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Machine Learning Algorithms as a Tool for Data-Driven Interpretation of Multiphysics Data Sets in Underexplored Areas

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Machine learning (ML) and artificial intelligence (AI) algorithms have become very popular in various mining industry sectors in recent years. The increasing popularity of the algorithms can be explained by their extreme efficiency in extracting valuable and objective information from enormous data volumes with minimal human input. Some of the algorithms have become an essential part while studying areas with dense data coverage. Various cases have shown that interpretation of geological-geophysical data sets can benefit from the application of ML techniques for tasks such as delineation of lithological units (Kuhn et al, 2018; Melo et al, 2021), anomaly detection (Zhong et al, 2019; Triskova, 2017), prospectivity analysis (Yeomans et al, 2020; Granek, 2016), etc. In this paper, we demonstrate the usefulness of supervised and unsupervised machine learning algorithms as a tool for inferring complementary geological information while studying poorly explored areas. As input data for the algorithms demonstrated, we use results of a high-resolution nationwide airborne geophysical survey flown in Sierra Leone in 2019 (Gorbunov et al., 2023), terrain measurements, and satellite imagery. We show that convolution neural networks allow extracting valuable information on structural features from acquired geophysical data. Moreover, we present results of self-organizing map clustering as a pseudo-lithological map.

The huge amount of data collected required efficient (but also sparse) interpretation techniques. Using high-quality geophysical and open-source remote sensing data sets has allowed us to confirm, challenge, and complement previous results of geological-geophysical interpretation of acquired data and to chalk out previously unknown prospective areas for further ground verification and detailed evaluation. The results of applying ML algorithms to geological-geophysical data sets have confirmed their appropriateness and value due to the fully data-driven approach.