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Petrology of the Early Cretaceous Sierra Nevada Batholith: the Stokes Mountain Region, CA

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Previous studies have shown that the early Cretaceous batholith (130-110 Ma) contains the least chemically and isotopically evolved lithologies of the composite Sierra Nevada batholith. Mapping at 1:24,000 of a 360 km^2 area in the foothills ESE of Fresno (the Stokes Mountain region; latitude 36°30') reveals a smoothly continuous range (SiO_2 = 44-78%) of calcic lithologies dominated by norites, hornblende gabbros, quartz diorites, tonalites and granodiorites. Field, geochemical and geochronological data suggest that these lithologies are cogenetic and were emplaced at approximately 125-110 Ma, possibly into a shallow, subvolcanic environment within a thin ophiolitic basement. This inference is supported by the presence of a ring complex 8 km in radius which is composed of representatives of most lithologies present in the study area. Extensive mingling between gabbroic and granodioritic magmas is observed at this level of the ring complex. Outside the ring complex these rocks enclose megaxenoliths (up to 8 km^2 in area) of cumulate troctolites and hornblende troctolites (SiO_2 = 43-48%; K-Ar amphibole age 123±3 Ma) containing a range of textures (modal layering; massive adcumulate to orthocumulate; orbicular). Mineralogical, chemical and isotopic data suggest that the cumulates formed from a magmatic system similar to that which produced the enclosing lithologies, and it is proposed that the separation of such cumulates controlled the early stages of differentiation within this system. Subsequent crystallization of orthopyroxene, lesser clinopyroxene, hornblende and biotite controlled further differentiation within this suite. Noncoeval igneous lithologies in the study area include an older (130 Ma), strongly deformed hornblende biotite tonalite, minor cross-cutting gabbroic and leucogranitic dikes, and remnants of an overlying, hydrothermally altered, porphyritic volcanic unit ($\delta^{18}O$ = +1.2 to +4.7‰; n=3).

Isotopic data [$(^{87}Sr/^{86}Sr)_{115}$ = 0.70374 to 0.70394 (n=8); $\varepsilon_{Nd\ (115)}$ = +4.5 to +5.1 (n=7); $\delta^{18}O$ = +6.5 to +8.7‰ (n=39)] indicate that the chemistry of this suite is dominated by a depleted mantle-derived component. The abundance of hornblende indicates a relatively hydrous parental magma, possibly a high alumina basalt. These data also demonstrate that little interaction occurred between the magmas and the immediately adjacent metasedimentary country rocks; the existence, however, of small amounts of partial melt is indicated by pods of garnet- and muscovite-bearing leucogranite having elevated $\delta^{18}O$ (+9.8‰). Important conclusions of this study are that new crust generation in the early Cretaceous batholith was dominated by the input of mantle-derived material and that layered olivine-plagioclase-hornblende cumulates may have been important constituents of this newly generated crust.