

Cohen, D., Hooyer, T.S., Iverson, N.R., Thomason, J., and Jackson, M., 2006. Role of transient water pressure in quarrying: a subglacial experiment using acoustic emissions. *Journal of Geophysical Research-Earth Surface*, v. 111, F03006, 15 p. **(06-15)**

Abstract

Probably the most important mechanism of glacial erosion is quarrying: the growth and coalescence of cracks in subglacial bedrock and dislodgement of resultant rock fragments. Although evidence indicates that erosion rates depend on sliding speed, rates of crack growth in bedrock may be enhanced by changing stresses on the bed caused by fluctuating basal water pressure in zones of ice-bed separation. To study quarrying in real time, a granite step, 12 cm high with a crack in its stoss surface, was installed at the bed of Engabreen, Norway. Acoustic emission sensors monitored crack growth events in the step as ice slid over it. Vertical stresses, water pressure, and cavity height in the lee of the step were also measured. Water was pumped to the lee of the step several times over 8 days. Pumping initially caused opening of a leeward cavity, which then closed after pumping was stopped and water pressure decreased. During cavity closure, acoustic emissions emanating mostly from the vicinity of the base of the crack in the step increased dramatically. With repeated pump tests this crack grew with time until the step's lee surface was quarried. Our experiments indicate that fluctuating water pressure caused stress thresholds required for crack growth to be exceeded. Natural basal water pressure fluctuations should also concentrate stresses on rock steps, increasing rates of crack growth. Stress changes on the bed due to water pressure fluctuations will increase in magnitude and duration with cavity size, which may help explain the effect of sliding speed on erosion rates.