Temporal, compositional, and structural development of the Idaho Batholith near McCall, Idaho

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The Idaho Batholith east of the Salmon River suture zone near McCall, Idaho, consists, from west to east, of elongated tonalite and granodiorite plutons and equant leucogranodiorite and monzogranite plutons. U-Pb and Ar/Ar ages indicate that the four plutonic units were formed in the same pulse of magmatism, uplift, and cooling. The emplacement ages are leucogranodiorite-~94 Ma, tonalite-~90Ma, and monzogranite-~83 Ma. Granodiorite is undated.

The west to east transition from tonalite to monzogranite represents a spatial change in source rocks; from subducted Blue Mountains island-arc amphibolite/trondhjemite for tonalite, to a mixture of arc-volcanic and continental rocks at the arc-continent boundary for granodiorite, to Proterozoic gneisses/metasediments of the North American continent east of the arc-continent boundary for monzogranite. Tectonic compression resulting from plate interactions produced shortening and thickening of the crust, metamorphism, and magmatism. Experimental models suggest tonalite magma formed by dehydration melting of amphibolite/trondhjemite source rocks in a 45-60 km crust at a geothermal gradient of ~35^{o}C/km. Extremely efficient partial melting of fertile Proterozoic rocks containing abundant muscovite and biotite resulted from crustal thickening and produced voluminous monzogranite magma that formed largely in place.

Foliations, lineations, dikes, and joints in the plutons record a tectonic history in which crustal strains changed in style, intensity, and orientation. Transpression existed at ~94 Ma for the leucogranodiorite pluton; NW-SE contraction occurred ~90-85 Ma for tonalite-granodiorite plutons; and SW-NE extension existed as early as 83 Ma for monzogranite plutons and certainly existed after ~80 Ma during formation of joints.

Sodic and potassic suites of the Cretaceous Idaho batholith

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Cretaceous plutons of the southern lobe of the Idaho batholith are predominantly sodic (Na_2O typically $>K_2O$) and thus similar to the Boulder batholith "sodic series" to the east in Montana, first recognized by Tilling (1973). Only the southeast part of the southern lobe is potassic (Kiilsgaard *et al.*, 2001). This potassic suite resembles the potassic "main series" of the Boulder batholith and contains more MgO, Rb, Cs, U, Sc, Co, and Cr than the sodic suite to the northwest.

Recent mapping shows that the northern lobe is more complex than the southern lobe, in part because deep-seated Eocene (Challis event) plutons that are mineralogically and texturally similar to the Cretaceous batholith are widespread. Nevertheless, the northern lobe appears to be sodic (Hyndman, 1983) and has high Sr/Y ratios similar to "HiSY" magmas (Tulloch and Kimbrough, 2003) of inboard plutons in Baja-California and New Zealand. Eocene plutons that intrude the northern lobe differ in that they have subequal K_2O and Na_2O concentrations and have much lower Sr concentrations (average 300 ppm versus 800 ppm). Outlying Cretaceous plutons east of the Purcell Trench in northern Idaho are potassic and similar to the potassic suite in the southeast part of the batholith. They have low Sr/Y ratios like potassic rocks in the southern lobe and in "LoSY" plutons of Baja-California and New Zealand. At least some of the plutons of the potassic suite are 10-15 Ma older than the sodic suite and were emplaced at shallower levels. The potassic suite apparently originated from a relatively enriched but more mafic source, perhaps located at a different depth than the source for the sodic suite.

References

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