Flat-slab subduction of the Farallon plate is inferred from western U.S. magmatic and deformation histories which are similar to those observed at modern flat-slab subduction zones. At its maximum extent, the Farallon flat-slab hinge was under present-day New Mexico, affecting lithosphere deformation, magmatism, and the upper mantle. Here we present results of geodynamic models of flat-slab subduction, that form an interpretive framework for the lithosphere and upper mantle structure below New Mexico, as well as patterns of magmatism. Our models show that arc magmatism ended when the Farallon flat slab advanced. This happened because the asthenospheric wedge filled with lowermost lithosphere of the North American plate, which was scraped off by the advancing slab. As the slab flattened, it compressed the North American plate through end loading. This resulted in compressional deformation far east of the slab hinge, into present-day central US.

Slab removal opened the asthenospheric wedge, resulting in magmatism of the San Juan, Mogollon-Datil and Trans-Pecos volcanic fields. It left a step in the lithosphere-asthenosphere boundary which focused Rio Grande rift opening. A keel, consisting of bulldozed material that had been scraped off by the flat slab, is present below southeastern New Mexico, leaving a fast seismic velocity anomaly in the upper mantle that inhibits magmatism.