Predicted spatial distribution of major copper deposits types in southeastern Europe

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The future search for mineral deposits will focus more and more on discoveries under cover. Indirect methods, such as prospective mapping, help in the early stages of exploration programmes to delineate potential target areas and thus reduce costs. On the Balkan peninsula, copper and gold ores have been mined for thousands of years and it hosts Europe’s highest concentration of large porphyry Cu (-Au) deposits. Over the last decades, the region’s mining history was strongly influenced by state-controlled mining under the previous communist regimes and the sudden demise of this mining activity after the collapse of the Union of Soviet Socialist Republics (USSR) in 1991. Following the shutdown of the mining industry and political, social and ethnic tensions in the years thereafter, the region remained comparatively poorly explored and thus holds a high potential for modern brown- and greenfield exploration. This is exemplified by several new discoveries of porphyry Cu (-Au) deposits, e.g. Kiseljak (Serbia) and Skourries (Greece).

Here we report on a regional-scale prospectivity mapping approach applied to the Balkan peninsula, covering Bosnia and Herzegovina, Serbia, Montenegro, Albania, Kosovo, Macedonia, Bulgaria and Greece. The area of interest (AOI) has an acreage of >1 Mill. km². We modelled the distribution of both porphyry and related epithermal Cu-Au deposits, ophiolite-hosted volcanogenic massive sulphide (VMS) and sediment-hosted stratiform Cu (SSC) deposits with the help of ESRI ArcGIS. The models used were knowledge-driven and mainly based on Fuzzy overlays using Gamma operator and µ-value of 0.975. Areas favourable for porphyry and epithermal Cu-Au deposits follow magmatic arcs that are of Cretaceous and Tertiary age. While the Cretaceous arc has long been known for its fertility, our results suggest that the Tertiary arc is at least as promising. The results were validated by both the magmatic arcs, recommended porphyry Cu tracts and known deposits or occurrences. Our areas of high probability explain 67 % of the 72 existing deposits/occurrences if the location of the latter is considered with a 5 km radius. As the examined VMS deposits are ophiolite-hosted, they are distributed along the ophiolite-bearing tectonic units. Prediction of so-far undefined ophiolites based on lithology lead to a better comparability of prospective areas for VMS deposits throughout the AOI. By validation with locations of existing mines within a radius of 2.5 km, 50% of 16 known deposits lie in areas with a probability of ≥0.5. So far no SSC deposits, which constitute the globally second most important source of Cu, have been discovered in the AOI. Our results suggest that areas favourable for SSC
deposits might exist in parts of Bosnia and Herzegovina, where the critical geological prerequisites for SSC formation were found in close vicinity. Whether this close spatial relationship, some of which is most likely tectonic, was realized at the right times remains to be investigated.