The Topographically Asymmetrical Alaska Range: Multiple Tectonic Drivers Through Space and Time

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The topographically segmented ~700 km long Alaska Range has evolved over the last 50 m.y. in response to both far-field driving mechanisms and near-field boundary conditions. To the east, the eastern Alaska Range follows the curve of the Denali Fault strike-slip system forming a large arc of high topography across southern Alaska. Interestingly, the majority of the topography in the eastern Alaska Range lies north of the Fault. A large gap of low topography (Broad Pass: 750 m), separates the eastern Alaska Range from the central Alaska Range where the majority of high topography lies to the south of the Denali Fault. To the west, there is a restraining bend in the Fault; and ~6,000 m Mount McKinley lies within the south side of the bend. Southwest of the bend the main topography of the western Alaska Range takes an abrupt 90 degree turn away from the master strand of the Denali Fault. This striking north-south limb of the Alaska Range is known as the Western Alaska Range.

Paleocene-Eocene ridge subduction and an associated slab window, Neogene flat-slab subduction of the Yakutat microplate, plate motion change (e.g., ~6 Ma), block rotation/migration, and fault reorganization along the Denali Fault are all likely responsible in varying degrees for periods of mountain building within the Alaska Range. However, it is clear from basin, petrological and thermochronological constraints that not all of the far-field driving mechanisms affected every segment of the Alaska Range to the same degree or at the same time. Alaska Range tectonic reconstruction is also complicated by near-field structural controls on both the timing and extent of deformation. Fault geometry affects both the amount of exhumation (e.g., ~14 km Susitna Glacier region in the eastern Alaska Range) and location of topographic development (e.g., north or south of the Denali Fault). Lithology also plays a role in where topographic highs exist (e.g., Denali; monolithic granite).

The average elevation within the eastern, central, and western segments of the Alaska Range is only ~1300 m. Along the whole range front, high topographic regions are only ~2500 m. Conversely the relief and verticality of the range from the tundra (~700 m) to glacier capped peaks (up to ~6000 m) is quite dramatic over a short horizontal distance (<20 km). It is quite possible that the topographic signature we see today is the result of a pre-existing landscape modified by Plio-Quaternary surface processes.

Deconvolving the orogenic and exhumation history of the Alaska Range has been a multi-party, mult-decade, multi-discipline project. We will present a summary of our understanding of the topograhic history of the Alaska Range from the Eocene to the present. We will also present a short overview of the big questions still unanswered.