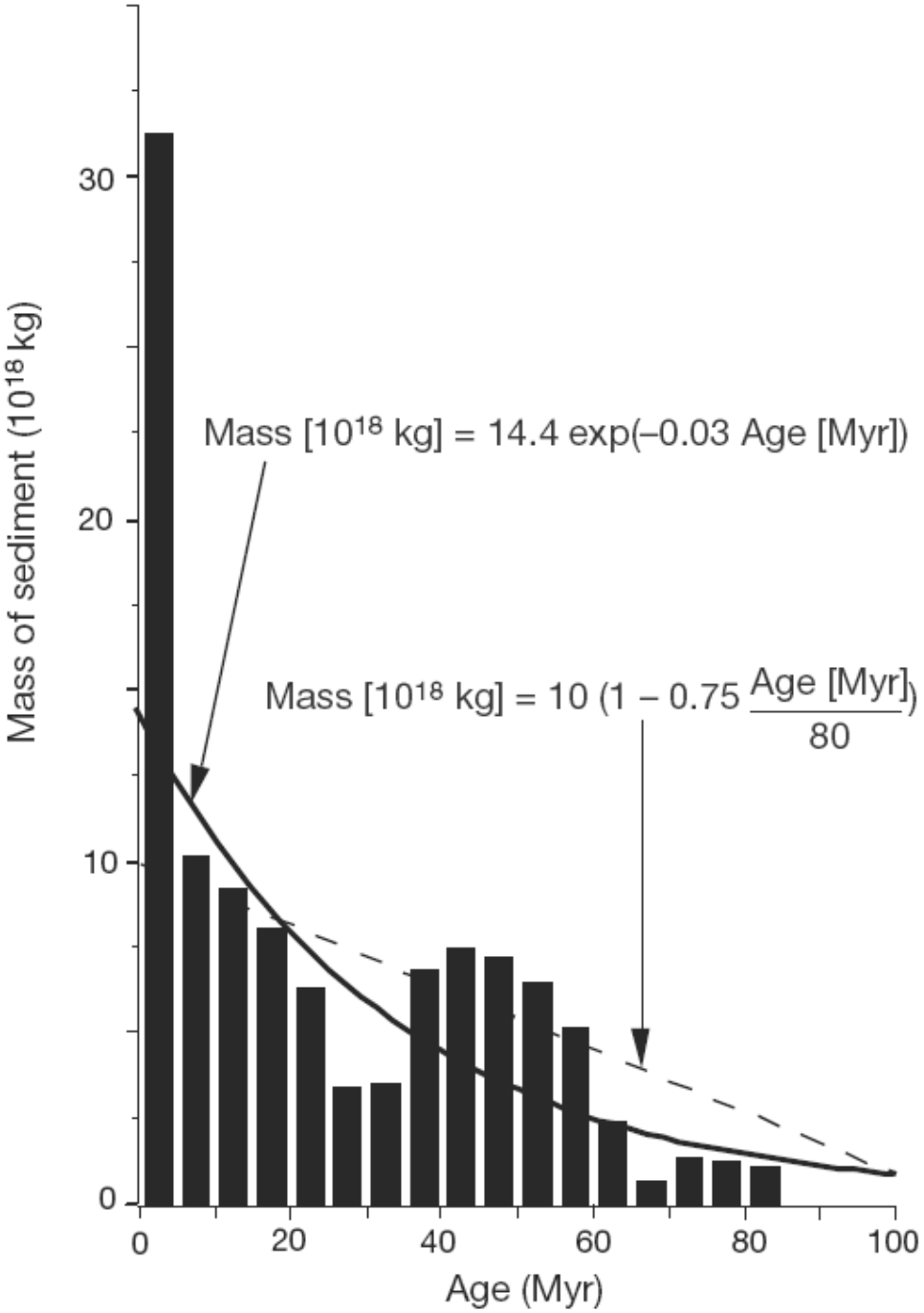
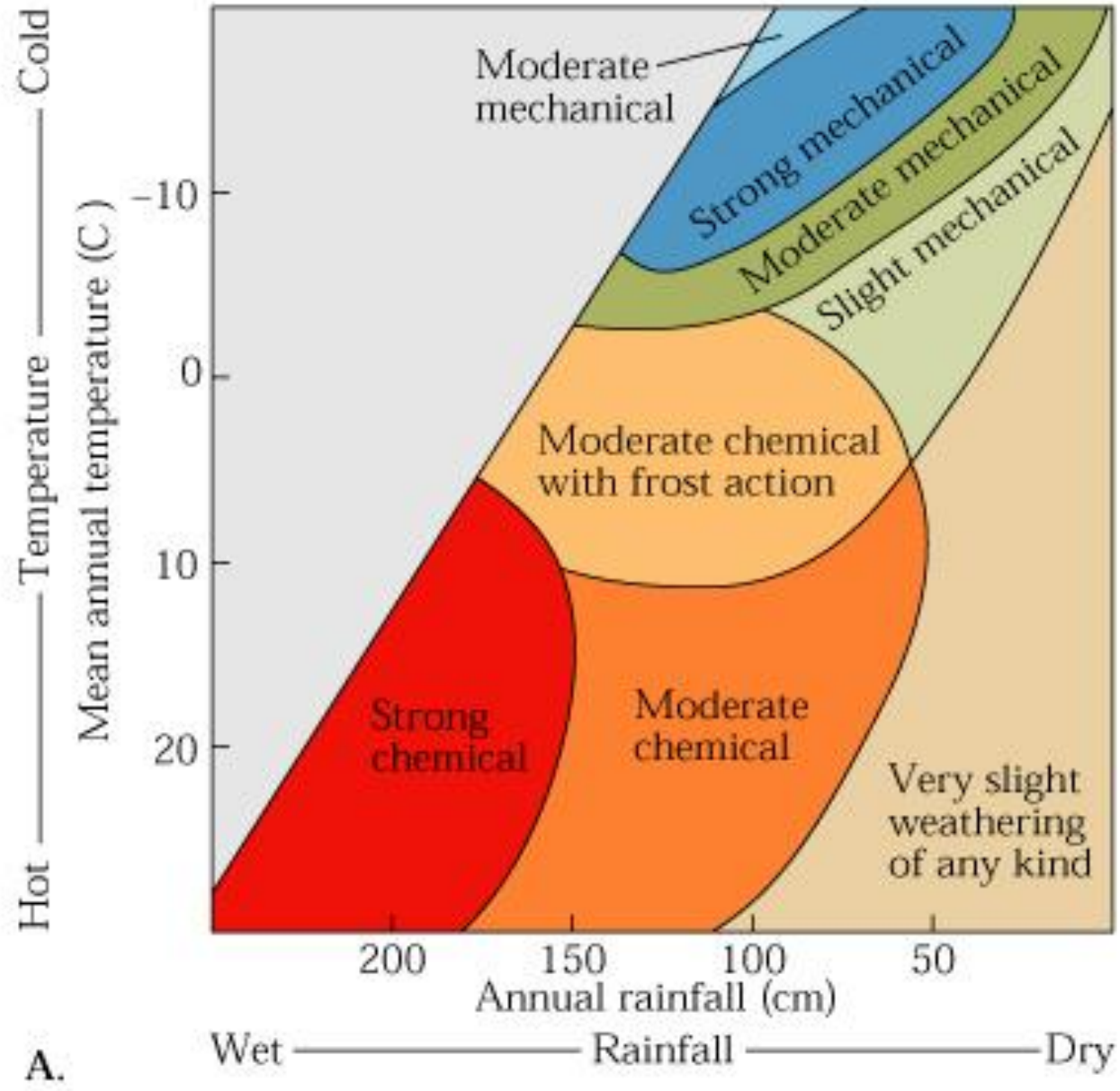

Bedrock weathering

Bedrock weathering:
The mother of all sediments


Mass of sediment (10^{18} kg)
30
20
10
0
Mass [10^{18} kg] = 14.4 exp(–0.03 Age [Myr])
Mass [10^{18} kg] = 10 (1 – 0.75 $\frac{\text{Age [Myr]}}{80}$)
0
20
40
60
80
100
Age (Myr)



A.

Mechanical weathering important in cold climate regions

Mechanical weathering

Mechanical weathering, Iceland

Mechanical weathering, Linnevannet, Svalbard


Free rock face, LairigGhru, Scotland

Talus, Panorama Mountain, AlaskaRange, GeorgeParksHighway, Alaska

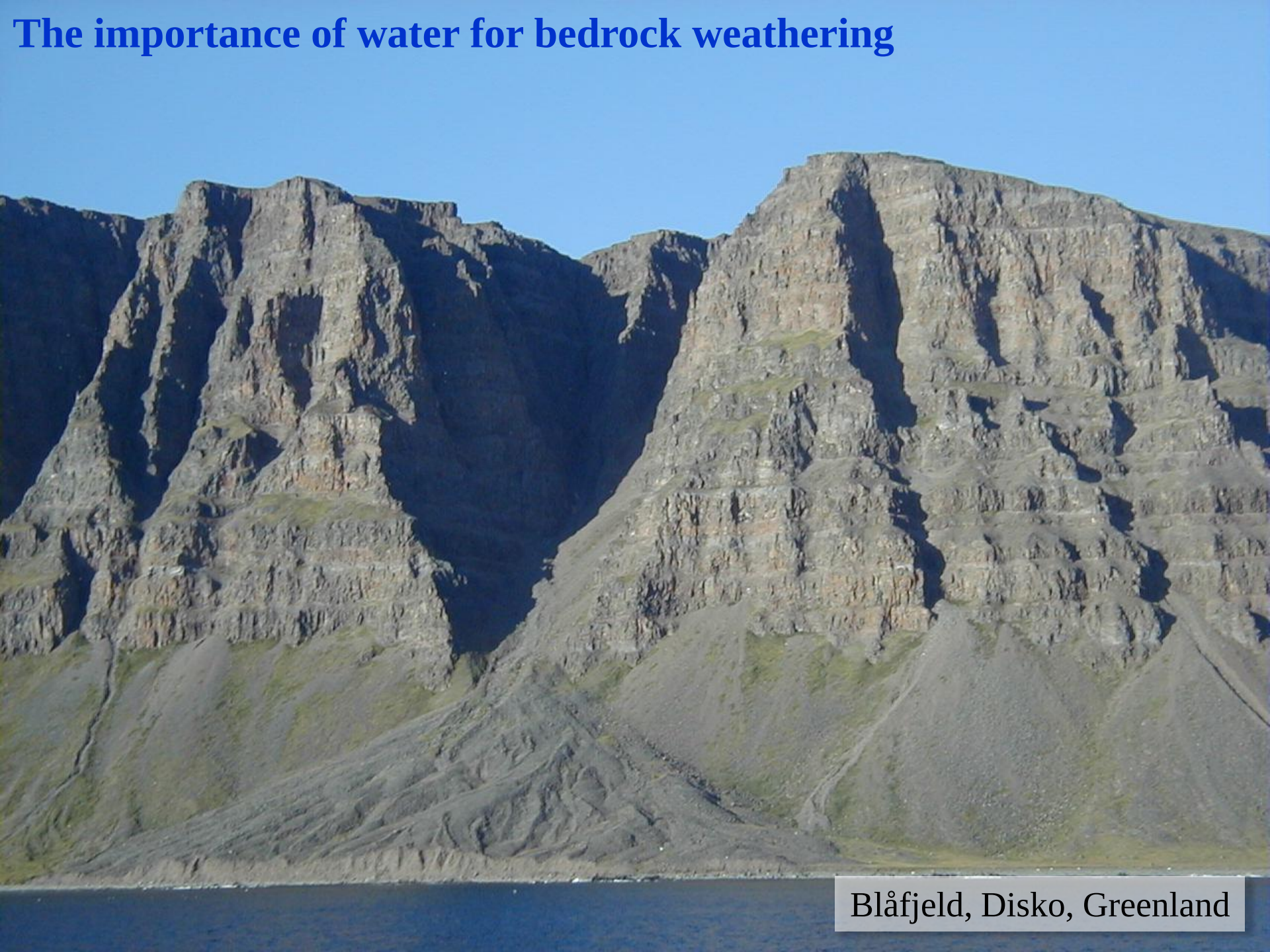
Talus, Bjørnapynten, Svalbard

Talus, LairigGhru, Scotland

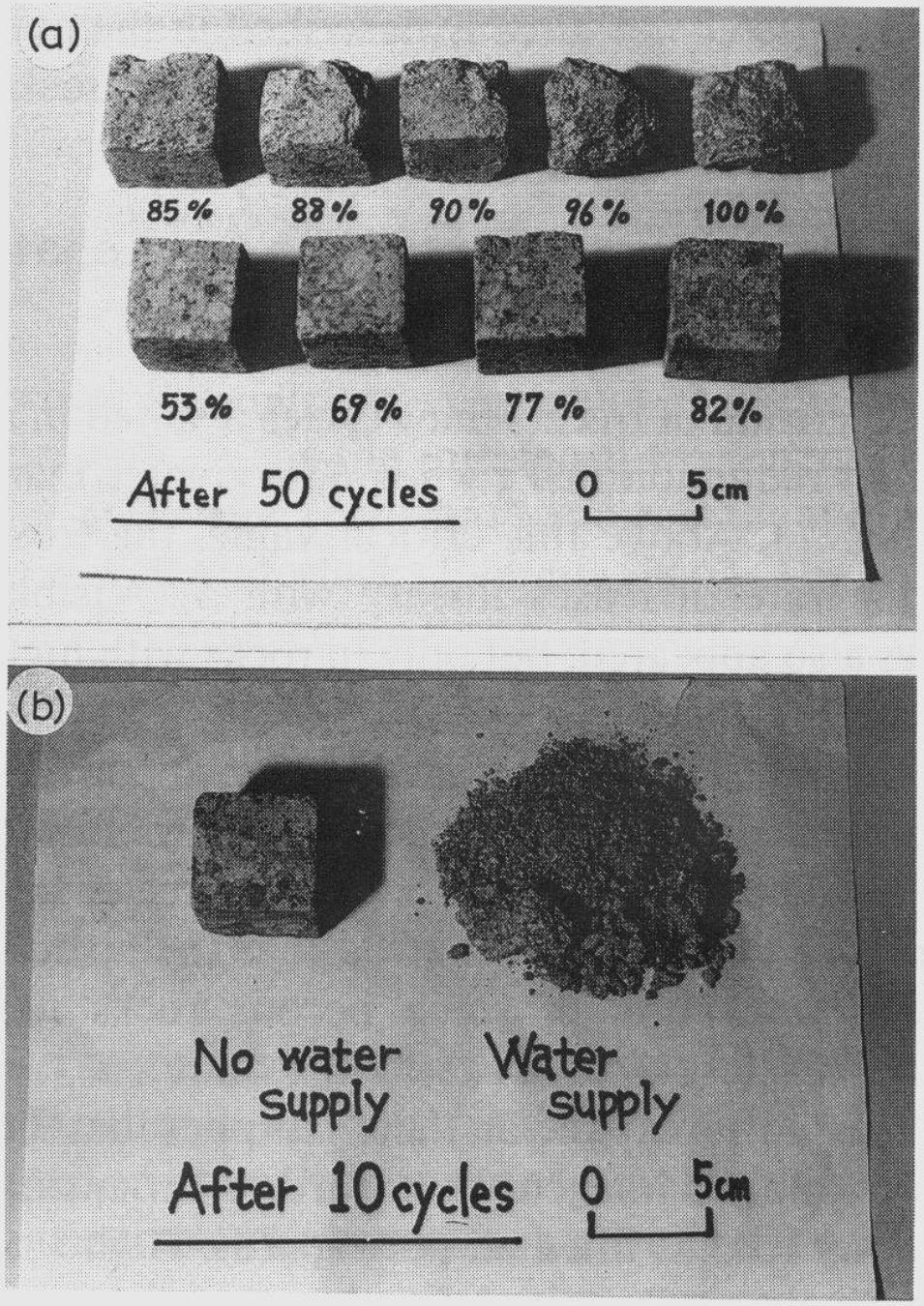
Talus, Endalen, Svalbard

Mechanical weathering processes

The importance of water for bedrock weathering



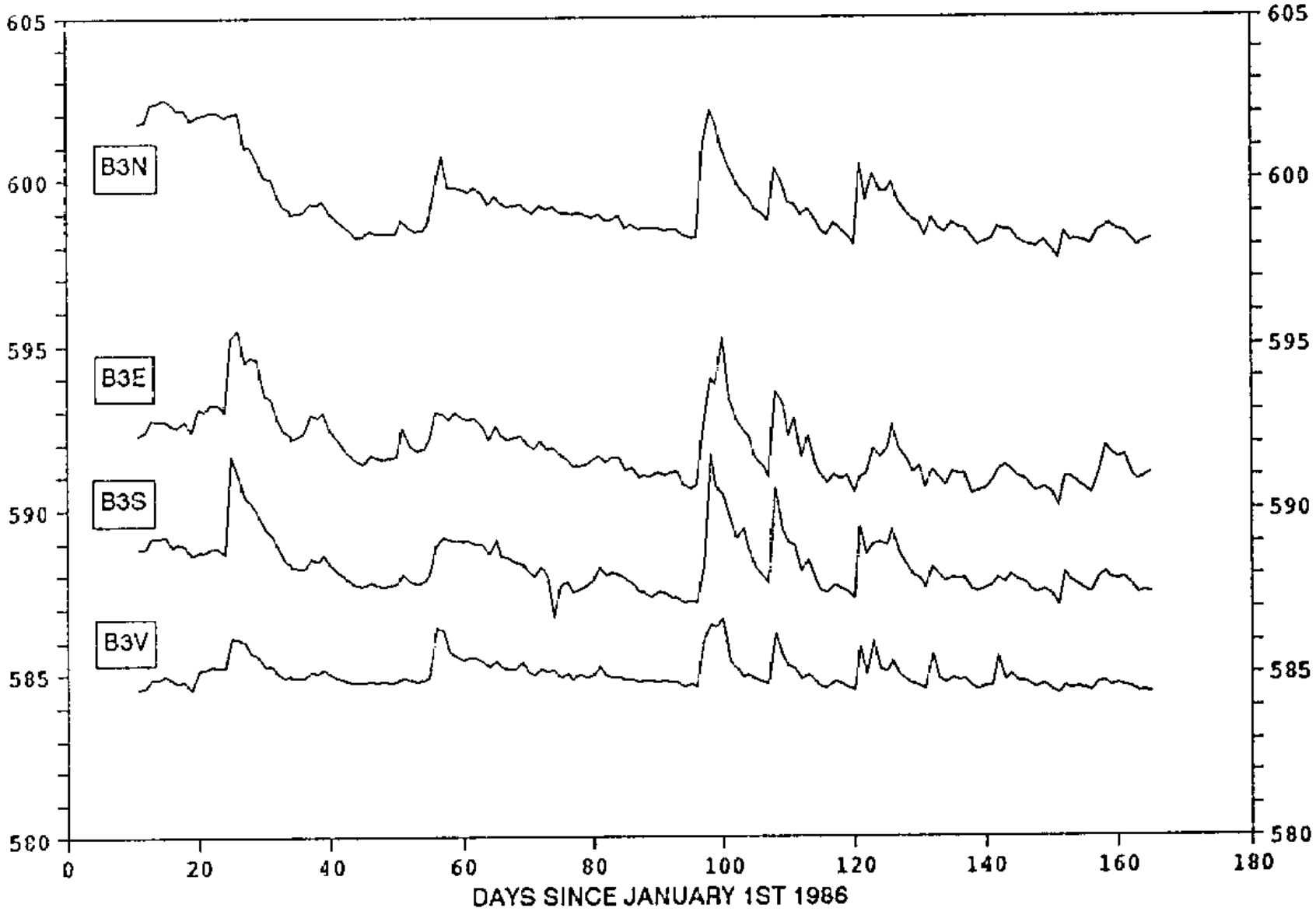
Blåfjeld, Disko, Greenland

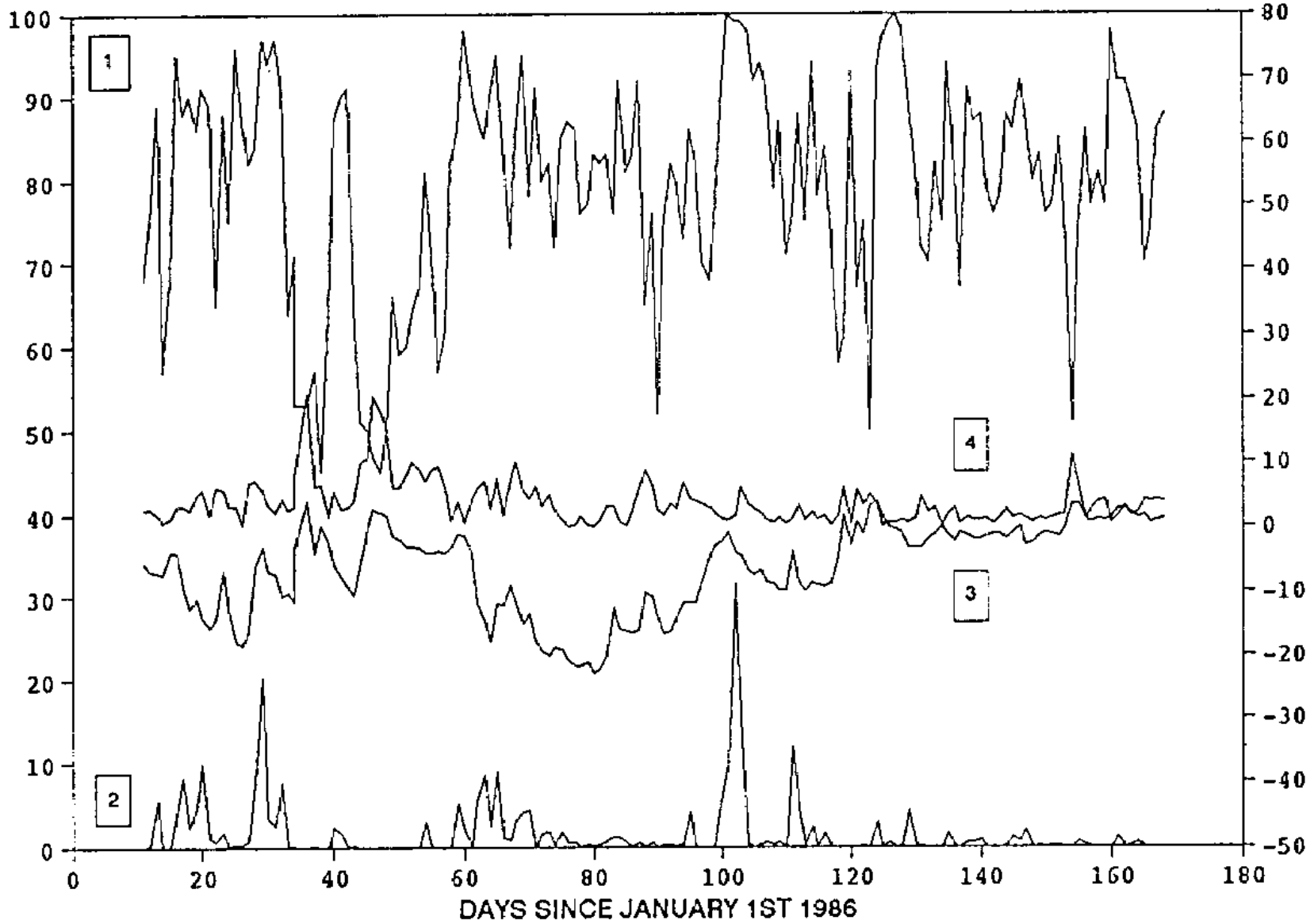

(a)
85 %
88 %
90 %
96 %
100 %
53 %
69 %
77 %
82 %
After 50 cycles
0
5cm
(b)
No water supply
Water supply
After 10 cycles
0
5cm

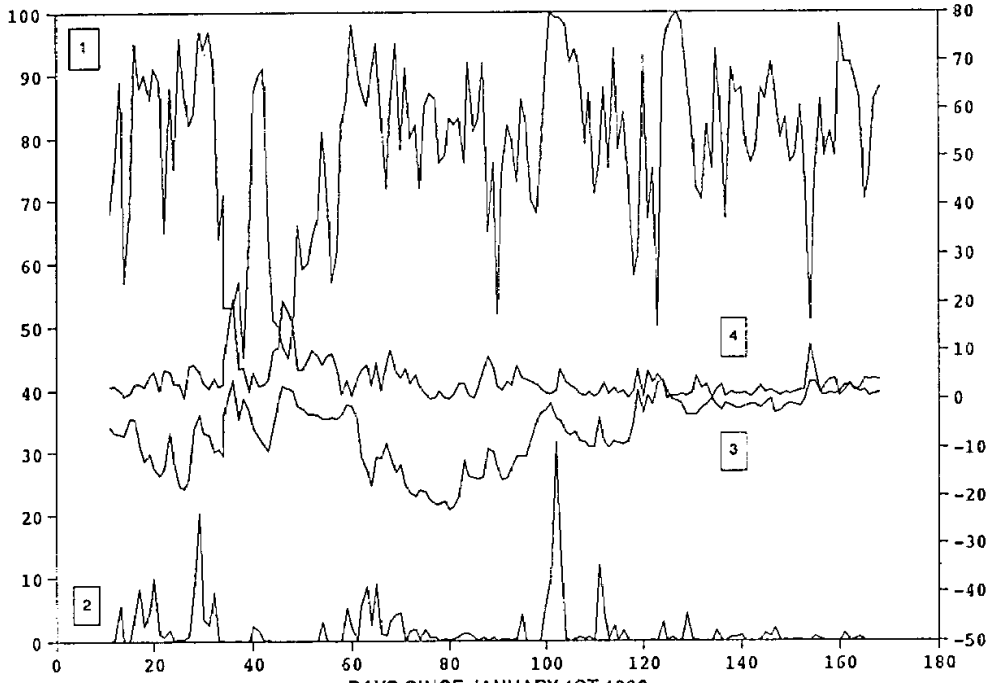
Arctic Station, Disko Island, Greenland

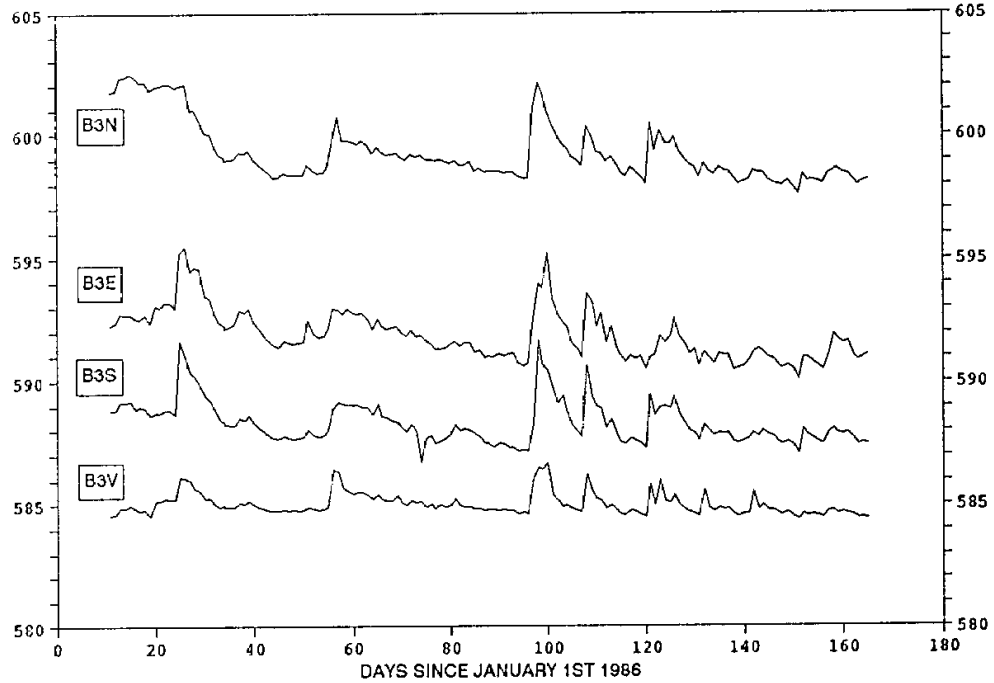
Siggu, Disko Island, Greenland

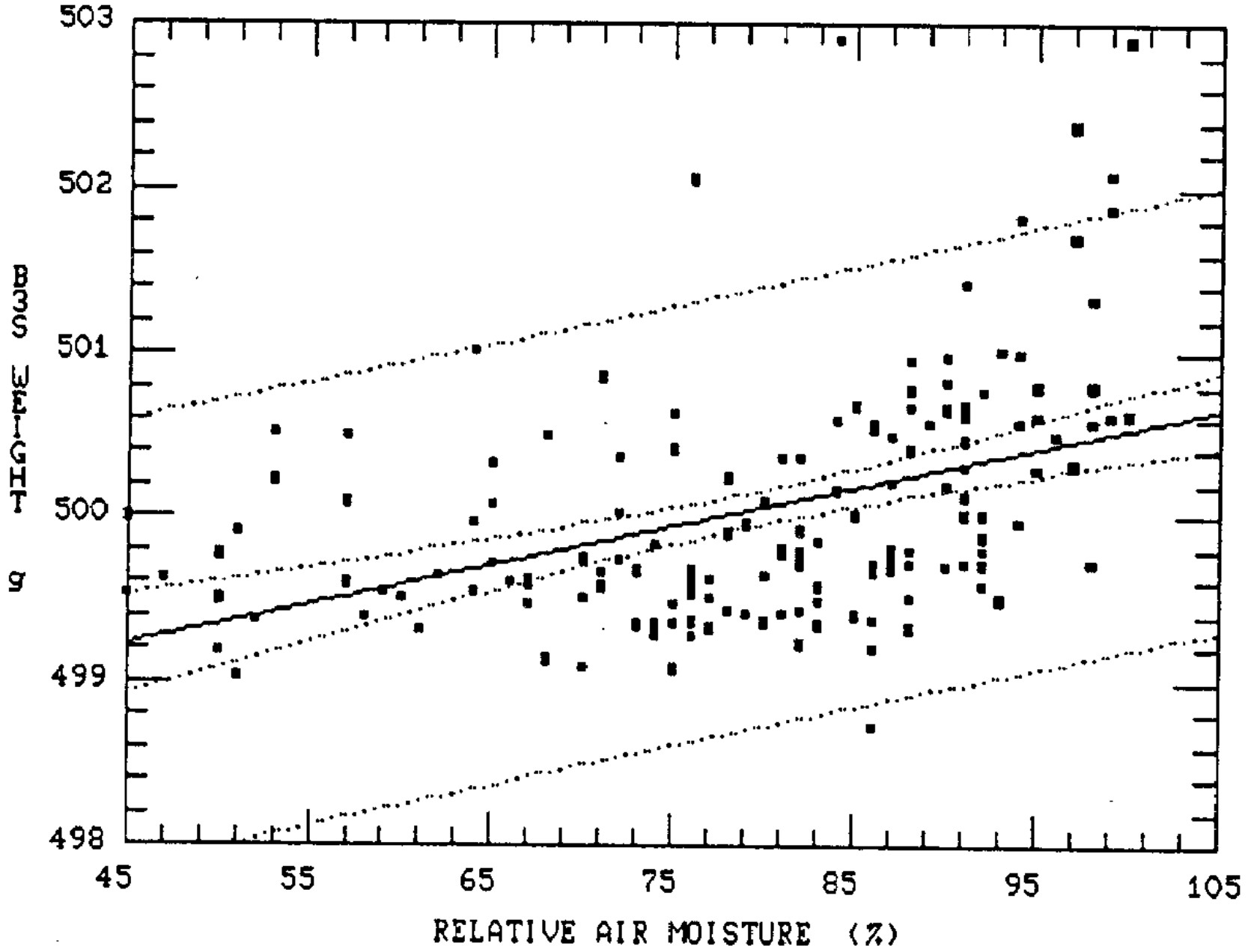

B3N


B3N
B3E
B3S
B3V
605
600
595
590
585
580
0
20
40
60
80
100
120
140
160
180
DAYS SINCE JANUARY 1ST 1986


100
90
80
70
60
50
40
30
20
10
0
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
0
20
40
60
80
100
120
140
160
180
1
2
3
4
DAYS SINCE JANUARY 1ST 1986

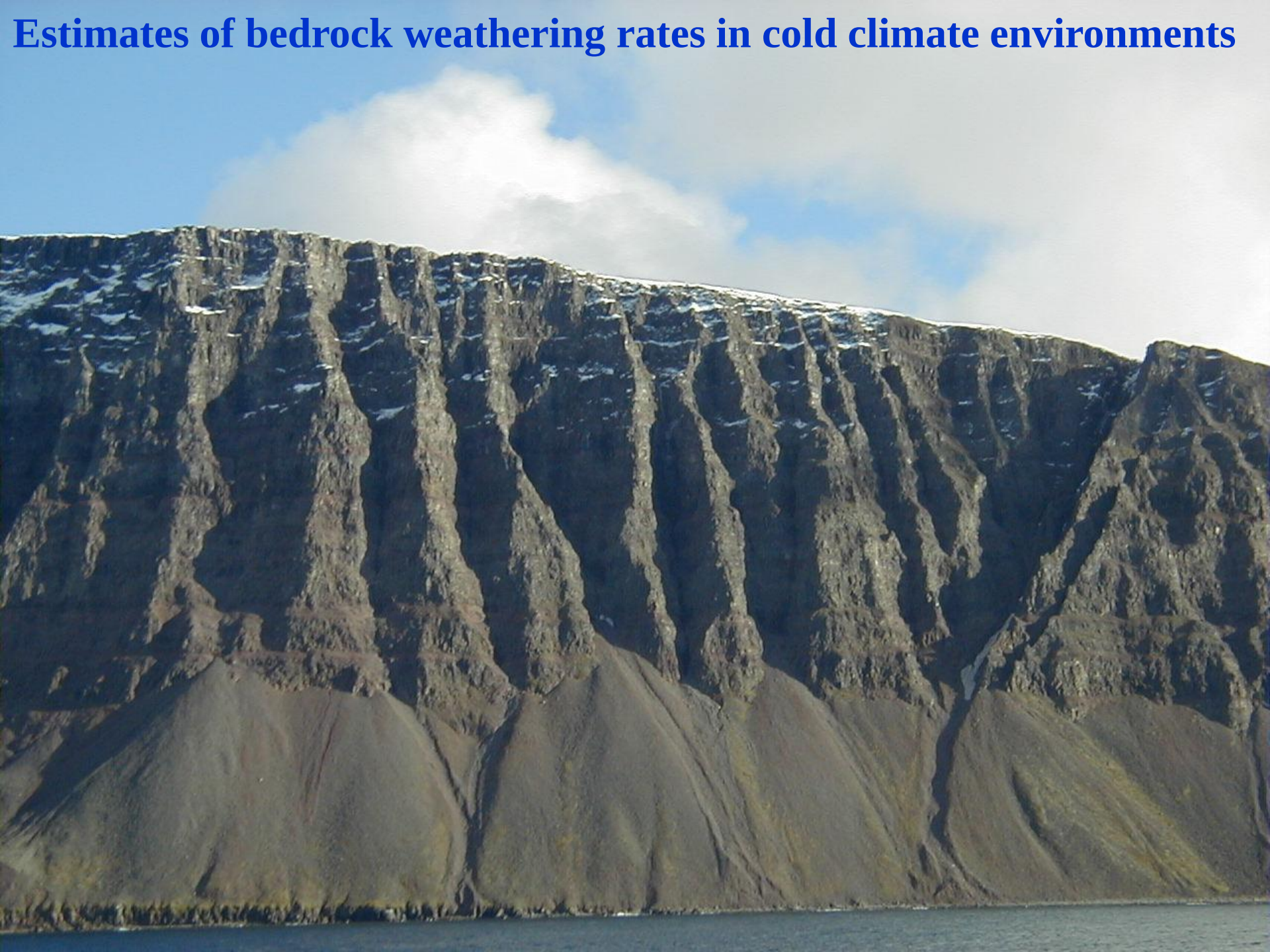

1
2
3
4
100
90
80
70
60
50
40
30
20
10
0
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
0
20
40
60
80
100
120
140
160
180

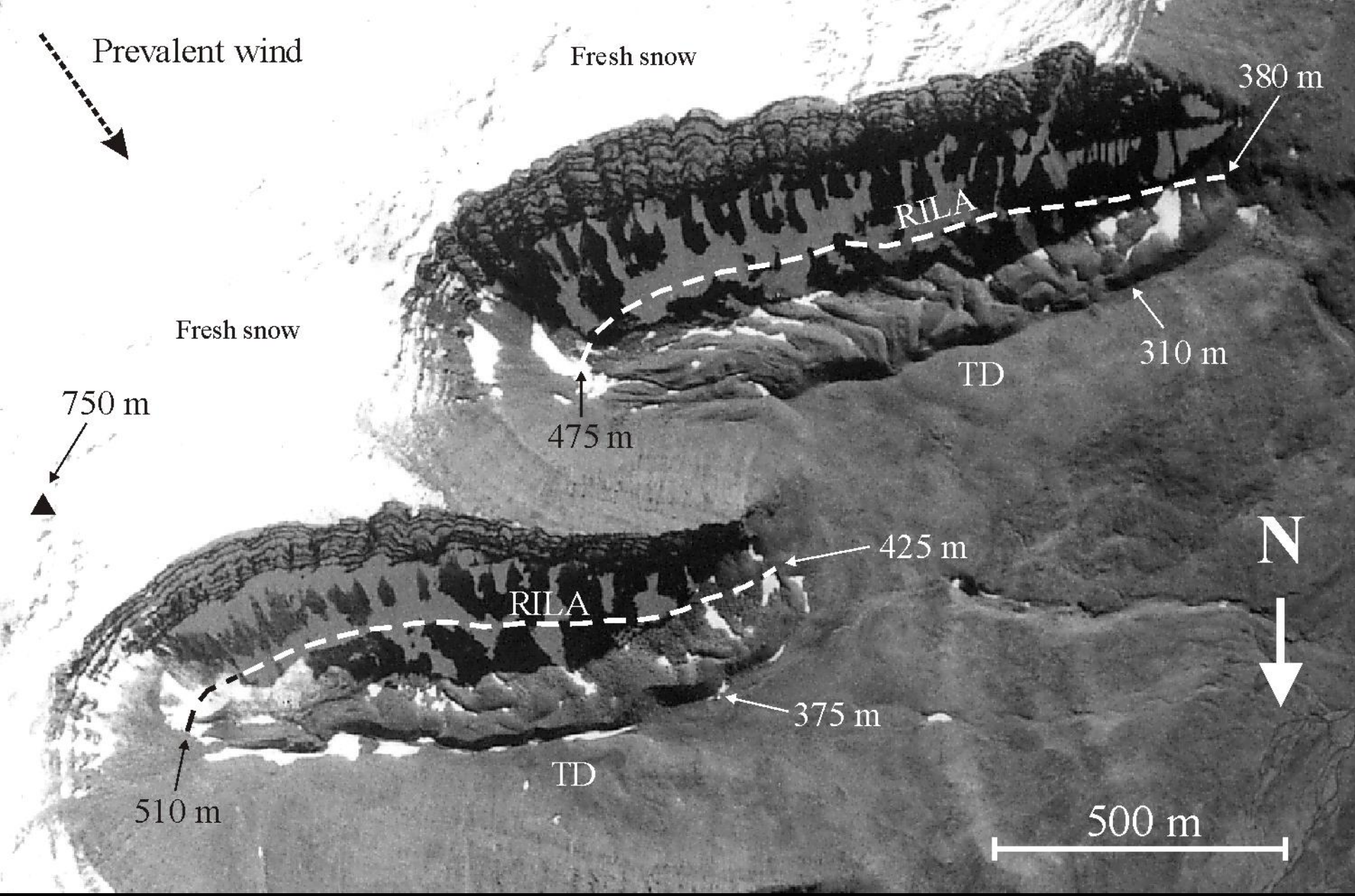

B3N
B3E
B3S
B3V
605
600
595
590
585
580
0
20
40
60
80
100
120
140
160
180
DAYS SINCE JANUARY 1ST 1986

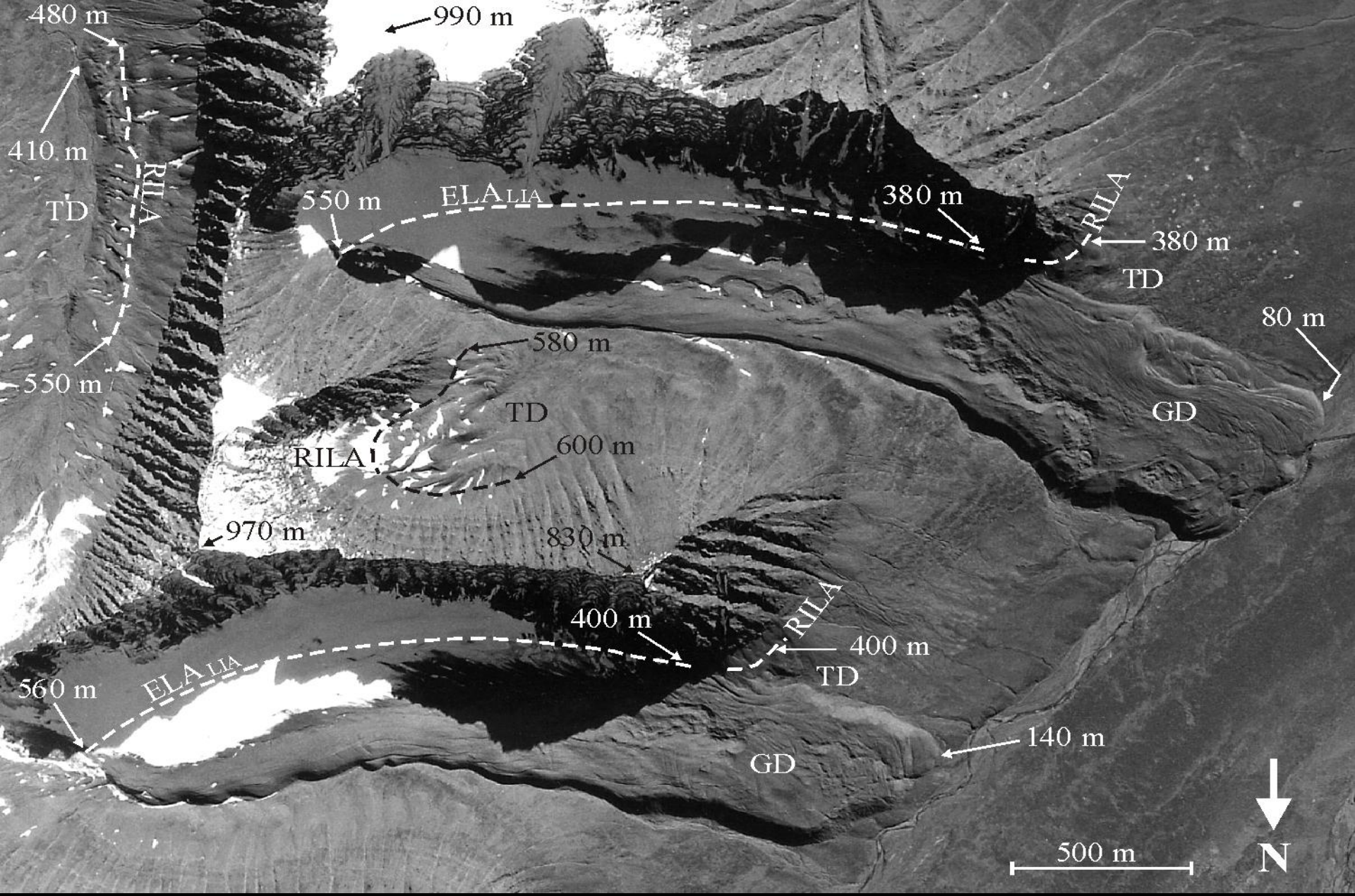

503
502
501
500
499
498
45
55
65
75
85
95
105
RELATIVE AIR MOISTURE (%)

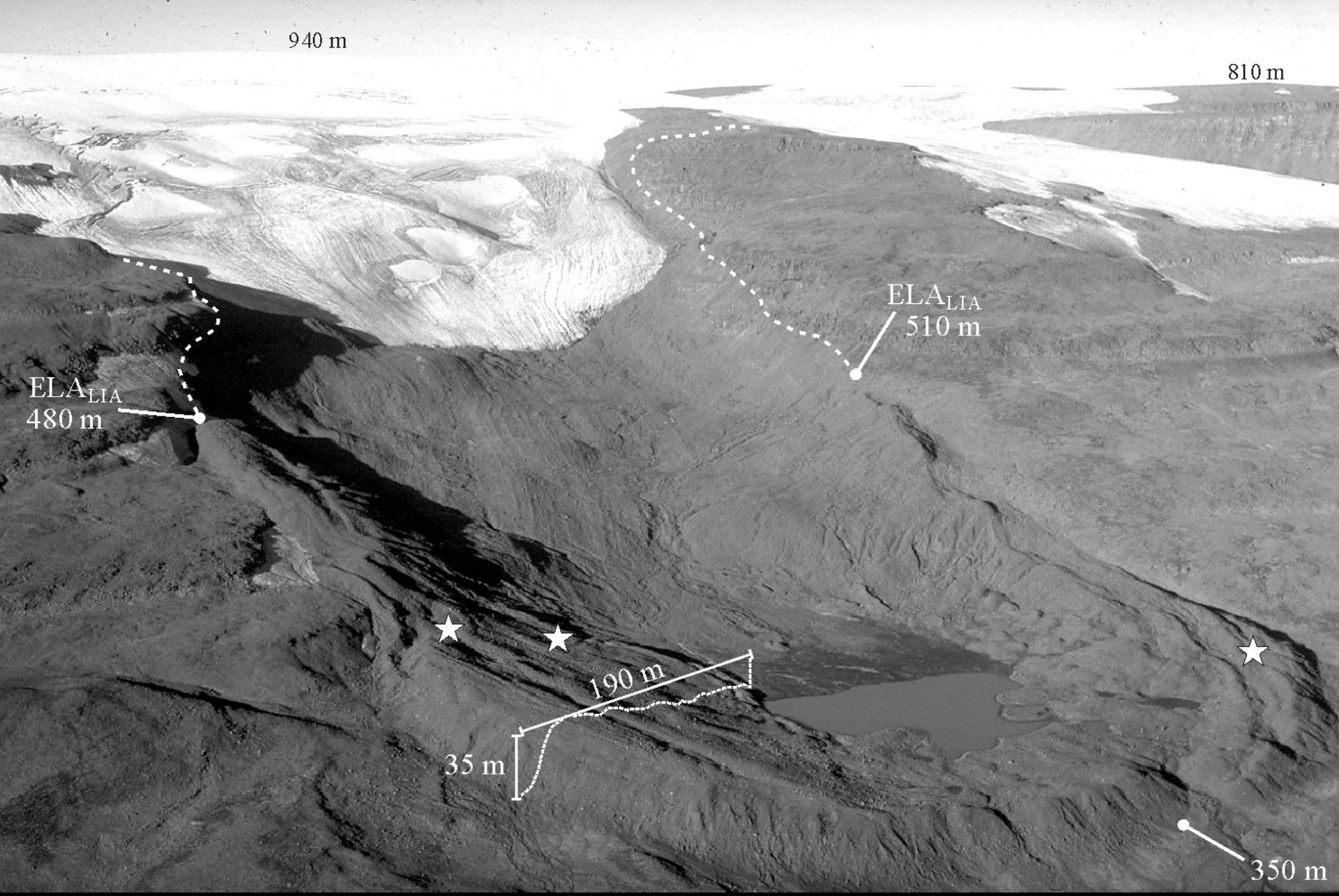
Importance of mechanical weathering

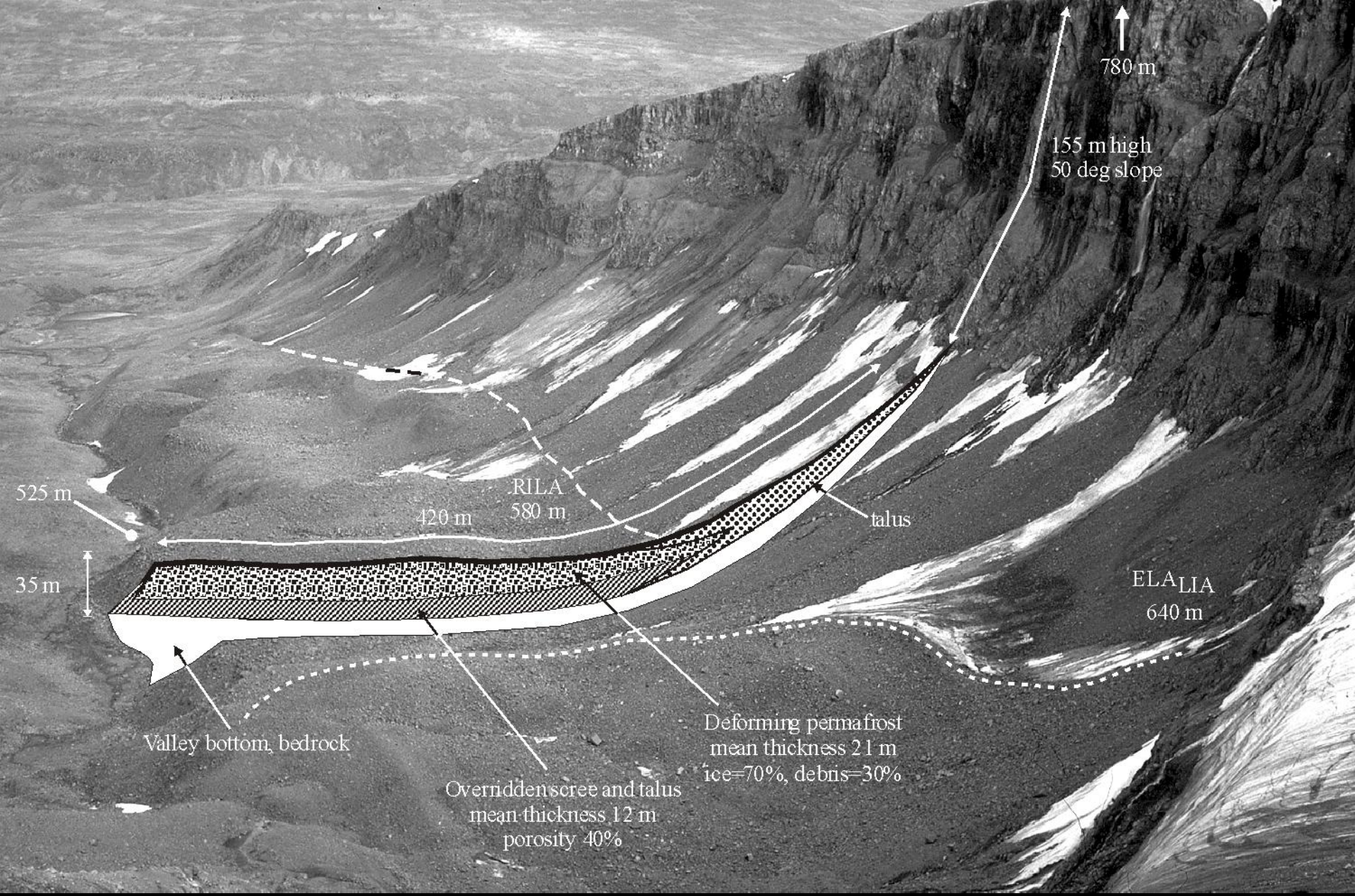
Estimates of bedrock weathering rates in cold climate environments

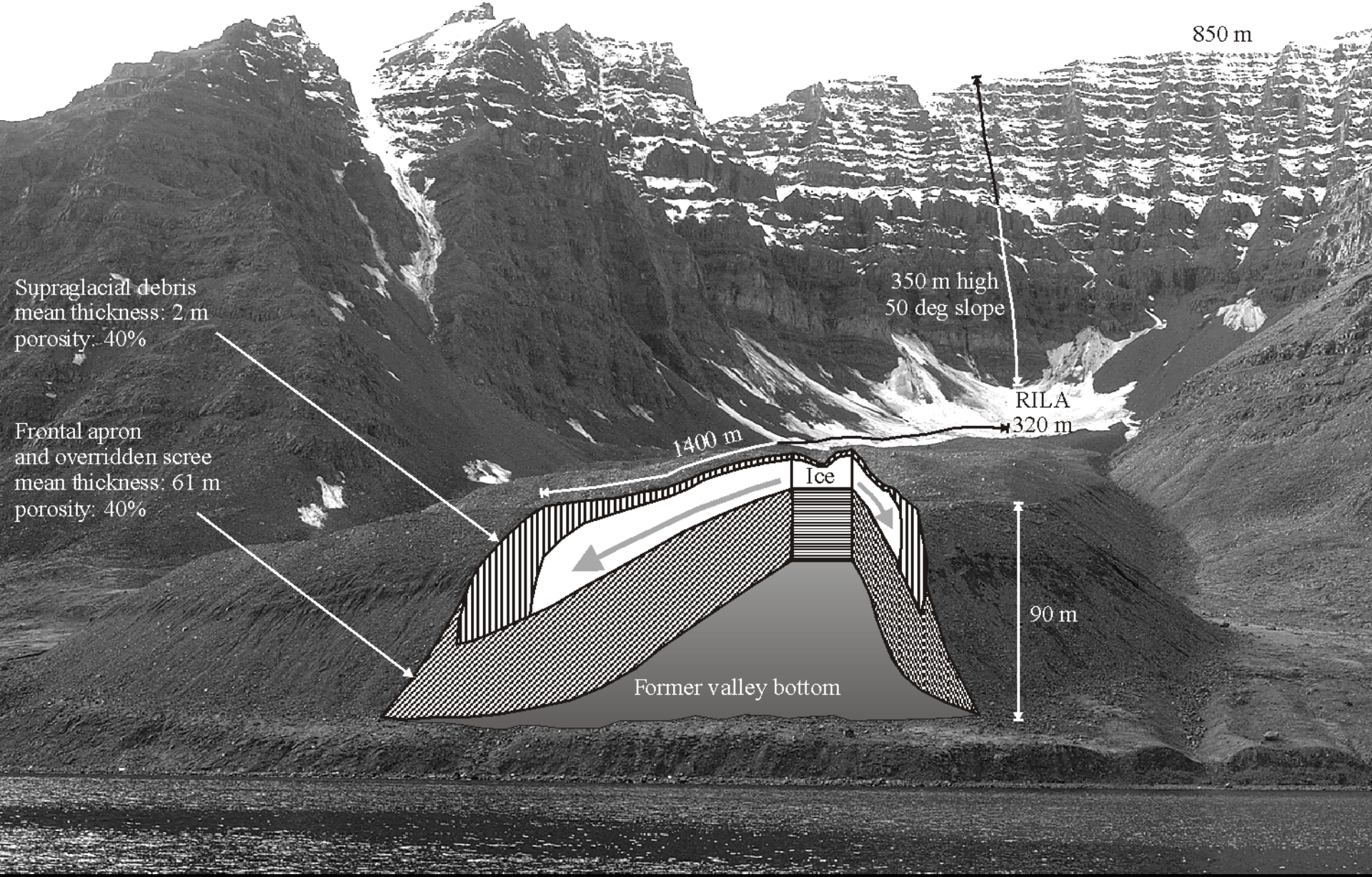


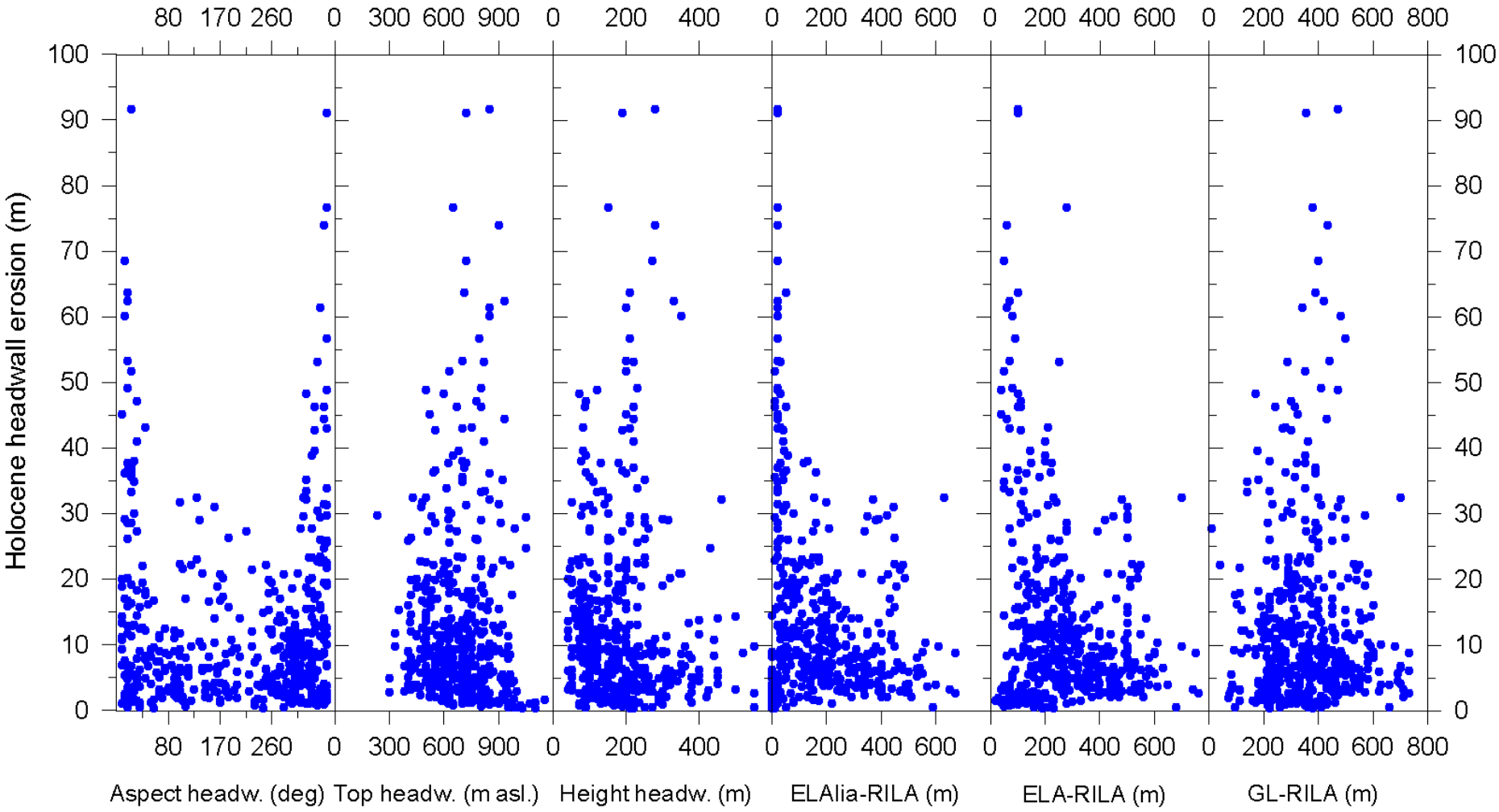

Prevalent wind
Fresh snow
380 m
RILA
Fresh snow
310 m
TD
750 m
475 m
425 m
N
RILA
375 m
TD
510 m
500 m


480 m
990 m
410 m
RILA
TD
550 m
ELALIA
380 m
RILA
380 m
TD
80 m
580 m
550 m
TD
GD
RILA
600 m
970 m
830 m
400 m
RILA
400 m
TD
560 m
ELALIA
140 m
GD
500 m
N


940 m
810 m
ELA$_{LIA}$
510 m
ELA$_{LIA}$
480 m
190 m
35 m
350 m

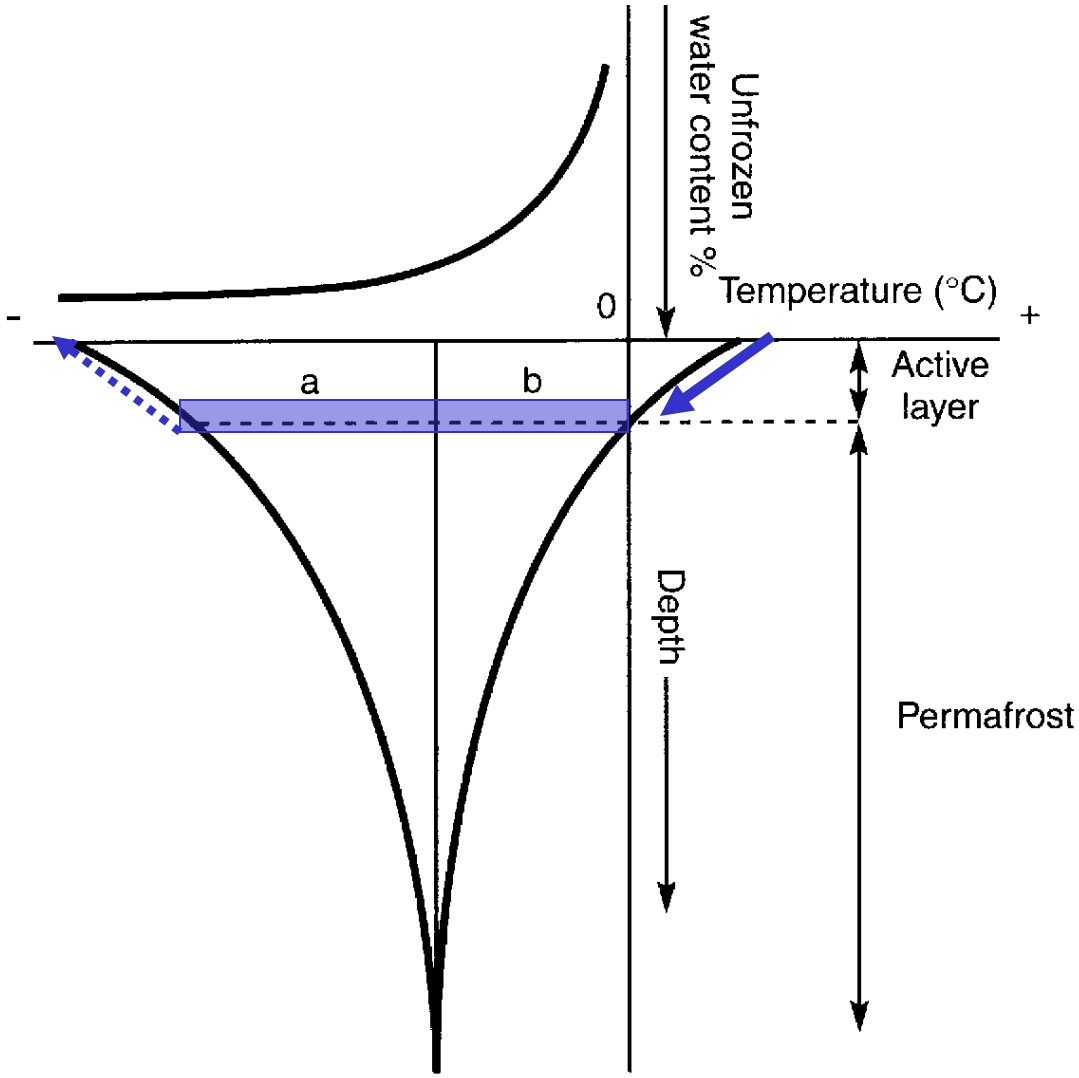

780 m
155 m high
50 deg slope
525 m
RILA
580 m
420 m
talus
35 m
ELA LIA
640 m
Valley bottom, bedrock
Overridden scree and talus
mean thickness 12 m
porosity 40%
Deforming permafrost
mean thickness 21 m
ice=70%, debris=30%


850 m
350 m high
50 deg slope
Supraglacial debris
mean thickness: 2 m
porosity: 40%
Frontal apron
and overridden scree
mean thickness: 61 m
porosity: 40%
RILA
320 m
1400 m
Ice
90 m
Former valley bottom


Holocene headwall erosion (m)
0
10
20
30
40
50
60
70
80
90
100
80 170 260
0 300 600 900
0 200 400
0 200 400 600
0 200 400 600
0 200 400 600 800
Aspect headw. (deg)
Top headw. (m asl.)
Height headw. (m)
ELAlia-RILA (m)
ELA-RILA (m)
GL-RILA (m)


Segregated ice in the active layer

High ice/water content in the lower part of the active layer



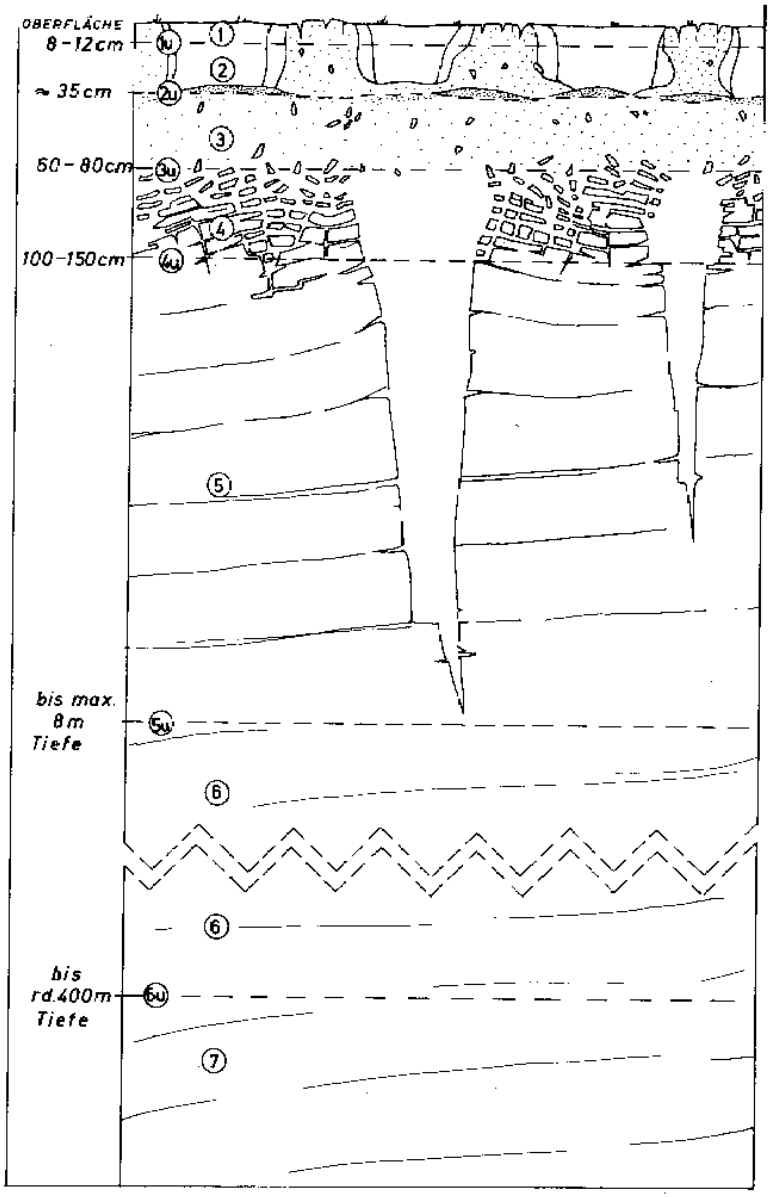


Fig. 19. Profil des Dauerfrostbereichs in Südost-Spitzbergen.

1 = Bereich hochsommerlicher Bodenaustrocknung, 1 u = dessen Untergrenze. 2 = Sommerlicher Auftauboden mit Froststrukturen, 2 u = dessen Untergrenze gegen den Dauerfrostbereich.

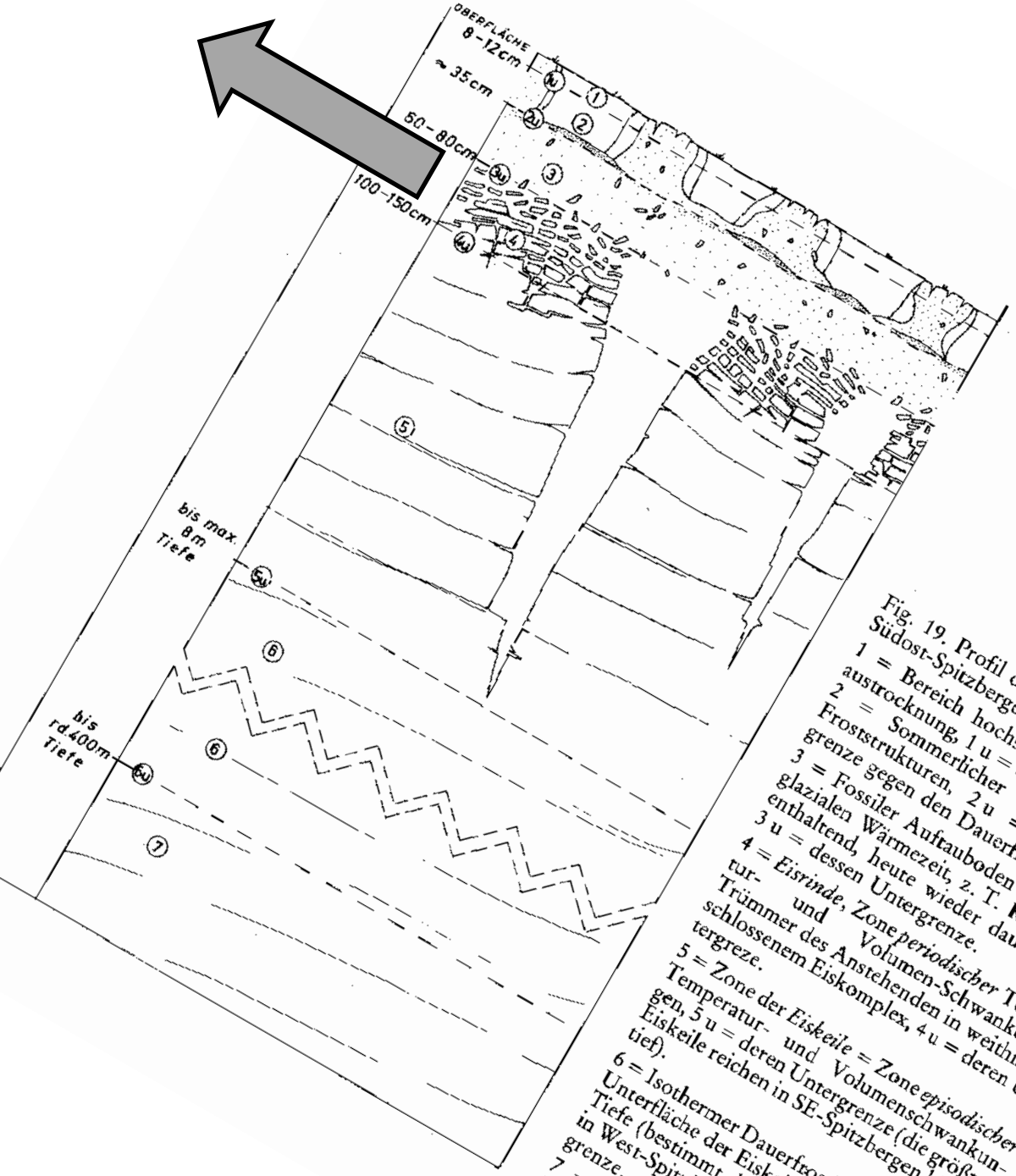
3 = Fossiler Auftauboden aus der postglazialen Wärmezeit, z. T. Kiefernpollen enthaltend, heute wieder dauergefroren, 3 u = dessen Untergrenze.

4 = *Eisrinde*, Zone *periodischer* Temperatur- und Volumen-Schwankungen, Trümmer des Anstehenden in weithin geschlossenem Eiskomplex, 4 u = deren Untergreze.

5 = Zone der *Eiskeile* = Zone *episodischer* Temperatur- und Volumenschwankungen, 5 u = deren Untergrenze (die größten Eiskeile reichen in SE-Spitzbergen bis 8 m tief).

6 = Isothermer Dauerfrostbereich von der Unterfläche der Eiskeilzone bis rd. 400 m Tiefe (bestimmt durch die Kohlengruben in West-Spitzbergen), 6 u = dessen Untergrenze.

7 = Niefrostboden (im Kalk mit alten Karstformen) unterhalb von 400 m Tiefe.



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7 = Niefrostboden (im Kalk mit alter Karstformen) unterhalb von 400 m

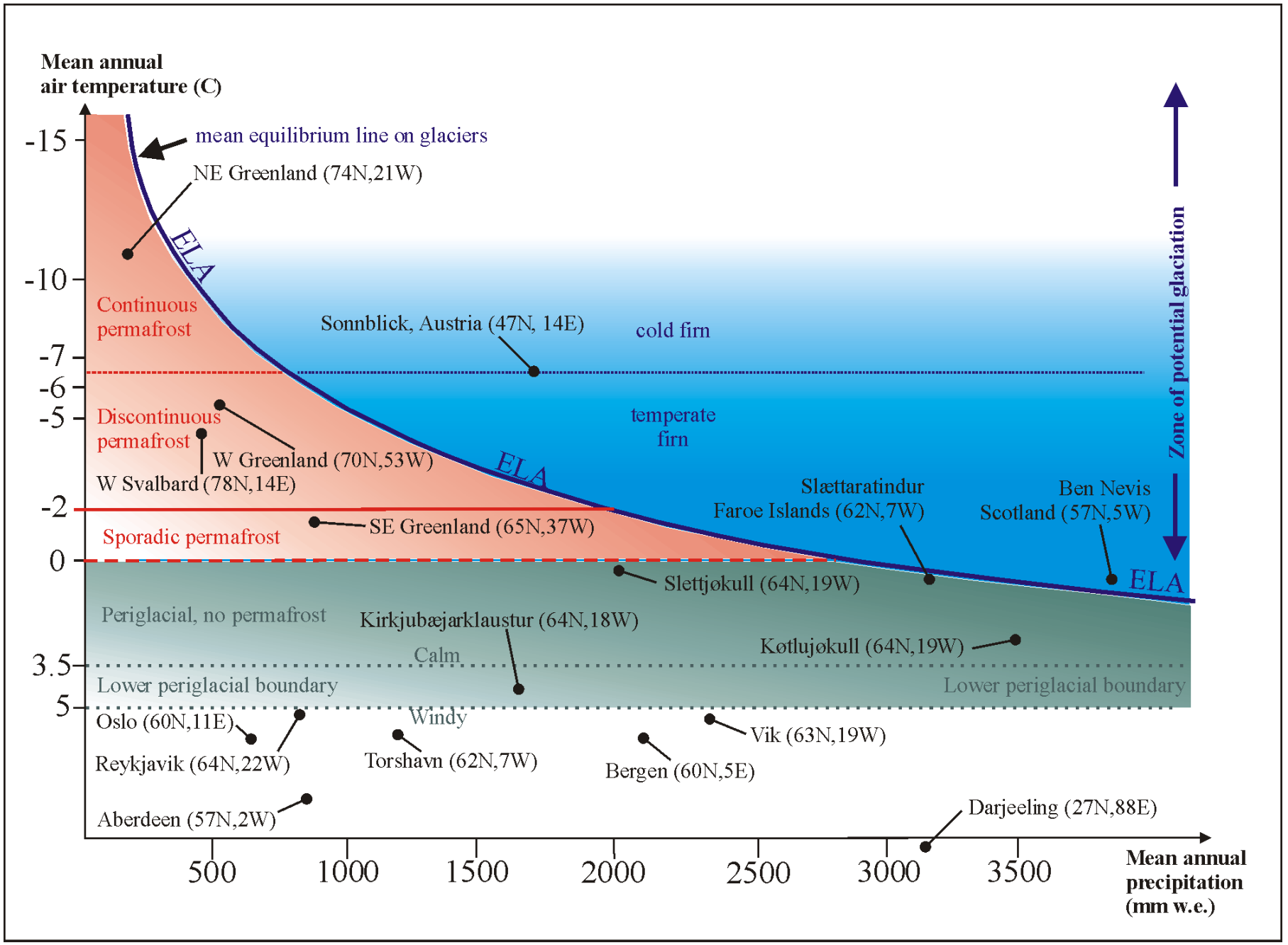
An optimal environment for mechanical weathering

Disko Island, Greenland

Disko Island, Greenland

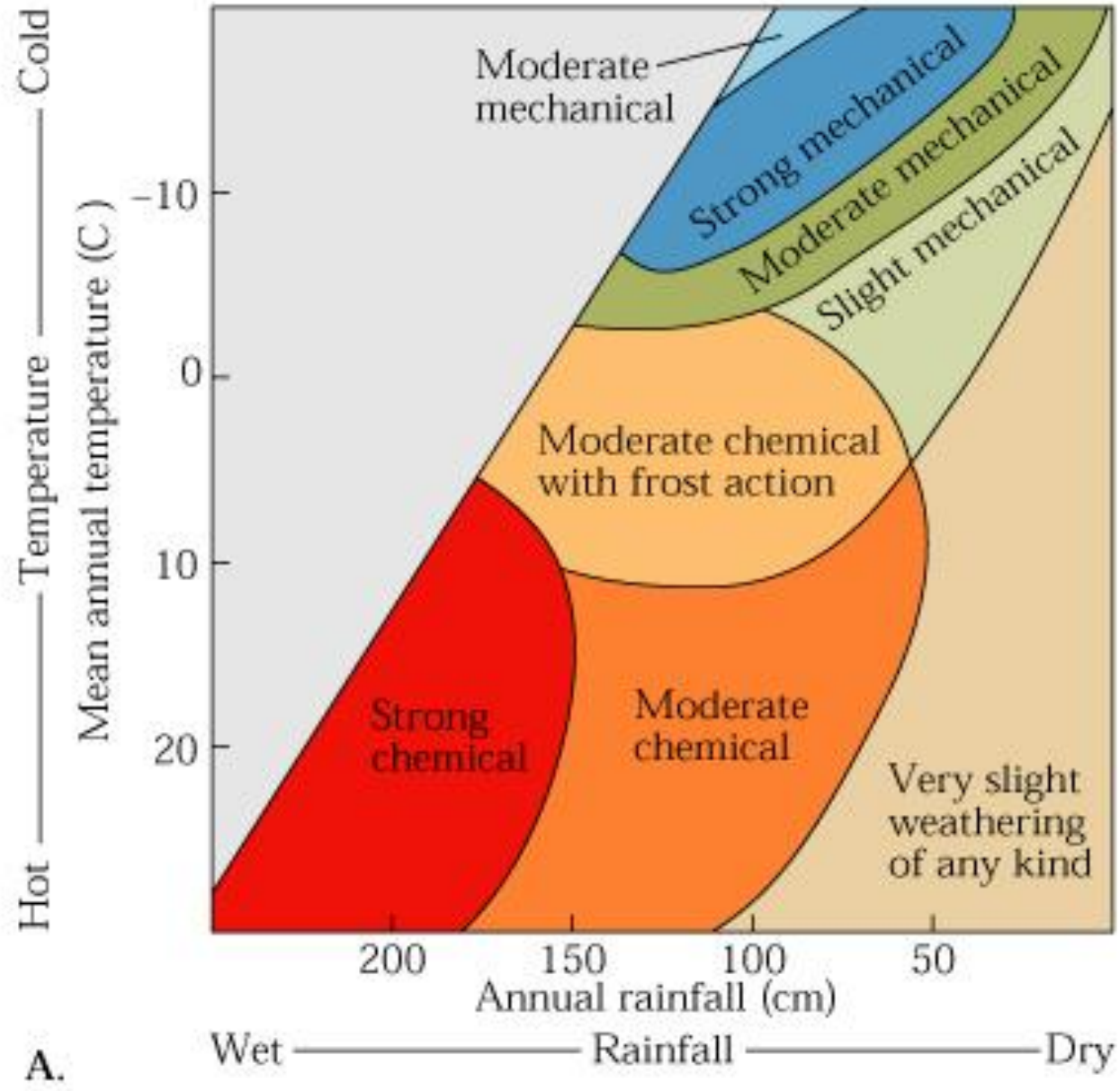

Disko Island, Greenland

Disko Island, Greenland


Mean annual
air temperature (C)
-15
-10
-7
-6
-5
-2
0
3.5
5
mean equilibrium line on glaciers
NE Greenland (74N,21W)
ELA
Continuous
permafrost
Sonnblick, Austria (47N, 14E)
cold firn
Discontinuous
permafrost
W Greenland (70N,53W)
W Svalbard (78N,14E)
temperate
firn
ELA
Slættaratindur
Faroe Islands (62N,7W)
Ben Nevis
Scotland (57N,5W)
Zone of potential glaciation
Sporadic permafrost
SE Greenland (65N,37W)
Slettjøkull (64N,19W)
ELA
Periglacial, no permafrost
Kirkjubæjarklaustur (64N,18W)
Kotlujøkull (64N,19W)
Calm
Lower periglacial boundary
Lower periglacial boundary
Oslo (60N,11E)
Windy
Vik (63N,19W)
Reykjavik (64N,22W)
Torshavn (62N,7W)
Bergen (60N,5E)
Aberdeen (57N,2W)
Darjeeling (27N,88E)
500
1000
1500
2000
2500
3000
3500
Mean annual
precipitation
(mm w.e.)

Ole Humlum

Chemical weathering



A.

Chemical weathering, Stadlandet, Norway

Chemical weathering, Jotunheimen, Norway

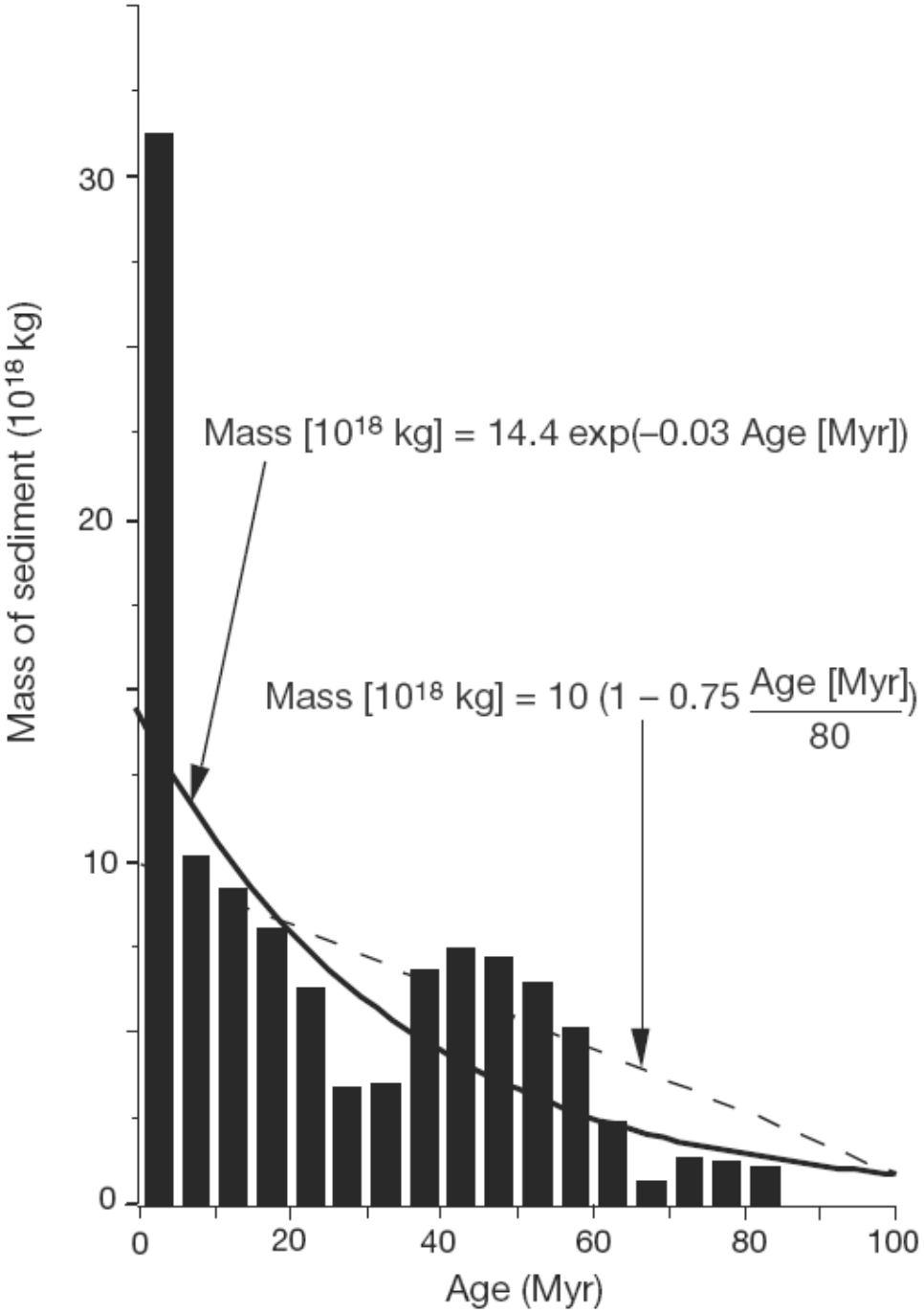
Chemical weathering, Jotunheimen, Norway

Pitted surface weathering, Griegsaksla, Svalbard

Salt weathering, Trollsteinen, Svalbard

Transport of weathering products


Endalen, Svalbard


Mass of sediment (10^{18} kg)
30
20
10
0
Mass [10^{18} kg] = 14.4 exp(–0.03 Age [Myr])
Mass [10^{18} kg] = 10 (1 – 0.75 $\frac{\text{Age [Myr]}}{80}$)
0
20
40
60
80
100
Age (Myr)

Next time:
Glacial erosion