

Linking metamorphism, partial melting and exhumation in a continental arc system, Skagit Gneiss, North Cascades

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The crust of continental arc systems is typically thick and characterized by high heat flow, but few continental arcs have been exhumed to sufficiently deep levels to allow investigation of the metamorphic and magmatic processes that occur at depth. The Skagit Gneiss, a migmatitic unit of the North Cascades, exposes abundant migmatitic metaigneous and metasedimentary rocks that formed at deep levels of a continental arc. Metapelitic rocks of the Skagit reveal pressures of 8-10 kbar at 650-725 °C followed by nearly isothermal decompression to 3-5 kbar (Whitney, 1992). These *P-T* studies were based on the 4 metapelitic samples (2 sillimanite-bearing; 2 kyanite-bearing) known at the time. During recent investigation to connect the metamorphic history to the processes and timing of deformation, magmatism, and partial melting, additional metapelite samples were discovered. On Ruby Mountain, near the eastern margin of the Skagit Gneiss, a garnet-sillimanite schist contains cordierite rims on garnet and records a maximum pressure of 9-10 kbar at 750-800 °C. Garnet-kyanite-cordierite schist yields similar results: 10 kbar at 700 °C. Both metapelites reveal ca. 60 Ma metamorphic dates from zircons using the CA-TIMS (Chemical Abrasion) technique. In order to investigate the timing of partial melting to the timing of metamorphism, leucosomes (including stromatic/discordant; fine-grained/pegmatitic) and adjacent gneisses were sampled for CA-TIMS analyses. Zircon dates range from ca. 53 Ma for a deformed, cross-cutting pegmatitic leucosome that envelops boudins of garnet-bearing metagraywacke, to 47 Ma for a strongly lineated biotite gneiss. A ~ 6 cm thick layer-parallel, coarse-grained leucosome yields an age of ca. 51 Ma. Other leucosomes in different textural and structural settings of the Skagit Gneiss yield older zircon crystallization ages (ca. 69-60 Ma), suggesting at least two pulses of migmatite crystallization during the evolution of the magmatic arc. The ca. 60 Ma ages are consistent with the metamorphic dates from metapelites. Furthermore, the ca. 50 Ma ages are similar to Ar cooling ages from much of the Skagit Gneiss and to the timing of Eocene extensional basin formation and volcanic activity in the region. The ca. 53-47 Ma dates are at the young end of the age spectrum for the North Cascades and indicate that magmatism, metamorphism, and partial melting were active until the latest stages of orogeny.