Reading Material

See class website

“Sediments”, from “Oceanography”
M.G. Gross, Prentice-Hall

Distribution of Marine Sediments

Lithogenic sediment

dominates near continents (shelf, slope, rise)
because source from land
glacial at high latitudes, fluvial at all latitudes

Biogenic sediment

dominates away from lithogenic sediments, usually away from continents
(exception: calcareous sediment can dominate shallow low-latitude areas)

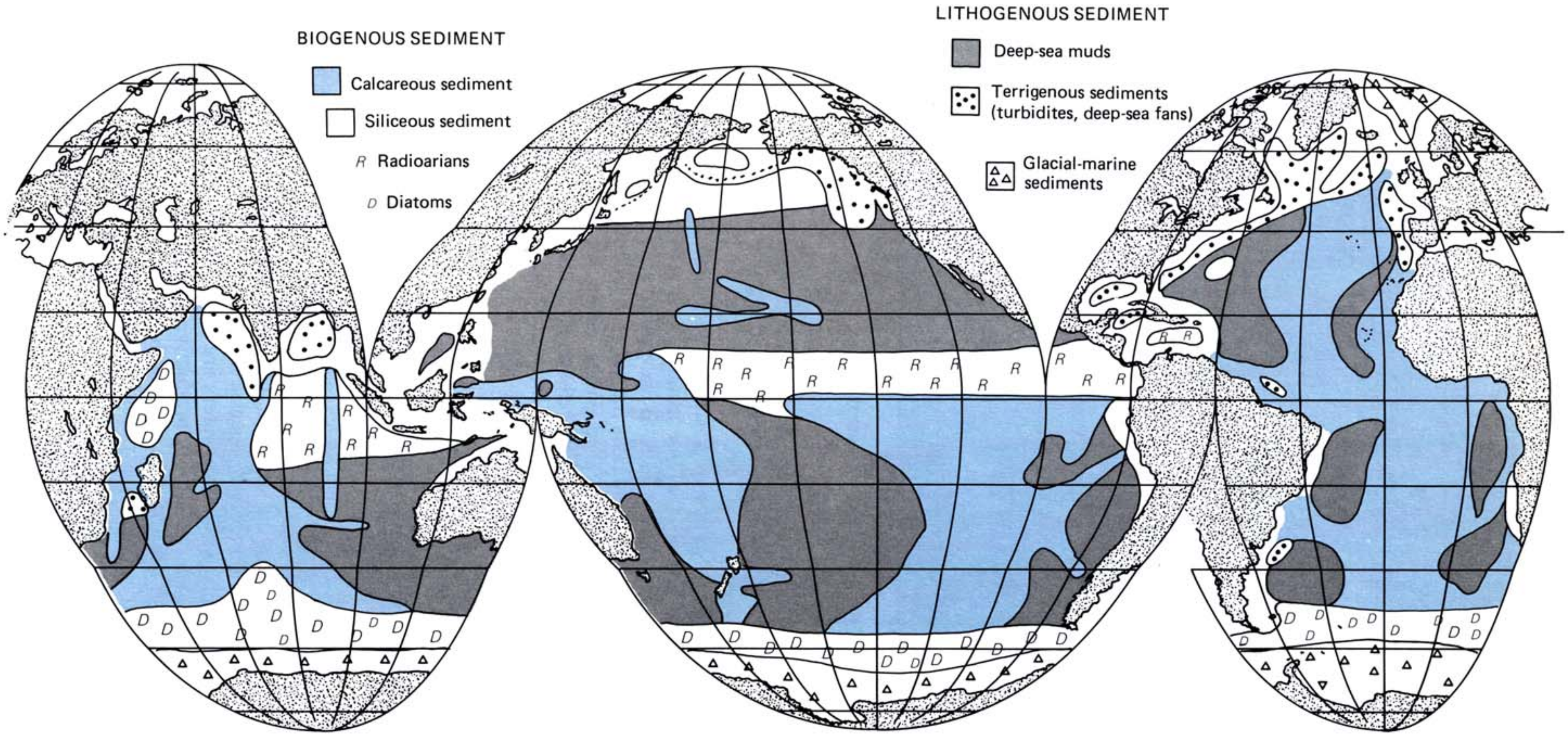
calcareous sediment (foraminifera) found on flanks of mid-ocean ridges
because it dissolves in water >4000 m deep

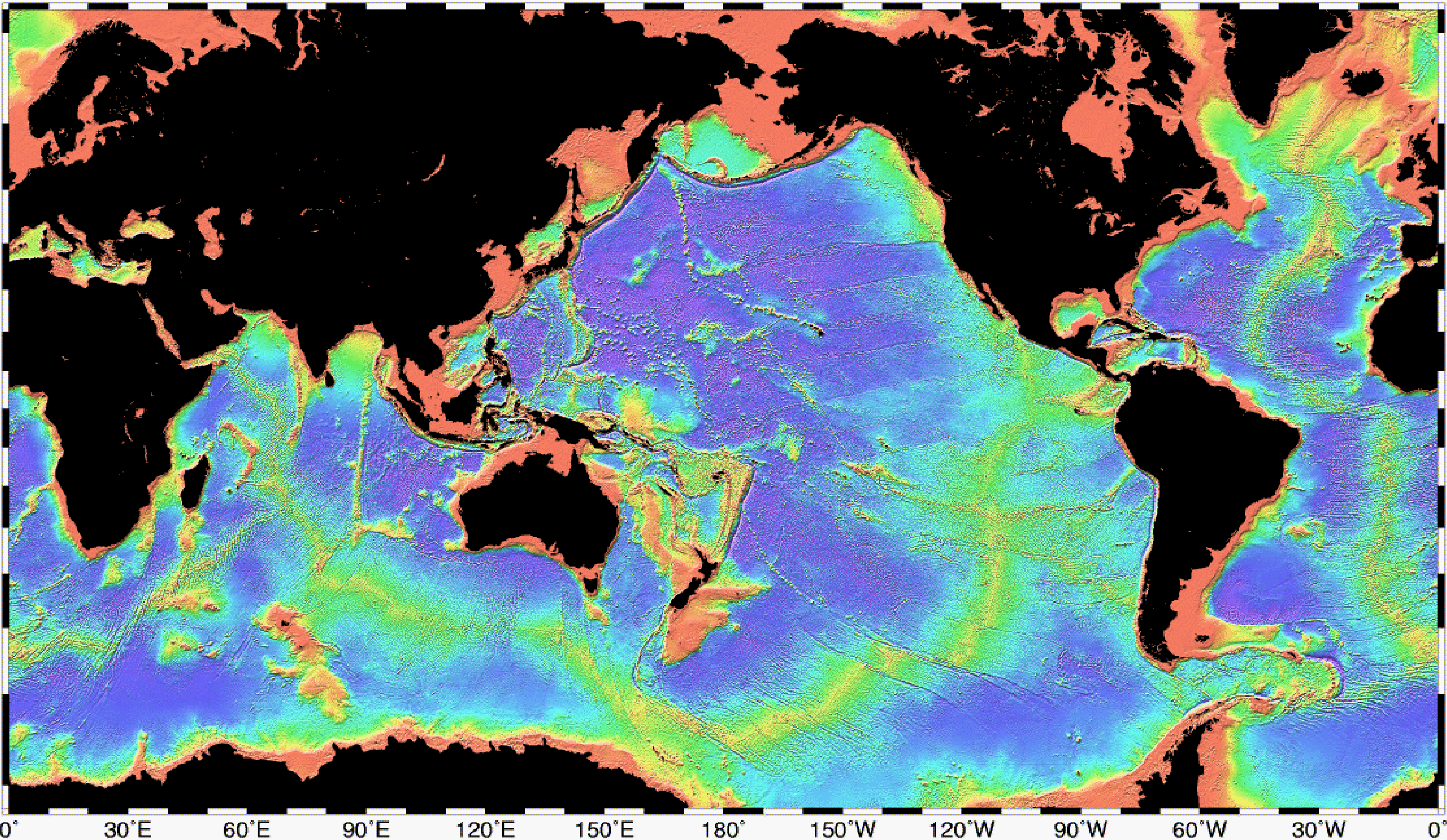
siliceous sediment found where nutrient supply is great
nutrients stimulate marine productivity (diatoms, radiolarians)

Authigenic sediment and red clay

dominates away from continents, in water depths >4000 m, not high prod
because they are overwhelmed everywhere else by lithogenic and biogenic

Deep-sea sediments




0°
30°E
60°E
90°E
120°E
150°E
180°
150°W
120°W
90°W
60°W
30°W
0°

Sea-Level Change

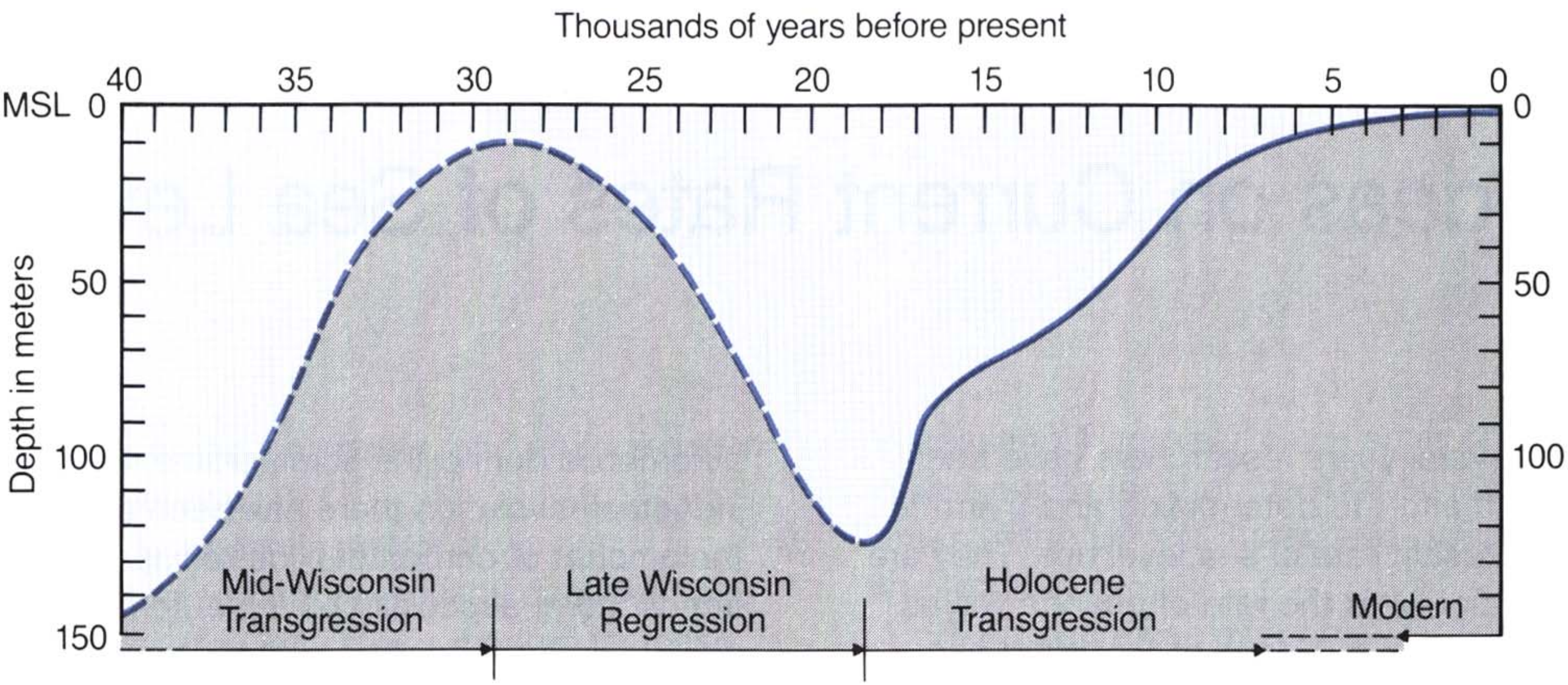
Time scales of ~10,000 years

Sea level fluctuates due to climate change

Cold periods
- more precipitation as snow (not rain)
- more snow remains for multiple years, ice sheets form miles thick
- evaporation continues from oceans, but return as runoff reduced
- cold temperatures cause sea water to contract
- sea level drops

Warm periods
- less precipitation as snow
- glaciers melt
- warm temperatures cause sea water to expand
- sea level rises

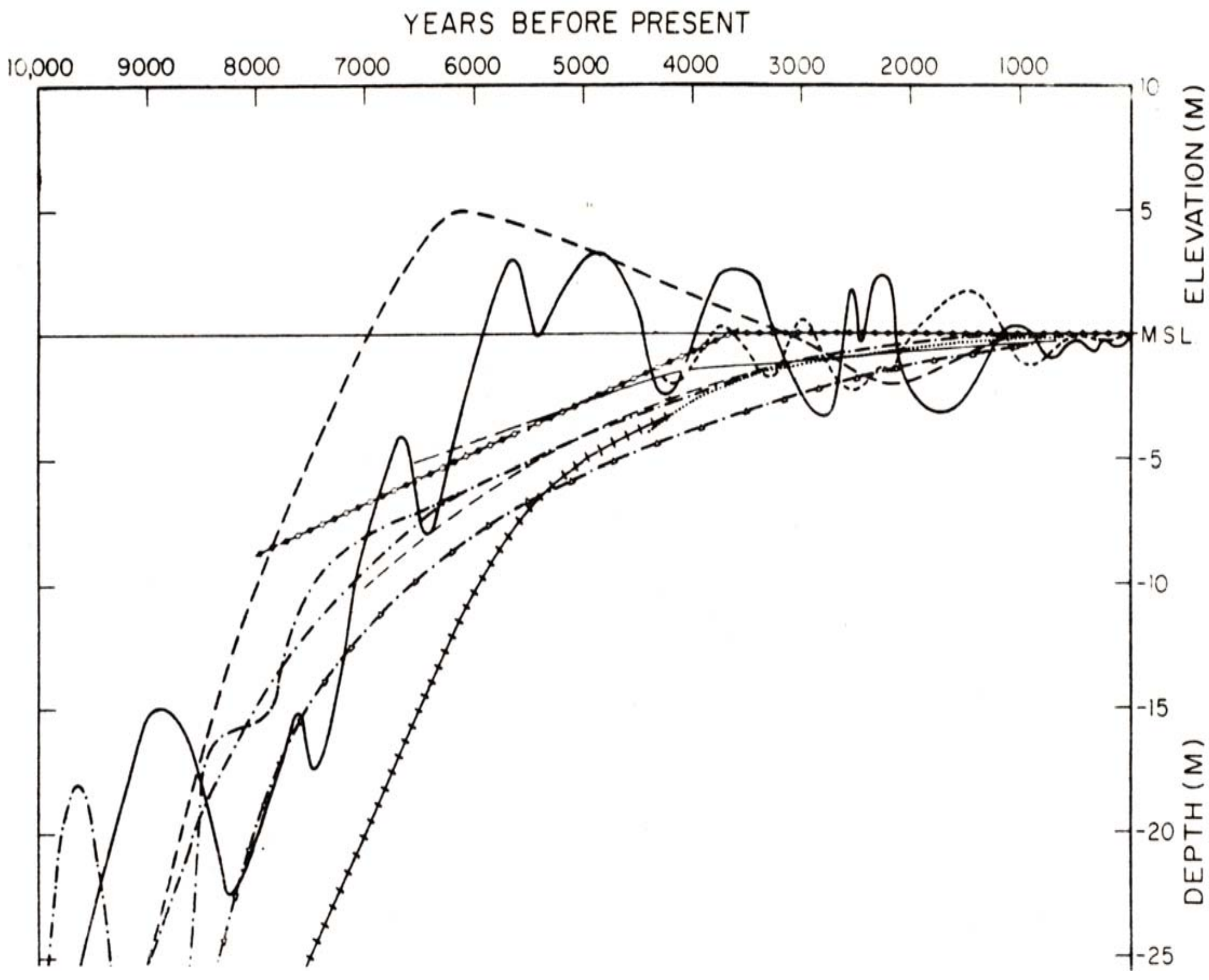
Sea-Level Change
Past 40,000 y



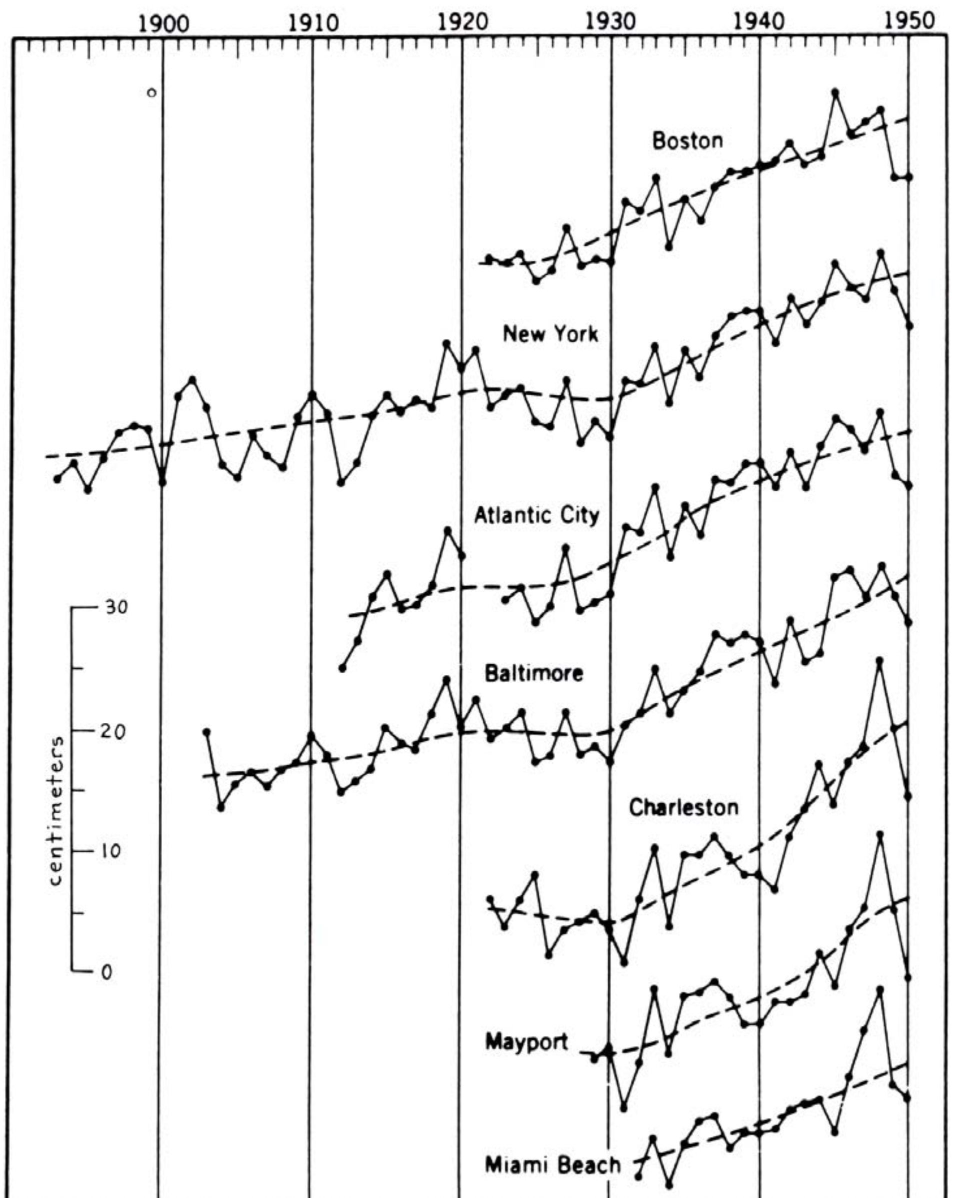
Holocene = past 20,000 y, when sea level was rising

Transgression = transfer of shoreline landward

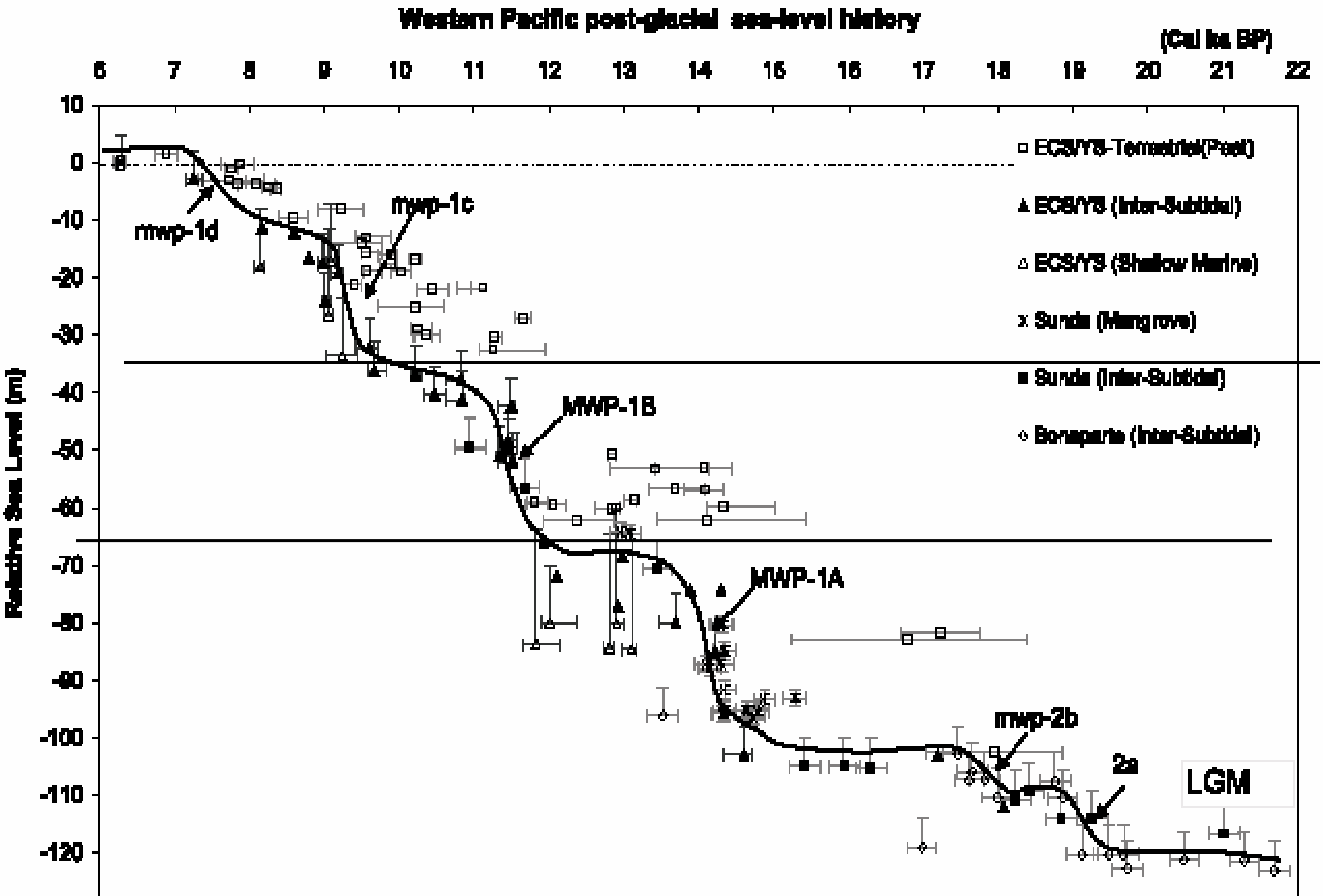
Sea-Level Rise
Past 10,000 y



Recent Sea-Level Rise



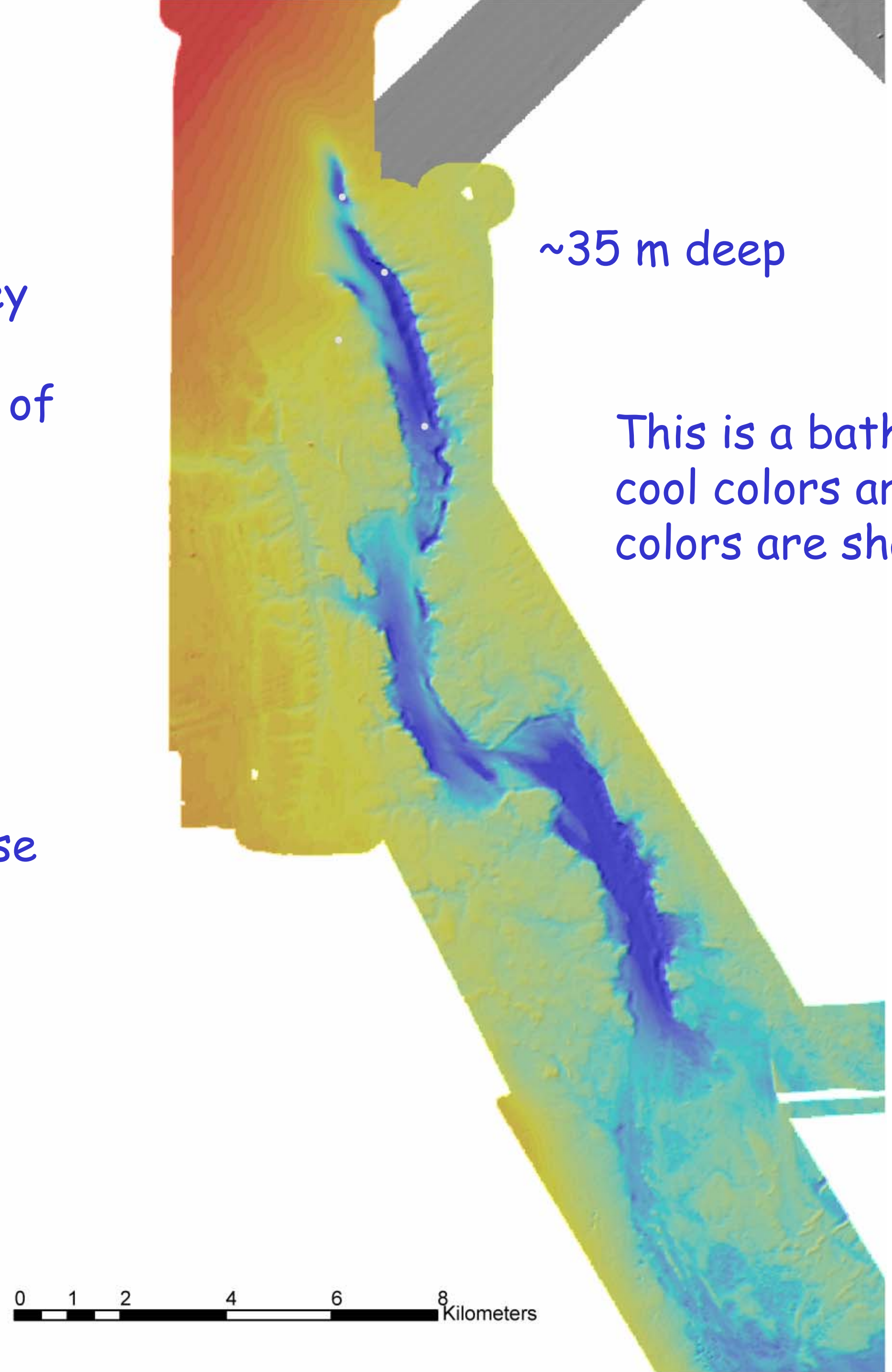
Example of step-wise sea-level rise




Sepik River Mouth
Irian Jaya
Northeast Coast
PNG
Fly River
Mouth
Markham River Mouth
Arafura Sea
Gulf of
Papua
Gulf of
Carpentaria
300 km
N

Flooded river valley on the continental shelf – in the Gulf of Papua (between Australia and New Guinea)

This valley might have been flooded quickly by step-wise sea-level rise



~35 m deep

This is a bathymetric chart, cool colors are deep, warm colors are shallow

~65 m deep

Holocene Rise in Sea Level

Cold period (ice age) ends ~20,000 years ago

Sea level stood ~130 m below present sea level
at edge of continental shelf (shelf break)

Global sea level rose quickly (~10 mm/y) until ~7000 years ago

Rate of global rise has been slow (~2 mm/y) since then

Sea-level change along any particular coast depends also upon land movement
plate tectonics
sediment consolidation (e.g., deltas sink)
glacial rebound (weight of glaciers removed, land rises)

Continental-Margin Sedimentation during Low Sea Level

Rivers and glaciers cross continental shelf to shelf break

Much sediment supplied at top of steep slope
creates unstable sediment

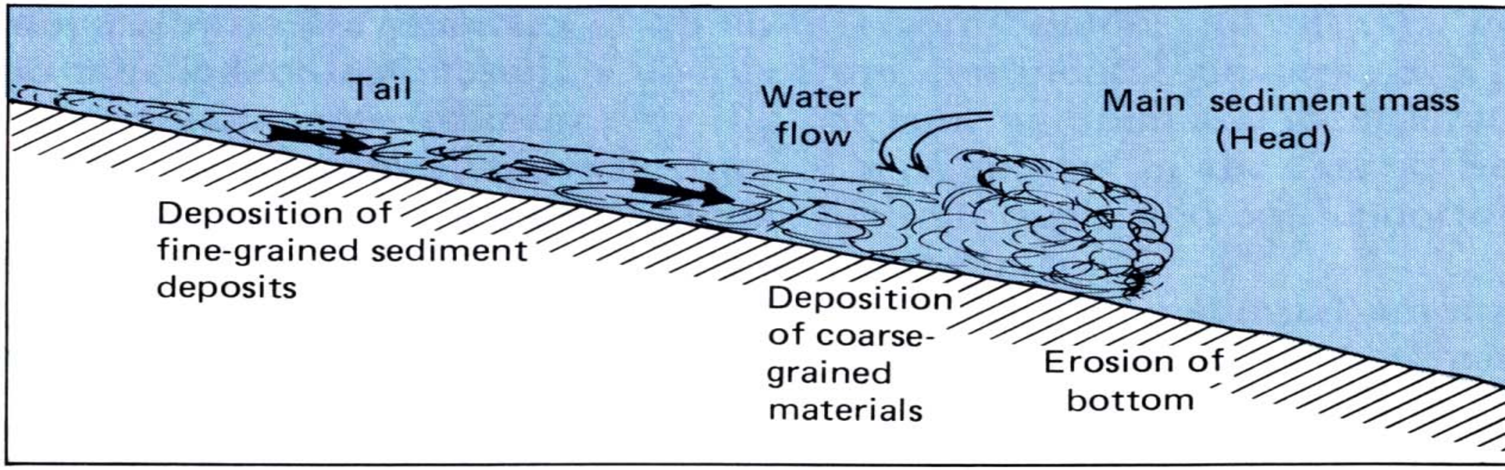
Large storms or earthquakes trigger underwater landslides

Slurry of sediment moves down continental slope
known as "turbidity currents" and "debris flows"

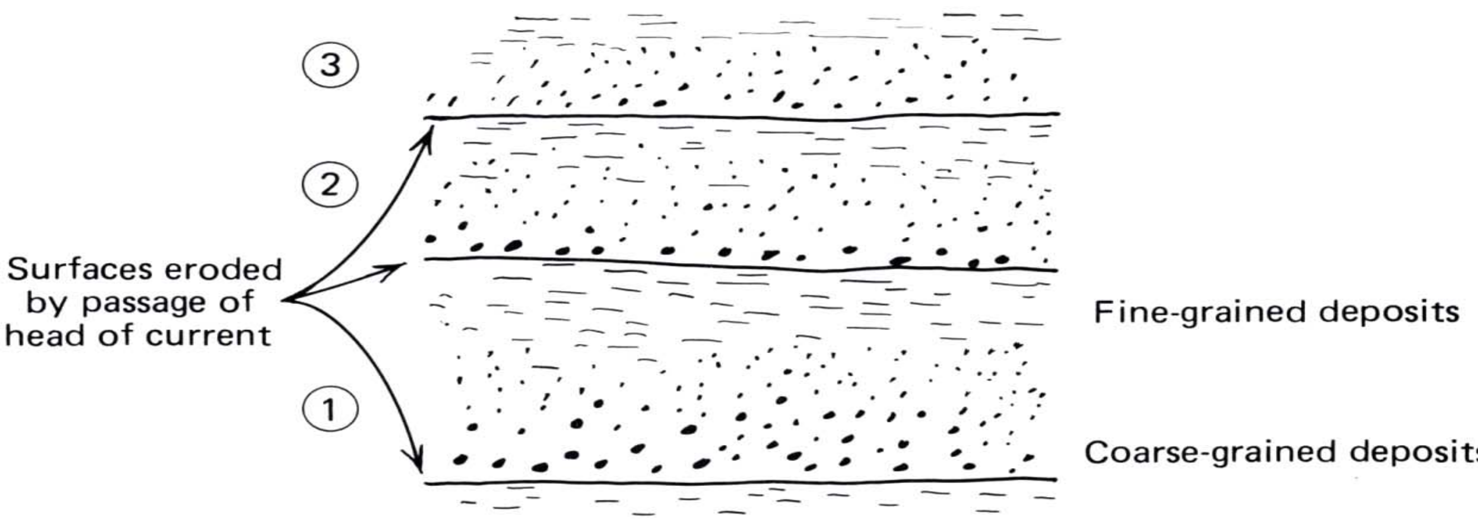
Erodes seabed on continental slope
forms submarine canyons

Deposits sediment on continental rise and abyssal plains
creates layers known as "turbidites"

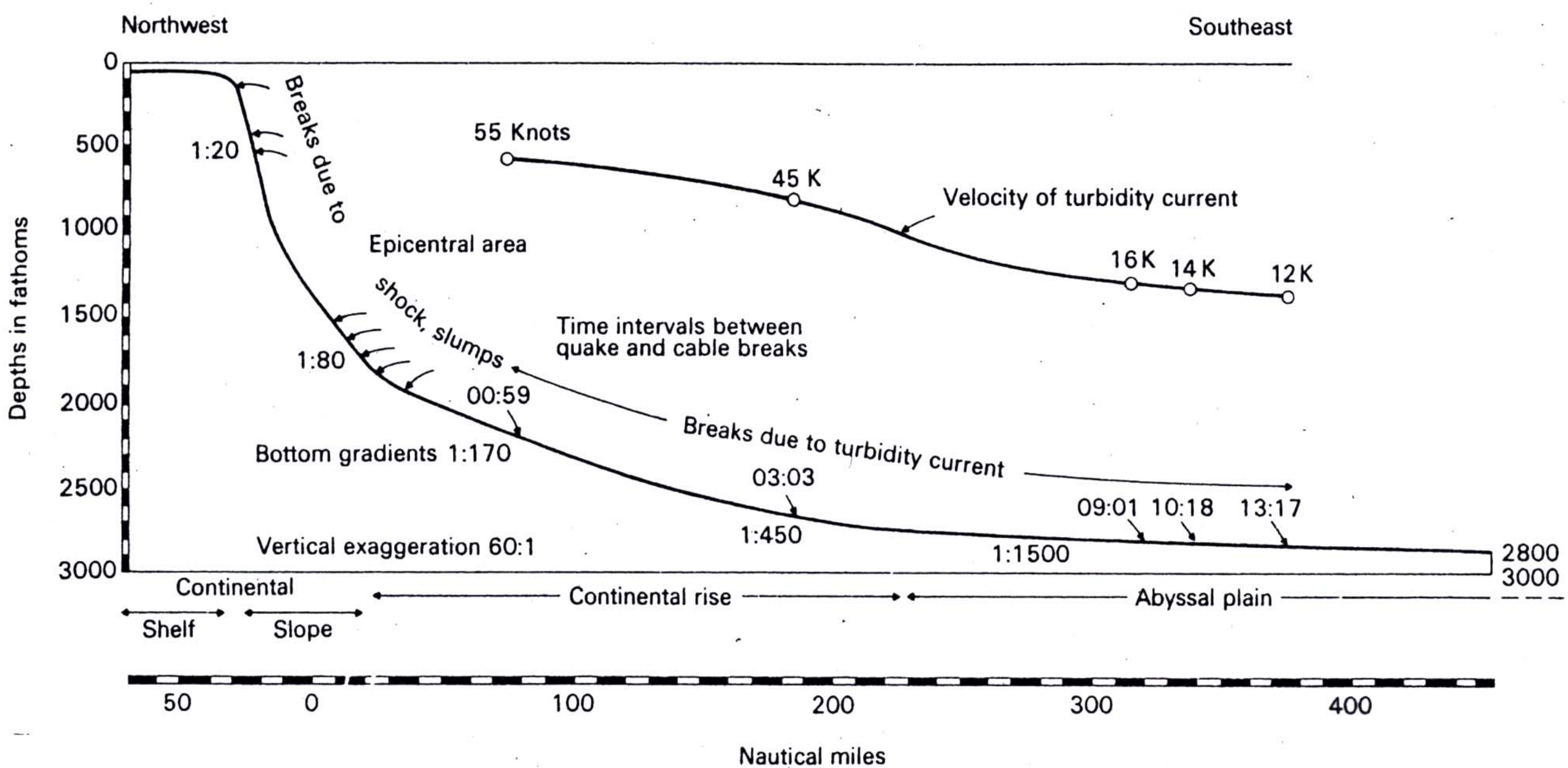
Turbidity Current and resulting Turbidite



(a)



1929 Grand Banks turbidity current



Continental-Margin Sedimentation during High Sea Level

Fluvial and glacial valleys flooded

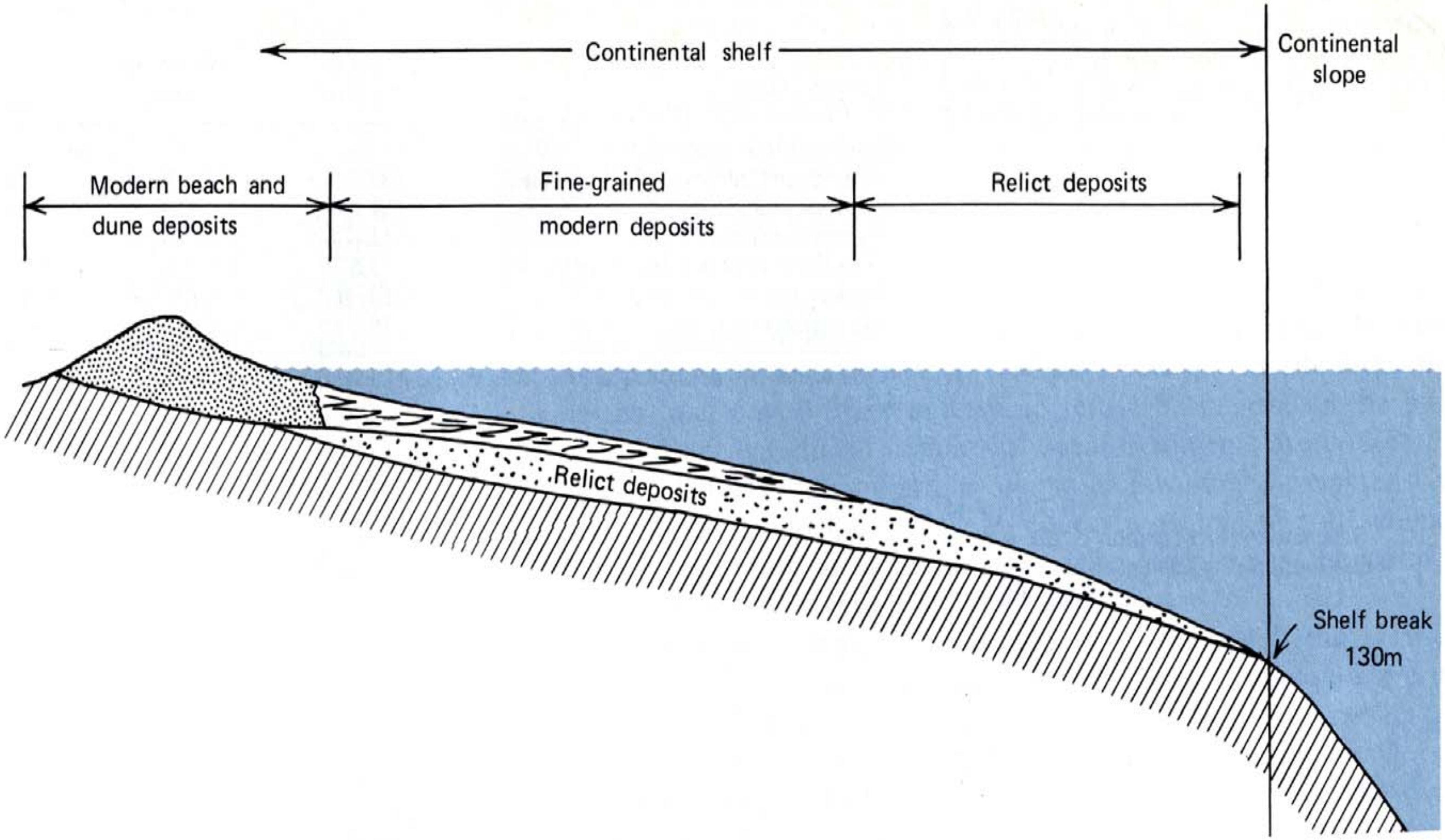
Sediments trapped in river-mouth estuaries and fjords

If much sediment supplied, estuaries and fjords are filled
- deltas formed

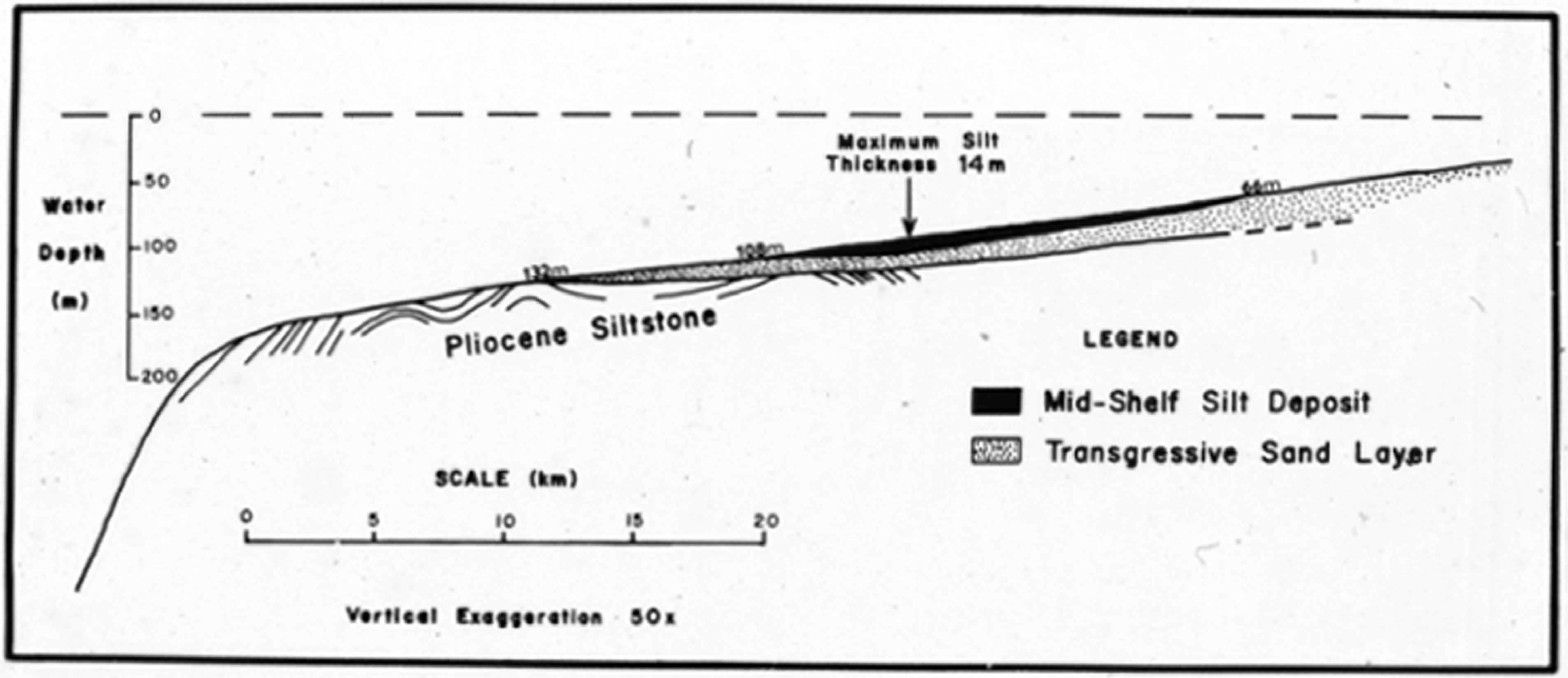
Sediment can escape to continental shelf
- mud winnowed by waves
- leaving sand nearshore
- mud transported to middle shelf

On collision margins (narrow, steep shelf)
- sediment can escape to continental slope

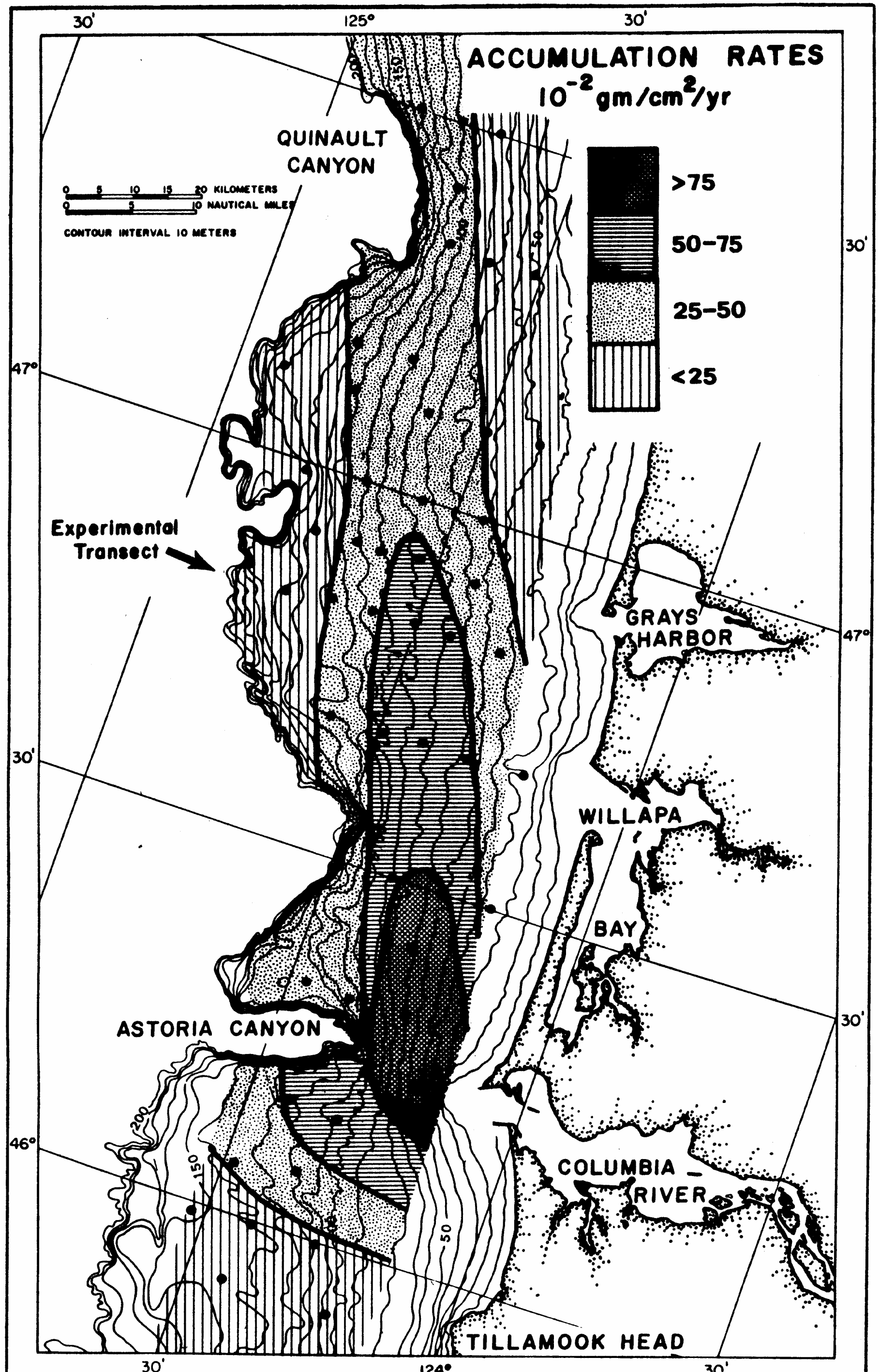
Holocene deposits (<20,000 y) on continental shelves



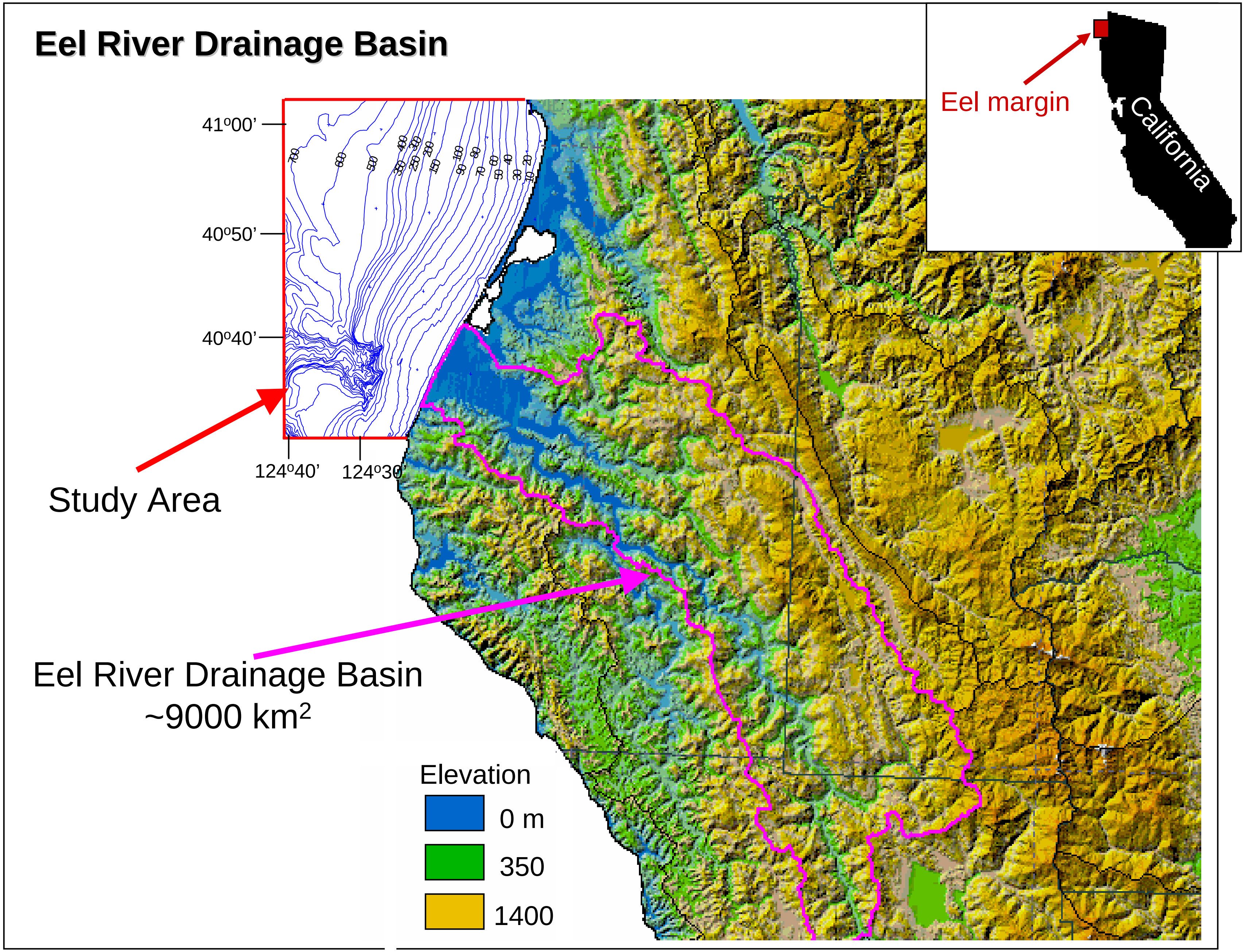
Note: boundary between modern inner-shelf sand and modern mid-shelf mud depends on waves

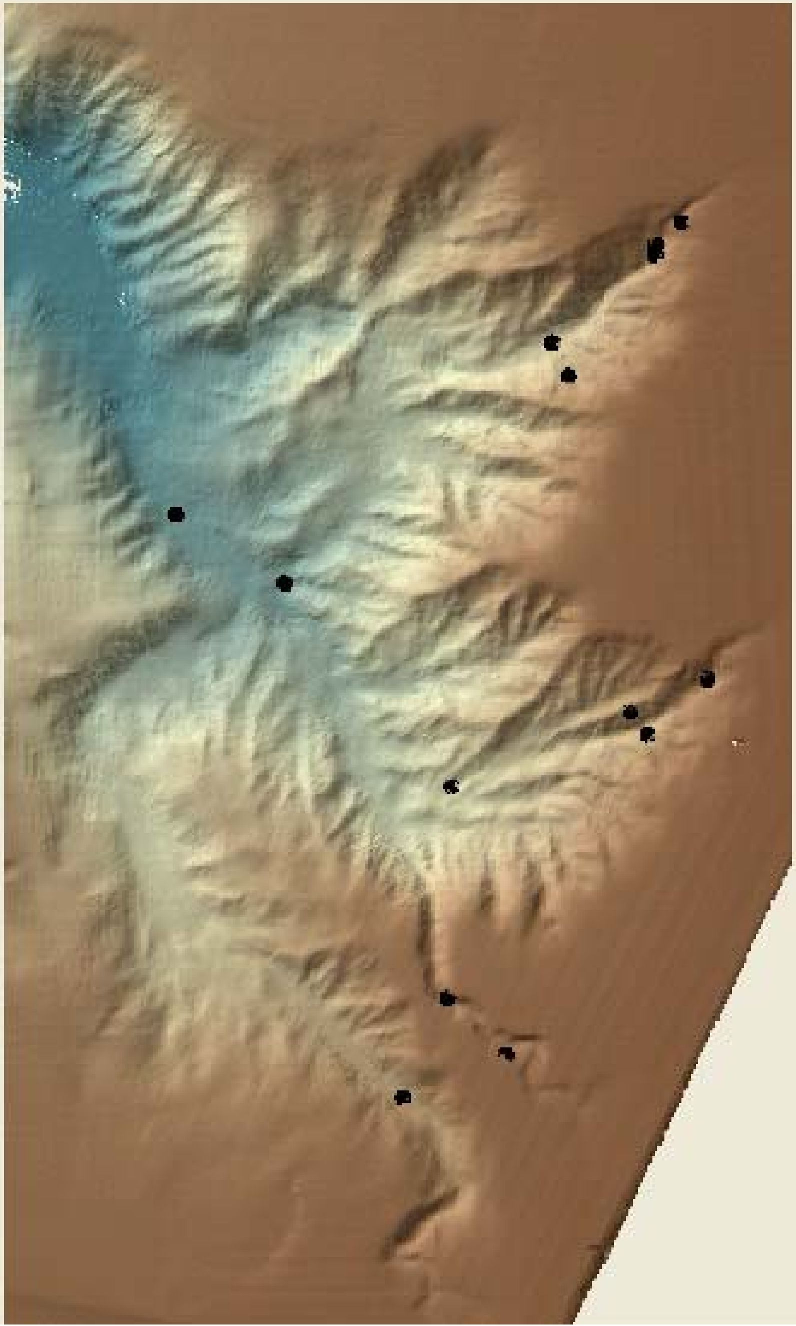


Washington continental shelf


ACCUMULATION RATES
10^{-2} gm/cm^2/yr
>75
50-75
25-50
<25
0 5 10 15 20 KILOMETERS
0 5 10 NAUTICAL MILES
CONTOUR INTERVAL 10 METERS
QUINAULT CANYON
Experimental Transect
GRAYS HARBOR
WILLAPA
BAY
ASTORIA CANYON
COLUMBIA RIVER
TILLAMOOK HEAD
125°
124°
47°
46°
30'
200
150
100
50

Eel River Drainage Basin





Eel Canyon, northern California

Multiple entrants that are presently receiving sediment and experience many turbidity currents each year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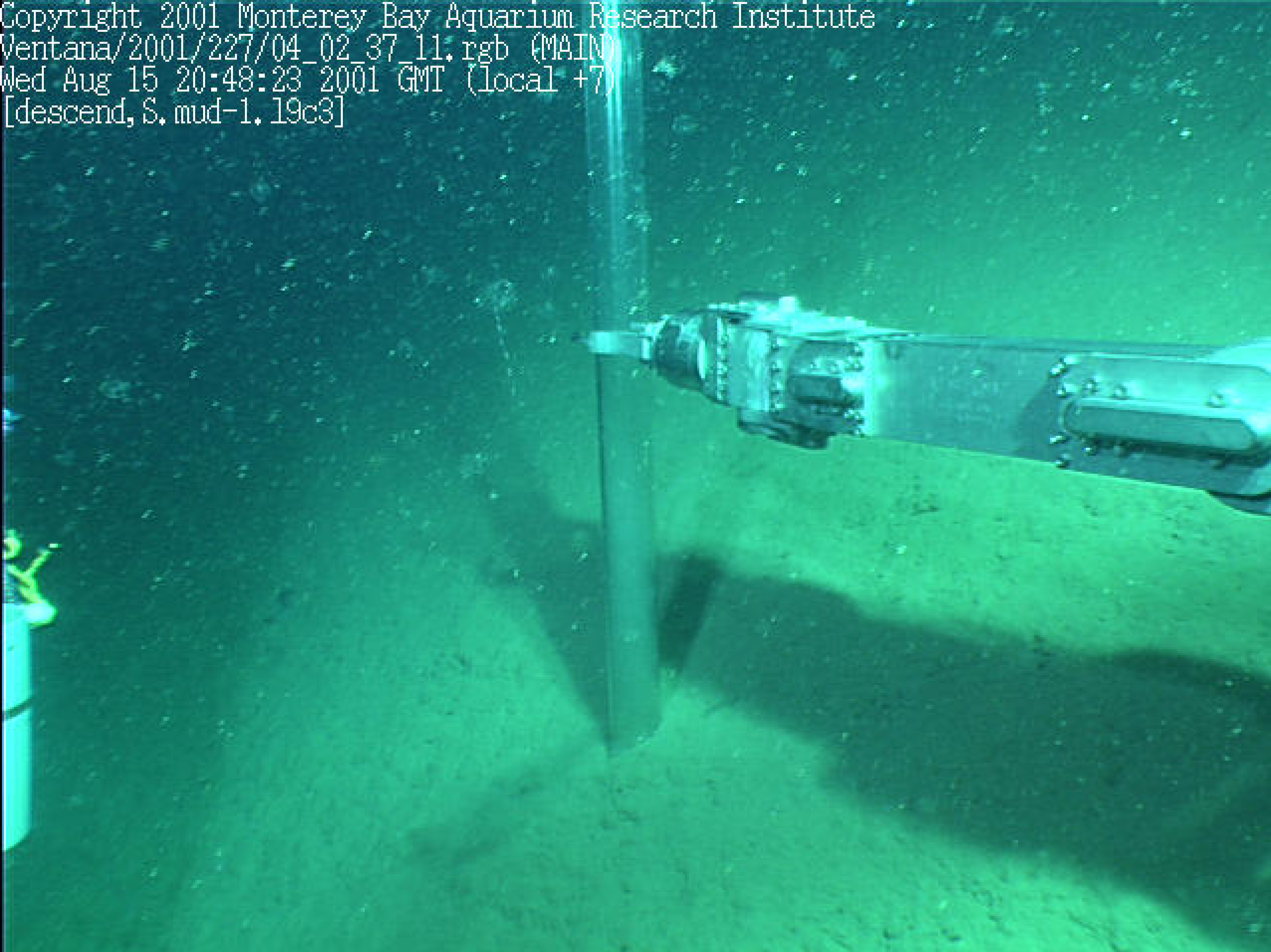
Copyright 2001 Monterey Bay Aquarium Research Institute
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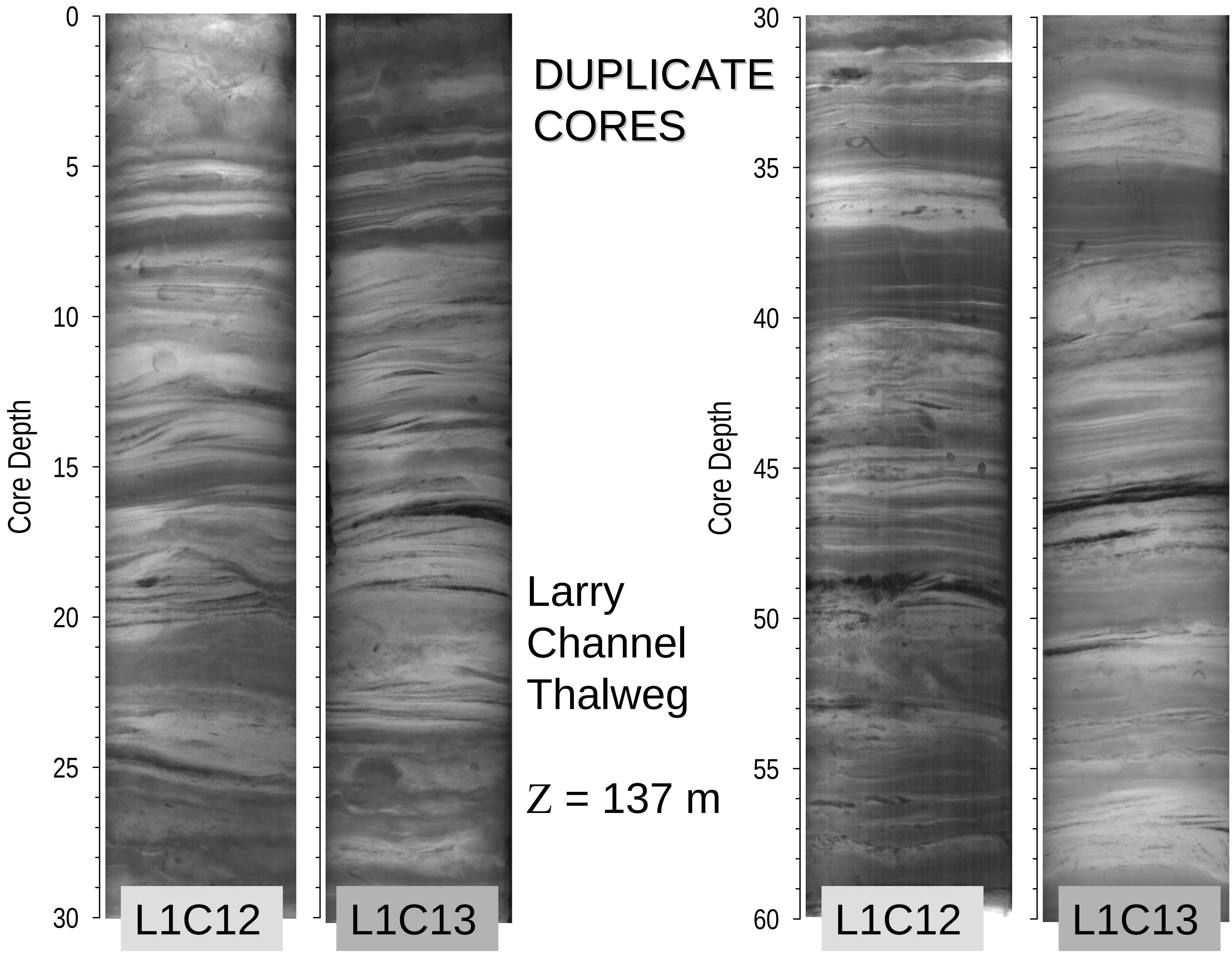
DUPLICATE
CORES
Larry
Channel
Thalweg
Z = 137 m
Core Depth
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5
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15
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45
50
55
60
L1C12
L1C13
L1C12
L1C13


Sepik River Mouth
Irian Jaya
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PNG
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Gulf of
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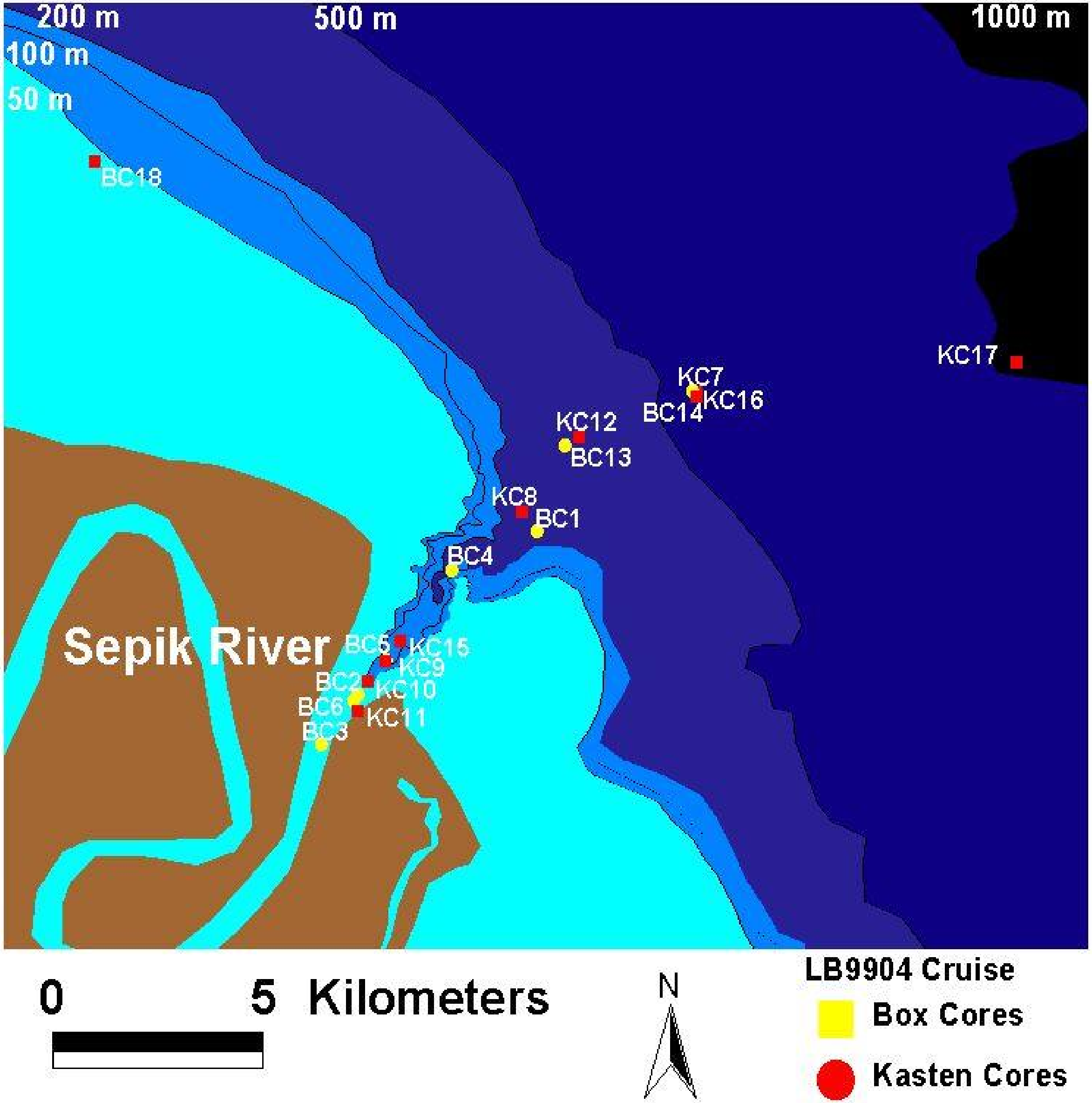
Carpentaria
300 km
N

Sepik Canyon enters the mouth of Sepik River (north coast of New Guinea)

Sediment from the river supplies many turbidity currents each year



Sepik Canyon turbidites