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Mineral Resource Assessment in Complex Ore Deposits based on International Standards

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ABSTRACT

Geostatistical simulation has been widely used in mineral resource classification of metalliferous deposits based on international standards such as JORC code. However, the modeling process becomes challenging whenever the relationship among the variables of interest are complicated and cumbersome to model. This characteristic sometimes manifest itself in complex spatial and global cross-correlation measures, deeply depending on the formation and genesis of the deposit. The objective is then to generate the models that not only reproduces this significant characteristics, but also, it leads to better understanding of a mineral resource estimation and successive decision-makings. In this respect, there are different approaches taking into account the spatial correlation structures, for which it can be classified as independent simulation, co-simulation and factor-based methodologies. In this paper, three techniques: Turning Bands Independent Simulation (TBSIM), Turning Bands Co-Simulation (TBCOSIM) and Projection Pursuit Multivariate Transform (PPMT); from those aforementioned approaches are selected to model two cross-correlated variables (Iron and Aluminum) belonging to an Iron ore deposit located in Brazil, in order to examine which methodology better reproduces the corresponding complexity in terms of local correlation measure. By comparisons among the results, it was determined that PPMT outperforms both TBSIM and TBCOSIM for reproducing such an abovementioned complexity. The reason is that these two latter methods which are based on Gaussian assumption, require traditional normal score transformation of the original variables. In this context, the complexity in bivariate distribution cannot be effectively preserved after back-transformation. In contrast, PPMT is an algorithm that transform any complexity nature of correlated variables into uncorrelated factors and then restitute it after back transformation on the basis of Gaussianizing highly non-Gaussian 1-D projection. Since the results of this method are more reasonable and satisfying in practice, they are employed to quantify and classify the mineral resources in the underlying Iron deposit based on JORC code into measured, indicated and inferred. The outputs are then compared with the ones obtained from TBSIM and TBCOSIM which were dramatically inadequate to reproduce the complex characteristics.

Keywords: Iron deposits, Geostatistical modeling, co-simulation, Projection Pursuit Multivariate Transformation, Mineral Resource Estimation.