An intra-arc strain gradient as a result of arc-continent collision – quantifying finite strain in the Alisitos arc, Peninsular Ranges, Baja California

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The Alisitos arc, located in the western zone of the Jura-Cretaceous Peninsular Ranges of Baja California, is an island arc that was accreted to North America during the mid-Cretaceous. Geological, geophysical, and geochemical evidence distinguish the Alisitos arc from the surrounding continental-margin arc. The northern and eastern edges of the arc, which record sinistral transpression and orthogonal convergence, respectively, are characterized by a fold-thrust belt that developed during collision and marks the suture zone between the arc and adjacent continentally-derived units.

Our 3-D fabric/strain analyses of 50 lithic-rich volcanic rock samples in four corridors across the Alisitos arc quantify fabric/strain intensities that are between 0.08 (4% shortening in Z, where X>Y>Z) and 2.71 (88% shortening) and ellipsoid shapes that range from dominantly flattened to constrictional. Low fabric intensities most likely represent primary fabrics since penetrative ductile structures are absent. The fabric probably represents tectonic strain where shortening exceeds 20%. Here, the XY planes of strain ellipsoids parallel the regional NW-trending cleavage and X axes parallel moderate to steeply plunging mineral lineations.

These data provide evidence for a significant strain gradient and accumulation of ductile strain within the Alisitos arc. Fabric intensities are low along the west side of the arc, where strata are generally flat lying or openly folded. In contrast, finite ductile strain is focused within the fold-thrust belt along the northern and eastern edges of the arc and ranges from 40 to 90% shortening. A strong strain gradient and accumulation of ductile strain along the northern and eastern edges of the Alisitos arc support the collision model for the arc. Furthermore, we speculate that high tectonic strains may in part be responsible for the increase in crustal thickness on the east side of the arc. In detail strain in the arc is heterogeneous and varies significantly with location. Heterogeneous strain magnitudes and ellipsoid shapes may be the results of superposition of primary fabrics and tectonic strain or local effects, such as matrix-lithic ratios, proximity to intrusive bodies, folds, or shear zones.