

Investigating the timing of sediment incorporation and metamorphism within the Ross Lake Fault Zone of the North Cascades Continental Magmatic Arc, Washington, USA

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Sediment incorporation into the middle-lower crust of magmatic arcs influences arc rheology, composition, and magmatism. The North Cascades range, Washington, USA, consists of a Cretaceous-Eocene continental magmatic arc that provides a natural laboratory for studying arc sediment incorporation, as a range of crustal levels and metasedimentary lithologies are exposed. We investigate the metamorphic history of two garnet-bearing metapelites from the dominantly strike-slip Ross Lake fault zone (RLFZ), which separates the exhumed arc from the unmetamorphosed clastic rocks of the backarc Methow Terrane.

Sample SK19-09A is from a slice of the Methow Terrane metamorphosed at peak conditions of 620-650 °C and 8.8-9.3 kbar [1]. The sample contains garnets preserving euhedral cores discontinuously zoned in major and trace elements, suggesting two distinct episodes of garnet growth. We isolated bulk garnets and rims through handpicking and microdrilling, respectively, and used garnet Sm-Nd geochronology (ID-TIMS) to obtain isochron ages of 63.7 ± 15.2 Ma (2SE; $n = 13$, MSWD = 9.9) and 59.7 ± 2.7 Ma (2SE; $n = 6$, MSWD = 1.7), respectively. Evident by an elevated MSWD, our bulk garnet data represents an errorchron that demonstrates mixing of core and rim components that differ significantly in age. Garnet major element diffusion modeling [2] suggests that peak metamorphic temperatures lasted less than 500 kyrs. Sample MFSG23-34 is a metapelite from the Napeequa Complex, which served as the host rock for the arc. Bulk garnet Sm-Nd yielded an isochron age of 59.23 ± 0.57 Ma (2SE; $n = 6$, MSWD = 0.36). The new diffusion modeling and garnet ages suggest sub-million-year metamorphism throughout the RLFZ at ca. 59 Ma. This metamorphic event occurs shortly after a high second magma flux event and is largely absent from the U-Pb geochronologic record; therefore, future work will include thermobarometry and thermodynamic modeling to better determine the mechanisms of metamorphism, sediment incorporation, and its influence on arc magmatism.

[1] Hanson et al. (2022), *Geosphere* 18, 298-326. [2] Hess and Ague (2024), *Lithos* 488, 107783.