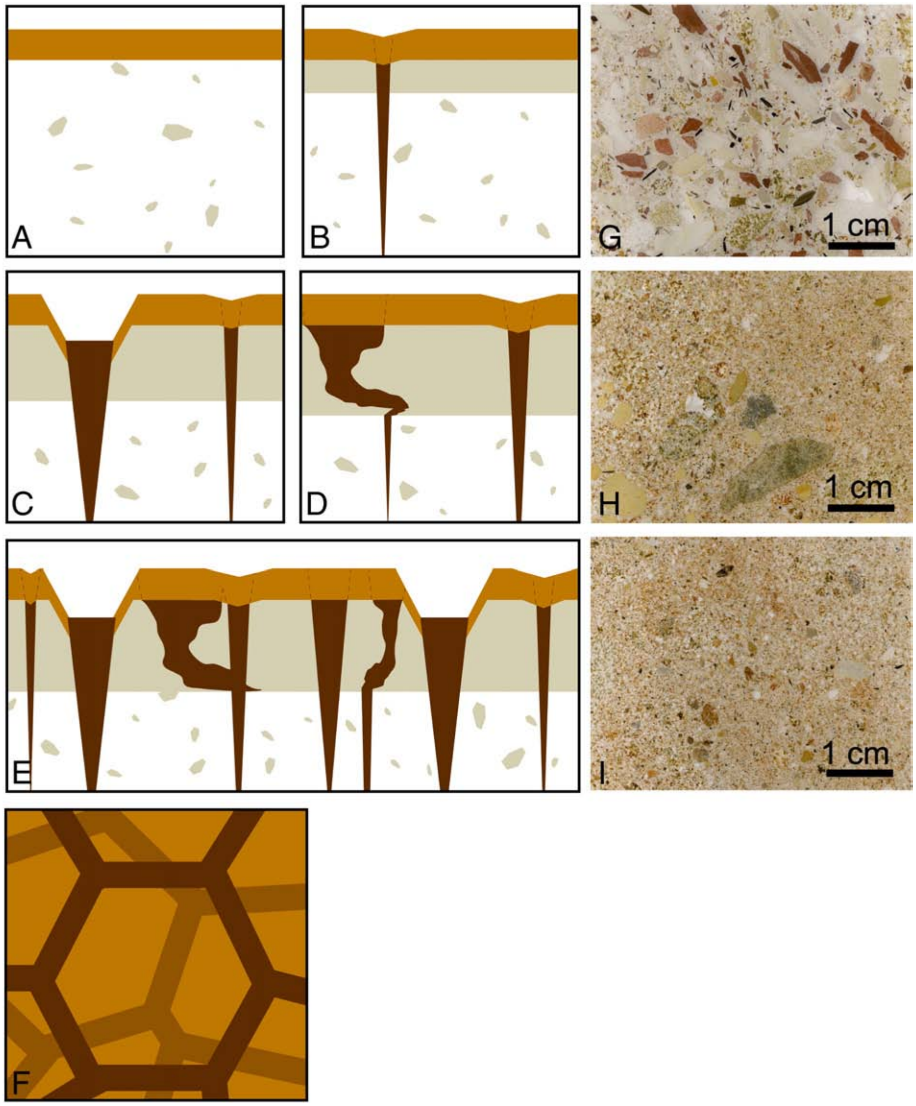

Fig. 6. Conceptual diagram showing the development and subsequent modification of all three facies of Mullins till. In (A), a 15-cm-thick weathered facies (brown) rests directly on buried glacier ice; the fresh facies is not present as the entire thickness of Mullins till lies within the zone of near-surface weathering (this is the case for most of upper and central Mullins Valley). In (B), continued sublimation of ice with pristine rockfall debris produces a fresh facies of Mullins till (tan) that lies below the weathered facies; note physical lowering of the buried ice surface from (A) to (B); also, a thermal contraction crack filled with stratified sands and gravels (dark brown) truncates both facies. In (C), continued growth of the sand wedge initiated in (B), as well as the development of a new wedge, increases the overall proportion of the sand-wedge facies in Mullins till; the mature sand wedge is now associated with a deep polygon trough (see text for explanation; Marchant et al., 2002). In (D), thermal contraction is abandoned at the first sand-wedge site (e.g., Berg and Black, 1966 ; Marchant et al., 2002; Levy et al., 2006); and as the ice surface continues to lower via sublimation, the once near-vertical sand wedge tilts to one side (in accordion-like fashion) as buttressing ice is lost. In (E), the effect of multiple generations of contraction-crack polygons and sand wedges produces an increasingly chaotic arrangement of the sand wedge facies; relict and active sand wedges truncate all facies of Mullins till. In (F), the cartoon shows a typical plain view image of active (dark brown) and relict (light brown) sand wedges; relict sand wedges (e.g., relict polygons) are typically only viewed in stratigraphic section. Panels (G)–(I) show textural characteristics for each of the three facies of Mullins till, as observed in thin-section analyses. In (G), the fresh facies shows angular grains with diagnostic green and maroon siltstone fragments, most of which are likely derived from the Arena Sandstone Formation at the valley headwall. Using MatLab image analyses, the average porosity of the fresh facies is estimated at ~29.5%. (For all estimates of porosity, a minimum of six image analyses were performed for each facies.) (H) The weathered facies of Mullins till; note the increase in stained grains (with iron oxides) over that seen in the fresh facies; the average porosity of the weathered facies is estimated at ~29%. (I) The sand-wedge facies; average porosity is estimated at ~31%.

4.4. Spatial variation in the distribution of each facies

4.4.1. Weathered facies

The weathered facies is present in all exposures of Mullins till. By definition, it is the only facies present where the till is ≤~20 cm thick (as occurs in most of Mullins Valley; Fig. 6).

4.4.2. Fresh facies

The fresh facies is uncommon. It is first observed at the base of soil pits ~3 km from the valley headwall, where Mullins till thickens consistently beyond ~20 cm. The fresh facies is spatially restricted (not laterally extensive) and commonly truncated by active and/or relict sand wedges. In all cases, the fresh facies rests directly on glacier ice; its maximum observed thickness is ~40–50 cm.

4.4.3. Sand-wedge facies

The percentage of sand-wedge facies comprising Mullins till increases with distance downglacier. The increase reflects the growing number of relict wedges that arise with the addition of each new generation of contraction-crack polygons. For sections of Mullins till most affected by multiple generations of contraction-crack polygons (e.g., on the floor of central Beacon Valley), the observed sedimentary architecture may consist of ~65% sand-wedge facies (the