**ENHANCED RESOURCE DOMAIN CLASSIFICATION FOR MINERAL ESTIMATION USING GEOSTATISTICAL CLUSTERING**

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**Enhanced Resource Domain Classification for Mineral Estimation Using Geostatistical Clustering**

The accurate definition of estimation domains is crucial for precision in mineral resource estimation, optimizing both efficiency and accuracy in mining decision-making. This study implements machine learning-based methodologies to classify estimation domains at the Molejón deposit, known for its economically significant concentrations of gold in quartz breccia and saprolite. The initial methodology includes exploratory data analysis, which characterizes the behavior of the variables of interest and prepares the data for an advanced analysis phase.

The second methodology employs unsupervised clustering techniques, including K-Means, Partitioning Around Medoids, and an adapted version of the latter using the Mahalanobis Geostatistical distance, which is especially valuable for incorporating the spatial dependency of regionalized variables. This approach enables precise and spatially coherent classification, significantly reducing the time needed to identify estimation domains and enhancing the accuracy of geological interpretation.

Results show that the Partitioning Around Medoids method with Mahalanobis Geostatistical distance optimizes domain definition and provides a significant advantage by delivering a more accurate delineation of mineralized areas. This allows mining professionals to efficiently allocate resources while improving strategic decision-making in resource planning and extraction. Therefore, this machine learning approach emerges as a valuable tool for the mining sector, maximizing the value of data and contributing to faster, more accurate resource estimation.