Mapping mineral prospectivity via convolutional neural network

TONG LI[1] RENGUANG ZUO[2]

[1]China University of Geosciences (Wuhan).No.78 Jincheng Street, Wuhan, China. E-mail:litong@cug.edu.cn

[2] China University of Geosciences (Wuhan).No.78 Jincheng Street, Wuhan, China. E-mail:zrguang@cug.edu.cn

Convolutional Neural Network (CNN) has been proven to be an effective tool for classification and prediction. In this contribution, CNN is employed for mineral prospectivity mapping (MPM) in the southwestern Fujian Province, China. Two issues limit the development of CNN in MPM. One is the high-dimension and complex spatial pattern of geoscience data; the other is the scarcity of labeled samples (known deposits) for training a high-capacity CNN model. To address these two issues, a data augmentation method which took randomly drop-outs from the data repetitively was firstly proposed to obtain enough samples for training, and then a modified CNN architecture for MPM. A variety of hyper-parameters like the size and the amount of kernels of each convolutional layer, the location of the max-polling layers, the size of the fully connected layers, learning rates and iterations were investigated to obtained the optimal hyper-parameters of CNN. This well-trained CNN model was applied on a testing area which is completely unknown for the network. The mapped areas show a strong spatial relationship with the known mineral deposits, most of the known Fe deposits are located in the areas with high probability (> 0.99). The findings indicate that (1) this random-drop data augmentation method is suitable and effective for supervised machine learning methods, and (2) such modified CNN is a potential technique for integration of multi-source geoscience data and a feasible method to guide further exploration.

Key words: mineral prospectivity mapping, machine learning, CNN, data augmentation.