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

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The ongoing collision between the Yakutat terrane and the North American plate in southeastern Alaska's St. Elias orogen is a modern analog for the tectonic processes which produced, and shaped, much of the Cordillera. With convergence rates comparable to that of the Himalaya (>4 cm/yr), a young and dynamic zone of thin-skinned interplate deformation has constructed the highest coastal relief on Earth, and given rise to the second and third highest peaks in North America (5,959 and 5,489 m). The orogen receives upwards of 4 m precipitation annually, has been heavily glaciated for the last 5 Ma, and contains some of the fastest short-term erosion rates known. Over the last few years, evidence has steadily mounted that within such tectonic settings, climate and tectonics exist as a coupled system (i.e. Taiwan and Nanga Parbat). Our ongoing research, aimed at quantifying spatial patterns in exhumation rate as well as the location of active structures within the western half of the St. Elias orogen, bolsters this new paradigm. Bedrock ([U-Th]/He) cooling ages in apatite show that exhumation is currently focused on the windward side of the orogen. Time-averaged, long-term, 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 with the highest rates measured thus far >5.5 mm/yr (0.4 Ma cooling age) situated near the Bering and Steller Glaciers. This locus of exhumation could reflect a redistribution of strain by focused erosion beneath these large outlet glaciers. Yet, the structural mechanism of this focused strain is still speculative. Pairs of helium ages spanning the foot-wall and hanging-wall of the Chugach-St. Elias thrust, the suture between the North American plate and colliding Yakutat terrane, imply that the thrust became inactive at some time between 2 and 5 Ma. Because of the coincidence in timing between this transition and the onset of glaciation, we speculate that deformation shifted onto more seaward fore-thrusts which were better situated to maintain a critical wedge geometry as erosion patters and magnitudes evolved. The pattern of ages also suggests that previously unrecognized back-thrusts, with unknown oblique components, exist beneath the Bagley Ice Field (Contact Fault) and north of the rapidly exhuming Mt. Tom White. New low-temperature cooling ages are thus important for constraining the activity and distribution of active structures in this thrust belt, as well as illustrating the influence of focused glacial erosion in the partitioning of strain within zones of crustal convergence.

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