Coasts

Coasts

1: Land and ocean

2: Coastal processes

3: Types of coasts

4: Sea level change

Planet Earth:

Land 29%

Ocean 71%

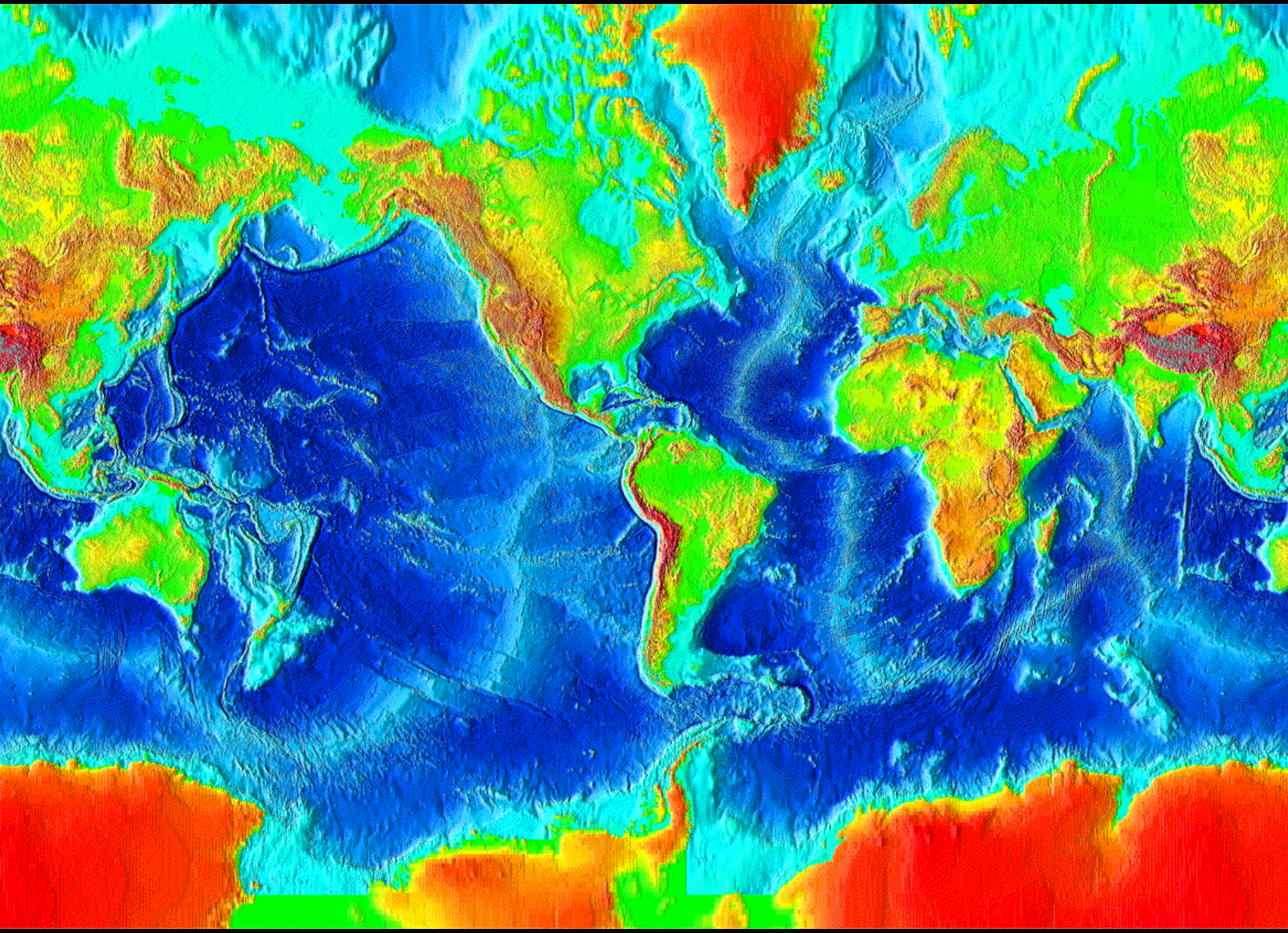
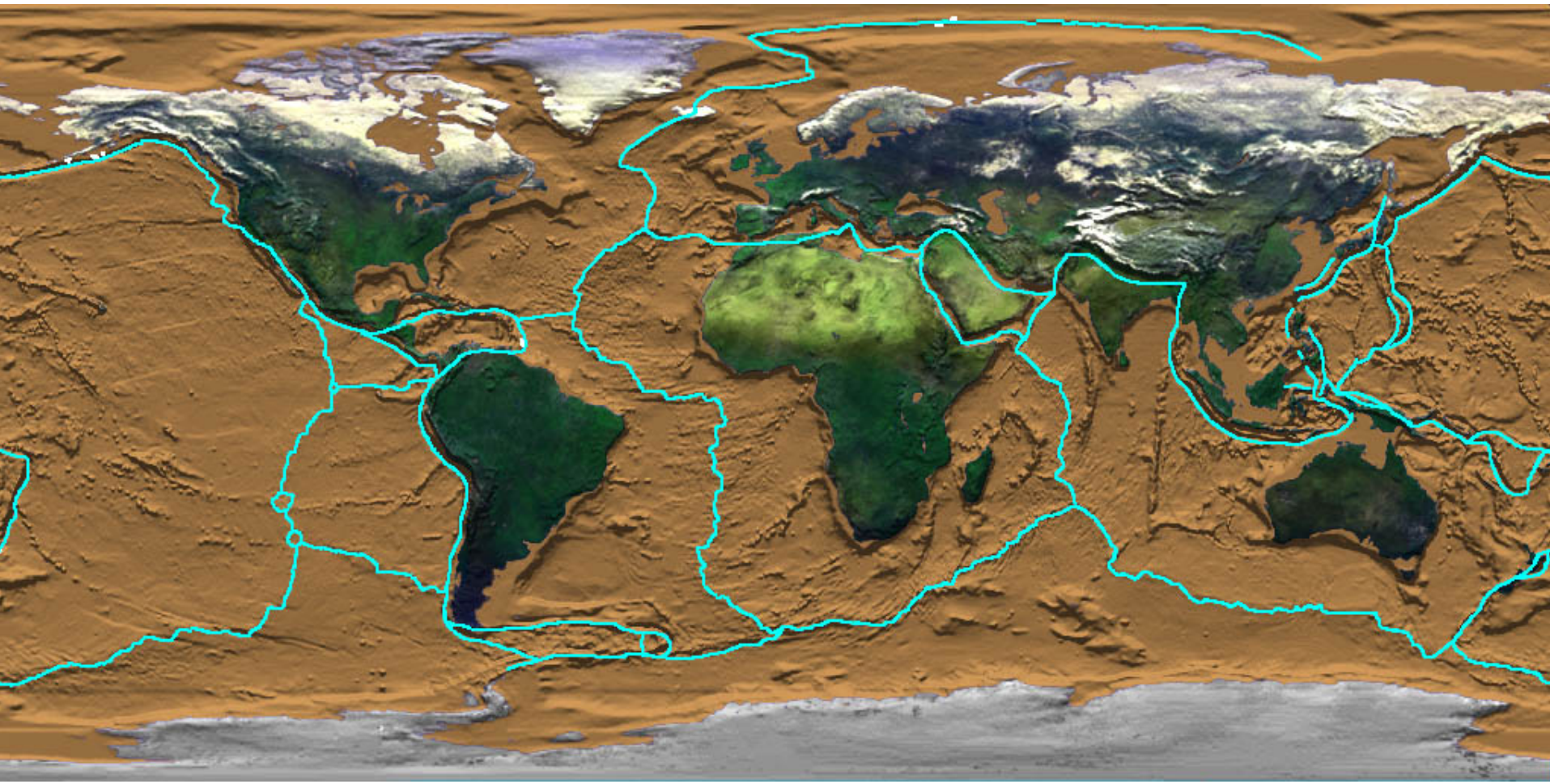
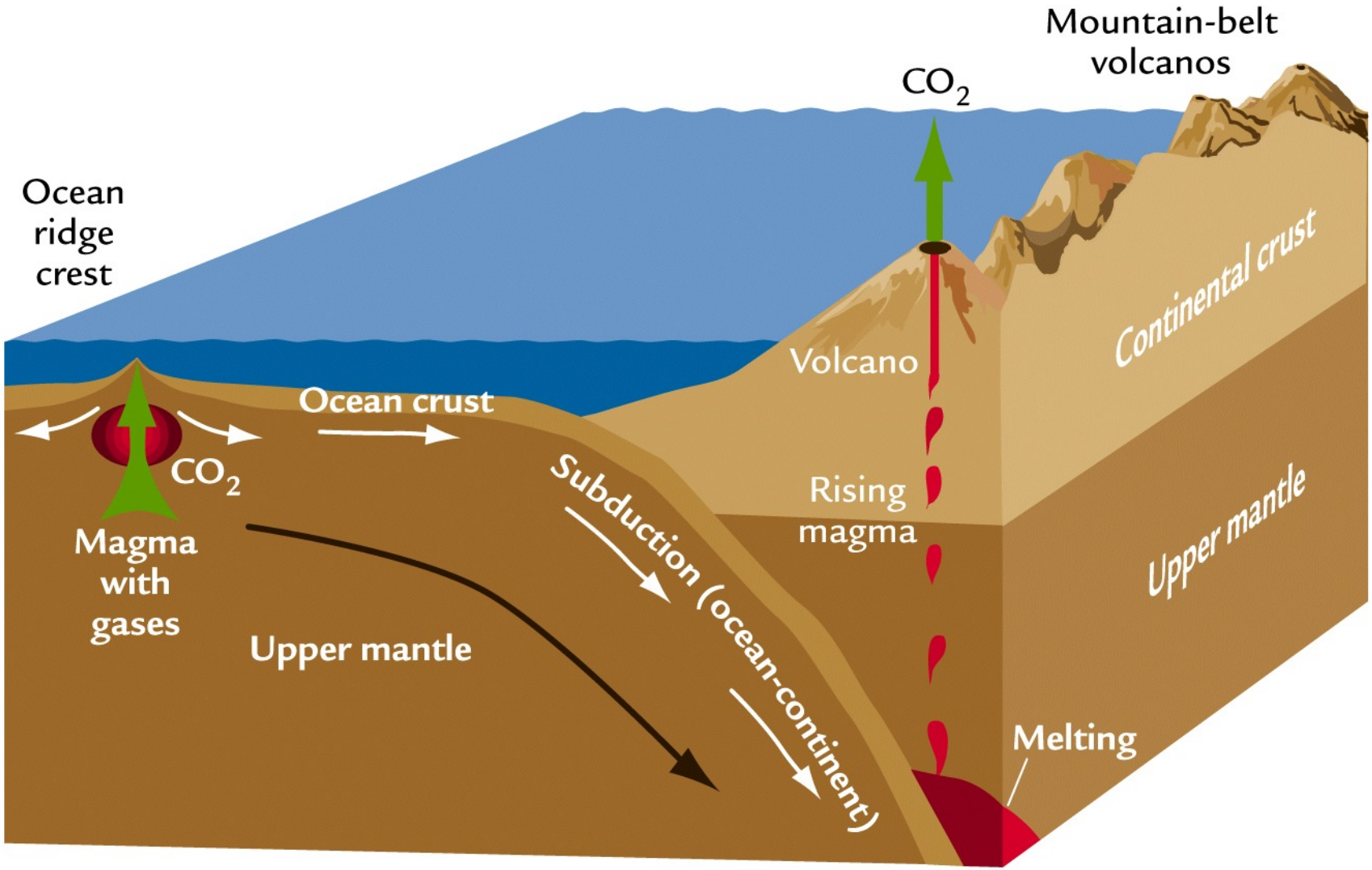


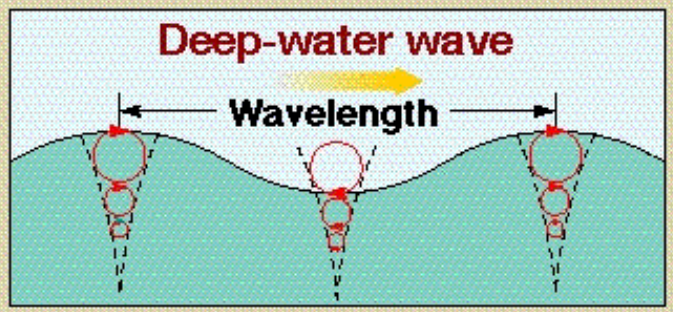
Plate boundaries



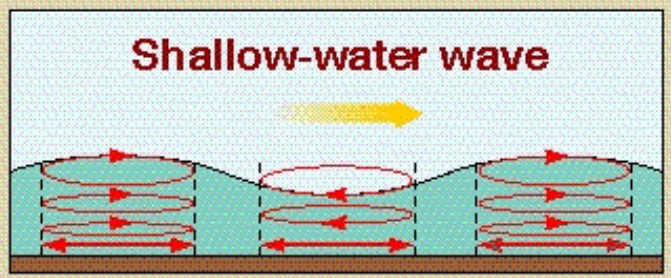

Mountain-belt volcanos
CO_2
Ocean ridge crest
Continental crust
Volcano
Ocean crust
CO_2
Rising magma
Subduction (ocean-continent)
Upper mantle
Magma with gases
Upper mantle
Melting


100%
0°
Andes
80%
Lowlands
20%
Eastern Andes
Western Andes
30°S
60°W
90°W

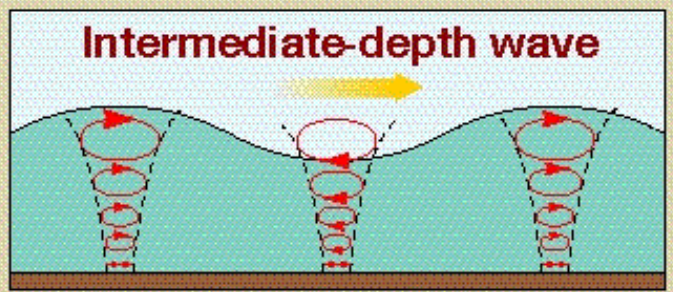
Progressive Waves



Depth $\geq \frac{1}{2}$ wavelength



Depth $\leq \frac{1}{20}$ wavelength



Depth $\leq \frac{1}{2}$ to $\geq \frac{1}{20}$ wavelength

Wave Speed Equations

For deep-water waves (D > L/2):

Speed (S) = L/T, i.e. Wavelength / period

Speed (S) = 1.56 T or (approx.) $1.25\sqrt{L \text{ (meters)}}$

In other words ... speed (celerity) is purely a function of wave properties

For shallow-water waves (L >1/20 D):

Speed (S) = $\sqrt{gD}$ = $3.13\sqrt{D \text{ (meters)}}$

In other words ... speed (celerity) is purely a function of water depth

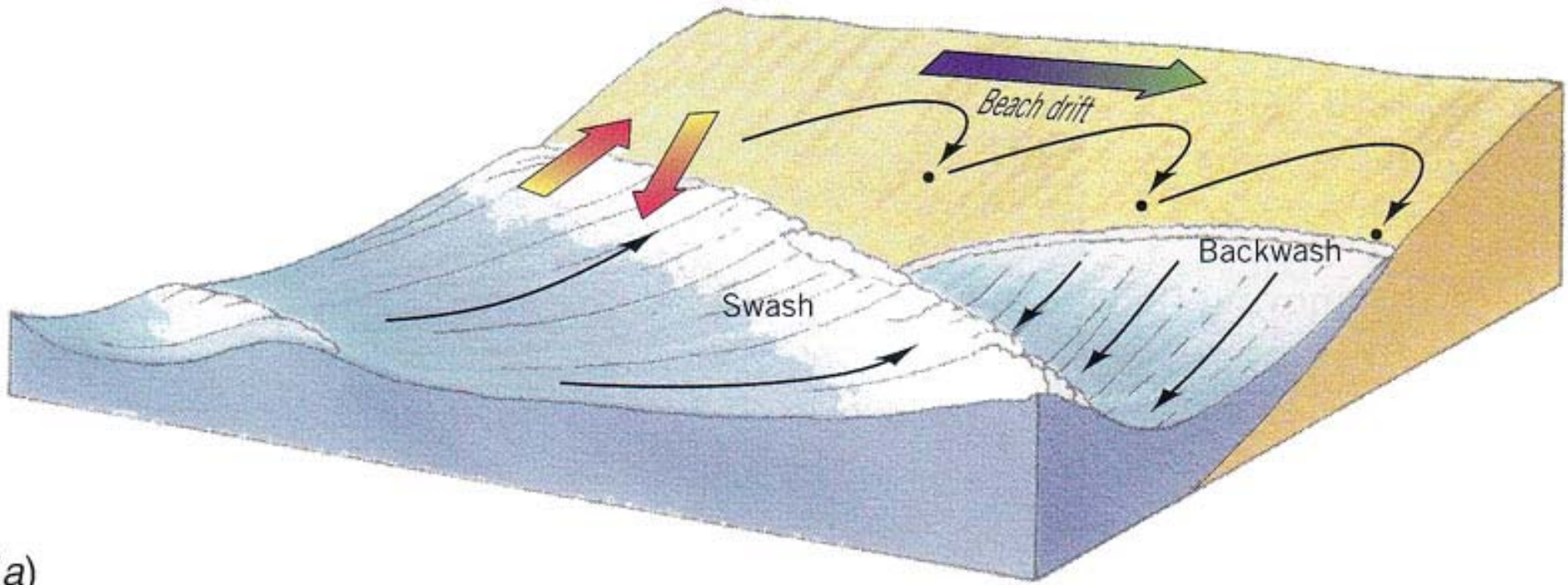
For intermediate-water waves (D <L/2 and > L/20):

Extremely complex ... speed (celerity) is a shifting function of both water depth and wave properties

D is water depth

L is wavelength

g is the acceleration of gravity



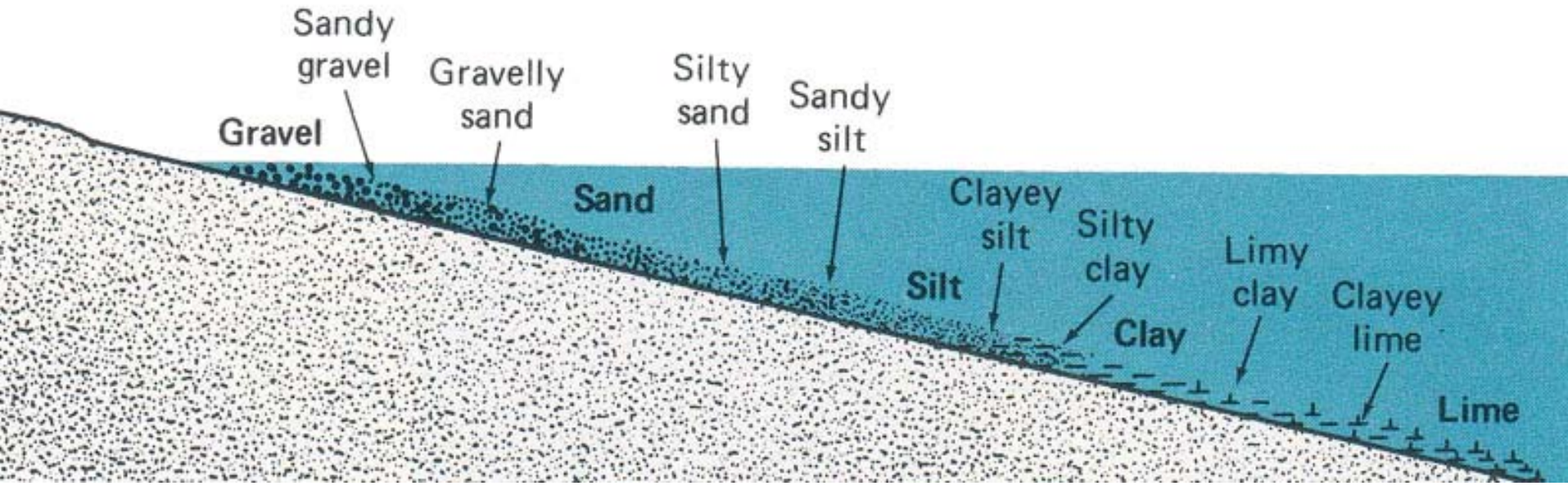
(*a*)


Chesil Beach, near Cove House Inn. - breaking wave. Ian We

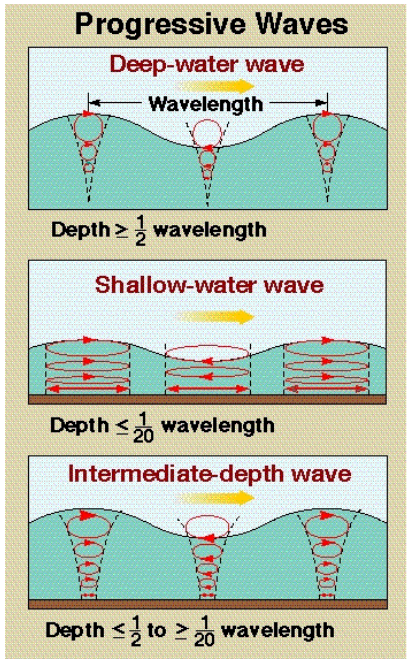

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
WH SMITH
Centimetres (cm)

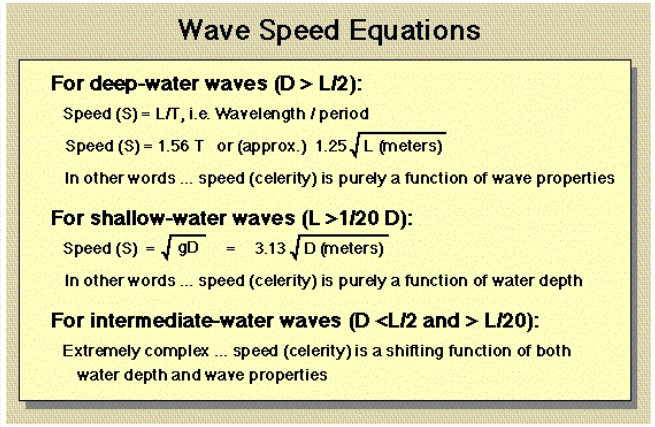

Wave ripples

Wave ripples

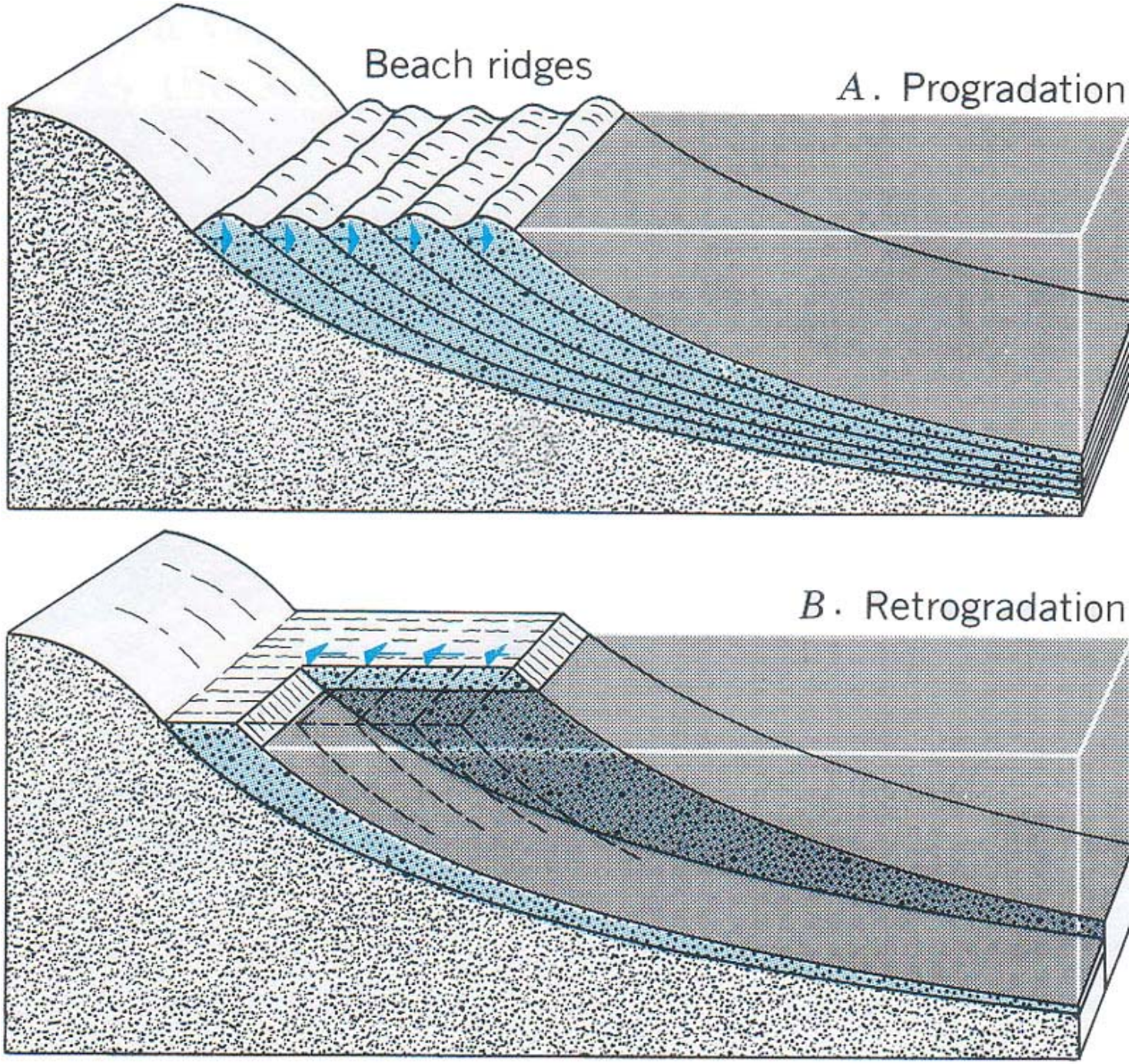


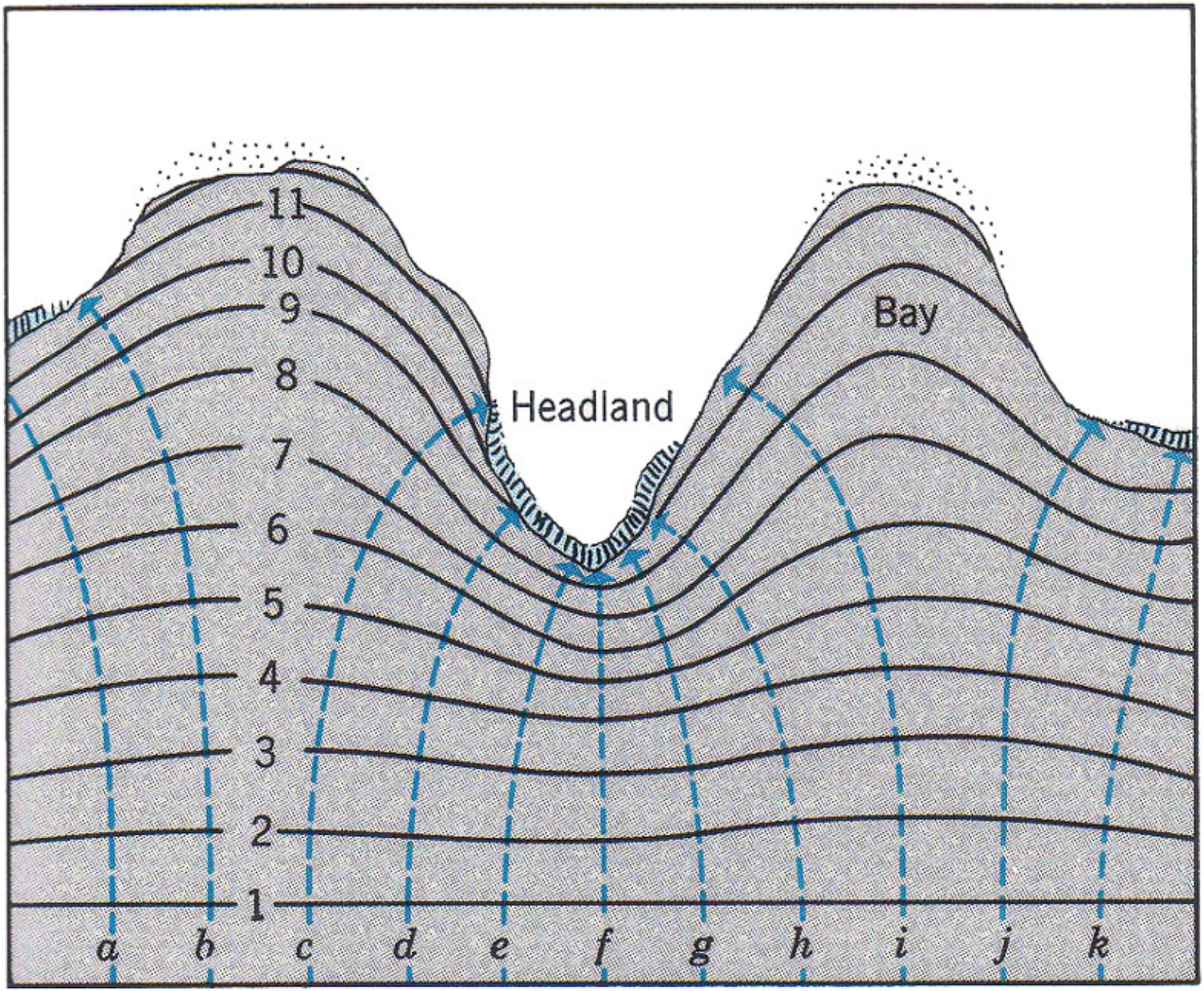
Sorting by wave activity

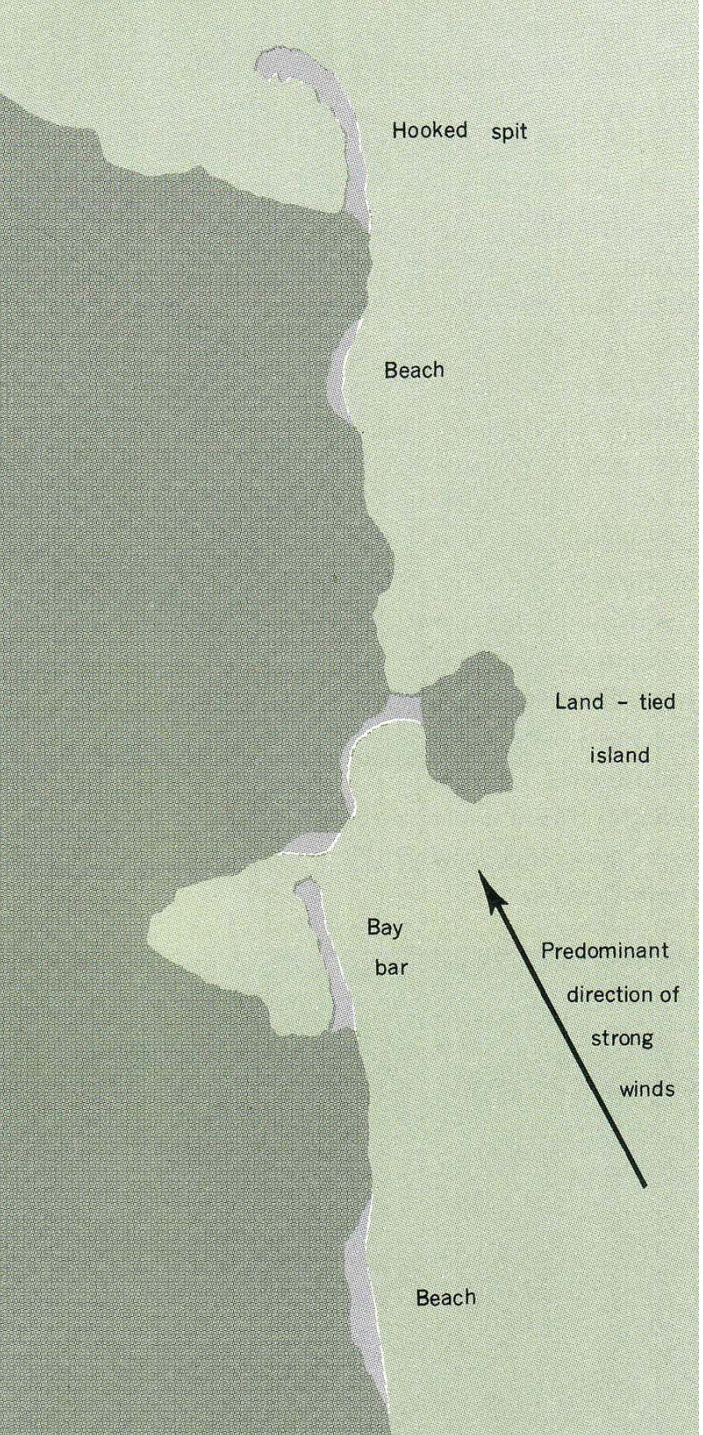


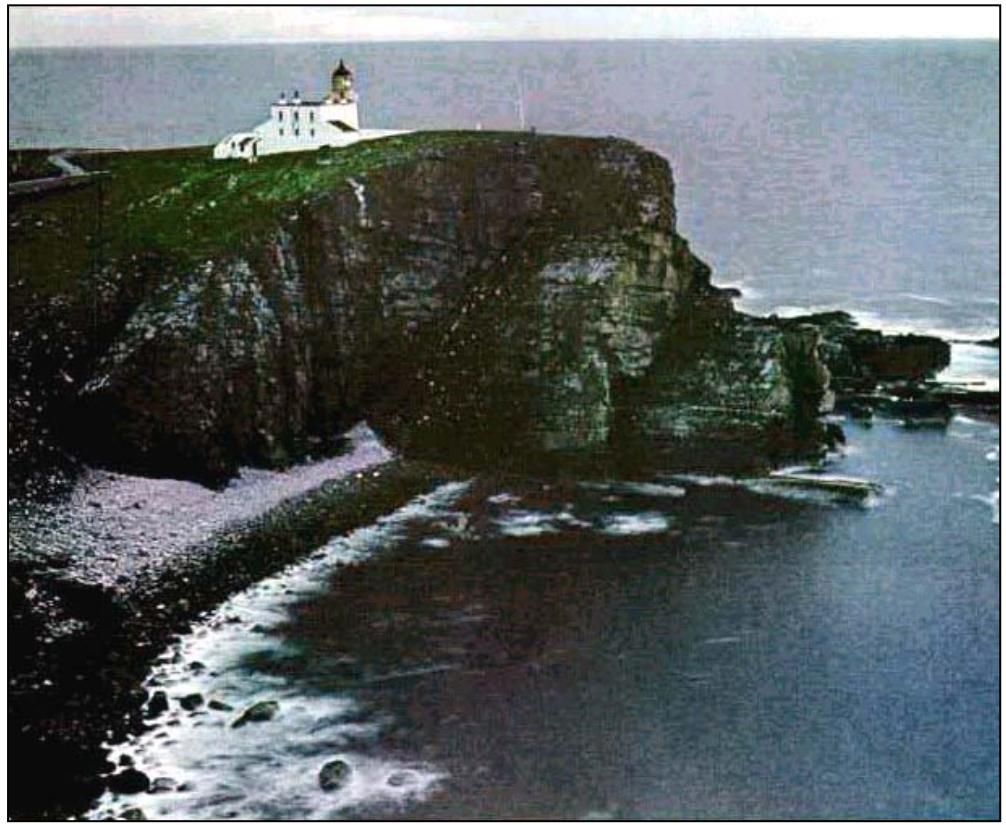


D is water depth
L is wavelength
g is the acceleration of gravity

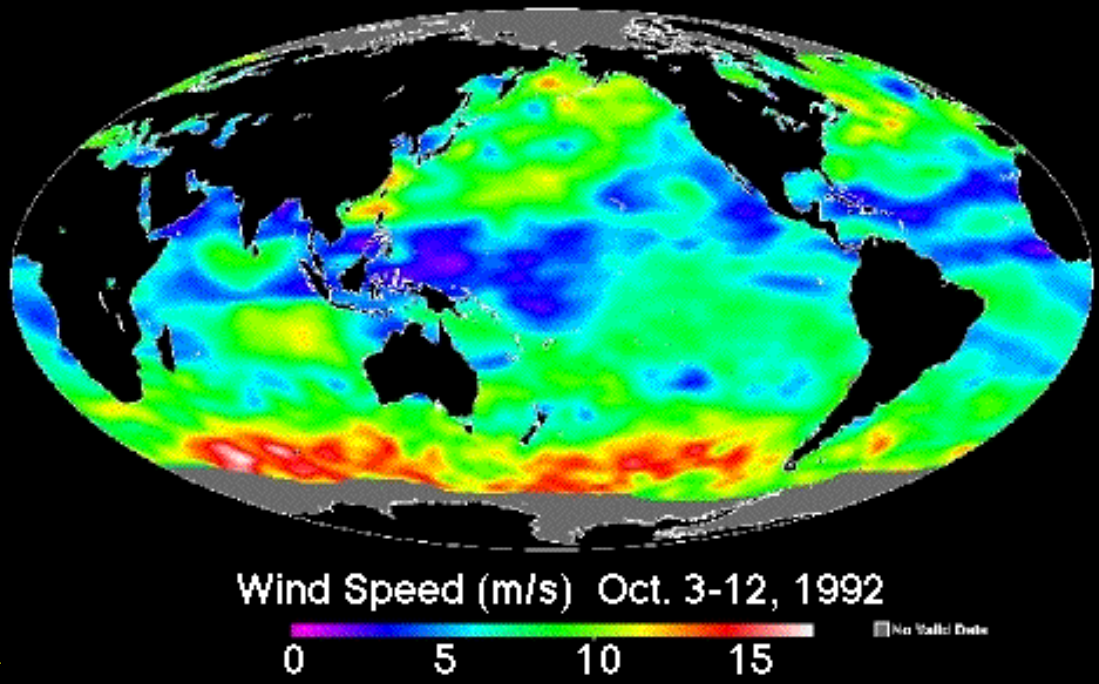

Beach ridges
A. Progradation
B. Retrogradation

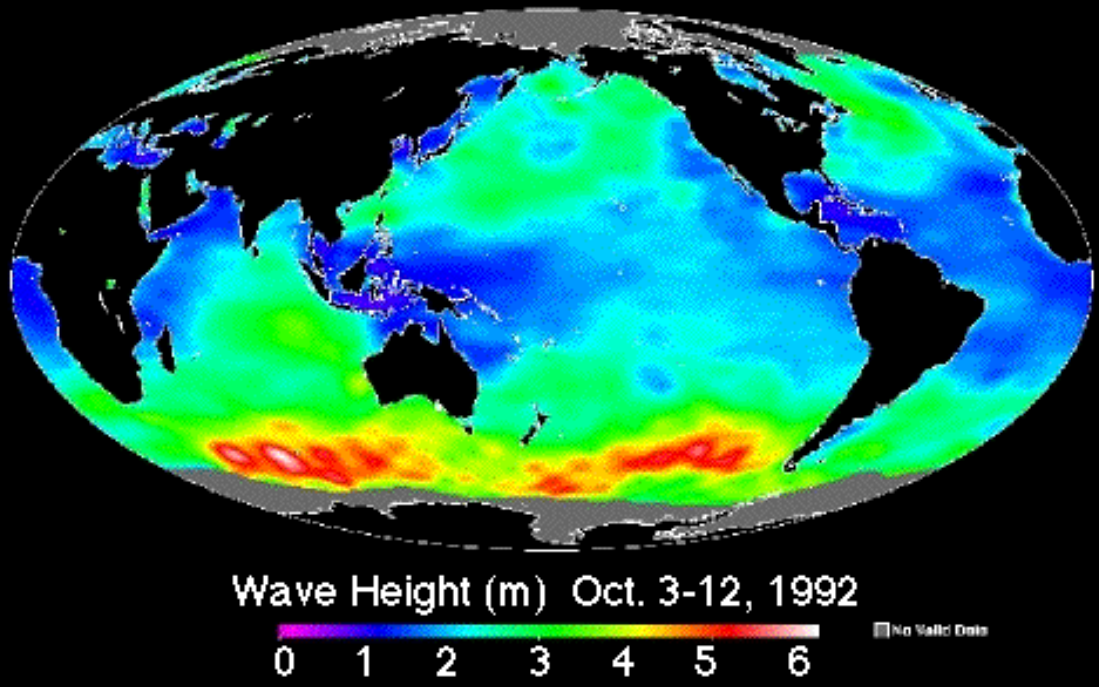

11
10
9
8
7
6
5
4
3
2
1
Headland
Bay
a
b
c
d
e
f
g
h
i
j
k


Hooked spit
Beach
Land - tied island
Bay bar
Predominant direction of strong winds
Beach

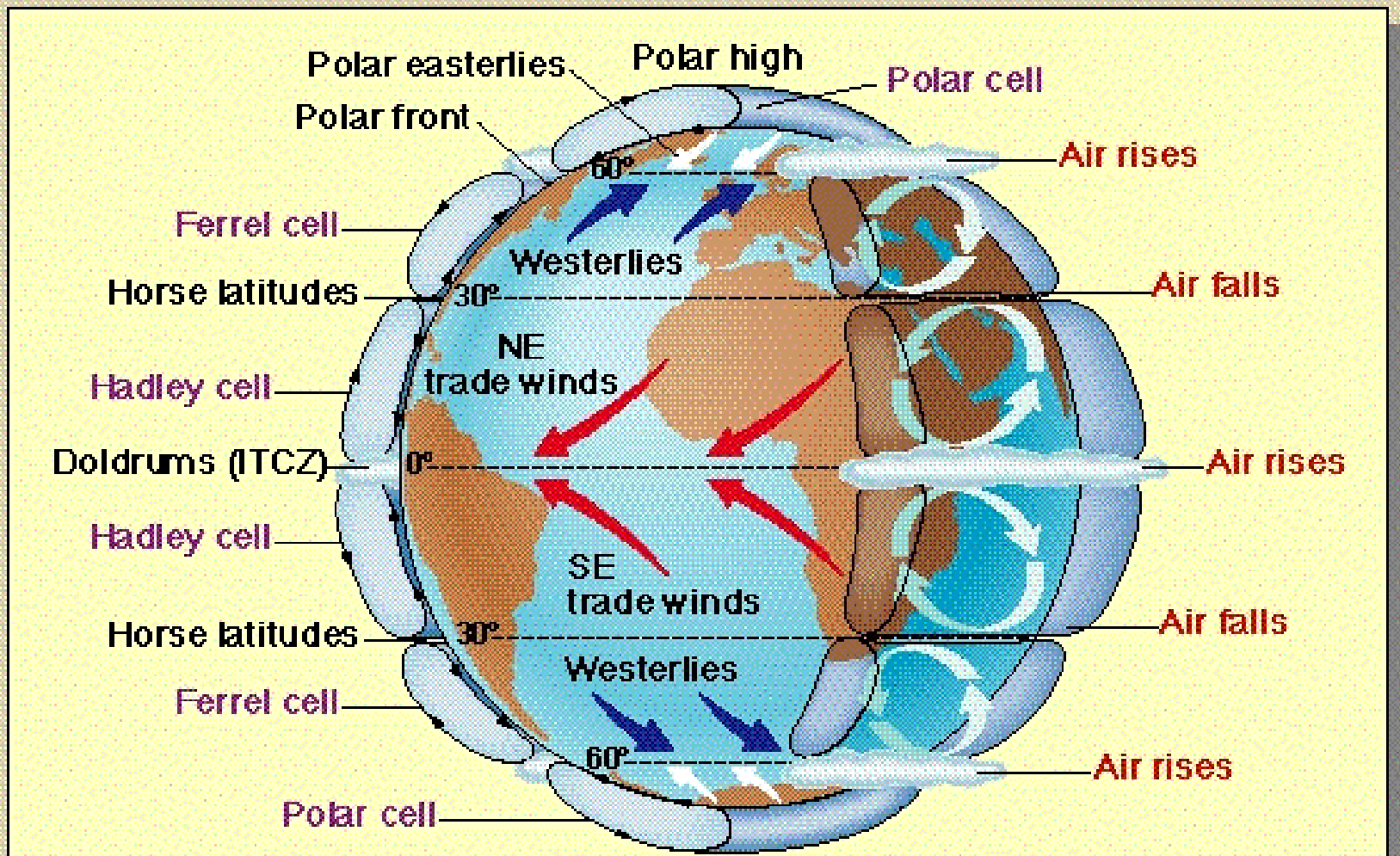


Global wind speed and wave heights





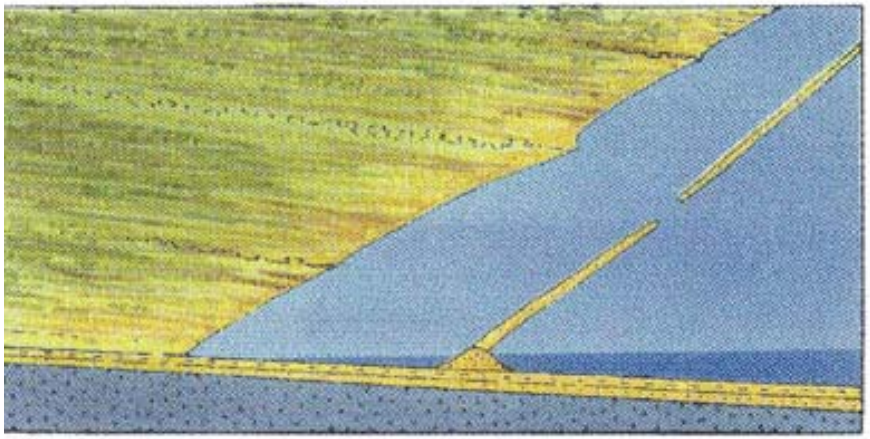
Global Air Circulation Patterns



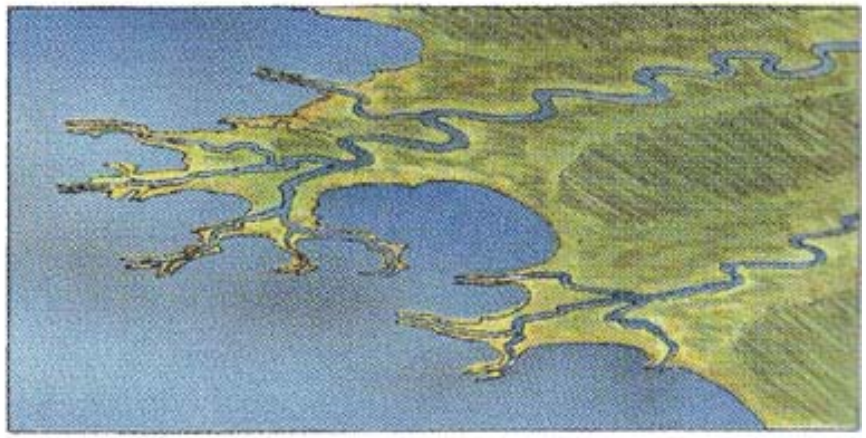
Global air circulation as described in the three-cell circular model. As in simpler circulation models, air rises at the equator and falls at the poles. But instead of one great circuit in each hemisphere from equator to pole, there are three. Note the influence of the Coriolis effect on wind direction.

Ria coast

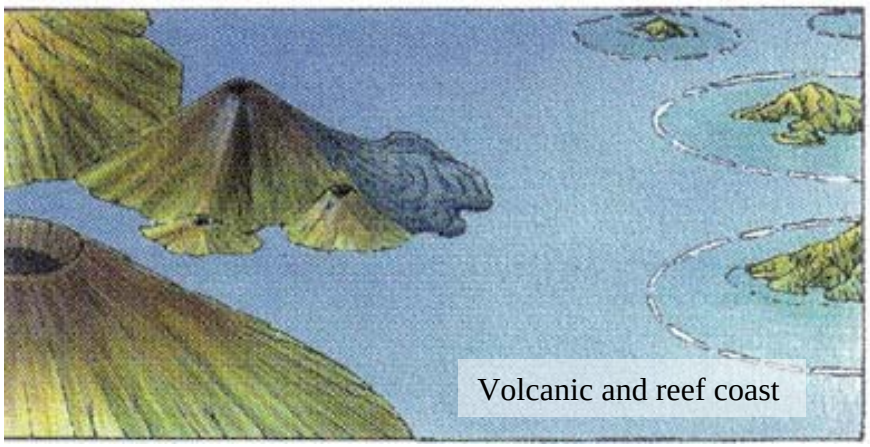
Fiord coast



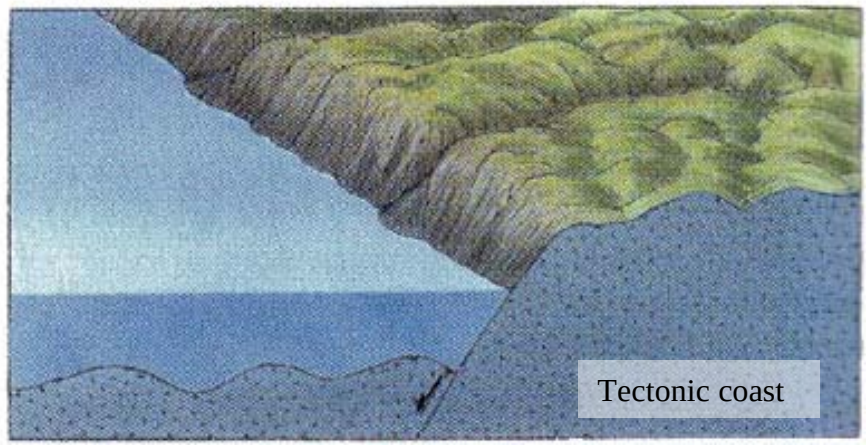
Barrier-island coast



Delta coast



Volcanic and reef coast



Tectonic coast

Exposed cliff coast, South Downs, UK

Exposed, active coastal bedrock cliff, Faroe Islands

Exposed, active coastal bedrock cliff, Faroe Islands


Exposed, active coastal bedrock cliff, Faroe Islands

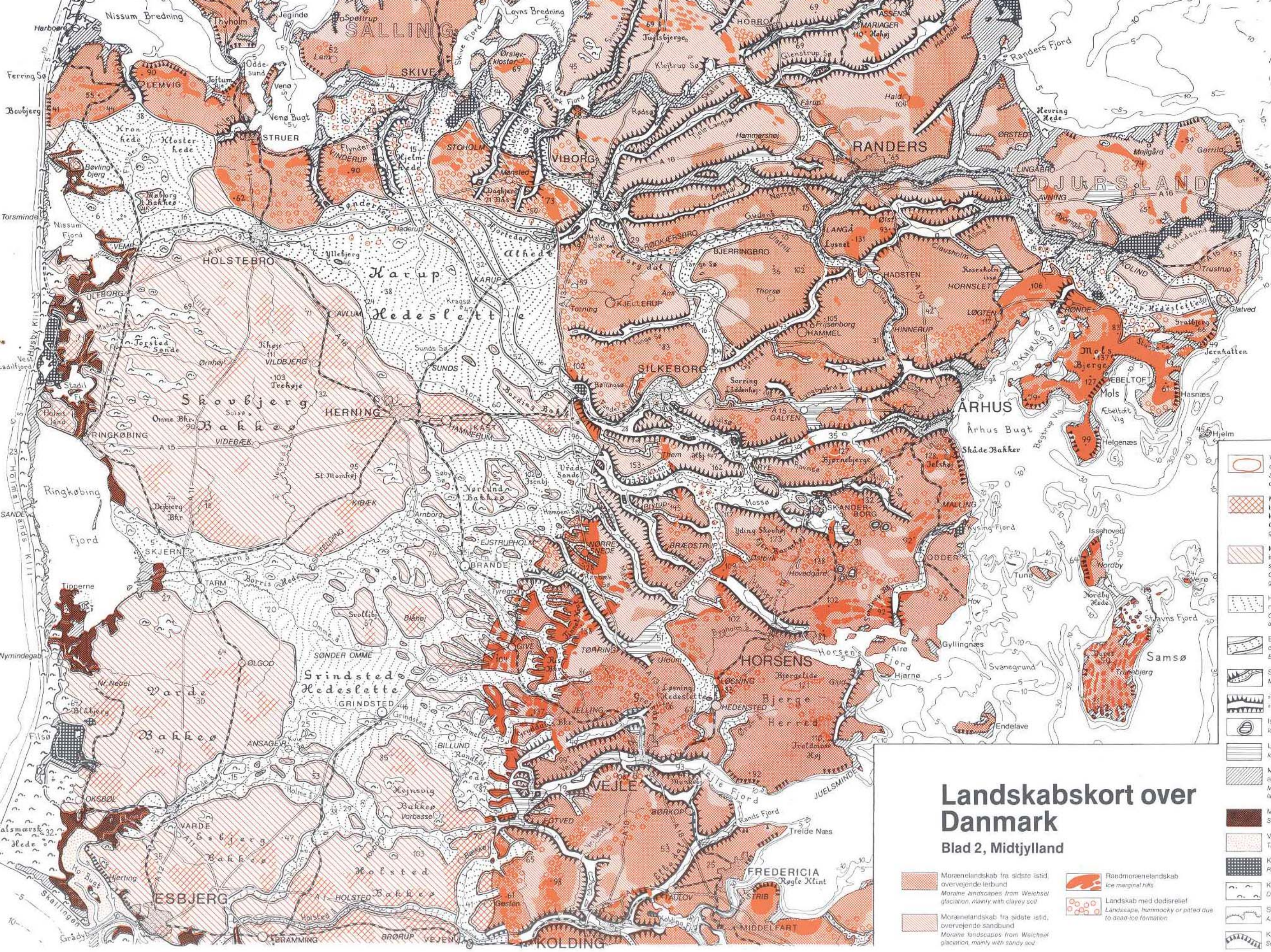
Exposed, active coastal bedrock cliff, Faroe Islands


Protected, coastal bedrock cliff, Faroe Islands

Protected fjord coast, Geiranger, Norway

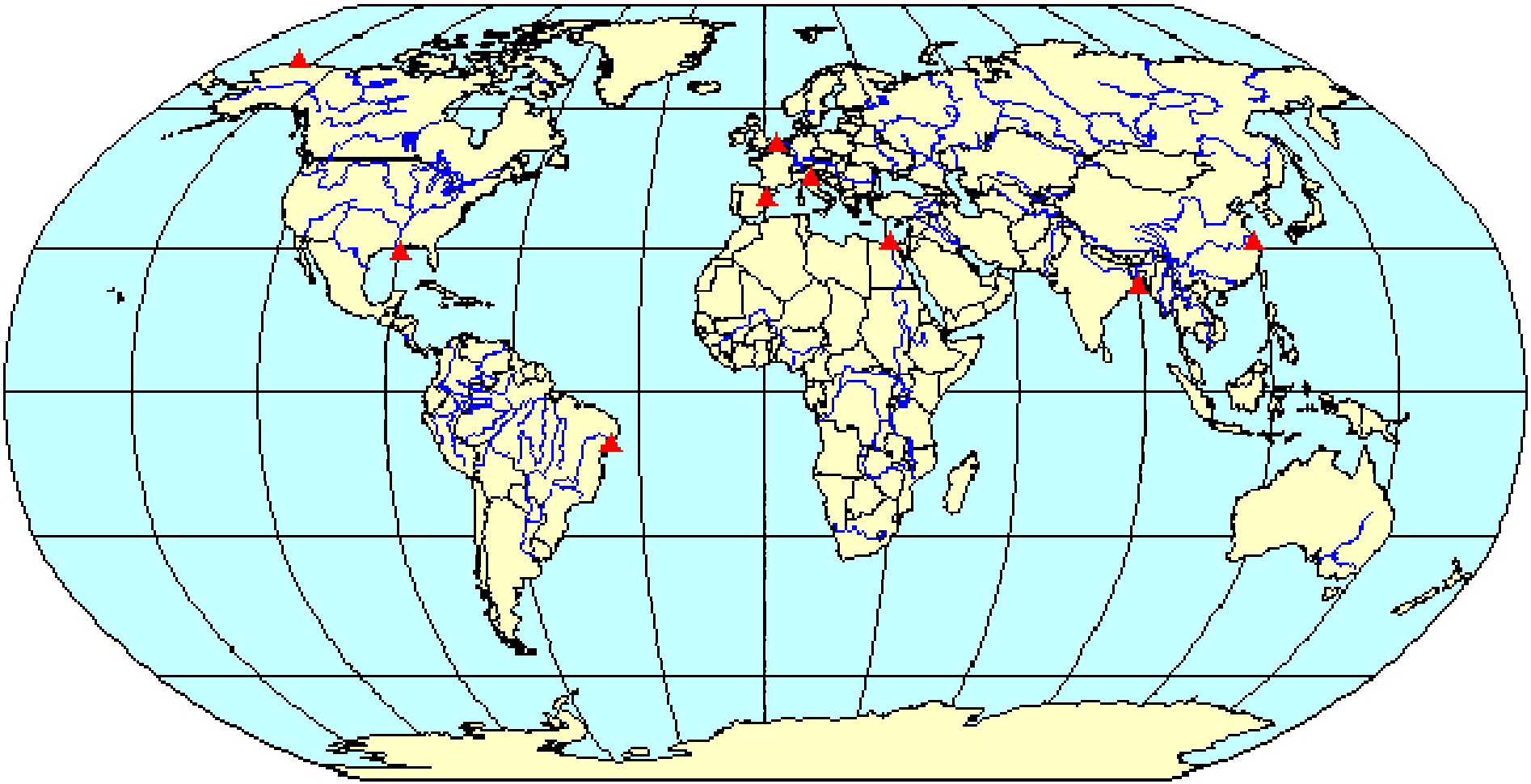
Exposed, sedimentary coast, Denmark

Exposed, sedimentary coast, Denmark

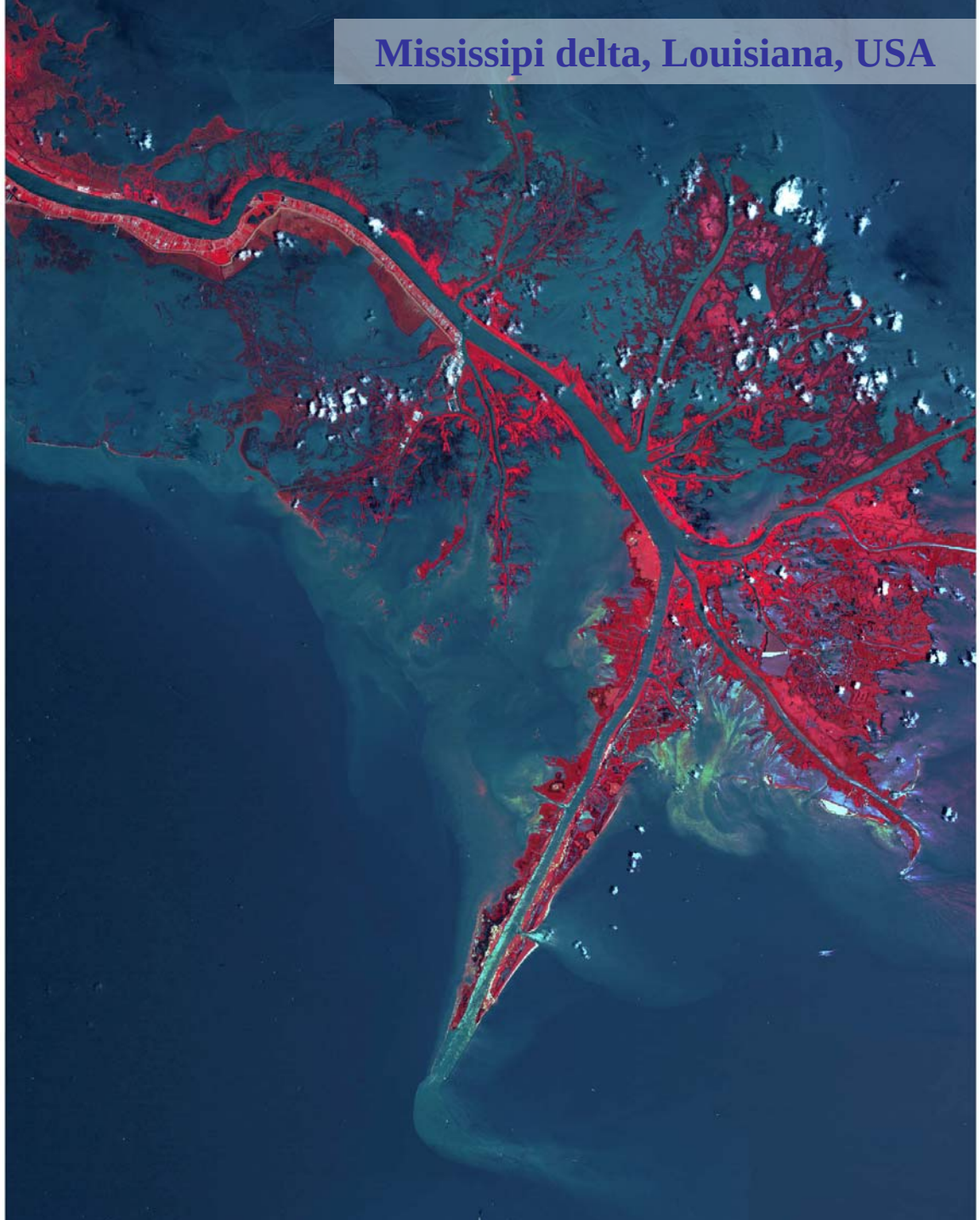

Landskabskort over Danmark
Blad 2, Midtjylland
Moræenelandskab fra sidste istid overvejende lerbund
Moraine landscapes from Weichsel glaciation, mainly with clayey soil
Moræenelandskab fra sidste istid, overvejende sandbund
Moraine landscapes from Weichsel glaciation, mainly with sandy soil
Randmoræenelandskab
Ice marginal hills
Landskab med dødisrelief
Landscape, hummocky or pitted due to dead-ice formation
SALLING
SKIVE
LEMVIG
STRUER
VIBORG
RANDERS
DJURSLAND
HOLSTEBRO
Karup Hedeslette
SILKEBORG
HERNING
Skovbjerg Bakkeø
ÅRHUS
Århus Bugt
Mols Bjerge
Ringkøbing Fjord
RINGKØBING
SKJERN
BRANDE
HORSENS
Horsens Fjord
Samsø
Grindsted Hedeslette
GRINDSTED
Varde Bakkeø
VEJLE
Vejle Fjord
FREDERICIA
KOLDING
ESBJERG
Holsted Bakkeø
BILLUND
SKANDERBORG
HAMMEL
GALTEN
ODDER
VARDE
JUELSMINDE
MIDDELFART

Exposed, sedimentary coast, England

Chesil beach, S England



Main rivers and deltas


Mississipi delta, Louisiana, USA


Delta coast, Nile, Egypt


Delta coast, Po, Italy


Colville
Makenenzie
Yukon
Copper
Columbia
Colorado
Mississippi
Appalachicola
Magdalena
Orinoco
Amazon
Sao Francisco
Parana
Lena
Ob
Amur
Dnepr
Po
Rhone
Ebro
Volga
Huang Ho
Yangtze
Nile
Tigris Euphrates
Ganges Bramaputra
Indus
Red
Irrawaddy
Mekong
Senegal
Niger
Tana
Congo
Zambeze
Orange
Mahakam
Fly
Purari
Ord
Burdekin
Shoalhaven
Murray
Solid Sediment
Discharge
10^6 Tons
2000
1000
500
250
125
not given

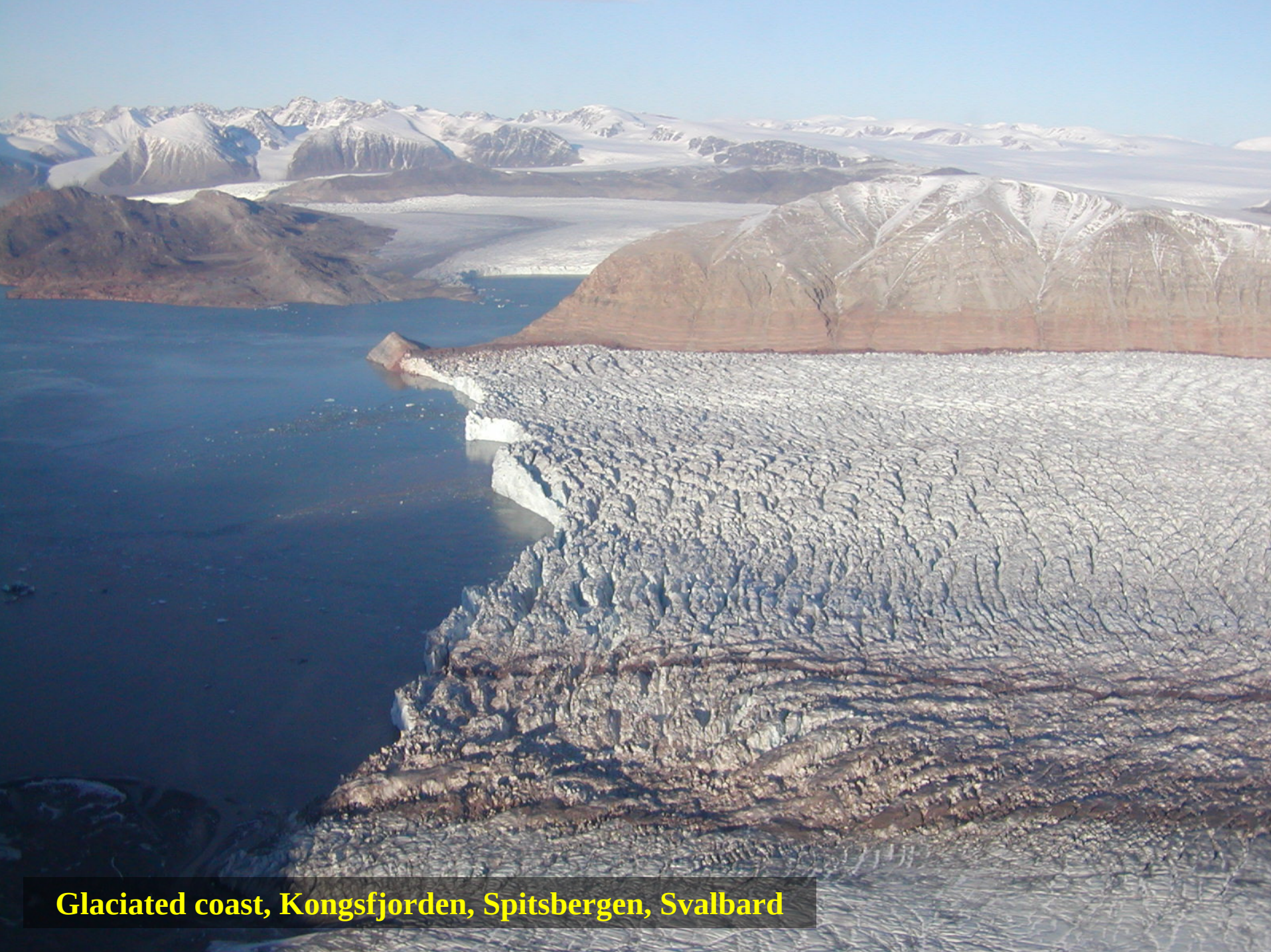
Rias coast with estuary, Chesapeake Bay, USA

Protected mangrove coast, Florida

Coral reef coast, Pacific Ocean


Great Barrier Reef, Australia

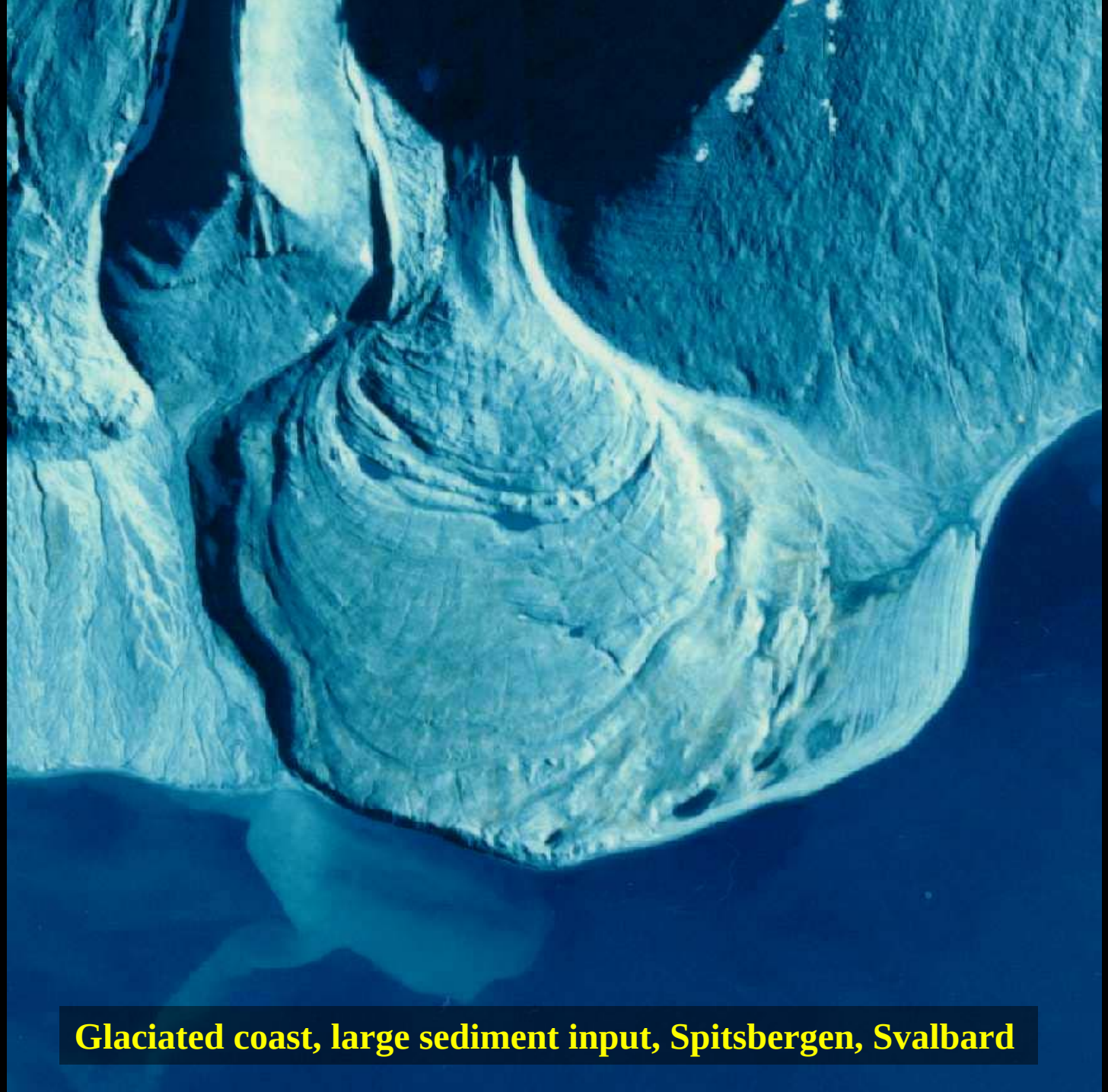

Great Barrier Reef, Australia



Glaciated coast, Kongsfjorden, Spitsbergen, Svalbard

Calving at glaciated coast

Glaciated coast, Kongsfjorden, Spitsbergen, Svalbard



Glaciated coast, large sediment input, Spitsbergen, Svalbard

Glaciated coast, large sediment input from braided rivers, Spitsbergen, Svalbard


Tidal flat

Tidewater channels on tidal flat

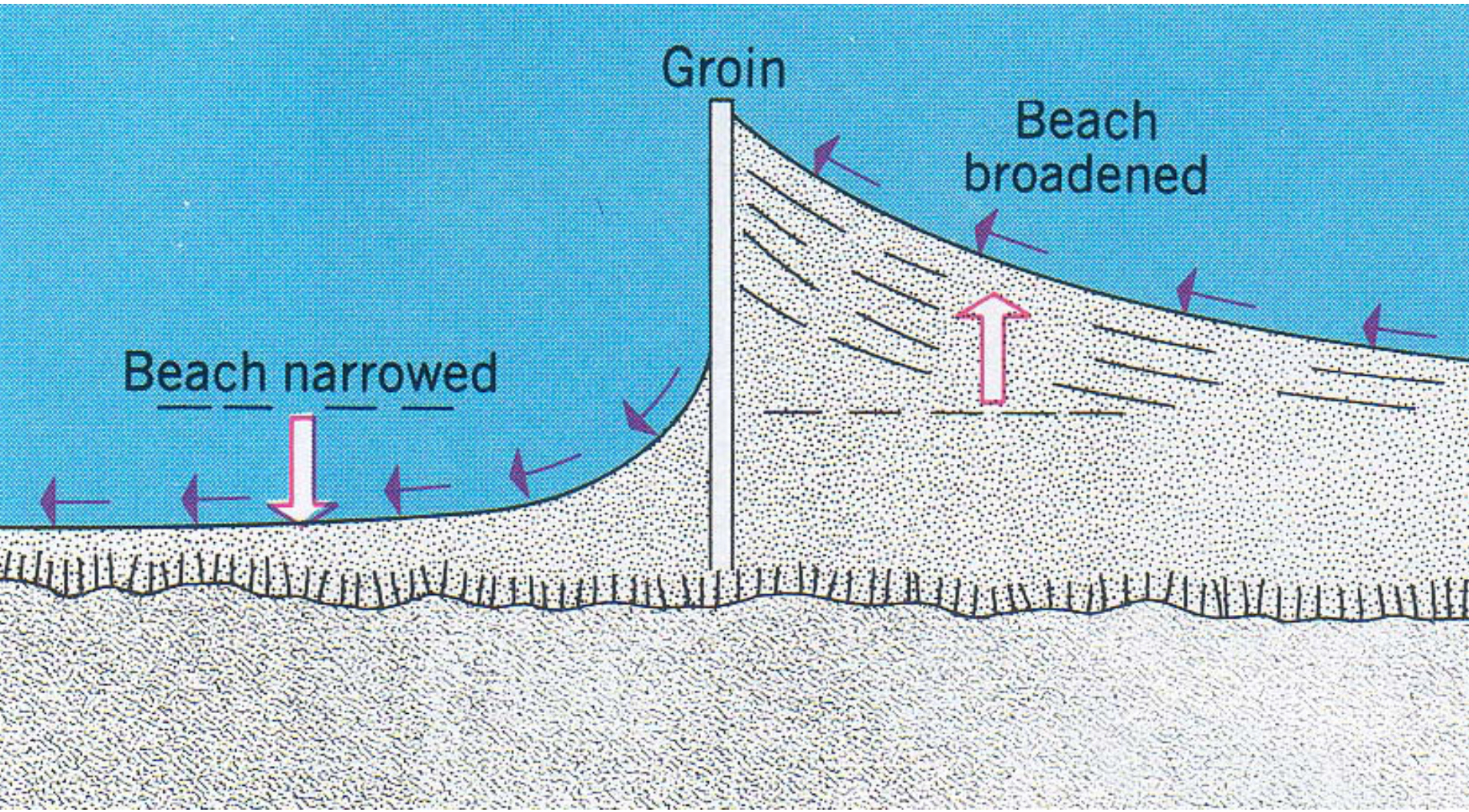
Chesil Beach Shipwreck 1908

Manmade coastline, Copenhagen, Denmark


Falmouth, UK

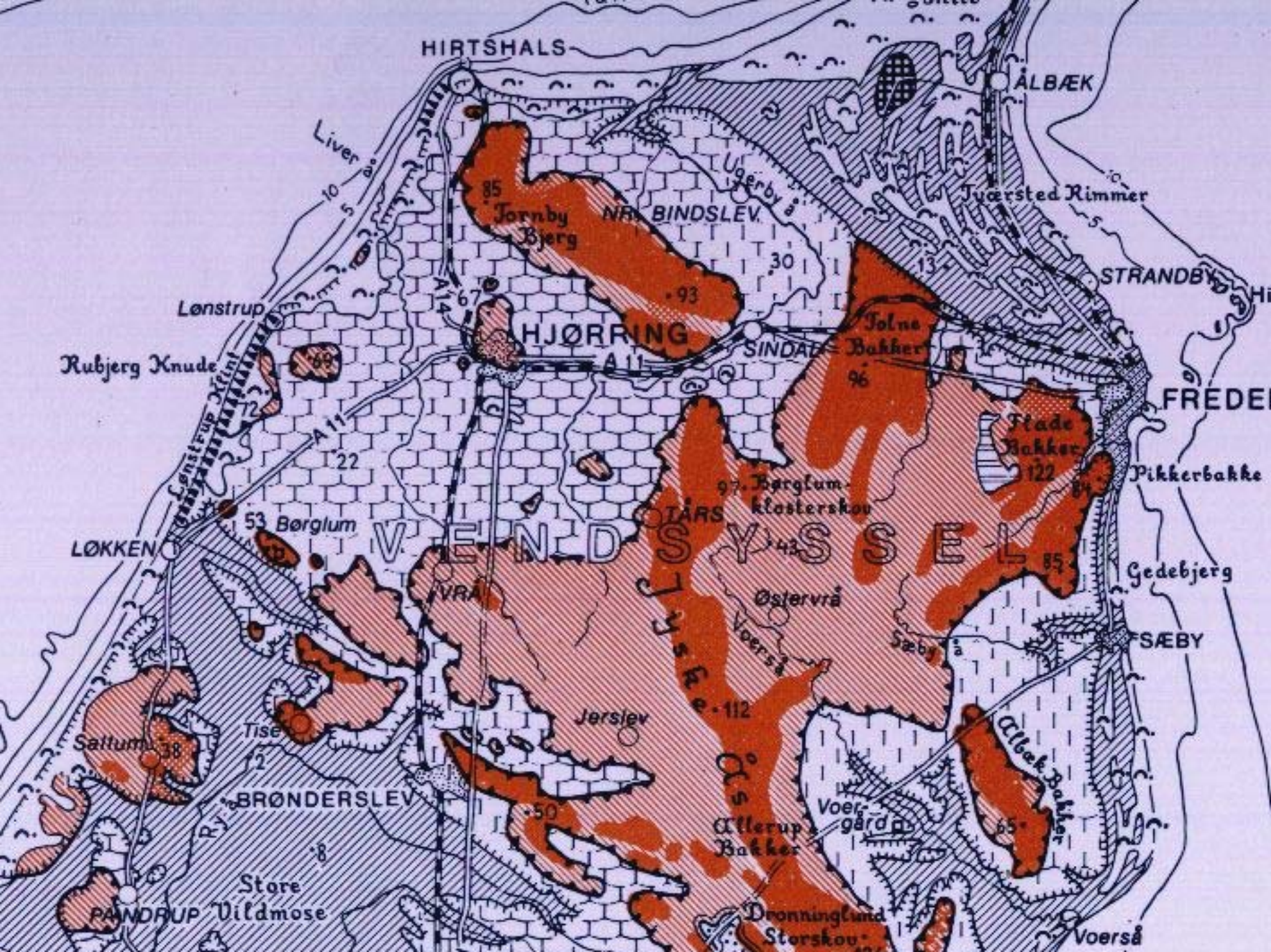
Tyborøn, Denmark

Exposed cliff coast, South Downs, UK


Groin
Beach
broadened
Beach narrowed

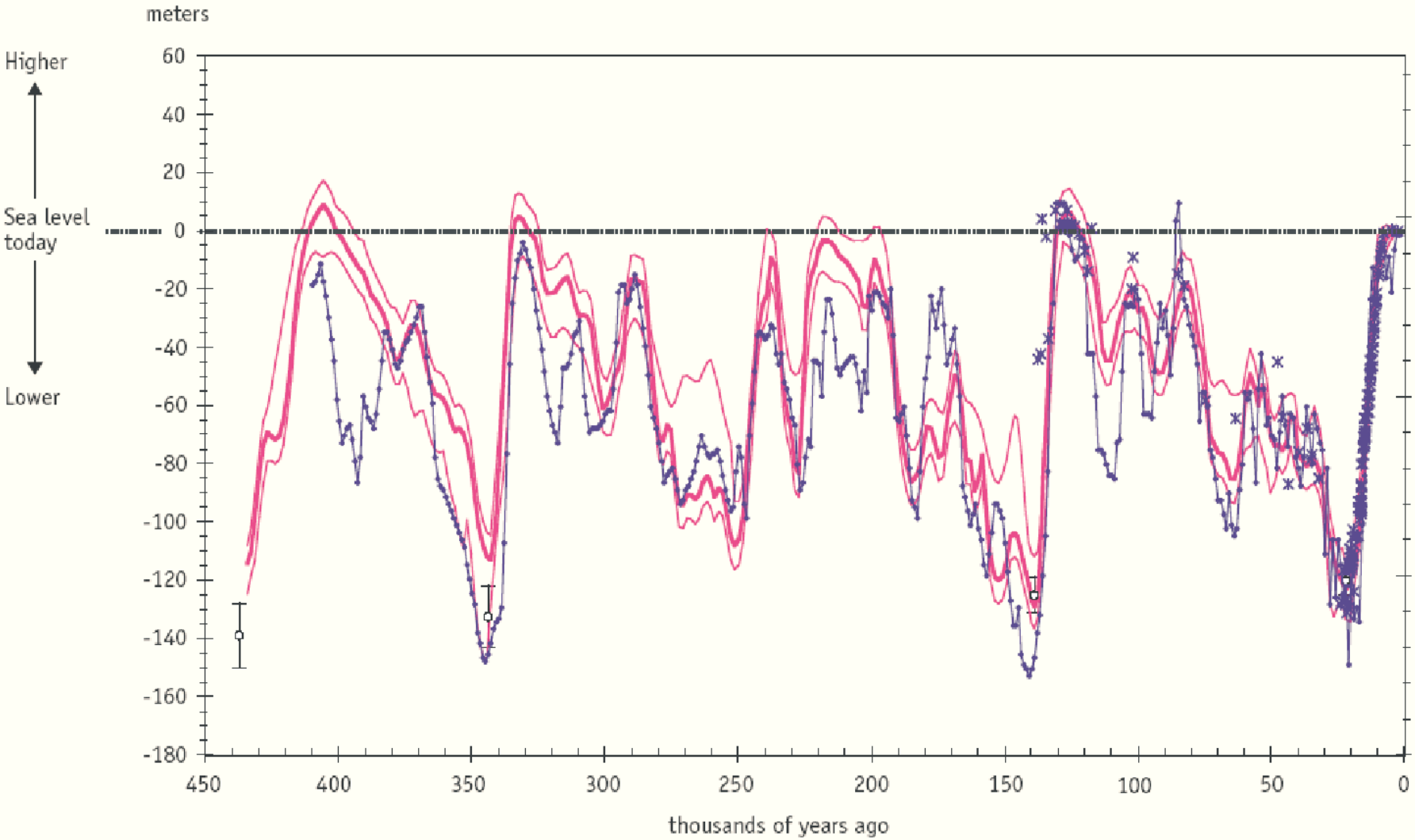
Raised beach, Wester Ross, Scotland

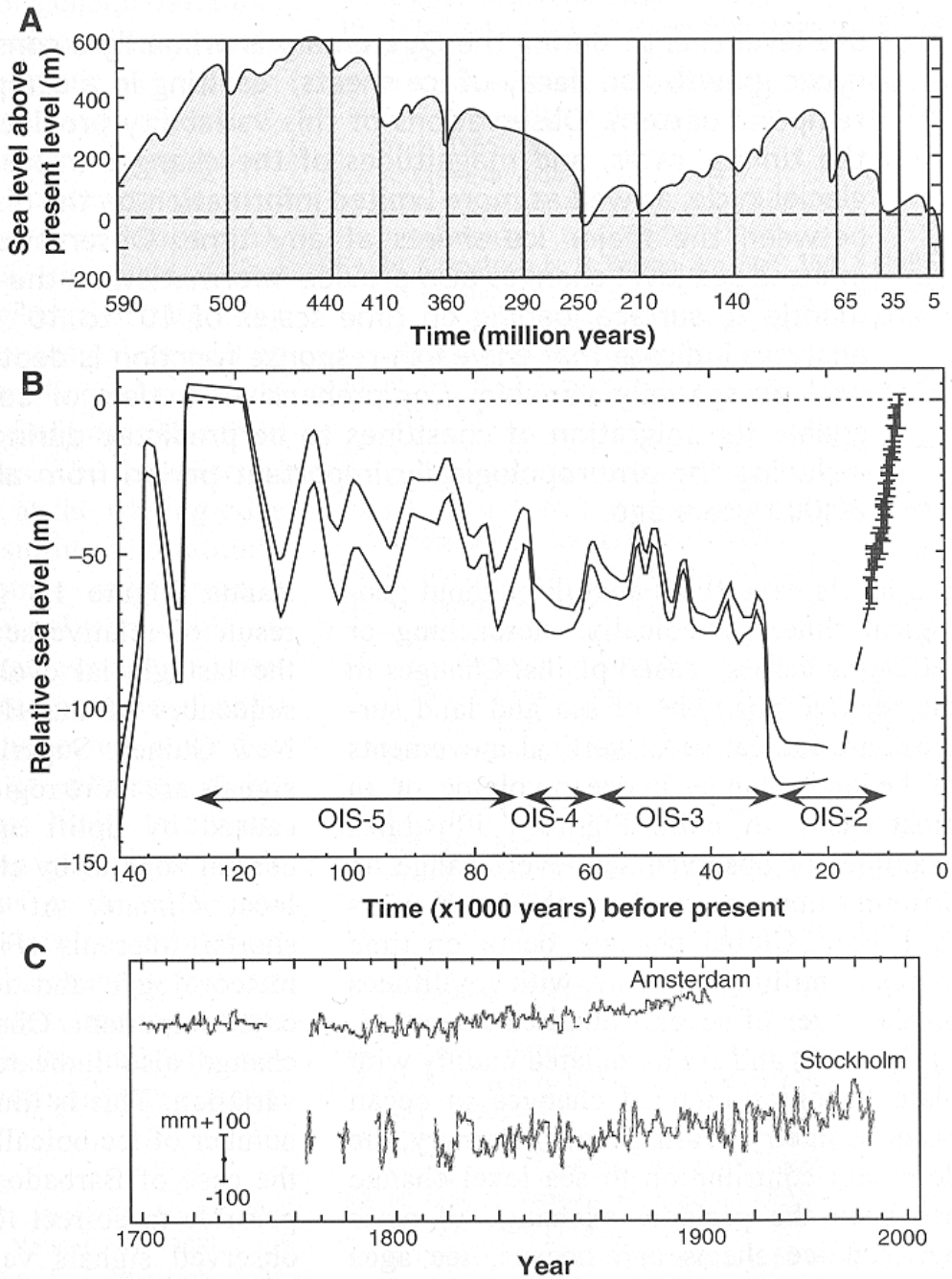
Raised beach, Sjælland, Denmark

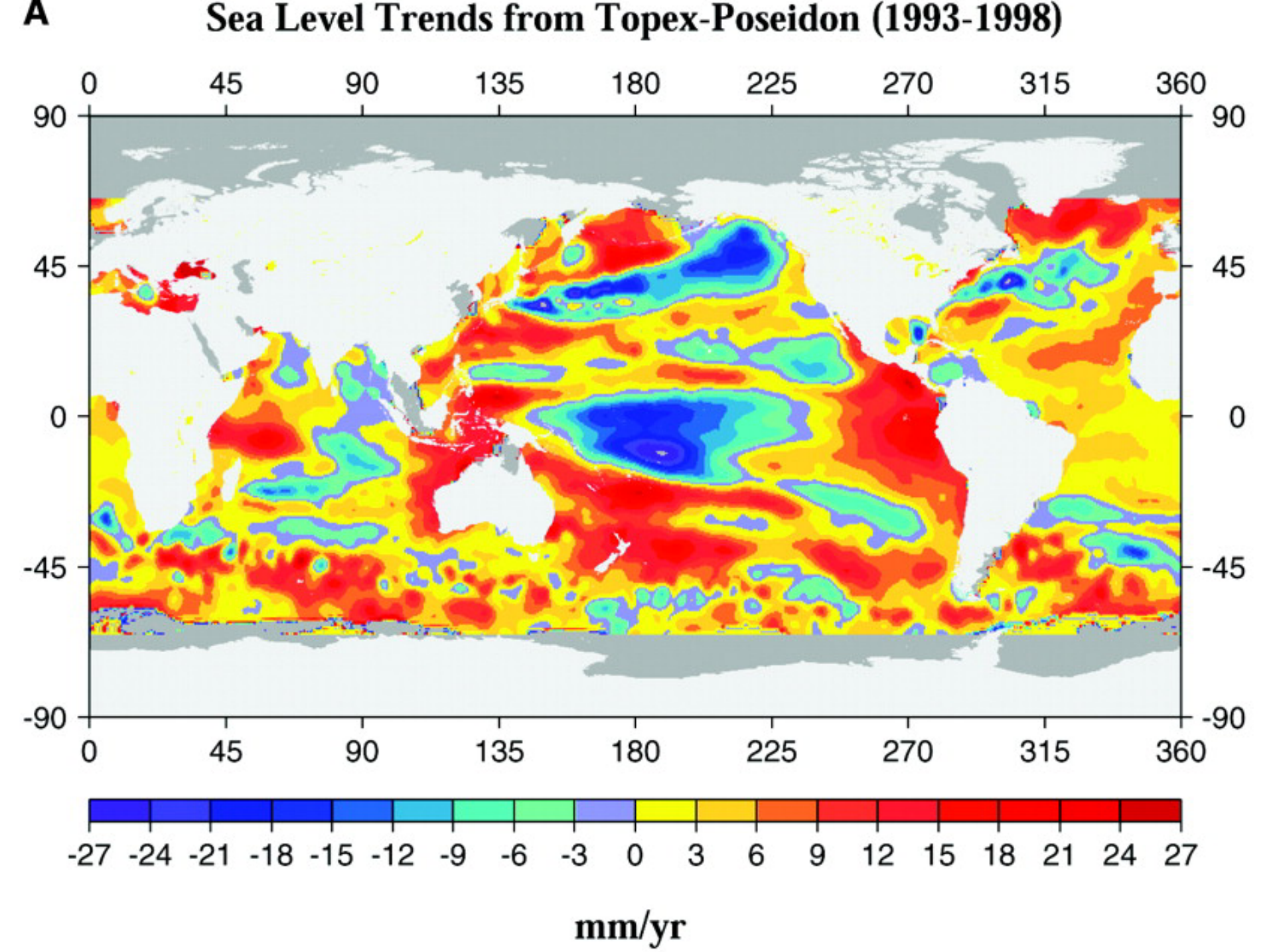

HIRTSHALS
ÅLBÆK
Liver å
Ugerby å
Tværsted Rimmer
Jørnby Bjerg
NR. BINDSLEV
STRANDBY
Lønstrup
HJØRRING
SINDAL
Tolne Bakker
Rubjerg Knude
A11
FREDE
Ttade Bakker
Pikkerbakke
Børglum-klosterskov
TÅRS
53 Børglum
LØKKEN
VENDSYSSEL
Gedebjerg
ØSTERVRÅ
Østervrå
Voers å
SÆBY
Jersiev
Tise
Saltum
BRØNDERSLEV
Ås
Allerup Bakker
Voer-gård
Allerk Bakker
Store Vildmose
PANDRUP
Dronninglund Storskov
Voersø


ice
Arctic Ocean
ice
PGR
(ice)
PGR
(ice)
EUROPE
NORTH AMERICA
PGR
ATLANTIC OCEAN
AFRICA
Pacific
Ocean
1,400
n.miles
SOUTH AMERICA
South
Atlantic

Sea level changes over four glacial cycles




A
Sea level above present level (m)
600
400
200
0
–200
590
500
440
410
360
290
250
210
140
65
35
5
Time (million years)
B
Relative sea level (m)
0
–50
–100
–150
OIS-5
OIS-4
OIS-3
OIS-2
140
120
100
80
60
40
20
0
Time (x1000 years) before present
C
Amsterdam
Stockholm
mm +100
-100
1700
1800
1900
2000
Year


A
Sea Level Trends from Topex-Poseidon (1993-1998)
0
45
90
135
180
225
270
315
360
90
45
0
-45
-90
-27
-24
-21
-18
-15
-12
-9
-6
-3
0
3
6
9
12
15
18
21
24
27
mm/yr