STRAIN PARTITIONING WITHIN THE WESTERN CHUGACH-ST. ELIAS OROGEN, ALASKA: THE EFFECT OF GLACIAL EROSION

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The dynamic zone of interplate deformation associated with southern Alaska's St. Elias orogen has produced the highest coastal relief on Earth and is the location of some of the fastest short-term erosion rates known. The orogen receives upwards of 4 m precipitation annually, has been heavily glaciated for the last 5 million years, and has convergence rates comparable to the Himalaya (~4 cm/yr). Over the last few years, evidence has steadily mounted that within such tectonic settings, climate and tectonics exist as a coupled system, in which differential erosion can lead to changes in the location and mode of deformation as rock is uplifted to replace eroded material in a positive feedback cycle. This new paradigm is bolstered by our ongoing research aimed at quantifying spatial patterns in exhumation rate and the location of active structures within the western half of the orogen. Bedrock radiogenic helium ([U-Th]/He) cooling ages in apatite show that exhumation is currently focused on the windward side of the orogen. Long-term, time-averaged exhumation rates near the coast are generally ~2-3 mm/yr, versus <0.5 mm/yr on the leeward side of the range. However, the rapid exhumation rates along the windward flank are not spatially uniform. The highest rates measured thus far are ~5 mm/yr near the Bering and Steller Glaciers (corresponding to cooling ages as low as 0.4 Ma). This locus of exhumation could reflect a redistribution of strain by focused erosion beneath these large outlet glaciers. However, the structural mechanism of this focused strain is not known. Pairs of helium ages spanning the footwall and hanging wall of the Chugach-St. Elias fault, the suture between the North American plate and colliding Yakutat terrane, suggest the thrust has been inactive since ~1 Ma. This is consistent with a southwards shift in deformation, potentially reflecting development of new fore-thrusts seaward of the St. Elias fault more suitable for maintaining a critical wedge geometry. The pattern of ages also suggests back-thrusts, previously unrecognized, exist beneath the Bagley Icefield and the Wernicke Glacier. Our new data thus implies that glacial erosion is a controlling factor in the partitioning of strain within this orogen and has helped identify structural mechanisms for the accommodation of crustal convergence.