Multispectral Survey Based on Remote Sensing for Chromite Prospecting in Oman Ophiolite

Cezar Augusto Teixeira Falcão Filho[1], Kim Braga Poletto[1], Eduardo Antonio Abrahão Filho Abrahão Filho[2], Luan Oliveira Lima[2], Parham Ahrabian[2], Ahmed Mohamed Al Rahbi[2], Mohammad Al Maktoumi[2]
[1]Geoterramar - Remote Sensing, Ilhéus, Brazil, [2]Oman Chromite Company, Sohar, Oman

This abstract presents the results of a collaborative mineral exploration campaign conducted by Geoterramar and Oman Chromite Company (OCC) in northern Oman's ophiolitic belt, a region recognized for its chromite mineralization potential. The 104 km² study area exhibits optimal conditions for remote sensing analysis due to minimal vegetation cover, limited anthropogenic disturbance, and an arid climate that reduces atmospheric interference.

High-resolution WorldView-3 multispectral imagery was utilized to develop a predictive model for chromite exploration targets. The dataset, consisting of the OR2A product dated 05/23/2021, was atmospherically compensated (AComp) and geometrically corrected/orthorectified by DigitalGlobe Inc. In addition to panchromatic (0.31 m) and VNIR multispectral (1.24 m) capabilities, the imagery includes SWIR bands positioned at diagnostic wavelengths for detecting Al-OH, Mg-OH, Fe-OH-bearing alteration minerals, and carbonate minerals.

Advanced digital image processing techniques were employed, including pan-sharpening, downscaling, band stacking, principal component analysis (PCA), and band ratioing, to enhance mineralogical signatures. Predictive spatial models for chromite exploration were developed using mean shift segmentation, Isodata clustering, Maximum Likelihood classification, and machine learning algorithms such as Support Vector Machine (SVM), Random Forest, and Artificial Neural Networks (ANN). The final predictive model was generated through map algebra integration.

Principal components PC3 and PC5 proved particularly effective in delineating the spatial relationship between dunite conduits and gabbro dikes, with all mapped chromite occurrences located along these conduit structures—confirming both lithological and structural controls on ore emplacement. The proximity of gabbro dikes to mineralized zones further suggests a metallogenic association among dunite conduits, gabbro intrusions, and chromite mineralization, establishing a robust framework for future prospecting efforts.

The integration of multiple machine learning models with spectral and spatial data significantly improved the identification of areas with high chromite mineralization potential, contributing to more efficient resource allocation and exploration planning.