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Opinion Article

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Development of a 3d Variogram Using the Analytical Geometry of the Plane and Space: Application in Nkout Center Iron Deposit (South Cameroon).

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Abstract

This paper contributes to improve the knowledge of the continuity of an ore body in order to optimize its estimation, both qualitative and quantitative. For the iron deposit of Nkout, the composites data were computed in a program which uses the principles of analytical geometry of plane and space to calculate variograms. This program consists of four main modules which deal with data management, basic statistical analyzes, spatial analyzes and 2D directional variogram analysis for the construction of the final three-dimensional variogram model. The mineralization has been subdivided into four major planes which have for dips 0, 45, 90 and -45 degrees respectively. For each plane, a 2D variogram model was produced following the minor and major directions of mineralization. The anisotropies encountered were corrected and it was found that the 3D variogram is a nested structure of the four planar variograms. The model was authenticated by cross-validation, which study showed that the produced 3D variogram model was adequate for estimating mineralization.

Keywords

Regionalized variable; Variogram; Variographic analysis; Anisotropy ;cross validation

Introduction

Variographic analysis is an essential key in geostatistics. It is a process that not only allows the determination and quantification of the spatial variability of a phenomenon, but also serves as a basic step for most estimation and simulation techniques. The variogram reflects part of the understanding of the geometry and continuity of regionalized phenomena, and can have a very significant impact on predictions from numerical models.

However, a three-dimensional interpretation of the variogram is necessary to fully describe geological continuity. One and two-dimensional variograms have experienced phenomenal advancements in recent years, unlike three-dimensional variograms which have not really been offered an adequate calculation technique.

Moreover, its formulation has been the subject of some research subjects. For example, when dealing with 3D data, the calculation is usually divided into calculations of a 2D variogram and a 1D variogram. It is this method that is commonly called 3D variogram because it uses three variograms, so two horizontal and one vertical. It has been cited and used by several articles and books mainly petroleum, but its approach, its calculation techniques have not been explained or even mathematized. Apart from horizontal and vertical variograms, it has been shown that there are other methods to estimate and model the covariance or variogram components. A study proposes a generalization of directional variograms to general partitions of spatial data before discussing how directional variograms are recovered with a specific partition function. De Iaco et al. developed a product-sum model using data obtained from the realization of spatiotemporal random fields. This technique is used to obtain space-time covariances and variograms. The methods described above present some major problems. The variogram is often computed in the horizontal and vertical directions, but geostatistical simulation programs require the variogram in diagonal directions where the distance vector simultaneously contains contributions from the horizontal and vertical directions. Thus, in this article, we will formulate a technique for the calculation and modeling of planar variograms and its application for the determination of the 3D variogram. The main objective of this paper is to find a model that can describe the spatial variability of a three-dimensional phenomenon that can refine the estimation of resources. The database used for the execution of this program comes from the Nkout Center iron deposit exploration project (South Cameroon).

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