Age and Tectonics of Plutonic Belts in Accreted Terranes of the Klamath Mountains, California and Oregon

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The Klamath Mountains province is a composite of several allochthonous terranes that are tectonic slices of oceanic crust and island arcs ranging from early Paleozoic to Jurassic in age. The primitive nucleus of the province was the lower Paleozoic rocks of the Eastern Klamath terrane, to which the Central Metamorphic terrane was added as a thick underplating during a Devonian subduction event. Other terranes were added sequentially to the enlarged nucleus during Jurassic time.

Granitoid plutonic rocks occur in all the terranes and are subdivided into belts that generally follow the trends of the terranes. The plutonic belts range from Ordovician to Early Cretaceous in age. The plutons of some belts were emplaced before their host terrane became attached to an adjacent terrane. These preamalgamation plutons occur either as parts of ophiolite suites or as parts of comagmatic volcanic-plutonic pairs that formed in island arcs. In contrast, the postamalgamation plutons are significantly younger than their host rocks and are assigned to belts mainly on the basis of their isotopic ages. Some are known to be postamalgamation because they are seen to cross-cut terrane boundaries or because of other regional tectonic considerations. Some plutonic belts are superimposed on older plutonic belts. All the plutonic belts probably intruded before the assembled Klamath terrane (composite) accreted to the North American continent, with the possible exception of the Shasta Bally belt (Early Cretaceous), which may be postaccretion.

Paleontologic evidence suggests that some of the terranes may have originated at great distances from North America. However, paleomagnetic studies on both stratified and plutonic rocks give no clear evidence of significant latitudinal displacement of the terranes, but they do indicate that some terranes have rotated clockwise through large angles relative to stable North America. The data suggest that major rotation began during Late Triassic or Early Jurassic time and that virtually all rotation of the Klamath terrane had ceased by Early Cretaceous time. Nearly all the rotation occurred while the terranes were parts of oceanic plates.

INTRODUCTION

The Klamath Mountains province is part of the mosaic of accreted terranes that make up the western margin of North America from Mexico to Alaska. The province is an arcuate west-facing structure that consists of several individual terranes (Fig. 1), each of which is characterized by its own peculiar combination of lithology, stratigraphy, age, plutonic rocks, and mineral deposits; it was in the southern part of the province that the term "terrane" was first defined and used in its currently accepted tectonic context (Irwin, 1972). All the terranes that constitute the Klamath Mountains are of oceanic rocks; none is continental, except for a few small patches of superjacent strata. Some of the terranes are ophiolitic, consisting partly of oceanic crust and upper mantle; their ophiolitic components are thought to have formed at oceanic spreading centers during Ordovician, Permian, Triassic, and Jurassic time. Most terranes include parts of volcanic island arcs that formed at various times during the Paleozoic and Mesozoic. Some terranes are structurally coherent rocks; others are melange.

The Eastern Klamath terrane is the nucleus of the province. It was a long-standing volcanic arc, built on oceanic crust and upper mantle now represented by the Trinity ophiolite, and shows evidence of intermittent volcanism that ranged from early Paleozoic into Jurassic time (Irwin, 1981). The Central Metamorphic terrane, consisting of the Salmon Hornblende Schist and Abrams Mica Schist, developed along the western edge of the Eastern Klamath terrane during eastward subduction beneath the Trinity ophiolite in Devonian time. No addition of other terranes to the enlarged nucleus seems to have occurred between Devonian and Jurassic time, even though volcanic strata of the Eastern Klamath terrane suggest that subduction events took place during late Paleozoic and early Mesozoic time. The North Fork, Hayfork, Rattlesnake Creek, and Western Jurassic terranes, which sequentially make up the western part of the province, were swept against the Paleozoic nucleus during Jurassic time. The Klamath terrane (composite), which consists of all the terranes that make up the Klamath Mountains province, probably accreted to the North American continent during latest Jurassic or earliest Cretaceous time.