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New Insights to Alaska Range Orogenesis from the Northern Margin of the Copper River Basin

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ABSTRACT

The stratigraphic and structural evolution of basins in south-central Alaska record the Cenozoic development of the Alaska Range orogen in response to the actively evolving Denali fault system. Published work on the Tanana basin north of the Alaska Range shows fault-bounded Mio-Pliocene strata contain a transition between fine-grained lacustrine strata and proximal alluvial gravels, interpreted to record unroofing in the Alaska Range. Geophysically imaged thrust faults and associated growth strata in the Susitna basin south of the Alaska Range are interpreted to reflect interaction between the Denali and Castle Mountain fault systems and related topographic development. East of the Susitna basin, the Copper River basin remains an under studied basin at the southern periphery of the Alaska Range, primarily due to the lack of exposed Cenozoic strata. We report new 1:10,000 scale geologic mapping, provenance data, and geochronology from inverted Cenozoic strata at the northern margin of the Copper River basin. Our analysis focuses on the region surrounding the headwaters of the Delta River, where the Trans-Alaska pipeline crosses the Alaska Range. New mapping reveals that conglomerate strata at the northern margin of the Copper River basin have been incorporated into a south vergent thrust system splaying from the south side of the Denali fault. Major thrusts in this zone include the Broxson Gulch fault west of the Delta River and the McCallum Creek fault east of the Delta River. Published ages show that conglomerate strata are as young as mid Pliocene in the footwall of the McCallum Creek fault and as old as Oligocene in the footwall of the Broxson Gulch fault. The fault-bounded conglomerate strata contain an array of meta-volcanic, intrusive, and metamorphic clasts, which match to provenance areas within the Wrangellia composite arc terrane to the south, the Yukon-Tanana composite metamorphic terrane north of the Denali fault, and the Maclaren metamorphic belt in between. New and existing detrital zircon U/Pb age spectra from conglomerate matrix sand supports sediment input from nearby uplifted terranes and recycling from inboard terranes. Existing low-temperature cooling ages from the adjacent regions of the Alaska Range show Oligocene-Miocene rapid cooling in the Alaska Range west of the Delta River and late Miocene-recent rapid exhumation in the range to the east. This pattern matches the apparent age progression exhibited by footwall conglomerate strata and indicates a causal link between unroofing in the Alaska Range and adjacent basin development. Collectively, fault bounded Oligocene-Pliocene conglomerate strata at the northern margin of the Copper River basin record unroofing in the adjacent eastern Alaska Range. Oligocene-recent thrust stacking via slip in the Broxson Gulch and McCallum Creek fault systems has overtaken the proximal portion of the Copper River basin, causing the boundary between the Alaska Range and Copper River basin (i.e. the range front) to migrate southward. Since the last glacial maximum, active shortening structures at the current range front have allowed the Delta River to capture streams from the Copper River watershed. The Oligocene-Present evolution of the northern margin of the Copper River basin augments results from the Tanana and Susitna basins, illustrating how the Denali fault and associated splays fundamentally control the morphology and stratigraphy of basins peripheral to the Alaska Range.