

3D Mineral Prospectivity Modeling for Targeting Concealed Mineralization Within the Chating Area, Middle-Lower Yangtze River Metallogenic Belt, China

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The Chating area is situated within the Yangtze metallogenic belt in Anhui Province, China. Several concealed skarn and porphyry-type deposits have been discovered in this area, indicating high potential for hosting hydrothermal deposits. However, due to the complex geological structure, exploration risks significantly increase with increasing depth. To overcome this challenge, three-dimensional mineral prospectivity modeling (3DMPM) has begun to be widely applied for mapping the prospectivity of deep-seated and concealed mineralization. However, most previous studies on 3DMPM were based on shallow supervised machine learning models and dimensionality-reduced 3D predictive maps. Although these models have shown good results, they may lose spatial correlation within the 3D predictive maps and fail to explore nonlinear correlations between the 3D predictive maps and mineralization. Therefore, this paper initially builds and optimizes 3D geological models through implicit 3D geological modeling and a "total litho-inversion" approach. Subsequently, the 3D predictive maps are generated by employing various 3D methods, which are further integrated using a 3D convolutional neural network (3D CNN) model to identify highly prospective areas for mineralization. The results show that the highly prospective areas identified by the 3DCNN based 3DMPM include not only the training data but also other mineral deposits that have previously been discovered within the study area. In addition, the 3D CNN model performs better prediction capabilities due to its enhanced ability to capture the correlations between 3D predictive maps and multiple types of mineral deposits. It suggests that the 3DMPM based on the 3D CNN model has commendable predictive capabilities in identifying prospective mineralization areas, and some new highly prospective areas can be considered priority areas for future exploration of concealed mineralization within the Chating area.