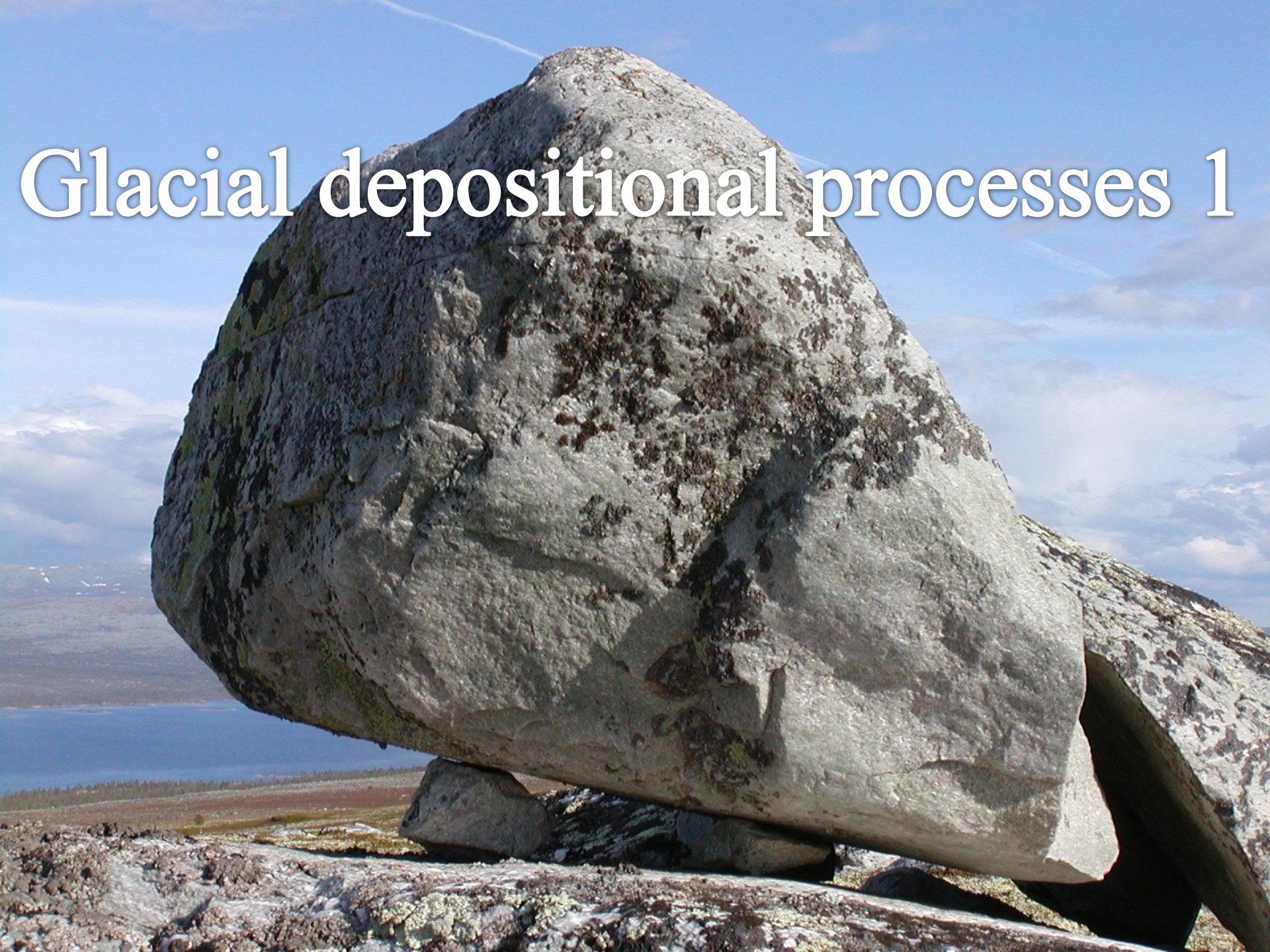
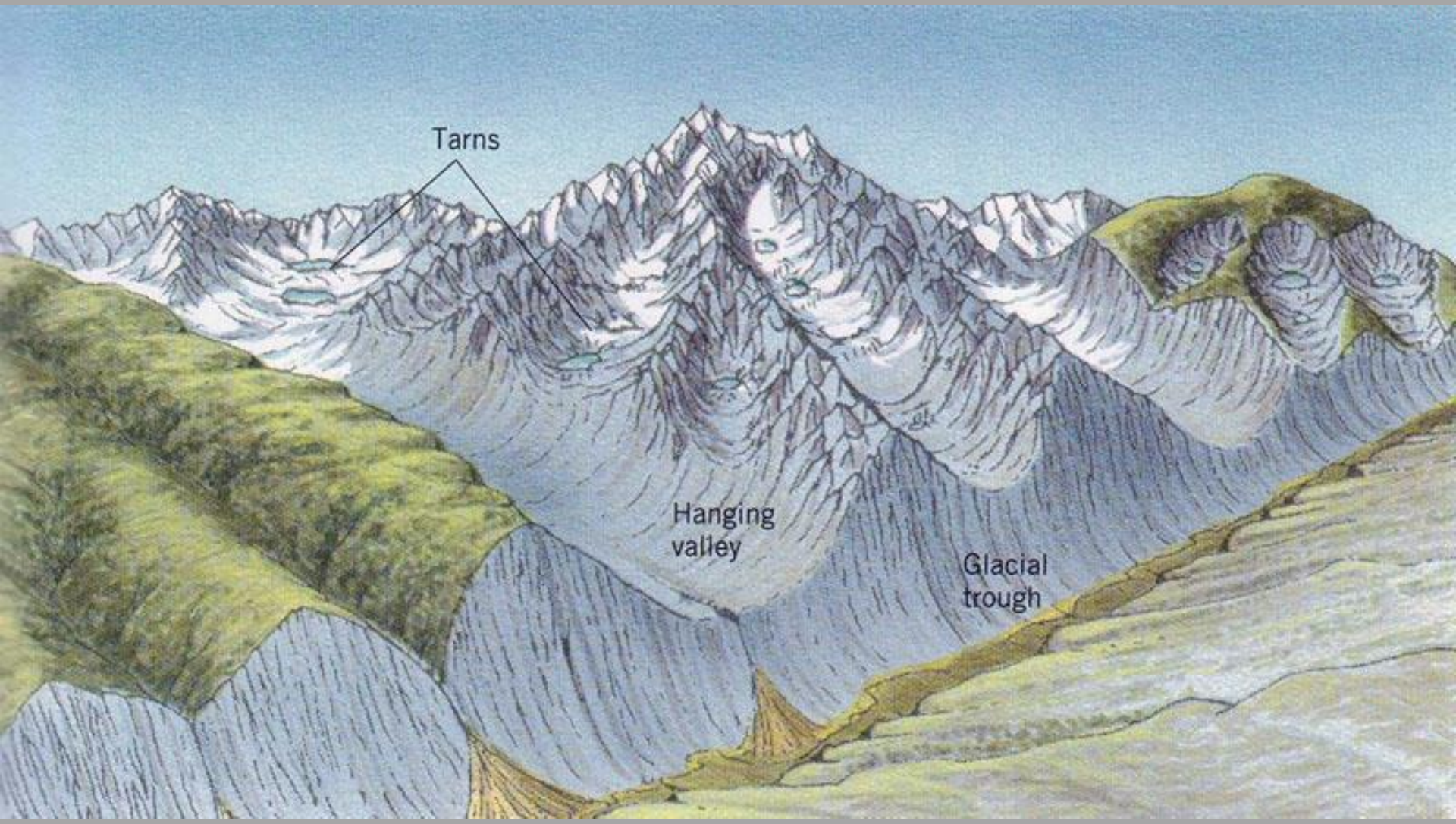

Glacial depositional processes 1

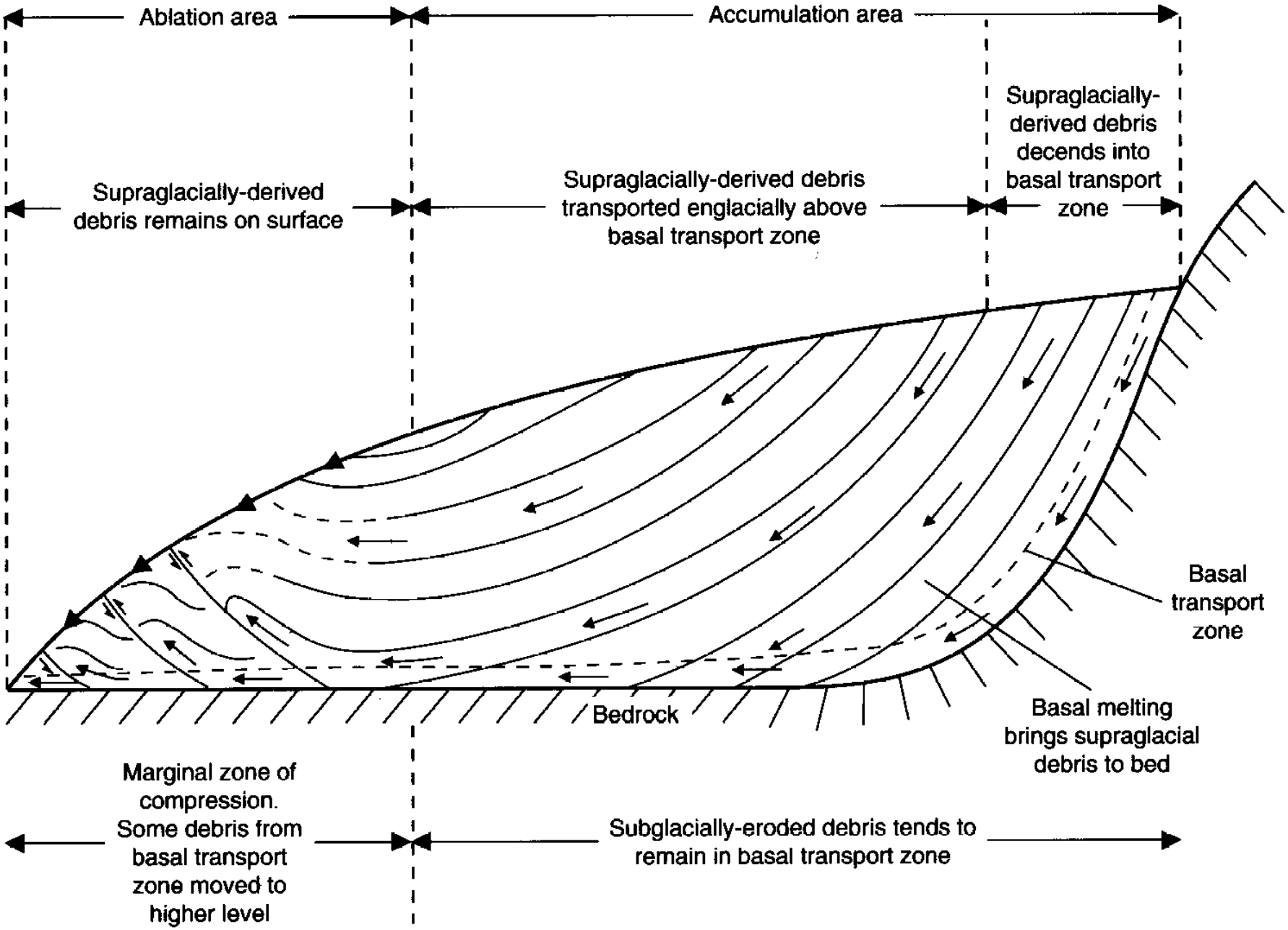
Glacial depositional processes 1

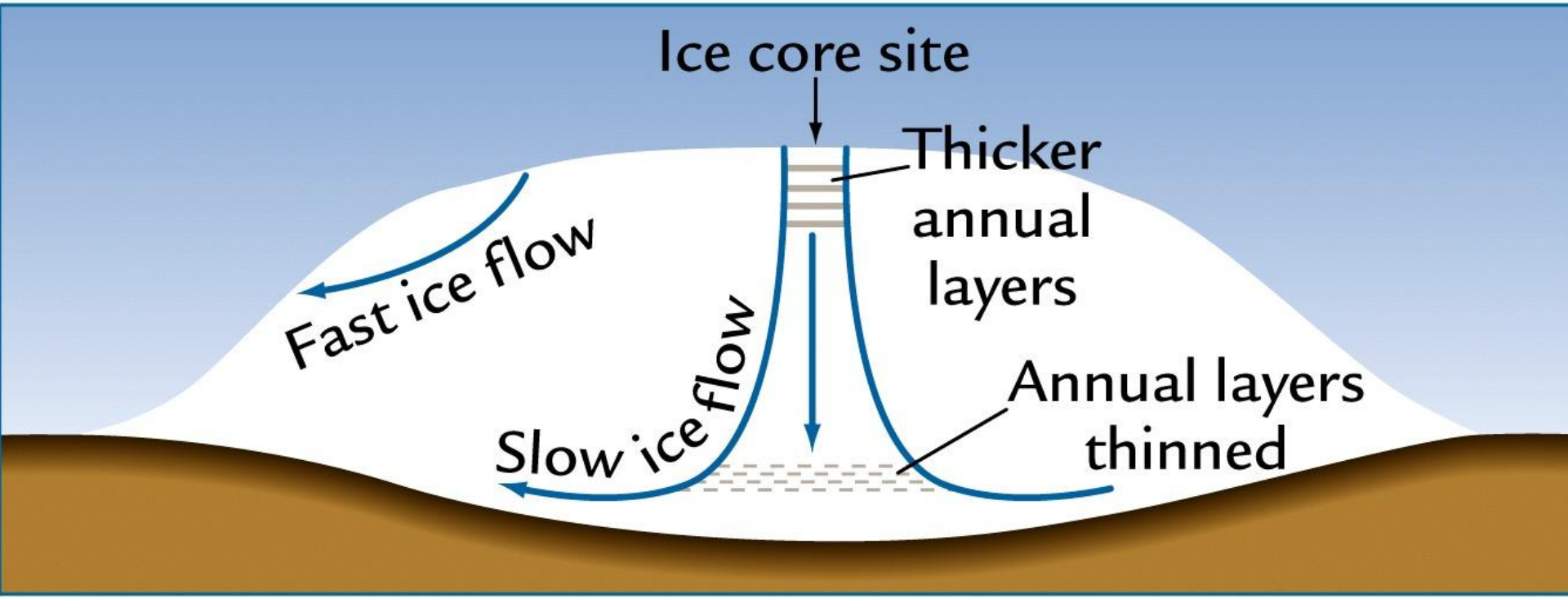
1: Controls by temperature and mass balance

2: Basics of subglacial deposition processes

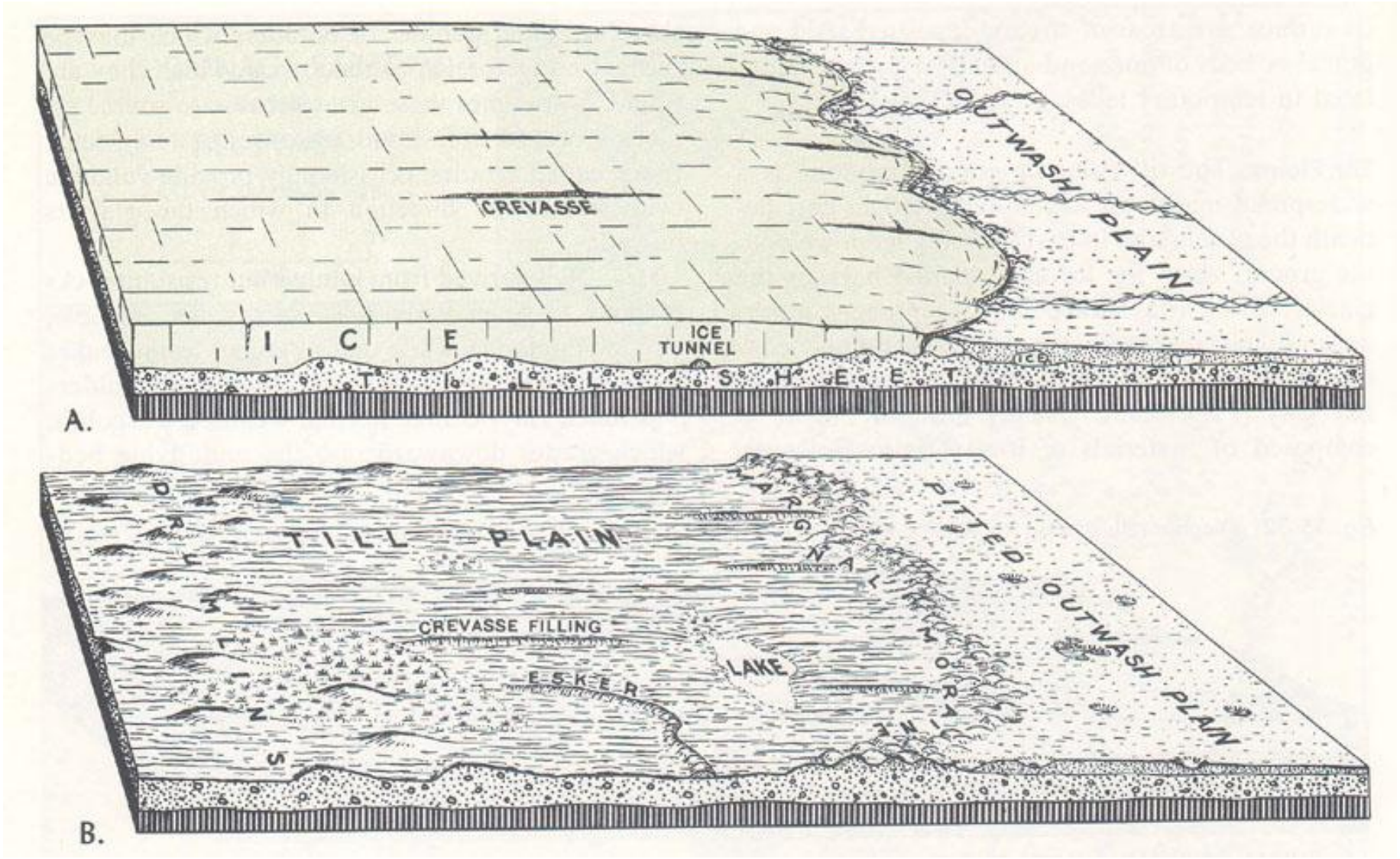


The typical textbook illustration: Evidence for glacial erosion.
But where is the eroded debris being deposited ?


Ablation area
Accumulation area
Supraglacially-derived debris remains on surface
Supraglacially-derived debris transported englacially above basal transport zone
Supraglacially-derived debris decends into basal transport zone
Basal transport zone
Bedrock
Basal melting brings supraglacial debris to bed
Marginal zone of compression. Some debris from basal transport zone moved to higher level
Subglacially-eroded debris tends to remain in basal transport zone

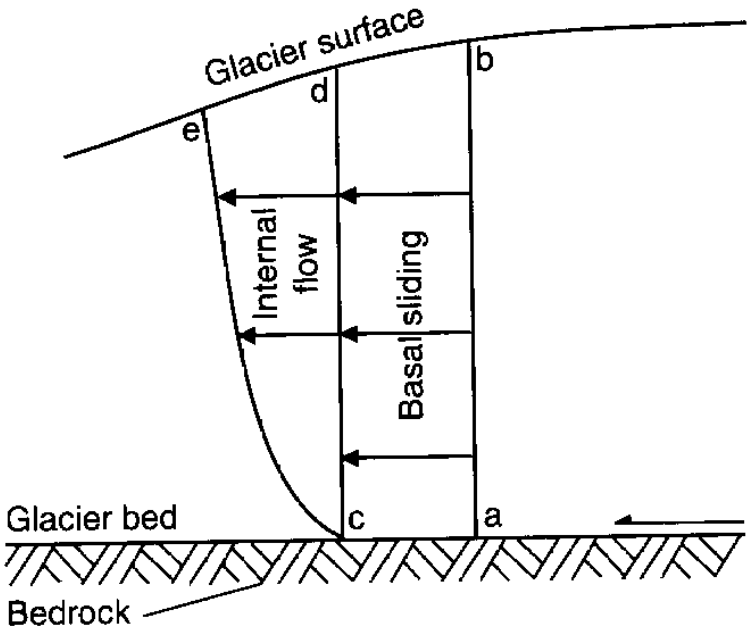


Deposition Erosion Erosion Deposition

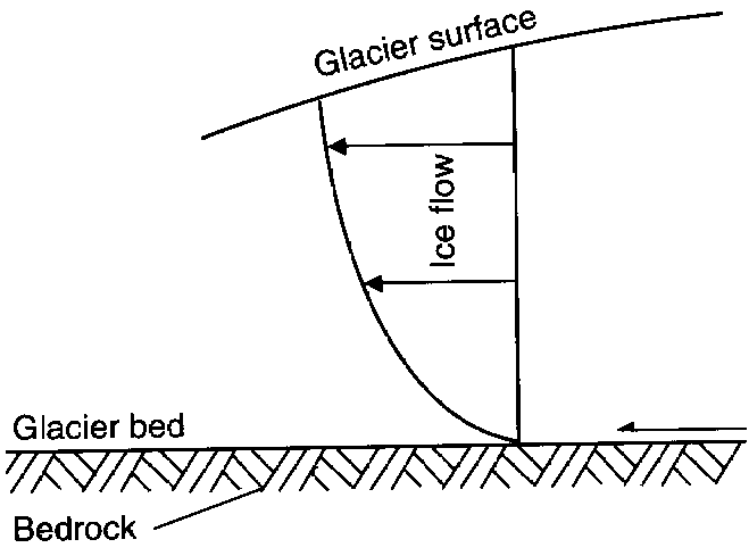

A.
CREVASSE
OUTWASH PLAIN
I C E
ICE TUNNEL
T I L L S H E E T
ICE
B.
TILL PLAIN
DRUMLINS
MARGINAL MORAINE
PITTED OUTWASH PLAIN
CREVASSE FILLING
ESKER
LAKE

Thermal conditions at glacier base important for production of new sediments of glacial origin

A Warm-based glacier resting on bedrock



B Cold-based glacier resting on bedrock



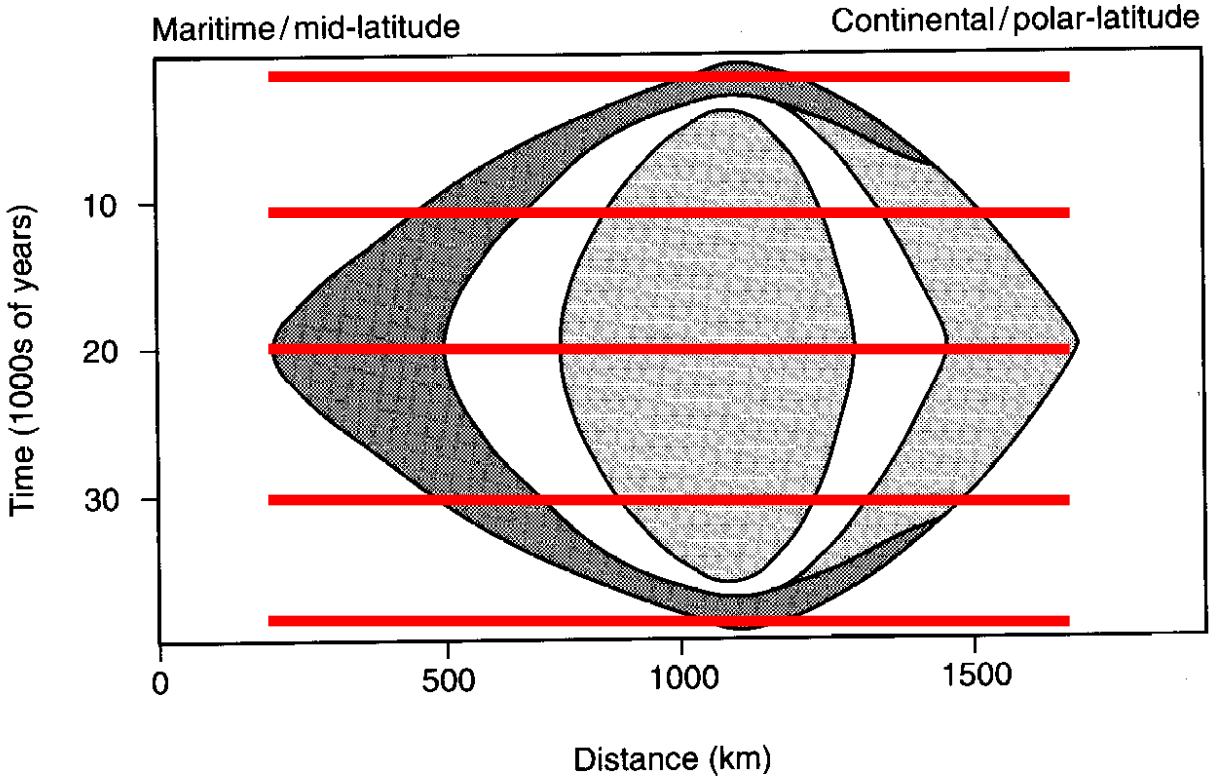
A warm-based glacier, Norway

A cold-based glacier, Austria


Big ice-cored moraine
A cold-based glacier, Norway

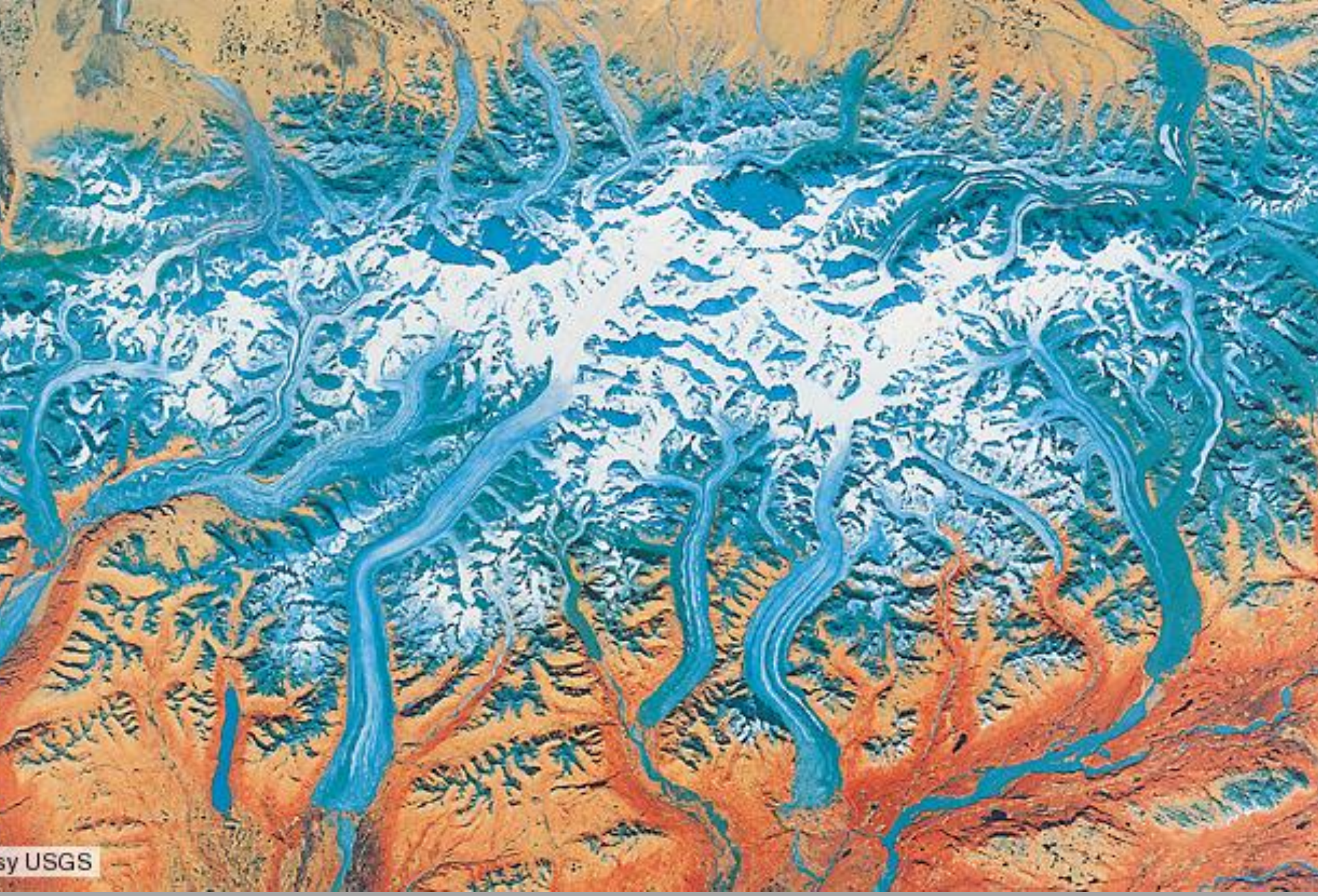
So all thermal glacier types
may be important
when it comes to deposition of sediments

Basal thermal conditioms may change over time, complicating matters

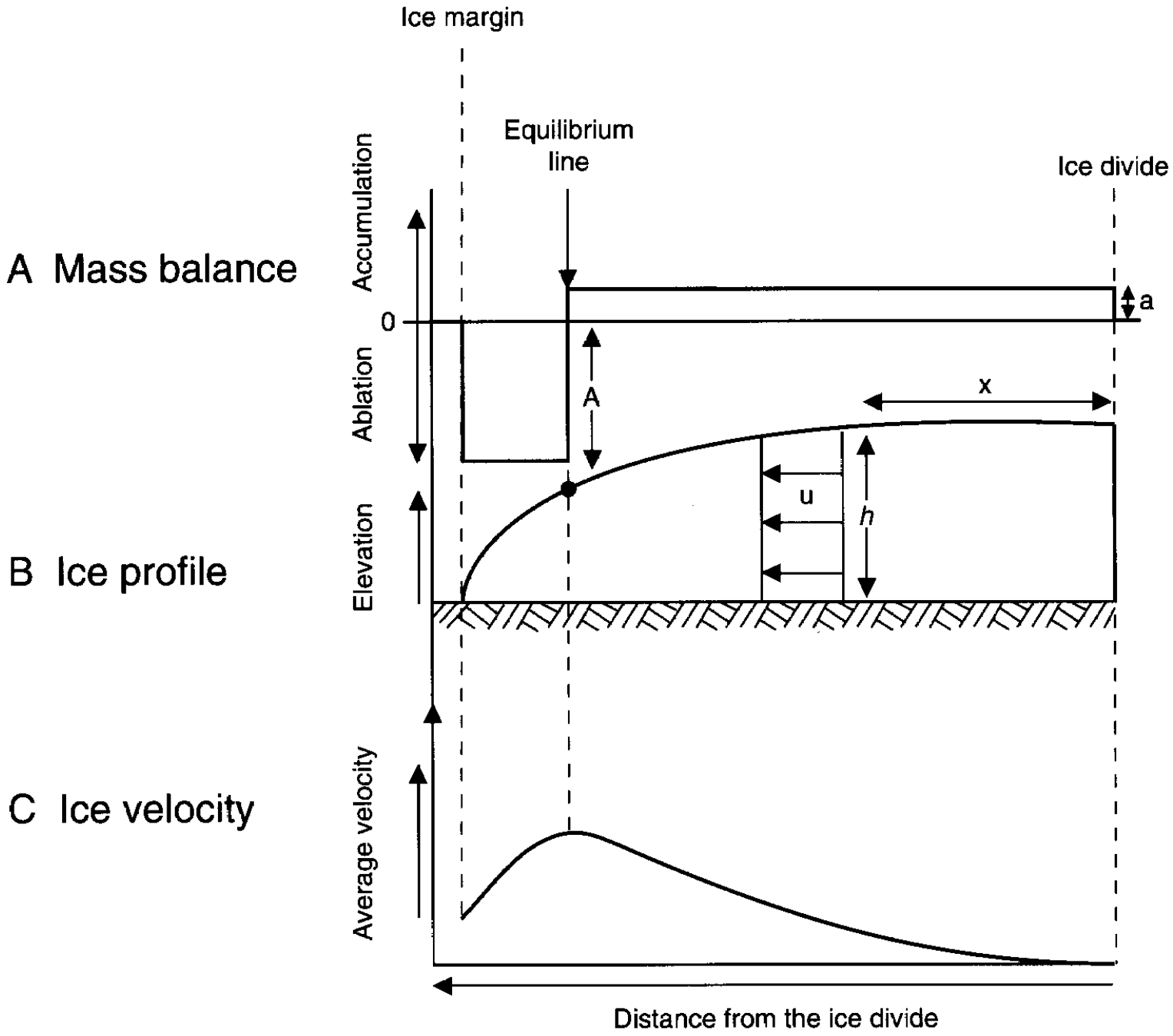


Changes over time for an ice sheet

The glacier mass balance

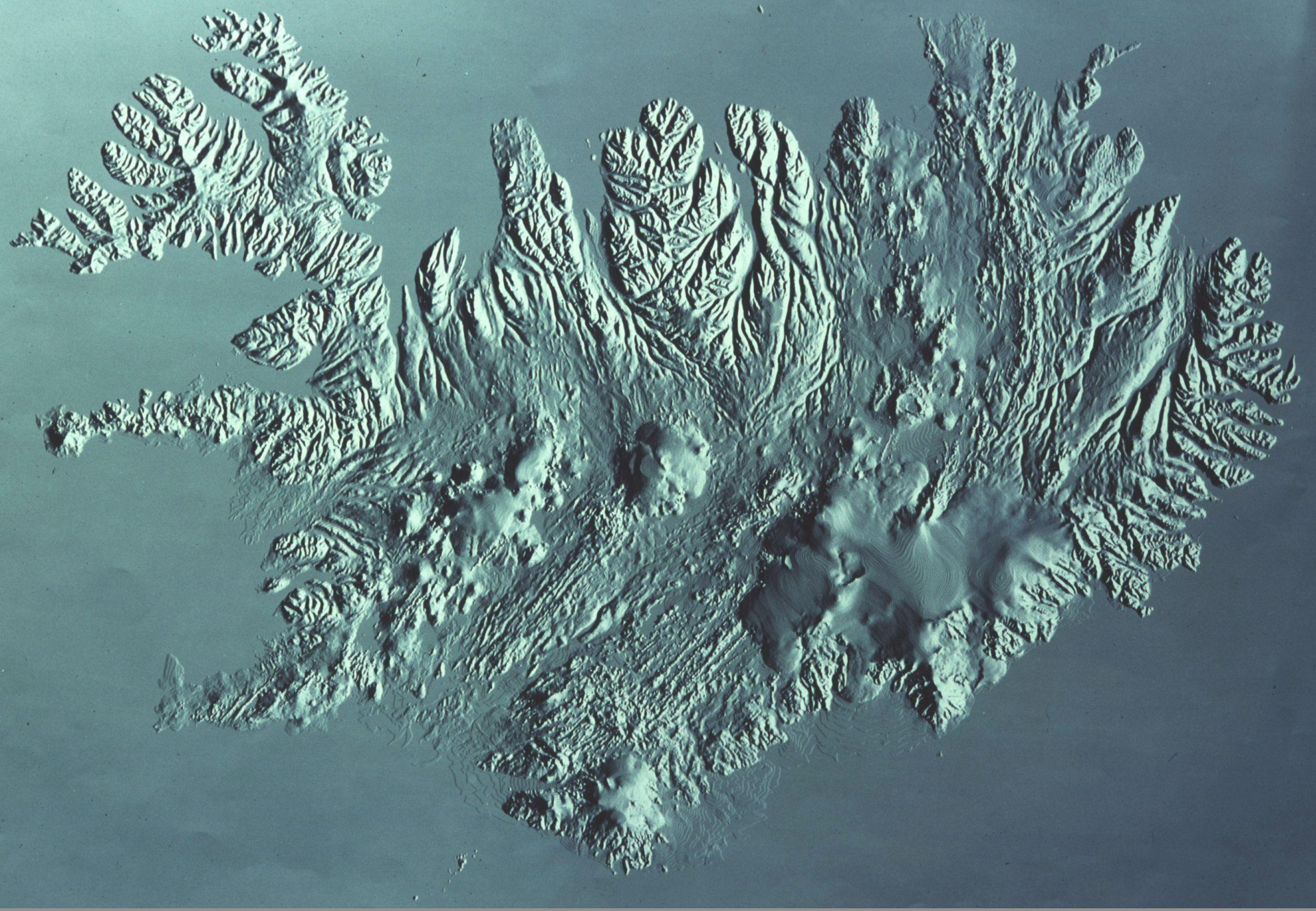


Highest velocity near ELA

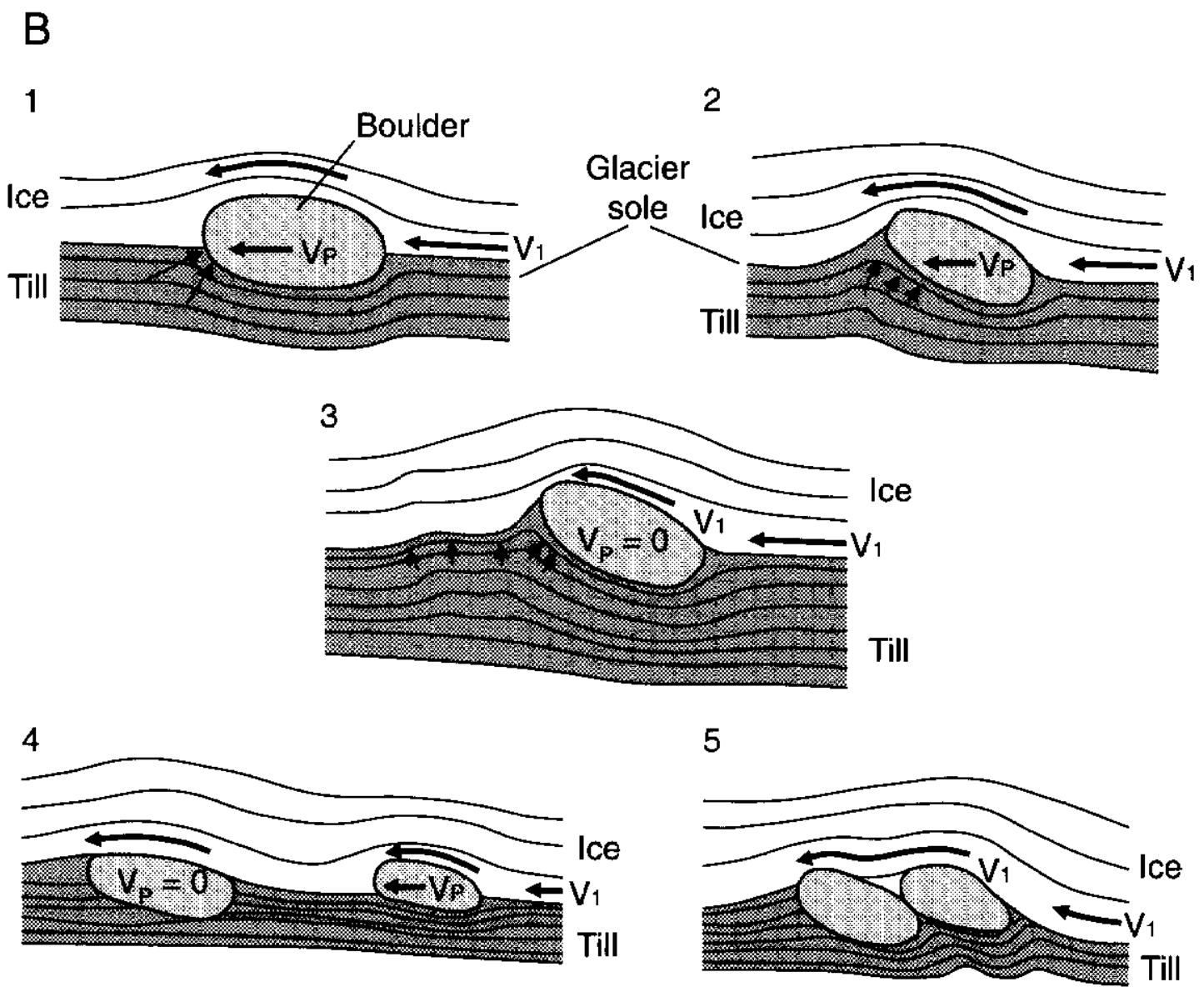

A Mass balance
B Ice profile
C Ice velocity
Ice margin
Equilibrium line
Ice divide
Accumulation
0
Ablation
a
A
x
u
h
Elevation
Average velocity
Distance from the ice divide

Rule of thumb:
Deposition mainly below ELA

Glacial deposition at the glacier bed: Some basic processes



Warm-based glaciers because of climate and geothermal heat flow


B
1
Boulder
Ice
Till
V_P
V_1
Glacier sole
2
Ice
Till
V_P
V_1
3
Ice
V_1
$V_P = 0$
V_1
Till
4
$V_P = 0$
V_P
Ice
V_1
Till
5
V_1
Ice
V_1
Till

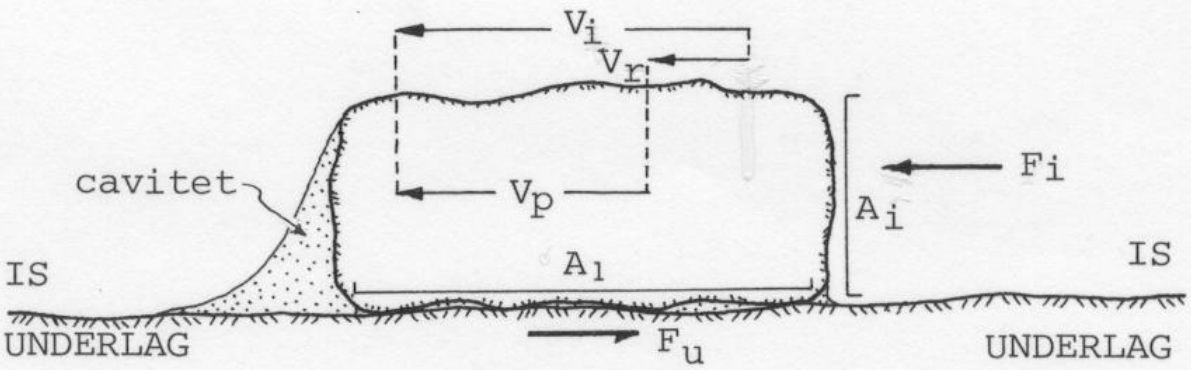
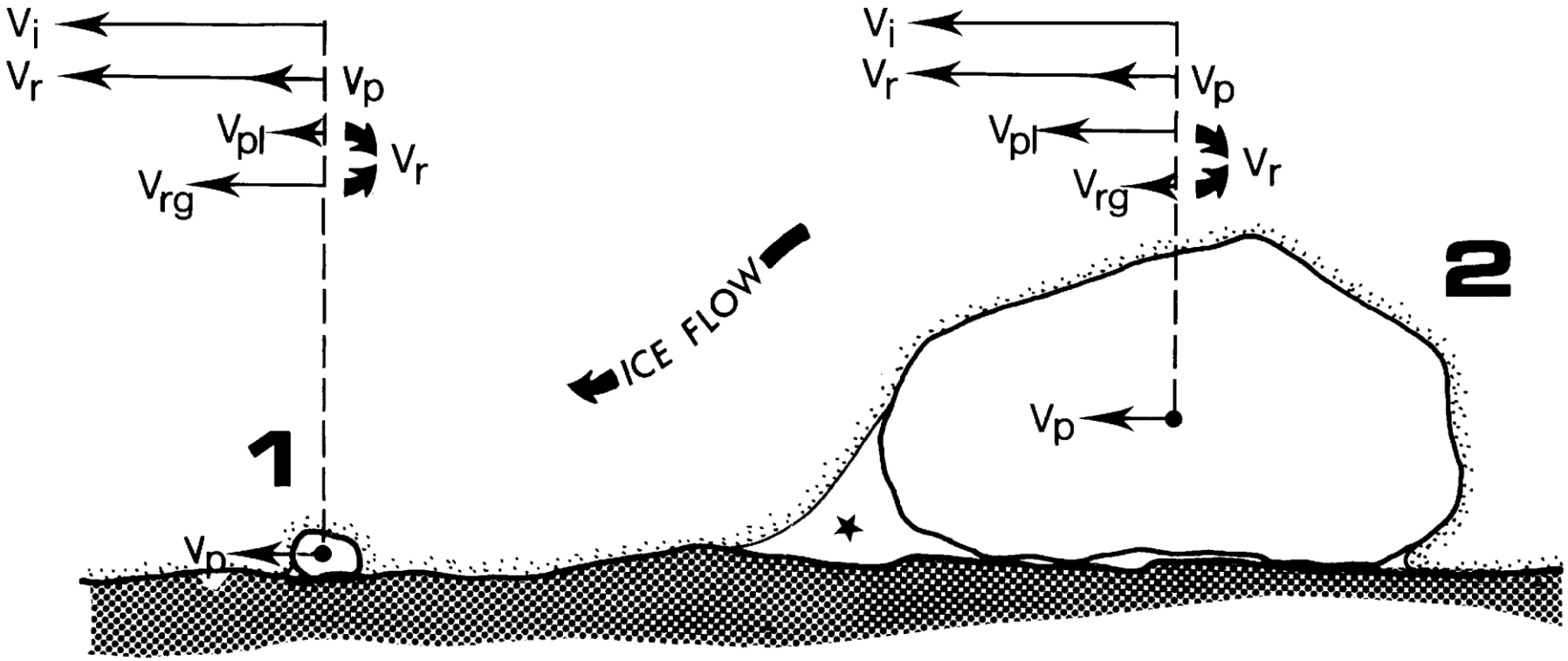
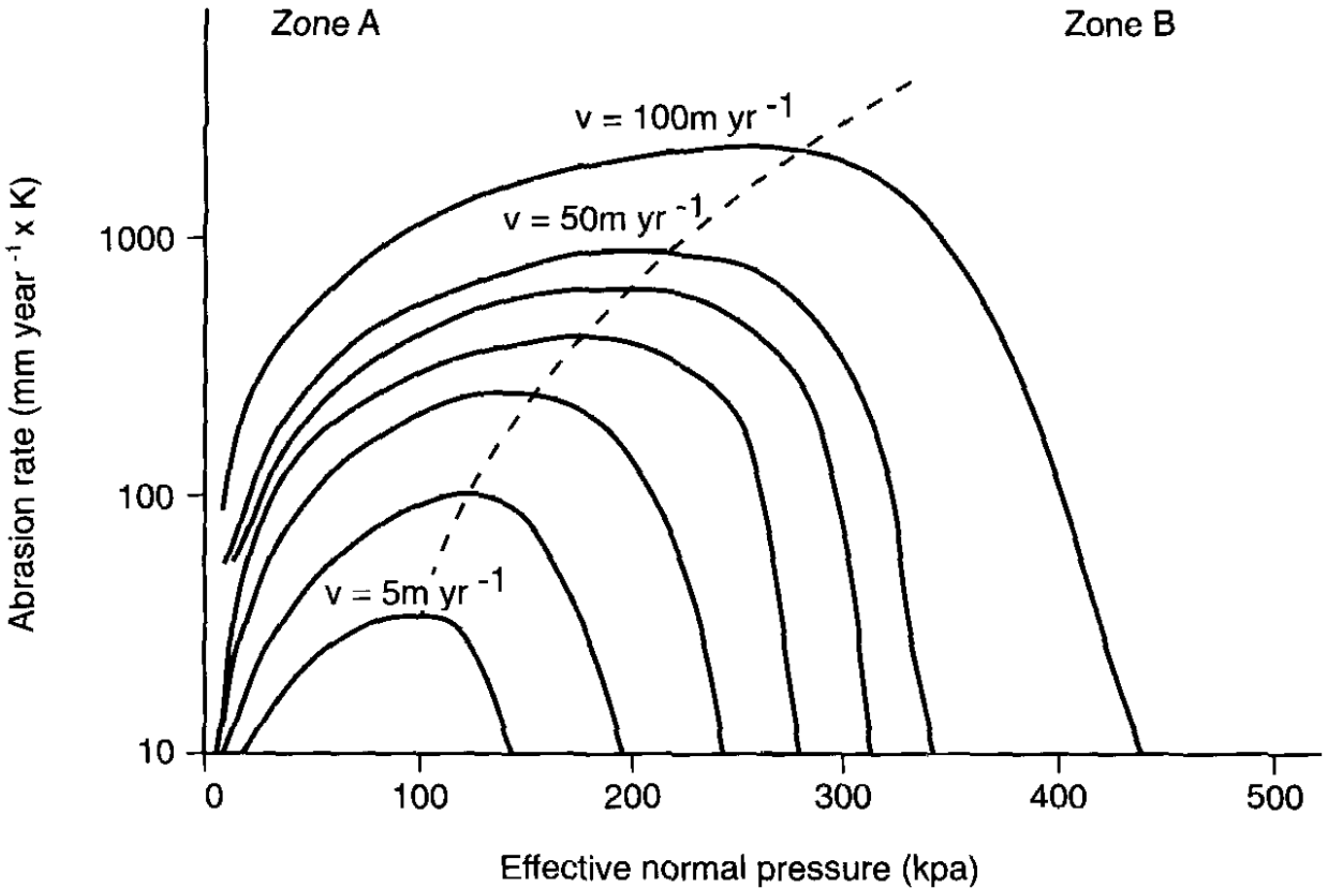
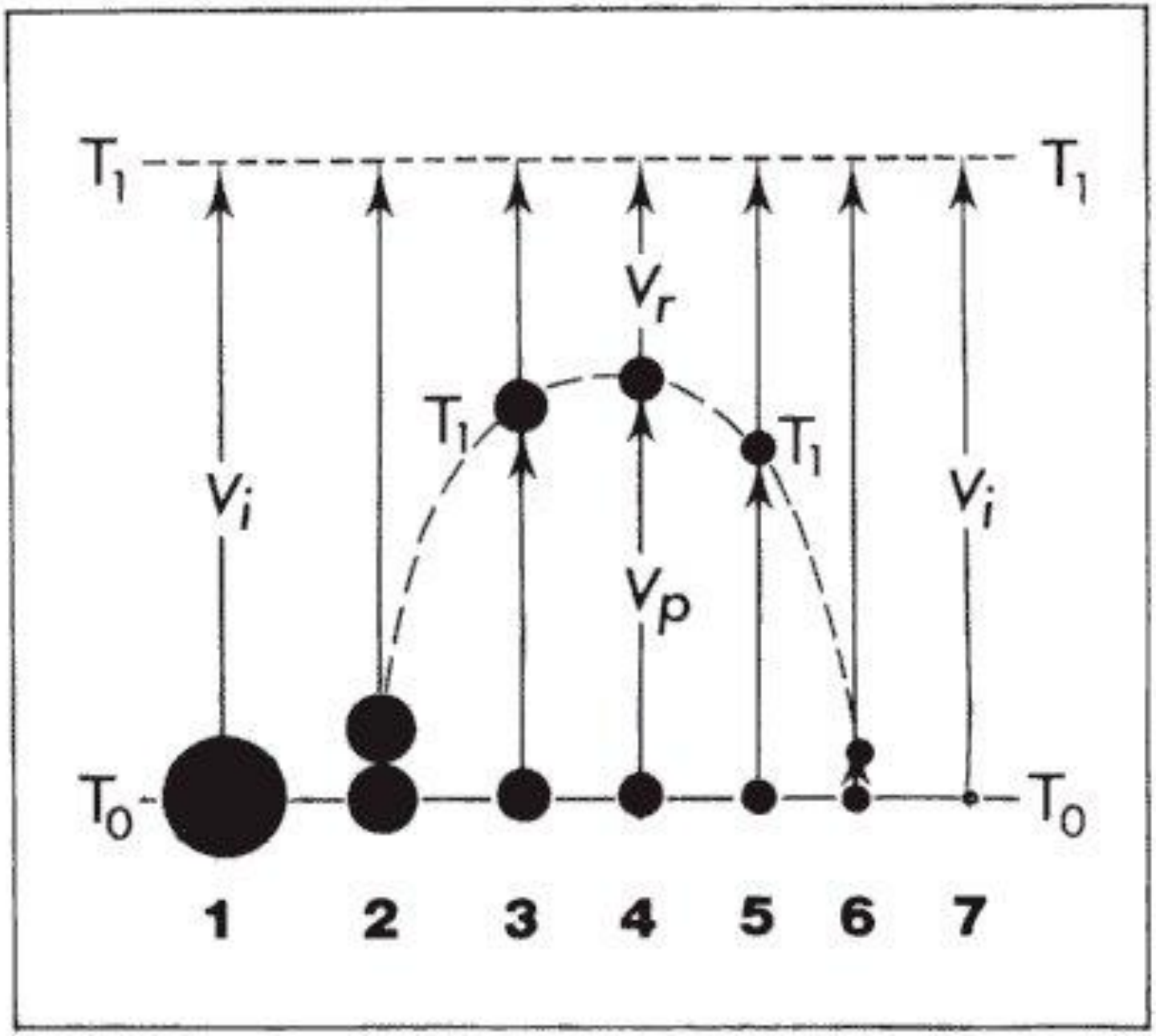


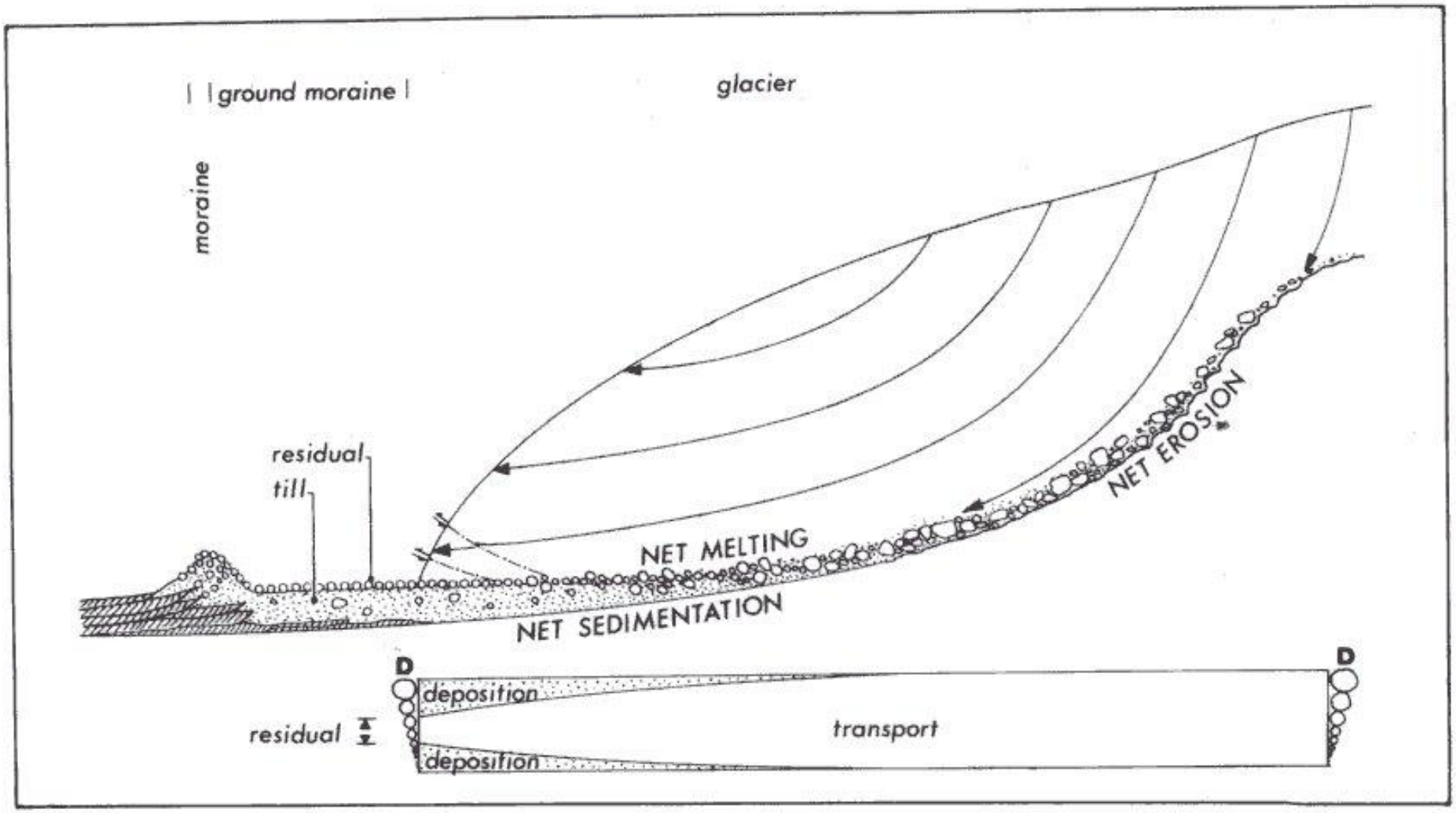
Fig.3.16. Partikel i basal transport og i kontakt med gletscherunderlaget. Gletscheren søger at skubbe partiklen mod venstre med kraften F_i, mens friktionen mellem partikel og underlag vanskeliggør bevægelsen mod venstre med kraften F_u. Gletscherisen bevæger sig mod venstre med hastigheden V_i, partiklen med hastigheden V_p. Hastighedsforskellen mellem partikel og is betegnes V_r ($V_r = V_i - V_p$).

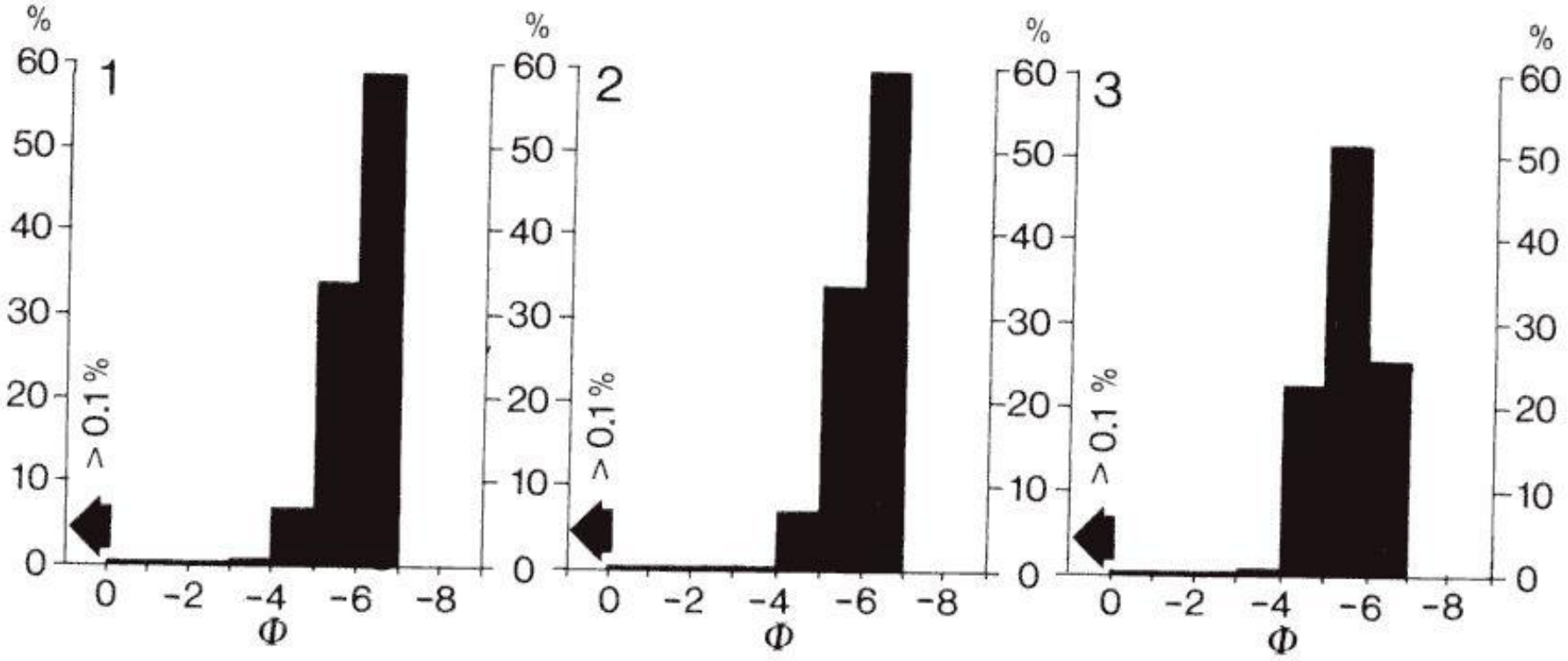
Humlum, 1980


V_i
V_r
V_p
V_{pl}
V_r
V_{rg}
ICE FLOW
1
V_p
V_i
V_r
V_p
V_{pl}
V_r
V_{rg}
2
V_p


Zone A
Zone B
v = 100m yr -1
v = 50m yr -1
v = 5m yr -1
1000
100
10
0
100
200
300
400
500
Abrasion rate (mm year -1 x K)
Effective normal pressure (kpa)

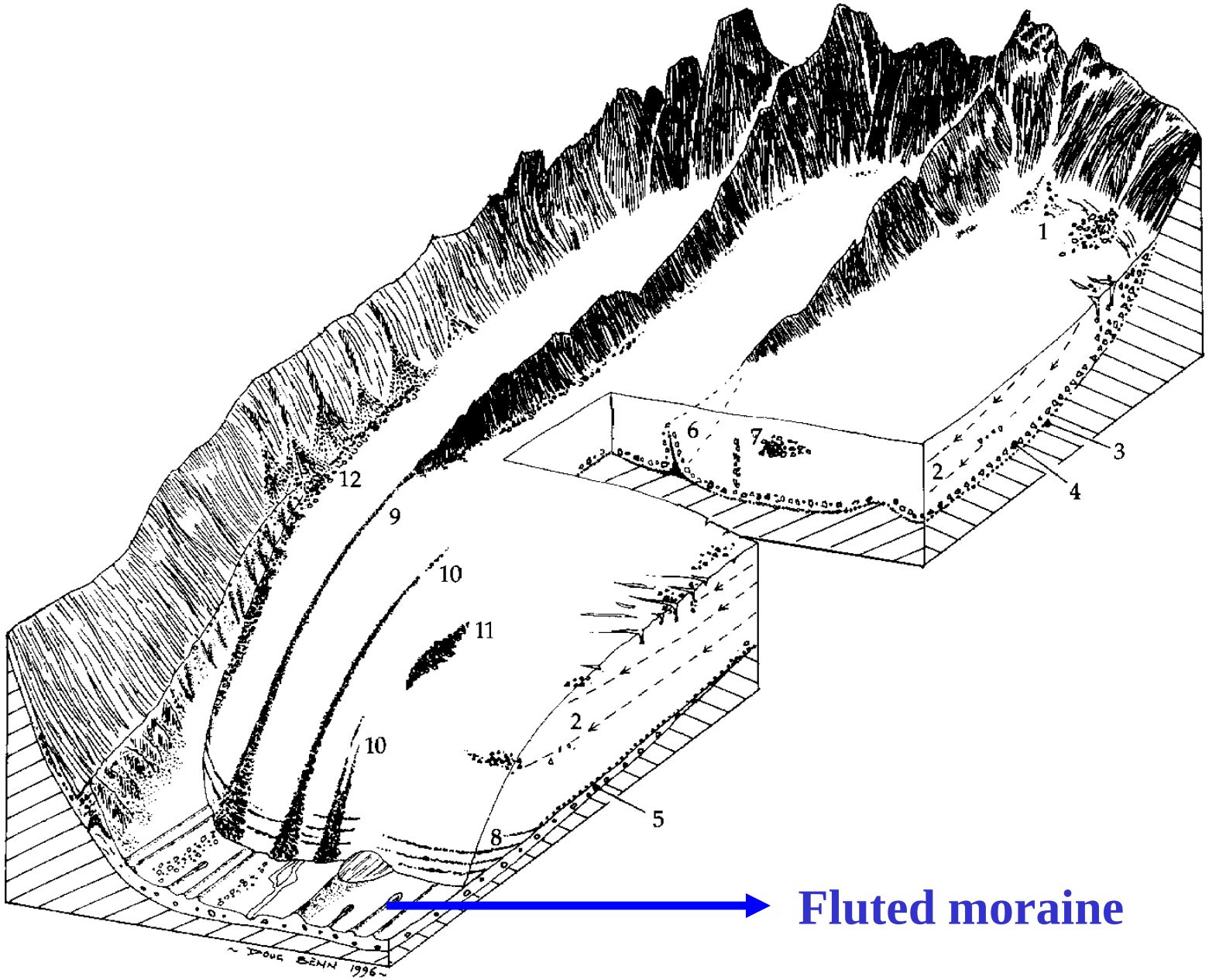

T1
T1
Vr
T1
T1
Vi
Vi
Vp
T0
T0
1
2
3
4
5
6
7

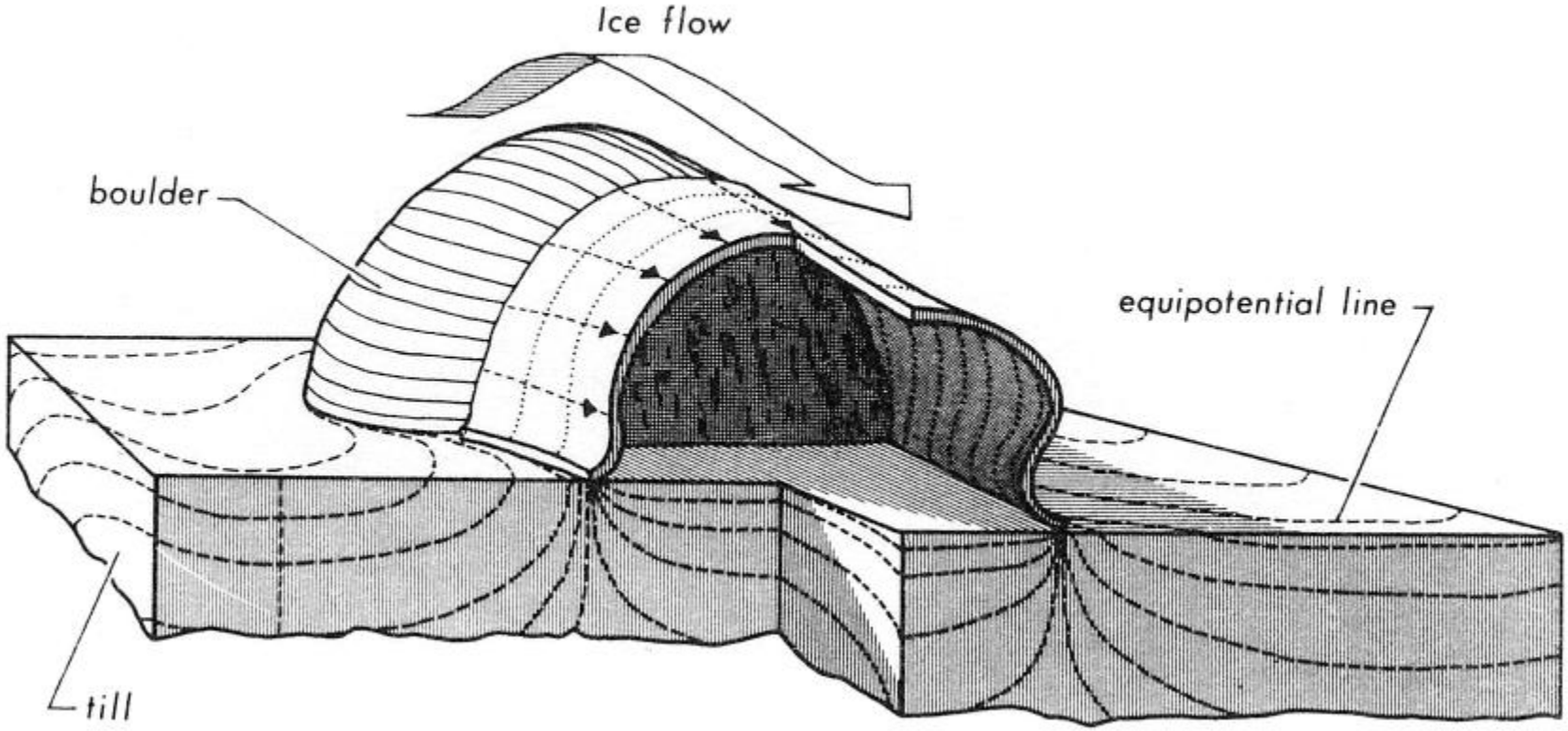

ground moraine
glacier
moraine
residual till
NET MELTING
NET EROSION
NET SEDIMENTATION
D
D
deposition
transport
deposition
residual


%
60
50
40
30
20
10
0
1
> 0.1 %
0 -2 -4 -6 -8
Φ
2
3

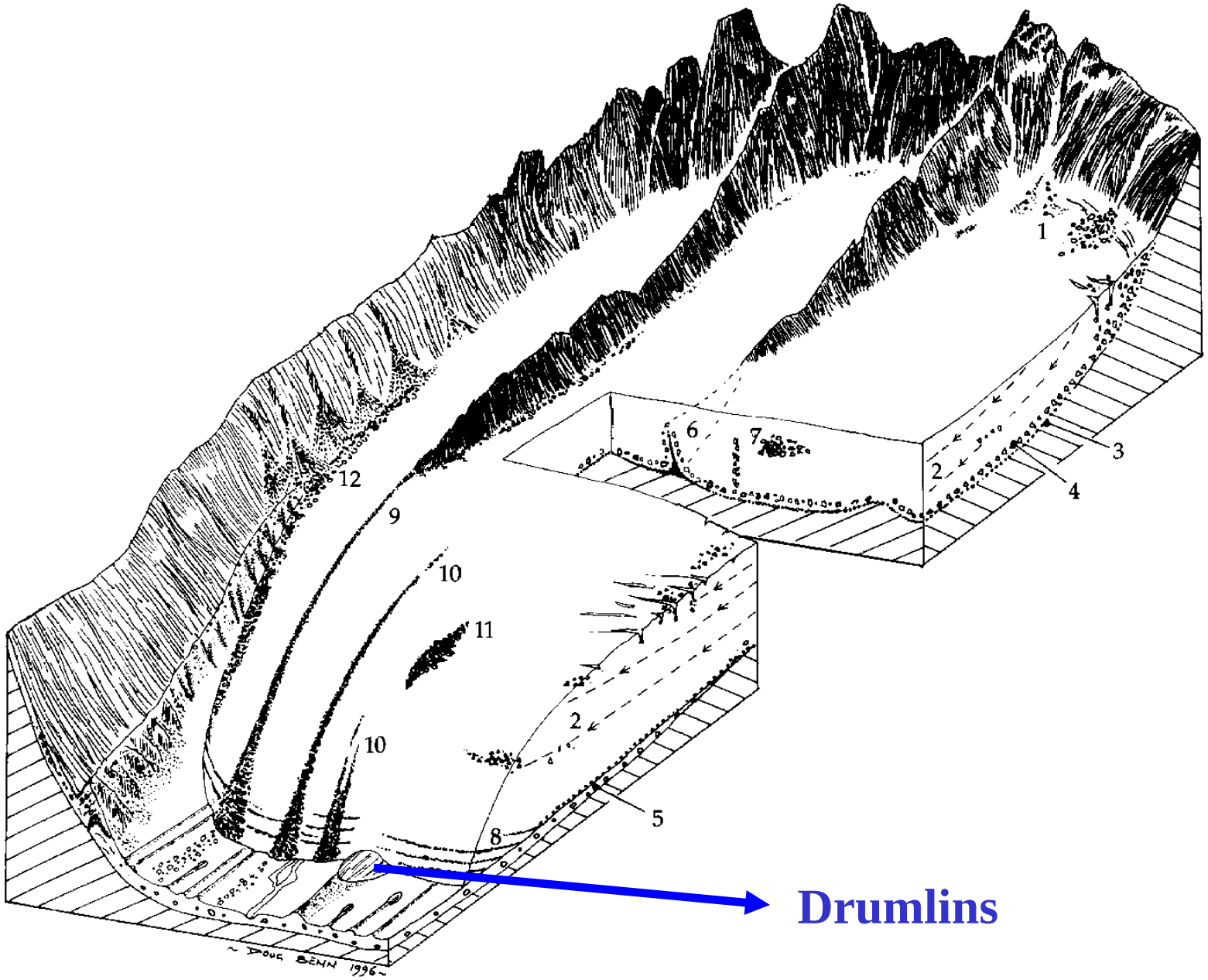
Some subglacial processes leading to specific landforms

Fluted moraine


1
2
3
4
5
6
7
8
9
10
10
11
12
~ Doug Benn 1996 ~
Fluted moraine


Ice flow
boulder
equipotential line
till

Drumlins


1
2
3
4
5
6
7
8
9
10
10
11
12
Drumlins