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Some aspects of resource model validation

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SUMMARY

For modeling and resource estimating of mineral deposits, control of the correctness the resource model is very important. There are a lot of methods for identification and elimination critical errors, including the application of incorrect methods in modeling and resource estimation. Geological objects, in particular mineral deposits, are highly complex, so a model created on the basis of a limited set of data cannot be true. It should reflect the individual properties and parameters with enough sufficient to solve actual practical problems. It can be achieved using an optimal set of verification procedures at different stages of creating a resource model.

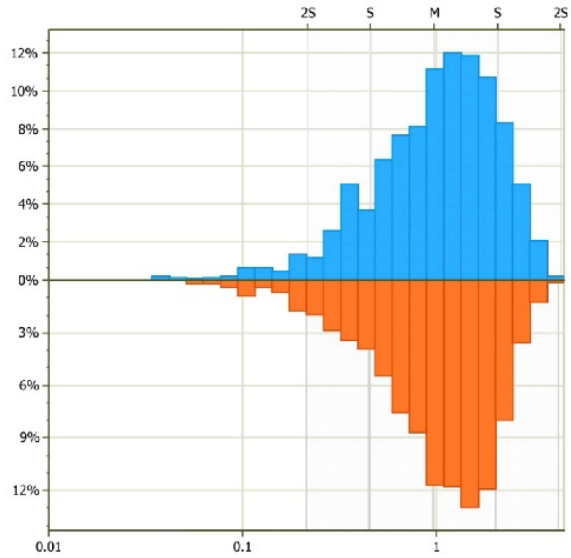
Introduction

Geological objects, in particular mineral deposits, are highly complex, so a model created on the basis of a limited set of data cannot be true, but it should be enough accurately reflect the source data, and correspond to concept of the mineralization distribution and the deposit geological structure (geological interpretation). To afford a sufficient reliability degree, various procedures for resource model verification are used.

Theory and Examples

Verification procedures should be applied already at preliminary stages, such as the creation of composites (composite samples), the creation of an empty block model, etc. [2].

Compositing – the declustering method, which provides the comparability of the influence of samples with different lengths on statistical estimates and consists in recalculating the grades at intervals of a fixed length. Compositing leads to a change the statistical characteristics of the distribution, including a decrease the dispersion, change the mean and anisotropy. The compositing quality is determined by minimizing the influence of this procedure on statistical distribution indicators. Verification of the operation is performed by comparing the grade distribution and statistical parameters on the source data and on composite samples (*Figure 1*).



	Assay	Composites
Minimum	0.4	0.0540
Maximum	4.5	4.2017
N	1347	1368
Mean	1.2139	1.1790
Variance	0.559	0.4885
Standard Deviation	0.7456	0.6989
Variation coefficient	0.6142	0.5928
Ln Mean	-0.0353	-0.0578
Ln Standard deviation	0.7503	0.7437

Figure 1 *Content distribution of the samples and ore intervals (composites)*

For creating a block model is important to choose the size of the parent blocks and sub-blocking parameters, which are used to more accurately follow the shape of the ore bodies. Checking the choice of optimal parameters is carried out by comparing the volume of the block and frame models.

The choice of interpolation parameters of the commercial component grades in the block model is performed using variographic (geostatistical) analysis. To control the variogram quality and interpolation parameters, a cross-validation procedure can be used. It consists in the sequential exclusion from source data set of each sample and the calculation of its parameters using theoretical variogram.

The resource model validation is performed at the local and global levels. For local verification, a visual comparison of the block model with values in samples is used; for a global one, histograms, graphs, statistical parameters of the block model and composite samples are compared [1-3].

The resource model in whole should reflect the main grades in the sampling data set. The expected average grade in a block depends on the value of the mean, mode, median, etc. In all domains, obtained mean should be similar to the original average (*Figure 2*).

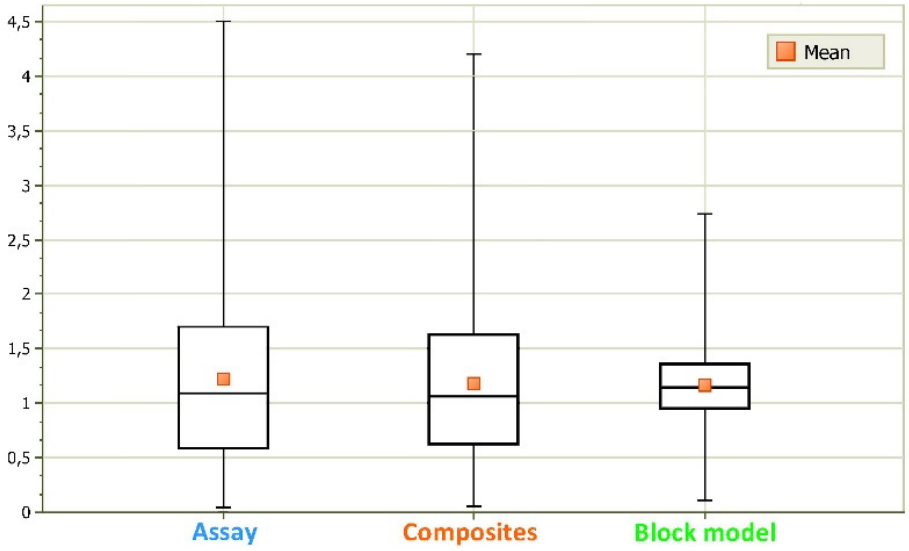
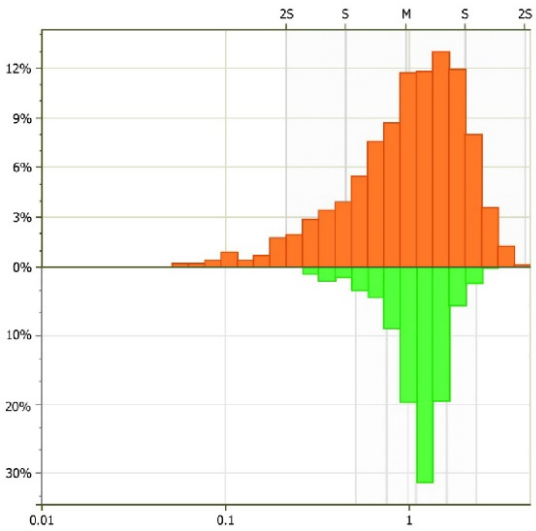


Figure 2 *Comparison of statistical parameters using a box-and-whisker plot*

The interpolation process has a smoothing effect, because the estimated mean of the grade in each block of the model is a weighted mean of the grades in nearby samples. In each domain, the resulting histogram should be similar in shape to the original histogram, with a certain degree of flattening and normalization (*Figure 3*).



	Composites	Block model
Minimum	0.0540	0.1056
Maximum	4.2017	2.7329
N	1368	262446
Mean	1.1790	1.1610
Variance	0.4885	0.1203
Standard Deviation	0.6989	0.3468
Variation coefficient	0.5928	0.2987
Ln Mean	-0.0578	0.0970
Ln Standard deviation	0.7437	0.3434

Figure 3 *Comparison of grade histograms for sampling and composites*

Visual inspection in section and plan allows to compare the block model grade distribution to the original sample grades. This is carried out by simultaneously displaying in a view block model shear and sampling results (*Figure 4*). Block grades should reflect the tenor of local sample grades and boundary conditions.

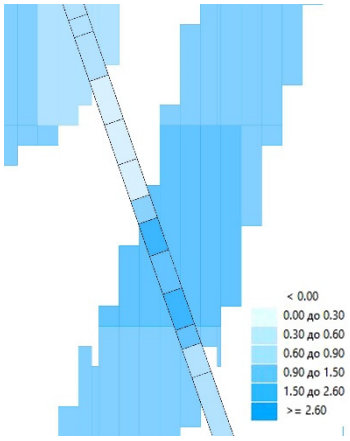


Figure 4 *Visual checking of block (resource) model*

In addition to those already mentioned is reasonably to carry out additional validations, which include: building scatter plots of grades (model and sampling), quantile-quantile plots, comparison with theoretical expectation, evaluation of kriging efficiency and regression line [4].

To validate the resource model is effective to compare with the results of mineral resource estimates using other methods, including traditional ones, as well as with the results of operational exploration and mining.

For example, the results of grade interpolation can be compared using various methods, including kriging and Inverse Distance Weighting method (IDW) [6]. This allows you to avoid critical errors in the interpolation process and determine the method that is most suitable for the deposit.

In comparative resource estimation, it is necessary to analyze the change in the parameters of average grade and tonnage from cut-off grade and explain type of the dependence.

When comparing with the results of previous mineral resources estimates, special attention should be paid to the change in input data: analytical results, methods and parameters of interpolation, etc.

The criterion for comparing the block modeling results and resource (reserves) estimation results by traditional methods is the degree of coincidence of the main estimated parameters: mineral resources and average grade of commercial component.

Comparison of the resource estimation results with the operational exploration data at the developed deposits determines the degree of quality of the performed estimation. At the same time, it is necessary to take into account ore loss, dilution, losses during processing at the factory.

Conclusions

Tools and methods for the resource model verification are numerous and various. The number of procedures for verification the results of modeling and resource estimation and their set for each object depends on the characteristics of the deposit, the modeling methodology, etc. The main purpose of such control is to ensure the required significance level of the modeling results, depending on the actual practical problem.

References

1. Coombes, J. [2008] *The art and science of resource estimation. A Practical Guide for Geologists and Engineers*. Coombes Capability, Perth.

2. Coombes, J. [2009] Validation of Resource Models – Myths, Materiality and Modern Approaches. *Project Evaluation Conference 2009* (Melbourne, Australia) 21-22 April 2009, **3**, 211-216.

3. Webster, R. Mineral resource validation. *https://amcconsultants.com/experience/mineral-resource-validation/*

4. Альмендингер, О. [2018] Методы заверки ресурсной модели. Возможности и ограничения. *https://www.micromine.ru/metodi-zaverki-resursnoy-modeli-minex-2018/*

5. Баряцкая, Н.В., Сафронова, Н.Г. [2019] Поэтапная заверка при трехмерном моделировании и оценке ресурсов рудных месторождений. *Геоинформатика*, **1**(69), 47-57.

6. Белоус, А.И., Ивкин, В.М. [2007] Оценка достоверности подсчета запасов минерального сырья горных предприятий. *Разведка и охрана недр*, **2-3**, 87-94.