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Structural investigations of the tectonic history of the western Greater Caucasus: exploring the geological expression of the transition from subduction to slab breakoff

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The Greater Caucasus Mountains (GC), located between the Black and Caspian Seas at the northern margin of the Arabia-Eurasia collision zone, presently accommodate most (70%) of the orogen-perpendicular shortening within this sector of the collision zone. However, the structural geometry and tectonic evolution of this range remain poorly constrained. The core of the GC is predominantly made up of marine sedimentary rocks that represent a Mesozoic marine basin that has been tectonically inverted over the last $\sim$35 Ma [1-3]. The width of this marine basin, the timing of its closure, and the total amount of shortening accommodated during its closure are debated.
Patterns in exhumation, shortening rate, and subcrustal seismicity suggest that the modern range records an along-strike transition from an attached subducted slab in the east to a detached slab in the west [4]. Thus, the GC appears to capture the surface expression of processes associated with slab breakoff, including closure of a relict back-arc basin. The subduction and slab breakoff model for the evolution of the GC predicts that the back-arc basin was at least several hundred kilometers wide. Investigation of the stratigraphy and structural geology exposed in the core of the range is therefore critical to evaluating the slab breakoff model against alternative models of GC evolution.
We combine 1:100k structural mapping along two orogen-perpendicular transects with stratigraphic and structural analyses to constrain the magnitude of shortening accommodated within the GC, and thus the minimum width of the GC ocean basin prior to basin closure and continental collision. Using these data, we find that balanced geologic cross sections of the western and central GC (along the Enguri and Aragvi Rivers, respectively) indicate a minimum of $\sim$200 km of total shortening. This estimate is a minimum, because it does not account for non-accretionary underthrusting. These magnitudes of shortening are similar to those expected for subduction/ slab breakoff, and exceed those expected for buoyancy-driven uplift. In addition, they are comparable to estimates of total shortening within the GC derived from paleomagnetic data [5]. The GC thus appear to offer insights into how the subduction/collision transition is recorded in the geologic record.

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