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Terminal zone glacial sediment transfer at a temperate overdeepened glacier system

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Continuity of sediment transfer through glacial systems is essential to maintain subglacial bedrock erosion, yet transfer at temperate glaciers with overdeepened beds, where subglacial fluvial sediment transport should be greatly limited by adverse slopes, remains poorly understood. Complex multiple transfer processes in temperate overdeepened systems has been indicated by the presence of large frontal moraine systems, supraglacial debris of mixed transport origin, thick basal ice sequences, and englacial thrusts and eskers. At Svínafellsjökull, Iceland, thrusts comprising decimetre-thick debris-rich bands of stratified facies ice of basal origin, with a coarser size distribution and higher clast content than that observed in basal ice layers, contribute substantially to the transfer of subglacial material in the terminal zone. Entrainment and transfer of material occurs by simple shear along the upper surface of bands and by strain-induced deformation of stratified and firnified glacier ice below. Thrust material includes rounded and well-rounded clasts that are also striated, indicating that fluvial bedload is deposited as subglacial channels approach the overdeepening and then entrained along thrusts. Substantial transfer also occurs within basal ice, with facies type and debris content dependent on the hydrological connectedness of the adverse slope. A process model of transfer at glaciers with terminal overdeepenings is proposed, in which the geometry of the overdeepening influences spatial patterns of ice deformation, hydrology, and basal ice formation. We conclude that the significance of thrusting in maintaining sediment transfer continuity has likely been overlooked by glacier sediment budgets and glacial landscape evolution studies.