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STOCHASTIC SEMI-AUTOMATIC LITHOLOGICAL MAPPING: A CASE STUDY OF THE TAPAJÓS GOLD PROVINCE, BRAZIL

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RESUMO: This research presents a novel approach for generating semi-automatic lithological maps, developed using an unsupervised self-organizing maps (SOM) analysis, and its subsequent validation. Validation tests were based on geophysical and remote sensing data obtained in the Tapajós Mineral Province. The processing steps are: (i) generation of a vector database using statistically significant variables; (ii) insertion of the database into the SOM domain, where an initial analysis was aimed at the selection of the most appropriate variables for model generation; (iii) principal components analysis (PCA1 and PCA2), for variable reduction; (iv) k-means clustering of the SOM analysis using a Davies-Bouldin index to estimate the optimal number of clusters; (v) bootstrap sampling of 1000 samples from each cluster is used for uncertainty analysis; (vi) application of the uncertainty analysis to the random samples from each cluster related to the SOM output dataset (this calculation is made from the cross-validation using machine-learning algorithms); (vii) computing a new SOM analysis using the variables selected in step ii, which is then repeated for all previous steps. The process is run "n" times to reach satisfactory result; and finally, (viii) the comparison of uncertainties should be an information source capable of producing the statistical improvement for the model. Thus, the interpretive reasoning and relevant knowledge available in the studied region are important. In the Tapajós Mineral Province, the results obtained from the original samples, when analyzed by the "Support Vector Machines" (SVM) method showed a 61% certainty. When analyzed by the "Bayesian Networks" (BN) method, these same data indicated certainty of about 85%. These two methods were also applied to the results obtained by the "Best Matching Units" (BMU) derived from the SOM classification. The results indicated about 95.5% certainty when analyzed using the SVM, and about 98.5% certainty when analyzed using the BN method. The proposed approach supports the systematic generation of semi-automatic lithological maps with enhanced certainty.

PALAVRAS-CHAVE: GEOLOGICAL MAPPING; SELF-ORGANIZING MAPS; UNCERTAINTY ANALYSIS.