Detection of Lead and Zinc Geochemical Anomalies Using Artificial Intelligence Techniques: A Case Study from the Dehagh Area, Isfahan, Iran

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Abstract:

The challenge of distinguishing geochemical anomalies from background levels is a significant issue in the field of geosciences and is essential for mineral exploration. Recently, artificial intelligence (AI) techniques have garnered considerable interest for their ability to process complex datasets and uncover hidden patterns. Among these techniques, autoencoders have proven to be particularly effective in reducing data dimensionality and detecting anomalies. This research focuses on utilizing the autoencoder method to pinpoint lead and zinc anomalies in the Dehagh region of Isfahan, Iran. The analysis is based on a dataset of 627 stream sediment samples examined through ICP-MS. The autoencoder was employed to identify geochemical anomalies, and the model's efficacy was assessed using the Receiver Operating Characteristic (ROC) curve, achieving an area under the curve (AUC) of 0.91, which indicates a high level of accuracy in differentiating anomalies from background data. Additionally, a P-A plot was utilized to evaluate the spatial relationship between the detected anomalies and existing mineral indices in the area. The findings showed a strong correlation between the identified anomalies and already known mineral indices, affirming the model's high effectiveness. This study illustrates that AI-driven approaches like autoencoders are valuable tools for analyzing geochemical datasets and facilitating mineral exploration, thereby enhancing exploration efforts and increasing the precision of geochemical anomaly detection.

Keywords:

Anomaly separation, artificial intelligence, Dehagh, lead and zinc.