Glacial Tills

Direct glacial sediments

Diamicton

(poorly sorted unconsolidated sediment)

- mudstone with dropstones (marine diamicton)
- debris flow sediments (including lahar sediments)
- glacial till

Toby Fm. conglomerate
(Proterozoic - Snowball Earth,
Windermere Gp.)
(diamictite)

Debris flow at
Charles Ck.

Vashon till on
Quadra Island

Types of Glacial Till

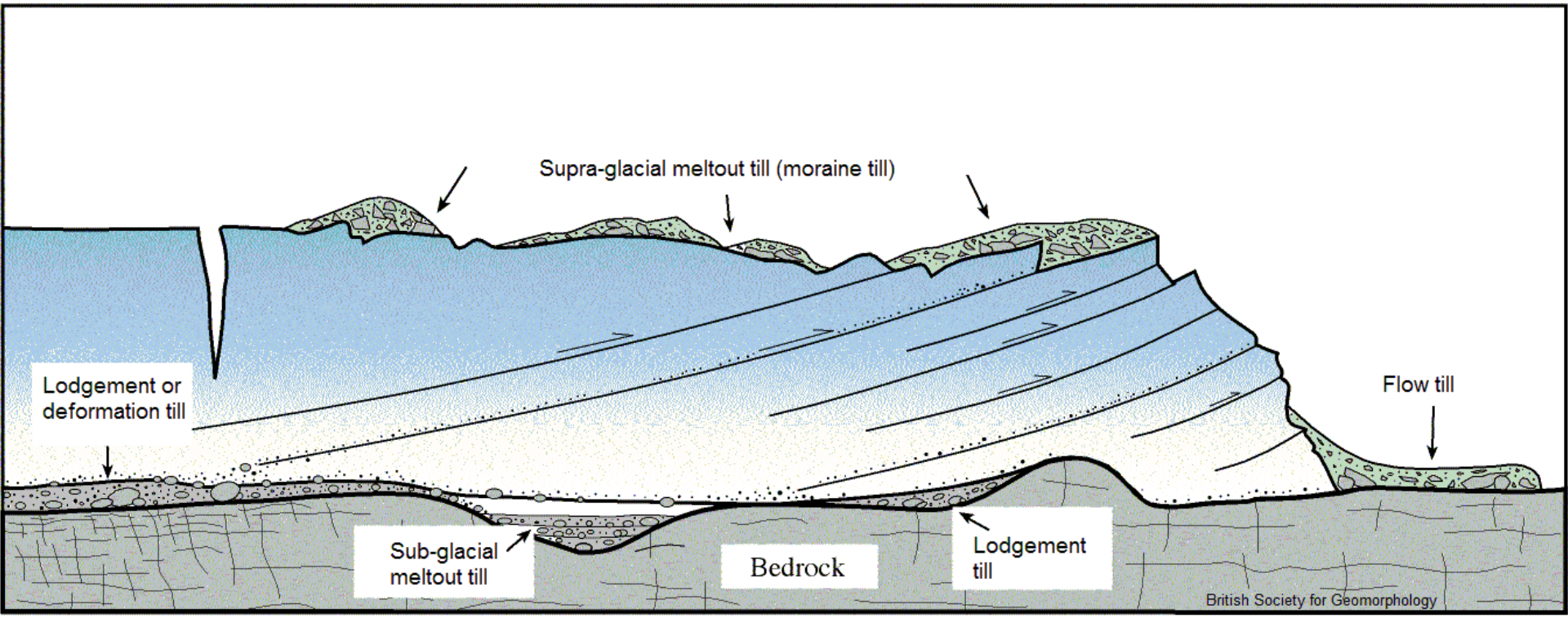
Sub-glacial tills

- Lodgement till ("lodged" by the ice onto the substrate)
- Sub-glacial meltout till (commonly forms within cavities)
- Deformation till (deformation of soft non-glacial sediments)

Supra-glacial tills

- Supra-glacial meltout till (e.g., lateral and medial moraines)
- Flow till (from flow of supraglacial material at the ice front)
- Sublimation till (form only in very cold regions, not common)

Depositional settings for various types of till



Characteristics of sub-glacial tills

	Lodgement	Subglacial meltout	Deformation
Particle shape	Rounded edges, spherical*, striated and faceted	Rounded edges, spherical, striated and faceted	Depends on parent material
Particle size distribution	Bi-modal (silt-clay and gravel plus) or multimodal	Bi-modal (silt-clay and gravel plus) or multimodal (sorting is possible)	Diverse, may include rafts of original material
Fabric	Elongated particles are aligned with flow direction	Elongated particles are aligned with flow direction (but less than lodgement)	Strong fabric in the direction of shear
Packing	Dense and well consolidated	Dense and well consolidated (but less than lodgement)	Dense and well consolidated
Lithology	Local rock types dominate	Local rock types dominate	Depends on parent material
Structure	Structureless, but with shear planes and foliations	Normally structureless but sometimes stratified (not sheared)	Fold and shear structures may be present unless homogenized. Rafts.

* Spherical means generally equal in all directions, not like a sphere

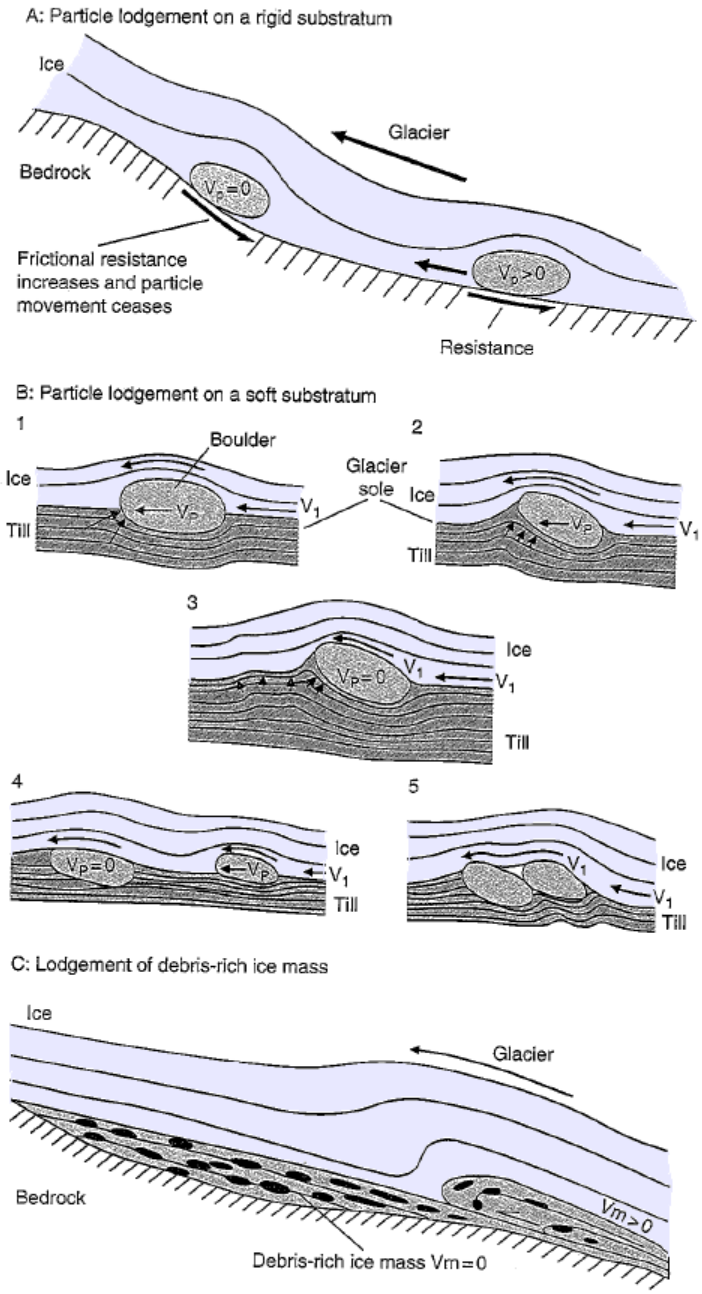
After Bennett and Glasser, 2009, Table 8.1


Athabasca Glacier

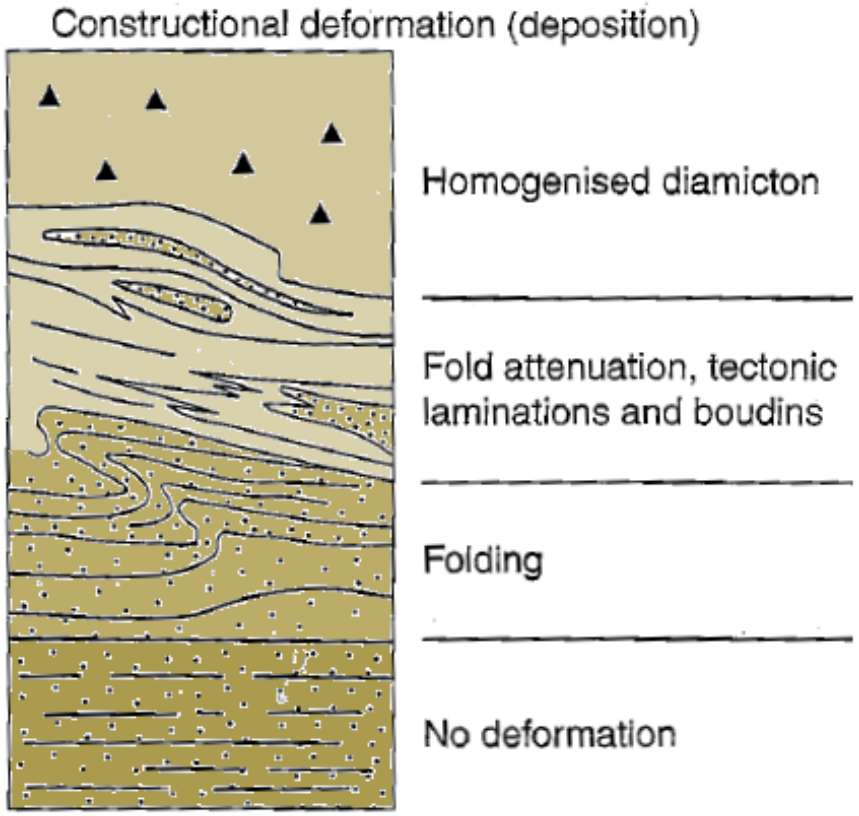
Horstman Glacier, Blackcomb

Thompson Glacier, Axel Heiberg, Canada, http://www.swisseduc.ch

Lodgement till

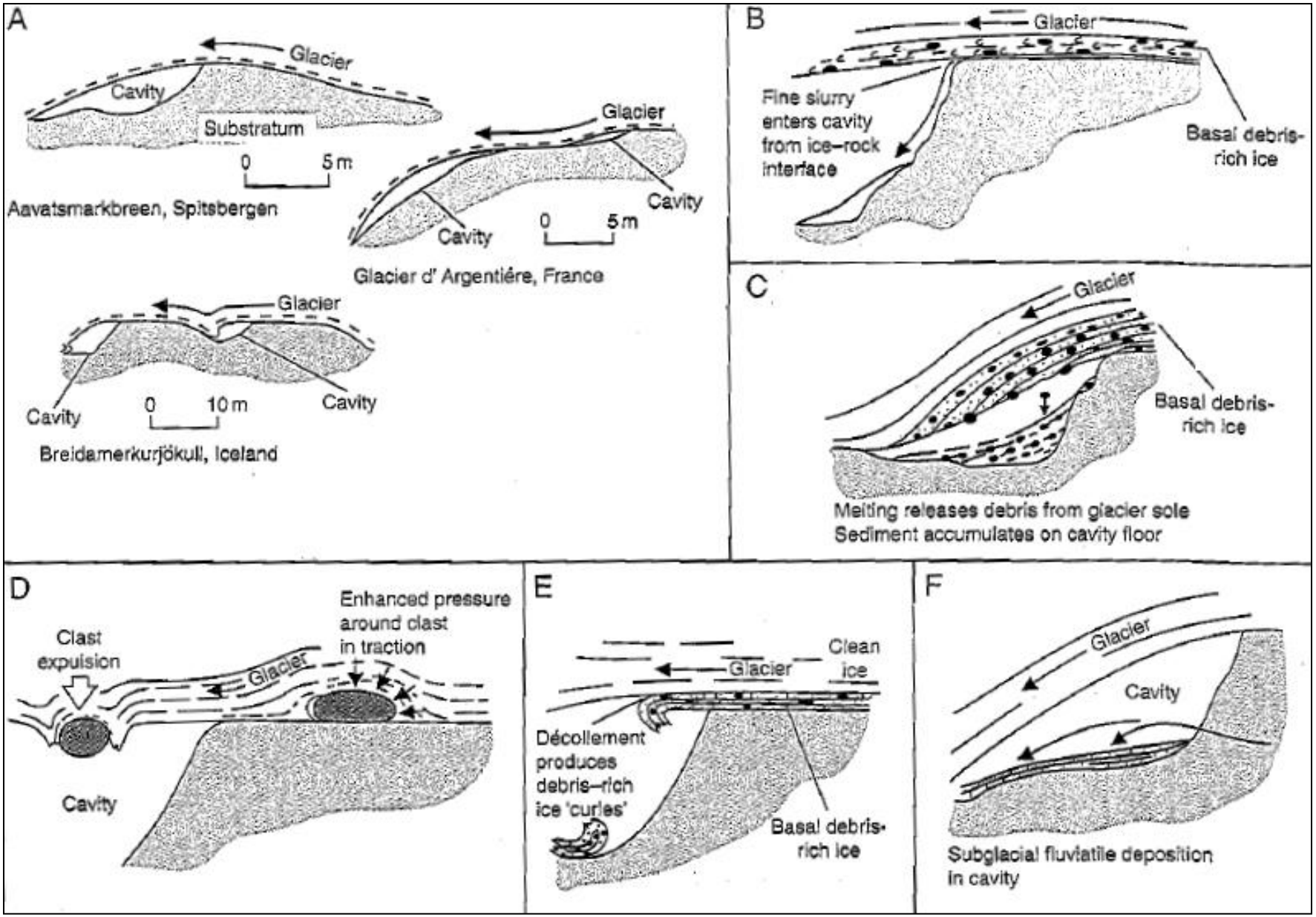


Deformation till



Bennett and Glasser, 2009

Accumulation of meltout till in sub-ice cavities



Bennett and Glasser, 2009

Characteristics of supra-glacial tills

	Meltout (morainal)	Flow	Sublimation
Particle shape	Mostly angular, not striated or faceted	Mostly angular, not striated or faceted	Rounded edges, equant, striated and faceted
Particle size distribution	Coarse and unsorted (similar to talus) Sorted if water-worked	Coarse and unsorted Individual flow packages may be sorted.	Bi-modal (silt-clay and gravel plus) or multimodal
Fabric	Poorly developed	Variable. Individual flow packages may show a flow fabric.	Elongated particles are aligned with flow direction
Packing	Poorly consolidated	Poorly consolidated	Poorly consolidated
Lithology	Can be quite variable (depends on size of glacier)	Can be quite variable	?
Structure	Structureless, but with possible crude bedding	May see evidence of individual flow packages	Stratified with possible fold structures

After Bennett and Glasser, 2009, Table 8.1


Horstman Glacier, Blackcomb


Horstman Glacier, Blackcomb


Whistler Glacier

Flow tills, Kongsvegen, Svalbard, http://www.swisseduc.ch

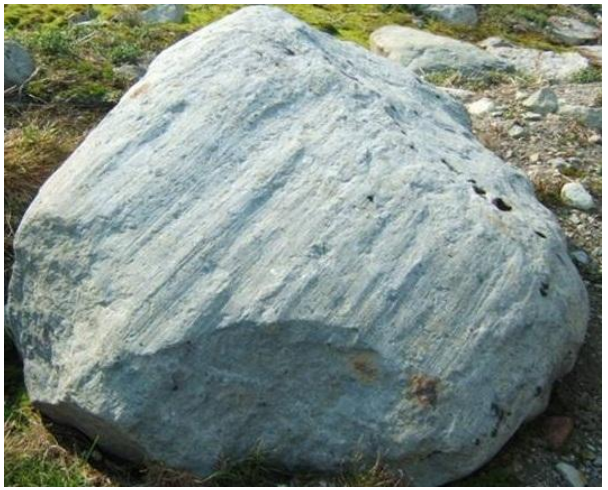
Debris flows (flow till) embedded in the top of outwash unit (gravelly sand), Allen County, Indiana
http://igs.indiana.edu

Hub City gravel pit, Nanaimo. Possible flow till, but probably just a debris flow.

Meltout till characterized by a vague layering of till units separated by thin horizontal partings filled with sand.
Allen County, Indiana,
http://igs.indiana.edu

Clast shape

- Subglacially transported tills typically have sub-rounded to rounded, striated, faceted and spherical (not elongated) clasts, with a bimodal distribution (silt/clay and coarse)



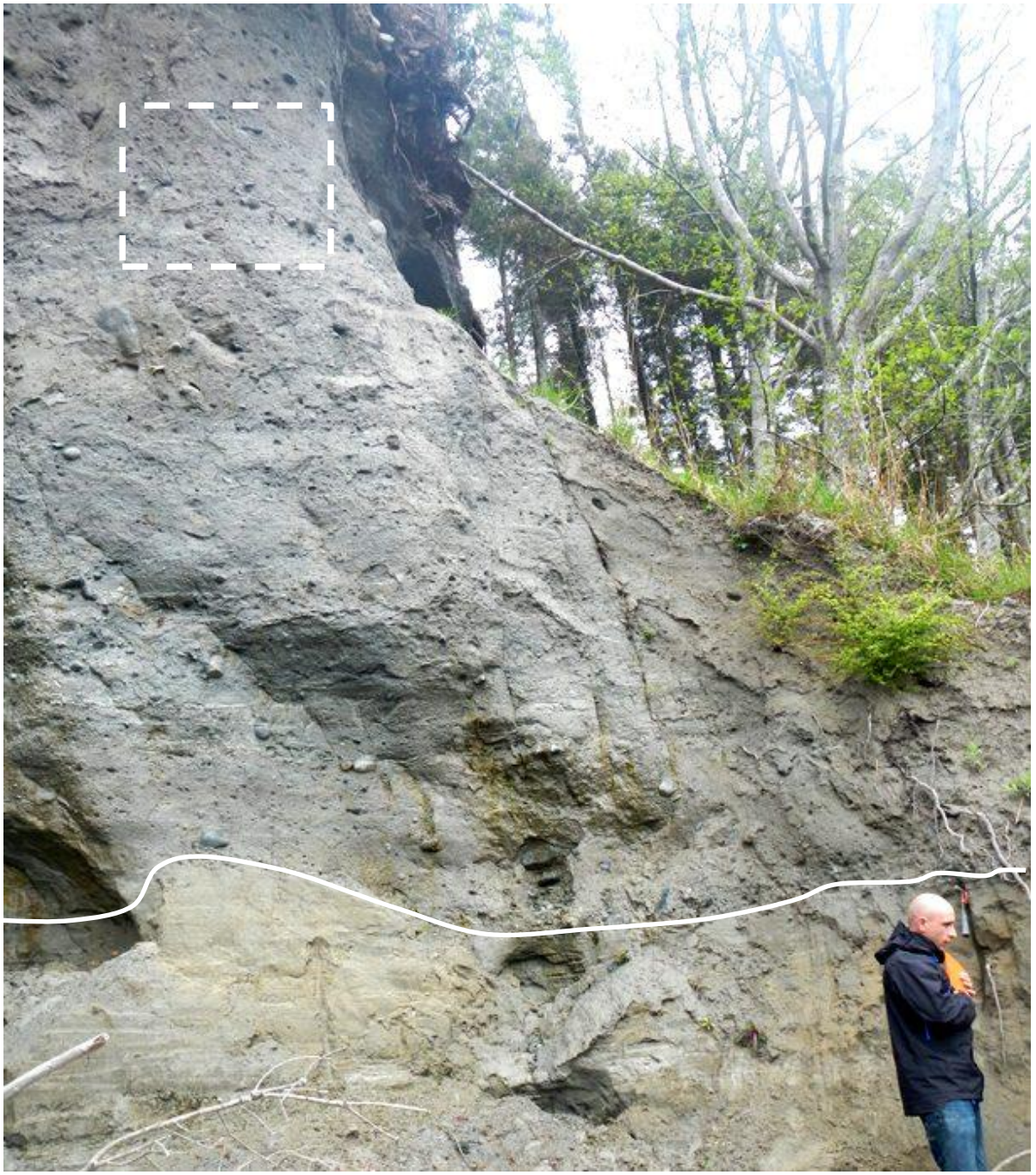
- Supraglaicially transported tills typically have angular, non-spherical clasts with a coarse unimodal grain-size distribution (this example from Whistler is not unimodal!)

Textural criteria for recognition of diamictons

Code	Facies	Description
Dmm	Diamicton, matrix supported, massive	Structureless mixture ranging in size from clay to boulders
Dmm(r)	Diamicton, matrix supported, massive w/ evidence of resedimentation	Mostly structureless with up to 10% silt & sand beds
Dmm(c)	Diamicton, matrix supported, massive w/ evidence of current flows	Mostly structureless with up to 10% silt, sand and pebble beds with ripples and cross beds
Dmm(s)	Diamicton, matrix supported, massive w/ evidence of deformation (shearing)	Mostly structureless with shear planes, foliation and/or brecciated clasts
Dms	Diamicton, matrix supported, with stratification	Diamicton with >10% stratified layers
Dms(r)	Diamicton, matrix supported, stratified w/ evidence of resedimentation	Diamicton with >10% stratified layers and flow noses*, rafts**, erosion of preceding layer
Dms(c)	Diamicton, matrix supported, stratified w/ evidence of currents	Diamicton with >10% stratified layers , sand-silt interbeds, ripples, cross-beds, removal of fines, channelized base
Dmg	Diamicton, matrix supported, graded	Diamicton with grading in matrix or clast content

*Flow nose: small soft-sediment fold or curved bed, indicating sediment flow, **raft: an inclusion of a coherent block of sediment

Quadra Sand and Vashon Drift



Vashon Drift on Quadra Island