Coupling Disc-Based Association and Random Forest for Prospectivity Mapping

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Abstract. From a general point of view, prospectivity mapping aims at outlining areas with the highest likelihood to host mineralization. In this frame, data-driven approaches rely on statistical and spatial analysis applied on diverse geological features and known mineral occurrences to estimate likelihood, while minimizing the expert inputs in the model. As such, we present here the new "Disc-Based Association" (DBA) method – a prospectivity tool derived from the "Cell-Based Association" (CBA) method (Tourlière et al., 2015) – used to pre-process the data. While most predictive models rely on searching for associations between mineralization and specific geological formations, this method aims at overcoming precision and positioning problems related to geological maps by considering geological environments. The study area is discretized in a regular node grid. Different information layers can be thus integrated (e.g. lithological and structural features, geochemical or geophysical data) and the associations of all these geological factors is defined around each node. Pre-processing of map data thus results in a multivariate matrix covering the study area. Finally, a Random Forest predictive model computes the score from this matrix, allowing it to (i) highlight specific associations around mineral deposits (ii) define one or several metallotects for the considered commodity and then (iii) produce favorability maps. This new methodology is here applied to prospectivity mapping of Sb throughout the West European Variscan Ranges at multiple scales along the Ibero-Armorican Arc. This allows testing and evaluating its consistency for a multi-scale approach. Its efficiency is compared to other methods already used with CBA. We infer that this new multiscale and multidomains data-driven approach coupling DBA and Random Forest will improve this prospectivity mapping method while giving new insights on the genetic processes resulting in Sb deposits through the Variscan Range. This Ph.D research work is funded by the ERA-MIN2 AUREOLE project (ANR-19-MIN2-0002, https://aureole.brgm.fr).