Detailed petrography, petrophysics, and SIP studies of Dargai ophiolitic complex located at the NW KP Pakistan

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SUMMARY

The current research deals with the petrophysical analysis of a collection of Chromite and associated host rock samples from the Dargai Complex Heru-Shah, NW, Khyber pakhtunkhwa (KP), Pakistan. Geophysical exploration for disseminated chromite deposits always proves difficult, as these deposits do not manifest significant geophysical anomalies. However, the Spectral-induced polarization (SIP) responses of rocks have not been fully characterized because of various petrological properties influence. A total of 200 samples were taken from outcrops and Chromite mines to study different intervals for lab analysis to make thin sections for detailed mineral identification. Petrographic analyses highlight significant alteration processes that transform chromite into ferrochromite and magnetite, particularly along grain margins and cracks. The studied areas consist of three primary ultramafic rocks, Dunite, Harzburgite, and Chromitite, but the petrographic studies have identified serpentinite as a host rock with dunite. We investigate the relationship between complex resistivity spectral parameters measured in the low-frequency between 0.01Hz-1000Hz range, with 26 frequency points, using GSZA-FW 01 impedance analyzer and other petrophysical properties, such as density and magnetic susceptibility. We applied Bayesian Inversion of SIP data (BISIP), an open-source Python program to perform Inversion of SIP data, then we fitted a double Cole-Cole model in Resistivity form to the spectra to extract the Cole-Cole parameters including R_0, c_1, m_1, and τ_1 in low frequency. Across all samples, resistivity amplitude decreases with increasing frequency due to reduced polarization effects at higher frequencies. Chargeability, relaxation time, and magnetic susceptibility values of the serpentinized and ferrochromite samples were higher than dunite and harzburgite, but the resistivity of chromite is higher than serpentine and less than harzburgite; on the other hand, ferrochromite density is the highest among all rock samples rocks however serpentinite is lowest. Finally, we suggest that gravity, magnetic, and spread spectrum-induced polarization (SSIP) be carried out for area future chromite exploration.

Keywords: Chromite Deposits, Petrophysical Properties, Spectral-Induced Polarization (SIP), Dargai Complex