Geophysical Characterization and Prospective Assessment of Copper Ore in Waziristan Complex

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The Waziristan complex, spanning over 500 km², formed during the Paleocene to early Eocene interval, featuring ultramafic rocks, gabbros, sheeted dikes, pillow lavas and pelagic sediments. It constitutes a typical ophiolite suite, hosting various economic minerals like copper, gold, chromite, and azurite. Copper mineralization in the area includes native and sulfide types, occurring as veins, veinlets, stringers, and rims around fragments, often associated with cupriferous breccia. The study employs integrated geophysical techniques, including gravity, magnetic, resistivity, and induced polarization (IP) surveys, to assess copper and associated ores within the Waziristan complex. Data collection involved 81 gravity and magnetic stations, leading to data acquisition along 3 IP and resistivity profiles across the project area. Analysis of the data revealed a Complete Bouguer Anomaly (CBA) with a total relief of 10.3 mGal and a Total Magnetic Field Anomaly (TMFA) indicating a total magnetic anomaly of 10749.7 nT. Gravity maps showcased southeast-northwest trending linear gravity highs, alongside north-south trending anomalies, while the magnetic maps displayed east-west trending linear magnetic highs. Notably, a shift in gravity and magnetic anomalies was observed, with southeast-northwest gravity highs correlating inversely with magnetic highs. Elliptical magnetic lows surrounded by highs emerged as key indicators for locating copper ore bodies. Additionally, resistivity and IP modeling identified zones of low resistivity and high chargeability, suggesting anomalous geological features at varying depths and distances. Based on these findings, a borehole depth of 150m is proposed at a location characterized by high gravity, low magnetic and low resistivity values, and high chargeability.