

Prospectivity modeling of Lithium-Cesium-Tantalum pegmatites in the Sanandaj-Sirjan zone of the Western Iran with Fuzzy Inference System Approach

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Lithium-Cesium-Tantalum (LCT) pegmatites are main sources of rare metals that power modern technologies, from electric vehicles to renewable energy storage. Finding these mineral-rich zones, require deep understanding of the geological processes that control their formation and a smart approach to integrating diverse exploration datasets. In this study, we used a Fuzzy Inference System (FIS) to identify prospective areas for LCT pegmatite mineralization in the Sanandaj-Sirjan Zone (SaSZ), Western Iran. Using mineral system modeling approach, we assessed the fertility of granitic source rocks, the structural pathways that control magma transport, and the conditions that favor pegmatite emplacement; targeting criteria for critical mineralization processes were identified. We used geospatial datasets, including geological, structural, airborne magnetic and stream sediment geochemistry data, to create predictor maps that reflect key aspects of LCT pegmatite formation. The output of the prospectivity map shows high potential for LCT pegmatites, particularly near the Alvand Plutonic Complex. These high-priority zones are closely associated with S-type granites, aligned with the major NW-SE trending fault system of the region, and predominantly correlated with LCT pegmatite pathfinder geochemical anomalies. The strategy demonstrated in this study indicates that the model is robust and cost-effective regarding exploration target generation.