Genesis of a tonalite-trondhjemite suite within the accreted terrane, north-central, Idaho

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Permian to Jurassic oceanic island-arc rocks of the Wallowa-Seven Devils terrane in north-central Idaho were juxtaposed during the Cretaceous against the North American craton. Cretaceous tonalite-trondhjemite suites intrude the accreted terrane and their emplacement coincides with the end of the suturing event. A small body of tonalite-trondhjemite located seven miles south of Greer, Idaho, the Sixmile Creek Pluton (SMCP), intrudes an older quartz diorite. The tonalite-trondhjemites have high alumina (>15 wt. %) and low potassium concentrations (<1%), similar to high-Al tonalite-trondhjemite suites that occur in other accretion complexes. The SMCP is enriched in LREE and depleted in HREE and exhibits positive Eu anomalies, suggesting that these rocks accumulated plagioclase during their formation. Whole-rock oxygen isotope ratios show a small increase from tonalite to trondhjemite consistent with a fractionation trend. Quartz-feldspar fractionations are about 2 ‰ and indicate that the rocks have not been hydrothermally altered.

U-Pb laser ablation inductively coupled mass spectrometry was conducted on zircon grains from a biotite tonalite and a biotite-muscovite trondhjemite from the SMCP. Concordant ages indicate that the biotite tonalite crystallized at 119 Ma and the biotite-muscovite trondhjemite at 116 Ma, which is consistent with their whole-rock fractionation trends.

Major and trace element concentrations indicate that the SMCP was produced from the partial melting of a basaltic source with garnet in the residue. This crust included an oceanic island-arc that was produced by pre-accretion subduction west of the Blue Mountains. Petrologic evidence indicates that deformation was occurring during emplacement of the SMCP. Thus, accretion was still active during emplacement. Geochronology is consistent with this interpretation and the crystallization age of the SMCP most likely marks the boundary for the end of accretion.

Strontium and oxygen isotopic evidence for strike/slip motion along the continental margin in the Idaho Batholith

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Strontium and oxygen isotope composition of granitic rocks on the western edge of the Idaho Batholith provide insight into the nature of the suture zone and subsequent shearing. Granitic rocks of the mid-Cretaceous Batholith intrude both sides of a major structural and geochemical crustal boundary. Early Cretaceous suturing juxtaposed Triassic/Jurassic accreted arc terranes and the Precambrian craton followed by Late Cretaceous shearing along the margin. The suture zone has previously been recognized as a nearly vertical structure containing imbricated sections of continental and oceanic mantle components. Imbrication would be apparent in transitional isotope values between oceanic and continental reservoirs. Late Cretaceous shearing would deform the isotopic trend representative of magmatic processes.

Isotopic ratios of granitic rocks intruded along a west-to-east transect in the Slate Creek area on the west side of the batholith appear to record a unique tectonic history. Initial $^{87}Sr/^{86}Sr$ ratios of granitic rocks along Slate Creek jump from less than 0.704 to greater than 0.707 in less than 1 km with no intermediate values. The $\delta^{18}O$ values of quartz and zircon increase gradually across the transect suggesting variability in the composition of the crust on either side of the suture zone.

The lack of intermediate initial $^{87}Sr/^{86}Sr$ ratios in granitic rocks presently exposed along the Slate Creek transect could have one of two tectonic implications. 1) The original suturing mechanism occurred with a transcurrent/transpresssional motion resulting in a nearly vertical suture with no mixing of oceanic and continental lithosphere; or 2) subsequent shearing could have removed transitional units. Either process is highly unique for the Idaho Batholith as other transects indicate imbrication during suturing and significant contractional deformation during Late Creaceous tectonic activity.