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RESOURCE ESTIMATION OF LATERITE NICKEL USING INVERSE DISTANCE WEIGHTING METHOD CASE STUDY OF NORTH KONAWE DISTRICT, SOUTHEAST SULAWESI PROVINCE

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Abstract

The mining industry's estimation of mineral resources is a stage that is carried out to determine the quantity of a mineral. This study aimed to determine the selection of laterite nickel resource estimation methods. The determination of the estimation method is based on the value of the coefficient of variance and the geological conditions of the mineral deposits. This research area is in Lasolo Kepulauan District, North Konawe Regency at PT—x block south. Statistical analysis found that the coefficient of variance in the limonite zone was 0.19, the saprolite area was 0.37, and it was included in moderate geological geometry conditions. The estimation method used in this research is the inverse distance weighting method. The estimation results in the limonite zone are 3,398 tons with an average Ni content of 0% Ni, 448,037 tons with a moderate Ni content of 1.32%, 588,256 tons with an average Ni content of 1.65%, and 14,912 tons with an average Ni content of 2.01%. In comparison, in the saprolite zone, there are 174.46 3 tons with a middle grade of Ni of 0.84%, 408,896 tons with an average quality of Ni of 1.26%, 788,818 tons with moderate content of Ni of 1.77%, 771,709 tons with a middle grade of Ni of 2.21%, 172,236 tons with an average quality of Ni of 2.63%, and 5,215 tons with an average rate of Ni of 3.04 %.

Keywords: *Resource Estimation, Nickel Laterite, coefficient of variance, IDW.*

INTRODUCTION

Resource estimation is one of the final steps in mineral exploration, where a deposit model will be created later (Gezley et al., 2014). As well as concluding the mineral exploration stage, resource evaluation is also a stage in estimating reserves used to compile an economic feasibility study (Mery & Marcotte, 2022). Based on this, the results of the evaluation of resources should be close to the actual value.

Specific requirements such as "sediment character" and "geological conditions" must be considered in estimating ore resources. In addition, a good assessment is guided by objectively processed data. Estimating resources or reserves that are representative and sufficiently detailed certainly requires a high level of accuracy and a long processing time; with the existence of computer technology at this time, it is beneficial to simplify the work in processing, classifying, and interpreting data.

RESEARCH LOCATION

Administratively PT. X is located in Marombo Village, Lasolo Islands District, North Konawe Regency, Southeast Sulawesi Province. The location of the study area is x: 419231 and y: 9628425 using the UTM Zone 51S coordinate projection system (WGS 1984 datum).

DATA SOURCE

In this study, the required data includes regional geological data in the form of morphology and lithology data, as well as other supporting geological data such as primary data and drill-hole data obtained from the exploration drilling results of PT. X Site Marombo, South Block of Southeast Sulawesi, with a drilling spacing of 50 m × 50 m at a depth of 100 meters.

RESEARCH METHODOLOGY

Inverse distance weighting (IDW) is a linear combination interpolation method with a weighted average of the surrounding data points. The use of the IDW method is to calculate estimated nickel laterite resources. As for the data collected from literature studies, primary data, and secondary data at the research location, then the primary and secondary data are analyzed to be processed into a block model. Processing includes data,

1. Collar is the coordinate data and elevation of the drill hole.
2. Assay is data from laboratory analysis of nickel content and others.
3. Lithology is data on the depth of nickel drill holes.
4. Survey is data on the total depth of the drill hole.

Mathematical solutions are widely used in the evaluation stages of mineral deposits. Local geological conditions, mining methods, and others influence calculation methods and techniques.

The IDW is a spatial interpolation method that uses spatial distance to calculate the correlation, namely the calculation of distance weights. For an unknown point P with position (x_0, y_0, z_0), There is a known point around it. Assume that every known point has a spatial coordinate (x_i, y_i, z_i) (i = 1, 2, ..., n), Moreover, the attribute value is Pi. The distance between each known point and an unknown point is $d_i(x, y, z)$. IDW is used to estimate the value of each unknown point.

The IDW interpolation function, as Zhan-Ning et al. (2021) is formulated as,

$$P = \left. \sum_{i=1}^{n} \frac{P_i}{d_i(x,y,z)^m} \middle/ \sum_{i=1}^{n} \frac{1}{d_i(x,y,z)^m} \right. \tag{1}$$

while $p \to +\infty$ Chebyshev distance and,

$$d_i = \lim_{n\to\infty} (|x_0 - x_i|^p + |y_0 - y_i|^p + |z_0 - z_i|^p)^{1/p} \tag{2}$$

If the distance increases, the weight becomes smaller (Shepard, 1968), and *p* is a multiplier that shows the weight decreases when the distance increases.

RESEARCH RESULT

Fundamental statistical analysis was carried out to see the data distribution in each domain, including the distribution of levels, average levels, variance, standard deviation, and coefficient of variance (CV). The domains include,

a. Limonite Zone
From the results of fundamental statistical analysis in the limonite zone, it is known that the average Ni content is 1.5%, the Variance value is 0.088, the standard deviation is 0.29, and the coefficient of variance is 0.19.

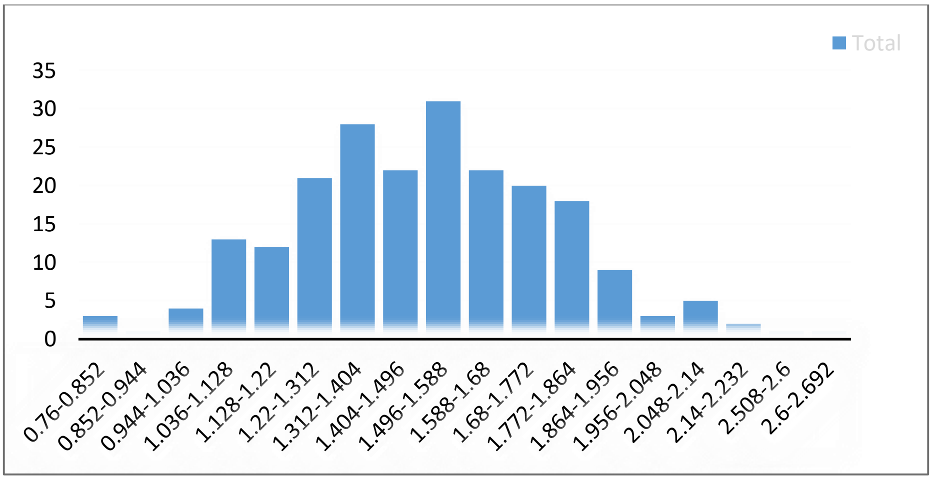

Figure 1. Histogram of Ni limonite zone

Fundamental statistical analysis was made for Ni element samples in each mineralization domain, where fundamental analysis was carried out to determine the average value of nickel content based on drill data, variance (homogeneity of content) coefficient of variance and distribution of data. Figure 1 shows the histogram of limonite zone. The distribution of nickel for limonite zone appears to be relatively normal.

b. Saprolite Zone
Likewise, the distribution of nickel in saprolite zone also appears to be relatively normal. From the results of fundamental statistical analysis in the saprolite zone, it is known that the average Ni content is 1.7%, the variance value is 0.43, the standard deviation is 0.65, and the coefficient of variance is 0.37.

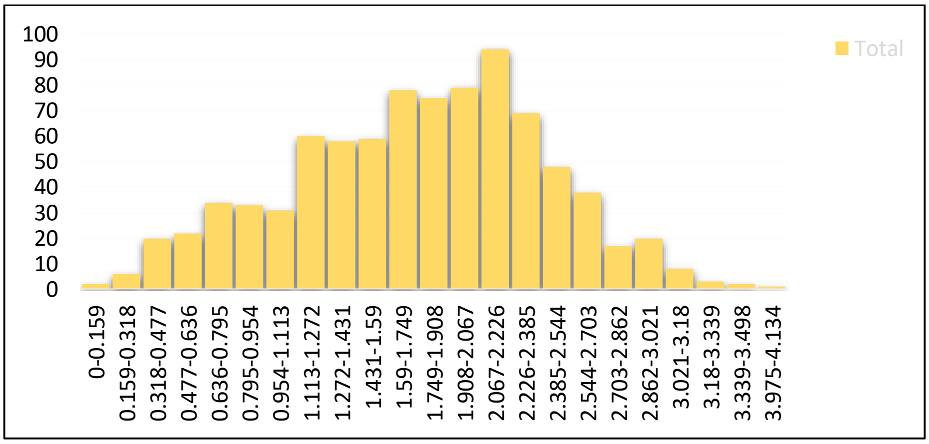

Figure 2. Histogram of Ni in the saprolite zone

Estimation is carried out by block size (12×12×1), then estimation in the limonite and saprolite zones. The result is,

a. Estimation results in the limonite zone

The estimation results in the limonite zone contained 3,398 tons of Ni with an average grade of 0% Ni, 448,037 tons of Ni with an average grade of 1.32%, 588,256 tons of Ni with an average grade of 1.65 and 14,912 tons of Ni with an average grade of - an average of 2.01%.

The area of each content zone can be seen in Figure 3 below.

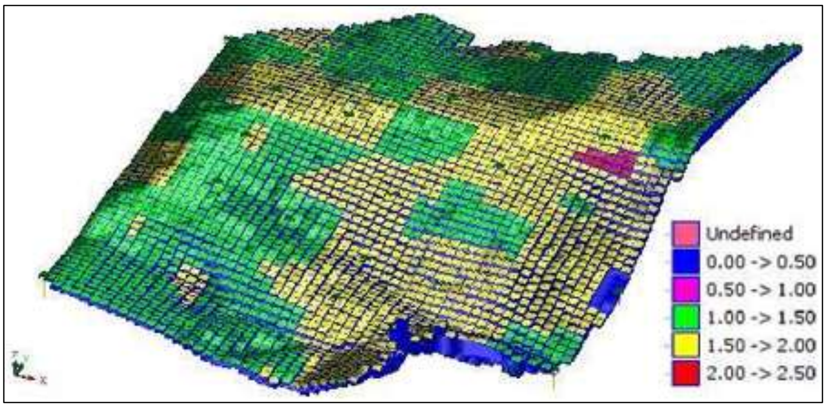

Figure 3 Grade zones in the limonite layer

Table 1 Tonnage and grade in the limonite zone

Rate Intervals	Volume	Tonase	Average Rate
0,0 – 0,5	2.266	3398	0
0,5 - 1,0	0	0	0
1,0 - 1,5	298.691	448.037	1,32
1,5 - 2,0	392.168	588.252	1,65
2,0 - 2,5	9.941	14.912	2,01
Total	703.066	1.054.599	

b. Estimation results in the saprolite zone
As in Table 2, the estimation results in the saprolite zone contained 1,547,560 m^3 volume in saprolite zoe, or 2,321,337 tons of Ni. The area of each content zone can be seen in Figure 4.

Table 2 tonnage and grade in the saprolite zone

Ni Rate	Volume	Tonase	Average Rate
0,0 - 0,5	0	0	0
0,5 - 1,0	116,309	174,463	0.84
1,0 - 1,5	272,598	408,896	1.26
1,5 - 2,0	525,879	788,818	1.77
2,0 - 2,5	514,473	771,709	2.21
2,5 - 3,0	114,824	172,236	2.63
3,0 - 3,5	3,477	5,215	3.04
Total	1,547,560	2,321,337	

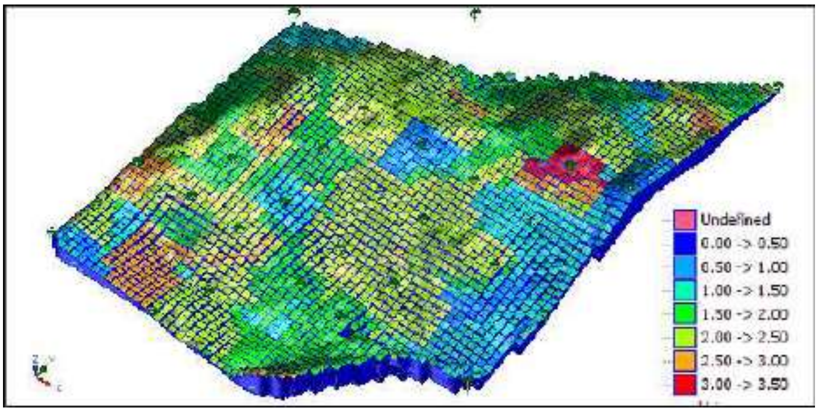

Figure 4 content zones in the saprolite layer

CONCLUSION

Fundamental statistical analysis on the saprolite zone found that the average Ni content was 1.7%, the variance value was 0.43, the standard deviation was 0.65, and the coefficient of variance was 0.37. The estimation results in the limonite zone contain 3,398 tons of Ni with an average grade of 0% Ni, 448,037 tons of Ni with an average grade of 1.32%, 588,256 tons of Ni with an average grade of 1.65% and 14,912 tons of Ni with an average grade - an average of 2.01 while in the saprolite zone, there are 174,463 tons of Ni with an average grade of 0.84%, 408,896 tons of ni with an average grade of 1.26%, 788,818 tons of ni with an average grade of 1.77%, 771,709 tons of Ni with an average grade of 2.21%, 172,236 tonnes with an average grade of 2.63, and 5,215 tonnes with an average grade of 3.04%

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