Tectonics of the Salmon River Suture Zone near Orofino, Idaho

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In the late 1800s Waldemar Lindgren (1897, 1898, 1900) described a zone of metamorphism and deformation in western Idaho and eastern Oregon along the western margin of a huge granitic mass. He noticed distinct lithologic differences, even in strata apparently of the same age, on opposite sides of this deformed zone. Lindgren (1915) later correlated the volcanic rocks west of this zone to similar volcanic rocks that extend from California to Alaska. Lindgren described what we recognize today as a suture zone between accreted island-arc rocks and the pre-Late Cretaceous North American continent, and, in essence, he was the first to make the "Wrangellian" connection.

This zone of accretion, which Lund and Snee (1988) named the Salmon River Suture Zone (SRSZ), is well-defined by an abrupt geochemical change across the suture zone from island-arc signature on the west to continental affinity on the east. The change occurs over about a few kms and trends north-south through much of western Idaho. In the region of Orofino, the geochemical change, as well as the apparent suture zone, make a sharp turn to the west. The nature of this bend has been an enigma.

Detailed $^{40}Ar/^{39}Ar$ and U-Pb thermochronology along the Orofino segment of the SRSZ records a tectonic history that begins with preaccretion plutonism that ended at about 140 Ma. Lower-amphibolite-facies dynamothermal metamorphism began at 130 Ma and was likely associated with arc accretion to North America. Plutons were emplaced into the island-arc terrane between 122 and 115 Ma, and some were deformed within the suture zone. Post-accretion southwest-directed thrusting occurred in the Orofino area between 93 and 80 Ma and emplaced rocks from deeper crustal levels along the terrane boundary over rocks from progressively shallower levels toward the southwest thickening the crust over the beheaded suture zone. This thrust plate was terminated along its northern extreme by a zone of ductile left-lateral, west-trending, strike slip translation, which produced the west-trending boundary and bend. Uplift resulting from the thrusting caused cooling of the overthrust high-grade rocks. Uplift progressed to the northeast resulting in a northeasterly decrease in mineral cooling ages to as young as 54 Ma in biotite.

Age, chemical, and isotopic complexity in magmatic belts along the Orofino segment of the western Idaho suture zone (WISZ)

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The Jurassic-Cretaceous WISZ was one of the first regions in which a major tectonic boundary was recognized based on systematic and sharp variation over short distances in isotopic ratios, chemistry, and K-Ar ages among plutons that intrude across it. We have examined a broad transect across the Orofino segment of the WISZ, where it strikes NW along the Clearwater River. This segment is more complicated than the N-S striking part of the WISZ that has been more rigorously studied farther south. Sparse U/Pb zircon age data suggest that the Orofino segment consists of several magmatic belts that differ in intrusive age, in Sr isotopic ratios, and to some degree in trace element composition. From SW to NE, these belts include: (1) a broad region of ~220-150 Ma plutons with low (<0.704) initial Sr ratios and island-arc major- and trace-element signatures that intrude Permian(?)-Triassic greenstone of the Wallowa accreted terrane; (2) a <10 km wide belt that straddles the WISZ consisting of ~120 to 115 Ma plutons with initial Sr ratios that vary systematically with some exceptions from ~0.703 to ~0.705 NE across the WISZ, which intrude rocks of the Wallowa terrane and Orofino series, a high-grade volcano-sedimentary assemblage of uncertain age; and (3) a >10 km wide belt of ~95 to 90 Ma plutons with initial Sr ratios >0.707 that intrude high grade Proterozoic cratonic sedimentary sequences. Few differences are apparent in major element chemistry between these magmatic belts. However, significant differences occur for many trace elements such as Hf, Ta, Th, U, Nd, Sm, Zr, Cu, and Sc. Belts 1 and 3 are readily distinguishable using these elements; belt 2 shows the most variation and overlaps with the other two belts. The presence of distinct tectonic belts defined by host rock assemblage, age, and isotopic and chemical character along and straddling the NW striking part of WISZ indicates that processes were probably different there than along the N-S striking zone of the WISZ. Either this part of the suture zone is characterized by tectonic slivering or thrusting, or the basement source regions evolved with time to produce contrasts in belts of varying age along it.