"Decoupling of Modern Tectonics, Climate, and Topography in the Greater Caucasus"

by

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Abstract

The Greater Caucasus are a young (~5 Ma) mountain range that lies along the northern edge of the Arabia-Eurasia collision zone and that are subject to order of magnitude, west to east, along-strike variations in modern convergence rate (from < 2 mm/yr to > 14 mm/yr) and precipitation rate (from >2 m/yr to <0.5 m/yr). Despite these dramatic along-strike gradients, the topography and exhumation history of the range is extremely similar along-strike, suggestive of an apparent disconnect between modern climate, shortening rates, and the topography of the Greater Caucasus. By combining multiple datasets, we examine plausible causes for this disconnect, presenting a detailed analysis of the topography of the Greater Caucasus utilizing established relationships between catchment-mean erosion rates and topography (local relief, hillslope gradients, and channel steepness), combined with a synthesis of previously published low-temperature thermochronologic data. Modern climate of the Caucasus region is assessed through an analysis of remotely-sensed data (TRMM and MODIS) and historical streamflow data. Because along-strike variability in either erosional efficiency or thickness of accreted material fail to explain our observations, we suggest that the topography of the Greater Caucasus maybe partially supported by geodynamic forces. Specifically, in the Greater Caucasus, maintenance of high topography in the western portion of the range despite extremely low (<2-4 mm/y) modern convergence rates and an extremely wet climate may be related to dynamic topography from detachment of the north-directed Greater Caucasus slab or to a recent slowing of convergence rates. Large-scale spatial gradients in climate are not reflected in the topography of the Caucasus and do not seem to exert any significant control on the tectonics or structure of either range. Ongoing work seeks to further quantify along-strike variability in erosion rates across a series of timescales throughout the range and consider these in the context of paleoclimatic data for the region.

Biography

Adam Forte is a geologist whose research integrates aspects of structural geology, stratigraphy, and geomorphology to understand the evolution of orogenic systems and their associated foreland basins. Much of Adam's work is field-based, but he also incorporates landscape evolution models, remotely sensed topographic / satellite data, and various geochronologic techniques into his research. His primary focus has been the Cenozoic evolution of the Greater Caucasus mountains and associated foreland basins, but also has interests in the role of rock strength contrasts in guiding landscape evolution and depositional records, along with significant working developing methodologies and tools for quantitative topographic analysis.