The tempo of crystallization and cooling of ultramafic rocks in arcs from the Giant Mascot intrusion, Canadian Cordillera

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Ultramafic intrusions in arcs trace the pathways of subduction zone magmatism from their source in the mantle wedge to their emplacement as juvenile additions to continental crust. Dating ultramafic rocks is challenging, however, with careful targeting their crystallization ages can be established. In this study, integrated U-Pb and Ar-Ar geochronology of the Giant Mascot ultramafic suite in British Columbia constrains the temporal and tectonic evolution of regional arc magmatism in a Late Cretaceous subduction zone setting. CA-ID-TIMS results for the ultramafic rocks yield high-precision crystallization ages of ca. 93 Ma and demonstrate that Giant Mascot contains the youngest dated Ni-Cu-PGE deposit worldwide. Dates from the hosting calc-alkaline diorites of the Spuzzum pluton are resolvably older at ca. 95 Ma. In contrast, in situ LA-ICP-MS dating of zircon from both intrusions defines a wide range of dates from crystallization at ca. 95-93 Ma down to 40 Ma reflecting open-system Pb loss from radiation-damaged zircon during a lengthy 40-50 million year mid-crustal residency prior to rapid exhumation in the Late Miocene. These new ages for the Giant Mascot and Spuzzum intrusions correlate with the 96 Ma Big Jim peridotite near the margin of the 90-96 Ma Mt. Stuart batholith in Washington State, confirming ~170 km of dextral displacement along the Straight Creek-Fraser fault system. The dating results of this study indicate that these mantle wedge-derived ultramafic rocks with calc-alkaline affinities are related to the extensive Late Cretaceous magmatic flare-up in the North American Cordillera. High-precision dating of ultramafic rocks in arcs presents new opportunities for examining the tempo of magmatic processes and continental growth mechanisms from below in subduction zone environments.