SEG 2024 Conference: Sustainable Mineral Exploration and Development

End-Orogenic, Granite-Hosted Uranium Mineralisation: A Solution from Namibia

Paul Nex, Judith A. Kinnaird
CIMERA School of Geosciences, University of the Witwatersrand, Johannesburg, South Africa

Unique world-class granite-hosted uranium mineralisation in Namibia includes deposits in the Central Zone of the Damara Orogen such as the Rössing and Husab mines. The Central Zone is characterised by a sequence of crustally derived, voluminous granitic intrusions over a period of c. 50 Ma, granulite to upper amphibolite facies metamorphism, a prominent NE orogenic trend, and elongate domes parallel to the orogenic trend.

Since the initial exploitation of the Rossing SJ deposit in 1976, these deposits have provided a conundrum in that the most recent felsic magmatism in the orogen has been recognised as the most uraniferous. This has since been confirmed by more detailed mapping and geochemical studies at Goanikontes, Valencia, Swakop River, and the Rossing mine area.

It has been difficult to construct a viable geological model in which incompatible elements such as uranium were sequestered into late-stage, post-kinematic anatectic partial melts if earlier melts had already been extracted from the source rocks. Recent metamorphic studies of migmatites involving LA-ICP-MS trace element determinations show that the partitioning of trace elements from muscovite dehydration melting may result in uranium-enriched restite including biotite and monazite. Subsequent higher temperature metamorphism, associated with biotite dehydration melting, will release uranium into the later partial melts thereby explaining the temporal occurrence of granite-hosted uranium deposits.Alternatively a second phase of anatexis involving earlier-formed granites as the source is a possibiloity.

As the local controls on the granite-hosted uranium mineralization are similar for all primary uranium deposits over the entirety of the Central Zone, the uranium enrichment must be a regional phenomenon and linked to orogen-scale processes, which we would suggest are fundamentally caused by the conditions of anatexis within the orogen.