Resource Modelling of Iron Ore Deposit using Surpac Software – T.S. Suresh Kumar, Chennai

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Resource estimation and grade determination is a significant phase in exploration, subsequently leading to the mining of a natural resource. Mineral reserve estimation attains its crucial importance owing to large investments in mining industries either due to mechanization or the need for recovery of metal to its optimum level from the mines to meet the end-use requirement.

During the process of prospecting and exploration, appreciable information pertaining to the mineralization is obtained/generated, subsequently, these data are collectively used for estimation of quantity, average grade, shape, and size of the ore body.

The accuracy of information gathered may vary due to techniques implemented commensurate with mineral commodity dealt and objective of exploration. The accuracy of information gathered in exploration determines the precision of estimation of mineral reserve. With the increase in the level of geological knowledge and confidence level in exploration data gathered, a mineral resource can be reported as potentially mineable by applying various factors.

There are several resource estimation methodologies from the traditional to the state-of-the-art geostatistical ones that use the block model as a geometrical representation. The traditional methods do not allow a sufficiently accurate representation or interpolation. However, with the advancement of the use of state-of-the-art software, which uses algorithms that sequentially divide each block into smaller blocks in order to follow the geological structures (sub-blocking), to achieve the level of precision required and results in models with an extremely high number of blocks.

Ore body modelling is a reflection of the geological and geometrical reality of an ore deposit. Geologists and Mining Engineers can benefit from such an integrated modelling approach by honouring the deposit's geology, understanding the statistical distribution and emphasizing the spatial continuity studies.

The use of geostatistical tools of exploratory data analysis, geological modelling for quantification of mineral resource tonnages, and prediction of the variability of grades in the deposit has been applied successfully in various mineral commodities.

The resource modelling of iron ore deposit using Surpac software as a case study is being outlined.

The case study of iron ore deposit dealt is part of Singhbhum-Keonjhar-Bonai belt which is part of the eastern limb of the major IOG synclinorium. The area is affected by series of antiforms and synforms with a N-S trend and a gentle northerly plunge. The lithological formation encountered in the region is mainly laterite at the top followed by iron ore and banded hematite jasper/quartzite, or chert followed by shale at the bottom. The iron ore mainly comprises of different types of ores, viz. massive hard ore/friable ore/powdery ore/ intercalated with sub-grade ore mainly constituting contaminated ore with shale or undigested BHJ/BHQ.

The following are the broad generic steps in carrying out 3-D resource modelling using Surpac software leading to resource estimation:

1. Creation of geological database with drill hole viz. creating of sample file with BH-ID, sampling ID, co-ordinates, lithology, and chemical analysis.
2. Validation of database of analysis.
3. QA and QC process.
4. Statistical analysis and data preparation and drawing inferences.
5. Delineating cross-section lines to best fit the available boreholes, placing them perpendicular to the strike direction of individual ore bodies.
6. Creating geological cross-sections, delineating different ore types, overburden, footwall and Inter-banded waste.
7. Solid-body modelling for each of the three areas, creating solid body envelopes for each individual ore type, subgrade, and waste.
8. In block model, the deposit is sub-divided into regular blocks each representing a planning unit. Based on chemical analyses of the drill holes and the geological model of the deposit, the quality parameters of each block are estimated.
9. Creating composites for individual material types within blocks.
10. Generation of variogram which is a measure of spatial continuity of data set.
11. Estimation methodology, viz., ISD (Inverse-Square Distance) and Kriging
12. Validation of variogram modelling
13. Reporting of results.

Block model is a simplified mathematical description of a deposit. The resultant block model is an accurate inventory of the deposit, which describes the expected quality and quantity for each point/block. It is the fundamental basis for strategic decisions and strategic planning. Further, it can be defined as the "Inventory" of a deposit. Evaluation of resources and calculation of reserves and finally the fundamental basis for long and medium-term mine planning and life of the mines.

Reference

Resource and Reserve Calculation in Seam-Shaped Mineral Deposits; A New Approach: "The Pentahedral Method". César Castañón, Daniel Arias, Isidro Diego, Agustin Martin-Izard and Yhonny Ruiz. Published by MDPI in May 2017

Abstract of the lecture delivered at the monthly virtual meeting of the Geological Society of India on 14 April 2021

DOI: 10.1007/s12594-021-1724-0