Predictivity modelling from multivariate environments coupling Disc-Based Association and Random Forest analyses

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Mineral prospectivity mapping (MPM) aims at outlining areas with the highest mineralization hosting likelihood. The outcome of data-driven MPM approach highly depend on the spatial resolution and precision of the input cartographic datasets. Besides, the geological map has the inherent specificity of displaying 3D structures on a 2D surface map view; some structural configurations can usually lead to a misestimation of the relative proportion of the geological units, the faults or other features displayed in the map. From the Cell-Based Association (CBA), we develop here a new approach – the "Disc-Based Association" (DBA) – analyzing neighboring associations of cartographic features. First, disks entities are generated over a regular node grid covering the study area. Each disk discretize the overlapped data layers by integrating their information into a multivariate spectrum. Then, a Random Forest (RF) predictive model classify the multivariate spectrum from both mineralized nodes (e.g. whose associated disk contain a mineralization) and non-mineralized ones. As mineral concentration processes are inherently rare natural phenomena, we argue that all nodes except the mineralized one can be regarded as non-mineralized and thus used in the classification process. Predictivity scores are computed over the area based on the multivariate spectrum classification. This approach could allow the identification of several signature spectra associated to mineralization; which could be interpreted as several distinct metallotects / mineralization processes forming deposits in the study area. To test and evaluate its consistency, this new methodology is applied to prospectivity mapping of Sb along the Ibero-Armorican Arc (Western European Variscan Range). We infer this new data-driven approach applied to natural cases will improve prospectivity mapping and automatic recognition of new metallotects while giving new insights on the genetic processes forming deposits.

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