Journal of Geology & Exploration
Vol. 2, No. 2, December 2023 : 48 – 52
E-ISSN 2963-2869

Estimation of Laterite Nickel Resources Using *Ordinary Krigging* Method at PT Vale Indonesia Nuha District East Luwu South Sulawesi Province

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ABSTRACTS

Resources have an economic value, form, quality, quantity rate, geological characteristics, and endurance to be economically extracted. Mineral resources are grouped according to their degree of geological certainty into the categories of assumed, indicated, and measured. The research aims to assess the potential resource potential of nickel laterite and the spread of the rate of mineralization of nickel in the research area using the geostatistical method of Ordinary Kriging. The research methodology is based on conducting statistical and geostatic analysis, starting with univariate statistical analysis, spatial statistics, bivariate statistics, and resource estimates. The results of the statistical calculation using the Ordinary Kriging for limonite and saprolite zones with an average gap of 25 meters and an average depth of 20 meters with their parallel directions to the west, north-northeast, south-east, southeast, and west-southwest obtained a total volume of 119,920,468 m^3 with a tonnage of 201,798,081 tons and a mean rate of nickel laterite of 1.56% Ni. Based on the results of an evaluation, it can be concluded that the number of nickel laterite deposits with a cut-off grade of 1.4% is 89,804,733 tons and the average rate is 1.83% Ni.

ARTICLE INFO

Article History:
Received 12 Oct 2023
Revised 13 Oct 2023
Accepted 14 Dec 2023
Available 30 Dec 2023

Keyword:
Nickel laterite, Resources estimation, Grade, Tonnage

https://doi.org/ 10.58227/jge.v2i2.113

INTRODUCTION

The potential of Indonesia's mineral resources is quite widely spread almost throughout the archipelago and is one of the capitals for mining activities. Proven in the mining sector Indonesia is rich because of mineral resources that generate considerable income for the country through taxes every year. Nickel is an economical excavated material needed by industry. Nickel is widely used for heavy industry, motor vehicle components, laboratory equipment, to as a mixture of stainless steel making. Nickel laterite is characterized by the presence of reddish-brown metal oxides containing Ni and Fe (Cahit et al., 2017). One of the factors influencing the formation of laterite nickel deposits is morphology, rock origin and weathering rate (Kurniadi et al., 2017). High levels of weathering contribute to the lateritization process (Tonggiroh et al., 2012).

Resource estimation itself plays an important role in determining the quantity and quality of a deposit. Some spatial interpolation techniques including the *Ordinary Krigging* method are methods that assume the average (*mean*) of the population is unknown, and the spatial data does not contain trends (Thamsi, 2017; Nawir et al, 2023). In addition to not containing trends, the data used also does not contain outliers. The krigging interpolation technique uses a basic device in the form of a variogram where variograms are used to measure spatial correlations between each observation (Bohling, 2005).

On this basis, in the framework of preparing the thesis, the author tries to conduct research estimating resources using the *Ordinary Krigging* Method method. So that the company has information related to the amount of resources from laterite nickel deposits in the research area.

METHODS

This research phase begins with taking primary data in the form of research documentation and location maps, then secondary data in the form of drill data consisting of *collar* data and *assay* data. The estimation method used is the *ordinary krigging* method using RM Studio Datamine *software and*

Journal of Geology & Exploration
Vol. 2, No. 2, December 2023 : 48 – 52
E-ISSN 2963-2869

validating data using *Snowden Supervisor software* conducted at the research site which aims to determine the direction of laterite nickel distribution and find out the amount of resources contained in the location based on the drill data obtained (Nawir et al, 2023).

RESULTS AND DISCUSSION

Drill Point Spread

Exploration drilling carried out at PT Vale Indonesia, resulted in a regular distribution of drill points with a number of drill points of 288 points with an average information collection or drilling space of 25 meters and an average drilling depth of 20 meters which is a detailed information collection and entered into measurable resources as explained in SNI 2019 concerning reporting exploration, resources and mineral reserves that measured resources are no more than 50 meters deep collect information.

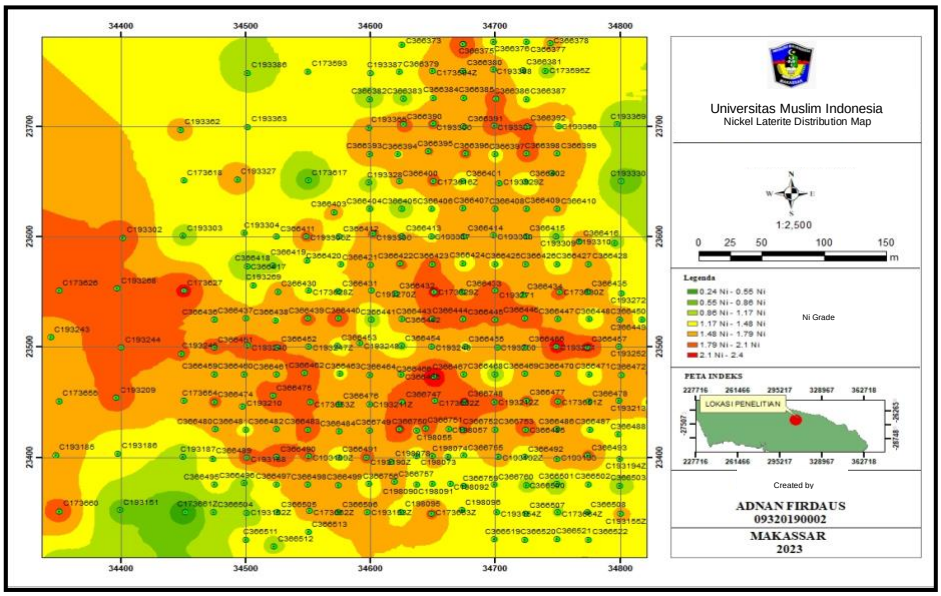


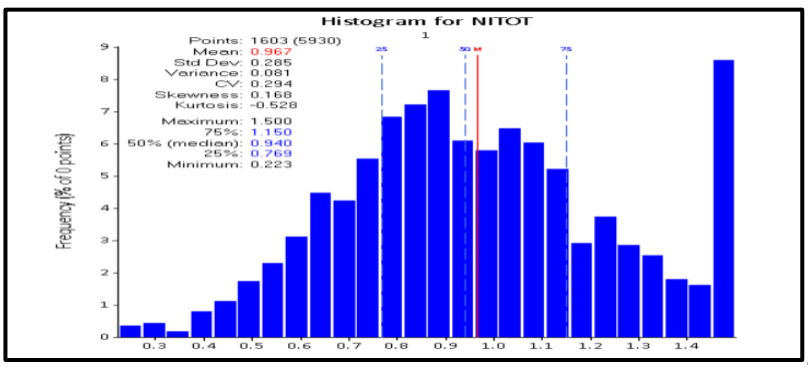
Figure 1. Drill point distribution map

Database and Spread

The research area of 645 m x 642 m has been drilled regularly with a space of 25 m. There are 288 drill points that have been sampled. The variables that will be taken into account are nickel content and thickness in the limonite and saprolite zones which are considered quite economical with *a Cut of Grade* (CoG) value = 1.4% Ini.

Univarian Statistical Analysis

The *skeweness* value is the symmetric value of the data, where the value 0 (zero) is the symmetric value of the data. In figure 2 it has *a fairly good skeweness* value because it is not too far from 0 (zero) and the median mean difference is not too far even close to it so that the possibility of error is fairly small



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Vol. 2, No. 2, December 2023 : 48 – 52
E-ISSN 2963-2869

Figure 2. Histogram of composite downhole data for Ni content

Spatial Statistical Analysis

The *range* value will be used as the radius value when assessing resources, while *the sill* and *nugget* are used as differences to determine what estimate is more suitable for use. Figure 3 shows the variogram model value of the *omnidirectional* variogram formed resulting in a *sill value of 0.62, a* nugget *of 0.2* and a range *value of* 30 m and is a horizontal active variogram and also the direction of the active variogram which determines the major axis of the ellipsoid. For variogram map, the direction of distribution of laterite nickel deposits is from north to south.

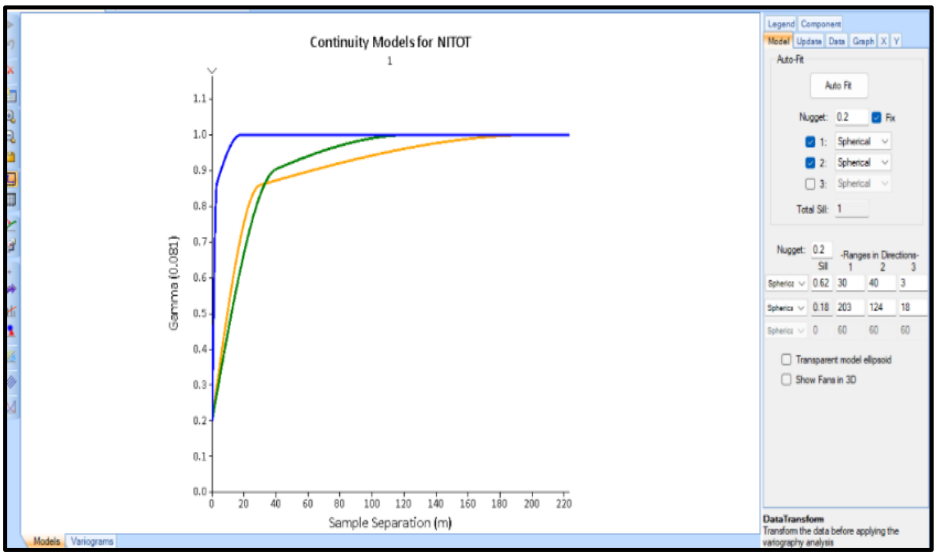

Figure 3. Variogram model

Resource Modeling and Estimation

Block modeling is created, adjusted to the drill point spacing of 25 m so that the *model block* size will match the drill point spacing. Making *block models* is adjusted to the spread of deposits of excavated materials. The *maximum user block size* is *12.5 meters long block, 12.5 meters wide block,* and 1 meter *thick block*.

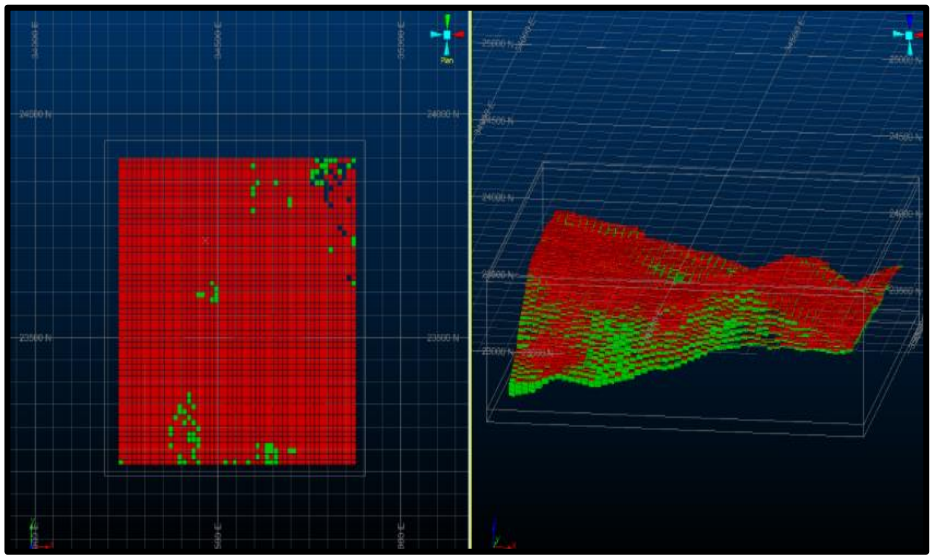

Figure 4. Block Model Limonite and Saprolite Layer

Making saprolite layer model blocks with *a Cut off Grade* (CoG) value of > 1.4% Ni, is carried

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out with *a Minimum % of sample to be included* of 3 m, Maximum Search radius *of 12 m, and* Power *used which is 2* the greater the power *used, the greater the volume produced to obtain data on total laterite nickel resources.*

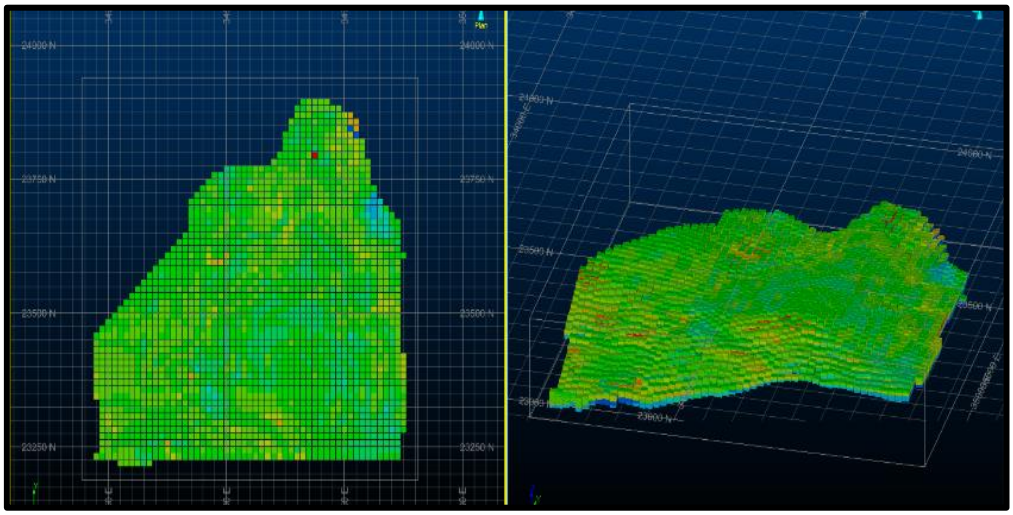

Figure 5. Ordinary Krigging Block Model Limonite and Saprolite Layer

From the results of resource estimation using *the ordinary kriging method* on limonite and saprolite layers with an average borehole spacing distance of 25 meters and an average borehole depth of 20 meters with the direction of distribution to the West, Northeast, Northeast, Southeast, East, Southeast and West-Southwest, a total volume of 119,920,468 was obtained with a tonnage of 201,798,081 tons and an average grade of laterite nickel 1.56 % Ni. Based on the estimation results, it can be concluded that the amount of laterite nickel deposits with *a Cut Off Grade* of 1.4% is 89,804,733 tons and an average grade of 1.83% Ni.

CONCLUSION

The conclusions that can be drawn from the research based on the objectives of this study are:

1. The direction of the spread rate for the limony and saprolite layers spread towards the West, North Northeast, Southeast East, East, Southeast and West-Southwest.
2. The results of resource estimation with the number of drill points 288 using *the ordinary kriging method* on limonite and saprolite layers with an average distance of 25 meters borehole spacing and an average borehole depth of 20 meters obtained a total volume of 119,920,468 with a tonnage of 201,798,081 tons and an average grade of laterite nickel 1.56% Ni. Based on the estimation results, it can be concluded that the amount of laterite nickel deposits with *a Cut Off Grade* of 1.4% is 89,804,733 tons and an average grade of 1.83% Ni.

ACKNOWLEDGMENT

The author would like to thank the leadership and employees of PT Vale Indonesia for the opportunity and guidance that has been given to carry out the research .

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