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Wyoming craton growth by Shatsky conjugate under-accretion at ∼65 Ma

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Several unusual characteristics of the Wyoming region appear difficult to explain: (1) Laramide-age thrusting occurred deep within the continent. (2) After lying near sea level for >500 m.y., the Wyoming craton elevated 1-2 km. This is a major change in craton buoyancy. (3) Seismically high-velocity mantle extends to depths of ∼270 km beneath the craton. (4) Post-Laramide xenoliths from below ∼150 km are only ∼140 Ma in age (whereas pre-Laramide xenoliths define a cool Archean mantle typical of cratons). But just when and where it is needed, a buoyant oceanic plateau is thought to arrive, being transported to Wyoming on the flat-subducting Farallon slab. We account for the above observations with flat-slab basal tractions driving Laramide thrusting and eroding the base of North American lithosphere, and with the oceanic plateau then being abandoned beneath Wyoming. We cannot think of another reasonable explanation.

But assuming the Shatsky conjugate is the deep craton beneath Wyoming, its ocean crust is absent: it is not seen in xenoliths; an eclogetic crust would offset the required buoyancy of a depleted mantle; and a basaltic crust would be obvious in receiver functions. Plate reconstruction models have the Shatsky conjugate subducting beneath southern California starting ∼90 Ma, and there is no evidence it lost much crust there. The record of vertical surface motion as the Shatsky conjugate passed beneath North America suggests the fate of the oceanic crust. The western Colorado Plateau elevated ∼1 km when the Shatsky conjugate arrived 80-70 Ma. This uplift suggests a basaltic (buoyant) oceanic plateau crust. In contrast, a strong and localized focus of rapid subsidence propagated east across the Rocky Mts ∼85-70 Ma, suggesting the oceanic crust was transforming to eclogite. This anomalous subsidence ended ∼75-70 Ma and the region rebounded, suggesting loss of ocean crust beneath the southern Wyoming/NE Colorado region at about this time. The Colorado Mineral Belt (the only Laramide magmatism attributed to mantle melts) initiated at ∼75 Ma. This magmatic trend lies along the southern margin of both the region of subsidence and the location of the Shatsky conjugate at 75 Ma, suggesting that it represents a tear in the Farallon slab through which the eclogizing ocean crust escaped.

The slab-stacking hypothesis for creation of Archean cratons is similar, with oceanic crust and lithosphere of properties similar to the Shatsky conjugate underthrusting the craton. In this model, the oceanic crust needs to be removed. The evidence preserved in the Wyoming example may suggest how this happened.