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Estimation Of Laterite Nickel Resources Using The Inverse Distance Weight Method PT Premlog Offshore Indonesia, Kolaka Regency, Southeast Sulawesi Province

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ABSTRACTS

Laterite nickel deposits are ores produced from the weathering process of ultraalkaline rocks on the earth's surface. The term laterit itself is taken from the Latin word "later" which means red brick. Mineral resources are a concentration or occurrence of materials that have economic value on or above the earth's crust, with certain shapes, qualities, and quantities that have a reasonable prospect to eventually be extracted economically. The purpose of this study is to determine the distribution of laterite nickel and calculate the number of resources at PT Premlog Offshore Indonesia. estimate the laterite nickel resources using the Inverse Distance Weighted method. In this study, the activities carried out are for modeling and estimation of laterite nickel resources using *the inverse distance weighting* (IDW) method. The creation of block models is done through the model block feature in the Surpac 6.5.1 program. The research is carried out directly in the field by taking documentation in the research area. Based on the results obtained from 19 drill points, a volume of 171,540 m³ and a tonnage of 257,310 tons with a COG of 1.5%. The density of nickel ore material at PT Premlog Offshore Indonesia is 1.5 tons/m3. Based on the research conducted at the research site, it can be concluded that in the Shapire Block area with a volume of 171,540 m3, the average Ni level is 1.8% with a nickel ore material density at PT Premlog Offshore Indonesia is 1.5 tons/m3, the indicated resource tonnage of 257,310 tons is obtained from the number of drill points as many as 19 with a drill point spacing of 50 m and COG 1.5 percent.

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INTRODUCTION

Laterite nickel deposits are ores produced from the weathering process of ultra alkaline rocks on the earth's surface. The term Laterite itself is taken from the Latin word "later" which means red brick (Buchanan, 1807). Resources are part of the deposits of excavated materials in a certain shape and quality and have reasonable prospects that allow them to be mined economically (Thamsi, Ainunnur, Anwar, 2023). Mineral resources are a concentration or occurrence of materials that have economic value on or above the earth's crust, with certain shapes, qualities, and quantities that have a reasonable prospect to eventually be extracted economically (Rafsanjani, 2016; Thamsi, Ainunnur, Anwar, & Aswadi, 2023). Mineral resources are further grouped based on the level of geological confidence in the categories of design, design, and measurement (Akhsanul et al., 2018). Reserves are a part of the designated and measurable resources that can be economically mined. The estimate of reserves must go through the calculation of dilution and losses that arise when the coal is mined ((Thamsi, Dadi, & Chalik, 2023a; Zibuka, 2016). Things that need to be considered in the supervision of resources and reserves of excavated materials are preparation, activities in the field, objects of supervision, implementation of supervision and reports (Anshariah, 2016; Wulandari et al., 2020).

The inverse distance weighted (IDW) method is an estimate that has taken into account the relationship between the location of space (distance), which is a linear combination or weighted average price (weigthing average) of the surrounding data points (Ramadhan et al., 2022; Thayib et al., 2017). By looking at each root mean square error (RMSE) value and looking at the comparison of power values of 1, 1.5, 2 and minimum neighbors, it can be concluded that the power value and minimum neigbors

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affect the estimation results (Afriandi, 2015; Thamsi, 2017).

Good and accurate estimation results that are in accordance with its existence in the field can determine the investment that will be invested by investors as investment in the mining business, the method of mining that will be carried out, even in estimating the time that will be needed by the company in carrying out its mining business so that it can reduce the amount of costs and provide profits for the company itself in the next mining process. Therefore, research was carried out on exploration activities that aimed to determine the amount of laterite nickel deposit resources. In this study, nickel laterite resources were estimated using the inverse distance weighting (IDW) method (Mustika, 2016; Roni et al., 2020). The aim of the study is to determine the distribution of laterite nickel at PT Premlog Offshore Indonesia and calculate the number of resources at PT Premlog Offshore Indonesia.

METHODS

This research was carried out in several stages. The first stage of administrative preparation is in the form of managing requirements from departments and faculties before the preparation of the final project report and the management of research recommendation letters before leaving for the research site. In the second stage, a literature study was carried out, the third stage was carried out field survey activities and data processing, the author made observations in the form of field orientation in order to understand the situation and conditions of the data collection area (Roni et al., 2020).

This study aims to estimate laterite nickel resources within the concession area of PT Premlog Offshore Indonesia, Kolaka Regency, Southeast Sulawesi, using the Inverse Distance Weighting (IDW) method. The research involves several stages, including data collection, data processing, resource modeling, model validation, and result analysis. The data used consists of primary and secondary data. Primary data includes drilling results such as depth, coordinates, nickel content (Ni%), lithological descriptions, and topographic data. Meanwhile, secondary data includes local geological maps, concession boundaries, and literature related to laterite nickel resources in the study area.
The initial stage involves validating the data to ensure the quality of drilling data, including identifying anomalies or invalid values. Subsequently, the data is analyzed spatially using Geographic Information Systems (GIS) to integrate and visualize the spatial distribution of nickel content within the study area. The IDW method is used to interpolate nickel content values on a 3D grid, considering parameters such as weighting exponent (power factor), search radius, and the maximum number of sample points. The interpolation results are then used to calculate the volume of nickel resources by accounting for the thickness of the laterite layer and material density (Thamsi, Yusuf, Rahma, & Wakila, 2023c).

Model validation is performed using cross-validation, comparing interpolated values with actual data from drilling points. Statistical parameters such as Root Mean Square Error (RMSE) are used to measure model accuracy, while 3D visualizations are created to verify geological interpretations visually. Resource estimates are classified into Measured, Indicated, and Inferred categories based on the spacing between drilling points and the reliability of the data.

The study results include maps of the spatial distribution of laterite nickel content, resource volume estimates, and an analysis of the uncertainty level in the estimations. Applying the IDW method is expected to provide an accurate representation of the nickel resource potential in the study area and serve as a reference for exploration decisions and mineral resource management. The tools and software used include GIS platforms (such as ArcGIS or QGIS) for spatial analysis and geological software (such as Surfer or Leapfrog Geo) for 3D modeling and resource estimation.

RESULTS AND DISCUSSION

The volume calculation is carried out by calculating the thickness of each saprolite layer block. The amount of volume is then multiplied by the density of the material to obtain the tonnage value of the deposit. This amount of tonnage is counted as a resource. The results of the calculation with the IDW method can be seen in the table below. (Christovel, R, H., et al, 2016)

Table 1. Results of estimation of laterite nickel resources using the Inverse Distance Weght (IDW) method

Ore Class	Ni %	Volume (m^3)	Tonnage (Tons)	Grade
LGS2	Ni 1.5-1.69	9.855	14.782	1,56
LGS1	Ni 1.7-1.79	68.220	102.330	1,74
HGS2	Ni 1.8-1.89	10.845	16.267	1,85

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HGS1	Ni >= 1.9	30.825	123.930	2,22
Grand Total		171.540	257.310	1,84

From the results of resource estimation using the IDW method in this study, a resource tonnage of 257,310 tons was obtained with a density value of 1.5.

Table 2. Ni Statistics

Descriptions	Value
Mean	1.05145752
Standard Error	0.01388707
Median	0.98
Mode	0.94
Standard Deviation	0.54319577
Sample Variance	0.29506164
Curtosis	0.42190376
Skewness	0.71100776
Range	3.41
Minimum	0.02
Maximum	3.43
Sum	1608.73
Count	1530

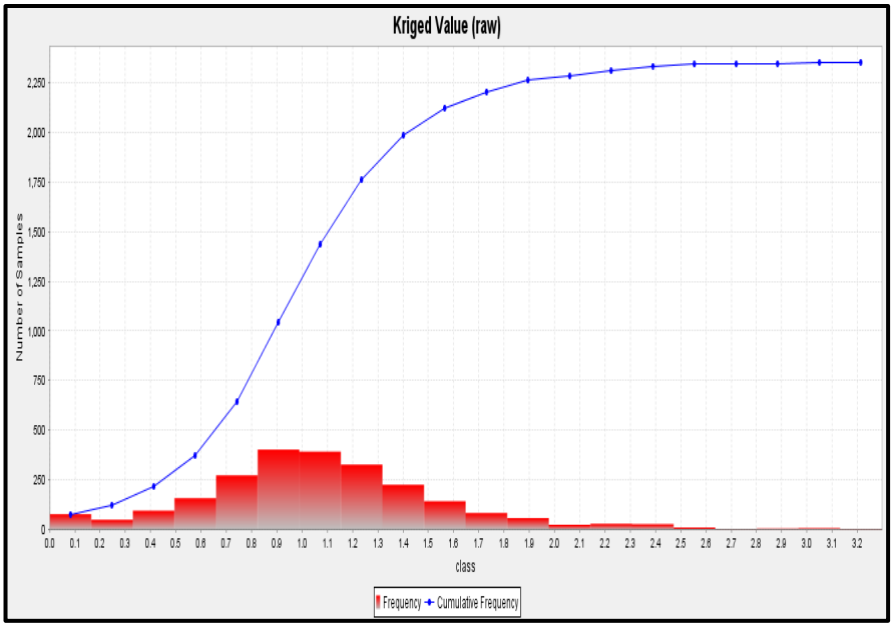

Figure 1. Ni Statistical Data

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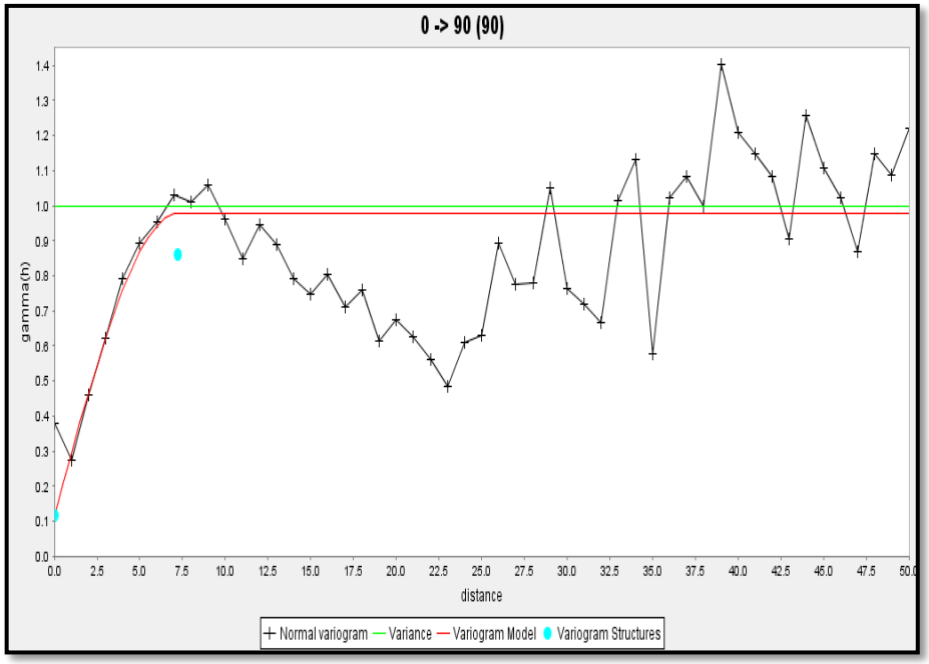

Figure 2. Variogram 0 – 90

The direction of spread was determined after obtaining the results of the variogram, the direction of nickel spread in the Shapire block of PT Premlog Offshore Indonesia was N 135° E.

Drill Point and Rate Data

The data obtained to estimate resources is based on the results of exploration that has been carried out in the mining business managed by PT Premlog Offshor Indonesia. The data is in the form of drill point data obtained from drilling results in the mining area at PT Premlog Offshore. The drill point data used in this study was 19 points and the level data was 166 data. The data required is the data from the drilling results, where from the drilling results data are obtained, including: hole id, grade (Ni), easting, northing, elevation, depth, dip. The level data was obtained after the drilling data was analyzed in the laboratory. The data is then accumulated in one data table in the form of a data table which is then processed with the help of MS. Excel and then the data is imported into surpac 6.5.1 for the next time so that the resources of nickel laterite can be determined.

Estimated Laterite Nickel Resources

The stages carried out in resource estimation are as follows:

Database Creation of a database serves to create a form of database system from drilling data, as well as make it easier to manage data inputs, data updates, data processes, data outputs and layouts to determine the potential of the excavated material. The creation of a database is used to correct the grouping and correctness of exploration data which will result in the spread of drill points which is the basic data in estimating resources. The design of the resource estimation system must look at the parameters that have been determined as a control unit in carrying out calculations and standardizing the drill data base (database). The database was created based on several variables such as hole id (borehole), drill point coordinates (easting, northing, elevation/x, y, and z), laterite nickel lithology, namely limonite (LIM), saprolite (SAP) and bedrock (BRK), drill hole depth (eoh/end of hole), thickness of each layer of laterite nickel (depth from – depth to), and Ni level data. The results that will be obtained from the data processing that has been imported into the Surpac 6.5.1 software are in the form of a three-dimensional drill point distribution where this three-dimensional drill point image displays an overview of the distribution of the ore level and the layer shape of the ore deposit itself.

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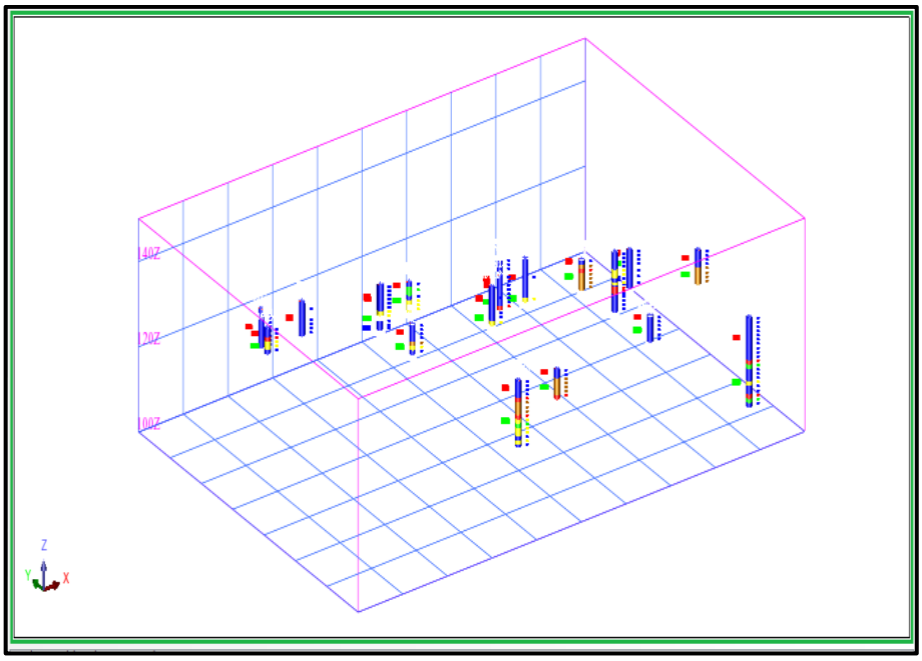

Figure 3. Drill Point

Figure 4.1 shows the appearance of drill points that have been arranged so that they display different colors between limonite, saprolite and bedrock to make it easier to distinguish the ore distribution boundaries in each layer. In addition, color differentiation is also intended to make it easier to estimate resources by separating ore levels above COG from each point. The color division used is red for the limonite layer, green for the saprolite layer and blue for the *Bedrock*.

Block model The block model is a form or medium to display data generated from a geological database with the aim of being able to find out the results, values or models that will be made later to estimate the amount of resources from the predetermined level according to the COG of the company as a reference in resource estimation based on the distribution of drill points. The distribution of drill points that have been obtained from database processing and has been carried out a level classification process, where the levels are grouped based on the type of ore (layer) in accordance with the classification that has been set at each drill point in order to get accurate results.

Resource Estimation with IDW Method

The resource estimation in this study was carried out using the IDW method with a COG of 1.50 % Ni. This method is based on point estimation and does not depend on the size of the block and only pays attention to the distance and does not pay attention to the effect of data grouping so that data with the same distance but with different distribution patterns will still give the same results. (Arif, A. K. D., & Djainal, H. 2019) It can be seen in figure 4.2 that the shape of the block model for the saprolite deposit. In the image display, several drill points based on the results of the level analysis explain that the drill points have not met the COG.

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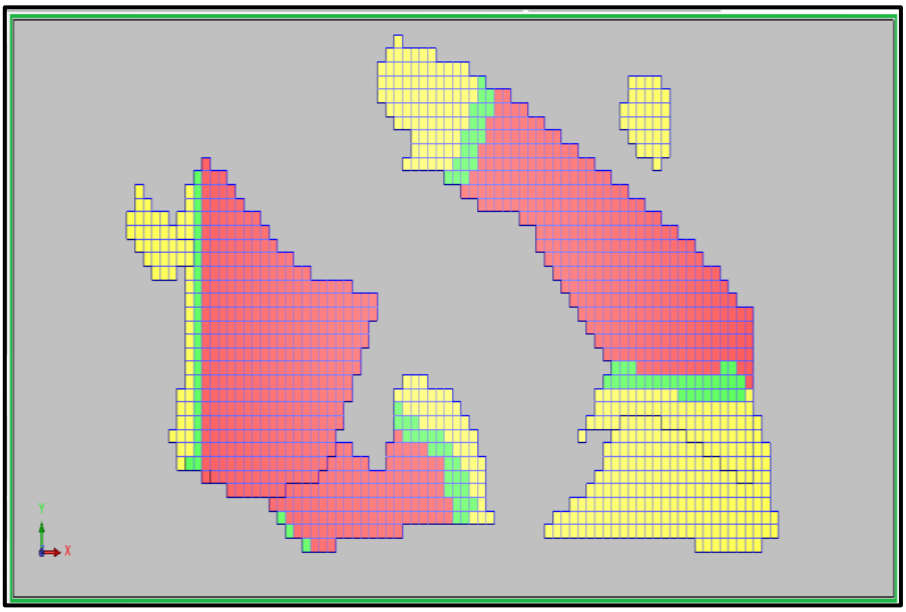

Figure 4. COG Saprolite Model Block >= 1.5%

Parameters in Estimation

Before calculating resources, you must first know the important parameters that will be used in the estimation, so that the estimates carried out will be more accurate in the results. The important parameters used in estimation include material density. Material density plays a very important role in estimating, this is because material density is a parameter used to obtain the tonnage figure of a reserve obtained from the product of volume multiplied by the density of the material itself. The density of nickel ore material at PT Premlog Offshore Indonesia is 1.5 tons/m3. In addition, to estimate ore, of course, there is a limit level of mining carried out so that the classification of nickel ore is different. From the company's data, nickel ore classification parameters with a cut off grade Ni ≥ 1.5%. From the parameters mentioned earlier, we can estimate resources using the inverse distance weight (IDW) method using Surpac 6.5.1 software.

CONCLUSION

Based on the research conducted at the research location, it can be concluded as follows. From the results of the research that the author has conducted, it can be concluded that the direction of the spread of laterite nickel in the Shapire block of PT Premlog Offshore Indonesia is N 135° E. From the results of the research that the author has conducted, it can be concluded that in the Shapire Block area with a volume of 171,540 m3, the average Ni level is 1.8% with a nickel ore material density at PT Premlog Offshore Indonesia is 1.5 tons/m3, the indicated resource tonnage of 257,310 tons is obtained from the number of drill points as many as 19 with a drill point spacing of 50 m and a COG of 1.5%.

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