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Rapid retreat of lake-terminating Alaskan glaciers through disarticulation

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Field observations and analyses of aerial photography and satellite imagery document that several dozen large Alaskan glaciers are rapidly retreating through disarticulation, a process described in this presentation. Observed disarticulating glaciers generally terminate in ice-marginal lakes. Typically, disarticulation events occur when the thinning, low-gradient, distal end of a retreating glacier reaches a state of buoyancy and separates from its bed. As the terminus of a disarticulating glacier begins to float, tabular pieces of ice, some which may be larger than a kilometer in maximum dimension, separate from the terminus or lateral margins. Separation usually occurs along old crevasse and fracture planes and may begin at distances of more than 2 km behind the terminus. Often, hundreds of large icebergs simultaneously separate. Once a glacier begins to loose ice by disarticulation, its retreat rate may increase by more than an order-of-magnitude over its former retreat by melting rate. During retreat, many terrestrial glaciers expose deeply eroded portions of their beds. With continuing retreat, the termini of these glaciers frequently transition from terrestrial to lacustrine and often begin to disarticulate. Compared to calving, which is an active, high-energy process; disarticulation is a much-more passive process. In 2005, Alaskan glaciers that were observed by the author to be retreating through disarticulation included: Allen Glacier, Alsek Glacier, Bainbridge Glacier, Bear Glacier, Bering Glacier, Brady Glacier, Bucher Glacier, Colony Glacier, Desolation Glacier, Ellsworth Glacier, Excelsior Glacier, Grand Plateau Glacier, Mendenhall Glacier, Norris Glacier, Tana Glacier, Valdez Glacier, and Yakutat Glacier. Since the 1930s, Bering Glacier has experienced at least four post-surge, decadal-scale, cyclic episodes of disarticulation-driven rapid retreat. The post-surge retreat pattern during the two most recent cycles, 1967-1992 and 1996-present, has been carefully documented. In each cycle, retreat began by calving. However, within a few years, as Bering Glacier's piedmont lobe rapidly thinned,

often by more than 20 m/yr, the dominant process transitioned to disarticulation. With disarticulation, the rate of retreat greatly increased. Evidence of two earlier disarticulation cycles was also identified on photographs from 1936, following a surge that ended in the 1920s; and 1948, following a surge that ended in the 1940s. In both the 1936 and 1948 photographs, the observed disarticulation was occurring at the same location in southwestern Vitus Lake. This bathymetrically-deep location was also the location of significant disarticulation during the last two post-surge cycles. The 1967-1992 cycle resulted in a maximum of 10.7 km of terminus recession. In a single year, recession exceeded 2.5 km.