PROCEEDINGS

4th International Conference on Technical and Vocational Education and Training (TVET)

Theme:
Technical and Vocational Education and Training for Sustainable Societies

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FOREWORD

Welcome for all respected scholars, researchers, post graduate studentsand especially Keynote Speakers to the 4 ICTVET. The theme of the conference focus on Technical and Vocational Education and Training for sustainable societies and consist of six subthemes. i.e Development of learning model on TVET, Workplace Learning and entrepreneurship, Innovationon applied engineering and information technology, Management and Leadership on TVET, Vocational and Technical Teaachers education, and Assessment and Evaluation on TVET.

Sustainable society shoul be followed by the improvement of various factors that have impacts to the quality of vocational and technical education and training, particularly to overcome the competitiveness of the world business. As we have already known the rapid change of technology as well as the change of demography, having a great effects to the life of peoples in this world, The competitiveness need a collaborativeness to survive the life of millions peoples who lost their jobs. Young peoples as aproductive generation have to be creative and innovative to face the competitiveness. So this prociding contents consist of various findings of research in the field of vocational and technical education as well as applied technology and mainly based on the subthemes of the conference.

Finally, we would like to thank a million for all participants of this conference and all parties who support the success of this conference. Hopefully the seminars and scientific work of this seminar can be a reference material for basic education and elementary school teacher education in Indonesia.

Padang, July 2, 2018

Tim Editor

CONTENT PROSIDING ICTVET 2017 REPOSITORY UNP

THE MODELING OF MASSIVE LIMESTONE USING INDICATOR KRIGING METHOD (CASE STUDIES OF MASSIVE LIMESTONE IN PT SINAR ASIA FORTUNA)

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ABSTRACT: In the context of mining, the estimation is an attempt to estimate the value of block or point that expected to approach the true value. An accurate geological modeling will greatly assist in mining minerals that expected production in accordance with the company's production targets. Therefore, the research was conducted at PT Sinar Asia Fortuna to determine the geological model and resources. The geological modeling and resource's estimation of massive limestone was done using Indicator Kriging Method. The geological modeling of massive limestone was carried out by using SGeMS version 2.0 and Datamine Studio 3, while the limestone's resource was estimated by using Datamine Studio 3. This study categorizes the limestone to be 3 types, i.e. massive limestone, vuggy limestone and chalk. The estimation of percentage by using Indicator Kriging Method obtained the distribution of limestone massive proportion of 75%, 23% vuggy limestone and 2% chalk. The resource calculation respectively obtains 130.889.422 tons of massive limestone, 40.139.422 tons of vuggy limestone, and 3.490.384 tons of chalk. Total tonnage for the indicator kriging = 174 519 228 tons

Keywords: Limestone, Indicator Kriging Method, Resource, Geological Modeling

1. INTRODUCTION

Modeling is an early stage before the appraisal levels which could subsequently be calculated resource or reserve. A resource estimation should reflect accurately the geological conditions and the character/nature of the mineralization, and in accordance with the purposes of evaluation. This research was conducted at PT. Sinar Asia Fortuna where it is located in Desa Tahunan, Kecamatan Sale, Kabupaten Rembang, and it is located geographically at 06°51'50 " - 06°53'00 " LS and 111°30'55 " - 111° 32'00 " BT. PT Sinar Asia Fortuna location can be seen in Figure 1 below:

Figure 1. Location of research area

To increase mining activities in the future, PT. Sinar Fortuna should make a modeling as an early stage before the cost of assessing the next level can be done. A resource estimate should be accurate and precise**.** The Modeling parameter consists of limestone rock type i.e. limestone massive, vuggy limestone and chalk. A method of estimation and interpolation is required to determine the geologic modeling and the distribution of quality limestone with a limited amount of data. In this method, an analysis is performed including the variogram indicator analysis that is used in the method of Indicator Kriging. Indicator Kriging is a method used for binary variables reflecting probabalistic models for an area that do not have a sample. Therefore, the aim of this study is to establish the geological domain model of limestone deposit with Indicator Kriging method.

2. METHODOLOGY

In conducting this research, several stages are compiled that began by the study of literature with collecting various reference regarding the genesis of limestone deposit, and studied the reports of research that has been done previously to determine the area of research in general. The secondary data were obtained as follows: drill log data, drill point of distribution maps, topographic maps of research areas. The next stage is data processing. From the secondary data that have been collected, then a recapitulation of borehole data was done as a database that will be used for further data processing, where the processing of the initial data using conventional statistical methods. While, it was also calculated as the variogram indicator studies, determination of estimation's parameter, estimation by method of indicator kriging. Then, it's proceed with the limestones deposition modeling. The processing of the database is using the SGeMS Program (Stanford Geostatistical Earth Modeling Software) version 2.0, and deposition modeling is using Datamine Studio 3 which will generate an estimation on a block model that has been determined. The final stage is to analyze both qualitatively and quantitatively. The qualitative analysis was conducted based on the model of limestone deposit that created from secondary data. While, the quantitative analysis was conducted by statistical analysis, variogram study, and the parameters are determined in the process of estimation results with the method of Indicator Kriging in the research area.

3. ANALYSIS AND DISCUSSION

The drilling data was used from the results of drilling in PT Sinar Asia Fortuna for amount 31 Boreholes with various depth from each other. The drilling spaced is 100 m and an average depth of drilling is 70 m . PT Sinar Asia topographic map of Fortuna can be seen in Figure 2 below:

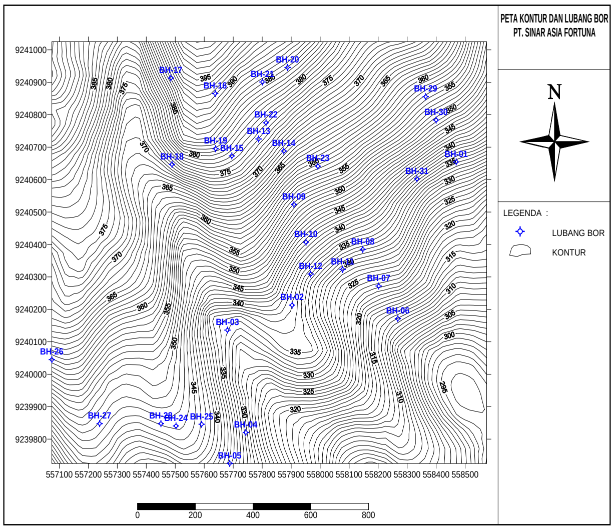


Figure 2. Topography and drill hole location map

3.1 The Experimental Variogram and a Variogram Fiting.

Variogram can be used to analyze the level of similarity or variability between each data. To determine the appropriate variogram, an experimental variogram indicator should be made. The process of making the experimental variogram indicator is done by SGeMS program, which done first with election of variogram constituent's parameters. Selection of this parameter is done by taking into account the pattern of data and samples used. Selection of good parameters will produce a good experimental variogram indicator to facilitate the process of fitting variogram in producing variogram model.

The process of making the experimental variogram indicator is done by SGeMS program, which done first with election of variogram constituent's parameters.

Table 1. Experimental Variogram Indicator Parameters for Each Rock Type

Rock Type	Azimuth	Dip	Angle Tolerance	Bandwith
Limestones	0	0	90	10000
	0	90	90	10000

While the search area of data on SGeMs program version 2.0 is expressed by the angle tolerance and bandwidth . Another parameter to consider in making the experimental variogram indicator is the distance between samples (lag) and lag tolerance. This process used a lag distance = 100 m, lag tolerance = 50 m towards the limestones to all directions (omnidirectional), and lag distance = 5 m, and 2.5 m lag tolerance for the vertical direction, where the objective is to get a pair of data and the variogram with spaced drilling. Number of lag was depent on the distribution and amount of available data.

Theoretical variogram models that is used for fittings on each rock type is a spherical models. Theoretical variogram models that is used for fittings on each rock type is a spherical models.

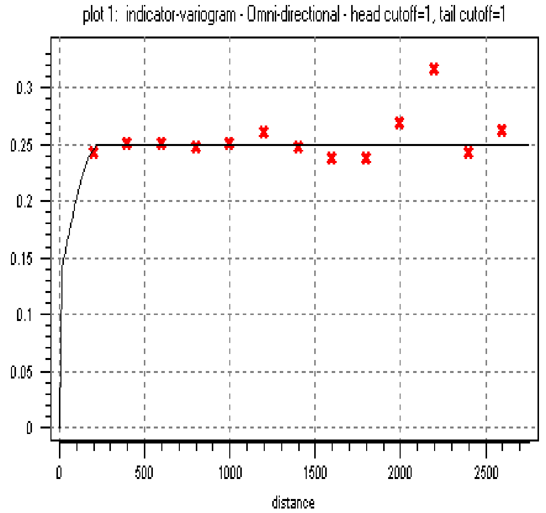


Figure 3. The variogram model of omnidirectional 3d horizontal for masive

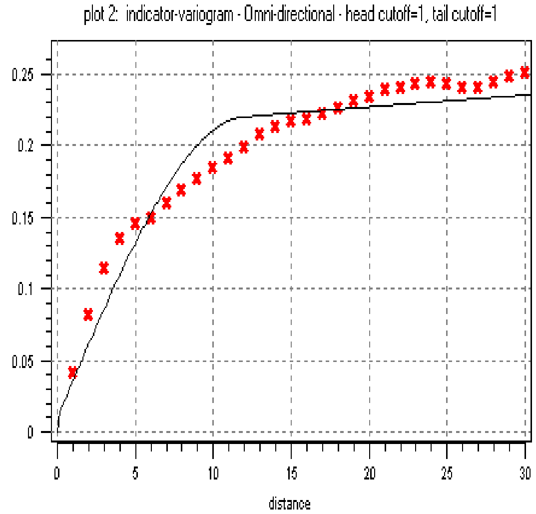


Figure 6. The variogram of vertical 3d omnidirectional for masive

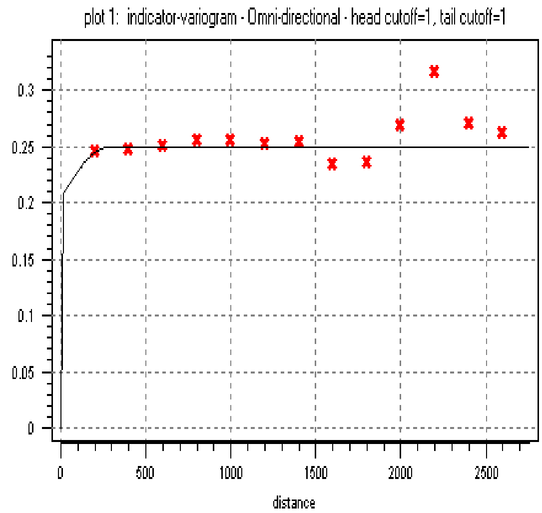


Figure 4. The variogram model of omnidirectional 3d horizontal for vuggy

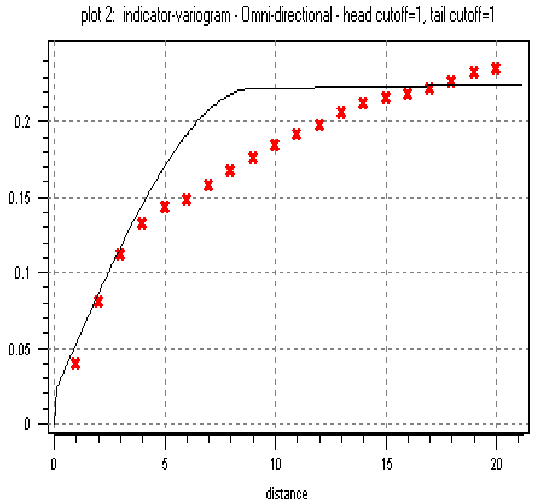


Figure 7. The variogram of vertical 3d omnidirectional for vuggy

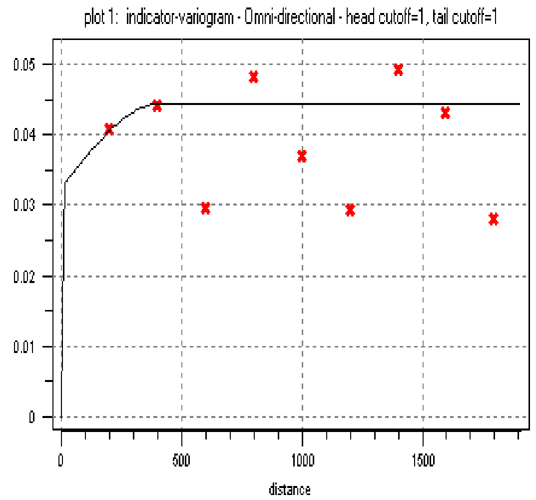


Figure 5. The variogram model of omnidirectional 3d horizontal for chalk

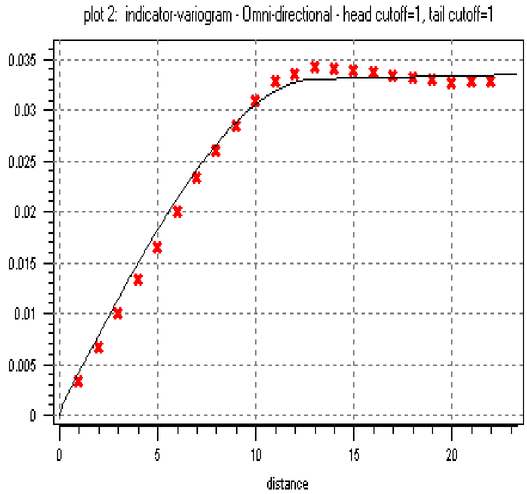


Figure 8. The variogram of vertical 3d Omnidirectional for chalk

Table 2. Value of variogram parameters for each category

Category	Struktur	Variogram type	Nugget effect	Sill	Range
Masive	Horizontal	Spherical	0.22	0.05	250
	Vertical	Spherical	0.02	0.2	12
Vuggy	Horizontal	Spherical	0.2	0.03	230
	Vertical	Spherical	0.02	0.2	9
Chalk	Horizontal	Spherical	0.035	0.01	150
	Vertical	Spherical	0.0005	0.032	13

3.2 The Geologic Modeling of Indicator Kriging Estimation Results

The Estimation Results was using an Indicator Kriging method, and then made a block model with a block size of 50 x 50 x 1 m . The modeling was made by using three rock types that there are massive limestones (blue) , vuggy limestone (light blue) and chalk (yellow).

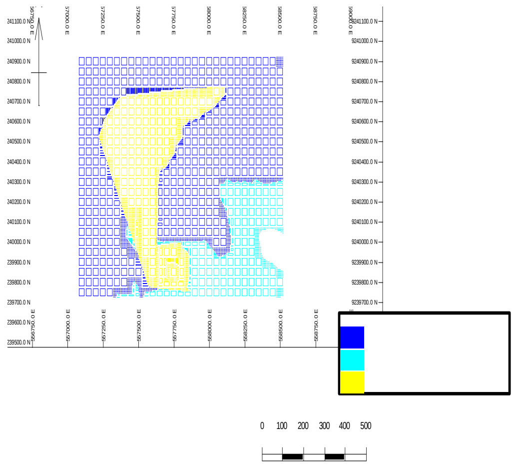


Figure 9. Plan view of model block with 300 elevation using indicator kriging method

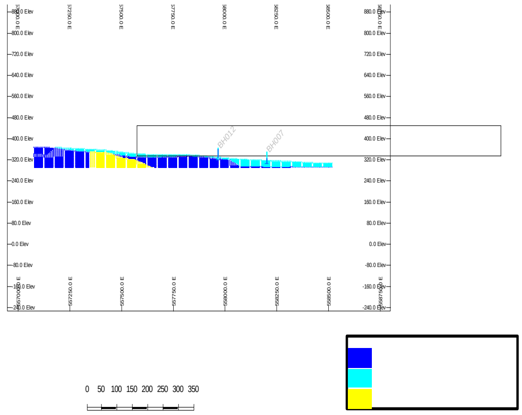


Figure 10. Plan view of model block with cross section 9240268 north indicator kriging method

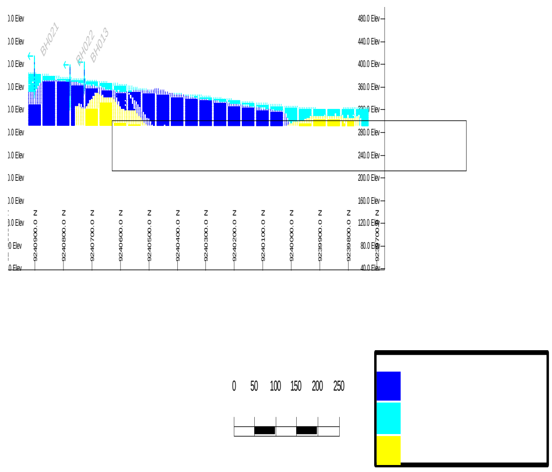


Figure 11. Plan view of model block with cross section 557800 east indicator kriging method

3.3 Manual Correlation

Manual correlation is done by making the cross section horizontally with the west-east and north-south direction. Manual correlation is done by connecting each existing drill hole according to the type of rock. The more drill hole data available to be correlated, the model will be better . Each person will produce a different form in every manual correlation, depending on the amount of data used and the different level of confidence for each person.

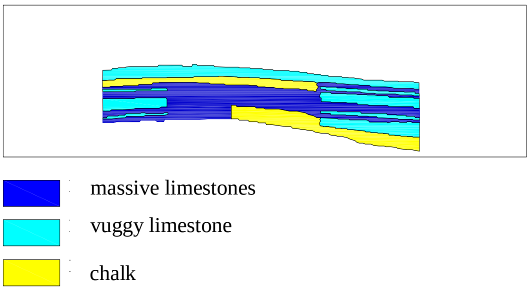


Figure 12. Cross section 557700 east

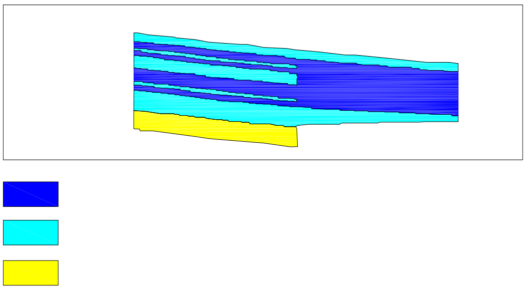


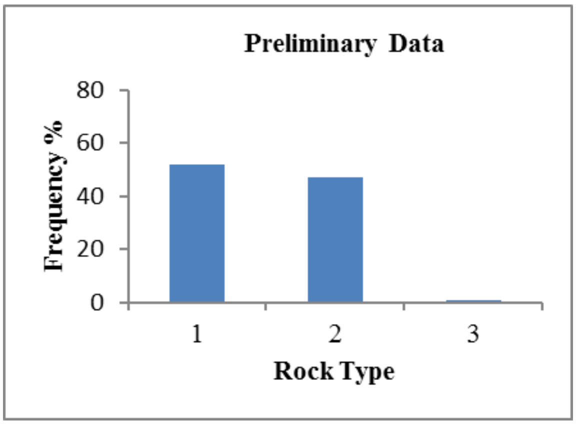
Figure 13. Cross Section 9240268 North

3.4 The Geostatistical Analysis

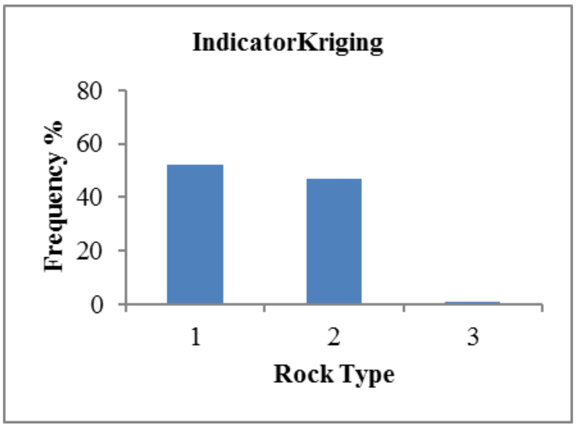
The geostatistical analysis was done by making the variogram indicator in horizontal and vertical directions . The goal is to determine the continuity of data in three dimensions and to get an approximation parameter which is representative for further data processing i.e. the assessment of the indicator kriging using 3-dimensional blocks. In the horizontal direction is observed four main directions, namely the direction of the N - S, NE - SW, E - W, and SE - NW. In the four main directions is known that there is a difference range in each direction. However, this difference was not significant, so it is assumed that the four directions of the isotropic variogram modeling in the four main directions represented by a single omnidirectional variogram. The variogram model used for the indicators massive limestones, vuggy and chalk are spherical models where data has initial linear behavior. For massive limestones with horizontal direction has nugget effect 0.22 %, while vuggy limestone has 0.2 % and 0.035 % of chalk limestone. It shows a variant of the massive limestone larger than massive limestone and chalk. As for the range of massive limestones has the greatest range of 250 m, 230 m for vuggy and 150 m for chalk. For massive limestones with vertical direction has a nugget effect of 0.02%, 0.02% of vuggy, and 0.0005 % of chalk. The nugget effect of chalk has the smallest value caused of the proportion of chalk rock type smaller than the other two rock types i.e. massive limestone and vuggy limestone.

3.5 The Data Analysis of Rock Code

The statistical analysis was performed in order to determine the percentage of attendance of each rock code for each data, whether it's from the drill data of initial research, as well as data processed of Indicator Kriging. Statistics are done by finding the percentage of presence of the three groups of rock codes for each data, ie by dividing the total amount of data. Statistics are obtained by generating bar graphs, for each data from the initial drill data and data using the indicator kriging method. The percentage of distribution for each type of rock can be seen in Figure 14 and Percentage of Rock Code can be seen in table 3 below:



(a)



(b)

Figure 14. Histogram Rock Code for (a) Data of Bor Per Meters (b) Indicator kriging and

Table 3. Percentage of rock codes for each estimation result

Rock Code	Indicator Kriging		Initial Data	
	Rock Code	Percentage (%)	Rock Code	Percentage (%)
Massive Limestone	1	75	1	52
Vuggy limestone	2	23	2	47
Chalk	3	2	3	1

On the indicator kriging method, the massive limestones increased in the percentage of 23% and a decrease in the percentage of 24% of vuggy limestone. While, the percentage of chalk is relatively not much different in the amount of 1 %

3.6 Cross Validation

Prior to the calculation of resources, first cross validation to compare the results of the indicator kriging method to proportion of each rock type of Massive Limestone, Vuggy limestone, Chalk. The proportion of each rock type can be seen in figure 15, 16 and 17 below

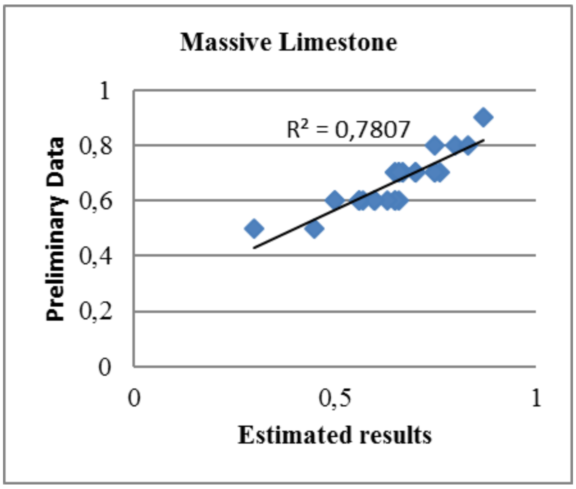


Figure 15. Comparison of proportion of rock type of massive limestone with estimation result of indicator kriging

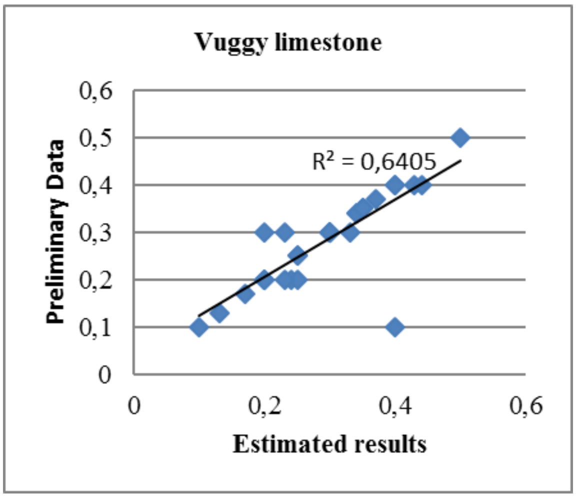


Figure 16. Comparison of proportion of rock type of Vuggy limestone with estimation result of indicator kriging

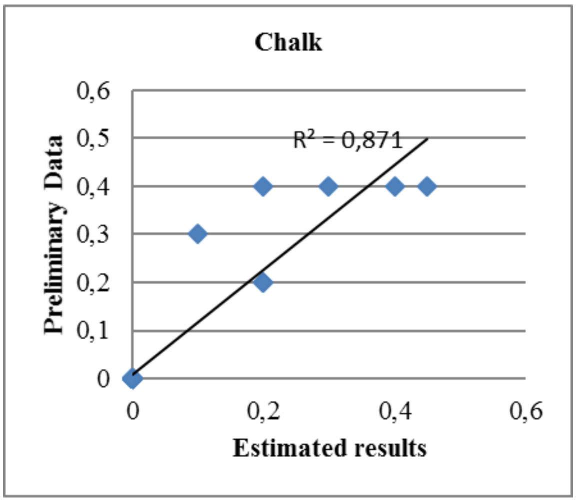


Figure 17. Comparison of proportion of rock type of Chalk with estimation result of indicator kriging

From the result of estimation of indicator kriging obtained the accuracy produced for rock type chalk is higher with value R^2 = 0,871. This is because the proportion of chalk attendance on the initial data is less than the two other rock types: massive limestones and vuggy limestones.

3.7 Calculation and Tabulation of Resource Calculation

The resource calculation was done using a grid model. Each grid has size of 50 x 50 x 1 m in accordance with a block of mining models created using Datamine program. Tabulation of each resources can be seen in Table 4 below :

Table 4. The resource tabulation of each rock type

Rock Type	Resource Tabulation Indicator Kriging (tons)
Massive	130.889.422
Vuggy	40.139.422
Chalk	3.490.384

Total tonnage for the indicator kriging = 174 519 228 tons

4. CONCLUSION

The analysis of the percentage of rock code from the estimation results are rock code 1 (massive by 75 %, rock code 2 (vuggy) by 23 %, and rock code 3 (chalk) by 2 %. Indicator kriging methods resulted in massive limestones resources as amount to 130 889 422 tons, 40.139.422 tons of vuggy limestone, and 3.490.422 tons of chalk. Total tonnage for the indicator kriging = 174 519 228 tons

5. REFERENCES

[1] Annels, A.E, 1991: *Mineral Deposit Evaluation*, A Practical Chapman & Hall, London.

[2] Clayton V Deutsch & Andre G. Journel,1998: *Geostatical Software Library and User's Guide.*

[3] Darijanto, T, 1999: *Geostatistik*, Diktat Kuliah Departemen Teknik Pertambangan Bandung Mulyono 2004.

[4] Heriawan, M. N., Koike K., 2007: *Uncertainty Assesment of Coal Tonnage by Spatial Modelling of Seam Structures and Qoal Qualities.*

[5] Journel, G.A. & Hujibregts, J., 1978: *Mining Geostatistic*, Academic Press, London.

[6] Koike, K., Minta, T., Ishizaka, S., and Ohmi, M., 1996: *Hydrogeological and Ground-Water Resource Analysis Using a Geotechnical Databasae*, Internatioan Association for Mathematical Geology.

[7] Matheron, 1963: *Principal of Geostatictics*.

[8] Moredo redolfo & Reinaldo Lorandi, 2006*: Indikator Kriging Geostatical Methodology Applied to Geotechnics Project Planning.*

[9] Mulyono, E.E., 2004: *Analisis Penaksiran Cadangan Vein Curug, UPBE Pongkor dengan Datamine.* Tugas akhir Sarjana Teknik Pertambangan ITB.

[10] Remy N., 2004: *Geostatical Earth Modelling Software User's Manual*.