Structural geometry and evolution of the central and eastern foothills of the Brooks Range, northern Alaska

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The central and eastern foothills of the Brooks Range represent different stages in the evolution of the frontal part of the Brooks Range orogenic wedge. Each area has different structural characteristics that reflect how far the wedge has built into the foreland basin and consequent differences in mechanical stratigraphy.

The first phase in the evolution of the Brooks Range was the Middle Jurassic to Valanginian collision of an intra-oceanic arc and emplacement of allochthons derived largely from the sedimentary cover of a south-facing passive continental margin. Shortening of hundreds of kilometers created little or no subaerial relief because it involved mainly the sedimentary cover of thinned continental basement. The structure of the central Brooks Range foothills is strongly controlled by the wedge-shaped leading edge of the northernmost and lowest allochthon, the Endicott Mountains allochthon (EMA), and the overlying wedge-top foreland basin deposits. Turbidites and olistostromes of the Okpikruak Formation were deposited on the front of the EMA wedge during its emplacement. Mid-Cretaceous uplift and erosion of the southern Brooks Range resulted in deposition of the stratigraphically complex and variable Fortress Mountain Formation on the front of the EMA wedge and eventual filling of the rest of the Colville foreland basin by the Torok and Nanushuk Formations. Growth strata and angular unconformities indicate continued folding during this time, although it probably was local and accommodated only minor shortening. A few tens of kilometers of shortening during Paleocene time (~60 Ma) formed most of the conspicuous structures of the central Brooks Range foothills. The leading edge of EMA was thickened by duplexing, the overlying wedge-top deposits were folded, and both were cut by breaching thrusts. These structures form the wedge-shaped core of a triangle zone beneath a backthrust that is localized above the tip of the EMA wedge in the upper part of the incompetent Torok. Additional shortening farther north was accommodated by a wedge with much lower taper that formed in distal Fortress Mountain and Torok and was capped by detachment folds in comptetent Nanushuk.

In Eocene (~45 Ma) and later time, deformation progressed northward into the foreland basin to form the northeastern Brooks Range and the eastern foothills. The basal detachment dropped into basement to form thrust faults in the foothills that cut steeply up section to the surface. The entire section is involved in first-order folds associated with these basement faults. The basement thrusts and folds overprint local zones of second- and third-order folds and thrust faults of variable vergence above incompetent intervals at multiple stratigraphic levels. In contrast with the central Brooks Range foothills, the front of the orogenic wedge in the east does not include allochthonous rocks, but instead includes the entire parautochthonous sequence from basement to foreland basin deposits. It also does not appear to have a regional triangle zone.