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Structural glaciology and debris transport at temperate glaciers with terminal overdeepenings: the examples of Kvíárjökull and Svínafellsjökull, southeast Iceland

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Evidence is presented for the transport of significant quantities of sediment via structures within englacial ice at two glaciers in southeast Iceland. Kvíárjökull and Svínafellsjökull are temperate outlet glaciers of the Öræfajökull ice cap that are fed by steep ice falls and terminate above large subglacial overdeepenings. The ablation areas of these glaciers are characterised by a distinctive transverse-arcuate englacial foliation and associated sediment structures. Most notably, both glaciers demonstrate up to metre-thick up-glacier-dipping transverse bands of debris-rich ice containing large clasts from both fluvial and basal transport sources. The presence of large subglacial overdeepenings means that glaciohydraulic supercooling is almost certain to contribute to debris-rich ice formation. However, the high calibre of the constituent debris and an abundance of striated rounded clasts indicates that supercooling is an unlikely mechanism of debris band formation. In addition, debris bands at Kvíárjökull indicate an origin upglacier of the reverse slope of the overdeepening, and strong variation in debris-type along certain debris bands points to the direct incorporation of debris from a heterogeneous glacier bed. We therefore support a model of debris band

formation by basal ice thickening and elevation under enhanced longitudinal flow compression due to the presence of large terminal overdeepenings. In addition, the appearance of the debris bands at the glacier surface indicates that transverse englacial foliation formed at the base of the ice fall provides an important control on thrust morphology. Debris bands exhibit locally high proportions of rounded clasts that may reflect the deposition of debris from subglacial fluvial transport to form a basal lag deposit on nearing the overdeepening.