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Cenozoic evolution of the Yakutat-North American collision zone and structural accommodation of St. Elias syntaxis exhumation, Alaska/Yukon

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Active convergent margins potentially pose multiple natural hazards to human life and infrastructure. Tectonic strain may be further focused where convergent margins are warped into broad syntaxes. However, the processes responsible for upper plate deformation in these settings are not well understood.
The St. Elias syntaxis in southeast Alaska and southwest Yukon is located at the eastern corner of the Yakutat microplate, which indents into the North American Plate and subducts at a flat angle beneath Alaska. High rates of long-term glacial erosion and exhumation (>2 mm/yr) are found on the southern, coastal flanks of the St. Elias orogen, but the deepest and most rapid exhumation is focused at the St. Elias syntaxis. In this location, transform motion transitions into subduction of the wedge-shaped, oceanic plateau of the Yakutat microplate.
In order to map the spatio-temporal pattern of exhumation in the Yakutat-North American collision zone, we conducted zircon and apatite fission-track analyses of predominantly detrital, sand-sized material and five bedrock samples from 47 different glacio-fluvial catchments covering an area of ∼45,000 km2 around the St. Elias syntaxis. Integration of the new thermochronologic data with prior work and other geologic and geophysical observations yielded information on past terrane accretion events at the North American margin since the late Mesozoic and the evolution of exhumation at the St. Elias syntaxis in the context of the ongoing Yakutat-North American plate collision.
Our results indicate a migrating focus of the most rapid exhumation from north to south and from the upper (North American Plate) to the lower (Yakutat microplate) plate in the syntaxis area over the past ∼10 Myr. This migration occurred in response to a change in plate motions, increasingly thicker crust of the subducting Yakutat microplate, and changes in surface processes after glaciation began that resulted in modification of the rheology. We propose a positive, two-sided flower structure to have accommodated the rapid, and temporarily deep (∼10 km), exhumation.