

## **From Mantle To Mountain Top – A Restorable East-West Transect Across Colorado Following Interstate 70**

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### **ABSTRACT**

In the spirit of past Colorado structural syntheses by Hayden, Grose and Tweto, the aim of this project is to build a restorable transect following Interstate 70 east to west across the state. The section incorporates disparate data sets including potential field, seismic, well, thermochronology, and outcrop data, much of which has become available since a section like this was last published, to illustrate Colorado's structural evolution. Restoring Laramide geometries involved using a projected top Cretaceous horizon as the upper bounding surface and a mid-crustal interface as the basal decollement/lower bounding surface. Refraction seismic combined with magnetotellurics provide evidence for the undulating mid-crustal interface at subsea depths between 12 and 29 km. In areas stripped to basement, missing stratal and structural cover geometries were projected into the section aided by low-temperature thermochronology and by analog to structures seen along strike. Ancestral Rocky Mountain structures were treated as early elements of the Laramide fault arrays, a premise supported by their reactivation during the Laramide. To permit restoration, the crooked section following Interstate 70 was projected into a straight profile oriented parallel to N65E, which approximates the Laramide transport direction. Recent wells and reflection seismic showing fault-bend folds, multiple bedding-parallel detachments, and stacked triangle zones guide the structural style and allow greater translation to be interpreted within the Laramide thrust systems. These data also show greater depths within some of the hinterland relative to the foreland basins suggesting underthrusting may have been an important structural process. Preliminary versions of the restoration show approximately 67 km of translation or 26% shortening across the uplifts between the Denver and Piceance basins. This synthesis indicates an early Laramide phase of differential subsidence starting at ~78 Ma and coincident with the arrival of magmatism related to encroaching flat-slab subduction beneath central Colorado. This was followed by a late Laramide phase of differential uplift starting at ~68 Ma and continuing episodically to at least 56 Ma. Onset of the early Laramide phase was marked by abrupt realignment of isopach trends with stratigraphic thicks developing in the Piceance and Denver basins separated by a thin across what are now South Park and the Sawatch Range. Onset of differential uplift during the late Laramide is indicated variously by the appearance of basement clasts in the Arapahoe Conglomerate at ~67 Ma, thrust deformation before, during and after intrusion of sills at ~63 Ma, fault gouge dated between ~68 and ~56 Ma, possible inflections in the apatite fission track elevation/age gradients at ~67 Ma, and deformation after the Laramie Fm. (~69 Ma) and before the South Park Fm. (~67Ma). The post-Laramide was marked by denudation and development of the Rocky Mountain Erosional Surface starting at ~45 Ma with localized increased heat flow and reburial of this surface beneath extensive volcanics to ~30 Ma. Differential extension overprinting the earlier contractional orogen began at ~28 Ma with the development of the Rio Grande Rift and other Tertiary basins and continues today. Finally, recent passive-source seismic shows low-density mantle and crust underly high elevations, active denudation and epeirogenic uplift centered on Colorado since ~10 Ma.