

3D predictive modelling using Artificial Neural Network Analysis in the Neves-Corvo deposits

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Resumo

This study focuses on mineral and lithological vectoring to target new VMS deposits in the Neves-Corvo district, Portugal. Neves-Corvo is a world-class deposit in the Iberian Pyrite Belt, discovered in 1977 by ground gravity survey and one of Europe's important copper-zinc producers. The deposit is hosted in volcano-sedimentary sequences within a moderately folded and thrust-faulted setting. Previous studies show differences between massive sulphide ores and stockwork ores, especially in trace-element associations. These geochemical particularities, combined with decades of exploration data, make the area well suited for advanced statistical and multivariate analysis. This study will apply an Artificial Neural Network Analysis (ANNA) methodology to the geochemical data, interpolated from boreholes, and a 3D rock density model, obtained by a constrained inversion of gravity data, to identify patterns that other methods might overlook, thereby improving targeting for new VMS mineralization. ANNA can extract trends from complex datasets and perform non-parametric analysis that do not assume a-priori relationships between variables. Therefore, instead of relying on linear or quadratic regressions approaches, this study employs the so-called black box to determine a mathematical function that can adequately approximate the representation of dependent and independent variables. In this study, the number of variables is considerably smaller than the number of training cases available. The training progresses iteratively, using the previous outputs to carefully and progressively adjust the predictors in an iterative manner, allowing for a continuous validation (based in a set of data taken from the total data before training to monitor the performance of the training in each cycle or iteration) of the different scenarios. The geological model was produced, and the drill-hole density database was used to constrain the 3D gravity inversion. All information was laid in a 5mx5mx5m 3D mesh, eliminating the blocks with missing data. The formatted data was then inputted into in STATISTICA's ANNA software. The variables considered for the first step of ANNA were Cu, Zn, rock density, gravity inversion and Cu/Zn ratio for the Lombador, Neves Graça, Corvo and Zambujal deposits. From the training and validation procedures, it was possible to conclude that using gravity inversion as target and Cu/Zn and rock density as input data produced the more accurate prediction map.

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