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Origin and significance of dispersed facies basal ice: Svínafellsjökull, Iceland

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Dispersed facies basal ice (massive ice with dispersed debris aggregates) outcrops at the margins of many ice masses and is important to glaciologists because of the information it provides about the nature of subglacial conditions and processes in the deep interior of glaciers and ice sheets. There has been little agreement, however, about how it forms with possible mechanisms including regelation and water flow through the intercrystalline vein network, strain-induced metamorphism of firnified glacier ice, shearing of basal debris-rich ice, freeze-on of subglacial water, and incorporation of surface debris into glacier ice. We test these established hypotheses at the temperate glacier Svínafellsjökull, southeast Iceland, and show that none fully account for dispersed facies characteristics here. From analysis of physical, sedimentological and stable isotope (δ^{18}O and δD) characteristics we suggest that dispersed facies forms from a combination of regelation and strain-induced metamorphism of debris-laden ice originally entrained by tectonic processes at the base of an icefall. We suggest that a terminal overdeepening may serve to further thicken dispersed facies as the glacier flows against a prominent reverse bedslope. There may also be a lack of subglacial drainage across the overdeepening which further allows dispersed facies to survive in thicknesses up to $\sim$20m despite the temperate location. Our results demonstrate that, despite its low sediment content ($\sim$1.6%), the thick layer of dispersed facies contributes a higher annual sediment flux than other more debris-rich basal ice types. Hence dispersed facies and the processes that create it should not be overlooked in assessments of glacial sediment budgets.