff Unit*

The tuff unit was found in the outcrop of the Serakaman Tengah river and the hilly area of Mid Serakaman. Locally discovered silicified tuff. Tuff in the research area has weathered so that minerals are found in the form of mineral goetite and there are vein filled with magnetite minerals. Has a dispersal area of approximately 25%

### 3.2 Geomorphology

Geomorphology of the study area can be divided into 4 units based on Van Zuidam (1983), ie the denudational terrain landform unit ($0^o$-$3^o$ slope), denudational hills landform unit ($8^o$-$16^o$ slope), structural hills landform unit ($3^o$- $16^o$ slope), and intrusion hill landform unit ($8^o$-$21^o$ slope).

### 3.3 Geological structure

The results analysis of the joint measurements of the Madang and the Middle Serakaman areas indicate the relative mainline of the southwest-northeast direction.

### 3.4 Characteristics of nickel laterite in research area

In general, laterite profiles can be distinguished into limonite zone, saprolite zone, and bedrock zone (Ahmad, 2008).

#### *3.4.1 Red limonite zone*

Based on its physical, red limonite has a dark red color and is sometimes brownish red, has a thickness of 1-3.5 meters, loose, soft hardness level, has a high weathering rate, medium-strong magnetism, clay-gravel size. The mineral composition of the red limonite zone is composed of hematite and goetite with hematite mineral dominated. The hematite has a red color that controls the color of the laterite in the red limonite zone (Figure 2a). Red limonite zone has Fe content of about 41.3 - 48.7%, Mg about 0.2-0.6%, Si of 0.9-2.5%, Al by 4.0-8.4%, and Ni 0.3-0.7%.

#### *3.4.2 Yellow limonite zone*

Yellow limonite zone has a yellow to brownish color, has a thickness of 2-8.5 meters, loose, soft hardness, has a high degree of weathering, moderate magnetism, fine grain size (clay-silt). Mineral composition in the yellow limonite zone consists of goetite and manganese with dominated of goetite, locally also found clay, quartz, serpentine, and carbonate minerals based on drilling logging data in Serakaman Tengah area. The dominance of goetite minerals affects the color of the laterite in this zone. Goetit has a yellow color so that the soil produced in this zone is also yellow (Figure 2b). Yellow limonite zone has Fe content of about 38.7-50%, Mg about 0.2-0.7%, Si of 1.0-4.7%, Al of 2.5-8.1%, and Ni 0.7-0.9%.

### *3.4.3 Saprolite zone*

Saprolite zone in the study area has a green to yellowish green color, has a thickness of 0.2-7 meters, sand-boulder grain size. Rock texture of origin in this zone can still be observed. This zone has low to moderate magnetism, the weathering rate in this zone varies from low to moderate. The mineral composition in this zone consists of serpentine, goetite, clay minerals, olivine, manganese, and locally found quartz in the Middle Serakaman region. Serpentine is the dominant composition of this zone. This is influenced by existing rock origin in the research area. Rock origin in the research area is ultramafic rocks that have serpentinized. The green color in this zone is affected by the presence of serpentine minerals (Figure 2c). The saprolite zone has a Fe content of 10-21%, Mg of 1.5-14.7%, Si of 2.9-17.8%, Al of 1-7.6%, and Ni of 1.0-2 , 2%.

### *3.4.4Bedrock zone*

Bedrock zone at the study area is ultramafic rocks consisting of serpentinized dunite and serpentinized harzburgite. The mineral composition in this zone consists of serpentine, olivine, and pyroxene (Figure 2d). The bedrock zone has a Fe content of about 3.9-8.3%, Mg of 19.6-29.6%, Si 16.9-20.7%, Al of 0-0.7%, and Ni of 0 , 2-0.4%.

## 4 CONCLUSION

Characteristics of lithology in the study area consisted serpentinized dunite, serpentinized harzburgite, gabbro, silicified gabbro, tuff, and basalt.

Geomorphologyl characteristics consist of denudational terrain landform unit ($0^o$-$3^o$ slope), denudational hills landform unit ($8^o$-$16^o$ slope), structural hills landform unit ($3^o$- $16^o$ slope), and intrusion hill landform unit ($8^o$- $21^o$ slope).

Characteristics of geological structure in the study area consisted joints of which the main direction is southwest-northeast.

The laterite characteristics can be divided into 4 zones ie, red limonite zone, yellow limonite zone, saprolite zone, and bedrock zone.

The lateritic chemical characteristics are divided into, the red limonite zone has Fe content of about 41.3 - 48.7%, Mg about 0.2-0.6%, Si of 0.9-2.5%, Al by 4.0-8.4%, and Ni 0.3-0.7%, yellow limonite zone has a Fe content of about 38.7-50%, Mg about 0.2-0.7%, Si of 1.0-4.7%, Al of 2.5-8, 1%, and Ni 0.7-0.9%. In the saprolite zone has a Fe content of about 10-21%, Mg of 1.5-14.7%, Si of 2.9-17.8%, Al of 1-7.6%, and Ni of 1.0- 2.2%, and on Bedrock has Fe content of about 3.9-8.3%, Mg of 19.6-29.6%, Si 16.9-20.7%, Al of 0-0.7 %, And Ni by 0,2-0,4%.

Ni element at the initial depth has a relatively small content, getting down, the Ni on saprolite zone becomes larger, then in the bedrock zone Ni content declines again. At the initial depth Fe has a considerable content, but getting down, it becomes smaller.

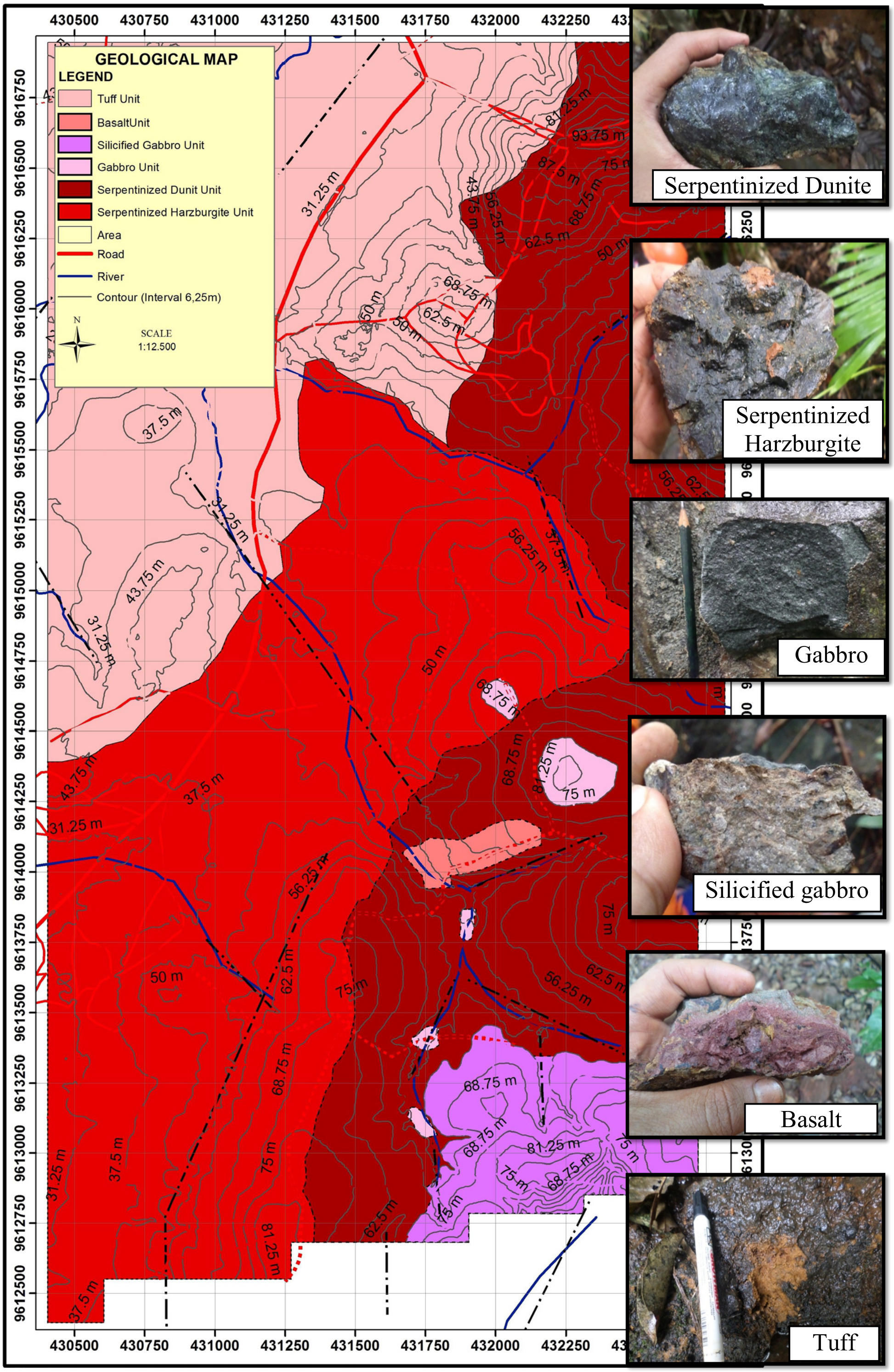


**Fig. 1.** Geological map and rock samples of research areas.

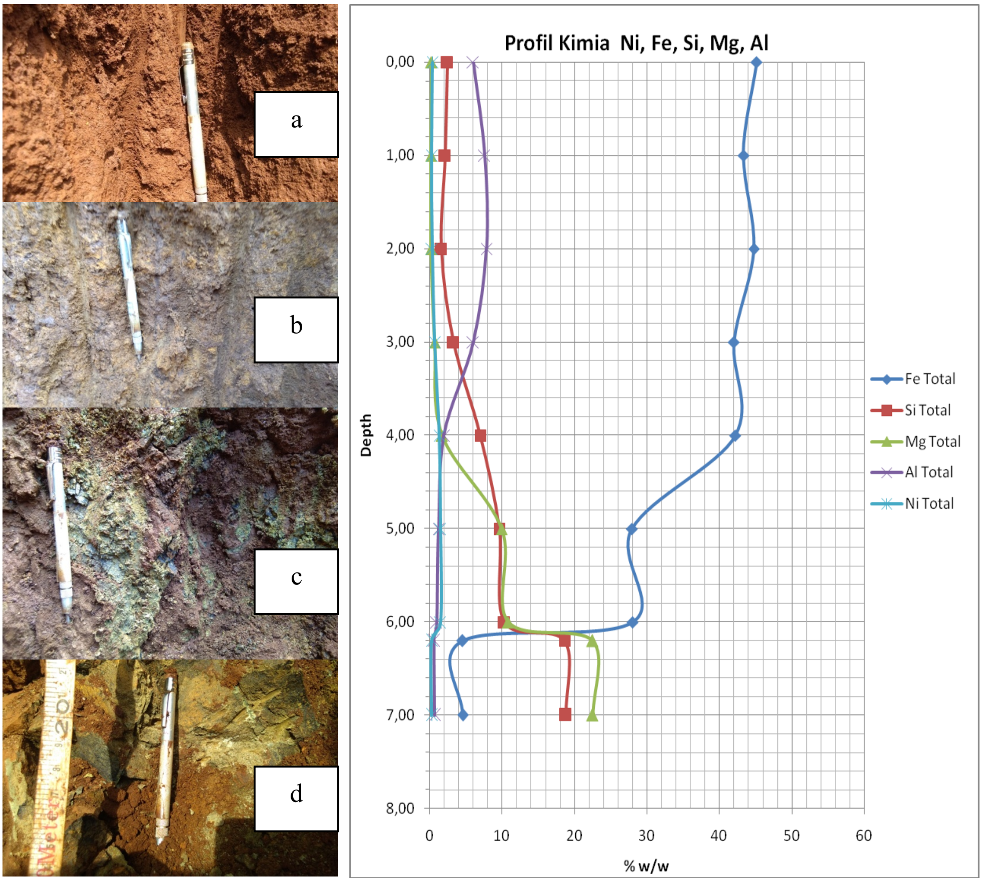


**Fig. 2.** Laterite and chemical profile.

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