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Uncertain paragenetic origins of disseminated submicroscopic zircon from the Nuiklavik Volcanics, north-central Labrador

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Summary

Intrusion-related rare metal occurrences possess potentially the greatest mineralogical and paragenetic diversity among any deposit types known. Modest compositional differences in alkaline magmatic systems produce a wide range of consequent primary magmatic and late-magmatic mineral assemblages, with many agpaitic complexes worldwide representing the unique type locality for multiple exotic REE- and HFSE-bearing mineral phases. Similarly diverse are their modes of occurrence, which may range from massive cumulates of rare metal-bearing phases, deuteric pseudomorphing of primary magmatic rare metal minerals, or altogether secondary introduction of these elements by metasomatic alteration of initially non-alkaline rocks.

The Nuiklavik Volcanics are a putatively comenditic tuffaceous assemblage spatially associated with the Flowers River complex, a silica-oversaturated peralkaline intrusive suite belonging to Labrador's Nain Plutonic Suite. The Nuiklavik Volcanics were emplaced over three volcanic episodes between 1290 – 1271 Ma, each tied to a coincident regional magmatic event. The uppermost two members, interpreted to be comagmatic with the Flowers River peralkaline granite, possess ubiquitously elevated but noneconomic concentrations of Zr, Nb, and REY associated with REE-fluorocarbonate minerals. However, the south-central portion of the caldera is occupied by densely-welded, aphyric ash-flows and ignimbrites that possess extreme concentrations of Zr (> 1 Wt.%), Y (> 1000 ppm) and Nb (> 500 ppm). Outcrops of these rocks exhibit pronounced radiation anomalies, owing to disseminated, submicroscopic, highly uraniferous zircon distributed along primary flow foliations. This style of mineralization, as well as its accompanying magnitude of enrichment, has been reported elsewhere from the "Niobium Tuff" of the Brockman deposit in Australia. Using *in-situ* LA-ICP-MS U-Pb geochronology, this zircon provides ^{204}Pb-corrected Concordia ages of ca. 530 Ma, suggestive of either: (i) wholesale resetting of the U-Pb system, facilitated primarily by the highly metamict nature of the zircon; or (ii) late mineralization driven by interaction with a HFSE-mobilizing fluid introducing foreign Zr, or else redistributing it from the moderately-enriched subjacent intrusive complex. These two possibilities carry contrasting paragenetic interpretations, implying either primary magmatic crystallization or focused metasomatism. In either case, the data record post-crystallization disturbance to the U-Pb system as recently as the Neoproterozoic in a region thought to have remained undisturbed since the Mesoproterozoic. This suggests that certain contemporaneous geodynamic events may have had a wider influential extent than previously thought, the tectonic affiliation of which can be better understood with further isotopic investigation.