DESCRIPTIVE NOTES

PHYSIOGRAPHY

The map area (NTS 56 J/9–16) lies north of the Arctic Circle within the northern portion of the Wager plateau, approximately 200 km west of Repulse Bay, central mainland, Nunavut. Rolling hills and uplands bisected by broad valleys characterize the region. The map area occupies the headwaters of three drainage basins with a mean elevation of 380 m, punctuated by highs and lows of 560 m and 220 m, respectively. Hayes River drains Walker Lake and flows into Chantrey Inlet (Gulf of Boothia West Watershed). The eastern margin of the map area drains into Committee Bay (Gulf of Boothia East Watershed). In the southeast, drainage flows into Wager Bay, and Hudson Bay (Northwest Hudson Bay Watershed).

CLIMATE AND VEGETATION

The map area lies in the Northern Arctic Ecozone, a region of continuous permafrost (Burgess et al., 2001). The map area is at the transition of the 'high' and 'low' Arctic, in terms of the climate and vegetation. There are areas of bare ground resulting from frost action, a characteristic of the high Arctic. There are, however, some species also found in the low Arctic, such as low shrubs *Salix sp.* (willow) and *Betula glandulosa* (dwarf birch). These species and climate are indicative of Tundra Forest Region (Bliss and Matveyeva, 1992).

The effects of permafrost processes are ubiquitous throughout the map area, affecting all surficial materials, and influencing how research was performed. Freezing and thawing of the active layer results in frost heaving (freezing from the top), lateral sorting (from sides, or from below), and mechanical sorting (aided by gravitational forces). Frost creep results from material being heaved normal to the slope; subsequent melting lowers the material nearly vertically, resulting in overall down-slope movement. Gelifluction refers to the downward flow of material because of reduced cohesion due to poor drainage and resultant high pore water pressures. Combined, the processes of frost creep and gelifluction result in the mass movement process solifluction. The active layer can also slide on the frozen layer below, resulting in plug-like flow (French, 1996). Frost sorting is possible because finer materials move by freezing and thawing processes in a wider range of freezing rates than large particles. This variability of the movement of sediment results in larger scale sorted and unsorted patterned ground of circles, polygons, nets, stripes and steps (French, 1996). These processes also lead to the development of frost boils (a.k.a. mudboils), where unweathered material from the C-horizon rises to the surface by frost action.

BEDROCK GEOLOGY

The map area lies within the Rae domain of the Churchill Province (Skulski et al., 2002). Three main lithologic domains dominate the bedrock geology in the map area; (1) a central domain of a NE-SW trending belt of Archean supracrustal rocks; (2) a northern domain containing metasedimentary rocks and plutons; (3) and a southern domain of granitoids (Skulski et al., 2002).

ICE MOVEMENT INDICATORS

One hundred and two ice-movement indicators were measured at 51 field sites, in addition to 81 landform measurements from aerial photographs. Three ice-movement phases could be determined from these ice-movement indicators (Fig. 1), two of which are main phases found throughout the Committee Bay Project (CBP) map area (that includes Walker Lake and Laughland Lake (NTS 56 K to the west), Arrowsmith River (NTS 56-O to the north), and Ellice Hills (NTS 56 P to the northeast)). For consistency, the interpretations presented here are placed into the framework developed within the CBP (i.e. Phase 1, 2a, 2b, and 3) (McMartin et al., 2003). In addition to these phases the chronology is further refined to include a late phase of ice-movement, Phase 4. Phase 2 (a and b) is the oldest event identified in the Walker Lake map area. Phase 4 is the most recent; a local, topographically controlled ice-movement event.

Phase 1

Phase 1 ice-movement was northward over the entire CBP area.

Phase 2

Phase 2 incorporates two distinct, but likely contemporaneous, ice-movement directions: Phase 2a and 2b. In the northeastern portion of the CBP study area (NTS 56-O/2–8, P/5–7, P/9–16 and J/13) the ice-movement (Phase 2a) is to the northeast, towards Committee Bay. In the northwest region of the study area ice-movement (Phase 2b) is to the northwest, towards Chantrey Inlet.

Phase 3

Phase 3 records ice-movement primarily towards the north and north-northwest. Ice-movement indicators associated with this phase are found only south of the Chantrey Moraines, which includes all of the Walker Lake and Laughland Lake, and southern portions of Arrowsmith River and Ellice Hills (NTS 56-O/1–4 and P/1–4, 8).

Phases 4a, b, and c

At the “Howling Wolf” lake site (Fig. 2) indicators were measured on a komatiite ridge. Northward ice-movement indicators (4a) are crosscut by the others signifying ice-movement to the north-northwest (4b and c). This locality is at the south end of a regional topographic high (340 m for the site vs. 400 m for the hill). North-northeast (bearing 025°) of this site there is a lower area with a maximum elevation of 365 m.

DISCUSSION

Thinning of the Laurentide Ice Sheet (LIS) at the deep Gulf of Boothia resulted in the separation of the LIS into two separate sectors — the Keewatin and the Baffin (Dredge, 1995). This structural change caused the shifting of the margin of the Keewatin sector ice, resulting in ice-movement Phase 2a towards paleo-Committee Bay. Dyke and Prest (1987) report that this ice-movement direction occurred from ca. 18 to 8.4 ka, and was also influenced by the position of the Ancestral Keewatin Divide (AKD). Away from the influence of paleo-Committee Bay (the western portion of the map area) ice-movement was towards the northwest (Phase 2b). This may have resulted from a similar “pull” of ice towards Chantrey Inlet (McMartin et al., 2003). The northwest movement of Phase 2b probably occurred in the later stages of the AKD, when the divide was oriented southwest-northeast, and when the ice-margin had retreated to near the coast.

Phase 3 ice-movement can be associated with the Keewatin Ice Divide, when the ice margin had retreated beyond the influence of large water bodies, such as Committee Bay and Chantrey Inlet (Fig. 1). The control on this ice-movement direction may be topography, which would have exerted a greater influence as the ice sheet thinned. The fact that the indicators for this phase are found only south of the Chantrey Moraines suggests this as the location of the ice margin for this phase, and that (based on the age of the moraines (Dyke et al., 2003)) this phase occurred at ca. 8 ka.

Phase 4 records a period when ice-movement became increasingly influenced by topography. This resulted in a gradual directional shift in local ice-movement towards the low area to the northeast. The site's substrate, easily striated fine-grained ultramafic rock (komatiite), explains why this record of topographically controlled ice movement was preserved at this site.

The southern portion of the map area, in particular the southeast (56 J/9) yielded few small-scale ice-movement indicators. Likely this is because the plutonic bedrock in this area does not readily preserve ice-movement indicators.

DESCRIPTION AND DISTRIBUTION OF MATERIALS

R—Bedrock

Bedrock exposures of a significant areal extent to be mapped as an individual map polygon were reported as “Bedrock”. The bedrock was not subdivided and no surface expression was used. Polygons consisting mainly of bedrock are found predominantly on the up-ice side of topographic rises. Sub-mapping scale bedrock exposures are common within veneers of other units, typically rare within blankets and also occur within composite units.

T—Till

Till (i.e. morainal deposits) is an unsorted, matrix supported sediment with grain sizes ranging from clay to boulders deposited by glacial ice (Dreimanis, 1988). The matrix of the till measured from till geochemistry samples is sandy-silt to silty-sand, with less than 10% clay, and usually less than 5%. The active layer (approx. upper 0.5 m) is extensively modified by cryoturbation that destroyed primary depositional features.

Till is the most extensive surficial unit in the study area. It covers most of the upland areas, but is generally absent in low areas, where it has been either eroded by glaciofluvial action or buried by colluvium or other glaciogenic deposits. Typical surface expressions are blankets and veneers with estimated thickness ranging from < 1 m to > 5 m. Some thicker deposits have landforms, such as flutings, crag-and-tails and Rogen moraine. The deposits are likely of one age, from the last (Wisconsinan) glaciation, although no stratigraphic exposures were found to test this inference.

G—Glaciofluvial

The composition of glaciofluvial deposits varies from well-sorted sands to poorly-sorted boulder gravel. Clasts are typically moderate to well-rounded. Exposures were poor in gravels but structures within sandy esker deposits included planar laminations up to fine bedding with both normal grading and ripple cross stratification.

Glaciofluvial deposits are widespread in the map area, but still less extensive than till. Although not exclusively, the majority of these deposits are found in NNW trending strips, known as “glaciofluvial corridors” (cf. St-Onge, 1984). These narrow bands of glaciofluvial material dissect areas of till and other materials throughout Keewatin (Aylsworth and Shilts, 1989). Three idealized types of corridor deposits were identified: undulating corridors, valley corridors, and kettled corridors.

Landforms such as eskers, pitted outwash, deltas, glaciofluvial corridor hummocks (GCHs) and transverse ridges are constructed of glaciofluvial material. These landforms are located in topographic lows (eg. valleys) although some cross local drainage divides. Some eskers may extend for several kilometres, but because they are narrow (< 100 m), they are typically reported using symbols.

Sandy, flat-topped, glaciofluvial landforms such as terraces and plains typically have recti-linear ice wedge polygons of up to 20 m in diameter. Glaciofluvial sediments are likely from the last glaciation — they overlie till, and do not appear to be modified by overriding ice.

L—Glaciolacustrine

Glaciolacustrine material is moderately to well sorted, and varies in composition from silt to coarse sand. Exposures of these deposits are primarily terraces above the shore line of present-day lakes. Eskers are commonly observed in kettle lakes.

Vertical exposures (> 10 m) at Walker Lake contain cross-bedded coarse sand within dominantly horizontally stratified fine sand. The lower contact was not observed, but likely all of the deposits uncomformably overlie bedrock, till and/or glaciofluvial material. The layers of cross-bedded and horizontally stratified sands suggest phases of relatively high water flows. The depositional environment of the horizontally stratified and cross-bedded sands likely results from underflows, caused by water density differences (Lambert et al., 1976).

C—Colluvium

Colluvium was a relatively extensive map unit compared to other low relief, northern mapping projects (e.g. Kerr et al., 1997; Ward et al., 1997; McMartin, 2002). This is mainly due to a broader application of the terminology, rather than an abundance of the material. Colluvium, *sensu stricto*, is material that has been transported solely by gravity (Howes and Kenk, 1997). However, for this project colluvium includes solifluction deposits (typified by horsetail drainage) and felsenmeer (a result of frost heaving and freeze-thaw processes), as both of these are difficult to distinguish from colluvium proper during aerial photograph analysis. These processes only affect the upper surface (i.e. active layer) and leave the underlying sediments unaltered. These types of deposits were reported as map units of the underlying material with hachure patterns denoting the overlying material (i.e. colluvium).

A—Alluvium

Alluvial deposits result from non-glacial related fluvial processes. Differentiating between distal glaciofluvial deposits (outwash), and alluvium presented a difficulty in this study. Because peak flow regimes in the present-day fluvial systems (even at maximum spring runoff) are low, the majority of fluvial deposits were reported as glaciofluvial material.

ACKNOWLEDGMENTS

I would like to thank my Masters supervisor, Brent Ward, for his guidance in field mapping techniques, and Edward Little for managing the Quaternary aspect of the Committee Bay Project. Overall project leadership was expertly provided by Hamish Sandeman and Tom Skulski. I would like to thank: Isabelle McMartin for providing logistical support through TGI funding, and her enthusiastic field support; Kaz Shimamura for his assistance in digitizing the maps; Celine Gilbert and Jo-Anne Dohar for their cartographic assistance; and Travis Ferbey and Carl Ozyer for their assistance in the field and collaboration on map boundaries.

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