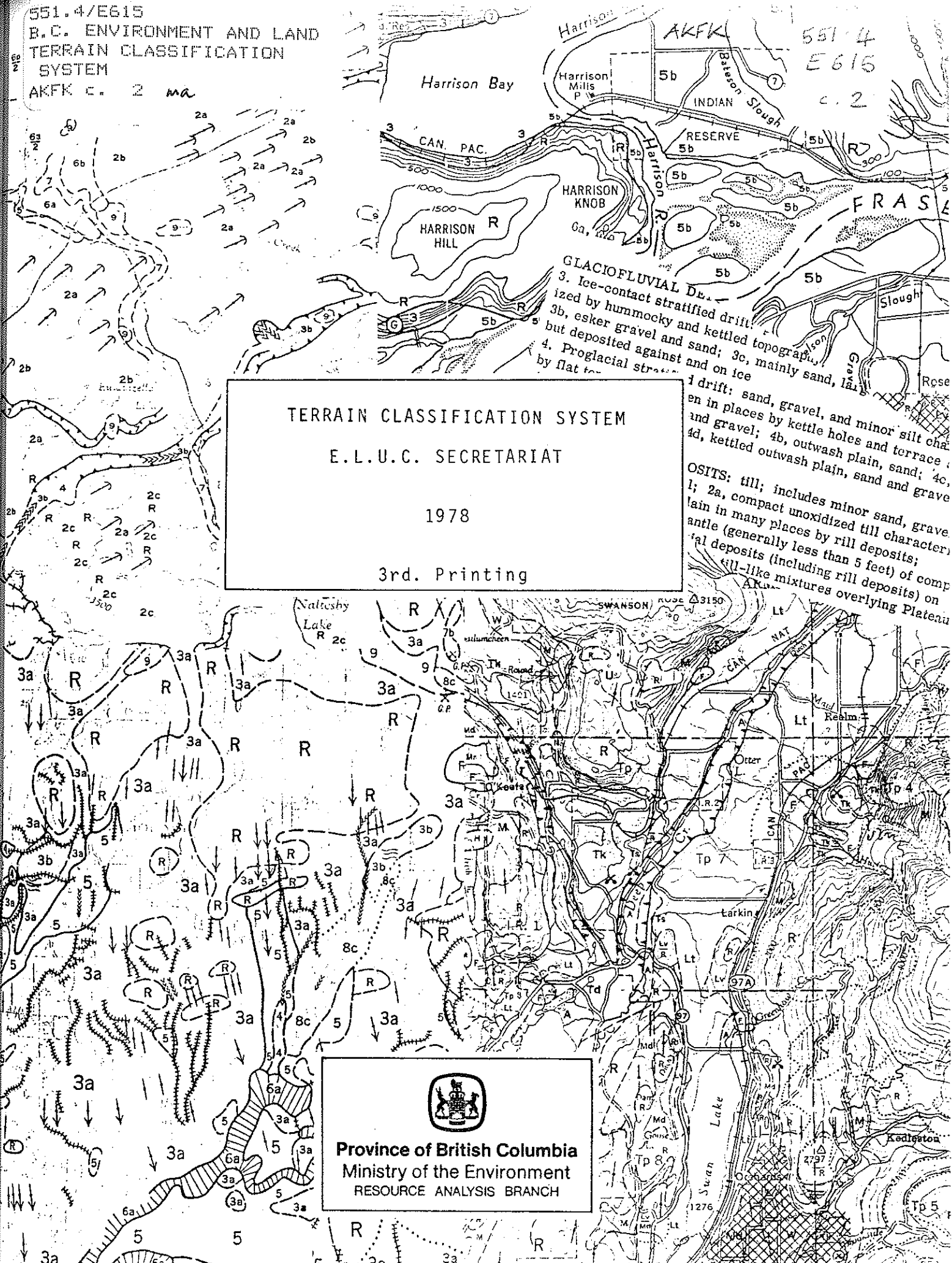


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 TERRAIN CLASSIFICATION  
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TERRAIN CLASSIFICATION SYSTEM

E.L.U.C. SECRETARIAT

1978

3rd. Printing

**GLACIOFLUVIAL DEPOSITS**  
 3. Ice-contact stratified drift  
 3b, esker gravel and sand; 3c, mainly sand, laid down by flat topography  
 4. Proglacial stratified drift: sand, gravel, and minor silt character-  
 ized in places by kettle holes and terraces  
 and gravel; 4b, outwash plain, sand; 4c,  
 4d, kettled outwash plain, sand and gravel  
**OSITS:** till; includes minor sand, gravel  
 1; 2a, compact unoxidized till character-  
 istic in many places by rill deposits;  
 2b, generally less than 5 feet of comp-  
 act deposits (including rill deposits) on  
 till-like mixtures overlying Plateau



Province of British Columbia  
 Ministry of the Environment  
 RESOURCE ANALYSIS BRANCH

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TERRAIN CLASSIFICATION SYSTEM

E.L.U.C. SECRETARIAT

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3rd. Printing

Produced by:

RESOURCE ANALYSIS BRANCH  
MINISTRY OF THE ENVIRONMENT  
PROVINCE OF BRITISH COLUMBIA

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## CONTRIBUTORS

The principal contributors of the Classification System are staff of the Resource Inventory and Analysis/Interpretation Divisions of the Resource Analysis Unit, Environment and Land Use Committee Secretariat, British Columbia Department of the Environment: A.N. Boydell, N.F. Alley, J.M. Ryder, D.E. Howes, M.E. Walmsley, A. Pattison, B. Thomson, T. Vold and R. Beale.

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## INTRODUCTION

Historically, the Geological Survey of Canada and a few provincial agencies were the principal exponents of what we might call the historical approach to terrain mapping which attempted, for the most part, to summarize the Quaternary history of a particular map area. It was not until the beginnings of this decade that the Geological Survey of Canada, involved in the upsurge of developments in the Northwest Territories, began a change over to a more pragmatic system which could provide a data base suitable for land-use planning and management.

Since then, we have seen a proliferation of classification methodologies, some satisfying immediate geological needs, others supporting a broader, multiple resource data requirement. What we have not seen, as yet, is any large measure of agreement over the components of classification, nor indeed any consensus as to the desirability of a single all-purpose scheme.

Through a project for developing a classification system suitable for mountainous terrain, Bob Fulton of the Geological Survey of Canada devised a scheme for use in British Columbia. The essence of this scheme was presented at the workshop on Base Data Inventories for Canada's Northlands, held at Toronto in April 1974, and was subsequently discussed at the Soil Survey meeting and tour in Kamloops later in that year. It has been used, with modifications, by a number of groups in British Columbia, and forms the basis of our proposed classification.

Placing our classification scheme in perspective, it firstly forms a part of the total process of terrain evaluation and it is our intent that it will ultimately appear together with a data collection methodology, a guide to our data storage and retrieval system, a treatment of map formats including scales and legends, and reports. To this end, this present classification should be treated as an interim document only.

It secondly represents a particular information level, a degree of generalization from the base data, which is the process of terrain classification. A pilot study is currently under way in the Secretariat to evaluate the application of a more generalized level of information to regional mapping.

Our proposed classification is largely descriptive and is designed to support terrain mapping at a 1:50,000 scale with the data presented in map form either at the same scale or preferably at 1:100,000. Its principal objective

is to generate an empirically-supported, qualitative geological data base for both geological and multiple resource interpretations. The basic element of the classification is the Terrain Unit or unit area in which parameters abstracted from the base data are combined to form discrete but commonly recurring patterns in the terrain. Genetic Materials form the substance of the terrain unit, but are shaped by their composition, surface expression and by the processes of modification that have acted or are acting upon them.

## TEXTURE

The size, roundness and sorting of particles in unconsolidated clastic sediments, and the proportional fibre content of unconsolidated organic sediments

DESCRIPTIVE TERMINOLOGY

SPECIFIC CLASTIC TERMS (Wentworth)	COMMON CLASTIC TERMS	ORGANIC TERMS
b bouldery	a blocky	e fibric
k cobbly	r rubbly	m mesic
p pebbly	g gravelly	h humic
s sandy	f fines	
sl silty		
c clayey		

Table 1.

Notes:

- (1) Recognition of the *Specific* size classes (Wentworth) in field mapping is a visual interpretation based on an estimate of the mean volume of particles in appropriate size ranges.
- (2) *Common Clastic Terms* incorporates a grouping of size ranges and/or an implication of roundness, defined according to each descriptor.

PARTICLE SIZE

The size of a *clast* greater than 2 mm is determined by the length of its "b" axis.

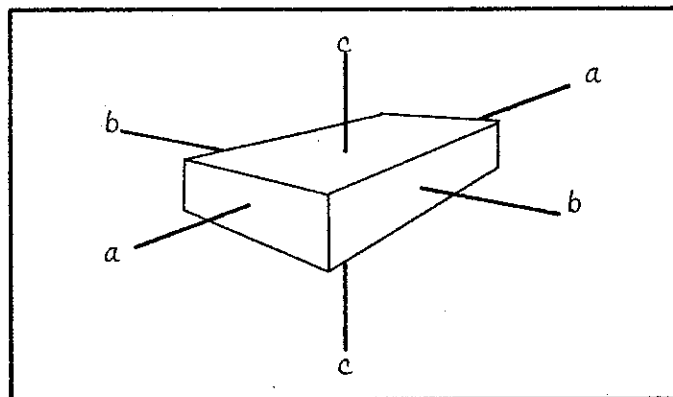


Figure 1. Model of the principal axes of a clast.

Methods for the field determination of particle sizes of less than 2 mm are listed in Appendix I.

PARTICLE ROUNDNESS

Degree of roundness refers to the sharpness of edges and corners of a particle. Figure 2 shows the two classes of roundness adopted for this classification.

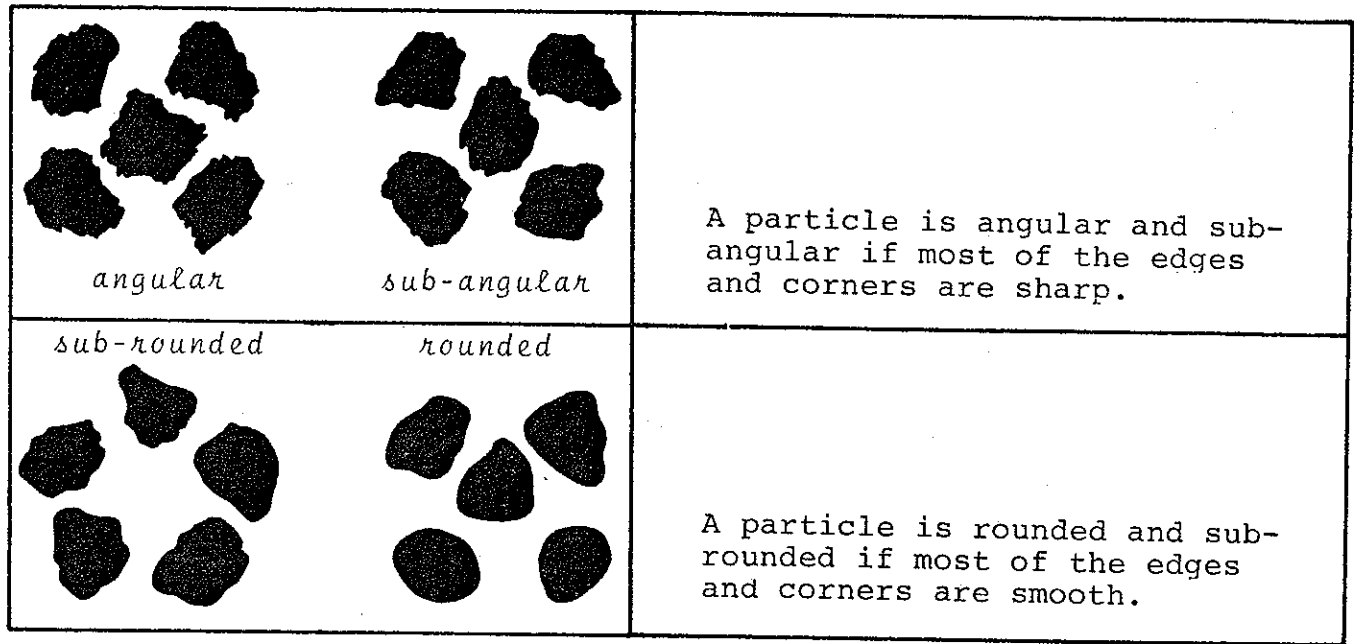


Figure 2. Scale of roundness.  
(After Pettijohn, 1949)

Note: Roundness should not be confused with sphericity; e.g. a nearly spherical particle may have sharp corners and be angular, while a flat pebble may not be spherical but still be well rounded as to its corners.

RELATIONSHIP OF SIZE AND ROUNDNESS IN THE TEXTURAL CLASSIFICATION OF CLASTIC SEDIMENTS

SPECIFIC	SIZE						
	ROUNDNESS	mm	256	64	2	.062	.0039
SPECIFIC	ROUNDED	BOULDERY	COBBLY	PEBBLY			
	ROUND. or ANGULAR				SANDY	SILTY	CLAYEY
COMMON	ROUNDED	GRAVELLY					
						FINES	
	ANGULAR	BLOCKY		RUBBLY			

Table 2.

DEFINITION OF SPECIFIC CLASTIC TERMS

The size limits for specific clastic terms are given in Table 2. For comparison of classification systems, refer to Appendix II, (p.41).

DEFINITION OF COMMON CLASTIC TERMS

- Blocky:** An accumulation of angular particles greater than 256 mm in size.
- Rubblly:** An accumulation of angular particles with a size range of 2 - 256 mm, but may include interstitial sand.
- Note: in general, little or no fine material will be visible on a rubble or block-covered surface. At depth, silt and clay particles may form a matrix occupying the interstices of the coarser particles.
- Gravelly:** An accumulation of two or more size ranges of rounded particles greater than 2 mm, but may include interstitial sand.
- Fines:** A mixture of silt and clay; may also contain a minor fraction of fine sand.

APPLICATION OF THE SPECIFIC AND COMMON TERMS IN THE TEXTURAL CLASSIFICATION OF CLASTIC SEDIMENTS

Well-sorted materials will generally be described by the use of a single textural term; less well-sorted and poorly-sorted materials will be described using two textural terms.

*No more than two textural terms will be used together.*

Most deposits can be characterized by dominant and subordinate textural components. Those exceptions can be accomodated by using the common clastic terms rubblly, gravelly, and fines.

*A subordinate textural component will not generally be shown if it constitutes less than 25% of the total volume of the deposit.*

This is a data presentation constraint which reflects the degree of confidence attached to the field recognition process.

FRACTION (Example: sand)	FRACTION (Example: boulders)	EXAMPLE: combination of boulders and sand
	VERY DOMINANT ( > 75%)	b boulders (sand <25%)
SUBORDINATE (25-50%)	DOMINANT (50-75%)	sb sandy boulders
DOMINANT (50-75%)	SUBORDINATE (25-50%)	bs bouldery sand
VERY DOMINANT ( > 75%)		s sand (boulders <25%)

Table 3. Two-fold Fraction Subdivision.

*The two-fold clastic textural description may comprise two specific terms, two common terms, or one specific and one common term, in appropriate combination and order of importance.*

Where specific and common are used together, the common term will denote two or more size ranges not accommodated by the specific term.

Where two terms are used together, this means that either the two textures are intermixed or that they are interstratified. Where discrete areas of outcrop of different textured materials occur, then a composite unit is used;

Example:  $\$sL$  means either the lacustrine material consists of a uniform silty sand, or it consists of interlayered beds of silt and beds of sand;

$\$L/sL$  means some outcrops of silt, and some outcrops of sand.

Note: Textural terms are written in reverse order of importance (as above) so that the symbology may be easily verbalized, and are placed before the Genetic Materials Term.

#### OMISSION OF TEXTURAL TERMS FROM THE TERRAIN UNIT DESCRIPTION

Omission of texture from a unit symbol implies one of the following:-

- (1) In areas of ground access: the material displays the entire range of textures included in the description of the genetic material. Discrete units of material of a single texture cannot be mapped.
- (2) In areas of air photo interpretation: texture of the material lies somewhere within the range of textures included in the description of the genetic material.

DEFINITION OF SPECIFIC ORGANIC TERMS

- Fibric: The least decomposed of all organic materials; there is a large amount of well-preserved fibre that is readily identifiable as to botanical origin. Fibres retain their character upon rubbing.
- Mesic: Organic material in an intermediate stage of decomposition; intermediate amounts of fibre are present that can be identified as to their botanical origin.
- Humic: Highly decomposed organic material; there is a small amount of fibres present that can be identified as to their botanical origin; fibres that are present can be easily destroyed by rubbing.

Note: see System of Soil Classification for Canada. 1974, for full definitions.

APPLICATION OF SPECIFIC ORGANIC TERMS

Organic textural terms are used to describe only the Organic genetic material, but follow the same system of two-fold subdivision and application as outlined on pages .

However, organic terms are not to be combined with either the Specific or Common clastic terms.

## GENETIC MATERIALS

Materials are classified according to their mode of formation. Specific processes of erosion, transportation, deposition, mass wasting and weathering produce specific types of materials that are characterized chiefly by texture and surface expression.

DESCRIPTIVE TERMINOLOGY

A	Anthropogenic	O	Organic
C	Colluvial	R	Bedrock
E	Eolian	S	Saprolite
F	Fluvial	V	Volcanic
I	Ice	W	Marine
L	Lacustrine	U	Undifferentiated
M	Morainal		

Genetic Materials are described in terms of their origin and the assumed status (active/inactive) of their formative process. In the following definitions some common examples of genetic materials are introduced.

DEFINITION OF TERMS

**Anthropogenic:** *Man-made or man-modified materials; including those associated with mineral exploitation and waste disposal, and excluding archaeological sites.*

Materials constructed by man, or geological materials modified by man (most commonly by removal from their original site and deposition elsewhere) so that their initial physical properties (e.g. structure, cohesion, compaction) have been drastically altered. Also includes areas where topography and/or surface materials have been extensively changed due to removal of rock or unconsolidated deposits.

Assumed process status is active.

Materials will commonly possess a wide range of textures.

On-site symbols will be used for Anthropogenic sites where the zone of disturbance is too small to be mapped as an areal unit.

Examples: areas of landfill, spoil heaps and open-pit mines.

Colluvial: *Product of mass wastage; materials that have reached their present position by direct, gravity-induced movement (i.e. no agent of transportation involved).*

Generally consist of massive to moderately well-stratified, non-sorted to poorly sorted sediments with any range of particle size from clay to boulders and blocks.

Assumed process status is active.

The character of any particular colluvial deposit will depend upon:

- (1) The nature of the material from which it was derived: Colluvial material derived from bedrock is characteristically rubbly and relatively easy to identify.

Examples: talus cone, rubbly colluvial blanket.

Colluvial material derived from Unconsolidated Quaternary sediments which overlies and closely resembles its parent unit, will be mapped as the parent unit.

Where colluvial materials are derived from an unconsolidated deposit, but overlie a different unit or form a discrete surface expression, they will be mapped as colluvial. Examples: colluvium overlying gravel but derived from till, mudflow fan, landslide.

- (2) The specific mass wastage process whereby it was moved:

Examples: mudflow, earthflow, landslide, rockfall, creep.

Eolian: *Materials transported and deposited by wind action*

Generally consist of medium to fine sand and coarse silt that is well sorted, poorly compacted, and may show internal structures such as cross bedding or ripple laminae, or may be massive. Individual grains may be rounded and show signs of frosting.

Assumed process status in inactive.

Examples: dunes, veneers and blankets of sand and coarse silt, loess.

Fluvial: *Materials transported and deposited by streams and rivers*

Synonymous with "Alluvial"

Generally consist of gravel and/or sand with a minor fraction of silt (and rarely, clay). Gravels are typically rounded and contain interstitial sand. Fluvial sediments are commonly moderately to well-sorted and display stratification, although massive, non-sorted fluvial gravels do occur.

Assumed process status is inactive.

Includes:

- (1) Channel deposits: relatively coarse gravel with weak to prominent stratification; may cover or underlie an entire floodplain in a zone of rapidly shifting channels.
- (2) Overbank Deposits, Flood Deposits, Levees: relatively fine sediments (silt and fine sand) that cover extensive areas of the floodplain away from the main channel; these commonly form a veneer over coarser deposits of abandoned channels.
- (3) Terrace Deposits: as in preceding definitions (1) and (2).
- (4) Alluvial Fans: fans which consist dominantly of stream-deposited gravels.
- (5) Deltas

Fluvioglacial Deposits: fluvial materials that show clear evidence of having been deposited either directly in front of, or in contact with, glacier ice. (See F<sup>G</sup> in definitions of Qualifying Descriptors, p.21.)

Ice: *Glacier Ice*

Areas of snow and ice where evidence of active glacier movement is present within the boundary of the defined unit area.

Assumed process status is active.

Glacier movement will be indicated by features such as crevasses, supraglacial moraines, icefalls and ogives.

Examples: cirque glaciers, mountain icefields, valley and piedmont glaciers.

Lacustrine: *Sediments that have settled from suspension in bodies of standing fresh water or that have accumulated at their margins through wave action.*

Sediments commonly consist of:

- (1) Stratified fine sand, silt and clay deposited on the lake bed.
- (2) Moderately sorted to well-sorted, stratified sand and coarser materials that are beach and other littoral sediments transported and deposited by wave action.

Assumed process status is inactive.

Glaciolacustrine Deposits: lacustrine materials that show clear evidence of having been deposited directly in contact with glacier ice. (See L<sup>G</sup> in definitions of Qualifying Descriptors, p.22.)

NOTE: Deltas are not included as lacustrine materials since most extensive (mappable) delta surfaces are essentially the result of fluvial processes. (See "Deltas", Note 5, p. 8.)

**Morainal:** *The material transported beneath, beside, on, within and in front of a glacier; deposited directly from the glacier and not modified by any intermediate agent.*

Generally consists of well-compacted material that is non-stratified and contains a heterogeneous mixture of particle sizes, often in a matrix of sand, silt and clay.

Assumed process status is inactive.

May contain small pockets or lenses of fluvial and lacustrine materials, but these generally constitute a minor fraction of the total unit and affect neither its overall form nor its overall physical properties.

Includes:

- (1) Basal Till (Ground Moraine).
- (2) Lateral and Terminal Moraines.
- (3) The material of rubbly moraines of cirque glaciers.
- (4) Hummocky ice-disintegration moraine.
- (5) Pre-existing unconsolidated sediments reworked by a glacier so that their original character is largely or completely destroyed.

**Organic:** *Materials resulting from vegetative growth, decay and accumulation in and around closed basins or on gentle slopes, where the rate of accumulation exceeds that of decay.*

Generally consist of peat, unstratified and locally containing minor amounts of marl and inorganic detritus.

Assumed process status is active.

Deposits of organic origin are only recognized as such if they contain at least 30% organic material (by weight), and if they meet the depth criteria of greater than 40 cms for sedge peats - usually fens (humic and mesic) - and 60 cms for bog peats - usually bogs (fibrics).

The thickness of an organic veneer of peaty origin will therefore lie between 40 cms and 1 m. The only exception to this will be where thin organic deposits overlie bedrock (cf folisols). In this case, a minimum depth criteria of 10 cms will be applied.

Bedrock: *Outcrop, and rock covered by a thin mantle (less than 10 cms thick) of unconsolidated materials.*

Saprolite: *Weathered bedrock, decomposed in situ principally by processes of chemical weathering.*

Rock that has been altered, chiefly by chemical weathering, so that it contains a high proportion of residual silts and clays. The rock remains in a coherent state, interstitial grain relationships are undisturbed, and no downhill movement due to gravity has occurred.

Assumed process status is active.

This genetic category applies only to rock that is sufficiently weathered that its properties related to its strength are significantly different from those of the equivalent unweathered rock.

Example: rotten rock containing corestones.

Volcanic: *Unconsolidated pyroclastic sediments that occur extensively at the land surface.*

Assumed process status is inactive.

Thin layers of volcanic ash that are buried by younger, non-volcanic sediments are not generally considered mappable units.

Includes: volcanic ash, lapilli and coarser ejecta.

Marine: *Sediments that have settled from suspension in salt or brackish water bodies or that have accumulated at their margins through shoreline processes such as wave action and longshore drift.*

Unconsolidated deposits of clay, silt, sand or gravel, well to moderately well-sorted, well-stratified to moderately-stratified, and in some places containing shells.

Assumed process status is inactive.

Non-fossiliferous deposits may be judged marine if they are located in an area that might reasonably be considered to have contained salt water at the time that the deposits were formed.

Glaciomarine: sediments of glacial origin, laid down in a marine environment in close proximity to glacier ice, are designated by the symbol W<sup>G</sup> (See W<sup>G</sup> in definitions of Qualifying Descriptors, p.23.)

Undifferentiated: *A layered sequence of more than three types of genetic material outcropping on a steep, erosional (scarp) slope (Us).*

Used where units relating to individual genetic materials cannot be delimited separately at the scale of mapping. Includes colluvium derived from the various genetic materials and resting upon the scarp slope.

The symbol 'U' may itself be written as part of a composite unit where it is judged necessary to indicate the presence of a specific member of the undifferentiated group, eg. Us//sLs

## SURFACE EXPRESSION

*The surface expression of genetic materials is their form (assemblage of slopes) and pattern of forms. It also expresses the manner in which unconsolidated genetic materials relate to the underlying unit.*

DESCRIPTIVE TERMINOLOGY

a	apron	m	subdued
b	blanket	r	ridged
f	fan	s	steep
h	hummocky	t	terraced
l	level	v	veneer

In general, Surface Expression describes all surface forms that are not adequately shown (principally by contours) on the 1:50,000 topographic base map.

*Form, as applied to unconsolidated deposits, refers to the product of the initial mode of origin of the materials.*

*Form, as applied to consolidated materials, refers to the product of their modification by geological processes.*

The use of two (or rarely three) surface expressions together implies:

1. That there is a mixing of discrete forms and not a combination of intermediate forms.
2. That no significance is attached to the order in which the symbols appear on the map. For convenience and consistency, symbols will be arranged in alphabetical order.

DEFINITION OF TERMS

(For illustrations, see pps.18-20.)

**Apron:** *A relatively gentle slope at the foot of a steeper slope, and formed by materials derived from the steeper upper slope.*

**Examples:** Two or more coalescing fans; a simple talus slope.

**Blanket:** *A mantle of unconsolidated materials thick enough to mask minor irregularities in the underlying unit, but which still conforms to the general underlying topography.*

A blanket must be greater than 1 metre thick but will possess no constructional forms typical of the materials genesis. In general, outcrops of the underlying unit will be uncommon.

Unless a blanket is overlying bedrock, stratigraphic information should be supplied when this term is used:

- (1) Where the underlying unit is known, and is unconsolidated material, then this will be indicated as stratigraphic information. (p. 33)

Example:  $\frac{Lb}{Mh}$  lacustrine blanket overlying hummocky moraine

- (2) Where the underlying unit is bedrock, no stratigraphic information need be supplied, except where it is necessary to show surface expression.

Example:  $Lb$  lacustrine blanket overlying bedrock

Example:  $\frac{Lb}{Rh}$  lacustrine blanket overlying bedrock that is hummocky

- (3) Where the underlying unit is not known, a decision will be made based on available evidence as to whether the underlying unit consists of bedrock or unconsolidated materials; if bedrock, then (2) applies; if unconsolidated, the surface expression symbol, alone, is used.

Example:  $\frac{Lb}{h}$  lacustrine blanket overlying undefined, hummocky unconsolidated materials.

Fan: *A fan-shaped form that can be likened to the segment of a cone, and possessing a perceptible gradient from apex to toe.*

Examples: alluvial fans; talus cones; some deltas (other deltas may be levels).

**Hummocky:** *Steep sided hillocks and hollows with multi-directional slopes dominantly between 10° and 35° (unconsolidated materials) and steeper (unconsolidated materials), and with local relief greater than 1 metre. In plan, an assemblage of non-linear, generally chaotic forms.*

Hummocky unconsolidated materials will be of a thickness sufficient to mask the irregularities of the underlying unit surface.

**Example:** Knob-and-kettle topography; debris of some landslides.

**Subdued:** *Linear and non-linear forms with slopes ranging up to 10° and with local relief greater than 1 metre.*

Subdued differs from hummocky and ridged only by virtue of having gentler slopes.

Subdued unconsolidated materials will be of a thickness sufficient to mask the irregularities of the underlying unit surface.

Linearity may be indicated by an on-site symbol; eg. glacial flutings.

**Examples:** Washboard Moraine;  
Swell-and-swale topography.

**Level:** *A flat or very gently sloping (less than 5°) uni-directional surface with a generally constant slope not broken by marked elevations and depressions of greater than 1 metre local relief.*

**Examples:** Floodplain; lake plain, some deltas

**Ridged:** *Narrow, steep-sided elongate hillocks with slopes dominantly between 10° and 35° (unconsolidated materials) and steeper (consolidated materials), and with local relief greater than 1 metre. In plan, an assemblage of parallel or sub-parallel linear forms.*

Ridged unconsolidated materials will be of a thickness sufficient to mask the irregularities of the underlying unit surface.

Linearity may be indicated by an on-site symbol.

Examples: Eskers; Crevasse Fillings.

Steep: *Erosional slopes generally greater than 35° on both unconsolidated and consolidated materials.*

Examples: terrace scarps, river banks and lakeshore bluffs.

Note: The form of a steep erosional slope on unconsolidated materials is not related to the initial mode of origin of the underlying material.

Terraced: *Scarp face and the horizontal or gently inclined surface (tread) above it.*

The term terrace is usually applied to both the scarp and the flat tread, that is, to the whole feature of the landscape.

In units comprising more than one terrace, individual terrace scarps may be designated by a scarp symbol.

Examples: river terraces; structurally controlled "stepped" topography.

Veneer: *Unconsolidated materials too thin to mask the minor irregularities of the underlying unit surface.*

A veneer will range between 10 cms and 1 metre in thickness and will possess no form typical of the materials' genesis.

Generally, stratigraphic information will be supplied when this term is used, i.e. the underlying unit must also be described, e.g.

Lv a lacustrine veneer overlying subdued  
Mm ground moraine.

If no stratigraphic information is supplied, it is assumed that the veneer overlies bedrock.

For organic veneers, refer to the Organic Genetic Materials term on page 10 .

#### SLOPES

Slopes are not included as a specific category at this level of information. General slope information is contained within the definitions of surface expression, within the definitions of specific landforms, and is expressed by the contours on the topographic base map.

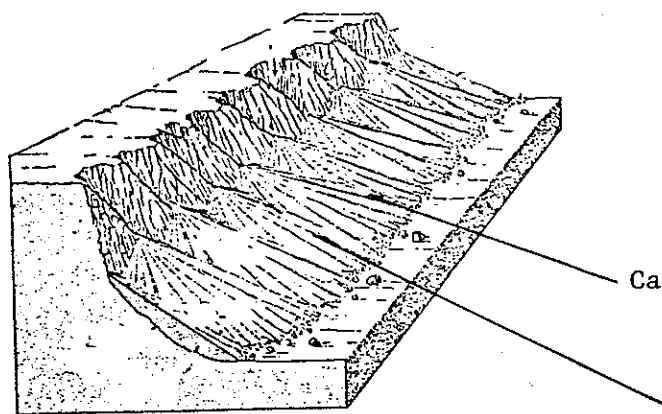


Fig. 1a Apron

Coalescing fans forming an apron

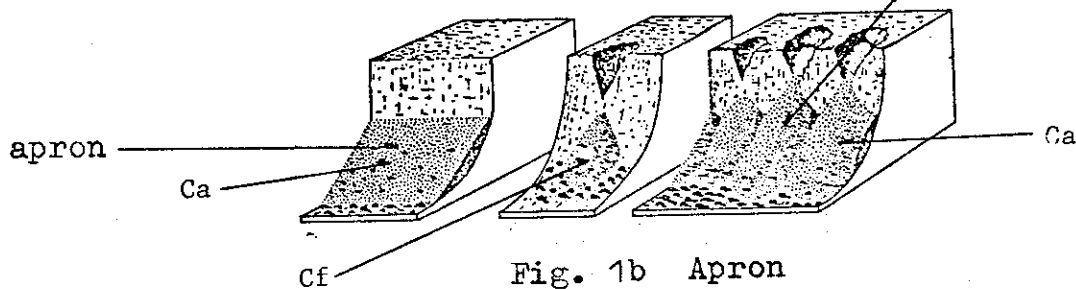


Fig. 1b Apron

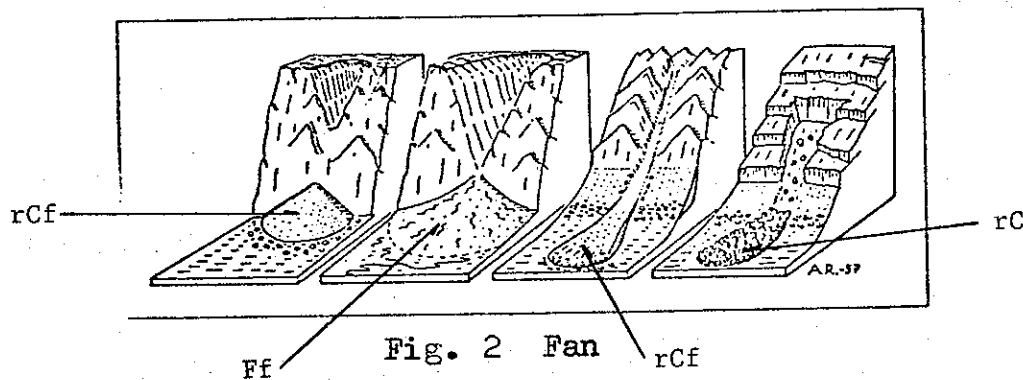


Fig. 2 Fan

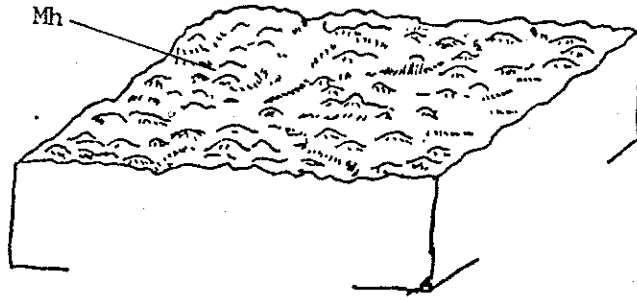


Fig. 3 Hummocky

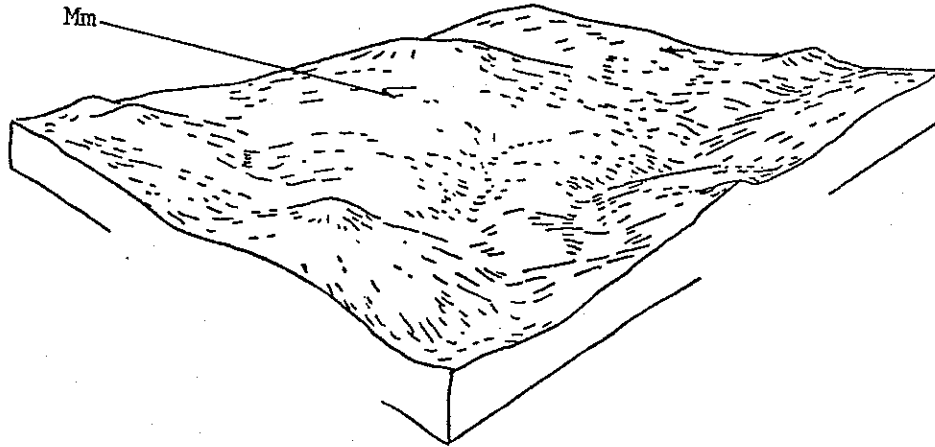


Fig. 4 Subdued

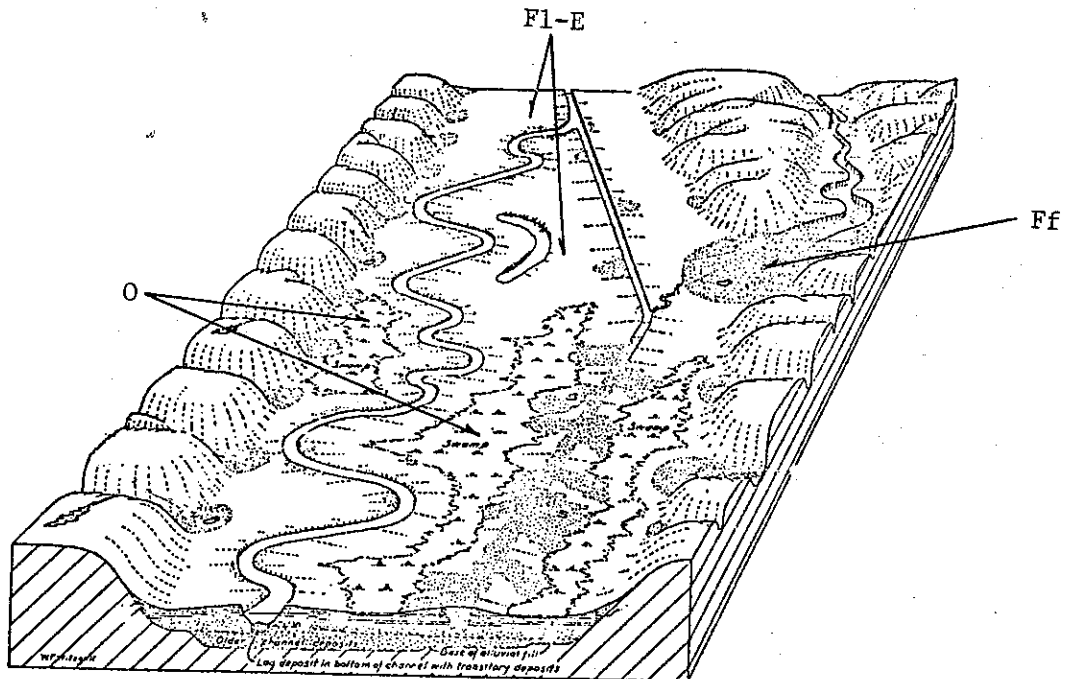
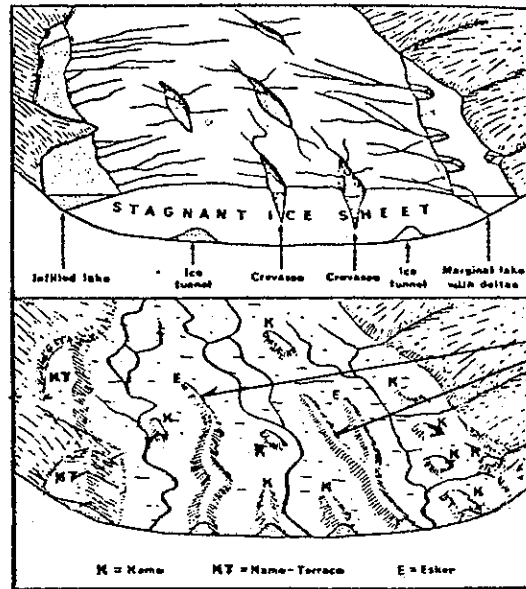


Fig. 5 Level



The formation of kames, kame-terraces and eskers (after R. P. Flint)

Fig. 6 Ridged

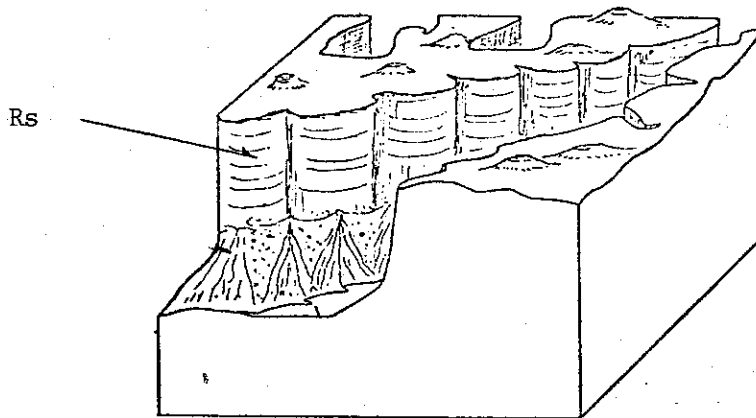


Fig. 7 Steep

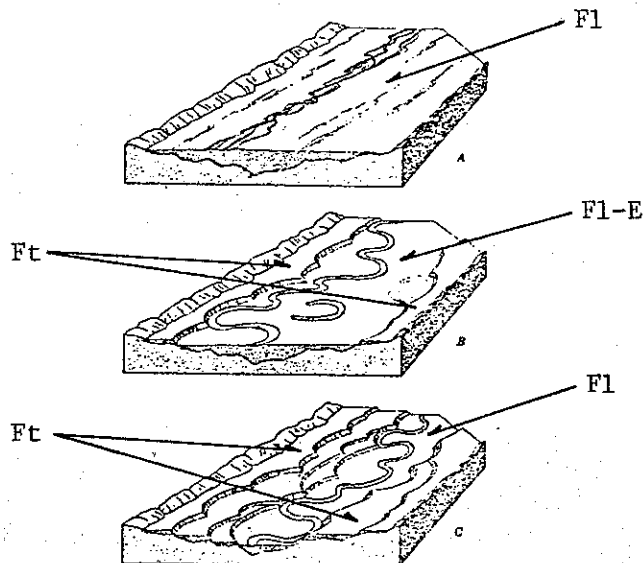


Fig. 8 Terraced

### QUALIFYING DESCRIPTORS

A number of descriptors have been introduced to qualify either the Genetic Materials or the Modifying Process terms. These are denoted by an upper case superscript following the term so qualified.

The descriptors qualify:

1. The clastic genetic material or modifying process terms, and are used to supply additional information about their mode of formation and/or depositional environment.
2. The organic genetic materials by classifying them on the basis of microrelief, height of water table, and vegetative origin. Where these qualifying descriptors are omitted, it indicates uncertainty or lack of data about the genesis of the organic deposit.
3. The status of the Genetic and Modifying processes. Included in the definitions of the Genetic Materials and Modifying Processes categories are statements concerning the commonly assumed status of their processes. Where the process status is contrary to the common assumption, it will be indicated.

### DESCRIPTIVE TERMINOLOGY

1. Clastic:       G    Glacial.
2. Organic:       B    Bog;   F    Fen;   S    Swamp.
3. Process:       A    Active;   I    Inactive.

### DEFINITION AND APPLICATION OF TERMS

**Clastic, Glacial:** *Used to qualify non-glacial genetic materials or process modifiers where there is direct evidence that glacier ice exerted a strong (but secondary or indirect) control upon the mode of origin of the materials or mode of operation of the process. The use of this qualifying descriptor implies that glacier ice was close to the site of deposition of a material, or the site of operation of a process.*

**Application:** F<sup>G</sup> Fluvio glacial (see also Fluvial Genetic Materials, page 8).

To be used only where fluvial materials show clear evidence of having been deposited either directly in front of, or in contact with, glacier ice. At least one of the following characteristics must be present:

1. Kettles, or otherwise irregular (possibly hummocky or ridged) surface that resulted from the melting of buried or partially buried ice e.g. pitted outwash, kame-and-kettle topography.
2. Slump structures and/or their equivalent topographic expression, indicating partial collapse of a depositional landform due to melting of supporting ice e.g. Kame terrace, delta kame.
3. Ice-contact and moulded forms such as gravelly or sandy crevasse fillings and eskers.
4. Non-sorted and non-bedded gravel of an extreme range of particle sizes, such as results from very rapid aggradation at an ice front, e.g. ice-contact gravels.
5. Flowtills.

Note: Outwash plains, fans and terraces which show none of the above characteristics are essentially the same as post-glacial fluvial plains, fans and terraces, and are mapped as such.

Application:  $L^G$  Glaciolacustrine (see also Lacustrine  
 $L$  Genetic Materials, page 9 ).

To be used only where there is evidence that the lacustrine materials were deposited in contact with glacier ice. One or more of the following characteristics must be present:

1. Kettles or an otherwise irregular surface that is not simply the result of normal settling and compaction in silt, nor the result of piping.
2. Slump structures resulting from loss of support due to melting of retaining ice.
3. Presence of numerous ice-rafted stones in the lacustrine silts.

Note: In British Columbia, most lacustrine sediments that lie at elevations above present valley floors (i.e. were deposited in lakes that have subsequently drained) originated in pro-glacial lakes. It is generally assumed therefore that the presence of such silts implies their pro-glacial origin, thus permitting them to be mapped as a single symbol. -  
 $L^G$  is used only for ice-contact lacustrine materials, as described above.

Application:  $W^G$  Glaciomarine (see also Marine Genetic Materials, page 12).

To be used only where there is clear evidence that materials of glacial origin were laid down in a marine environment, by settling through the waters from melting, floating ice and ice shelves. Sediments may be poorly sorted and poorly stratified to non-sorted and massive; shells present will generally be whole and in growth positions.

Application:  $E^G$  Channelled by glacial meltwater. (See also Modifying Processes: Channelled, page 2b).

To be used to indicate the presence of glacial meltwater channels in a unit where they are too small and/or too numerous to show individually by an on-site symbol.

Organic, Bog  $O^B$ :

A bog is an area covered or filled with peat material which generally consists of undecomposed to moderately decomposed sphagnum mosses. The watertable is generally high, but the effect of nutrient-rich ground water emerging from surrounding mineral soils is minor due to the slightly elevated nature of the bog surface (ombrotrophic). The dominant vegetation is black spruce, feathermosses, sphagnum spp. and ledum spp. Tamarack sometimes occurs in association with black spruce.

Organic, Fen  $O^F$ :

A fen is an area covered or filled with peat material which generally consists of well to moderately decomposed sedge (carex spp.) species. The watertable is generally higher than that of a bog and often at the surface. The groundwater is influenced by passage through mineral soils and hence is considered nutrient-rich (minerotrophic). Vegetation dominantly consists of sedges, grasses and reeds with some shrub cover. Scattered tamarack may occur in some places.

Organic, Swamp  $O^S$ :

A swamp is a level or slightly concave area covered or filled with peat material which generally consists of decomposed sedge or feathermoss species. The watertable is generally at or above the peat surface and is considered minerotrophic due to the influence of surrounding mineral soils. The vegetation is usually characterized by a tree cover of cedar and spruce.

Process:    A   Active;    I   Inactive.

Application: The application of the process status qualifiers is discussed in the introduction to the Qualifying Descriptors (page 21 section 3). The status of the process of deposition (Genetic Material) or modification (Modifying Process) is viewed as a function of its present-day activity or inactivity.

A Active:    *Any evidence of the recurrent nature of a modifying process or of the contemporary nature of the process forming a genetic material.*

I Inactive:   *No evidence that the modifying process is recurrent, and also that the processes of formation of the genetic materials have ceased.*

## MODIFYING PROCESSES

Terms which describe those geological processes that have modified or are currently modifying genetic materials and their surface expression.

DESCRIPTIVE TERMINOLOGY

-A Avalanched	-K Karst Modified
-B Bevelled	-N Nivated
-C Cryoturbated	-P Piping
-D Deflated	-S Soliflucted
-E Channelled	-V Gullied
-F Failing	-W Washed
-H Kettled	

- Notes:
1. Process modifiers are to be used where a relatively large portion of the map unit is modified. In other instances, on-site symbols can be used to indicate modification of a relatively small portion of the map unit. Whether an on-site symbol is available is indicated under each modifying process; illustrations of these and other on-site symbols are given later (see On-Site Symbols, page 35).
  2. The assumed common process status (active, inactive) is specified in the definition of each modifier. Where this status varies from the assumed state, it must be qualified in the description.

DEFINITION OF TERMS

(For illustrations see pps.29-32.)

**Avalanched:** Slopes modified by frequent avalanche activity.

**On-site symbol:** Yes.

**Assumed process status is** active.

Avalanches are defined as rapid, downslope movements of snow, ice and other incorporated debris, commonly associated with areas of high local relief and moderate to heavy snowfall.

**Example:** avalanche cone Cf-A; avalanche slope Rs-A.

Bevelled: *Surface cut or planed by running water but not underlain by fluvial materials.*

On-site symbol: No.

Assumed process status is inactive.

Applies to river-cut terraces in bedrock, river terraces cut into till or lacustrine silts.

Example: river-cut terrace in bedrock Rt-B.

Cryoturbated: *The modification of unconsolidated sediments by frost action in Alpine and Sub-alpine environments; patterned ground.*

On-site Symbol: No.

Assumed process status is active.

Includes processes of frost heaving, sorting, and/or churning; congeliturbation.

Examples: stone polygons on morainal blanket  
Mb-C

Deflated (Wind Eroded): *Modification through the removal of unconsolidated materials by wind action; commonly, the removal of fines in areas of sparse vegetation.*

On-site symbol: No.

Assumed process status is active.

Example: deflated lacustrine terrace Lt-D.

Channelled: *Surfaces crossed by a series of channels*

On-site symbol: No.

Assumed process status is inactive.

Glacial meltwater channels are indicated by the symbol E<sup>G</sup> (see Qualifying Descriptors, page 23).

The term applies to fluvial plains, terraces and fans.

Example: abandoned channels on alluvial terrace  
Ft-E.

Failing: *Modification of surfaces by the formation of tension fractures or by large consolidated or unconsolidated masses moving slowly downslope.*

On-site symbol: Yes.

Process status is only active.

Colluvial processes resulting in shallow surface movements are not described as failing.

Examples: till slopes on which slumping is a continuous process Mb-F.

Kettled: *Deposit or feature modified by depressions left by melting ice blocks.*

On-site symbol: Yes.

Assumed process status is inactive.

Depressions can be formed by the melting blocks of ice buried in glaciofluvial, glaciolacustrine or glacial till materials.

Kettle depressions usually have steep sides and are bounded by an abrupt convex break of slope. They occur in a variety of shapes and sizes, from round basins to branching valleys.

Examples: pitted outwash FG<sub>1</sub>-H; knob-and-kettle topography Mh-H.

Karst Modified: *Modification of carbonates and other rocks by processes of solution, and of overlying unconsolidated materials by collapse resulting from that solution.*

On-site symbol: Yes.

Assumed process status is active.

Applies to:

1. Carbonate and other rocks whose surfaces are marked by features of collapse and solution.
2. As in (1) but where the rocks are overlain by unconsolidated materials which show posthumous collapse depressions.

Examples: (1) Sinkholes, uvalas

(2)  $\frac{Mb}{R}$ -K

Nivated: *Surface modified by frost action, erosion and mass wasting beneath and around a snowbank, so as to produce transverse, longitudinal and circular hollows.*

On-site symbol: No.

Assumed process status is active.

Occurs in Alpine and Sub-alpine areas and is frequently associated with solifluction processes.

Example: nivation terrace in colluvium Cb-N; hollow.

Piping: *Surface modified by small hollows, commonly aligned along routes of subsurface drainage, and resulting from the sub-surface removal of particulate matter in unconsolidated materials.*

On-site symbol: Yes.

Assumed process status is active.

Subterranean erosion initiated by percolating waters which remove solid particles from clastic (fragmental) rocks to produce tubular underground conduits.

Occurs most commonly in lake silts but may also affect alluvium, loess and volcanic ash.

Example: piping in silty lacustrine terrace  
Lt-P.

Soliflucted: *Surface modified by the process of slow gravitational downslope movement of saturated, non-frozen earth material behaving apparently as a viscous mass over a surface of frozen ground.*

On-site symbol: No.

Assumed process status is active.

Commonly associated with processes of cryoturbation and nivation, occurring in alpine and sub-alpine areas.

Examples: lobes, stripes, sheets, terraces in colluvial blanket Cb-S.

Gullied: *The modification of surfaces by fluvial erosion, resulting in the development of parallel and sub-parallel, steep-sided and narrow ravines in both consolidated and unconsolidated materials.*

On-site symbol: Yes.

Assumed process status is active.

Example: gullied lacustrine terrace Lt-V.

Washed: *Modification of a deposit or feature by wave action in a body of standing water, resulting in lag deposits, beaches of lag materials and wave-cut platforms.*

On-site symbol: No.

Assumed process status is inactive.

Occurs most commonly in areas of former marine inundation or glacial lakes. Active washing occurs along present shorelines.

Example: terrace or beach cut or deposited on morainal blanket Mb-W.

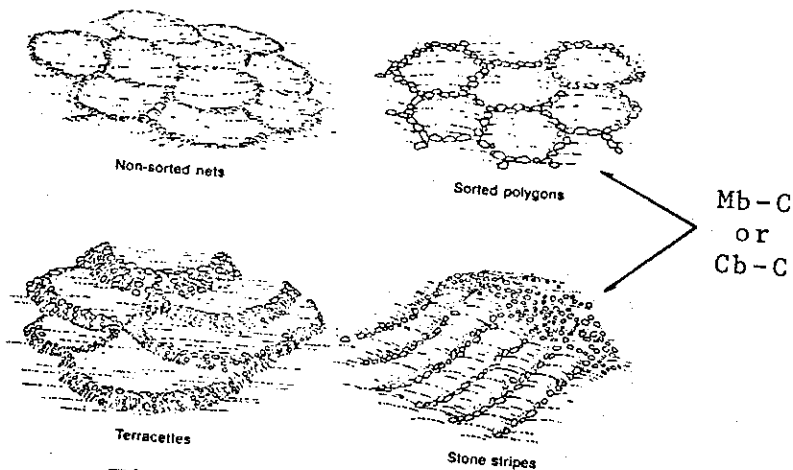
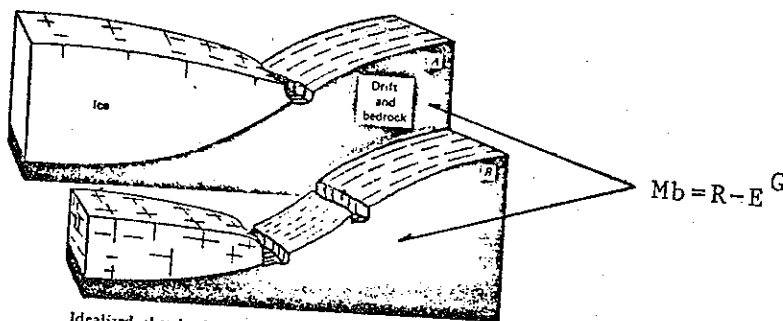


Fig. 1 Cryoturbated



Idealized sketch showing development, during deglaciation, of two glacier-margin hillside channels.

Fig. 2a Channelled

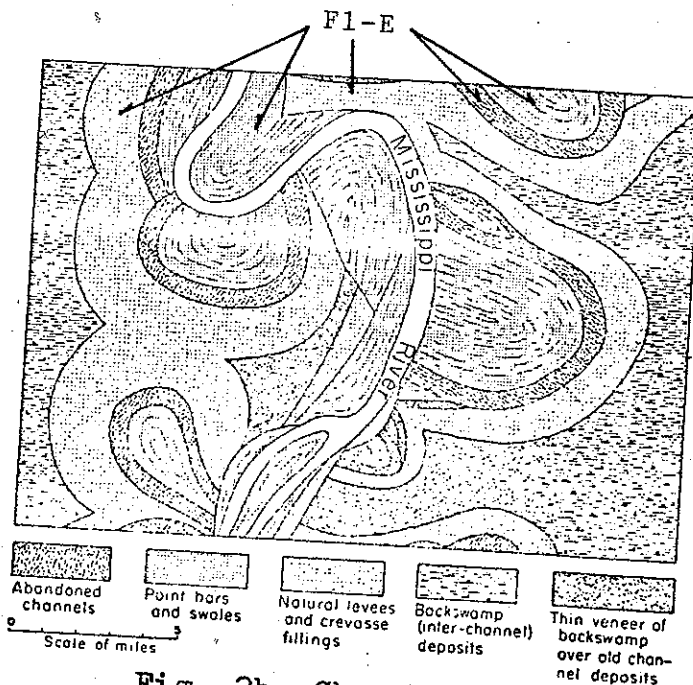


Fig. 2b Channelled

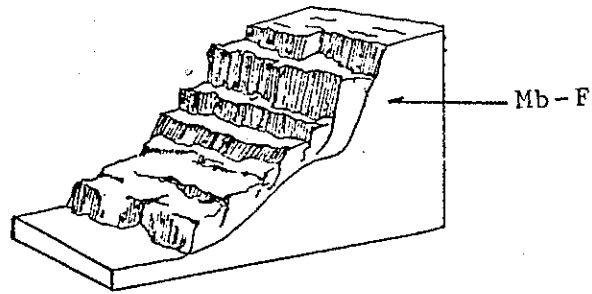


Fig. 3 Failing

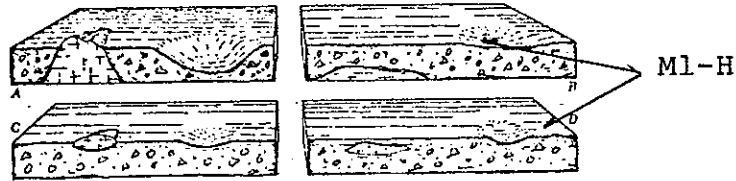


Fig. 4a Kettled

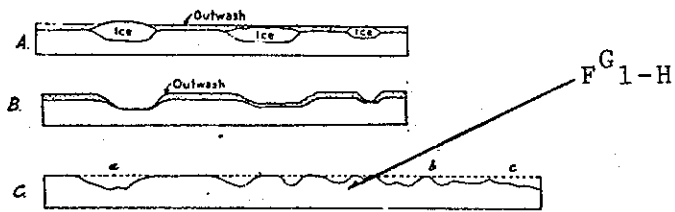


Fig. 4b Kettled

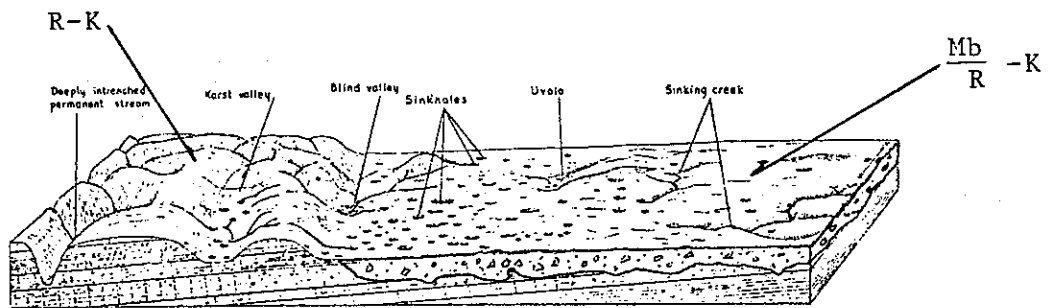
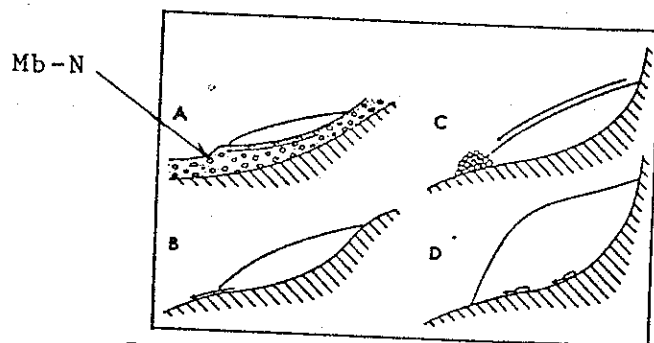


Fig. 5 Karst Modified



Four ways in which snowpatches may transport. A: saturation of subjacent unconsolidated material, perhaps aided by weight of snow, causes solifluction beneath the snowpatch and the construction of frontal terraces; B: snow-melt runoff on a hard, impermeable and perhaps steeper surface moves finer material away from the snowpatch; C: material falling on to the snow surface from above slides down to form a protalus rampart; D: in a deep snowpatch snow pressure causes basal sliding and the movement of loose particles over a hard surface.

Fig. 6 Nivated

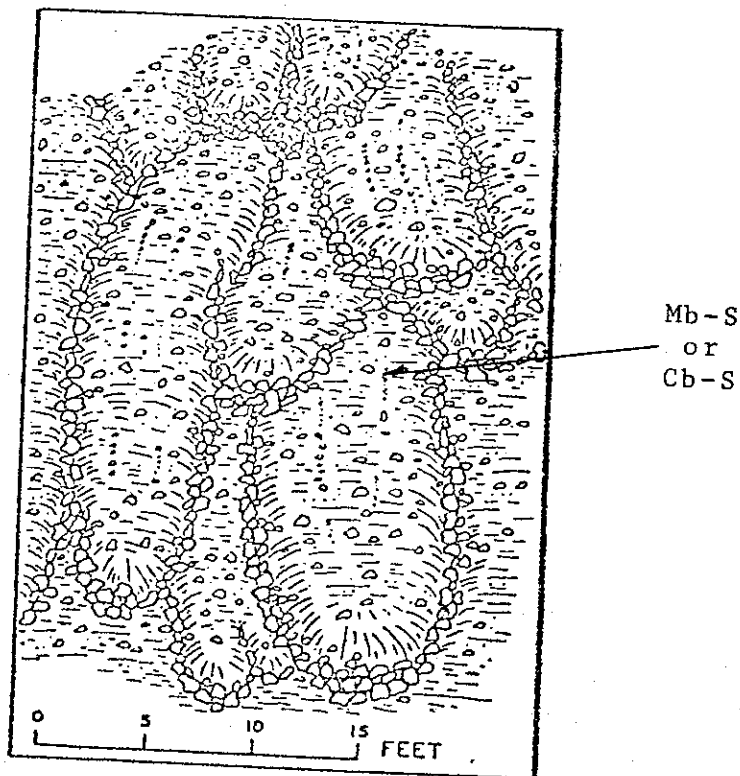


Fig. 7 Soliflucted

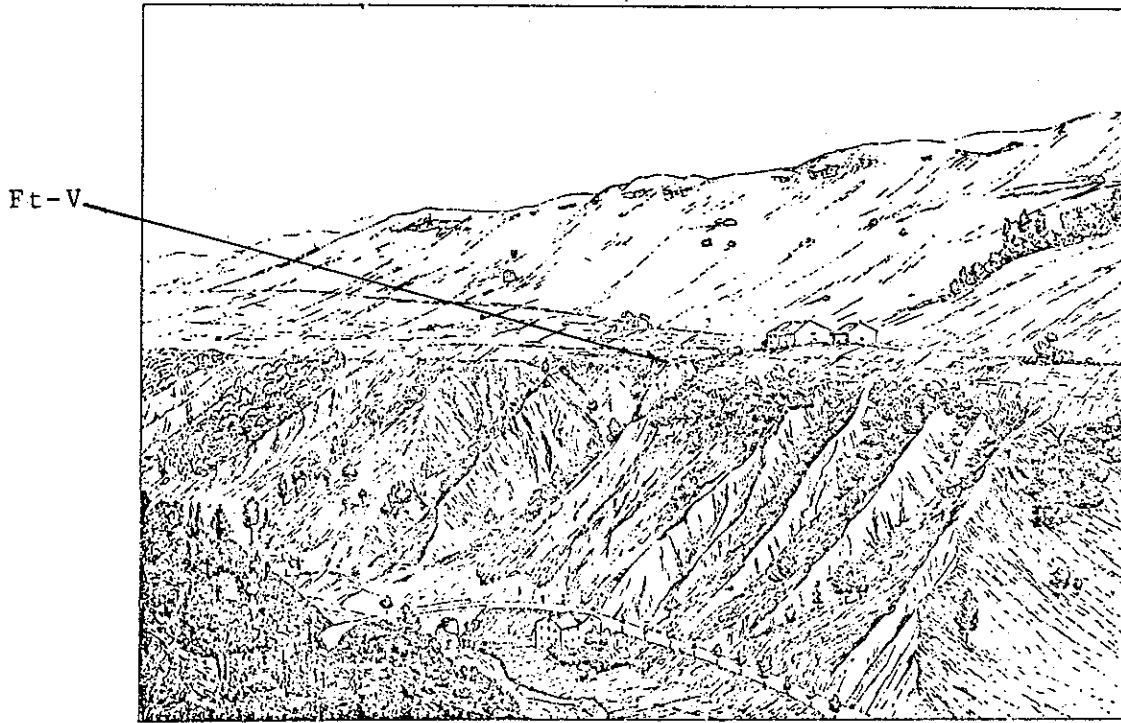
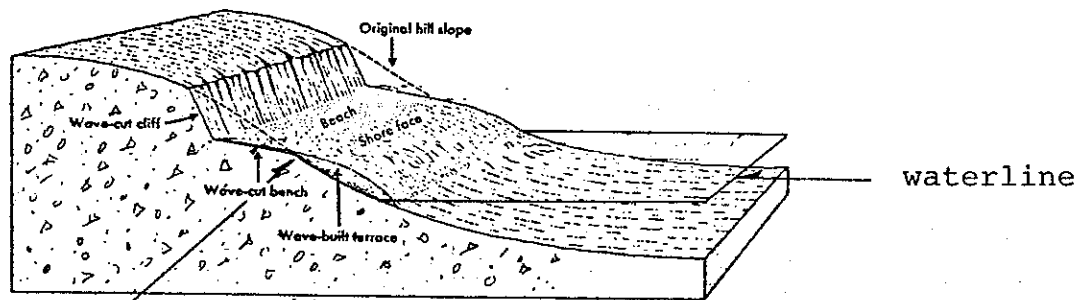


Fig. 8 Gullied



M1-W

Fig. 9 Washed

### STRATIGRAPHIC DATA

Stratigraphic data may be presented to supplement the surficial data. Stratigraphic information must be given for veneers and blankets which overlie unconsolidated materials (see definitions of veneer and blankets). In addition, where the depth of the surface unit is such that the nature of the underlying unit may be important, and/or where it is deemed necessary to show the character of the underlying unit, then stratigraphic information will be shown.

For map presentation, a horizontal bar is used to separate the components which are arranged in stratigraphic order. Surface expressions may be attached to underlying units if appropriate. Symbols are generally limited to two components. Some examples are as follows:

$\frac{\cancel{E}V}{gFt}$  veneer of eolian silt overlying terraced fluvial gravels

$\frac{Mh}{gFG}$  hummocky morainal materials overlying glaciofluvial gravels

If the type of unconsolidated material underlying a blanket or veneer of different genetic material is not known, then only the surface expression of that underlying material is given. For example

$\frac{Mb}{h}$

indicates hummocky unconsolidated material of unknown specific type underlying a blanket of morainal materials.

Where it is desired to indicate a surface expression for bedrock underlying a blanket or veneer of materials then the following is used

$\frac{Mv}{Rh}$  and not Mvh

If further stratigraphic information is collected during the data acquisition stage, it will then be stored in data files and included in the report for the area.

Composite Units  
(see also pg. 13)

Not all terrain can be presented as simple units since terrain units commonly occur that are of small areal extent and cannot be delimited individually at the scale of the mapping. Consequently, a system of composite units is employed whereby up to three types of terrain may be designated within a common unit boundary. The relative amounts of each terrain type are indicated by the use of the symbols =, /, and //. The components are always indicated in decreasing order of abundance.

- = components on either side of this symbol are approximately equal
- / the component in front of the symbol is more abundant than the one that follows
- // the component in front of the symbol is considerably more abundant than the component that follows

An example of each possible combination of symbols and its interpretation is given below:

Mb=R	Roughly equal
Mb/R	R less than Mb
Mb//R	R considerably less than Mb
Mb=R=Cv	All roughly equal
Mb=R/Cv	Mb and R roughly equal; Cv less than each of Mb and R
Mb=R//Cv	Mb and R roughly equal; Cv considerably less than each of Mb and R
Mb/R=Cv	R less than Mb; R and Cv roughly equal
Mb/R/Cv	R less than Mb; Cv less than R
Mb/R//Cv	R less than Mb; Cv considerably less than R
Mb//R=Cv	Mb considerably more extensive than each of R and Cv; R and Cv roughly equal
Mb//R/Cv	R considerably less than Mb; Cv less than R
Mb//R//Cv	R considerably less than Mb; Cv considerably less than R

The relative proportions of the components of two-term composite units are approximately:

45-55% = 45-55%

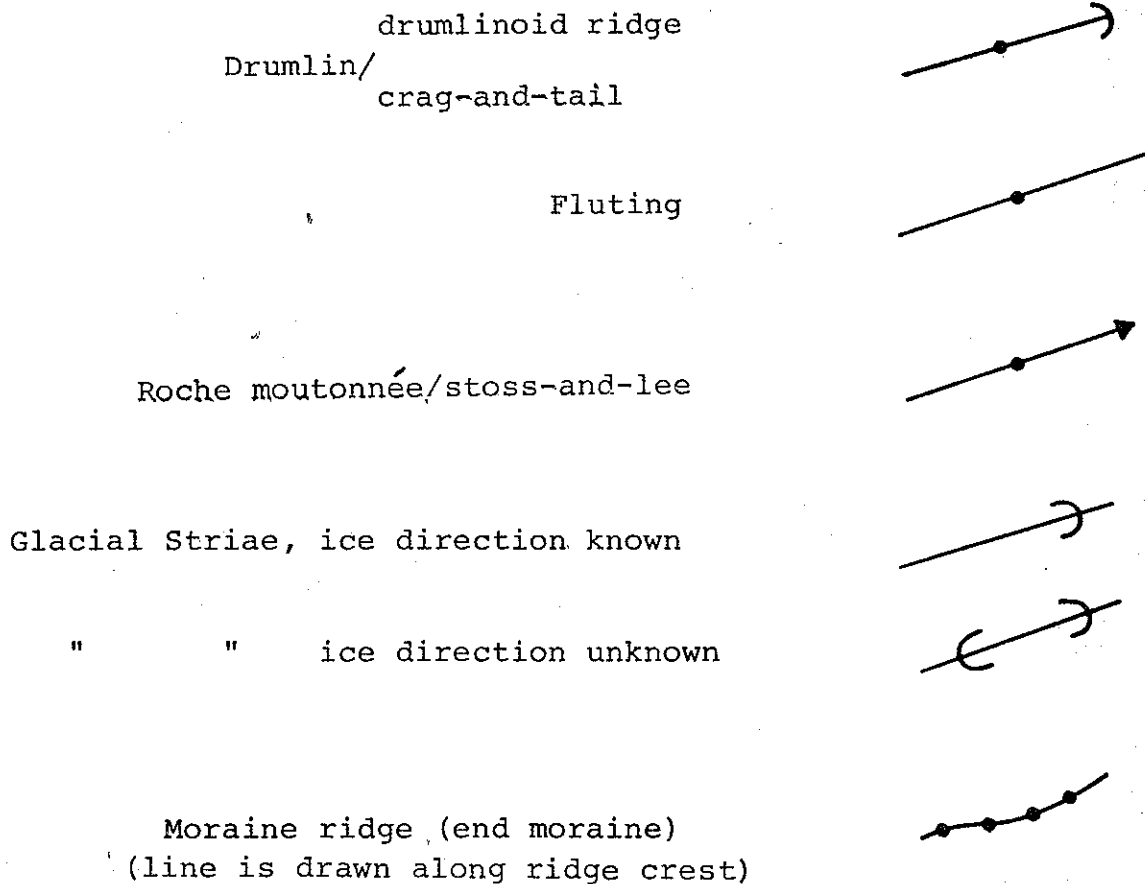
55-70% / 30-45%

70-90% // 10-30%

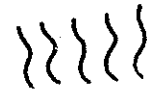
ON-SITE SYMBOLS

On-site symbols or map symbols are used to describe features or processes in the terrain which express either a limited (by scale) areal function or are simply point observations. These may be linear features such as eskers or moraine ridges; site specific information such as gravel locations or kettle holes; or to add details of Quaternary history such as striae, glacial meltwater channels or abandoned shorelines.

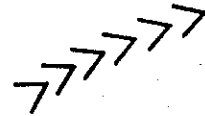
The size of the on-site symbols will vary with the type of symbol. For example, those symbols which connote an areal extent such as *failing* or *blockfields* will vary in size whereas those which are point observations and have no relation to areal extent, such as *fossil locality* or *karst* will be of a standard size. Those symbols which have linear connotations such as *eskers*, *gullying* or *end moraines* will vary in length but will be of standard width.



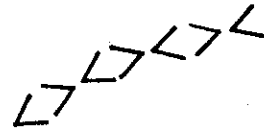
Minor moraine ridges  
(lines are drawn on ridge crests)



Eskers, direction known



Eskers, direction unknown



Kettle



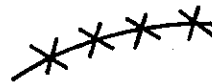
Glacial meltwater channel, large



small  
(arrow indicates direction of flow)



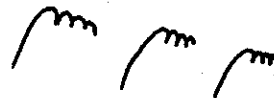
Abandoned shoreline



Dunes, active



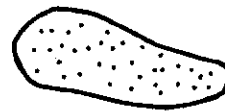
inactive



Block fields  
(outline corresponds to  
true shape of feature)



Rock glaciers  
(outline corresponds to  
true shape of feature)



Escarpment



Cirque  
(symbol is drawn along crest of ridge (arête)  
that bounds the cirque)



Avalanched



Failing  
(arrow indicates direction of failure)  
(outline corresponds to true shape of feature)



Piping



Gullied  
(symbols become broader down-gully)



Erratic



Quaternary Fossil Locality



Anthropogenic site



Landslide scar



Karst



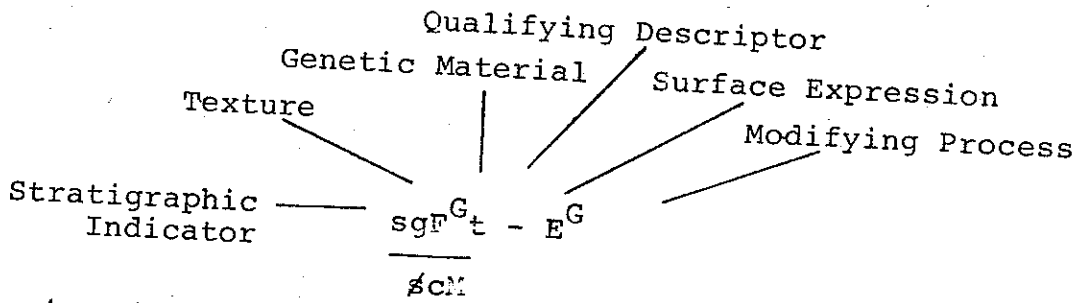
Gravel location



Unit boundary



EXAMPLE OF TERRAIN UNIT SYMBOLOGY



*A sandy gravelly fluvioglacial terrace over silty clay moraine whose surface has been eroded by glacial meltwater channels.*

Appendix I

## Field Determination of Texture for Sand, Silt and Clay

Determination of the texture of sand and finer materials in the field is done by "hand texturing" - feeling the sediment with the fingers. This is sometimes supplemented by examination under a hand lens. Whenever possible, comparisons of the results of hand texturing and of laboratory analyses should be made.

In hand texturing, both dry and moist sediment samples are examined. In the latter case, proper moisture content is difficult to judge. Generally, coherent sediment should be as wet as necessary to permit it to be rolled between the palms of the hands and pressed into a ribbon between thumb and forefinger, leaving moisture on the skin when handled, but without sticking to the fingers.

The following paragraphs are intended as a guide to the characteristics of the chief types of fine textured sediments. This outline is not intended to be all inclusive, however, and additional combinations of sand, silt, clay and fines may occur.

- Sand:** This material is loose and single grains can readily be seen or felt. When dry and squeezed in the hand, the sediment will fall apart when pressure is released. When moist sand is squeezed, a cast will form, but it will fall apart when touched.
- Silt:** This material breaks up into small angular fragments when compacted and dry. When these are pulverized, the sediment feels soft and floury. Dry or moist, this sediment forms casts that can be handled. When moist and squeezed between thumb and forefinger, it forms a broken and rough ribbon. Very moist sediment has a soapy feel. Silt has a gritty taste when chewed between the teeth.
- Clay:** This material breaks into very hard, angular lumps when dry. It is plastic and usually sticky when wet. When the moist sediment is pinched out between thumb and forefinger it will form a long, flexible ribbon. A roll will bear its own weight when flexed. Clay is not gritty when chewed between the teeth.
- Silty sand (Roughly equivalent soil texture is sandy loam):**  
This material contains much sand, but also has enough fines (silt and clay) to make it somewhat coherent. Individual sand grains can readily be seen and felt. If squeezed when dry it will form a cast which will readily fall apart, but if squeezed when moist, a cast can be formed that will

bear careful handling without breaking.

**Sandy silt** (Roughly equivalent soil texture is silt loam): This material consists dominantly of silt with a moderate amount of sand. When compacted and dry, it will break up into small angular fragments, and when these are pulverized, sand grains will be apparent either visually or by an abrasive feeling to the touch. The groundmass of silt will be soft and floury. Either dry or moist, this material forms casts that can be freely handled without breaking, but when moistened and squeezed between thumb and finger, it forms a broken and rough ribbon.

**Silty clay** (Roughly equivalent soil textures are clay loam and silty clay loam): This material consists predominantly of clay with a secondary component of silt. It breaks into small, hard, angular fragments when dry. When moist sediment is squeezed it will form a thin ribbon which may break under its own weight. The moist sediment is plastic and forms a cast that will bear much handling.

**Sandy fines** (Roughly equivalent soil texture is loam): This material contains a relatively even mixture of sand, silt and clay. It has a somewhat gritty feel, yet is fairly smooth and slightly plastic. Squeezed when dry, it forms a cast that will bear careful handling. A cast of moist sediment can be handled quite freely without breaking. When squeezed between thumb and finger it forms a rough ribbon that breaks under its own weight.

The above outline has been adapted from:-

U.S.D.A. Soil Survey Manual, 1951

Class notes, Soil Science 416, U.B.C. by Dr.L.Lavkulitch

Appendix II Comparison of Various Particle Size Classifications

MILLIMETERS	INCHES	WENTWORTH	U.S.D.A. and I.C.D.A.	UNIFIED	AASHTO
400		BOULDERS	STONES	COBBLES	BOULDERS
100	10-1				
200		COBBLES	COBBLES		
80	3-6				
60	2-5				
40				GRAVEL	GRAVEL
20	3	PEBBLES	GRAVEL	GRAVEL	
10	1			GRAVEL	
7.5					
6	1/2				
4.75	1/2				
4	3/8				
3	3/8				
2.5	1/4				
2	1/4				
1.5	3/16				
1.18	3/16				
1	1/8				
0.85	1/8				
0.75	3/16				
0.6	3/16				
0.5	3/16				
0.425	3/16				
0.375	3/16				
0.3	3/16				
0.25	3/16				
0.2	3/16				
0.15	3/16				
0.106	3/16				
0.075	3/16				
0.05	3/16				
0.0425	3/16				
0.0375	3/16				
0.03	3/16				
0.025	3/16				
0.02	3/16				
0.015	3/16				
0.0106	3/16				
0.0075	3/16				
0.005	3/16				
0.00425	3/16				
0.00375	3/16				
0.003	3/16				
0.0025	3/16				
0.002	3/16				

GLOSSARY OF TERMS

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