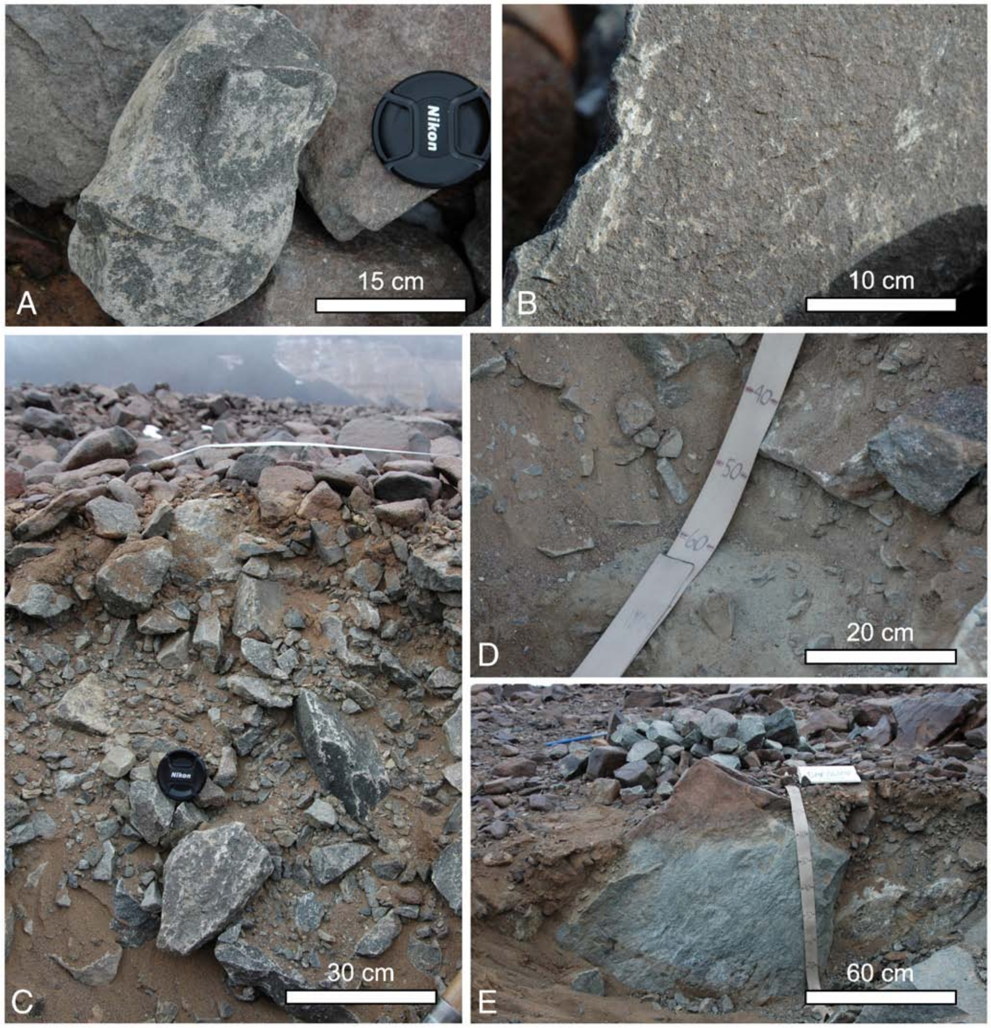

Fig. 5. Textural characteristics of facies within Mullins till. (A) A fresh (unweathered) clast (dolerite) removed the fresh facies of Mullins till; the color variation reflects locations of impact gouges and loose powder coating the clast that likely formed during initial rockfall deposition. (B) A close up view of gouges fringed with loose powder on a separate clast removed from the fresh facies; all clasts within the fresh facies lack evidence for surface weathering features/chemical alteration. (C) A section of Mullins till exposing the weathered facies (upper 15 cm) and underlying fresh facies; note that clasts at the surface are coated with rock varnish and lack evidence for impact gouges. (D) Detail of the base of soil excavation in (C); the buried ice surface (gray color) lies at a 60-cm depth and is smooth and dry, without evidence for melting and/or the formation of superposed, secondary ice. Fresh-appearing dolerite clasts are partly embedded in the glacier ice; upon removal, these embedded clasts are shown to contain impact scars on all sides, such as those seen in (A) and (B). (E) A ~ 1-m^3 boulder within Mullins till, the upper 15 cm of which reveals the effect of surface and near-surface weathering; below 15-cm, the dolerite boulder appears fresh and without visible evidence for chemical alteration. A relict sand-wedge deposit occurs to the left of the boulder, whereas a small portion of the fresh facies capped by the weathered facies occurs to the right.

clasts are brought together via sublimation of intervening ice (e.g., Lewis et al., 2007). Ultimately, the clasts are stacked precariously at the buried ice surface, each with minimal grain contacts, and hence fall readily from the surface of exposed soil pit walls. Paired analyses of englacial clasts and exposures of the fresh facies located immediately above show identical characteristics in terms of grain size distribution, grain shape, lithology, and surface textures, including chipped corners, gouges, and fringing powder.

4.2.3. Sand-wedge facies: periodic infilling of thermal contraction cracks

The sand-wedge facies forms as aeolian and/or slumped debris periodically fills open thermal contraction cracks at polygon margins (e.g., Pewe, 1959; Marchant et al., 2002; Levy et al., 2006). Repeated infilling produces a downward-tapering wedge of stratified sand and gravel that may penetrate several meters down into glacier ice. In cross section, the sand wedges display an overall trend toward coarser grains at the top and center. Relict wedges, e.g., those wedges no longer associated with active thermal contraction crack polygons (Berg and Black, 1966), also occur within Mullins till. Typically, these wedges are deformed, being contorted in accordion-like fashion as buttressing ice is lost via sublimation. Indeed, as thermal cracks shift, initially upright wedges grade sequentially into subvertical to subhorizontal lenses (Marchant et al., 2002) (Fig. 6). The evolving stratigraphy is complex, as sand-wedge deposits truncate all facies of Mullins till, even other sand wedges (Fig. 6).

4.3. Porosity variation

Because porosity is a key factor that regulates vapor diffusion through supraglacial tills (see Section 5.1), we measured the rate-limiting porosity for each facies (e.g., the porosity of the finest grain size fraction observed in the field). Thin-section analyses (Fig. 6) show that the porosity averages 29%, 29.5%, and 31% for the weathered, fresh, and sand-wedge facies, respectively (Table 2). As noted below, these small variations in porosity appear sufficient to impact ice sublimation and long-term landscape evolution over buried glacier ice (Section 5.2).