

An Updated Appraisal of the Mineral Prospectivity of the Arabian Shield

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The Arabian Shield forms the eastern component of the Arabian-Nubian Shield (ANS), which straddles the Red Sea and represents one of the largest portions of exposed, juvenile Neoproterozoic crust on Earth. The Arabian Shield has been subject to significant historic academic study in parallel with geological survey-driven mineral exploration, resulting in tectonic models of formation with broad consensus. However, renewed interest in the region by mineral explorers, combined with newly available high-resolution datasets, has highlighted the uncertainty of historic geodynamic models, as well as resultant knowledge gaps regarding the geological prospectivity of some mineral systems in the shield.

This study builds upon a revised geodynamic framework developed by SRK and Ma'aden for the Arabian Shield and focuses on mineral prospectivity mapping and target generation for a wide range of mineral systems.

The results demonstrate a broad range of metallogenic potential that is temporally, spatially and genetically diverse, reflecting a protracted history of tectonism and magmatism across the Arabian Shield. Some of the oldest metallogenic events (ca. 870 Ma) comprise primitive oceanic crust development and ophiolite obduction, preserving podiform chromite mineralisation along the Yanbu and Bi'r Umq suture zones. Bi-modal magmatism emplaced during the accretion of juvenile arc terranes during a period of plate reorganisation at ca. 700 Ma, prior to Nabitah orogenesis, are prospective for VMS, epithermal and magmatic Ni-Cu-PGE systems. Suturing of the western and eastern halves of the Arabian Shield (ca. 660-620 Ma) resulted in the development of the dominantly N-S trending Nabitah Orogenic Belt that is highly prospective for orogenic gold mineralisation, extending undercover along a newly interpreted arcuate geometry that trends northeast of the exposed Arabian Shield. Voluminous post-orogenic felsic magmatism (ca. <620 Ma) exploited reactivated NE-SW trending pre-Nabitah translithospheric structures, resulting in localised occurrences of highly evolved peraluminous and peralkaline granitic complexes prospective for Sn-W-Li-Cs-Ta and REE-Zr-Nb-Ta mineralisation, respectively. A series of volcanic arcs accreted to the ANS throughout pre- to post-Nabitah orogenesis demonstrate potential fertility for porphyry and related epithermal mineralisation, ranging from the Jiddah and Birak arcs in the west, to the Ar Rayn arc in the east of the exposed ANS.

The results of this study provide an updated understanding of the geological history of the Arabian Shield based on the integration of a wide range of geoscientific datasets and related expertise. The updated geodynamic framework, along with mineral system models for eight geologically permissible deposit styles, form the basis of the widest range of prospectivity maps and associated exploration targets generated to date in the Kingdom of Saudi Arabia.