Data mining of remotely sensed datasets for ore grade estimation

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1. Abstract

Estimation of ore grade is a time and cost consuming process that requires laboratory-based and exploratory information. Recognition of ore grade distribution in each alteration zone will help to decrease the risk of exploration and plan for further mining activities (Brown et al., 2000; Harris and Grunsky, 2015). Previous remotely sensed alteration mapping methods were merely focused on the spatial distribution of alteration zones (Ranjbar et al., 2001; Ranjbar et al., 2011; Honarmand, 2016). However, further information like ore grade distribution and whether the explored area is an economic deposit or not remains as a question. To find out the relationships between ore grade and alteration minerals, quantitative modelling as a combination of geological knowledge with the mathematical analysis is suggested. The aim of this study is to develop an algorithm as a predictive model of copper content. The model could be used not for only broad regional exploration of ore deposits but also the estimation of ore grades in the different alteration zones by using remotely sensed datasets. The proposed remotely sensed datasets which will be used in this study include ASTER and Sentinel 2 satellite images, airborne magnetics and radiometrics.

The geological setting of the studied Neotethyan Cu-porphyry deposit is the collision of the Arabian and the Neotethyan plates, leading to the subduction of the Neotethyan oceanic plate under the central Iranian micro continental plate during the Paleocene to Oligocene (Maghsoudi Moud and Fathianpour, 2016). As a consequence, intensive calk-alkaline magmatic activities occurred and led to the formation of Urumieh-Dokhtar Magmatic Belt (UDMB). This belt is the host of several porphyry copper deposits (e.g. Sar Cheshmeh, Darreh Zar, Meiduk) in Iran and known as one of the main Cu-bearing belts in the world (Zarasvandi, 2015). Samples from the surface (weathered) and depth (drill hole) will be collected from the different alteration zones of Dalli deposit within the central part of the UDMB to derive the predictive model of copper ore grade. Also, samples from different alteration zones will be collected from the Kouh Panj area within the southeastern part of the UDMB to test the performance of the model.

The study is divided into the following steps. First of all, different laboratory measurements like hyperspectral imaging, point spectroscopy, X-ray powder diffraction (XRD), X-ray fluorescence (XRF), and magnetometry will be applied to the samples of the Dalli area. The laboratory measurements

demonstrate truthful information, including ore grade, mineral composition, and mineral assemblages. Then, the relationships between the truth information and remotely sensed dataset would be quantified as a set of equations which make the predictive model of copper content. Afterwards, the model will be applied on the datasets to build a remotely sensed estimation of ore grade. The quantified estimates will be integrated to create a map in which illustrates the ore grade distribution in each alteration zone. The outcome will be compared to exploratory reports and approved ore reserve to evaluate the uncertainty and accuracy of the model. In the next stage, to assess the operation of the model, it will be applied to remotely sensed datasets of the Kouh Panj area to create a predictive ore grade map within the different alteration zones. Finally, the outcome will be compared to the analysis results of the collected rocks from the Kouh Panj area to determine the uncertainty and accuracy of the model for the prediction of ore grade and alteration mapping. Since Cu porphyry mineralization systems of both Dalli and Kouh Panj areas are the same, it is expected that the created model in the Dalli area would be operative in Kouh Panj area with a derived estimation of uncertainty.

2. References

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