Employing Geospatial Technology for Mineral Exploration in South Africa

Priyanka Devdath (South Africa)

SUMMARY

The global transition to clean energy is driving an upswing in demand for lithium, requiring more efficient and cost-effective mineral exploration methods. South Africa, which hosts significant potential in pegmatite deposits like the Orange River Pegmatite Belt (ORPB), the application of machine learning (ML) with satellite data for lithium exploration remains underdeveloped. This study investigates the effectiveness of geospatial technology and ML for identifying Lithium-Caesium-Tantalum (LCT) pegmatites. Spectral analysis confirmed Sentinel-2 bands B11, B12, and Landsat 8 bands B6, B7 as the pre-eminent indicators, leveraging the Aluminium-Hydroxyl (Al-OH) index.

Two supervised ML algorithms, Random Forest (RF) and Gradient Boosting (GB), were tested for classification. The results demonstrated that the RF algorithm significantly outperformed GB, achieving an overall accuracy of 94% and a kappa coefficient of 0.88 in the ORPB, compared to 81% and 0.63 for GB. The RF classification produced geologically plausible results, correctly highlighting the LCT-rich western part of the belt. While application at a national scale revealed limitations in regions with differing climates and geologies, it also suggested a novel potential for detecting lithium in brine deposits associated with inland salt pans.

The study concludes that geospatial technology, particularly the RF algorithm, serves as a powerful and cost-effective complementary tool to conventional geology, enabling the prioritisation of exploration targets and improving the overall efficiency of mineral exploration in South Africa.

This study investigates the effectiveness of geospatial technology and ML for mineral exploration in South Africa, with a focus on identifying LCT pegmatites in the Orange River Pegmatite Belt (ORPB).