

Erosion

GES-441

Erosion occurs by **abrasion** and **plucking**

Abrasion - the wearing away of rock beneath a glacier by cutting and polishing

Rate is dependent upon

- 1) basal contact pressure
- 2) rate of sliding
- 3) concentration and supply of debris
- 4) shape of debris
- 5) rock hardness
- 6) effectiveness of debris removal

Is contact pressure generated by the effective normal pressure (pressure generated by ice minus basal water pressure – i.e., Boulton)? Or is it a factor of how much ice is flowing towards the bed and how high the basal melt rate is (Hallet)?

Plucking/Quarrying - fracturing and crushing of rock beneath glacier and subsequent removal

Pre-existing geology important - joints etc....

Glaciers can also create fractures due to varying stress fields at the bed

Plucking often occurs on the lee side of an obstacle where there would have been a basal cavity. If this cavity is filled with pressurized water, the high-pressure water can cause crack propagation in the bedrock and aid in the plucking of rock. In some situations, water in the cavity refreezes. Water in the cracks in the rock freezes, expands, and by expansion causes the cracks to open wider. Repeated freeze-thaw would cause a section of the rock to detach. Under freezing conditions, the rock would adhere to the base of the ice, as well as become entrapped in regelation ice.

Subglacial meltwater also causes erosion, both mechanical and chemical.

Mechanical erosion depends upon the susceptibility of the bedrock, the water discharge and turbulence, and the sediment supply.

Chemical erosion

best when there are high flushing rates (no saturation), rock flour present (large surface area), and low temperatures (enhanced solution of CO₂)

Rates of Erosion

Not easy to measure - tunnels, sediment traps, geomorphological reconstructions

Abrasion - happens almost everywhere

Rates generally a few mm to few tens of mm a year, depending on rock type, ice thickness, and velocity

Plucking - more localized, very hard to quantify

Patterns of Erosion

Basal thermal regime is prime control - but not constant - temperature zones change over time under ice

Wet-based ice favors erosion - particularly abrasion because new clasts are being brought to bed constantly

Erosion, especially plucking, is favored where wet ice gives way to ice that is starting to freeze

Cold-based ice causes very little, if any, erosion - allows preservation of old landscapes