UPPER CRUSTAL OVERTURN DURING MAGMATIC SURGES – A POTENTIAL SIERRA-WIDE PROCESS

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The Cretaceous Harriet Lake and Fremont Lake granodiorite plutons in northern Yosemite and adjacent areas are intruded into slightly older metavolcanic units, all of which share steep foliations and down-dip lineations. The plutons range in silica from 62-69 wt. %, and although distinct in detail, are comparable in being magnetite series (high fO2), metaluminous, calc-alkaline, and medium to high K. Metavolcanics have comparable compositions demonstrating a common evolution.

The Harriet Lake, although variably recrystallized, and the younger Fremont Lake granodiorites contain hornblendes that exhibit “reverse zoning” with low Al and Ti cores, which we attribute to pseudomorphic replacement after early pyroxene. HBLD-PLAG thermobarometry (calibrations of Anderson and Smith, 1995; Holland and Blundy, 1994) yield estimates of emplacement conditions of 684-726 ± 11 °C at 2.6 ± 0.3 kb for the Fremont Lake and 684-698 ± 15° C at 2.5 ± 0.4 kb for the Harriet Lake, corresponding to emplacement depths of 9-10 km. Based on apatite saturation, liquidus temperatures were in excess of 920 °C. Metavolcanic and metasedimentary units achieved middle amphibolite grade based on mineral assemblages. HBLD-PLAG thermometry, at pressures derived from pluton emplacement, yield metamorphic temperatures ranging 640 - 712 °C, thus exhibiting near thermal equilibration with adjacent plutons and indicating Cretaceous geothermal gradients in excess of 70 °C/km.

Our evidence for overturn and significant downward displacement of only slightly older volcanic strata during rising pluton emplacement at 90-100 Ma is provocative, but is also supported by our prior work in the Jackass Lakes region of the Sierra Nevada batholith and that of Saleeby (1991) in the southern Sierras. We view this as a major, magmatic arc-wide, downward flow of upper crustal sections during a Cretaceous surge of magmatism. Rather than in narrow aureoles, the material transfer process appears to have occurred across wide areas and during regional deformation.