Magma differentiation in a 40-km-thick accretionary complex, Klamath Mountains, CA, USA

C. G. BARNES[1], N. COINT[2], M. A. BARNES[1], J. COTTLE[3] AND O. T. RÄMÖ[4]

[1]Geosciences, TTU, Lubbock, TX, USA; cal.barnes@ttu.edu
[2]NGU, 7491 Trondheim, Norway
[3]Geology, UCSB, Santa Barbara, CA
[4]Geosciences, Univ. of Helsinki, Helsinki, Finland

The Wooley Creek batholith and Slinkard pluton are part of a vertically extensive, 158–159 Ma magmatic complex intruded into an accretionary arc complex. The complex extends from paleo-depths of ~10 km to ~25 km; it was emplaced into ~40-km-thick crust. It is zoned from lower gabbro–tonalite, upper tonalite–granite and central transition zone. Xenolith swarms are common near the lower–central zone boundary, synplutonic dikes and mafic magmatic enclaves characterize the central and upper zones.

Basalt in the region was derived from depleted mantle (ε_{Nd} +10; ε_{Hf} ~ +19; $^{87}Sr/^{86}Sr$ ~ 0.7027) and hybridized with lower crustal rocks and melts. Some lower crustal melts formed isolated peraluminous plutons in the middle crust (ε_{Nd} 2.1–4.5; ε_{Hf} -3.0–2.4; $^{87}Sr/^{86}Sr$ 0.7039–0.7046; $\delta^{18}O$ 10.3–12.2). However, the greatest influence of lower crust is seen in the metaluminous rocks that range from gabbro to granite, yet have small bulk-rock isotopic variability, with ε_{Nd} 2.8–4.5; $^{87}Sr/^{86}Sr$ 0.70416–0.70474; and $\delta^{18}O$ 8.0–9.9‰. In contrast, average ε_{Hf} (zircon) varies from 2.9–11.7, and these averages mask intra-sample variation up to 10 epsilon units. Moreover, zircons from lower and central zones have slightly lower average ε_{Hf} (7.6) than those from the upper zone (9.1). Xenoliths in the lower–central zone boundary have ε_{Nd} from +7.6 to -23.7 and ε_{Hf} (159Ma, zircon) from +8.9 to -40.9.

The isotope data indicate hybridization in the lower crust and at the level of emplacement, with the lower crust composed of metasedimentary rocks that produced peraluminous granites, and hybridized with arc basalt. It is possible that the inter- and intra-sample variation in ε_{Hf} reflects heterogeneous lower crustal contaminants. However, lower zone samples with low ε_{Hf} are proximal to xenoliths and upper zone samples with high ε_{Hf} are associated with enclave swarms. The data indicate *in situ* contamination of lower zone magmas by melts from xenoliths, and *in situ* magma mixing/mingling of mafic magmas with upper zone rocks. Evidently, modification of magmas in the complex occurred throughout the crustal column.