

Magmatic Response to Differential crustal thickening: Geochemical constraints on the tectonic evolution of the Alisitos arc segment of Baja California, Mexico

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The Alisitos arc segment, the southernmost part of the western Peninsular Ranges batholith, is the only portion of the Peninsular Ranges to have been accreted during the Cretaceous. Dramatic accretion-related deformation is present along the northern and eastern margins of the arc segment with the greatest intensity west of the Sierra San Pedro Mártir (SSPM). Several geochemical and geochronologic studies of the Alisitos arc segment further indicate that this accreted arc was developed on and through oceanic lithosphere that had not been previously associated with a continental margin.

Supporting data for this interpretation include primitive chemical signatures (mean: epsilon Nd ~+6, Sr initial ~0.7034, delta ¹⁸O ~8.0) and the absence of Precambrian-Paleozoic zircons within Cretaceous volcanics and intrusives, while they are common to all other parts of the Peninsular Ranges.

Notwithstanding, many of these same studies also betray the fact that the Alisitos is not a typical oceanic island arc (e.g., Tonga arc). In contrast to most island arcs, the Alisitos arc is characterized by numerous silicic volcanics (dacites-rhyolites) and average silica contents in plutons of ~65%. Similarly, the Alisitos arc was characterized by unusually thick crust during Early Cretaceous magmatism. Tate and Johnson (2000) report that plutons from the SSPM, emplaced between 115 and 110 Ma, were derived from lower crustal melts at a depth of ~28 km. Similarly, plutons from the same area but emplaced between 108 and 102 Ma were derived from lower crustal melts from ~35 km depth and exhibit adakitic chemical signatures (e.g., Sr/Y 92-114; La/Lu (chondrite normalized) 12-16). Tate and Johnson interpret this chemical transition as reflecting an increase in crustal thickness caused by accretion related shortening.

In contrast to the SSPM, plutons emplaced between 108 and 105 Ma in the northern part of the Alisitos near San Vicente, do not yield adakitic signatures. Rather, their chemistries overlap with those of the older SSPM plutons. This indicates that the San Vicente area melts were derived from shallower depths in the crust (~28 km), and implies that the crust was not thickened to the extent it was near the SSPM. This interpretation is consistent with observed differences in shorten between the two regions.