International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

The Use of Explicit Method on 3D Modeling Ore Bodies

Sirelda Bele

Albanian Geological Survey, Geo-information Department, Tiranë, Albania

Abstract: ***This article discusses the use of classical methods in three-dimensional geological modeling, the advantages and minimum requirements to build a model that approaches reality as much as possible. New modeling techniques now offer the ability to quickly and timely build complex three-dimensional (3D) models and manipulate large datasets. Our goal is to use these new techniques of creating 3D models, applied to the zinc ore in the Fushë Arrëz region in Munella's polymetallic ore deposit. The results of this study showed that; based on Zinc mineralization, the historical database was built with geological, topographic, geophysical and geochemical data. Also based on the ore's 3D modeling resources, 225 drills were applied and 10 profiles were used to construct the 3D model of the ore with the IDW interpolation method. The application of the model was used to evaluate Zn's ore reserves with 0.1% ZN content. This study shows that the use of new 3-dimensional modeling techniques for Zinc ore is very important and efficient in seeking further exploration of mineral resources.***

Keywords: IDW, 3D Modeling, Reserves, Zn

1. Introduction

With the rapid change of technology, it is easier to create, process data, create a geological body, and increase the accuracy of calculating the mineral content of a mineral resource. This shortens the time and cost of searching and using a resource by facilitating the work of geologists, institutions, agencies, or companies for their respective functions. Previously this work was done by calculating the data obtained from each profile manually or as it is otherwise now known, by the traditional methods, in order to distinguish them from the new methods that have recently been used with the massive use of powerful software and computing mineral industry.

The creation of a 3-dimensional geological model is a technology developed over the last few years, assisting geological studies, mineral resource inventions, and quantitative estimation of mineral reserves. Nowadays the 3-dimensional geological model can integrate 2D GIS data, databases, statistical analysis and 3D visual technology by developing 3D visualization models ('Calcagno, 2007)'.

3D geological modeling can be applied to build 3D structural patterns, rocks, geophysical anomalies, geochemical anomalies, and mineral bodies or any spatial three-dimensional information. It should be understood that every point in space has x, y, z and one or more other attributes referring to this space point. The application of these developed 3-dimensional Geological Modeling Methods is used for the realization of zinc ore modeling in this article.

2. Description of the study area

Munella's polymetallic source is located in the district of Puka about 30 km in the southeast of the Town of Fushë Arrëz and has the following coordinates:

1.	X= 4423700	3.	X= 4423300
	Y= 4650200		Y= 4650200
2.	X= 4423300	4.	X= 4423700
	Y= 4649800		Y= 4649800

Figure 1: Image taken from Google Earth, together with the drillings

2.1 Geomorphology of the Munella source

The territory of the Mirdita municipality is generally disordered because of the geological construction and the impact of the hydrography, which has caused a disruption of the uniformity of this region where there is a large number of hills and fields.

southeast. Munella is the vertebrate separator between two Fan rivers. The upper part has good alpine pastures. Inside it contains rich minerals like copper, pyrite, volcanic glass, limestone, etc.

2.2 Geological construction of the source

In the geological construction of the Polymetallic Munella ore deposit, two volcanic rock types are well distinguished micro and macroscopically from each other and are represented by the upper package and the subunit Munella spilite (calcibazalto - andesite) with their types which are generally located at the levels upper and sub-base of Qafë Bari set down. The rocks that build Munella's ore deposit, in the narrow sense of the word, within which mineral areas and minerals of copper, zinc, are:

- Basalt andesites,

Licensed Under Creative Commons Attribution CC BY

- Andesite basalt
- Dacia riolitet.

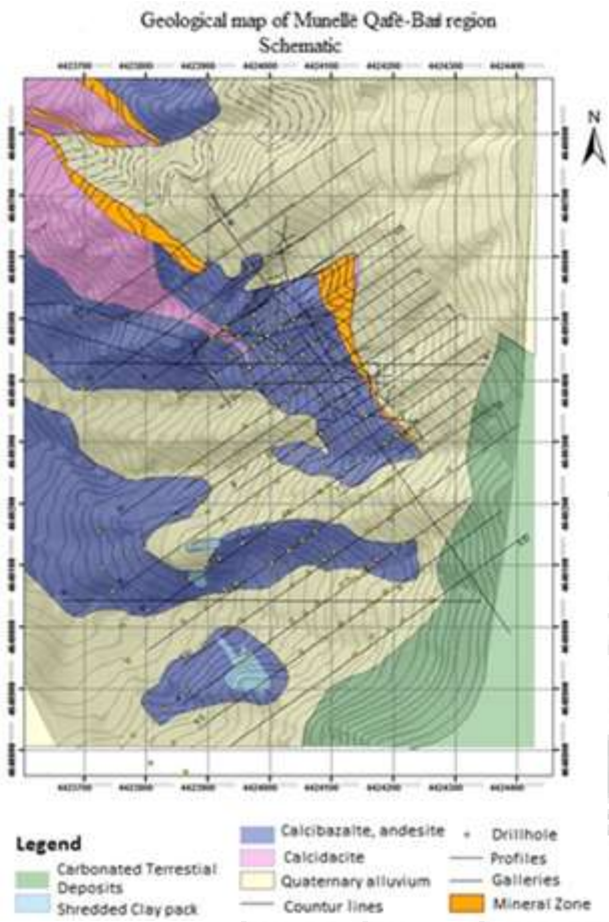

Figure 2: Geological map

2.3 Tectonics of the study area

From the geological position itself, volcanic and sedimentary rocks appear to be wrinkled. In the provincial range starting from Qaf Mali in the north we have the sync of Lak Roshit-Paluce anticlines Tuc - Kodër Keqe and sincline Qaf Bari - Munellë - Gurth-Spac.

All of these structures are complicated by the longitudinal grouting of the N-S Qaf Bari – Gurth with an amplitude of 250-300 m, with an eastern slope of about 30 °, marking the volcanic rocks over the shingle formation. In the horizontal plane, this tectonic has a N-S stretch and emerges quite clearly with an area of 2-3 m thick, crushed, clayed and cracked 2-3m.

2.3 Useful Minerals

In the Munelle polymetallic region, some useful minerals are observed - such as:

- mineralization of sulfur of copper, zinc, iron placed on volcanic rocks,
- mineralization of manganese (oxide) in the bulky,
- volcanic glass in volcanic rocks,
- the appearance of the coal in the terrestrial rocks of the cretaceous and the building materials from the carbonate of the cretaceous.

Thus this zinc copper deposit and other accompanying elements have polymetallic nature with more frequent and higher content of many useful elements compared to other deposits. To evaluate the composition of Munella's ore elements, the following chemical analysis is used for the main elements Cu, Zn, Co, S, Au, Pb, as well as the spectral analysis of all the relevant tests for the accompanying elements. For the most complete evaluation of the types and the bodies we used a set of tests for the elements As, Ag, Pb, Se, to which were chemically analyzed for the main elements and companions as well as the silicate analysis for the evaluation of elements and non-metallic composites.

3. Methodology used

A modeling is a representation or an interpretation of mineral resources. Resources can be products that include gold, zinc, copper etc. To achieve the most accurate creation of a geological body by using special modeling programs, a very good geological knowledge is required, as well as good knowledge in the field of programs, and by combining both of them, a high result can be achieved . For the realization of the model, it was seen as reasonable to combine the interaction of mapping software and modeling programs with the data of the region under study ('Kamberaj, 1980)'.

For the realization of the 3D model, there are four main steps we follow:

3.1 Geoscientific data collection and processing

The study area includes the geological map of the Munella basin with scale 1: 2000 (Deda.T), mining plan, 10 profiles (longitudinal, structural), tables, graphs. Geological profiles, geological columns with drilling number, coordinates (x, y, z) of drilling, direction azimuth, dip angle, depth, information on rock formations. In total, 225 drilling data was used. Chemical analyzes, topographic, geochemical data have been processed and standardized in the same 3D coordinate system ('Guillen, 2008)'.

3.2 Organization of Data

After filtering and evaluating all the collected material we go into its standardization, information is stored in the .xls format by organizing the data in the following 4 tables: Collar, Assay, Survey, Litology.

Table 1: Collar

DHole	*X*	*Y*	*RL*	*Tdepth*	*Dip*	*Azimuth*
1	4424229.94	4649447.64	1297.7	214.6	-75	235
2	4424115.05	4649365.93	1218.78	160.5	-65	55
3	4424115.05	4649365.93	1218.78	249.15	-85	55

Display of x, y, z coordinates and depth of drilling.

Table 2: Analysis

The analysis table presents the data of the results of the analysis, considers the number of drilling, depth, and content in% of elements such as Cu, S, Co, Zn etc.

Licensed Under Creative Commons Attribution CC BY

Dhole	*Sampled*	*From*	*To*	*Thickness*	*Cu*	*Zn*
117	1	191.1	192	0.90	0.017	0.2
117	2	192.2	192.6	0.40	0.05	0.26
117	3	192.6	193.4	0.80	0.03	0.69
117	4	193.4	193.9	0.50	0.09	0.4
117	5	193.9	194.5	0.60	0.16	0.55

Table 3: Survey

The table shows the coordinates X, Y, Z, azimuth, zenith angle. Here it turns out that the depth of the drilling is with the average drop angle -81. The maximum depth reaches 560m.

Dhole	Sample	X	Y	Depth	Dip	Azimuth
1	1	4424229.94	4649447.64	0	-75	235
2	1	4424115.05	4649365.93	0	-65	55
3	1	4424115.05	4649365.93	0	-85	55

Table 4: Lithology

Coordinates, depths of drilling and litology are presented.

Dhole	Sample_id	From	To	Lithcode
1	1	0	13.7	DEL
1	2	13.7	52	MEL
1	3	52	214.6	AN

It is essential that the systematic surveying of geological observations from mapping and drilling is input into an organized database.

3.3 Creation of a 3D geological model

The third stage consists of the preparation of data, their import and compilation in the modeling program, the use of computational statistics to document the data, the construction of 3D surfaces, the construction of 3D bodies blocks into zinc blocks and the interpretation of Zn content, verification of the model created and distribution of the useful element by the classical geostastic interpolation IDW method('Lajaunie, 1997)'. Modeling programs were used to create a block of 4 * 4 * 1 size as well as through the explicite method, 18 Zinc bodies were created, as well as the distribution of Zinc element content in 0.05,1.5, 20% Zn. Calculation of zinc ore reserves were done by IDW interpolation method.

4. Results

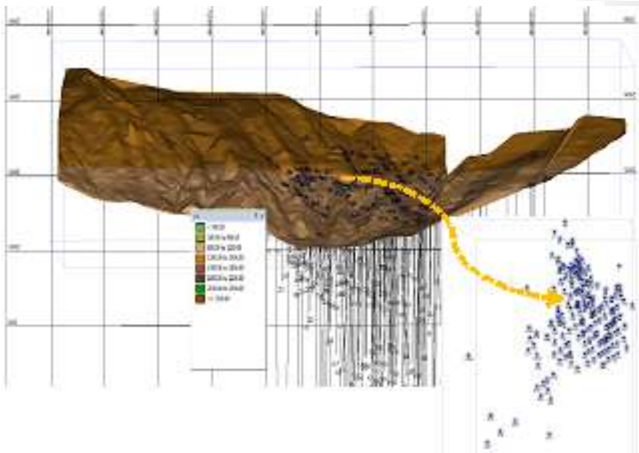

Figure 3: Presentation of the drilling and topography of the region taken in the study

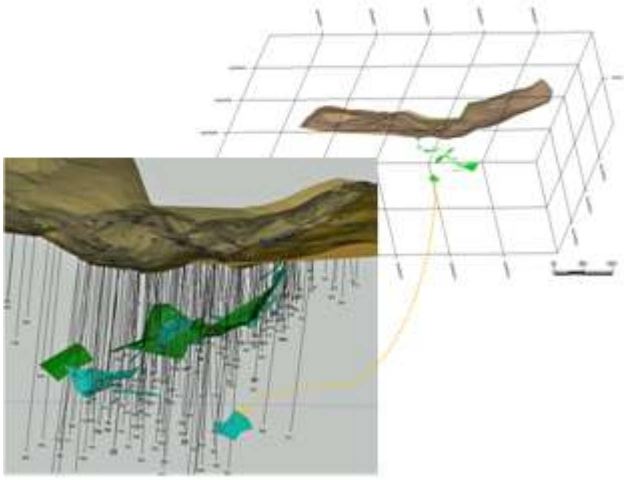

Figure 4: Presentation of zinc bodies created by explicit methods. Created bodies are with a descreasing angle of ~ 87^0 and azimuth ~ 55^0.

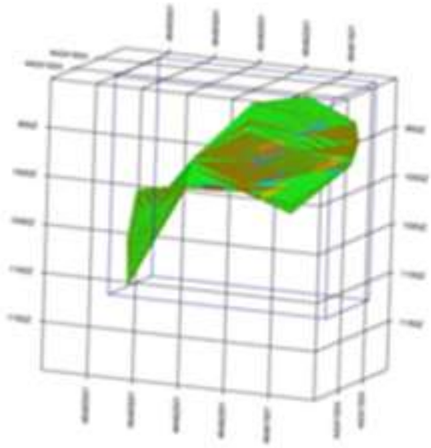

Figure 5: Distribution by percentage content of the zinc element presented in the Zn6 body.

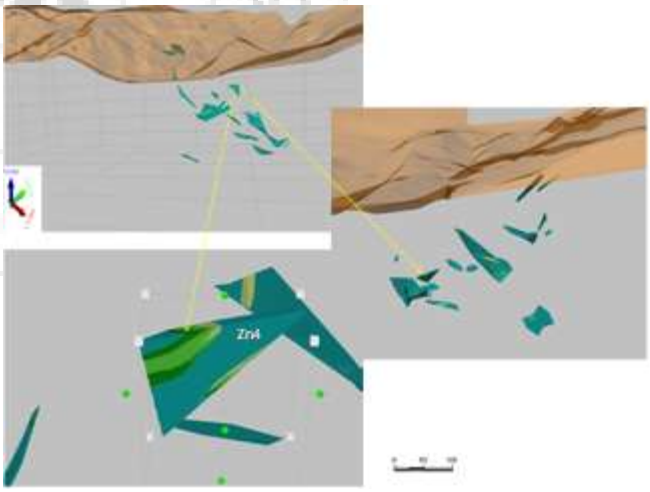

Figure 6: 3D presentation of zinc bodies together with the distribution of zinc content in percent (%)

Table 5 shows the results of the calculation of reserves with the distribution of different categories of zinc content Zn (%) for the 18 ore body created in blocks and interpolated by the Inverse Distance Weight geostastic interpolation method.

From the estimation of the reserves calculated by the method

Licensed Under Creative Commons Attribution CC BY

of division into blocks is estimated 65548.23 tons with an average content of 1.5% Zn. The average density of the body was 2.7 tons / m3.

Table 5: Results of the calculation of reserves

Grade From	*Grade To*	*Volume (m^3)*	*Tonnes*	*SG*	*Zn %*	*Cum_Volume*	*Cum_ Tonnes*	*Zn%*
0	0.05	11750.67	31726.8	2.7	0.251477	11756.2	31558.22	0.271
0.05	1.5	3828.23	10336.18	2.7	1.186987	15515.04	15515.04	0.908231
1.5	20	9568.14	25833.99	2.7	2.23075	25661.34	65548.23	1.482915

5. Conclusion

Based on the results achieved, we can come to very important conclusions about the advantages of using 3D geological modeling methods such as:

- Increase the range of problems that can be solved by using computer models again by generating 3 dimensional geological models.
- Geological interpretation is fundamental to exploration and exploitation
- Geologists should have the knowledge to discover new sources
- Use of the appropriate technology in order to solve complex problems that lie in the depths of the earth

New modeling techniques now offer the ability to quickly create and update complex 3D models and manipulate large volumes of data.

Also the results of modeling and valuation of Zinc ore reserves can be used with interest for exploration and exploitation

References

[1] Calcagno P, ChilesJ P, Courrioux G, Guillen A. (2007). Geological modelling from field data and geological knowledge, Part I – Modelling method coupling 3D potential-field interpolation and geological rules, Physics of the Earth and Planetary Interiors, doi:10.1016/j.pepi.2008.06.013

[2] Guillen A, et al. (2008) Geological modelling from field data and geological knwledge. Phys. Earth Planet. Interiors, doi:10.1016/j.pepi.2008.06.014.

[3] Lajaunie C, Courrioux G, Manuel L. 1997. Foliation fields and 3D cartography in geology: principles of a method based on potential interpolation, Mathematical Geology, 29(4):571-584.

[4] McInerney P, Guillen A, Courrioux P, Lees T. 2005. Building 3D geological models directly from data?An approach applied to Broken Hill,Australia.Digital Maping techniques pp 119-130.

[5] Milligan P, Lyons P, Direen N. 2003. Spatial and directional analysis of potential field gradients — new methods to help solve and display three-dimensional crustal architecture:ASEG Extended Abstracts, Adelaide.

[6] Kamberaj R, Bardhoshi 1980.On the results of geological exploration works at the Munella site and the calculation of reserves with state I.I.1980. "

Author Profile

Sirelda Bele received the Bachelor degrees in i Geoinformation Engineering and M.S. in Geological Engineering Geoinformation profile, from Polytechnic University of Tirana, Geology and Mining Faculty During 2006-2011. Now work in Albanian Geological Survey, Geo-information Department.

Licensed Under Creative Commons Attribution CC BY