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FATE OF THE LOWER LITHOSPHERE DURING SHALLOW-ANGLE SUBDUCTION: THE LARAMIDE EXAMPLE

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Continental arc lower crust and underlying mantle wedge assemblages native to the Mojave Desert (i.e., the southern California batholith; SCB) were displaced eastward during Laramide shallow-angle subduction and reattached to the base of the Colorado Plateau transition zone (central Arizona) and further inboard. We identify here two xenolith localities from the transition zone (Camp Creek and Chino Valley) that likely contain remnants of the missing Mojave lithosphere. Nodules of garnet clinopyroxenite, the dominant xenolith type at both studied localities, yield low jadeite components in clinopyroxene, chemically homogeneous “type-B” garnet, and peak conditions of equilibration from 600-900 ˚C and 12-28 kbar. These relations strongly suggest a continental arc residue (“arclogite”), rather than a lower plate subduction (“eclogite”), origin. Zircon grains extracted from these nodules yield a bimodal age distribution with peaks at ca. 75 and 150 Ma, overlapping SCB pluton ages and suggesting a consanguineous relationship. In contrast, Mesozoic and early Cenozoic igneous rocks native to SW Arizona, with age peaks at ca. 60 and 170 Ma, do not provide as close a match. In light of these results, we suggest that transition zone xenoliths: 1) began forming in Late Jurassic time as a mafic keel to continental arc magmas emplaced into the Mojave Desert and associated with eastward subduction of the Farallon plate; 2) experienced a second ca. 80-70 Ma pulse of growth associated with increased magmatism in the SCB; 3) were transported ~500 km eastward along the leading edge of the shallowly subducting Farallon plate; and 4) were reaffixed to the base of the crust at the new location, in south central Arizona . Cenozoic U-Pb zircon and Sm-Nd garnet ages suggest that displaced arclogite remained at elevated temperature (>700 ˚C) for 10s of Myr following its dispersal and until late Oligocene entrainment in host latite. The lack of arclogite and abundance of spinel peridotite xenoliths in Miocene and younger volcanic host rocks, and the presence of seismically fast and vertically dipping features beneath the western Colorado Plateau, suggest that arclogite has been foundering into the mantle and being replaced by upwelling asthenosphere since at least 12 Ma and perhaps as early as 25 Ma.

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