Metallogenic Prediction of Manganese Ore Based on Generation Adversarial Network and Multi-source Geological Sample in Songtao

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Abstract

Songtao County in northeastern Guizhou province is endowed with abundant manganese (Mn) ore resources, but, recently, the shallow and easy deposits have been found completely in the region exhausted, and the focus of prospecting has shifted to the coverage area and deep. Data-driven metallogenic prediction using machine learning (ML) is emerging as a powerful tool to support mineral exploration targets for regional scale and deep prospecting. However, due to the complex geological conditions and mineralization process, it is particularly difficult to extract and identify deep mineralization information. At the same time, mineral prediction based on supervised learning faces some common problems, especially the few mineral samples, insufficient and unbalanced training samples, and vague subtle information in exploration data. This paper presented a new integration scheme for mineral prediction using generative adversarial network (GAN) based on multi-source geological sample data (Geo-GAN) and semi-supervised learning of biased support vector machine (biased-SVM) to solve the above problems. Specifically, the purpose of using Geo-GAN is used to solve the problem of insufficient samples, while the biased-SVM is used to deal with the sample imbalance problem to reduce its impact on mineral prediction. Firstly, for the weak or hidden information caused by hidden deposits, multiple methods are used to obtain the original sample data. Secondly, the Geo-GAN is used to solve the problem of insufficient samples. Then, the biased-SVM is used to modify the classification bias of the model and increases the weight factor of positive sample. Finally, the 12 prediction evidence was integrated for producing a manganese ore perspective prediction map. The results show that the Geo-GAN can effectively solve the problem of sample shortage, but cannot guarantee the performance of the sample set; while the biased-SVM based on semi-supervised learning is used to construct balanced sample set in batches to effectively solve the sample imbalance problem. On this basis, a deep convolutional neural network model based on geological sample data (Geo-DCNN) is established, and the performance of the Geo-DCNN is demonstrated by the AUC

values of the balanced and original samples. The final results show that the Geo-DCNN model trained by the balanced sample set after multi-method treatment has better universality and robustness of metallogenic prediction.

Keywords

Datangpo-type Mn Ore (DMO), Generative Adversarial Network (GAN), Semi-supervised Learning, Biased Support Vector Machine (biased-SVM), Metallogenic Prediction, Northeastern Guizhou