

Prospectivity Modeling and Metallogeny of Pre-Orogenic and Orogenic Base and Precious Metals of the South Nabitah Belts, Arabian Shield

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The Neoproterozoic Arabian Shield currently experiences an exploration revival on various commodities such as precious and base metals. Deposits hosting them cover a wide range of mineralization styles, related to the accretion history, marked by remnants of sutures amalgamated and sheared during orogeny. To optimize discovery of new deposits, prospectivity modeling has been increasingly used. In our study, we focus on VMS and orogenic gold mineralization that formed during the Nabitah-Najd orogenies. In such context, assessing this high degree of primary ore preservation related to deformation, metamorphic, and hydrothermal/supergene alteration gradients, is key for target generation in such polyphased metallogenic context. Knowledge- and data-driven approaches have been combined based on compilation, harmonization, and interpretation of GIS geoscientific as well as field data. They will allow us to (i) produce a metallogenic synthesis of the Nabitah belts; and (ii) build an integrated metallogenic model critical for predictive modeling of base and precious metal deposit prospectivity. In southern Saudi Arabia, pre-accretion arc-related VMS mineral systems are predominantly preserved along the Nabita suture zone. Orogenic gold veins mainly developed in the N- to NNE-trending Nabitah shear zones, but also along the NW-trending Najd strike-slip fault system during late orogenic extension. Field studies are used as reference sets to validate key geological factors controlling the spatial distribution of the mineralization. Favourable tectonic environments (e.g., back-arc or rifted arcs settings) and lithologies (e.g., bimodal volcanism with tholeiitic affinities), strain gradients (e.g., dilatational jogs and reactivation of early structures), occurrences and geochemical anomalies (e.g., CCPI and AI indexes), and remote sensing (e.g., structural domaining and complexity and alteration footprints) are considered to delineate the fertility and mineral potential. Such models will open new perspectives and implications for the exploration of VMS and orogenic gold in the Arabian Shield and elsewhere in Precambrian metallogenic provinces.