Mineral prospectivity mapping in GIS using fuzzy logic integration in Khondab area, western Markazi province, Iran

Morteza Tabaei[1,*], Mahin Mansouri Esfahani[1], Pezhman Rasekh[1], Ali Esna-ashari[2]

1- Department of Mining Engineering, Isfahan University of Technology, Isfahan, Iran.
2- Geological Survey of Iran

* Corresponding Author: mtabaei@cc.iut.ac.ir

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Abstract: Khondab area is located in western Markazi province, within the Sanandaj-Sirjan Zone. The zone has been previously known to be associated with Pb, Zn, Cu, Fe, Ba and Si elements. The current study is carried out to identify new promising targets for regional exploration. Multiple data sources (e.g., magnetic surveys, faults, geological and satellite data) are processed and then integrated by using Fuzzy Logic modelling to produce a final prospectivity map for regional exploration of MVT deposits in the Khondab area. Finally, resulted prospectivity map is validated by analyzing field derived samples collected over revealed promising zones of the study area and ore-microscopic studies of the collected samples also confirmed MVT mineralization.Validation process indicates that Cretaceous limestone units are in high correlation with MVT mineralization in this area. Based on priority rating of exploration targets, the eastern and the south-eastern parts of the study area are the most promising parts for further exploration of MVT deposits.

Keywords: Fuzzy Logic modelling; Khondab area; MVT; Sanandaj-Sirjan Zone.

1- Introduction

Acquiring the pre-known exploration models and proper integration techniques to delineate new promising zones is widely recommended in mineral prospectivity mapping. There are two GIS-based integration techniques including data-driven and knowledge-driven modelling techniques. In the first case, mineralization features of the pre-known deposits are applied over the unknown ones. Some common methods of this approach are including: weight of evidence (Bonham-Carter, 1994), logistic regression (Chung and Agterburg, 1980), decision tree analysis (Reddy and Bonham-carter, 1991) and neural networks (Brown et al., 2000). The mentioned methods are applicable only if the number of the same pre-known deposits and their associated information are sufficient for further decision makings. Due to this limitation of data-driven methods, knowledge-driven methods were introduced (Bonham-Carter, 1994). Based on these methods, different crisp values are assigned to the informative layers one after another assuming their respective relative importance toward the mineralization process. The crisp values are assigned based on the exploration expert's knowledge. Methods including Boolean logic, index overlay (Harris et al., 2001) and fuzzy logic (An et al., 1991) are classified as knowledge-driven methods. Previous studies have already demonstrated that fuzzy modelling approach within GIS environment is widely accepted among geoscience experts. The approach is widely used in exploration of iron deposits (An et al., 1991), Mississippi Valley-Type (MVT) mineralization (Eddy et al., 1995) and also epithermal gold deposits (Carranza et al., 1999). An et al. (1991) used a reclassified lithology map combined with several geophysical maps to generate a fuzzy model and