Structural interpretation of the Alma inlier (Western Anti Atlas, Morocco) from an aeromagnetic analysis: Implications for copper exploration

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Résumé

The Alma inlier, located in the Western Anti-Atlas of Morocco, consists of a Proterozoic basement overlain by a Paleozoic sedimentary cover. Unlike other well-studied inliers of the Anti-Atlas, such as Kerdous or Igherm, the Alma inlier has received little attention despite its structural framework being known to influence sedimentary copper mineralization. This knowledge gap provides an opportunity to better constrain its geological architecture and metallogenic potential. To address this, hyperspectral and multispectral remote sensing were employed to identify copper-related alteration zones and delineate major lineaments. The results, validated through a dedicated field mission, provided valuable insights and established a solid foundation for subsequent geophysical investigations. High-resolution aeromagnetic data were then analyzed using multiple processing techniques: Reduction to the pole (RTP) was applied to center magnetic anomalies over their sources, tilt-angle analysis was used to enhance structural boundaries, and Euler deconvolution provided source depths. These analyses reveal two principal structural trends: NE–SW and N–S lineaments associated with Pan-African tectonics, and NW–SE to E–W features linked to the Variscan orogeny. Depth estimates from Euler deconvolution range from near-surface to several kilometers, reflecting a complex subsurface architecture. Copper mineralization appears structurally controlled, occurring mainly along faults at the edges of Proterozoic uplifts, where paleo-basins with basal sediments were intersected by faults that likely acted as conduits for hydrothermal mineralizing fluids. Overall, this study demonstrates that combining remote sensing, field validation, aeromagnetic interpretation, and geological mapping provides new insights into the structural framework and tectonic evolution of the Alma inlier. Beyond its contribution to the regional geodynamic context, the identification of major fault-controlled corridors highlights prospective zones, offering a valuable guide for future copper mineralization exploration strategies in the Western Anti-Atlas and comparable regions.

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Mots-Clés: Aeromagnetic analysis, Alma inlier, Copper exploration, Structural interpretation, Western Anti, Atlas