GEOMETALLURGICAL CLUSTERS CREATION IN A NIOBIUM DEPOSIT USING DSCLUS AND HIERARCHICAL INDICATOR KRIGING WITH TREND

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# ABSTRACT

Mining in weathered alkaline carbonatite complexes involves the extraction of minerals in areas where geological processes have altered the original composition of the rocks. These complexes are formed by magmatic, hydrothermal, and weathering geological events, which alter the minerals present in the rocks. This geological complexity is reflected in the processing plant, which presents different behaviors related to the mine region that was mined, what motivated the creation of a 3D block model with geometallurgical clusters. To achieve this, four different algorithms were tested: K-Means, Hierarchical Agglomerative Clustering, Dual Space Clustering (Dsclus), and Clustering by Autocorrelation Statistics (Acclus). The first two consider only the multivariate aspects of the data, while the latter take spatial position into account. The Dsclus was the chosen method, once it proved itself effective in separating zones with similar metallurgical behaviors, respecting the spatial continuity of the clusters made and provided the more coherent results with deposit’s geology. For spatial mapping of the defined geometallurgical domains, we propose a workflow based on a well-known geostatistical framework derived from indicator kriging. This method is herein adapted from its original formulation of mapping multiple (K categories) simultaneously to a hierarchical approach, incorporating trends during the estimations to well reproduce the circular aspect of the deposit. The generated model was validated through reconciliations carried out in the mine's production process, showing high consistency with the real metallurgical recovery. The results demonstrate the potential of the applied methodologies not only to improve the understanding of the geometallurgical characteristics of the mineral deposit but also to support mine planning and optimize production processes.