Terminus Dynamics and Active Deformation of Proglacial Sediments at an Advancing Glacier: Taku Glacier, Alaska

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Taku Glacier, an advancing former tidewater glacier in Alaska, has been actively pushing its proglacial sediments along part of its terminus over the last 50 years, producing so-called push moraines. The mobilization of these sediments, which were locally lifted more than 20 m above sea level by 2004, has happened episodically rather than steadily. The last major event of proglacial sediment deformation occurred in 2001, presumably caused by sliding along a basal detachment layer. Since then, most deformation has been localized within a few meters of the terminus, including impressive deformational features of the terminal ice, where slabs of ice, tens of centimeters in thickness, have undercut proglacial sediments and vegetation and lifted them up. Between 2002 and 2004, surface velocities and horizontal displacements were measured across the terminus and in the proglacial push moraine area using GPS. Sediment displacement was highest between the end of March and mid-June. A decrease in displacement with distance from the terminus revealed that the sediments were deforming internally rather than along a basal décollement. An observed wet clay-rich layer presumably acted as a major fault plane during the 2001 event.

Figure 1. Push moraine area in front of Taku Glacier. (a) Orthophoto 2002 with terminus positions from 2001 to 2004. The contour lines represent the topography of the glacier surface near the terminus (m HAE). The toes of the bulges are shown with solid lines where based on measurements and with a dashed line where inferred. Points A–E refers to sites where different deformational features at the glacier-sediment interface were observed (note that A is 400 m west of figure boundary). (b) Map view with the contour lines of the glacier bed (m HAE). GPS2003 and GPS2004 are the locations of continuously running GPS. The arrow labeled “trench” shows the location where a trench was dug, and T-T’ and P-P’-P” indicate the profiles discussed in the text. (c) Cross profile along profile P-P”. The thrust layer at bulge 1 and at the toes of the other bulges was observed. The basal décollement is inferred from seismic refraction measurements (not shown here).

References

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