MORPHOLOGY, FREQUENCY AND MAGNITUDE OF ACTIVE-LAYER DETACHMENT SLIDES, FOSHEIM PENINSULA, ELLESMERE ISLAND, N.W.T.

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Abstract

Hundreds of active-layer detachment slides are present on the Fosheim Peninsula both above and below the marine limit within a 50 km radius of Eureka. These landslides occur in silty or sandy materials on slopes from 2->40° and range up to 700 m in length and 150 m in width. Length distributions are positively skewed and modal values are 20-40 m. Typical scar depths are 03-0.5 m and since these represent the position of the thaw front in mid- to late summer, slope failure occurs at this time. Minimum estimates of downslope movement of soil materials by active-layer detachment sliding in three locations range from 6 to 60 mm yr^{-1} for the upper 0.5 m of the active layer. These rates correspond to volumetric transport of 30-300 cm^3 cm^{-1} yr^{-1} and indicate that this geomorphic process is at least as important as solifluction. Unequal responses at three sites to a particularly warm period in the summer of 1988 suggest that where active-layer detachment slides are already common, climatic warming might initially induce additional failures. More frequent external triggers will not affect long-term activity rates, however, unless internal slope processes such as weathering and moisture migration are also influenced by climatic change.

Résumé

Sur la Péninsule Fosheim, au-dessus et au-dessous de la limite marine se trouvent des centaines de ruptures du mollisol à l'intérieur d'un rayon de 50 km de Eureka. Ces glissements de terrain se produisent dans des matériaux limoneux ou sablonneux sur des pentes allant de 2° à >40° et ils font jusqu'à 700 m en longueur et 150 m en largeur. Les distributions de fréquence des longueurs montrent une asymétrie positive avec mode entre 20-40 m. Les profondeurs typiques des cicatrices sont entre 0.3-0.5 m, représentant la position du front de dégel durant le milieu et la fin de l'été; donc les ruptures se produisent à cette saison. Les estimés minimaux de trois sites donnent des mouvements annuels vers le bas des pentes de 6-60 mm pour les premiers 50 cm du mollisol. Ces vitesses correspondent à un transport volumétrique annuel de 30–300 cm^3 cm^{-1} an^{-1} et montrent que ce processus est aussi important que la gélifluxion. Des réponses inégales dans les mêmes sites à une période particulièrement chaude dans l'été de 1988, suggérent que là où les ruptures de mollisol sont nombreuses, un réchauffement climatique pourrait causer l'initiation de glissements additionels. Des déclenchements externes plus fréquents n'affecteront pas les taux d'activité à long-terme sauf si les processus internes, par exemples l'altération superficielle par les agents atmosphériques et la migration de l'eau, sont aussi influencés par le changement de climat.

Introduction

Active-layer detachment sliding is a rapid mass movement process that occurs in summer on permafrost slopes. Failure involves the unfrozen mass detaching from the underlying substrate and sliding downslope over a thawing ice-rich zone within the active layer or the upper part of the permafrost. There is some confusion in the literature regarding terminology for these landslides but they fall within the general categories of "active-layer failures" or "detachment failures" (Permafrost Subcommittee NRCC, 1988). The term active-layer detachment slide is used here to differentiate between these landforms, which involve sliding of a relatively rigid, dry active layer, and morphologically similar features termed "skinflows" (Hughes *et al.*, 1973) or "earth flows" (Holmes & Lewis, 1965) which are also active-layer failures, but result from the flow downslope of saturated materials.

In North America, active-layer detachment slides have been described in the Mackenzie Valley (e.g. Hughes *et al.*, 1973; Mackay & Mathews, 1973; McRoberts & Morgenstern, 1974) and on the mainland coast (Mackay & Slaymaker, 1989), in Alaska (e.g. Carter & Galloway, 1981), and in the Canadian Arctic Archipelago (e.g. Hodgson, 1977; Stangl *et al.*, 1982; Mathewson & Mayer-Cole, 1984; Edlund *et al.*, 1989). They are known to be triggered by warm weather (e.g. Carter & Galloway, 1981), summer rainfall events (e.g. Cogley & McCann, 1976) and forest fires (e.g. Harry & MacInnes, 1988), but there has been little detailed study of their morphometry or frequency. Slope conditions at initiation are frequently linked to positive porewater pressures and the theory of thaw-consolidation (McRoberts & Morgenstern, 1974). An alternate analytical view assumes a particulate structure in which frozen soil lumps are surrounded by thawing ice veins and lenses (Vallejo, 1980; Vallejo & Edil, 1981).

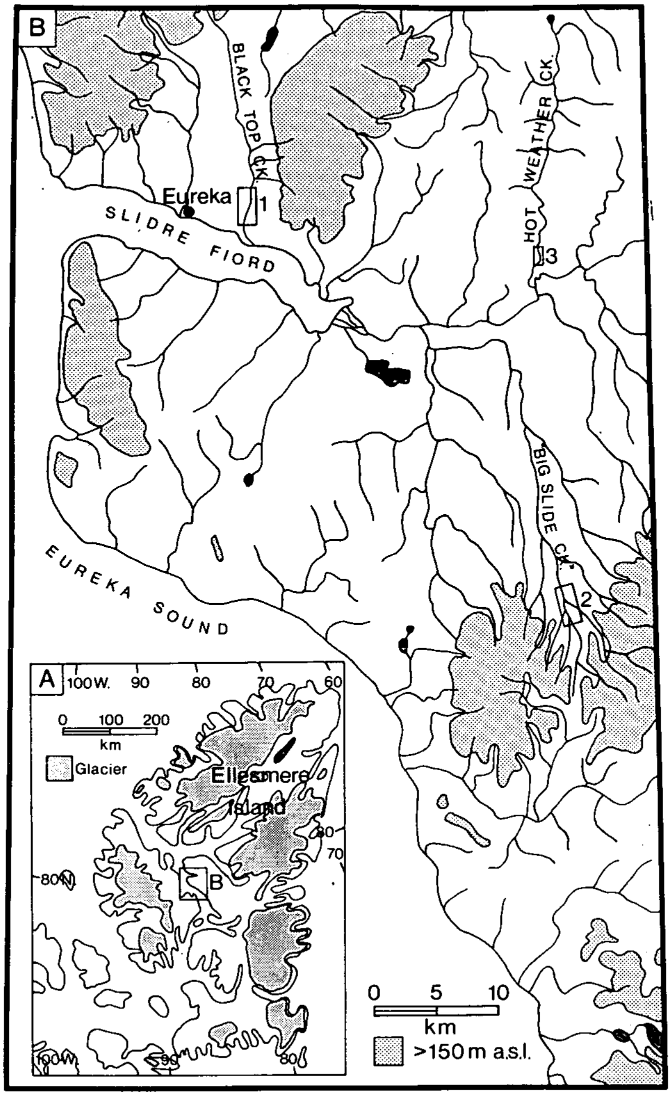

Figure 1. A: Location map of Fosheim Peninsula study area on Ellesmere Island, Northwest TerritoriesB: Study sites on the Fosheim Peninsula: 1- Black Top Creek, 2- "Big Slide Creek", 3- Hot Weather Creek.

This paper describes studies undertaken on the Fosheim Peninsula, Ellesmere Island where hundreds of active-layer detachment slides have occurred. Because of the large number of individual failures, meaningful statistics concerning morphometry, frequency and mass transfer rates can be derived. Links can be drawn between climatic variables and the occurrence of these landslides that are relevant to the effects of potential climatic change on permafrost slopes.

Study Area

The study was undertaken in the summers of 1988 and 1989 on the Fosheim Peninsula, Ellesmere Island, N.W.T. within a 50 km radius of Eureka (Fig. 1). Reconnaissance flights showed isolated active-layer detachment slides to be present throughout the region, but that particularly high concentrations of these slope failures occurred in certain

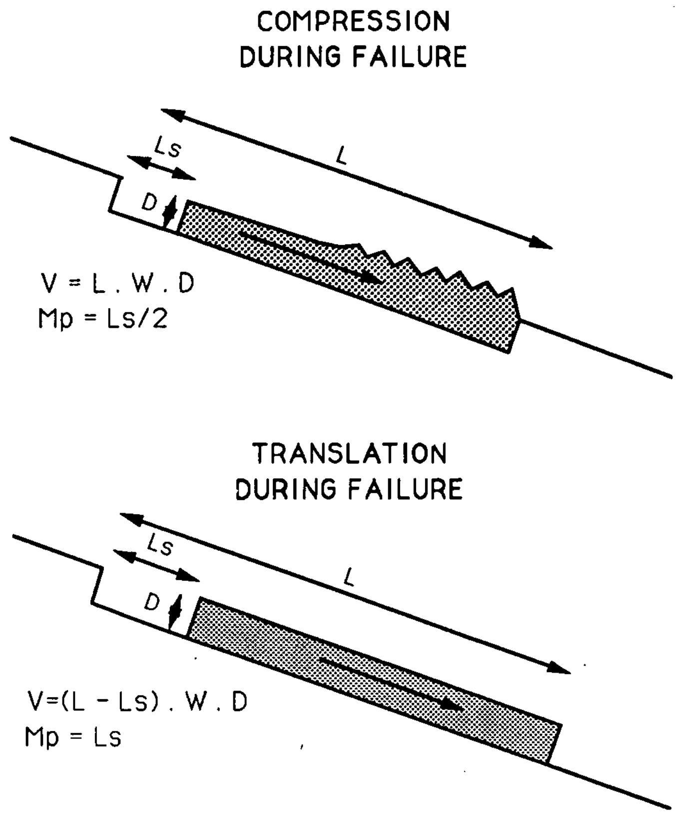

Figure 2. Effect of different modes of movement on the volume and distance travelled by the failed mass.

locales. Two valleys were selected for detailed investigation in 1988: the lower part of Black Top Creek (79° 58'N, 85° 40'W) and the central part of an unnamed valley hereafter referred to as "Big Slide Creek" (79° 42'N, 84° 23'W) (Fig. 1B). Further work was carried out at these sites in June 1989 and a third area, the middle portion of Hot Weather Creek (79° 58'N, 84° 28'W), was also examined in the light of the numerous new failures which had occurred there in July and August 1988 (Edlund *et al.*, 1989).

Theory and Techniques

Active-layer detachment sliding involves a combination of compression and translation of the soil mass (e.g. Mathewson & Mayer-Cole, 1984). In order to calculate volumes of material involved and transportation rates, these two types of motion can be taken as extremes, with most landslides involving elements of both.

If an active-layer detachment involves only compression (Fig. 2), its volume V (m^3) can be calculated from:

$$V = L \cdot W \cdot D \qquad (1)$$

where L is the length of the failure from the top of the scar zone to the toe of the depositional zone (m); W is the mean width of the failure (m); D is the mean depth of failure (m). If an active-layer detachment slide fails as a rigid slab that over-rides downslope material, V is calculated from:

$$V = (L - L_s) \cdot W \cdot D \qquad (2)$$

where L_s is the length of the scar zone (m). The mean distance moved by the failed material parallel to the slope M_p (m) also varies according to the failure process. For compressional failures:

$$M_p = L_s/2 \tag{3}$$

For translational failures:

$$M_p = L_s \tag{4}$$

Mass transfer (Rapp, 1960) downslope (i.e. parallel to the slope) T_p (Mg m) for both failure modes is:

$$T_p = V \cdot M_p \cdot D \tag{5}$$

where D is the dry bulk density of the sliding material (Mg m^{-3}). Vertical (T_v) and horizontal (T_h) components of mass transfer are obtained from:

$$T_v = T_p \cdot \sin \Theta \tag{6}$$

$$T_h = T_p \cdot \cos \Theta \tag{7}$$

where Θ is the mean slope angle (degrees).

Lengths and widths of active-layer detachment slides were obtained by mapping using photogrammetry at Black Top Creek where large-scale photos were available and by field measurement using tapes at "Big Slide Creek" and Hot Weather Creek. Failure depths were derived by measuring the sides of upright failed blocks within the scar or track zones. The slope angle of the scar zone was measured using an Abney level and any substantial changes along the long-profile were also recorded.

Results

Morphometry

An active-layer detachment slide consists of (1) a scar zone or source area from which material moves downslope, (2) a track or extension zone along which the material travels and (3) a toe or compression zone where the transported material accumulates (see Fig. 3). In some cases, a fourth zone may exist, made up of disturbed material located in front and beside the main slide mass (Mathewson & Mayer-Cole, 1984).

At the time of failure, the scar floor is relatively smooth since it corresponds to the thaw plane which undulates gently, paralleling the surface topography. Afterwards, however, parts of the scar floor often erode rapidly as the icy layers over which the blocks move begin to ablate and rills or gullies form (e.g. Holmes & Lewis, 1965). The removal of the surface material subsequently causes degradation of the upper horizons of permafrost. Where the failure track crosses ice wedges, troughs develop or wedge tops may be exposed with resultant thermokarst activity that extends outside the boundaries of the failure. Limited degradation of slopes following failure at most sites suggests that active-layer detachment slides on the Fosheim Peninsula are not usually associated with massive ground ice.

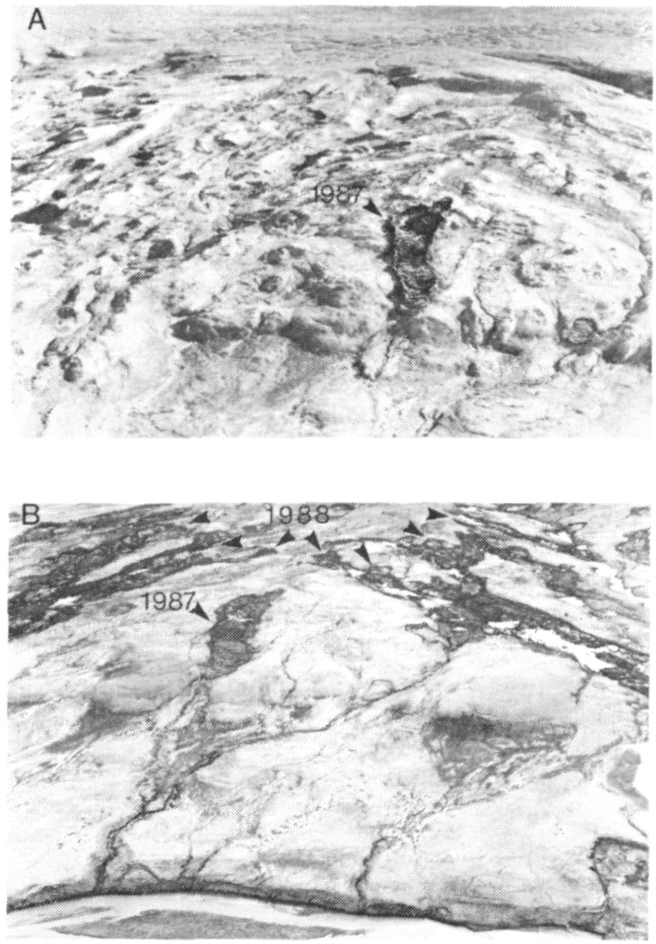

Figure 3. A: Oblique aerial photograph of part of the Black Top Creek study area in early July 1988 Note the 120 m long active-layer detachment slide (arrowed) which occurred in 1987 It represents a fairly typical feature with a distinct upper scar zone, lateral berms and a ribbed accumulation area B: Approximately the same valley slope viewed in 1989 transformed by the numerous large active-layer detachment slides of the summer of 1988.

The floor of the scar and track zones frequently includes ridges 1-3 cm high, 2-5 cm wide and up to 1 m in length that represent the paths taken by individual blocks and show that the failed material moves by sliding, not flow. The track may be bordered by berms up to 2 m high which are contiguous with the toe zone where material has accumulated. In the largest failures, the toe zone is usually wider than the track and may exhibit transverse ribbing caused by compressional forces. In smaller failures, this zone may be confined by topography resulting in thicker accumulations of material (up to 2-3 m thick) and more pronounced berms (see Fig. 3A).

In the three study areas, active-layer detachment slides varied in length from <10-680 m and in width from 5-150 m. Distributions of lengths were very similar at Black Top Creek and "Big Slide Creek" with the modal category in each case being 20-40 m (Fig. 4A). However, there were no failures >160 m in length in the valley of Hot Weather Creek and this resulted in a mean that was less than half those of the other two sites. The longest features exceed the greatest lengths of active-layer detachments reported elsewhere (e.g. 450 m (Carter & Galloway, 1981)).

Mean widths were positively skewed at the three sites with modal categories of 0-10 m for Hot Weather Creek and 10-20 m for the other locations (Fig. 4B). Many failures had length-to-width ratios of 2-3, a range which is somewhat smaller than for more fluid mass movements such as mudflows. Failure angles at the three sites varied from <2°->40° (Fig. 4C). The Hot Weather Creek distribution again differs from that of the other two, with a mean angle of 23° and a modal category of 25-30°. Black Top Creek and "Big Slide Creek" exhibit more gently sloping failure surfaces, with >75 % between 5-20°.

Failure depths were all between 0.2-0.65 m. Mean depths were 0.43 m for Black Top Creek and "Big Slide Creek" and 0.37 m for Hot Weather Creek. Allowing for local differences in the rate of thaw, these values confirm that failures occur in mid- or late summer. Scar lengths as a percentage of the total active-layer detachment slide length varied from 5-80%. The mean value was highest in Hot Weather Creek (53 %) and lowest in Black Top Creek (33 %).

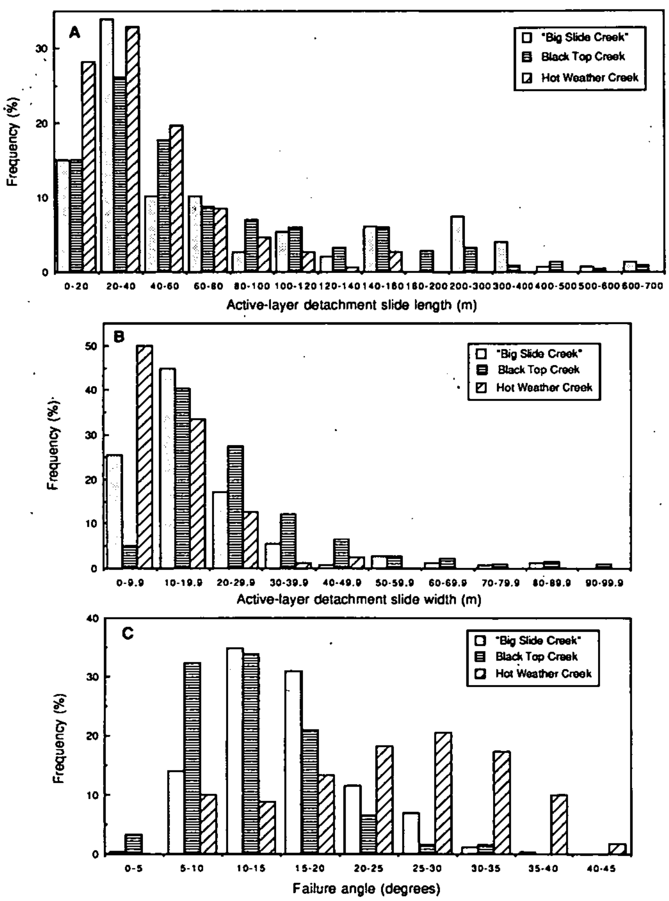

Figure 4. Morphological characteristics of active-layer detachment slides in "Big Slide Creek", Black Top Creek, and Hot Weather Creek A: Length from scar apex to toe (mean values are 85 m, 84 m, and 39 m respectively) Note the change in the category range for lengths greater than 160 m B: Average width of failure (mean values are 18 m, 29 m, and 12 m respectively) C: Average failure angle (mean values are 14 °, 12 ° and 23 ° respectively).

In summary, the active-layer detachment slides at Black Top Creek and "Big Slide Creek" are very similar morphometrically. Landslides in Hot Weather Creek differed, tending to be shorter, with a higher percentage of scar zone, and steeper failure angles. These differences relate to the grain-size distribution of the materials at these locations. The dominant size fraction at Black Top Creek and "Big Slide Creek" is silt, while that at Hot Weather Creek is sand. Consequently, failures at Hot Weather Creek take place mostly on the steeper slopes which tend to be short due to the limited relative relief available. When failure does occur, however, the failed blocks tend to move further, giving rise to a higher percentage scar zone.

Frequency

The frequency of active-layer detachment sliding in Black Top Creek was calculated by field mapping and comparing sequential aerial photos. Photographic coverage is available from the summers of 1950, 1959, 1974, 1982 and 1986 at scales varying from 1:7 000 (1986) to 1:60 000 (1959). In addition, oblique photos were taken from a helicopter in July 1988 and June 1989. The boundaries of all active-layer detachment slides visible on the ground in 1988 and 1989 were mapped. It is estimated that the resultant map illustrates 50-100 years of activity with a bias towards the most recent period and under-representation of earlier failures. Active-layer detachment slides degrade relatively quickly as blocks are broken down by weathering and slopewash processes, and some which were clearly outlined on the 1950 photos were difficult to demarcate in 1988. Preservation is greatest in the toe zones which are positive-relief features. Scar zones are rapidly rendered indistinguishable from the surrounding slope as drainage and erosion is concentrated in these depressions. For example, a live sample of *Salix arctica* taken from a barely discernible scar floor in Hot Weather Creek had 32 growth rings. The specimen appeared to have grown in place and allowing some years for colonization in the slight depression, lends support to the estimated period of 50-100 years.

The frequency of active-layer detachment sliding in Black Top Creek is shown in Table I. It ranges from 0.2 failures yr^{-1} for 1950-59 to 75 failures yr^{-1} in 1988. Assuming the period of activity mapped to be 50-100 years, this gives mean rates of 2-4 active-layer detachment slides annually. The extreme nature of the events in the summer of 1988 is indicated by the 50 % increase in the numbers of pre-existing active-layer detachment slides in this part of the catchment.

Judged by thawing degree-days recorded at Eureka, 1988 was only the 6th warmest summer since 1948, being surpassed by 1960, 1962, 1957, 1952 and 1977 (Fig. 5). From July 16-August 15, however, the mean temperature was 8.4 °C and this constituted the warmest 31-day period in the 40-year record. The warmest summers are likely to produce the greatest depths of thaw while a particularly

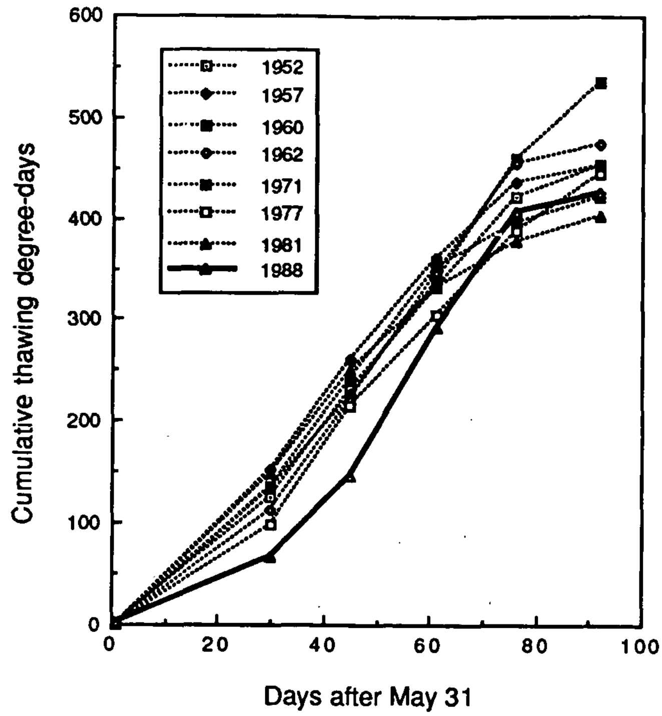

Figure 5. Cumulative thawing degree-days recorded at Eureka for the 8 warmest summers since 1948 compared to 1988 Source : station records.

warm period in mid-summer results only in a more rapid rate of thaw of the active layer. Since the earlier warmer years did not initiate large numbers of failures in Black Top Creek (see Table I), it appears that rate of advance of the thaw front is the critical factor. This analysis is based on the assumption that Eureka temperatures, while lower than those of the interior Fosheim Peninsula (Edlund *et al.*, 1989), represent an index of the climate away from coastal influences.

Most parts of the valley sides of Black Top Creek have probably failed on numerous occasions in the period since Holocene emergence. The typical time that elapses between failure of the slope in the same place can be assessed by examining the overlaps between the 1988 detachment slides and those mapped previously (Table II). This comparison suggests that failure will not recur at the same point on the slope for at least 6 years and that it only becomes common after 15 years or more have elapsed. More than half of the 1988 summer active-layer detachment slides occurred on terrain that probably has not experienced failure in the past 50-100 years.

Mass Transfer

Equations (1)-(7) can be used to calculate the volume of soil material transported in the three areas by active-layer detachment sliding (Table III). Depending on the assumptions concerning compression or translation of material during failure, soil volumes mapped as having moved in Black Top Creek total 195-307 $\times 10^3$ m^3 (37–58 $\times 10^3$ m^3 km^{-2}) while those in "Big Slide Creek" and Hot Weather Creek were 71-161 $\times 10^3$ m^3 (6-14 $\times 10^3$ m^3 km^{-2}) and 14-30 $\times 10^3$ m^3 (9-19 $\times 10^3$ m^3 km^{-2}) respectively. Vertical mass transfer amounts were also greatest at Black Top Creek (5-6 $\times 10^6$ Mg m). Horizontal mass transfer was 3-5 times vertical mass transfer at the three sites (Table III), as a consequence of the slope angles (see Fig. 4C).

A range of long-term slope movement rates can be calculated from Table III by changing mass transfer amounts to volumetric values, dividing by the areas mapped and assuming either that 50 or 100 years of activity has been recorded (Table IV). The results show that active-layer detachment slides are significant modifiers of the landscape in all three study areas, but are most important in Black Top Creek and least in Hot Weather Creek. At the former site, the minimum estimate is that active-layer detachment sliding has resulted in an average downslope movement rate of 61 mm yr^{-1} for the upper 0.5 m of soil materials on all slopes over the past 100 years (i.e. an annual volumetric transport of 305 cm^3 cm^{-1} of slope width). This value is a minimum

Table I Frequency of active-layer detachment sliding in Black Top Creek

Dates	Number of active-layer detachment slides mapped[a]	Frequency (No. yr^{-1})[b]
Pre-07/50	75	?
07/50-07/59	2	0.2
07/59-08/74	9	0.6
08/74-07/82	29	4.1
07/82-08/86	11	2.2
08/86-06/88	5	5.0
06/88-06/89	75	75.0

[a] 11 additional slides are known to have occurred prior to 1974 but are not included as the scale of the 1959 photos is too large to positively identify them.
[b] Number of years calculated from number of Augusts between photography dates since August appears to be the critical time for failure activity.

Table II Overlap of failure zones between late-summer 1988 events and earlier active-layer detachment slides in Black Top Creek

Dates	Number of overlaps[a]	Number of failures in group[b]	Overlap rate
Pre-07/50	31	75	0.41
07/50-07/59	0	2	0.0
07/59-08/74	4	9	0.44
08/74-07/82	4	29	0.14
07/82-08/86	0	11	0.0
08/86-06/88	0	5	0.0

[a] If a single 1988 failure crossed more than one older failures, all overlaps were counted. 42 of the 1988 failures did not overlap any earlier mapped failure zone.
[b] See Table 1

because it assumes pure compression during failure which is unlikely and because older failures are under-represented during the mapping process. Minimum downslope movement rates at "Big Slide Creek" and Hot Weather Creek are 23 mm yr^{-1} and 6 mm yr^{-1}, respectively. Vertical movements correspond to an equivalent lowering of at least 2 mm yr^{-1} at Hot Weather Creek, 5 mm yr^{-1} at "Big Slide Creek" and 13 mm yr^{-1} at Black Top Creek.

The importance of the summer of 1988 to the long-term rates is shown in Table V. At Black Top Creek and Hot Weather Creek, the percentage of slide volume exceeds the percentage of numbers of failures, indicating that the 1988 failures tended to be bigger than average. Mass transfer percentages are even higher, showing that the 1988 failures also tended to travel further. At Black Top Creek, the 1988 events account for more than two-thirds of the mass transfer mapped in the valley over the past 50-100 years and represented downslope movements averaging >4 m for the slopes in the area. These results contrast with those from "Big Slide Creek" where only 6 new failures were mapped in 1989. These tended to be smaller than average, representing <1 % of total mass transfer, and corresponded to downslope movements of about 10 mm.

Discussion

The importance of active-layer detachment sliding as a geomorphological process can be assessed by comparing Tables III and IV with values for other processes. No published values of solifluction activity are known for Ellesmere Island, but rates are unlikely to be greater than those for Banks Island because of greater aridity on the Fosheim Peninsula. Rates for southern Banks Island averaged 11 mm yr^{-1} over the top 0.3 m of soil (French and Lewkowicz, 1981), while the mean surface displacement on eastern Banks Island was 6 mm yr^{-1} (Egginton and French, 1985). Even in the Hot Weather Creek area, the location where least activity was concentrated, active-layer detachment sliding is probably as important as solifluction. In the Black Top Creek area, rates are an order of magnitude greater.

Table III Total mapped slide volumes and components of mass transfer in study locations

	Black Top Creek		"Big Slide Creek"		Hot Weather Creek	
Area mapped (km^2)	5.3		11.5		1.6	
	C[a]	T[b]	C[a]	T[b]	C[a]	T[b]
Slide volume ($x10^3$ m^3)	307	195	161	71	30	14
Downslope mass transfer ($x10^6$ Mg m)[c]	24.3	28.5	24.3	19.5	0.9	0.8
Vertical mass transfer component ($x10^6$ Mg m)[c]	5.1	5.9	5.1	4.2	0.3	0.2
Horizontal mass transfer component ($x10^6$ Mg m)[c]	23.9	27.9	23.7	18.9	0.8	0.8

[a]Volumes and distances moved calculated assuming compression (eq. (1) and (3)).
[b]Volumes and distances moved calculated assuming translation (eq. (2) and (4)).
[c]Bulk density of soil materials assumed to be 1.5 Mg m^{-3}.

Table IV Slope movement rates in study locations

	Black Top Creek		"Big Slide Creek"		Hot Weather Creek	
	50 yr	100 yr	50 yr	100 yr	50 yr	100 yr
Mean downslope movement (mm yr^{-1})	122-143	61-72	45-56	23-28	13-14	6-7
Mean vertical movement (mm yr^{-1})	26-30	13-15	10-12	5-6	4	2
Mean horizontal movement (mm yr^{-1})	120-140	60-70	44-54	22-27	12-13	6-7

Note: rates calculated as an average movement for the top 0.5 m of soil material over the period shown; range of values produced assuming pure compression or pure translation during failure.

Table V Magnitude of 1988 active-layer detachment slides in study locations

	Black Top Creek	"Big Slide Creek"	Hot Weather Creek
Number of active-layer detachment slides[a]	35	4	24
Slide volume[a]	44-47	2-3	35-36
Downslope mass transfer[a]	68-72	<1	39-40
Vertical mass transfer component[a]	70-74	<1	45-46
Horizontal mass transfer component[a]	68-72	<1	39-40
Downslope movement (mm)[b]	4420-4910	11-12	250-280
Vertical movement (mm)[b]	940-1040	2	80-90
Horizontal movement (mm)[b]	4320-4780	11-12	230-270

[a] (% total in 1989)
[a]Calculated as an average movement for the top 0.5 m of soil materials; range of values produced assuming pure compression or pure translation during failure.

A comparison of mass transfer values with the data obtained by Rapp (1960) in the Kärkevagge, Lappland also illustrates the importance of active-layer detachment sliding in the three study areas. Rapp obtained an areal mean annual value for T_v of about 6 x 10^3 Mg m km^{-2} for all types of earth slides and mudflows, many of which were produced by a single very high recurrence interval rainstorm. This compares with unit annual vertical mass transfer rates of 10-22 x 10^3 Mg m km^{-2} for Black Top Creek, 4-8 x 10^3 Mg m km^{-2} for "Big Slide Creek" and 1-4 x 10^3 Mg m km^{-2} for Hot Weather Creek depending on the assumptions of failure mode and number of years of activity mapped. It appears therefore, that this type of vertical transfer is of similar importance in the study areas on the Fosheim Peninsula as in Northern Scandinavia.

The summer of 1988 was an important trigger of active-layer detachment slides on the Fosheim Peninsula but two points suggest that the link between warm weather conditions and rapid slope failure is not necessarily direct. First, the 1988 active-layer detachment slides in Black Top Creek did not overlap with any failures that were less than 6 years old, and overlapping became frequent only over parts of the slope which had failed at least 15 years before (see Table II). Moreover, the majority of 1988 failures did not overlap with any previously mapped landslides. This suggests that a recovery time is necessary before slopes can fail again in the same place. Second, while Black Top Creek and Hot Weather Creek experienced substantial activity in 1988, "Big Slide Creek" did not (see Table V). It is believed, however, that a considerable number of failures occurred in the latter area in 1987 which was the 9th warmest summer at Eureka since 1948 and the warmest since 1981. The two largest failures in the area both triggered small retrogressive thaw slumps along ice wedges. The headwalls of these features had retreated outside the margins of the slides by about 8 m in 1988 and 14-16 m in 1989 indicating that the initial exposure of ice took place in 1987. These two active-layer detachment slides alone constitute about 40 % of the vertical mass transfer and 50 % of the horizontal mass transfer mapped in the area. It appears therefore that a series of important rapid mass movement events occurred in the "Big Slide Creek" area as a response to a fairly warm summer in 1987 and that despite air temperatures being warmer at Eureka in 1988, slope conditions were no longer favourable for a major response.

The implications of these observations are relevant to the possible effects of global climatic warming on the permafrost environment. They suggest that under a warmer climatic regime, active-layer detachment slides might recur no more frequently in the long-term in an area where they are already common. While more frequent warm summers provide increased potential for rapid failure, the required changes in substrate strength (likely as a result of weathering) and moisture conditions (probably as a result of the slow accumulation of moisture at the top of the permafrost) in the slope take many years to develop. On the other hand, in areas where active-layer detachment slides are currently rare but high concentrations of ground ice are present at the top of the permafrost, climatic warming may result in a substantial increase in activity.

Conclusions

Active-layer detachment sliding near Eureka on the Fosheim Peninsula is an important geomorphic process. It results in the downslope transport of sediment at rates that equal or substantially exceed the probable effect of solifluction. In the Black Top Creek area, slope movements in the top 0.5 m of soil average at least 60 mm yr^{-1}. Typical active-layer detachment slides in this area and at "Big Slide Creek" are 10-20 m wide, 20-40 m long and occur on slopes of 10-15°. At Hot Weather Creek, however, a sandier substrate results in failures which are shorter, narrower and steeper, and the distribution here does not include the very long failures (up to 700 m) observed at the other localities.

The frequency of active-layer detachment sliding in Black Top Creek has varied since 1950 from <1 event yr^{-1} during 1950-59 to 75 events yr^{-1} in 1988. The 1988 events are the result of the warmest air temperatures ever recorded at Eureka for mid-July to mid-August. Numerous failures also occurred within Hot Weather Creek in 1988, but "Big

Slide Creek" was relatively unaffected. This varying response indicates that in addition to a climatic trigger, antecedent slope strength and moisture conditions must be suitable for failure. Analysis of the recurrence of active-layer detachment slides in the same spots on slopes in Black Top Creek suggests that the elapsed time between events is at least 6 years and more often greater than 15 years. Consequently, a climatic warming might provide more frequent opportunity for active-layer detachment sliding on the Fosheim Peninsula, but might not result in a change in the actual event frequency unless long-term preparatory processes such as weathering or moisture migration in the soil are also affected.

Acknowledgements

Funding for this study was provided by the Natural Sciences and Engineering Research Council of Canada. Logistical support was kindly supplied by the Polar Continental Shelf Project, Energy Mines and Resources, Canada. Field assistants were K. Stoker (1988) and T. Watkins (1988 and 1989), while C. Spencer counted the tree rings and B. Alt kindly supplied the thawing degree-day data. The hospitality offered by S. Edlund and the Geological Survey of Canada party at Hot Weather Creek in 1989 is gratefully acknowledged. G. Lalonde and J. Lalonde helped translate the abstract.

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