Quantifying the 'deformable bed' using cosmogenic ^{10}Be concentrations in a paleotill

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The Hartlen Till is an extensive, variably thick (>20 m), highly compacted, grey silty diamicton that cores many of the drumlins exposed along the eastern shore of central Nova Scotia. Due to its apparent homogeneity, many of the observations made at specific locations are transferrable to other outcrops. Based on ice flow measurements, pebble provenance, and offshore stratigraphy, it has been previously determined that the till was deposited during the Caledonian glacial phase, but its exact age has yet to be established. Analysis of diamicton pebble fabrics (eigenvalues of 0.8718 and 0.8505 at two separate locations in the till) at Conrads Head, support the previously interpreted classification that this is an undeformed lodgement till. As it commonly occurs at the base of the terrestrial stacks of tills, it may comprise material from Meguma and associated terranes that had been previously exposed to cosmic rays for a prolonged period of time. The overlying tills appear more immature (clasts are more angular and more abundant) but have different sources. The till therefore provides an ideal means of demonstrating the plausibility of a deformable bed in a drumlin environment using cosmogenic isotopes.

Although the concept of deformable beds accounting for a significant portion of the movement beneath glaciers is generally accepted, the thickness and contribution of a deforming bed at a given time is less predictable, varying with the material properties of the bed, flow velocity, and subglacial hydrology conditions. The thickness of a deforming bed has only been observed under modern glaciers. Is it possible to use a combination of ^{10}Be with other sedimentological data to determine its thickness? The experiment uses a vertical sequence of eight samples of quartz sand from the Hartlen Till matrix. Based on previous measurements of ^{10}Be in till, it is assumed that the Hartlen quartz sand contains inherited ^{10}Be from exposure as regolith prior to its deposition. Although AMS results are unavailable at the time of abstract submission, it is thought that the vertical distribution of the ^{10}Be concentrations will have three basic end member distributions: (i) if the concentration is invariant with depth, then there was either no deformable bed, or the entire Hartlen Till was mixed by shear-induced deformation; (ii) if the concentration increases with depth in the till, indicating an inversion of stratigraphy where the most weathered (exposed) regolith was deposited first, then the pattern of concentrations provide constraints on the deformable bed thickness; and

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(iii) if the concentration decreases exponentially with depth, this would imply that the Hartlen Till was exposed for a quantifiable duration prior to the deposition of subsequent tills (i.e., an interglaciation). 10Be measurements on the till matrix between clasts of a stone line on top of the Hartlen Till will also provide genetic insights into the origin of subglacial boulder lines.