# 52. Recognition and Significance of Boundary Transforms and Rift Edges within Island Arc Terranes of the Western Sierra Nevada

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Fragmentation of island arcs and related dispersion of the resulting arc segments is common in modern continental margin environments. Inasmuch as a majority of Cordilleran accreted terranes show island arc affinities one would expect to find remnants of arc-related transforms and rifts within such terranes. Jurassic arc and ophiolitic terranes of the western Sierra Nevada and Klamath Mountains have regional age and structural patterns which suggest multiple rifting and transform faulting episodes, and some areas offer remnants of the actual rift or transform complexes.

Regional age patterns show a strong correlation between island arc volcanism and ophiolite generation (Saleeby, 1982; Saleeby and others, 1982). In particular ophiolite generation at two distinct times (200 m.y. and 160 m.y.) coincides with the termination or waning of volcanism and magmatism along major arc segments and the emplacement of dike swarms across the arc framework. Such relations suggest that ophiolite generation represents the disruption of arc constructional patterns which is a phenomenon seen in modern environments with the formation of inter-arc basins (Karig, 1971, 1972). The edges of disrupted arcs consist of rift or boundary transform contacts with juvenile ophiolitic crust.

In the central Sierra Nevada between the American and Merced Rivers remnants of early Jurassic arc rocks (210-200 m.y.) are exposed along with their ophiolitic melange basement in the core areas of large late Jurassic anticlinal or upright nappe structures. The arc sequences are clearly resting with primary relations on a previously disrupted ophiolitic substrate. This ophiolitic basement comprises a distinct tectonostratigraphic package with distinct geochronological patterns, and can be shown to extend southward into the southern Sierra Nevada (Saleeby, 1982). Here distal arc-related tuffs and tuffaceous cherts are interbedded with aphyric pillow lava, sedimentary serpentinite and ophicalcites (Saleeby, 1979). This complex volcanic-sedimentary sequence lies depositionally above the ophiolitic melange of the arc basement. A dike swarm which appears to have fed volcanic rocks of the superjacent sequence has been dated at 200 ±10 m.y. by Pb/U zircon. The nearby Kings River ophiolite has yielded 200 m.y. zircon dates from plagiogranite within sheeted dikes and from diorite layers within its gabbroic intrusive sequence (Saleeby, 1982). An outstanding feature of this ophiolite is major mylonite and flaser gabbro zones with minimum structural thicknesses of 5 km (Saleeby, 1978). Such mylonitic rocks formed during ophiolite genesis with flaser gabbros showing deformational fabrics developed under magmatic and hot sub-solidus conditions. Furthermore, syngenetic mylonitization accompanies juxtapositioning of the ophiolite against older ophiolitic melange of the arc basement along a structurally complex dynamothermal aureole. This aureole shows pervasive amphibolite facies metamorphism superimposed across pre-existing melange structure in the arc basement.

Capping of ultramafic basement uplifts with pillow lava, sedimentary serpentinite and ophicalcite sequences, and the development of major flaser gabbro-mylonite zones under magmatic and hot sub-solidus conditions in ophiolitic crust are processes that have only been documented within transform fracture zones. The 200 m.y. fracture zone complex of the southern Sierra formed along and across the basement of the early Jurassic island arc. Arc activity appears to have ceased at about 200 m.y.. It is suggested that the southern Sierra fracture zone complex comprises the remnants of a boundary transform which formed during the rifting disruption of the early Jurassic arc.

The remnants of a mid- to Late Jurassic inter- or intra-arc rift edge are preserved in the American River area of the northern Sierra Nevada. Here Callovian to Oxfordian arc rocks are built on a complex basement which includes lower Jurassic arc rocks and their ophiolitic melange basement (Behrman, 1978; Behrman and Parkison, 1978; Saleeby, 1982). These rocks are cut by a layered pyroxenite-gabbro-diorite plutonic complex (Springer, 1980) and by a sheeted dike complex, both of which have been dated at 163 m.y. by Pb/U zircon techniques (Saleeby, 1982). The layered intrusive complex is the same age as, and can be petrologically linked to the overlying arc volcanic pile. The ophiolitic melange and early Jurassic arc remnants are contact metamorphosed and occur as local screens within the intrusive complex. The 163 m.y. intrusives along with their wallrocks were deformed while still hot from primary heat in the core area of a Nevadan (155 to 150 m.y.) anticline or upright nappe.

North of the American River complex occurs a large sheet with ophiolitic affinities referred to as the Smartville complex. This complex represents a rifted arc (Xenophontos and Bond, 1978) with sheeted dikes yielding Pb/U zircon ages of 162 m.y.. The Smartville sheet was obducted during the Nevadan orogeny eastward over ophiolitic melange and arc rocks which have scattered ages and strong similarities to wallrocks of the American River complex (Moores and Day, 1983). These relations suggest that the hot attentuated Smartville arc rode over a rift edge similar to the American River complex.

An additional example of imbrication along rift edges in the upper Jurassic Josephine ophiolite and neighboring arc segments is described in Saleeby and others (1982). It is suggested that Jurassic arc terranes of the California region underwent multiple rifting and imbrication events, and that rift edges and boundary transforms served as nucleation sites for convergence and imbrication. It is also suggested that young warm ophiolitic crust is preferentially preserved along such zones. The tendency towards imbrication immediately following rifting and transform disruption is interpreted to be a result of the opening of small intra-orogenic ophiolite floored basins contemporaneous with the accretion of the larger Cordilleran framework to North America. (Saleeby, 1983).

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