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# Micromorphological evidence of liquefaction, injection and sediment deposition during basal sliding

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The sliding of an ice mass over its bed represents one of the main mechanisms for the forward motion of glacier and ice sheets. The basal sliding process is thought to be facilitated by either regelation of the overriding ice and/or the introduction of meltwater along the ice-bed interface. The periodic nature of these conditions results in a stick-slip style of motion with phases of basal sliding leading to the repeated decoupling of the ice from its bed. However, in the geological record, physical evidence of this process having occurred beneath former glacier and ice sheets is limited. We present the results of a detailed micromorphological study of thinly stratified subglacial tills exposed at two sites: (i) Galmis in Switzerland and (ii) Plumpe Farm, near Gretna Green in SW Scotland. The stratification within these tills comprises alternating layers of massive to weakly foliated diamicton and variably deformed (folded, faulted) laminated silt and clay. Micromorphological and microstructural evidence is interpreted in terms of repeated phases of basal sliding as the ice overrode a soft-sediment bed. Elevated meltwater contents/pressures encountered immediately prior to, and during basal sliding promoted localised liquefaction within the underlying bed. Decoupling of the ice from the bed enabled the injection of the liquefied diamicton along the ice-bed interface and/or into the laminated sediments immediately adjacent to this boundary. The laminated silts and clays record the settling out of fines (clay, slit) from meltwater trapped along the ice-bed interface after an individual phase of basal sliding has ceased. Injection of till into the locally water saturated silts and clays resulted in partial liquefaction and incomplete mixing of these fine-grained sediments with the diamicton. Density contrasts between the two liquefied sediments led to the development of a complex ‘vinaigrette’ like texture (in analogy with igneous petrological terminology) comprising rounded to irregular till pebbles within a matrix of variably homogenised silty clay. Recoupling of the ice with its bed led to localised folding and thrusting within the laminated silts and clays, hydrofracturing and injection of a network of sand- filled veins, and the imposition of a variably developed clast microfabric in the diamicton layers. Analysis (S1 and S2 eigenvalues) of the clast microfabrics indicates that the intensity of these fabrics is highly variable reflecting the variation in the intensity of deformation mposed by the overriding ice.