Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11788

Primitive arc magma conduits from the zircon petrochronology perspective in the Polaris Alaskan-type intrusion, North American Cordillera

JAMES A. NOTT[1], JAMES S. SCOATES[1], DEJAN MILIDRAGOVIC[2], GRAHAM T. NIXON[3] AND DYLAN W. SPENCE[1]

[1]University of British Columbia
[2]Geological Survey of Canada
[3]British Columbia Geological Survey
Presenting Author: jnott@eoas.ubc.ca

The Early Jurassic Polaris Alaskan-type ultramafic-mafic intrusion records primitive arc magmatism in a mush-dominated sub-volcanic conduit system. It was emplaced in the upper crust (≤12 km) in late Paleozoic arc-derived volcanosedimentary rocks of the Lay Range assemblage (Quesnel terrane) and coincides with onset of terrane accretion in the North American Cordillera during the Early Jurassic. Field relationships (magma mingling, magmatic brecciation, brittle diking, disrupted chromitite layers and schlieren) preserved in the ultramafic rocks indicate episodic magmatism, mobilization of cumulates, and variable rheological states during pluton assembly. A detailed petrochronological investigation of zircon from the Polaris intrusion provides insight into the geochemical evolution of fractionated near-solidus interstitial melts and the duration of magmatism. Zircon was studied from a wide range of rock types, including clinopyroxenites, hornblendites, and gabbros through evolved monzodiorites and syenites. SEM-CL imaging reveals variable zircon morphology and internal structure, including oscillatory and sector zoning, partial grain resorption with subsequent epitaxial overgrowth, and late-stage recrystallization. LA-ICP-MS analyses of zircon (n ~3400 spots) show highly variable trace element concentrations and incompatible trace element ratios related to variations in parental magma chemistry, fractionation of zircon and co-existing mineral phases, and post-crystallization processes. Variations on trace element discrimination diagrams follow the magmatic arc array and preliminary LA-MC-ICP-MS Hf isotope results (initial ε_{Hf} = +3 to +8) indicate a juvenile mantle source for the Polaris magmas. The LA-ICP-MS U-Pb results provide evidence for protracted magmatism (190-181 Ma) during assembly of the Polaris intrusion and reveal a previously undocumented phase of Permian to Middle Triassic mafic magmatism as recorded by 245-260 Ma gabbroic rocks adjacent to the Polaris intrusion. There is also evidence for post-emplacement sub-solidus recrystallization of zircon at ca. 155 Ma and 160-175 Ma related to younger regional magmatism and fluid flow. Combined, these results highlight the role of a multi-stage intrusive history for the Polaris Alaskan-type intrusion, prolonged mantle-derived ultramafic-mafic magmatism within the Quesnel arc of the North American Cordillera, and the diverse range of processes that operate within a sub-volcanic magma plumbing system.