Oceanic plateau subduction beneath North America and its geological and geophysical implications

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We use two independent approaches, inverse models of mantle convection and plate reconstructions, to predict the temporal and spatial association of the Laramide events to subduction of oceanic plateaus. Inverse convection models, consistent with vertical motions in western US, recover two prominent anomalies on the Farallon plate during the Late Cretaceous that coincide with paleogeographically restored Shatsky and Hess conjugate plateaus when they collided with North America. The distributed deformation of the Laramide orogeny closely tracked the passage of the Shatsky conjugate massif, suggesting that subduction of this plateau dominated the distinctive geology of the western United States. Subduction of the Hess conjugate corresponds to termination of a Latest Cretaceous arc magmatism and intense crustal shortening in Early Paleogene in northwest Mexico. At present, conjugates of the Shatsky and Hess plateaus are located beneath the east coast of North America, and we predict that +4% seismic anomalies in P and S velocities are associated with the remnant plateaus with sharp lateral boundaries detectable by the USArray seismic experiment. Flat subduction of the Shatsky conjugate caused drastic subsidence/uplift and tilt of the Colorado Plateau (CP). From the inverse convection calculations, we find that with the arrival of the flat slab, dynamic subsidence starts at the southwestern CP and reaches a maximum at ~86 Ma. Two stages of uplift follow the removal of the Farallon slab: one in Latest Cretaceous and the other in Eocene with a cumulative uplift of ~1.2 km. The southwestern plateau reaches a high dynamic topography in the Eocene which is sustained to the present. Both the descent of the slab and buoyant upwelling may have contributed to late Cenozoic plateau uplift. The CP tilts downward to the NE before the Oligocene, caused by NE trending subduction of the Farallon slab. The NE tilt diminishes and switches to a SW tilt during the Miocene when buoyant mantle upwellings occur.