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The Magmatic-Hydrothermal Nature of Granite-Hosted Uranium Mineralization on the Example of the Omahola Project in the Damara Orogen, Namibia

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Within the ~540-500 Ma Damara orogen's southern Central Zone lies the world-renowned leucogranite-hosted Roessing and Husab deposits. Uranium mineralization occurs alongside sheeted leucogranite intrusions, classified into six types (A-F) by Nex et al. (2001), with types D and E being the most uranium-rich based on field relationships.

A new interpretation of existing research and new data highlight the role of magma-derived hydrothermal fluids for uranium mineralization. Field evidence indicates that leucogranite melts preferentially intrude the cores of domes (such as Ida Dome) and minor anticlinal structures, as seen at the Ongolo and MS7 deposits. Most leucogranite intrusions exhibit similar textural styles and compositions but display significant differences in relative ages across the Omahola area. The observed crosscutting relationships between different sets of leucogranites and their deformed host rocks are characteristic of highly ductile and heterogeneous host rocks with significant competency contrasts. Consequently, classifying leucogranites into different types regarding uranium mineralization may not be relevant for the study area. Another notable regional observation is the widespread occurrence (at 1-10 km scale) of skarns within the Rössing formation marbles. The distal and earlier skarn assemblage is dominated by wollastonite, scapolite, and clinopyroxene, while the proximal garnet-rich skarn is hosted in gneisses of the Khan formation and spatially associated with uranium mineralization (e.g., MS7, Ongolo, Inca, Garnet Valley). Pegmatite pods within fine-grained granite and quartz veins suggest a significant role of hydrothermal fluids during uranium mineralization. Magmatic fluids within the leucogranite melt percolated throughout the melt, concentrating uranium towards the Rössing-Khan boundary, acting as a fluid outlet. At Inca, uranium mineralization is part of an evolving hydrothermal system associated with skarn alteration, including hedenbergite, Fe actinolite, and magnetite. On a larger scale, the outermost expression of this mineral system is the Shiyela magnetite/hematite deposit approximately 25 km south of the leucogranite-hosted Ongolo deposit.