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Paragenesis and thermobarometry of Ca-amphiboles in the Barcroft granodioritic pluton, central White Mountains, eastern California

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ABSTRACT

Mid-Mesozoic to Tertiary igneous activity reflects arc evolution along the Sierra + White-Inyo sector of the continental margin. The Ca-amphibole + biotite ± augite-bearing Middle Jurassic Barcroft pluton consists of intergradational, quartzose gabbro-diorite, metadiorite, voluminous mafic-to-felsic granodiorite, and rare alaskite-aplite. It was emplaced along the Barcroft structural break—a major ENE-striking suture juxtaposing mid-Mesozoic bimodal metavolcanics on the north against metamorphosed Lower Cambrian platform strata on the south. The Cretaceous, two-mica McAfee Creek Granite intruded both wall rocks and the Barcroft granodioritic pluton on the east. Geologic mapping and petrochemical studies have documented the structure and metaluminous geochemistry of the Barcroft body.

Analyses of Ca-clinoamphiboles from 16 Barcroft rocks allow the assignment of *P-T* conditions of crystallization/recrystallization based on experimentally determined and calculated clinoamphibole thermobarometers. Combined with earlier studies of country-rock metamorphism, and oxygen isotopic investigations of mineral assemblages in both plutons and wall rocks, four stages in the *P-T* evolution of the Barcroft pluton have been identified: Stage 1, partial melting of a mafic protolith at ~25 km or greater depth, then onset of crystallization of refractory hornblende and other ferromagnesian phases at ~915 ± 25 °C attending magma ascent. Stages 2 → 3, crystallization of progressively more actinolitic hornblende during decompression cooling and stalling of the pluton at a depth of 10–12 km, as temperature declined over the interval ~760–650 °C. Stage 4, subsolidus recrystallization/exsolution of nearly stoichiometric actinolite ± grunerite attending deuteric alteration over the range ~395–545 °C at a depth of 4–5 km. Mineral assemblages of stages 1 → 4 are disposed progressively inward, indicating that the Barcroft pluton lost heat along intrusive contacts with the wall rocks, cooling, annealing, and re-equilibrating in the process. The Cretaceous McAfee Creek Granite transected this ENE-trending thermal zonation, but exerted little effect on Ti + Al contents (and $\delta^{18}O$ values) of Barcroft amphiboles.