Cordilleran Section - 116th Annual Meeting - 2020

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SPATIOTEMPORAL EVOLUTION OF A MAGMA FEEDER ZONE BETWEEN THE LOWER AND UPPER CRUST IN THE FIORDLAND CONTINENTAL ARC OF SW NEW ZEALAND

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The Median Batholith, located in Fiordland New Zealand, represents one of the most deeply exhumed and best exposed Cordilleran-style magmatic arcs on the planet. A compilation of 66 new ^{206}Pb-^{238}U zircon dates (SHRIMP-RG, LA-SF-ICPMS), 17 new U-Pb titanite ages (LASS), and thermobarometric data have allowed us to reconstruct a nearly complete crustal section through this arc from ~5 to ~65 km depth. We use this restored section to determine the spatiotemporal patterns of magmatism associated with an arc flare-up that emplaced ~70% of the lower crust in Fiordland within ~3 Ma. The ages and locations of plutons allowed us to track the upward migration of magma from the lower to the upper crust over a 13-14 Ma period.

Beginning at ~124 Ma, pluton emplacement was concentrated in the deep root of an inherited, crustal-scale boundary that dipped moderately to the west (present orientations). This boundary may have originally formed during a period of Paleozoic convergence and is marked by a linear belt of Carboniferous plutons and lower- to mid-crustal shear zones. Geochemical data, including tracer work using oxygen and hafnium isotopes in zircon, show strong isotopic differences in the lower crust across the boundary, suggesting it was a crustal-scale feature during the Early Cretaceous. The deepest part of the exposed section shows that magma infiltrated this boundary at ~65 km depth as steep-sided diapirs that were surrounded by steep, concentric shear zones. Higher up in the crust, arc magmas continued to be emplaced into a 10 km-wide zone of transpression but then ponded and spread out laterally at 48-30 km depth, forming tabular bodies up to 18 km thick. From 30-20 km depth, plutons and dikes display highly variable shapes and sizes, including steep-sided bodies up to 5 times longer than they are wide. In this latter region, shortening and transpression helped spread magma laterally across a 40-50 km wide zone in the mid-crust. Above ~20 km depth, plutons were emplaced within and on either side of the old inherited boundary, with many displaying ovoid shapes. These patterns show that transpressional deformation that was focused along an old inherited boundary was essential for moving magma vertically through the crust, and they explain why arc magmatism remained focused in narrow zones for many tens of millions of years.

Session No. 18

D8. The Origin and Spatiotemporal Evolution of Arc Magmas Recorded From Mineral to Plate-Boundary Scales I
Wednesday, 13 May 2020: 8:00 AM-12:00 PM

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