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The role of the glacial buzzsaw in active orogen development: Testing theoretical models with observed variations in erosion rate in the Patagonian Andes

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The match between the glacial equilibrium line altitude (ELA) and summit elevations in many active orogens has led to the hypothesis that glaciers act as an erosional buzzsaw limiting orogenic topography. Our study involves the ongoing development of a coupled geodynamic and surface process model that incorporates glacial erosion in an active critical orogenic wedge to test this hypothesis. The model makes quantitative predictions of long-term temporal and spatial variations in rock uplift and erosion following climate induced ELA lowering. The predictions vary dependent on the effectiveness of the glacial buzzsaw, and whether the orogen responds by passive isostasy or deforms internally to maintain critical taper. To test these predictions we apply low-temperature thermochronology to evaluate temporal/spatial changes in erosion rates in the Patagonian Andes - the orogen where the match between ELA and orogen height was first recognized. Preliminary data from 47-49° S indicate an erosion rate increase of ˜60% following the onset of widespread glaciation in the Patagonian Andes. This is significantly lower than expected for a strong glacial buzzsaw acting on an active critical orogenic wedge (ca. 400%), but higher than predicted for a weak glacial buzzsaw acting on either an active or passive orogen, implying that the onset of ELA lowering (glacial buzzsaw) caused some erosional response at the centre of the orogen. With the acquisition of further data we will be able to more closely match the resolution of the numeric model, and hence better ascertain the importance of the glacial buzzsaw in limiting orogen development. Also by tailoring the numeric model to represent the local climate and geodynamics of the Patagonian Andes, we can feed back observed variations in erosion rate into the model to test and improve theoretical

models of glacial erosion over geological timescales.