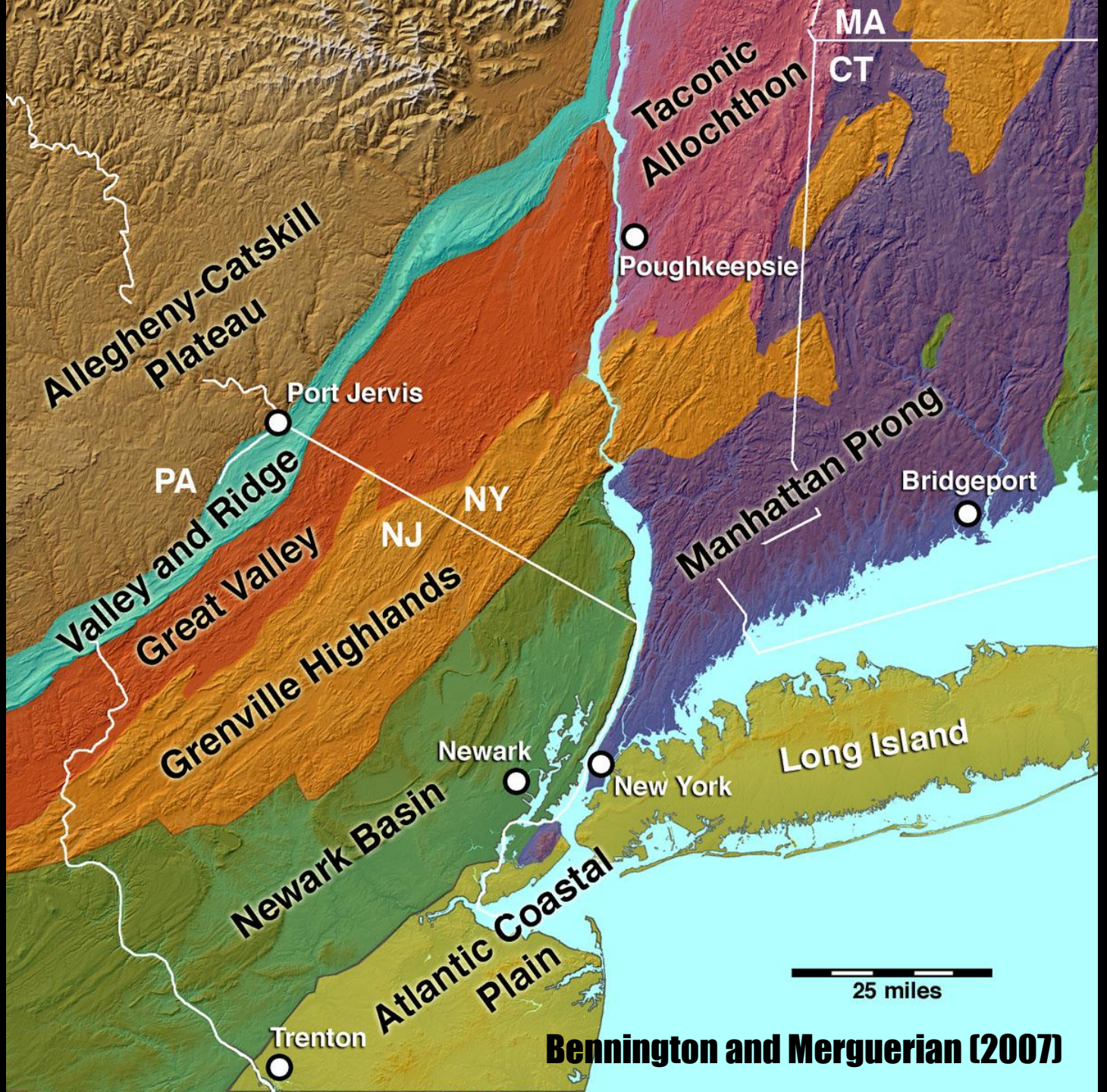
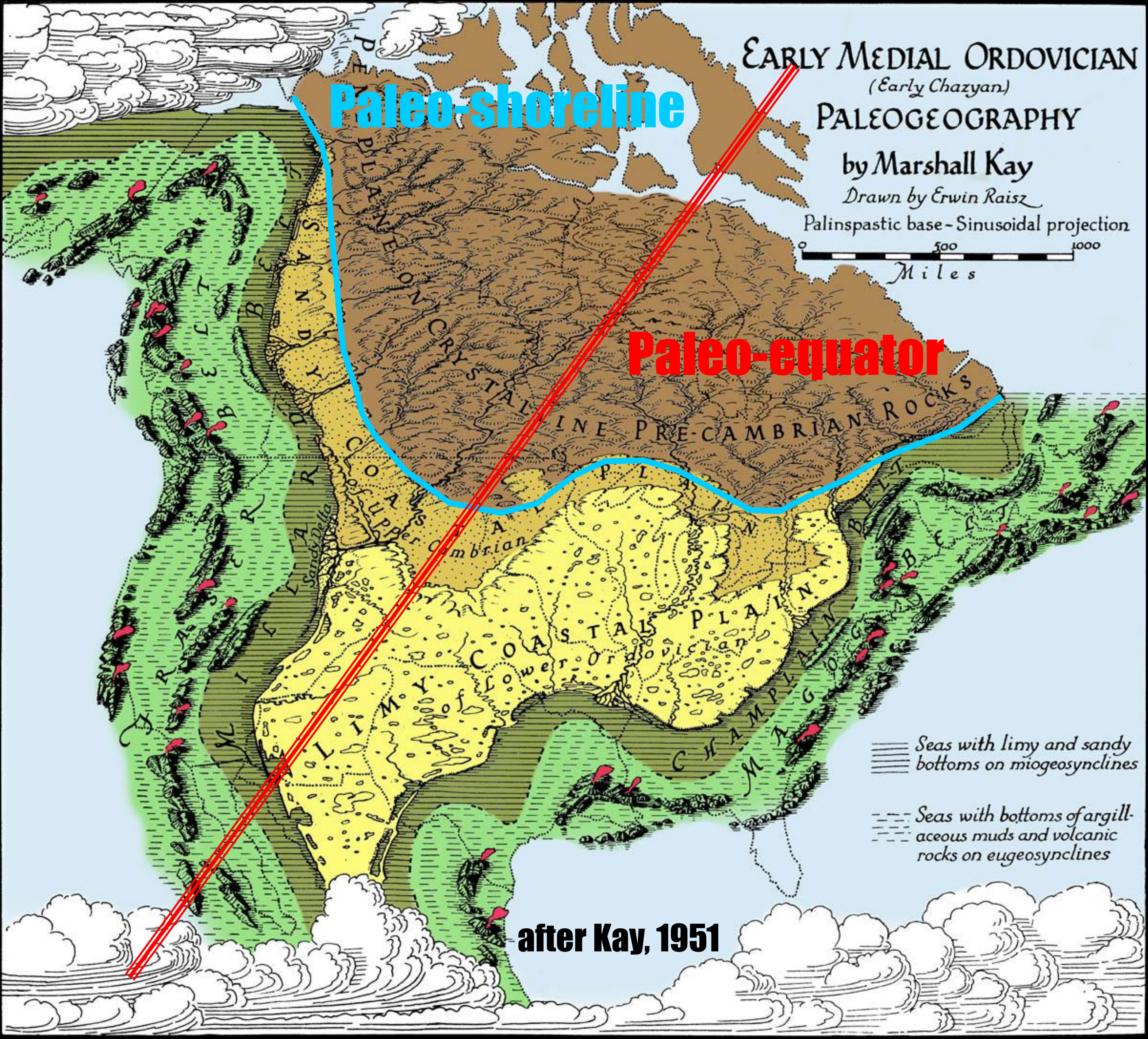
Bedrock and Glacial Geology of New York City

Charles Merguerian

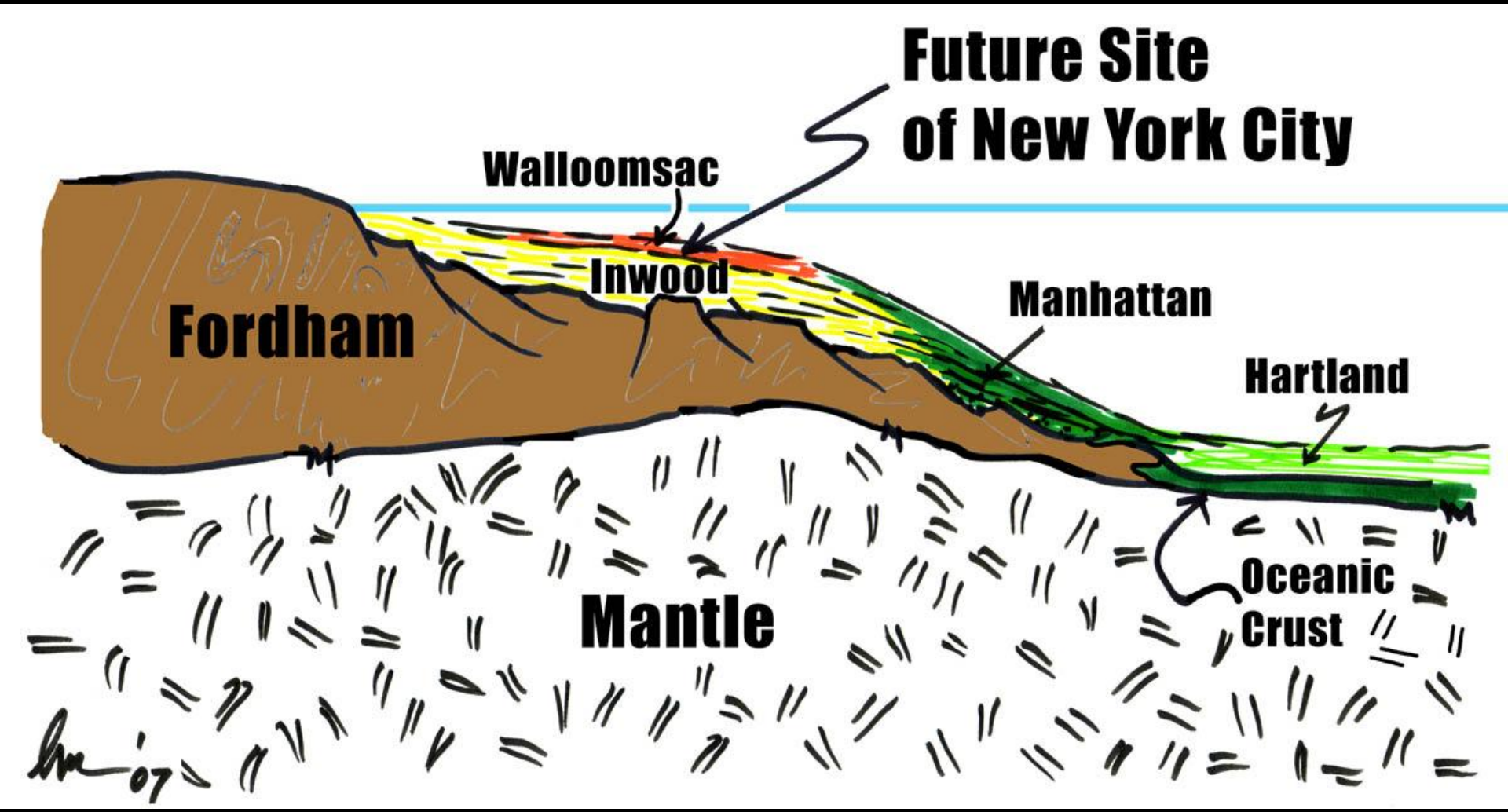
Dukelabs

HOFSTRA UNIVERSITY

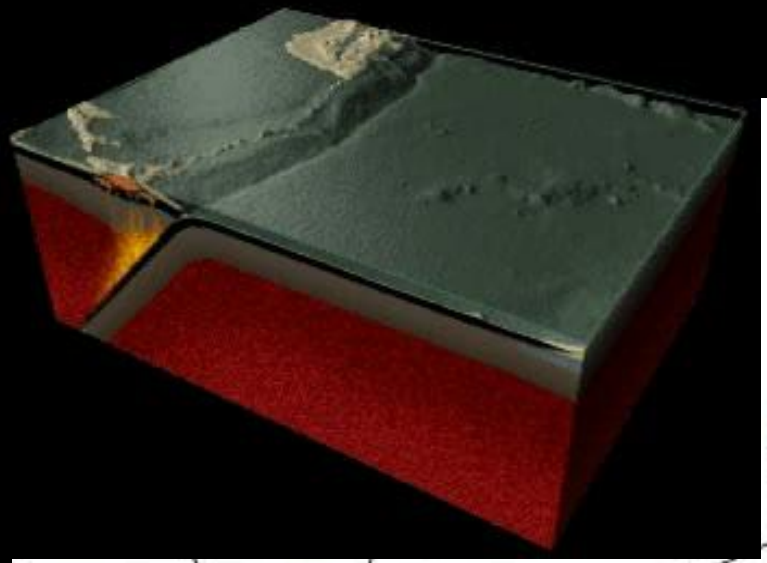

MA
CT
Taconic Allochthon
Poughkeepsie
Allegheny-Catskill Plateau
Port Jervis
PA
NY
NJ
Valley and Ridge
Great Valley
Grenville Highlands
Manhattan Prong
Bridgeport
Newark
New York
Long Island
Newark Basin
Atlantic Coastal Plain
25 miles
Trenton
Bennington and Merguerian (2007)

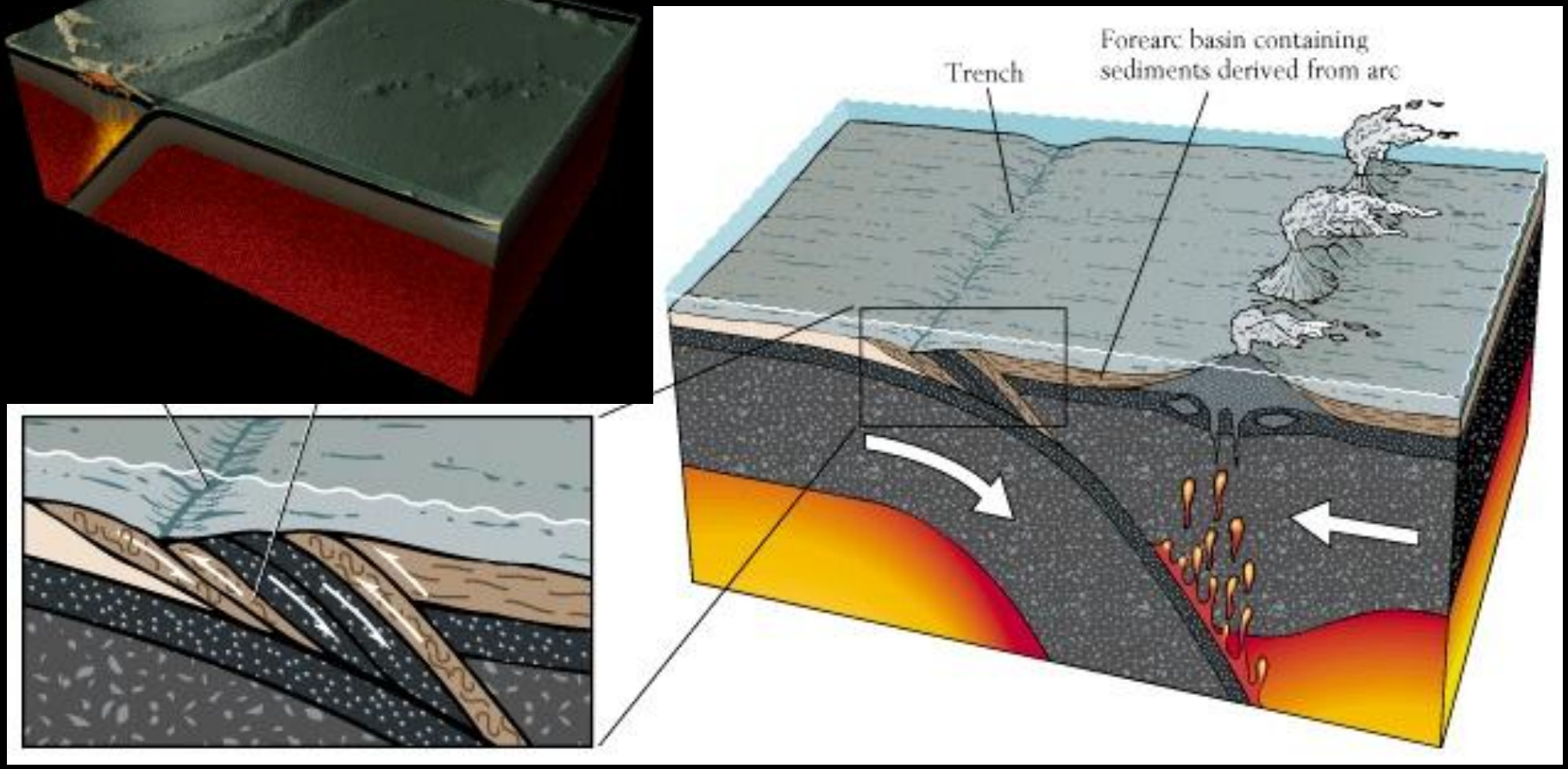


Early Medial Ordovician
(Early Chazyan)
Paleogeography
by Marshall Kay
Drawn by Erwin Raisz
Palinspastic base - Sinusoidal projection
0 500 1000
Miles
Paleo-shoreline
Paleo-equator
Peneplane on crystalline Pre-Cambrian rocks
Sandy coastal plain
Upper Cambrian
Limy coastal plain of Lower Ordovician
Sandy Delta
Millard Belt
Fraser Belt
Champlain Belt
Magog Belt
Seas with limy and sandy bottoms on miogeosynclines
Seas with bottoms of argillaceous muds and volcanic rocks on eugeosynclines
after Kay, 1951


Future Site
of New York City
Walloomsac
Inwood
Fordham
Manhattan
Hartland
Oceanic
Crust
Mantle
'07

~ 450 Ma Taconic Arc – Passive Margin Collision





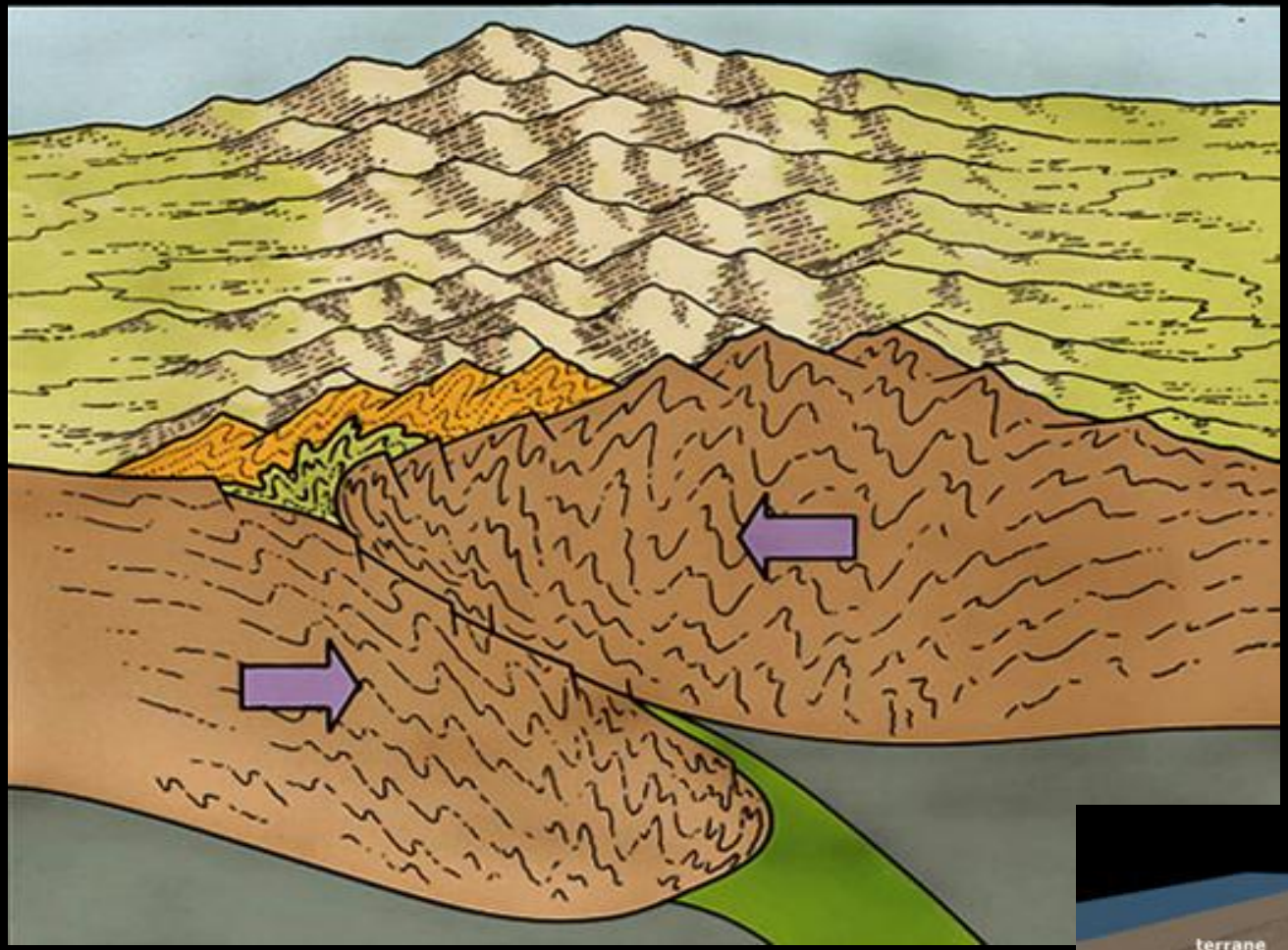
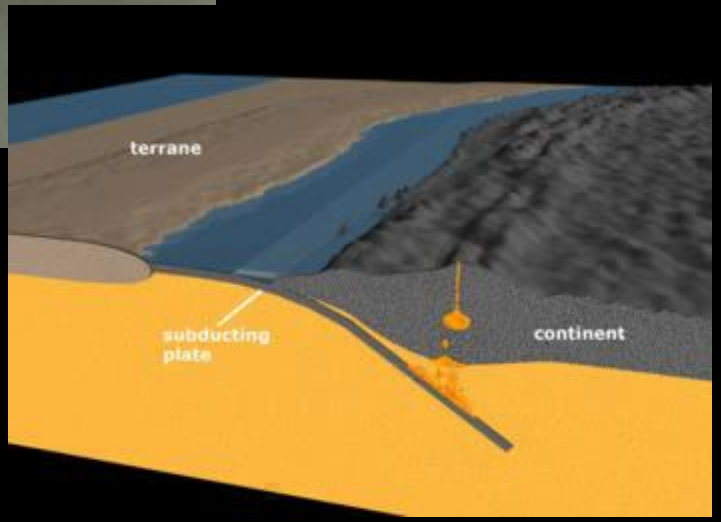
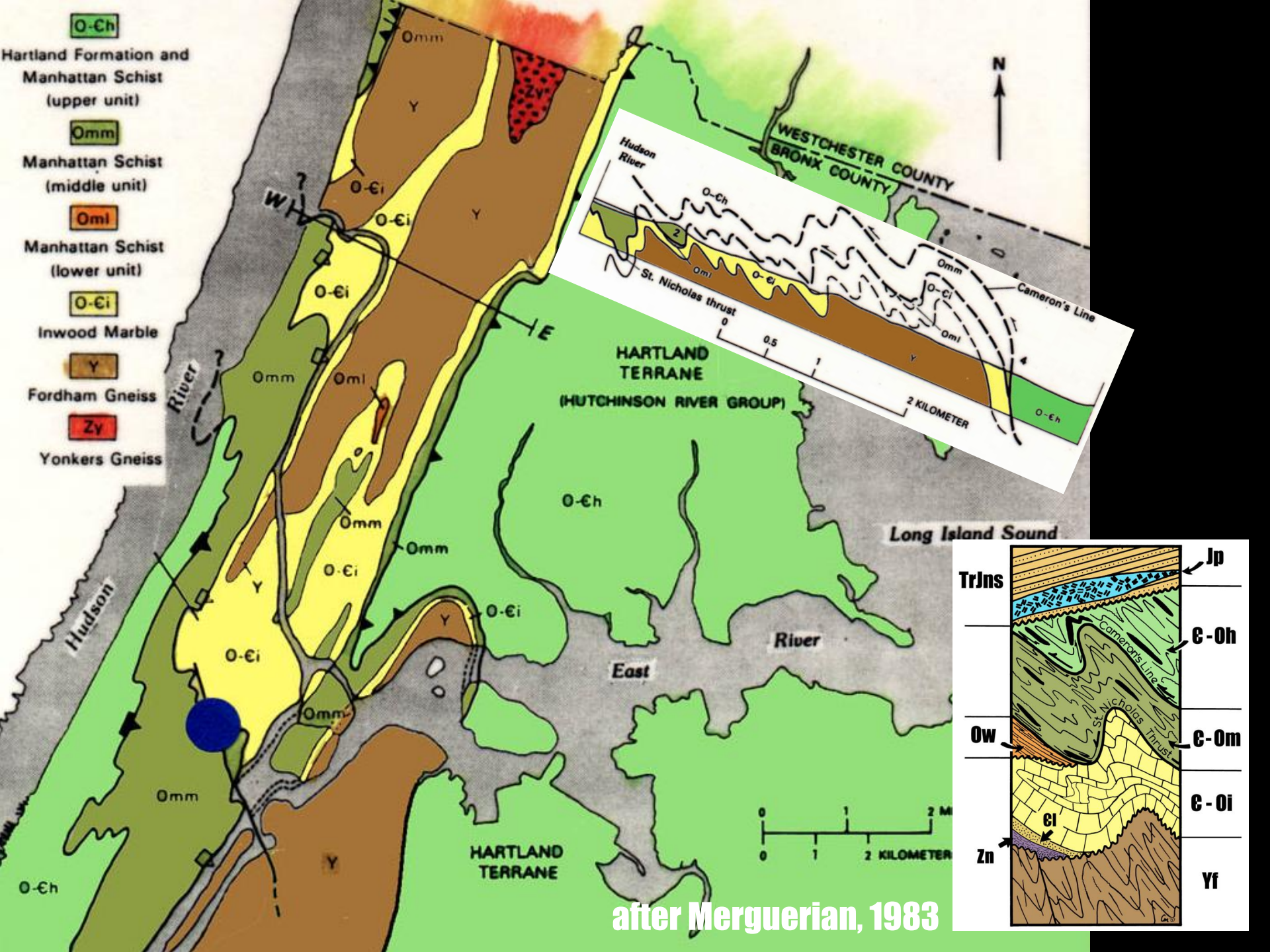


Plate Collisions

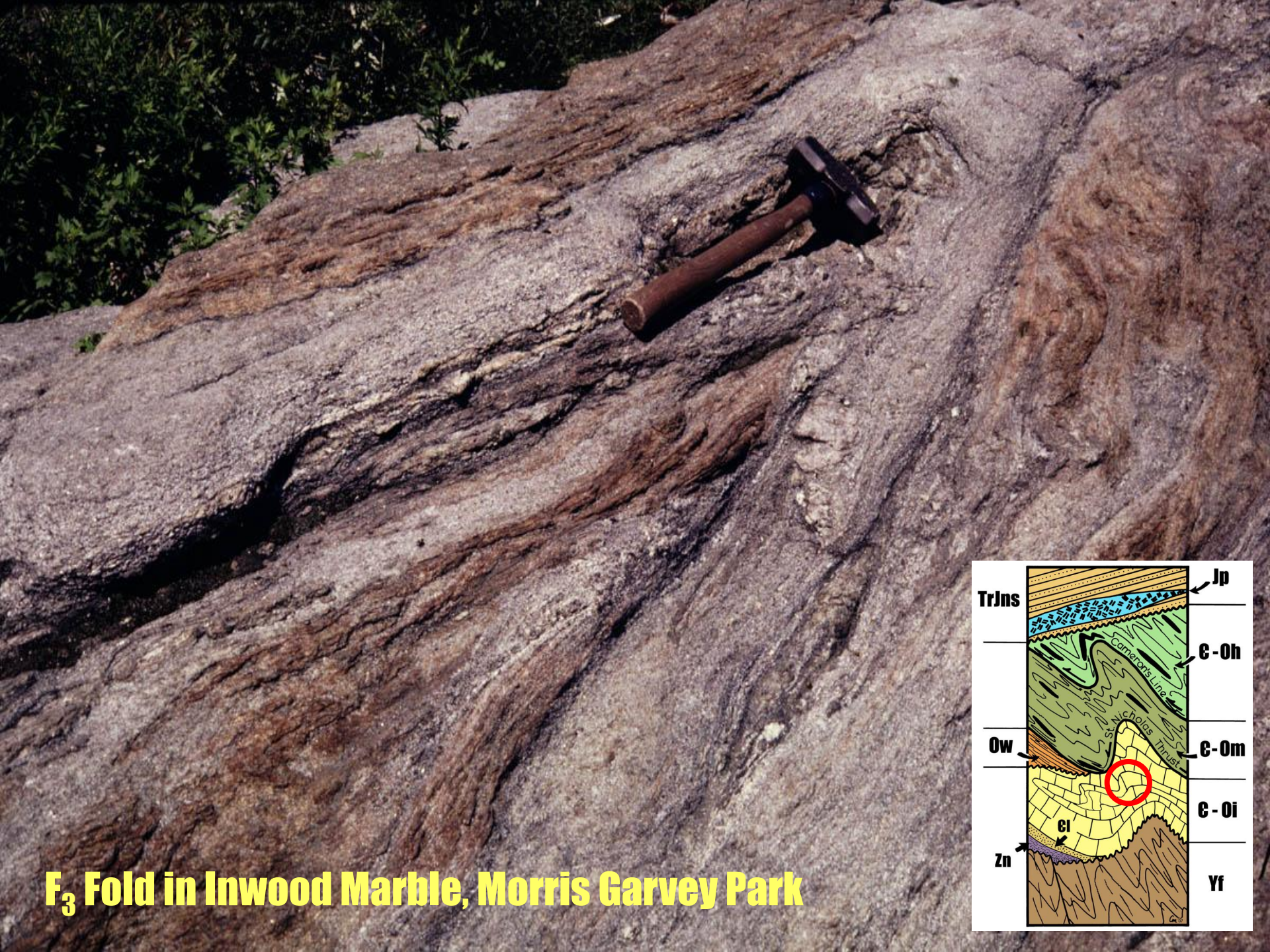


Merguerian Has Spent Most of his Career Mapping the Surface and Subsurface Geology of NYC

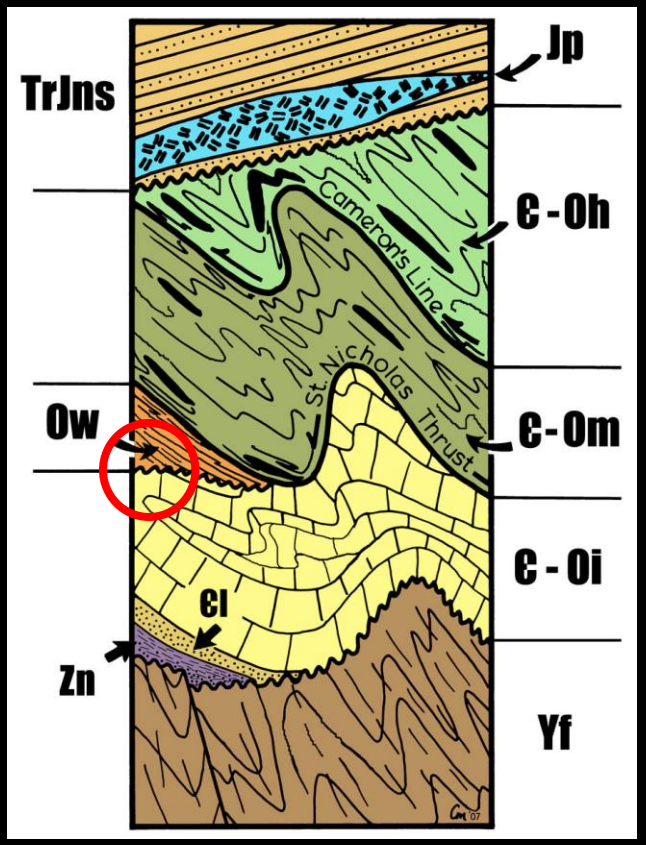
Proper Field Attire For NYC


O-Ch
Hartland Formation and Manhattan Schist (upper unit)
Omm
Manhattan Schist (middle unit)
Oml
Manhattan Schist (lower unit)
O-Ei
Inwood Marble
Y
Fordham Gneiss
Zy
Yonkers Gneiss
N
WESTCHESTER COUNTY
BRONX COUNTY
Hudson River
O-Ch
St. Nicholas thrust
Cameron's Line
2 KILOMETER
HARTLAND TERRANE
(HUTCHINSON RIVER GROUP)
Long Island Sound
Hudson River
East River
HARTLAND TERRANE
2 KILOMETER
TrJns
Jp
Ow
Zn
Ei
Yf
Cameron's Line
St. Nicholas Thrust
after Merguerian, 1983

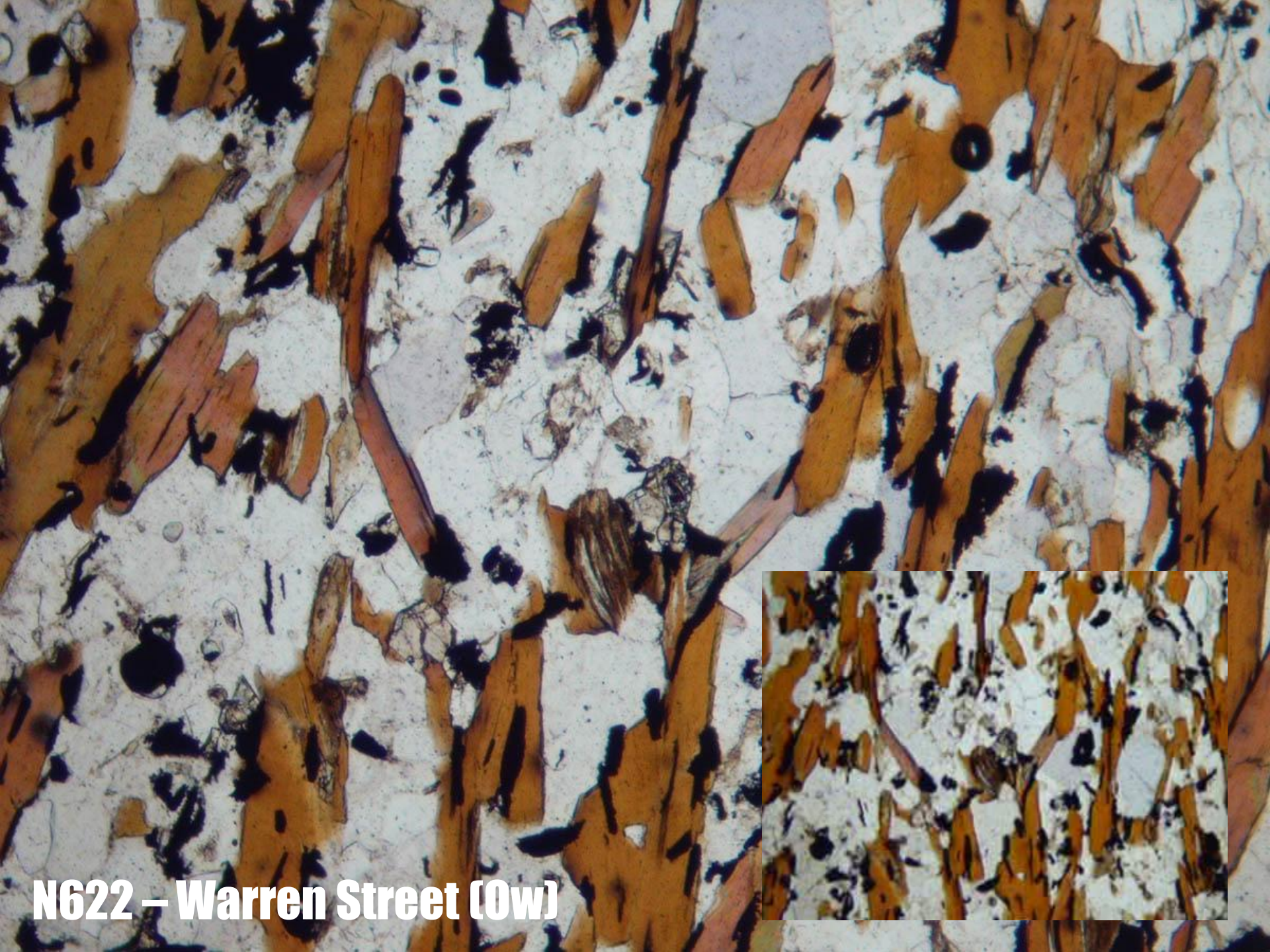

Fordham Gneiss, Echo Park
TrJns
Jp
Cameron's Line
St. Nicholas Thrust
Є - Oh
Ow
Є - Om
Є - Oi
Єl
Zn
Yf

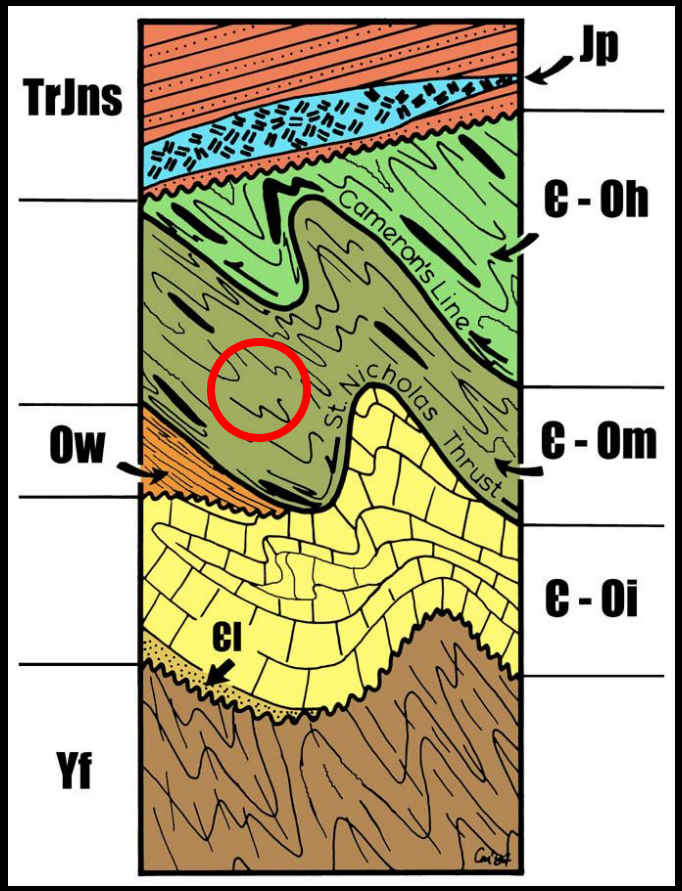


F_3 Fold in Inwood Marble, Morris Garvey Park



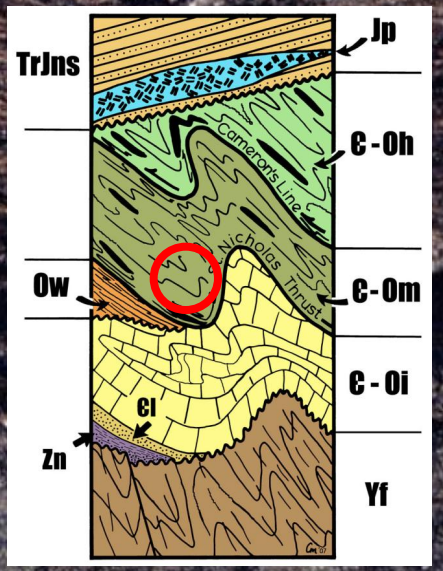
Walloomsac "Balmville" Contact, Grand Concourse, Bronx, NY

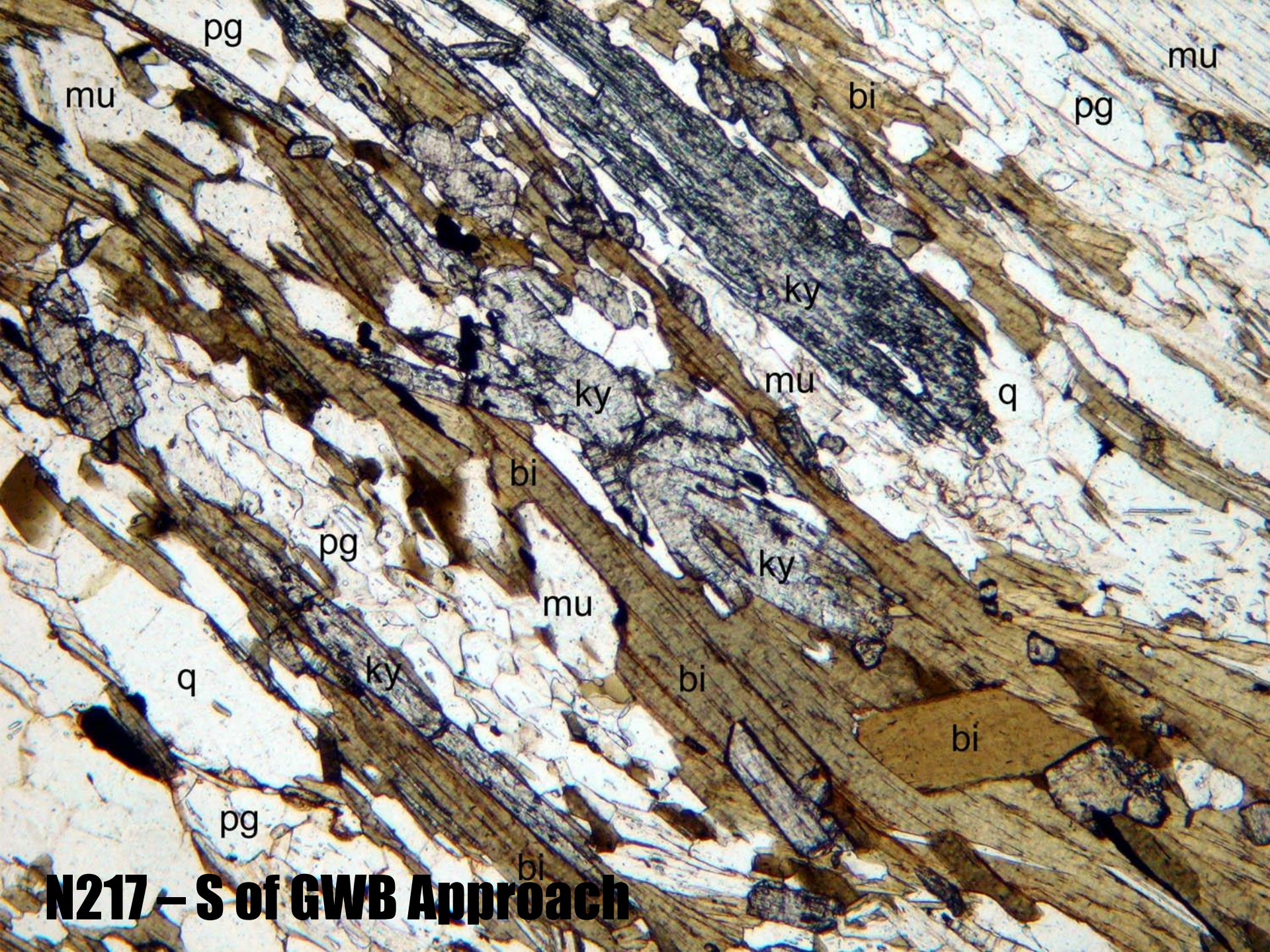

N622 – Warren Street (Ow)



Manhattan Schist
F_3 Folds of S_2
Central Park, NYC

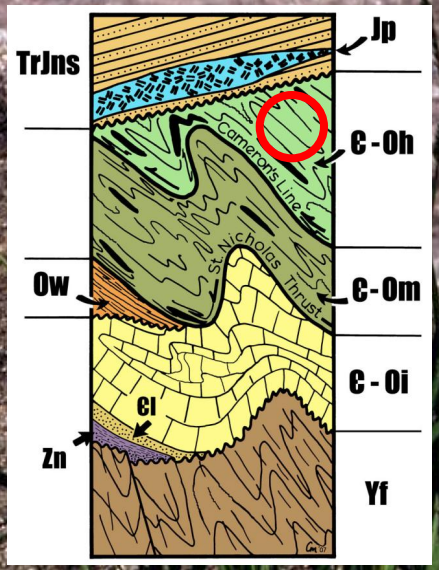
Sheared Manhattan Schist, St. Nicholas Park, NYC

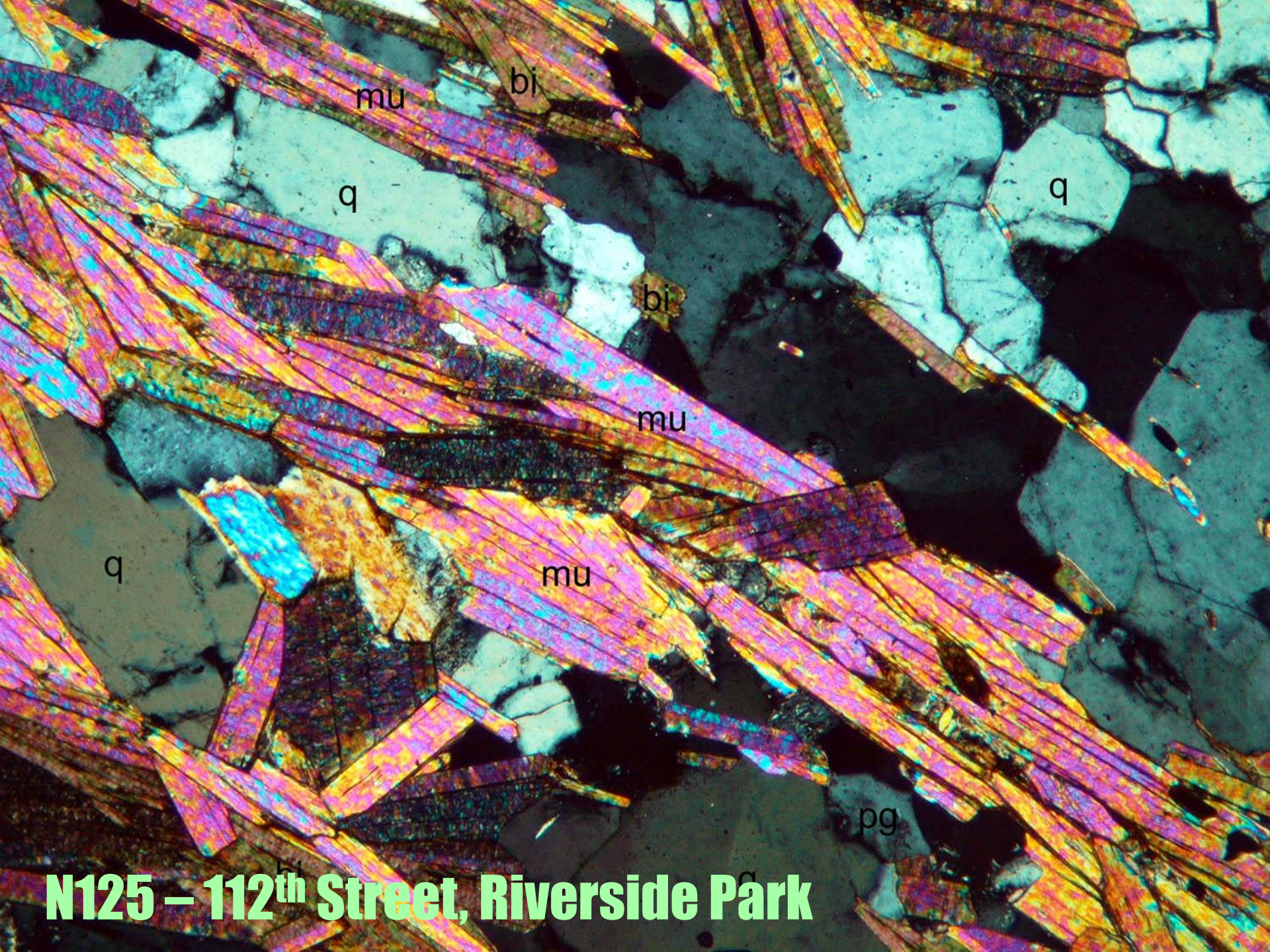




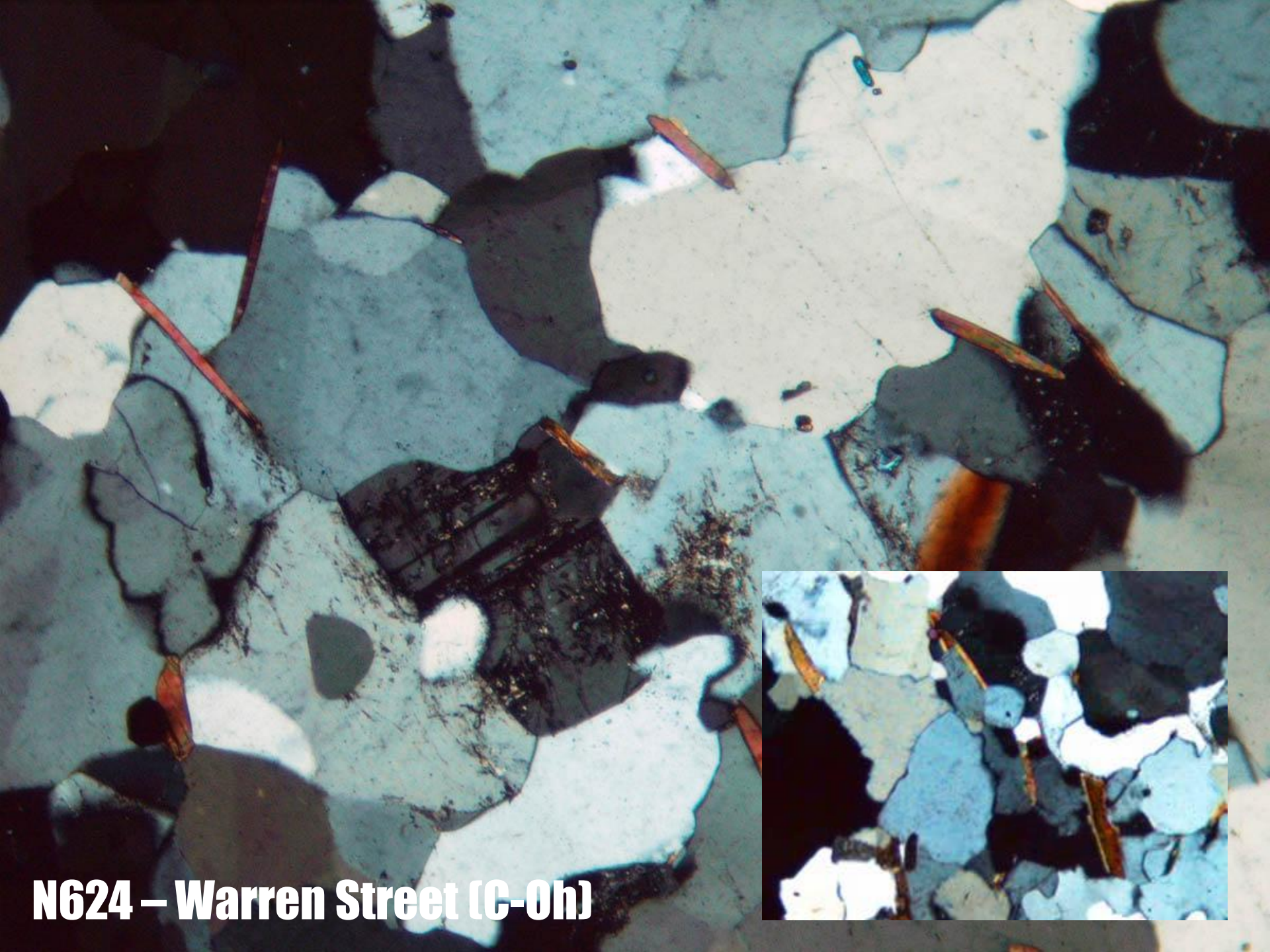
N217 – S of GWB Approach

Hartland Schist, Riverside Park





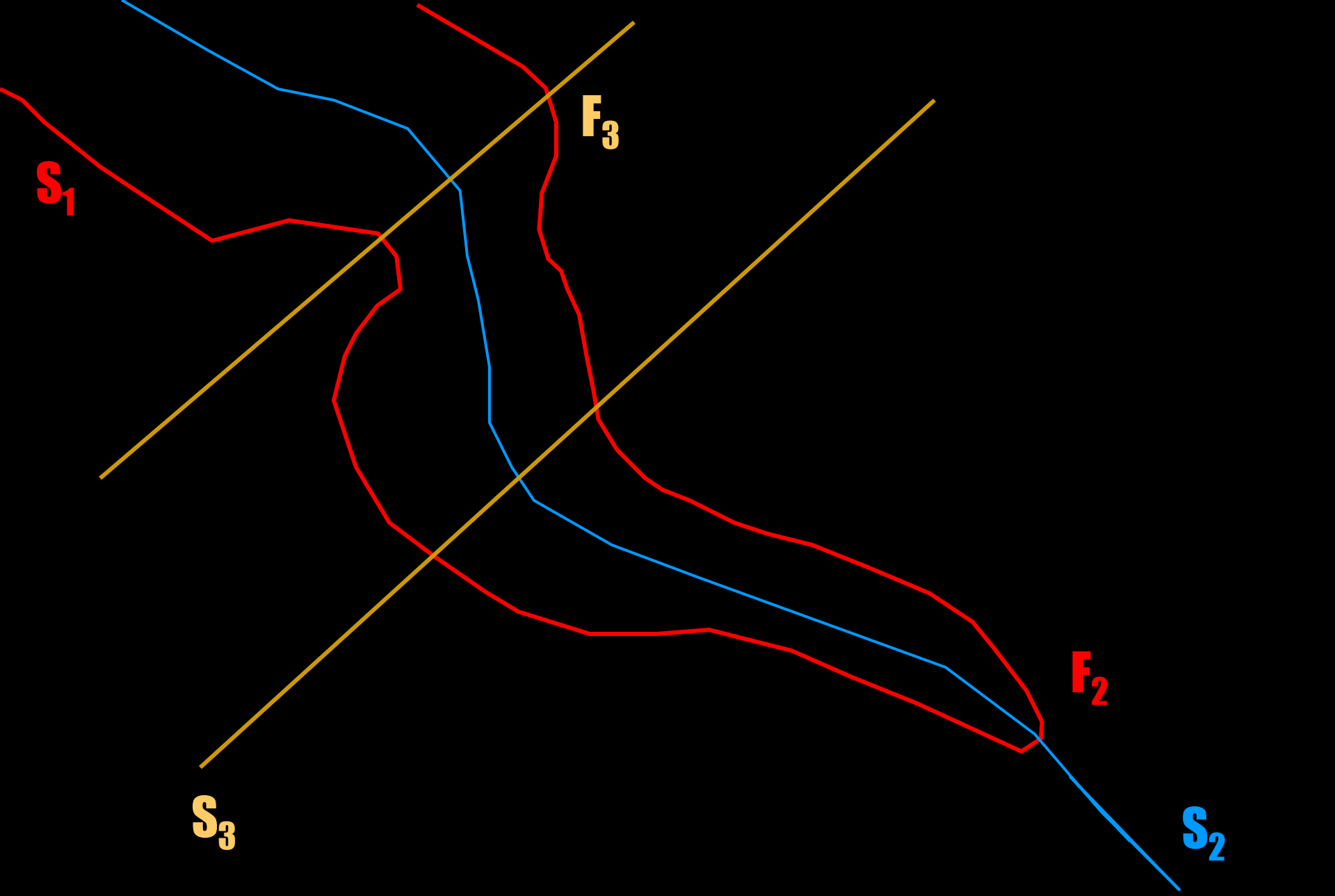
N125 – 112th Street, Riverside Park


N624 – Warren Street (C-Oh)


TrJns
Jp
Є-Oh
St. Nicholas Thrust
Ow
Є-Om
Є-Oi
Єl
Zn
Yf
Hartland Amphibolite N567

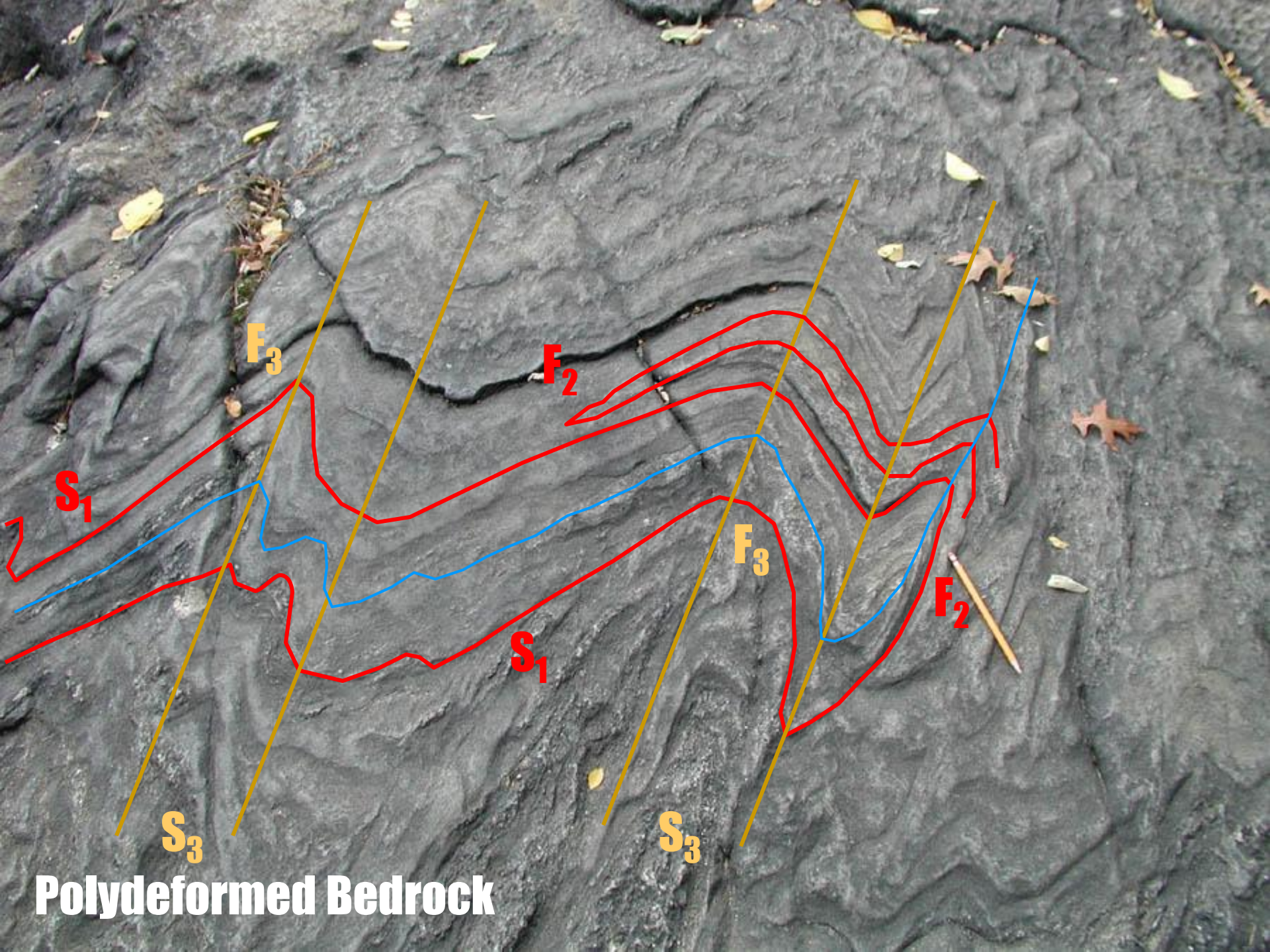
Polydeformed Bedrock

Polydeformed Bedrock

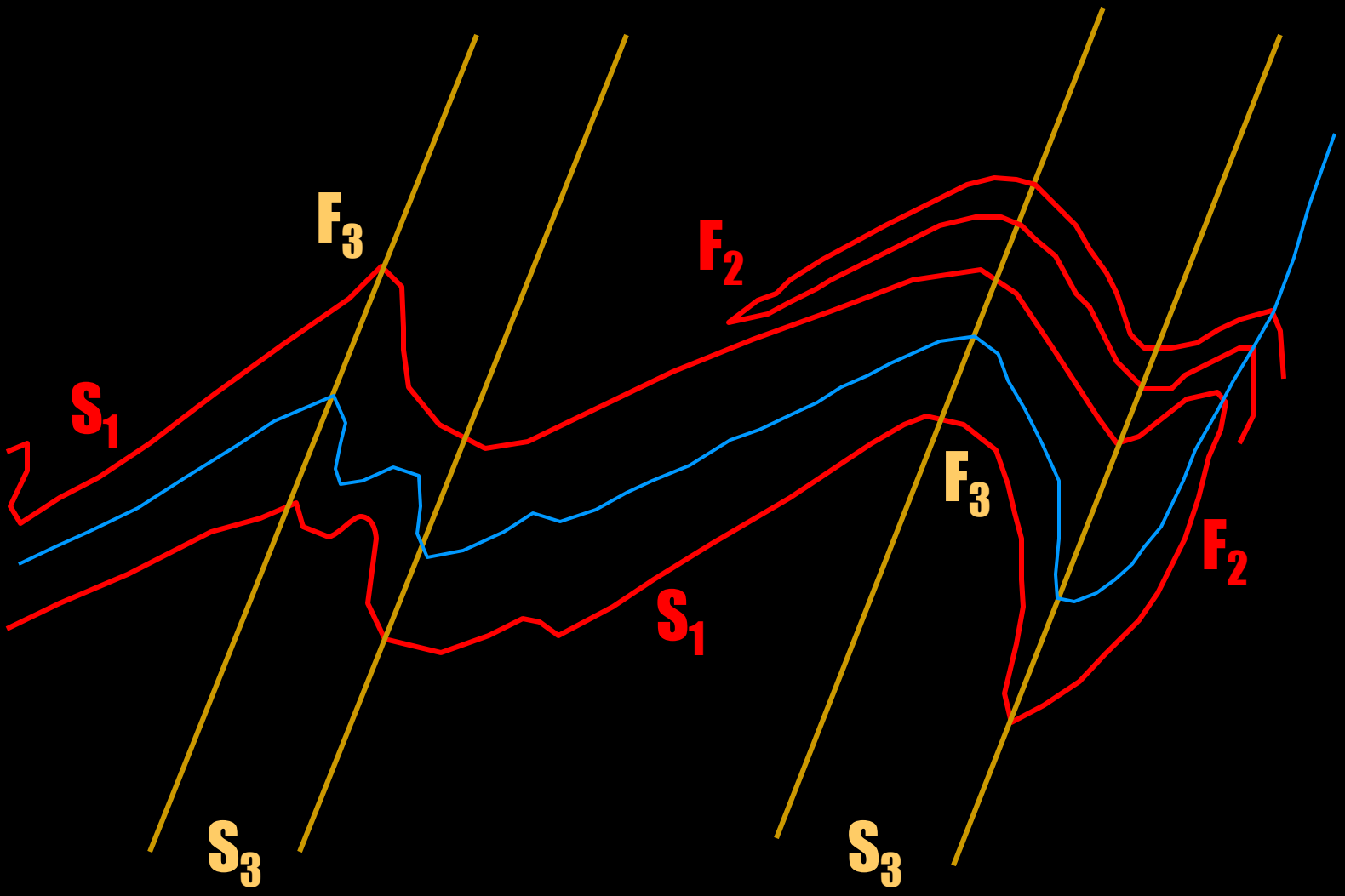


Polydeformed Bedrock

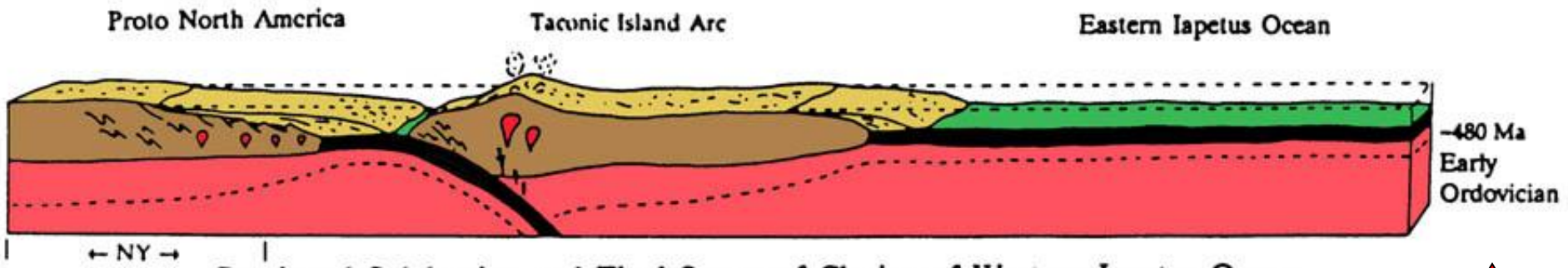
Polydeformed Bedrock



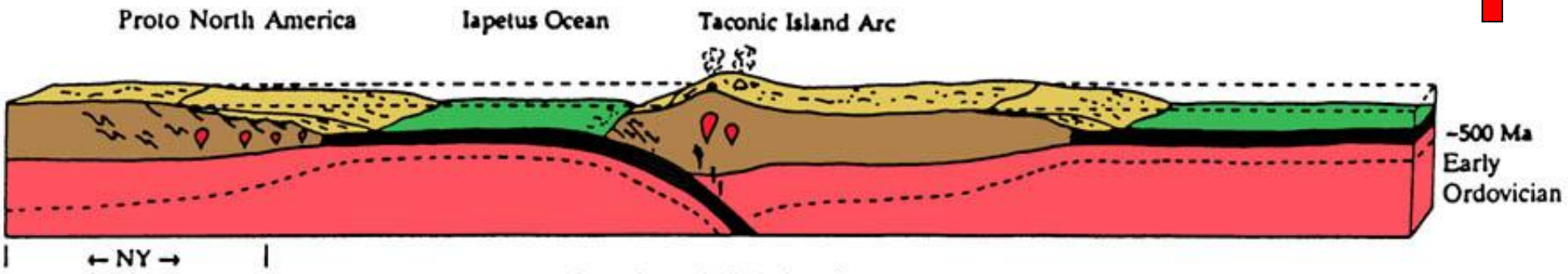
Polydeformed Bedrock



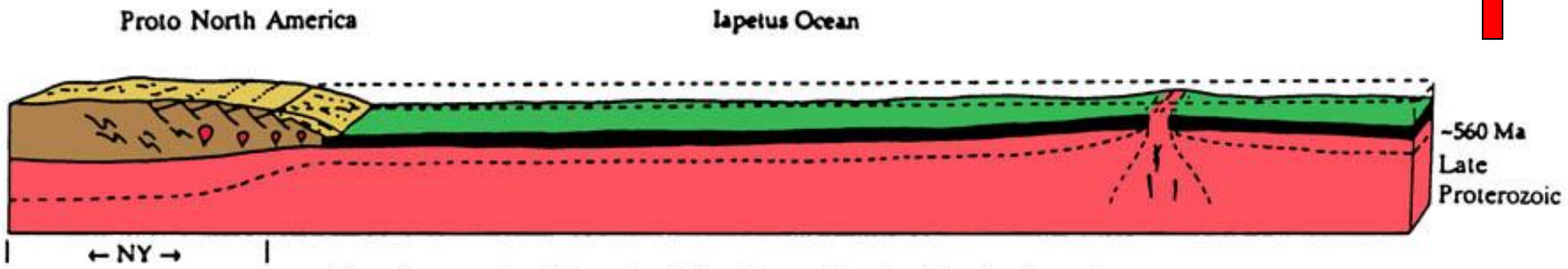
Polydeformed Bedrock



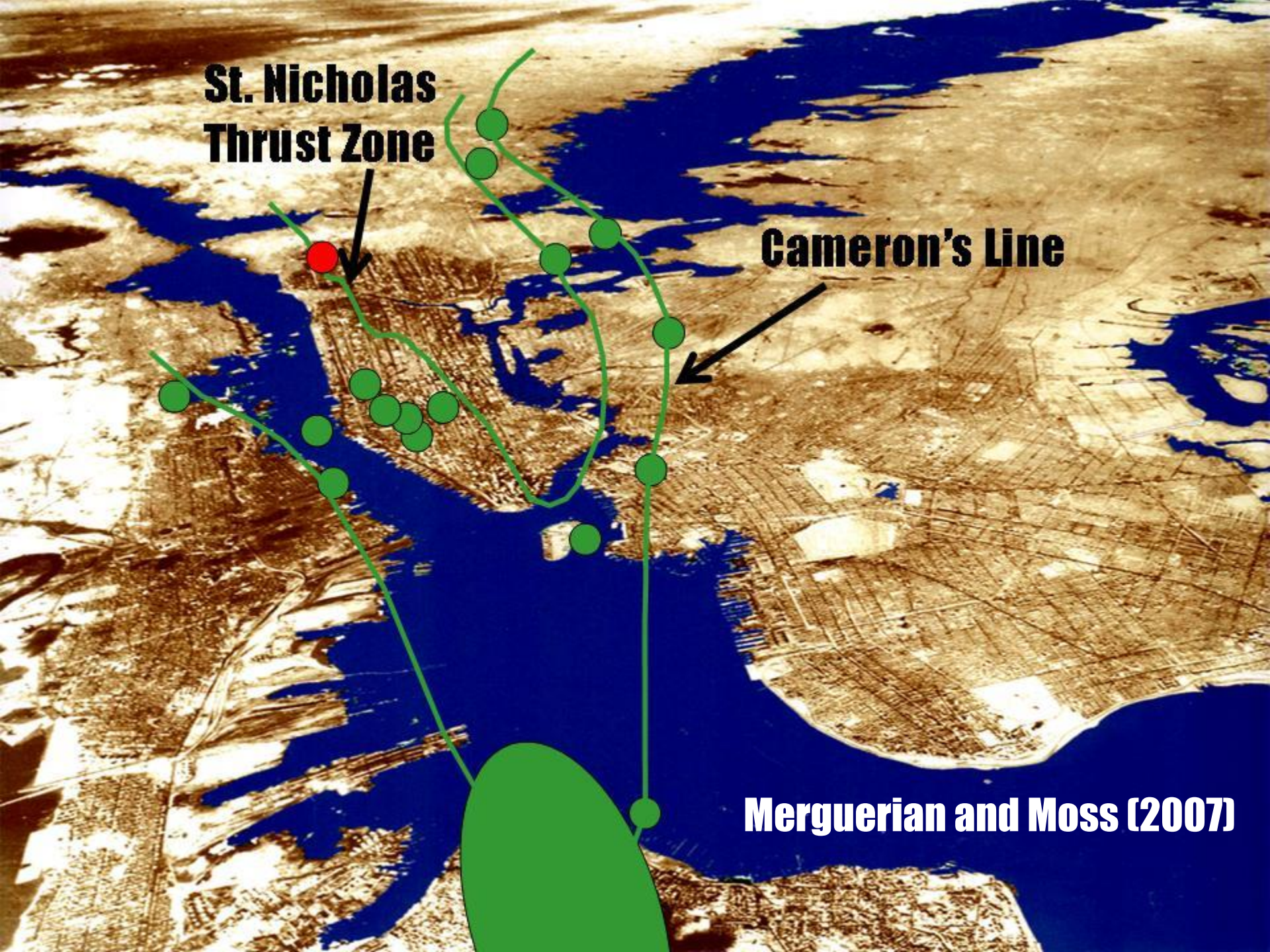
Continued Subduction and Final Stages of Closing of Western Iapetus Ocean

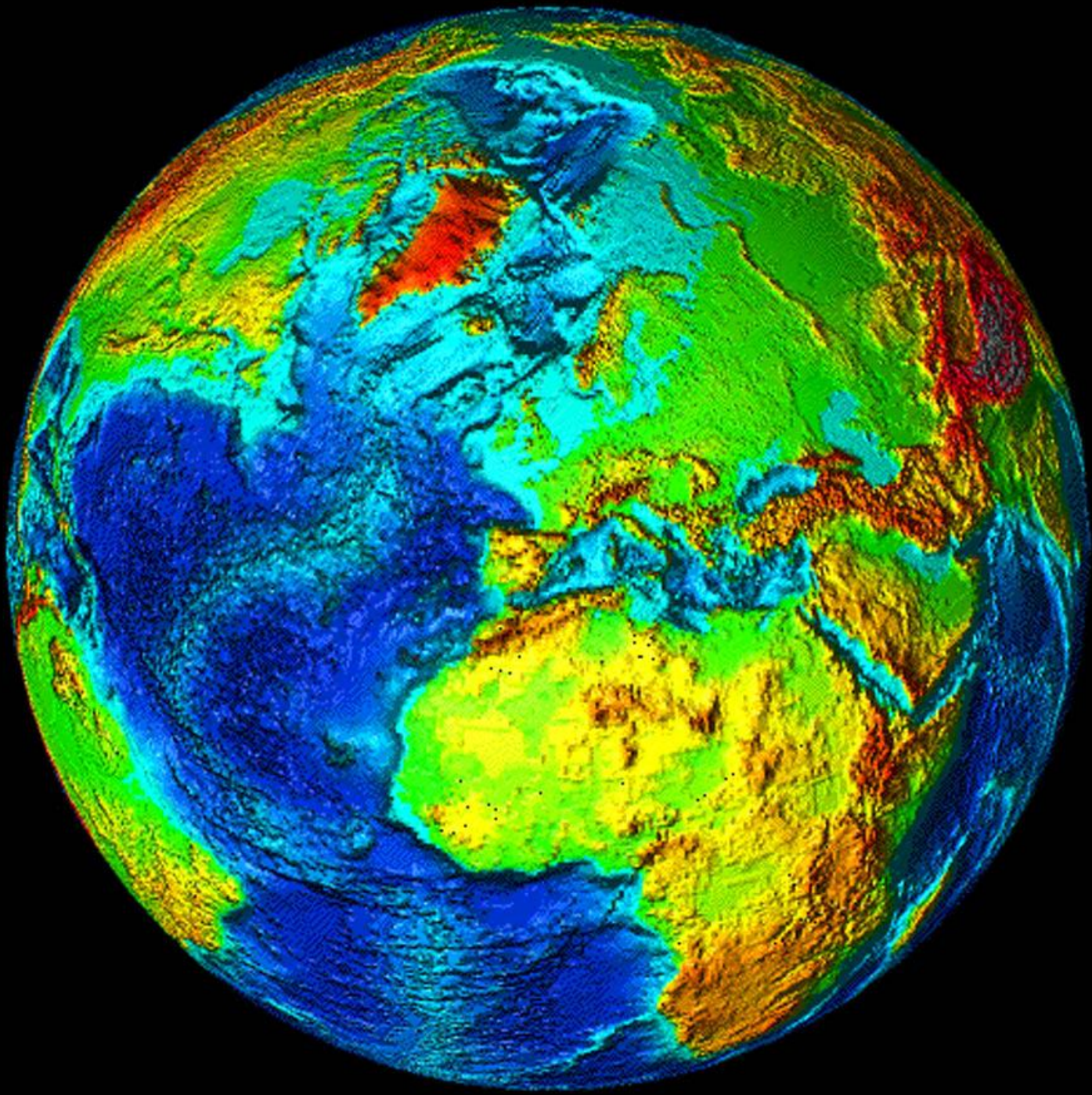


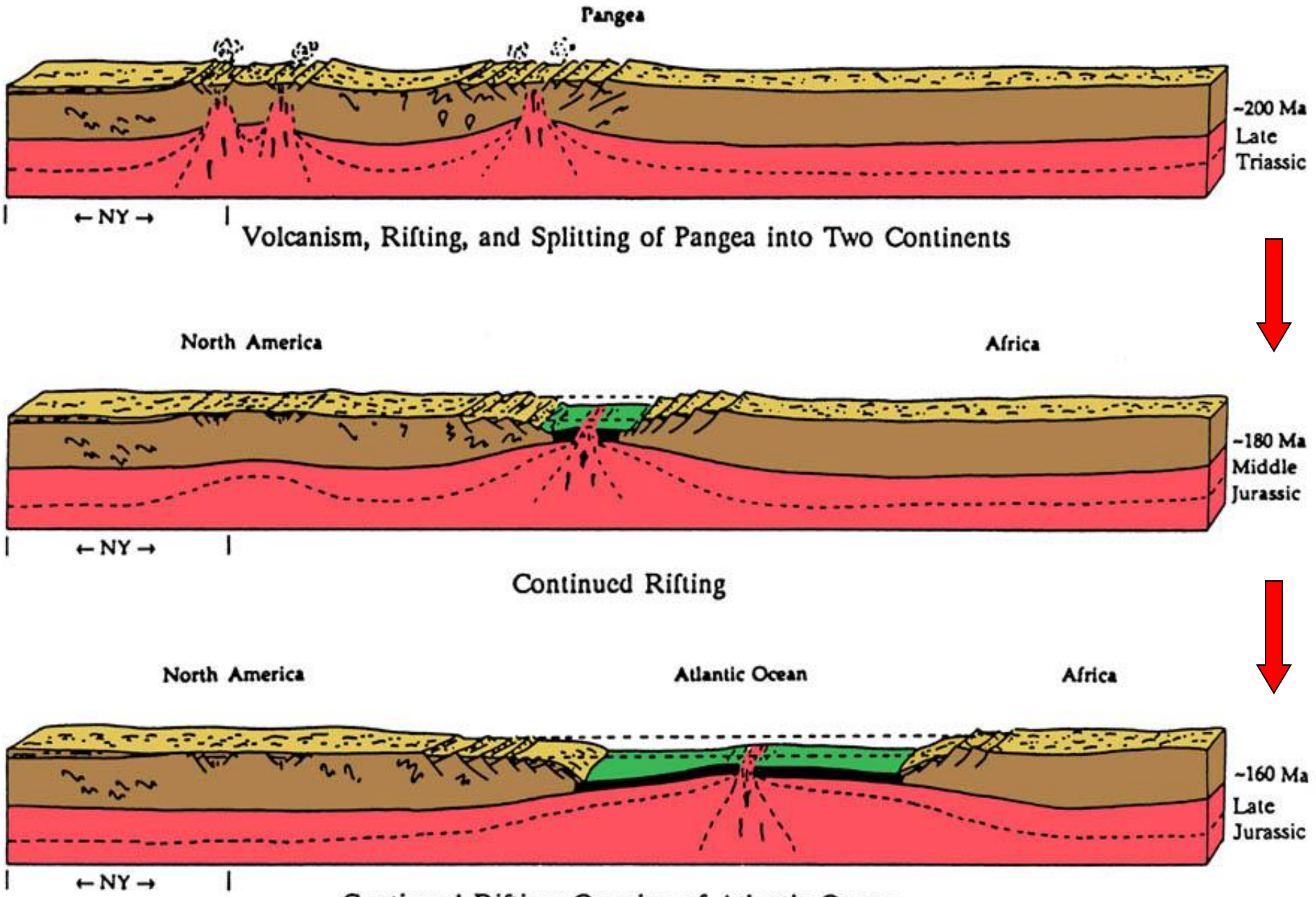
Continued Subduction

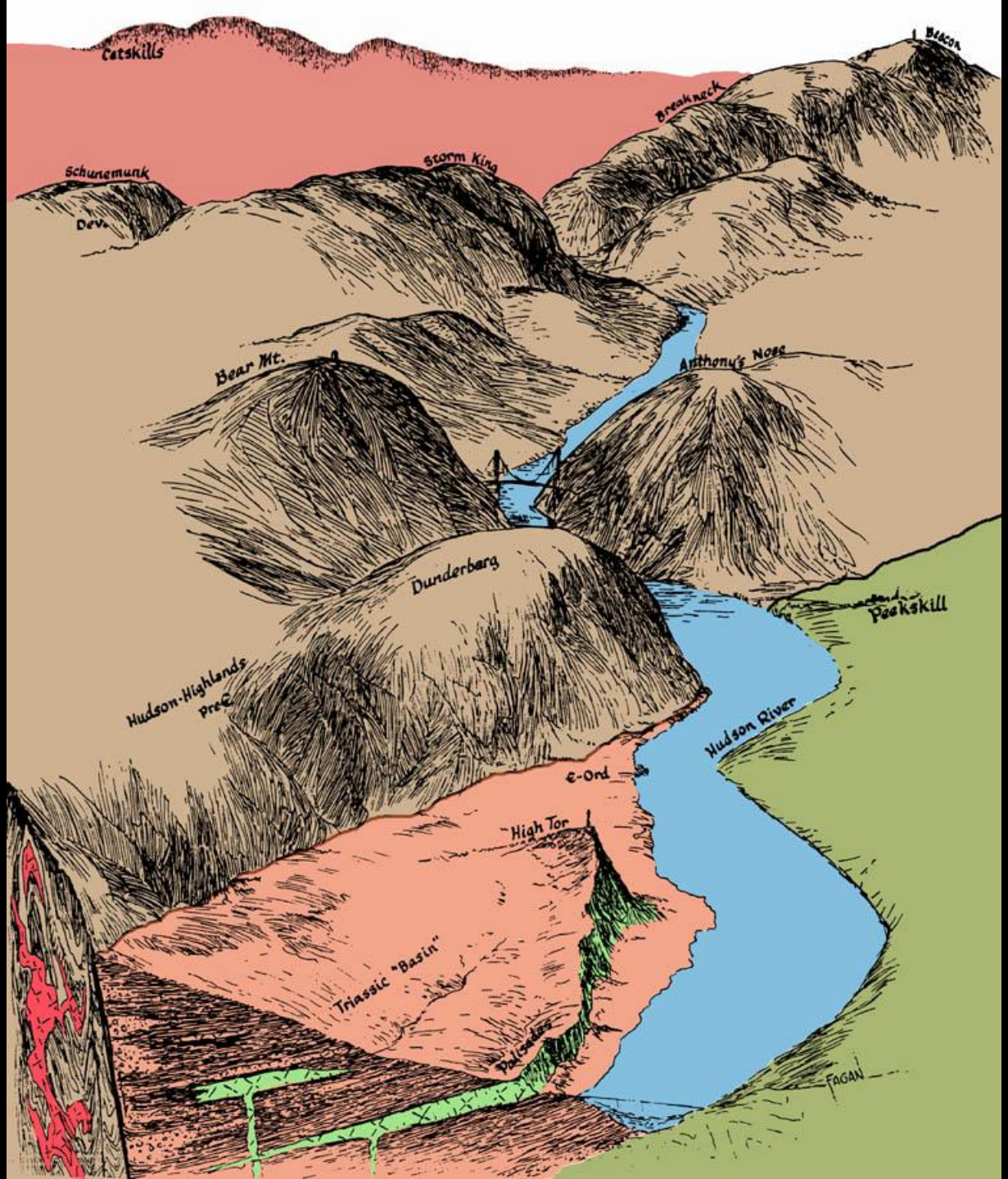


Development of Passive Margin on Proto North America

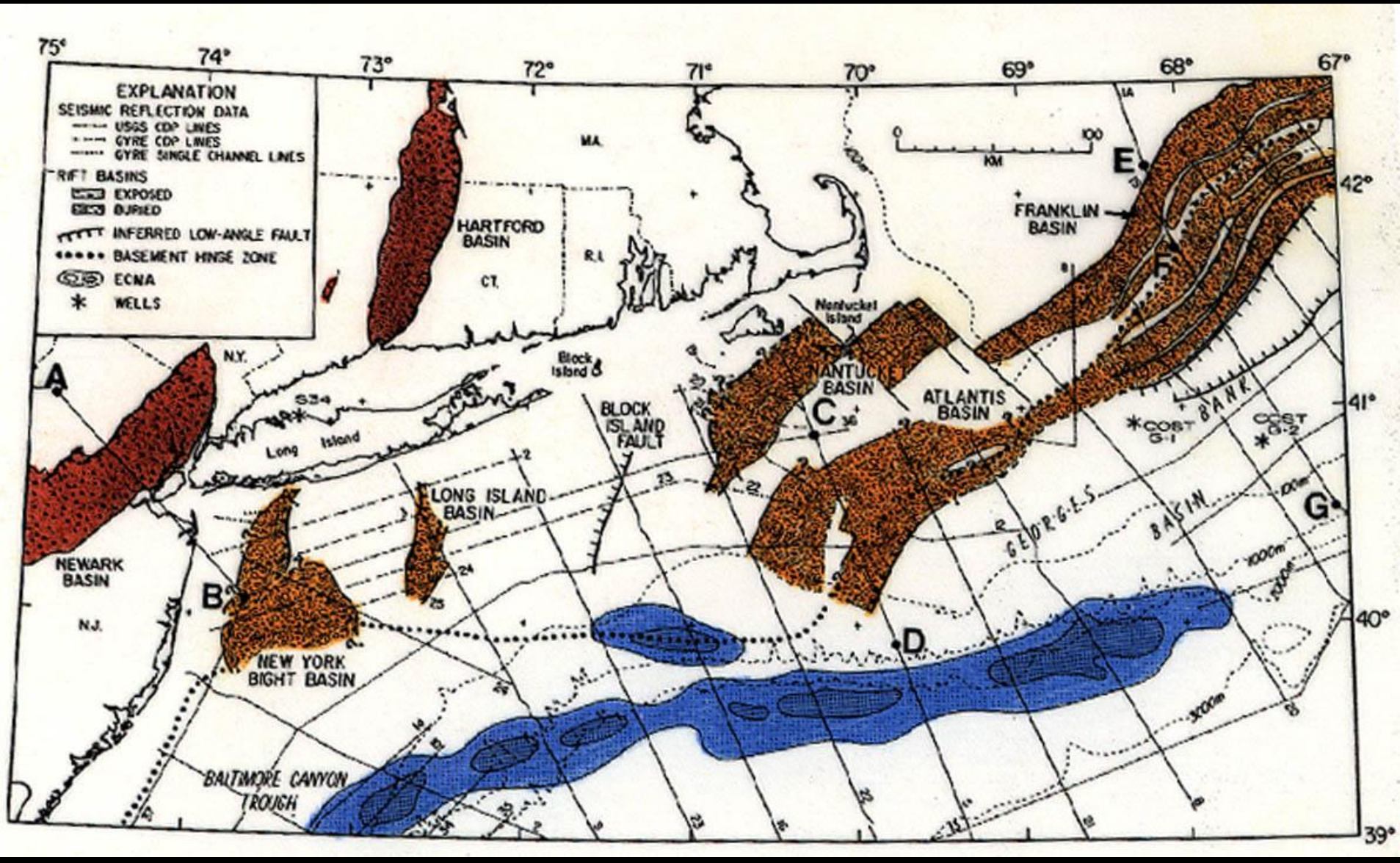

St. Nicholas
Thrust Zone
Cameron's Line
Merguerian and Moss (2007)



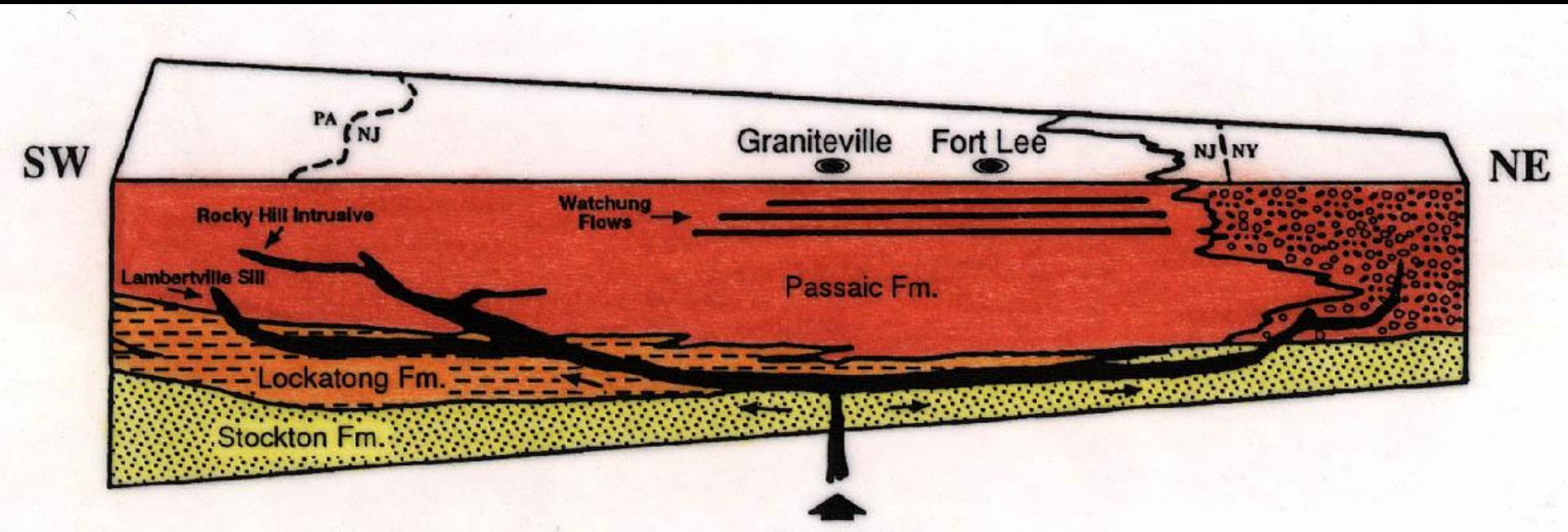

Pangea
~200 Ma
Late
Triassic
← NY →
Volcanism, Rifting, and Splitting of Pangea into Two Continents
North America
Africa
~180 Ma
Middle
Jurassic
← NY →
Continued Rifting
North America
Atlantic Ocean
Africa
~160 Ma
Late
Jurassic
← NY →
Continued Rifting; Opening of Atlantic Ocean

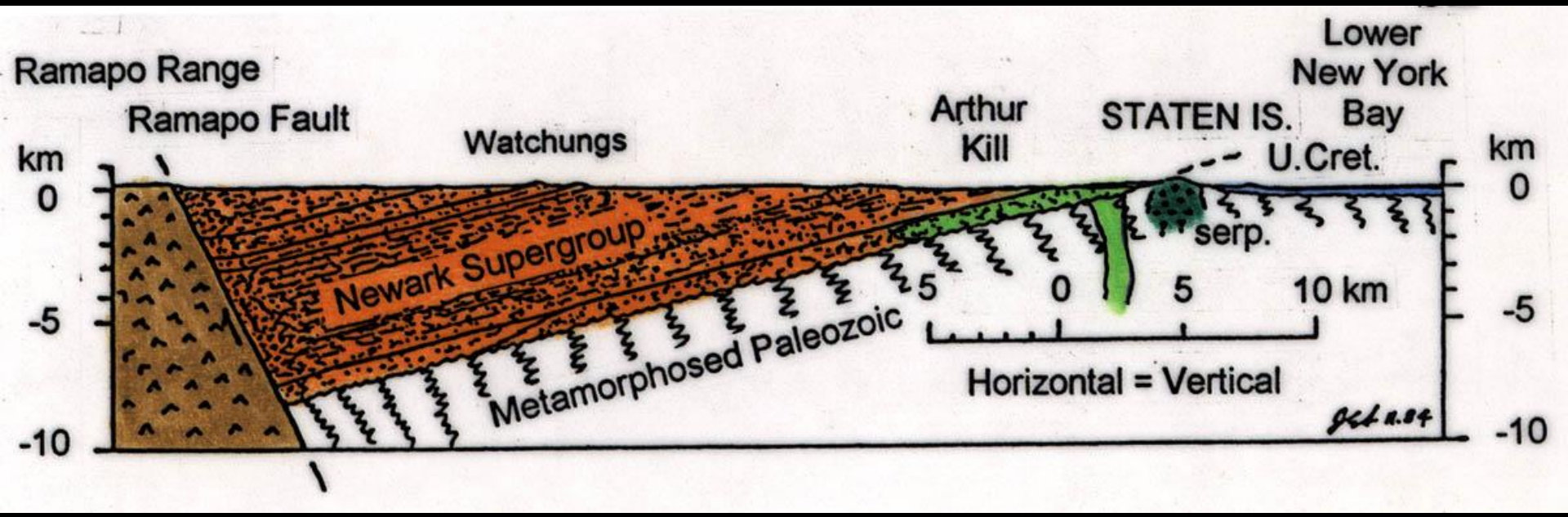


after Fagan 1958

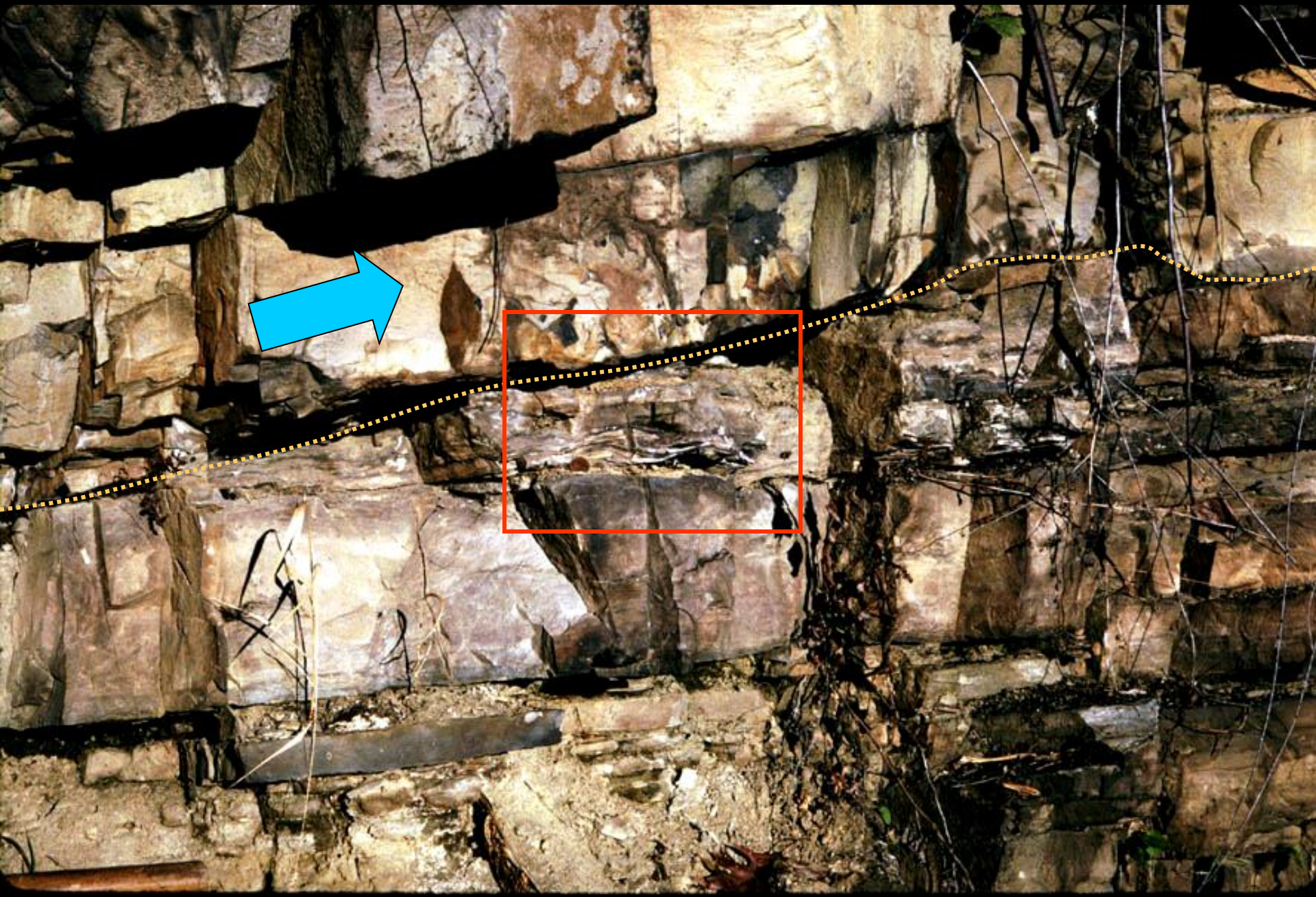


Buried Mesozoic Basins


SW
NE
PA
NJ
Graniteville
Fort Lee
NJ
NY
Rocky Hill Intrusive
Watchung Flows
Lambertville Sill
Passaic Fm.
Lockatong Fm.
Stockton Fm.

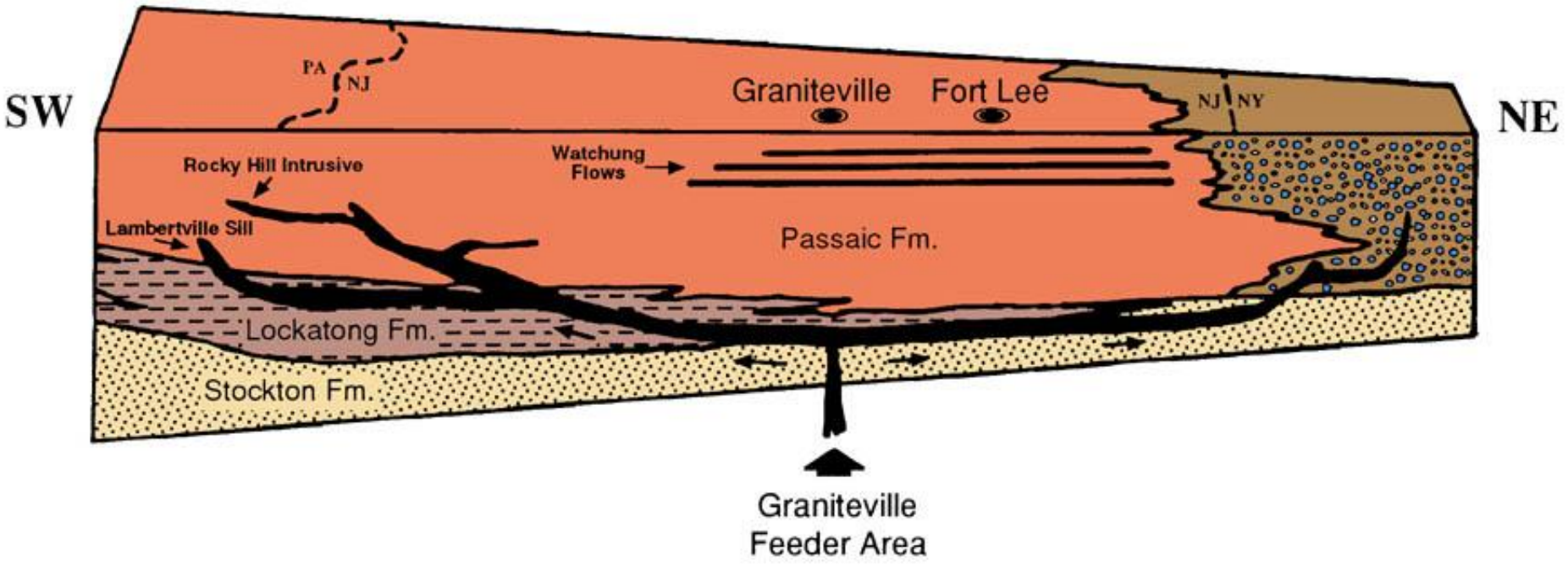

Ramapo Range
Ramapo Fault
Watchungs
Arthur Kill
STATEN IS.
Lower New York Bay
U.Cret.
km
0
-5
-10
Newark Supergroup
Metamorphosed Paleozoic
serp.
5
0
5
10 km
Horizontal = Vertical
jcb n.04


Lockatong Formation


14° into S75°W Overturned Fold

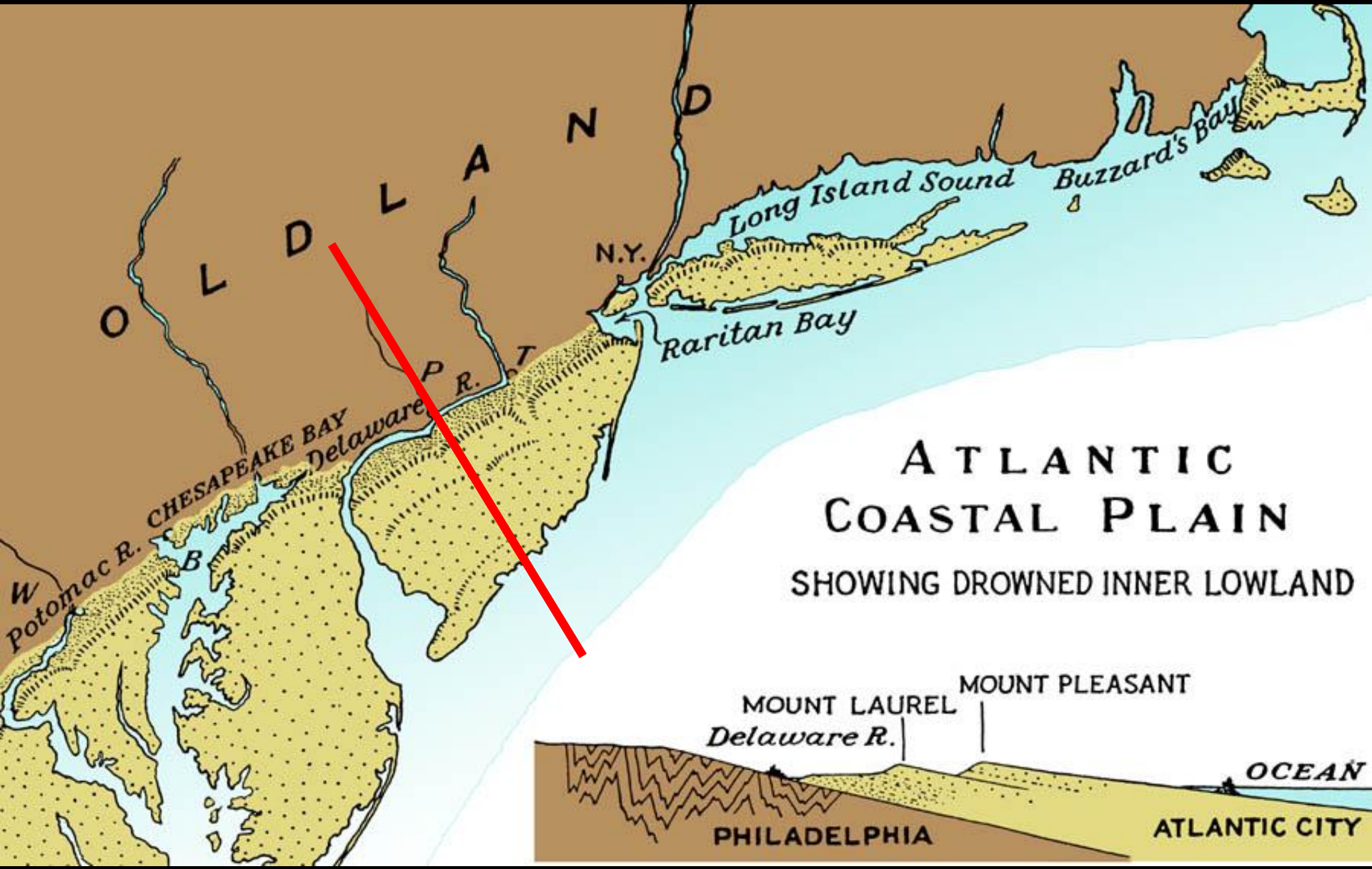

NE-Directed Shear
14° into S75°W Overturned Fold

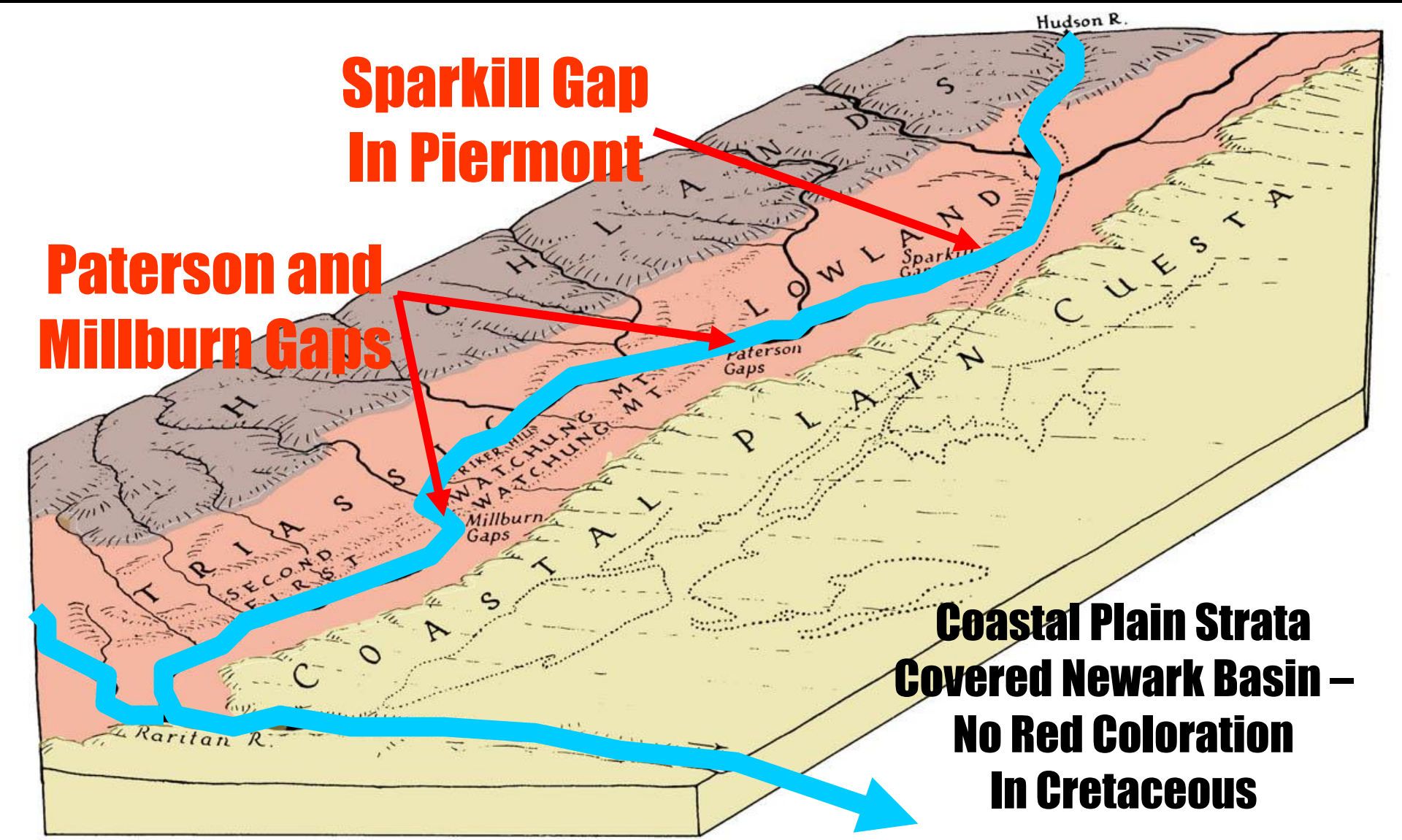
Palisades Intrusive Sheet



Palisades "Sill" is an Intrusive Sheet or a Lopolith as it cuts upwards in stratigraphy from the center

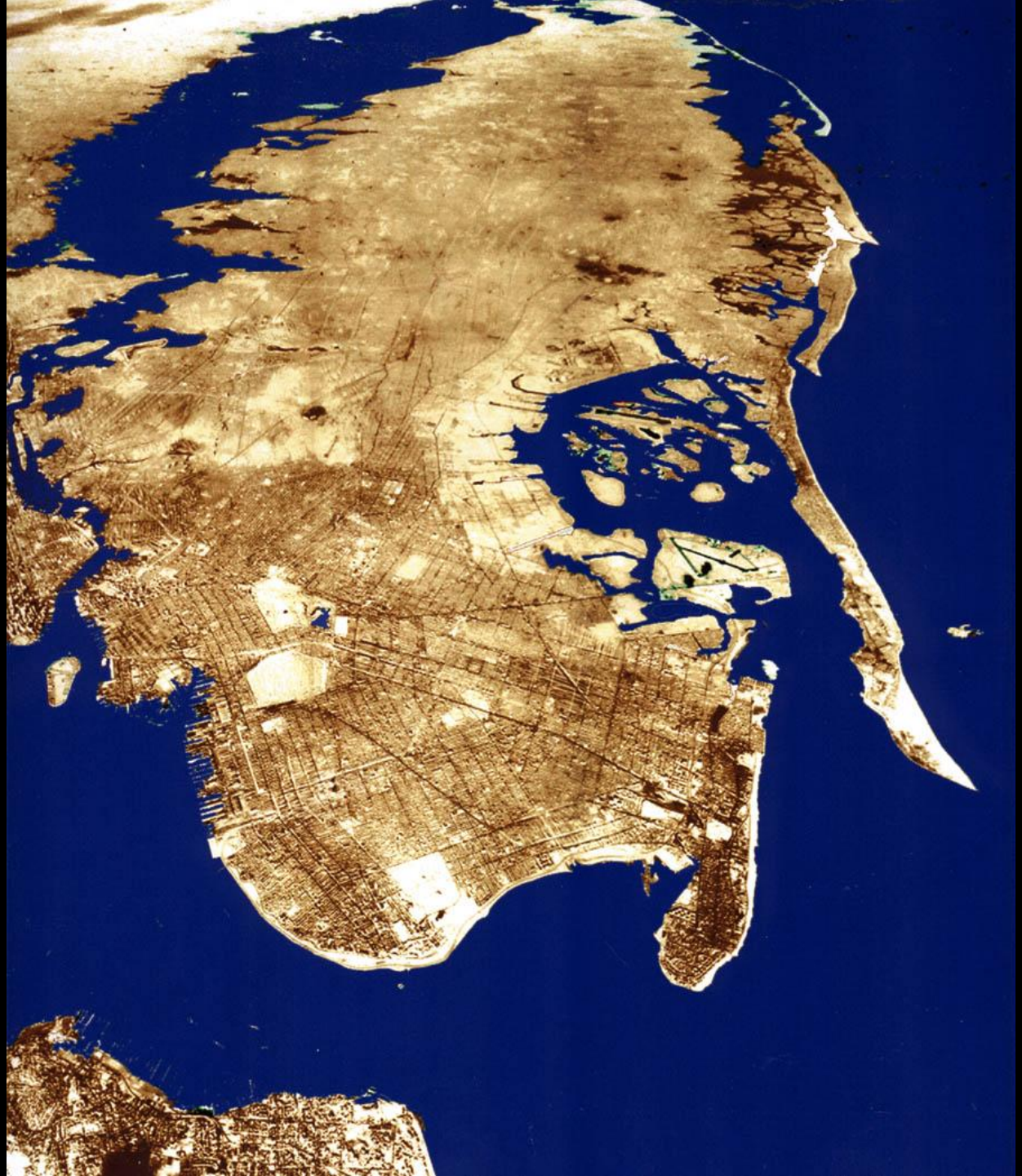
after Van Houten, 1969


O L D L A N D
N.Y.
Long Island Sound
Buzzard's Bay
Raritan Bay
P R.
Delaware
CHESAPEAKE BAY
Potomac R.
ATLANTIC
COASTAL PLAIN
SHOWING DROWNED INNER LOWLAND
MOUNT LAUREL
MOUNT PLEASANT
Delaware R.
OCEAN
PHILADELPHIA
ATLANTIC CITY

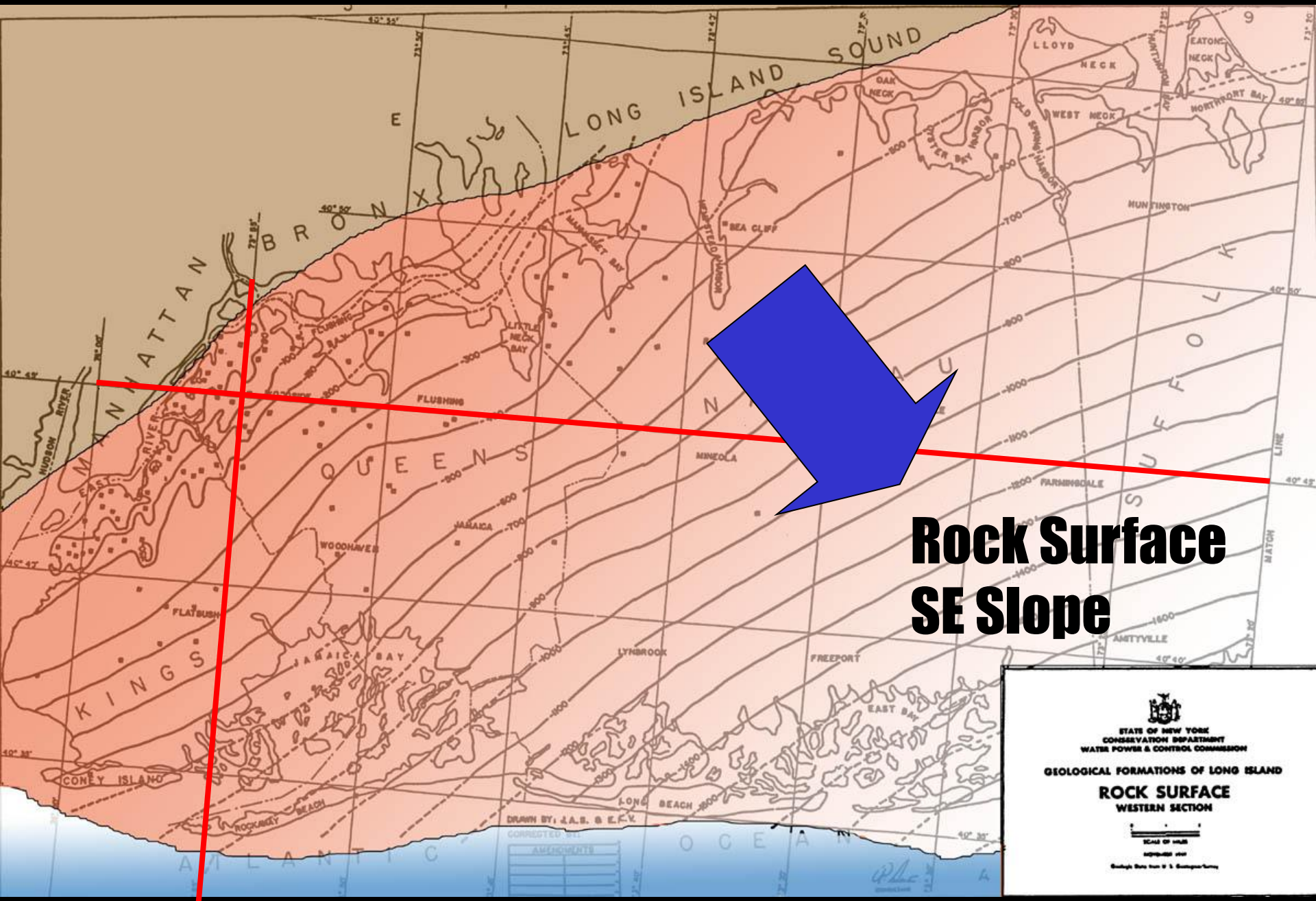


Mio/Pliocene

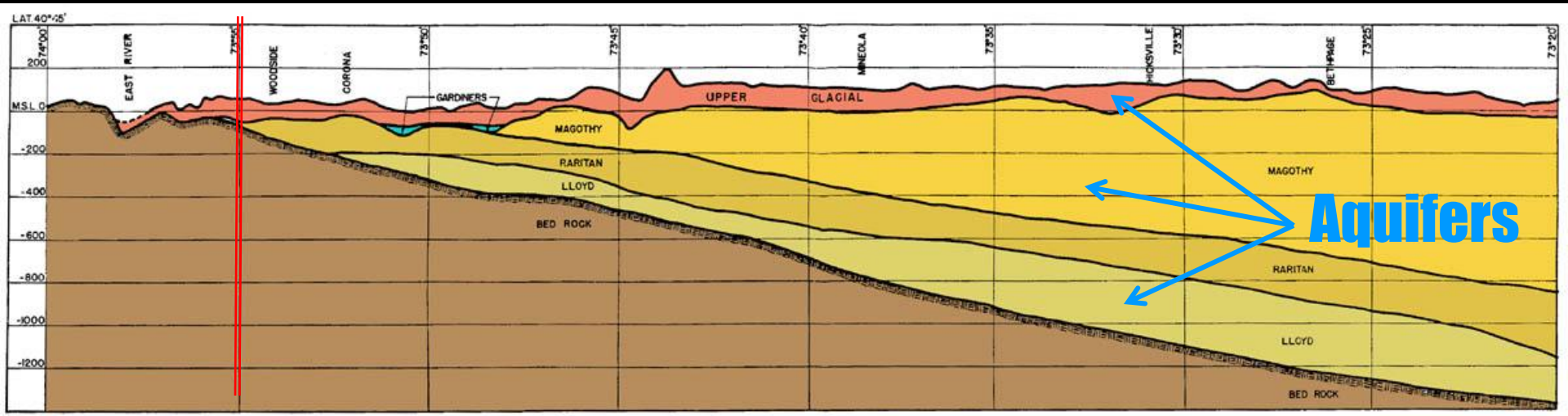
Johnson (1931)



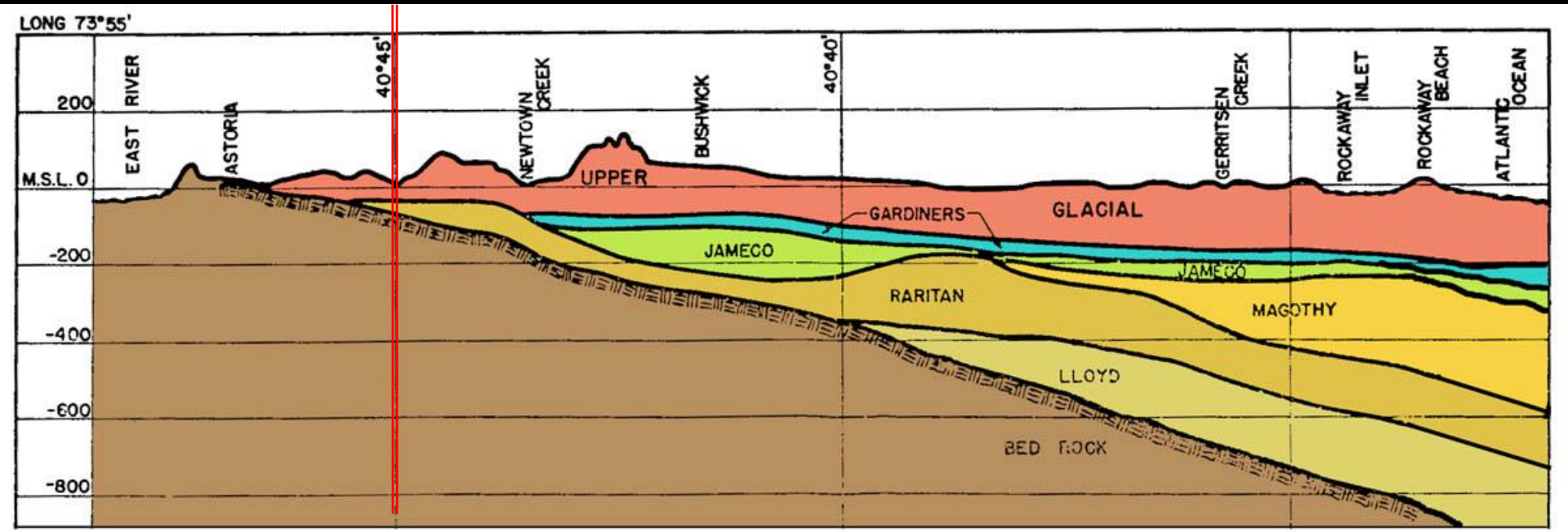
Lon Gisland



Rock Surface
SE Slope



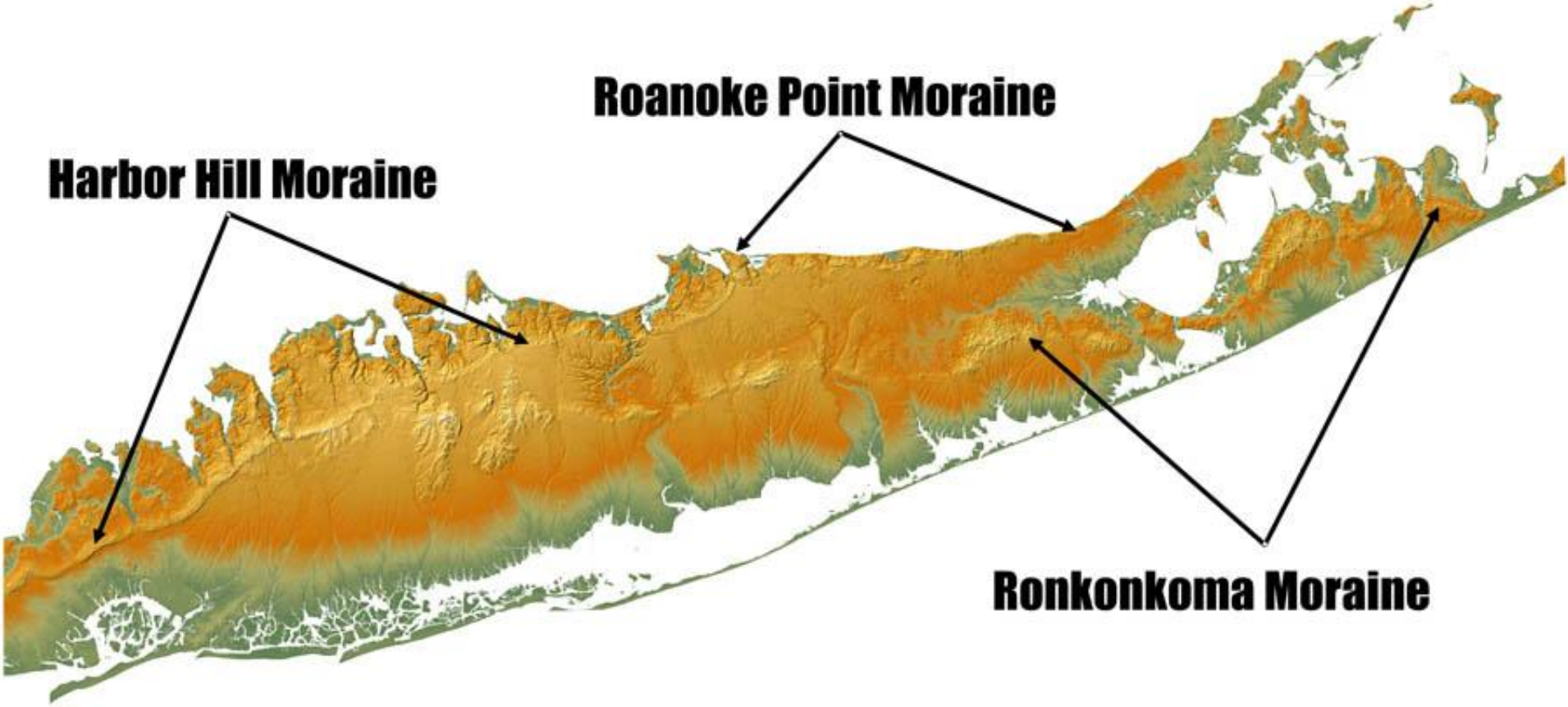
LAT. 40°=45' N



LONG. 73°=55' W

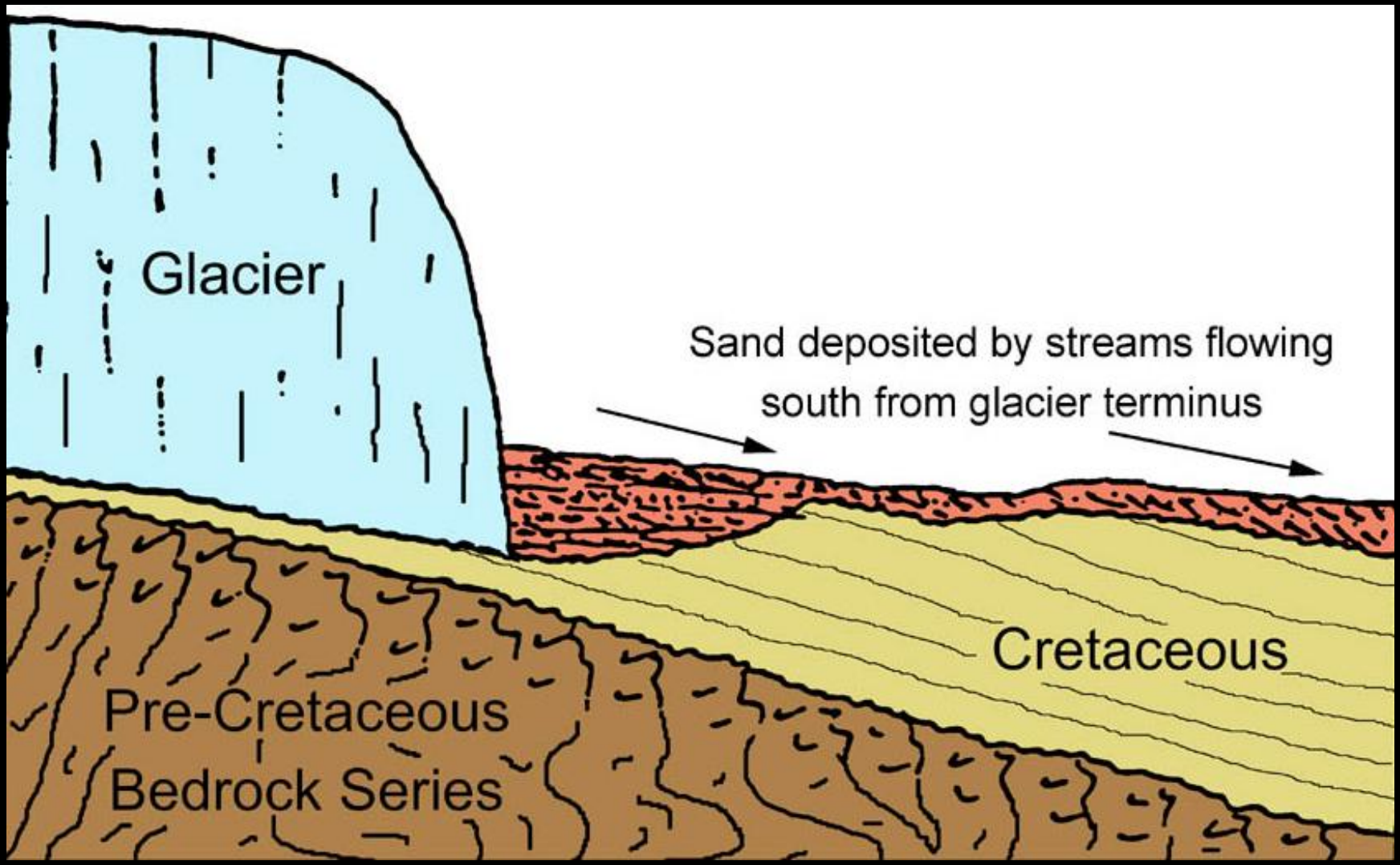
Suter et al, 1949

Truncation of Ronkonkoma by Harbor Hill Moraine



after Bennington, 2003

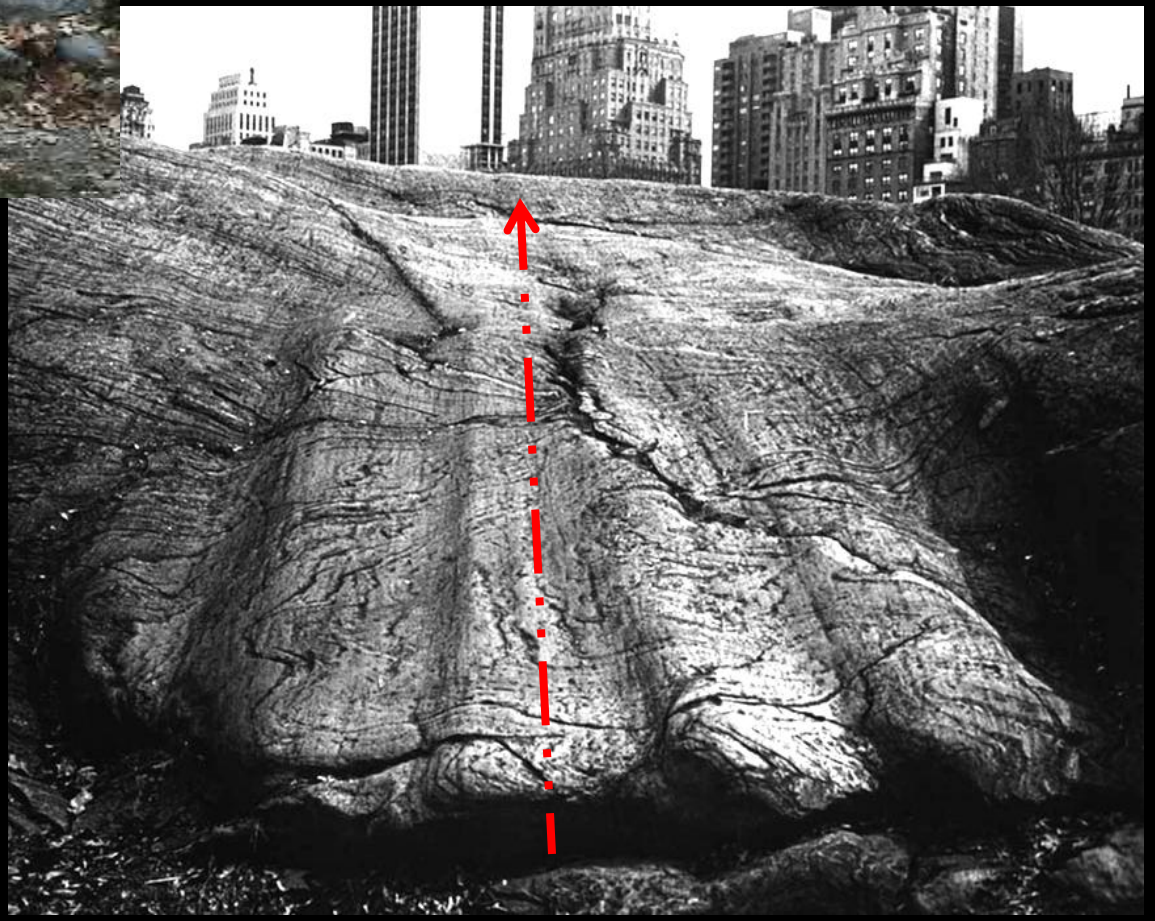
Long Island Outwash Fans



after Merguerian and Sanders 1993

S35°E-Directed Striae, So. Twin Island, Bronx

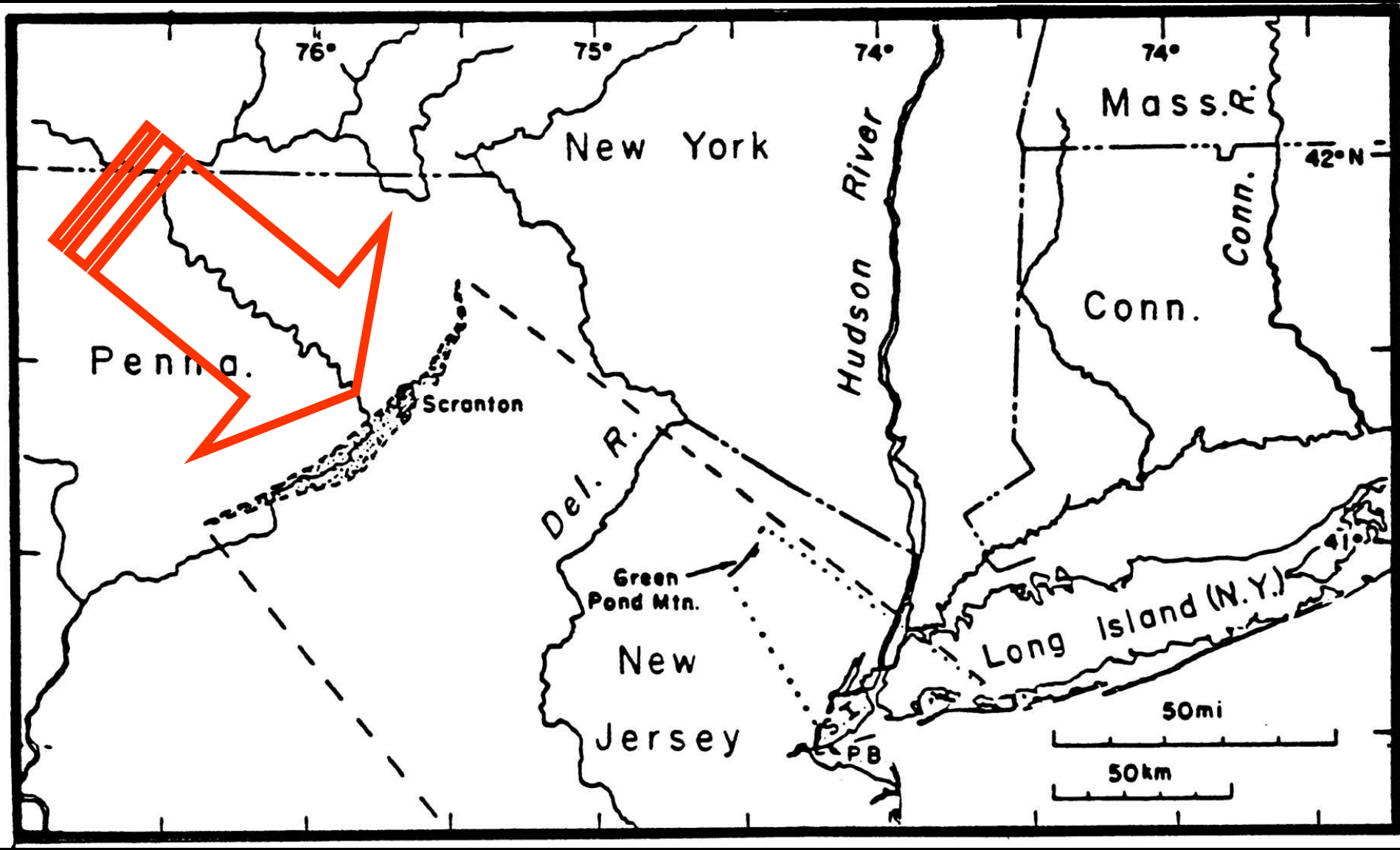
NW to SE Glacial Grooves and Striae, Bear Mtn., NY



SE Glacial Grooves, Central Park, NYC

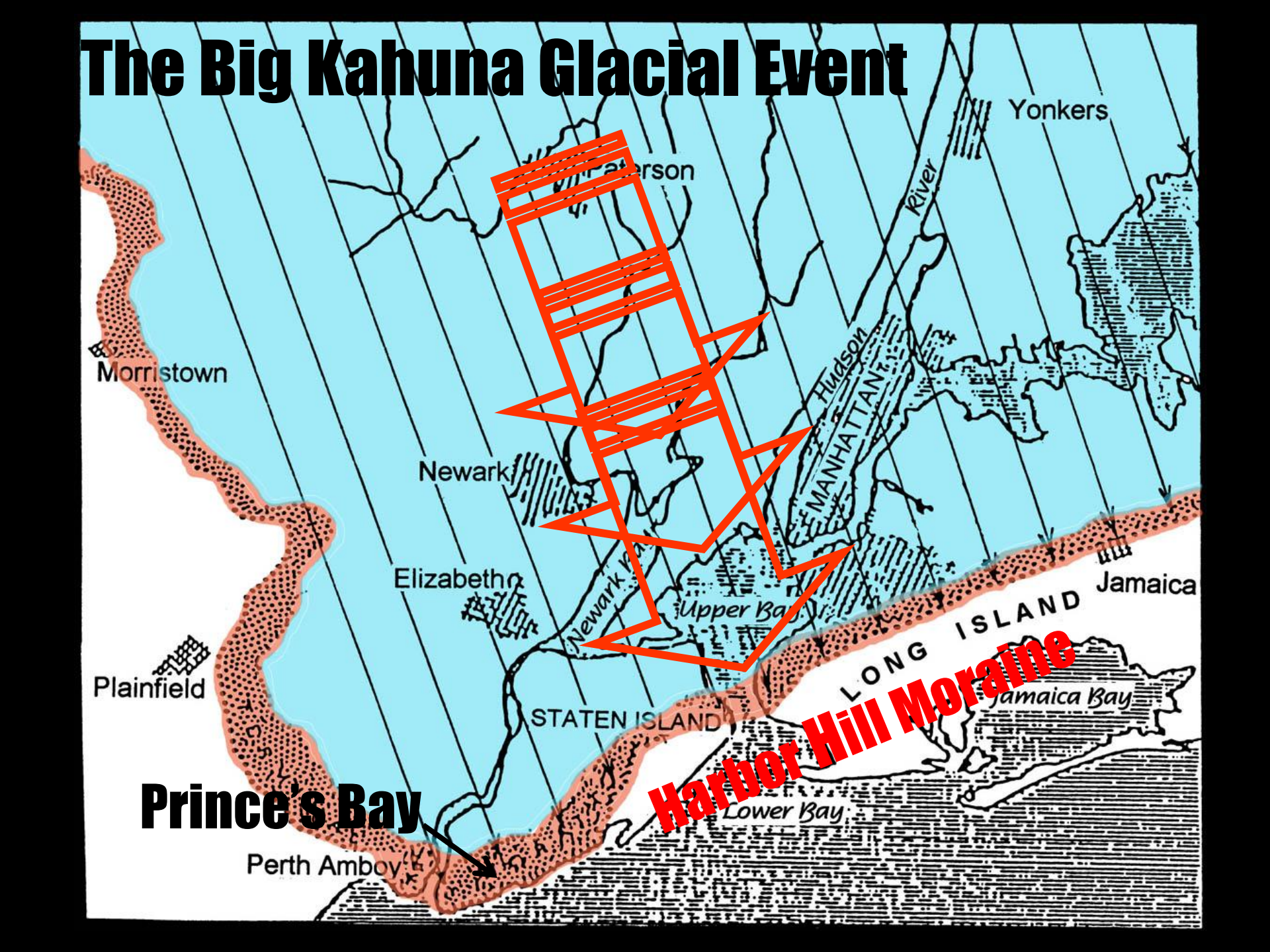
NE Sculpting, NW Striae, and Erratic - Central Park, NYC


SE-directed Chattermarks, Bear Mtn., NY

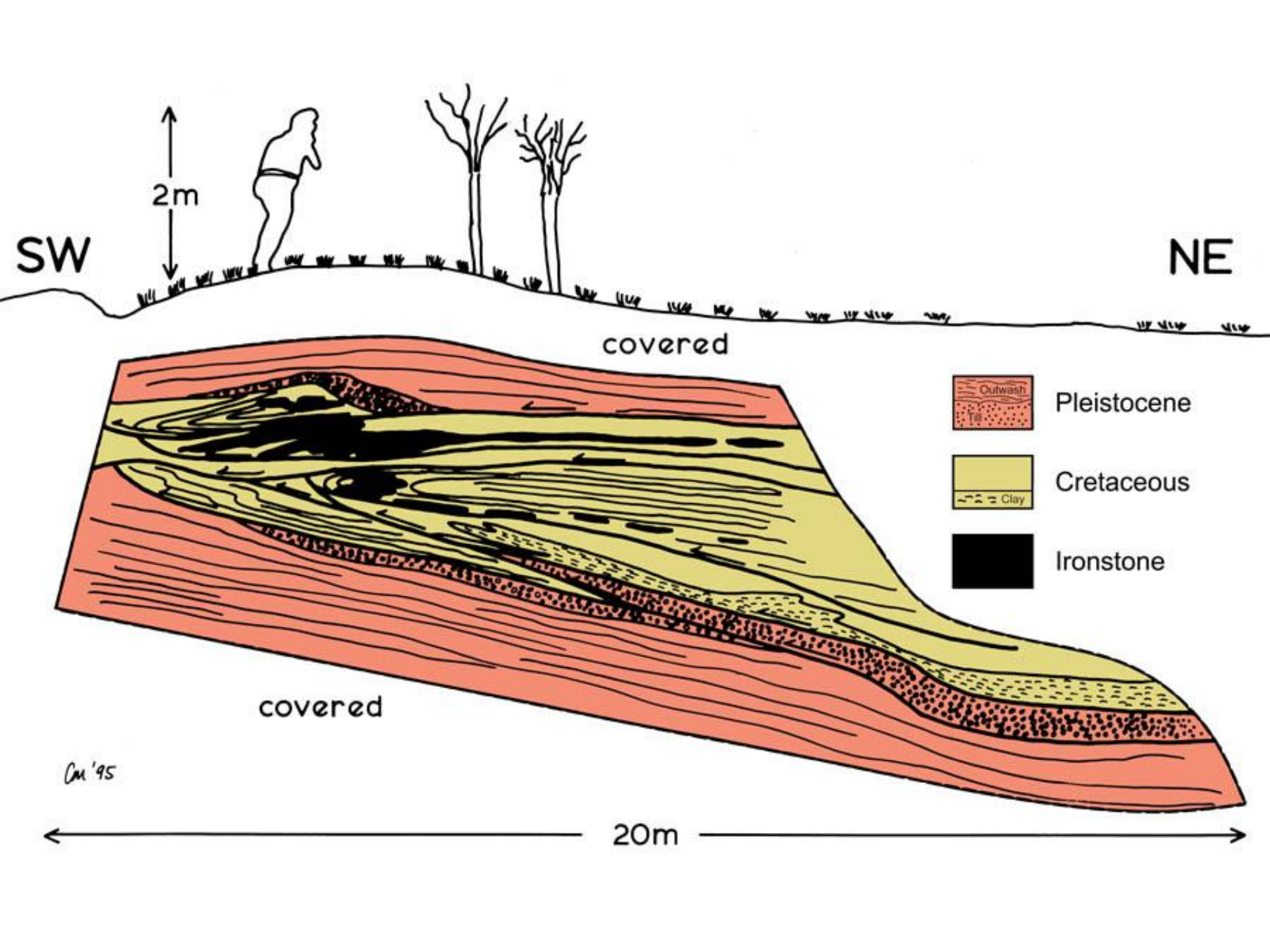


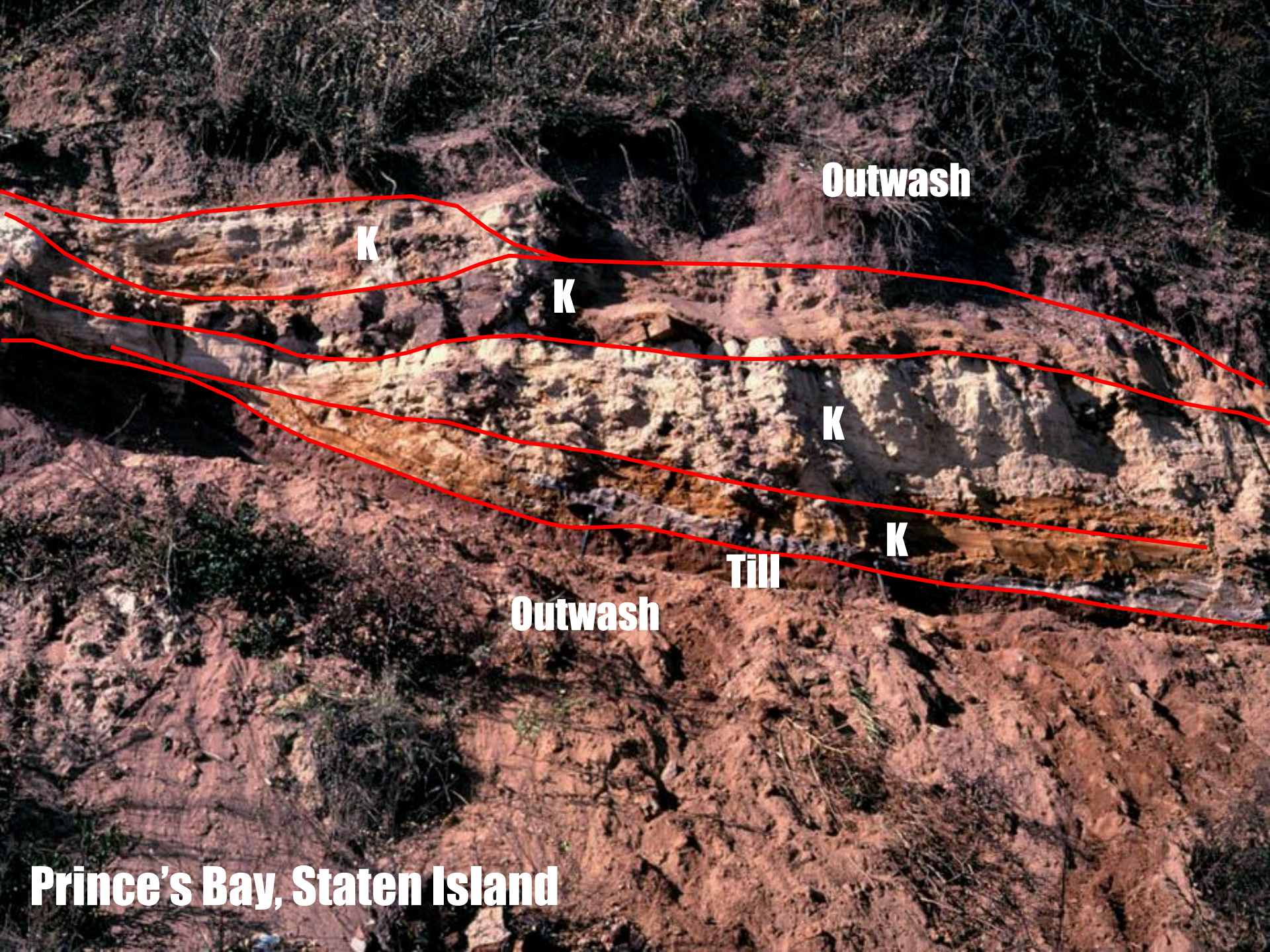
Anthracite and Green Pond Conglomerate Indicator Stones

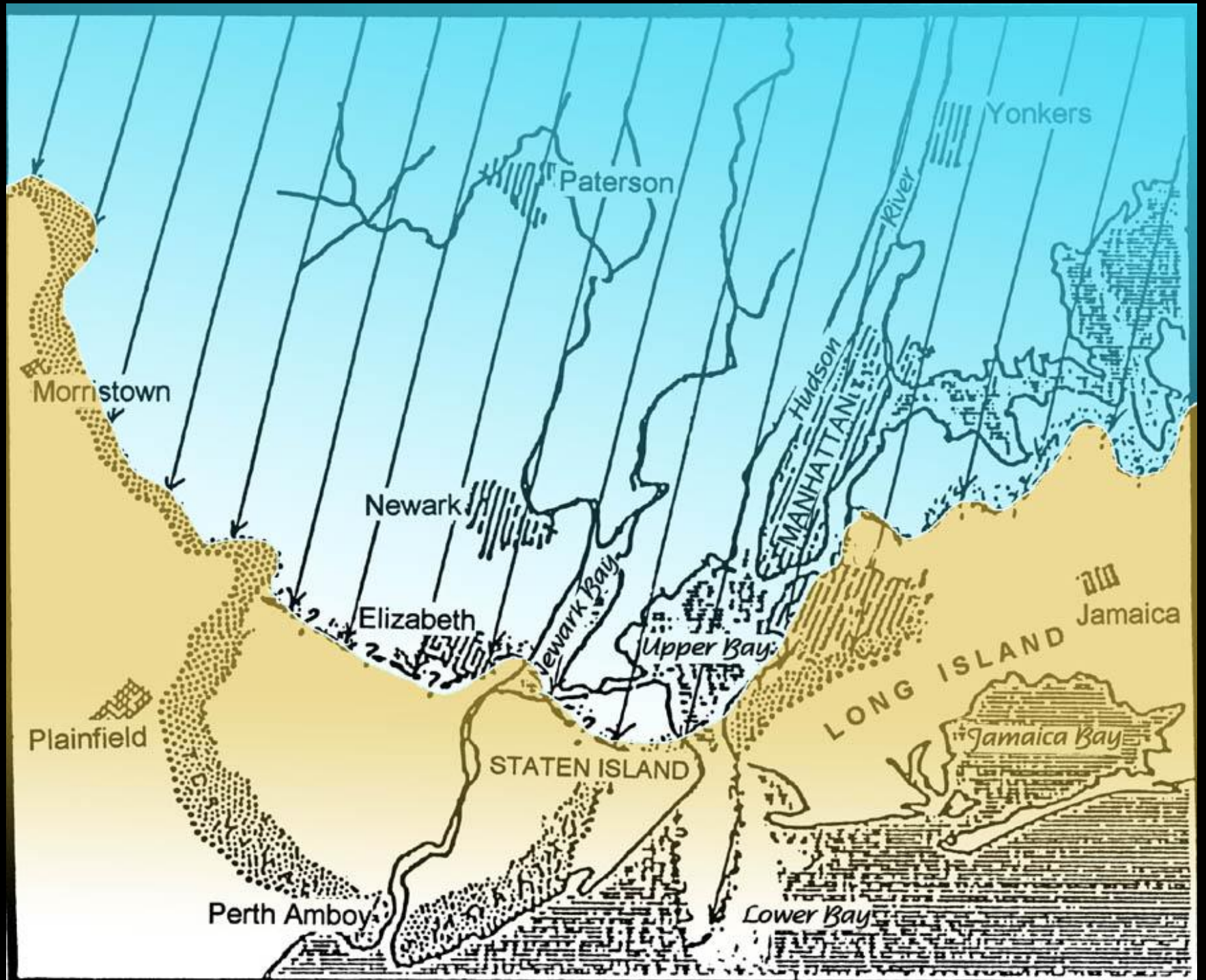
Friedman and Sanders (1994)


The Big Kahuna Glacial Event
Yonkers
Hudson River
MANHATTAN
Morristown
Newark
Elizabeth
Newark Bay
Upper Bay
Jamaica
LONG ISLAND
Plainfield
STATEN ISLAND
Jamaica Bay
Harbor Hill Moraine
Prince's Bay
Lower Bay
Perth Amboy


Prince's Bay, Staten Island

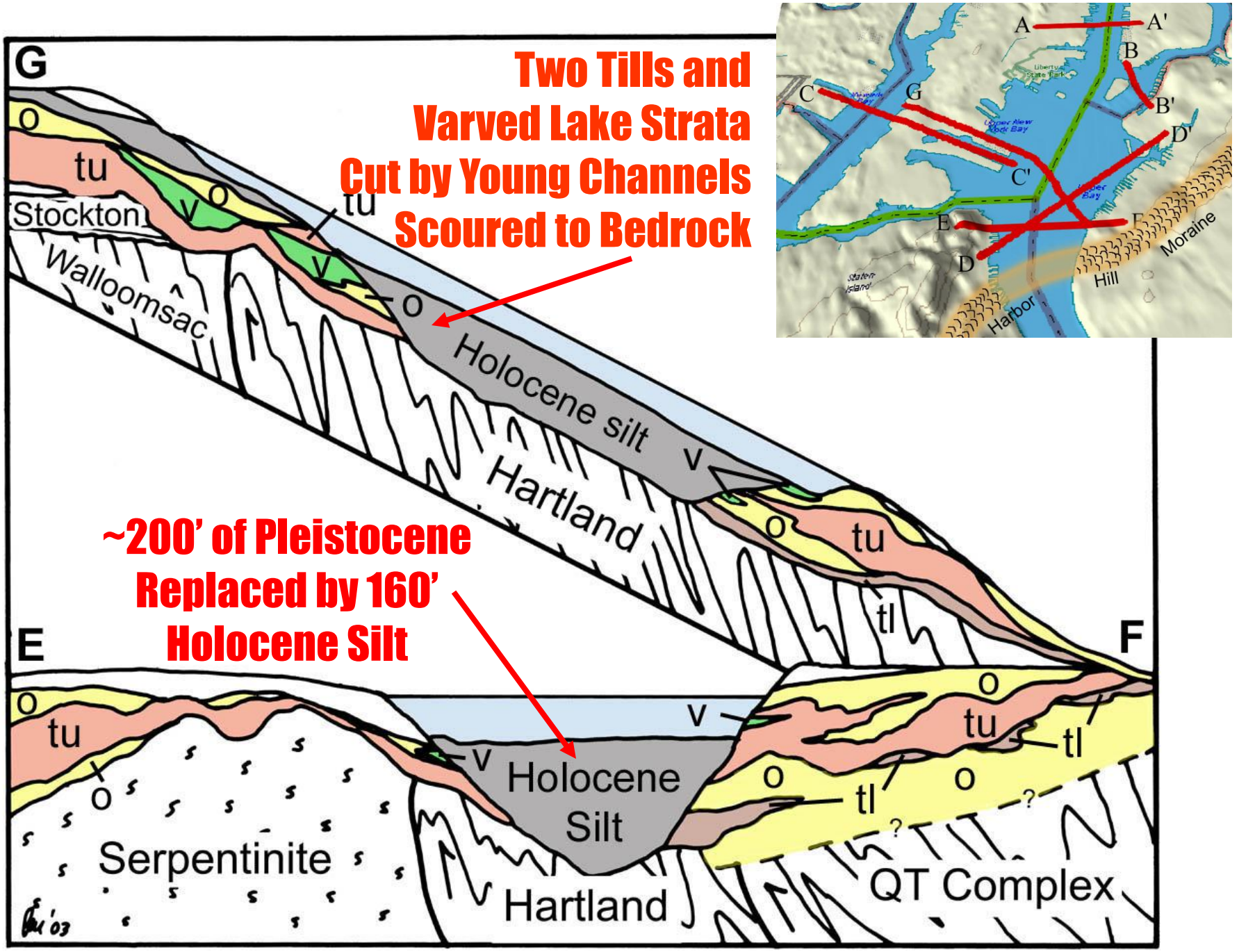

2m
SW
NE
covered
Outwash
Till
Pleistocene
Cretaceous
Clay
Ironstone
covered
Cm '95
20m


Outwash
K
K
K
K
Till
Outwash
Prince's Bay, Staten Island


Yonkers
Paterson
Hudson River
Morristown
MANHATTAN
Newark
Newark Bay
Elizabeth
Upper Bay
Jamaica
LONG ISLAND
Plainfield
Jamaica Bay
STATEN ISLAND
Perth Amboy
Lower Bay

Age	Till No.	Ice-flow Direction	Description; remarks
Late Wisconsinan ("Woodfordian"?)	I	NNE to SSW	Gray-brown till in Westchester Co., Staten Is., Brooklyn, & Queens (but not present on rest of Long Island); Hamden Till in CT with terminal moraine lying along the S coast of CT; gray lake sediments at Croton Point Park, Westchester Co.
Mid-Wisconsinan (?)			Paleosol on Till II, SW Staten Island.
Early Wisconsinan(?)	II	NW to SE	Harbor Hill Terminal Moraine and associated outwash (Bellmore Fm. in Jones Beach subsurface); Lake Chamberlain Till in southern CT.
Sangamonian(?)			Wantagh Fm. (in Jones Beach subsurface).
	IIIA	NW to SE	Ronkonkoma Terminal Moraine and associated outwash (Merrick Fm. in Jones Beach subsurface).
Illinoian(?)	IIIB		Manhasset Fm. of Fuller (with middle Montauk Till Member; in lower member, coarse delta foresets (including debris flows) deposited in Proglacial Lake Long Island dammed in on S by pre-Ronkonkoma terminal moraine.
	IIIC		
Yarmouthian			Jacob Sand, Gardiners Clay.
Kansan(?)	IV	NNE to SSW	Gray till with decayed stones at Teller's Point (Croton Point Park, Westchester Co.); gray till with green metavolcanic stones, Target Rock, LI.
Aftonian(?)			No deposits; deep chemical decay of Till V.
Nebraskan (?)	V	NW to SE	Reddish-brown decayed-stone till and -outwash at AKR Co., Staten Island, and at Garvies Point, Long Island; Jameco Gravel fills subsurface valley in SW Queens.
			Pre-glacial (?) Mannetto Gravel fills subsurface valleys.

Sanders and Merguerian, 1998

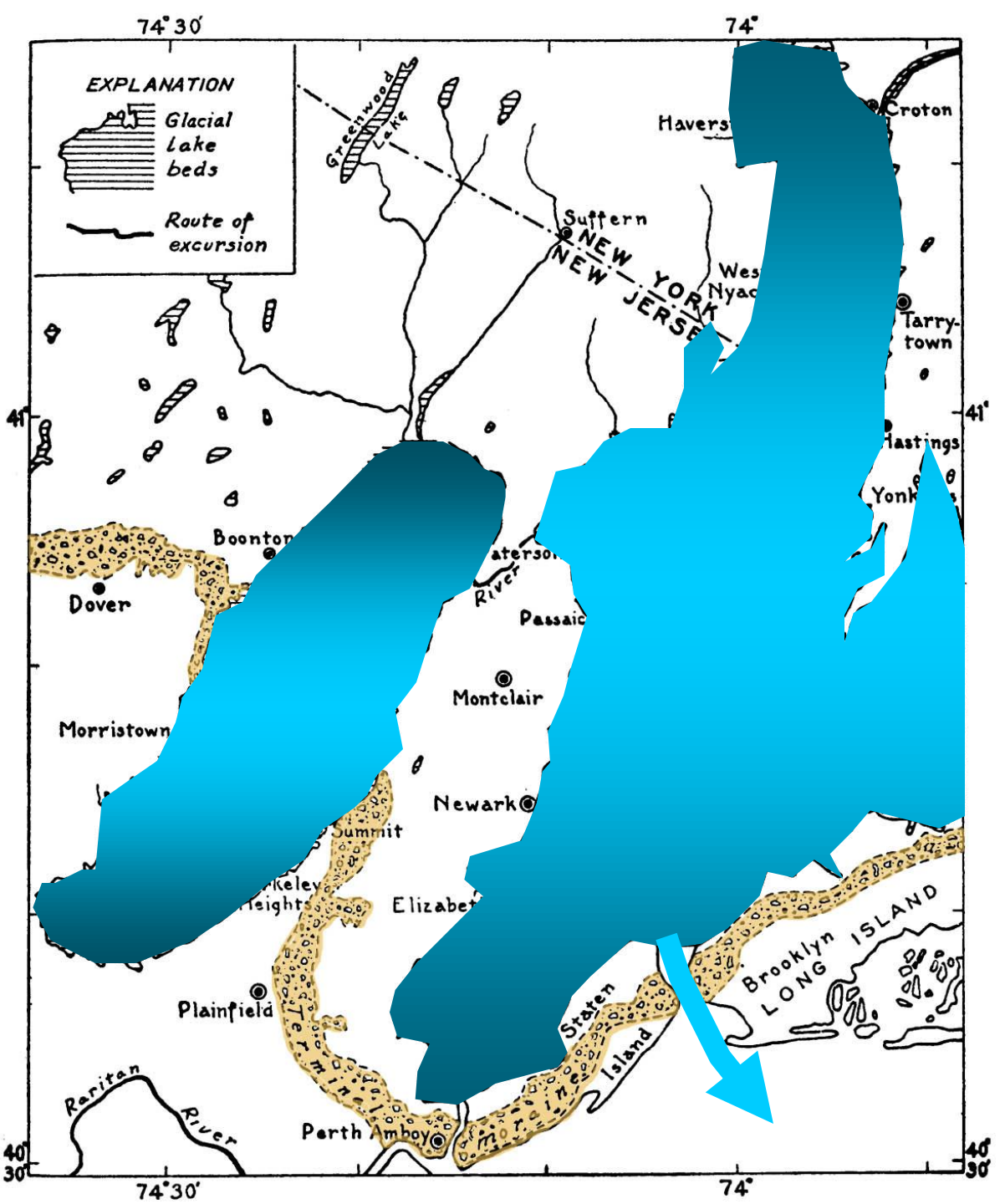


(after Merguerian 2003)

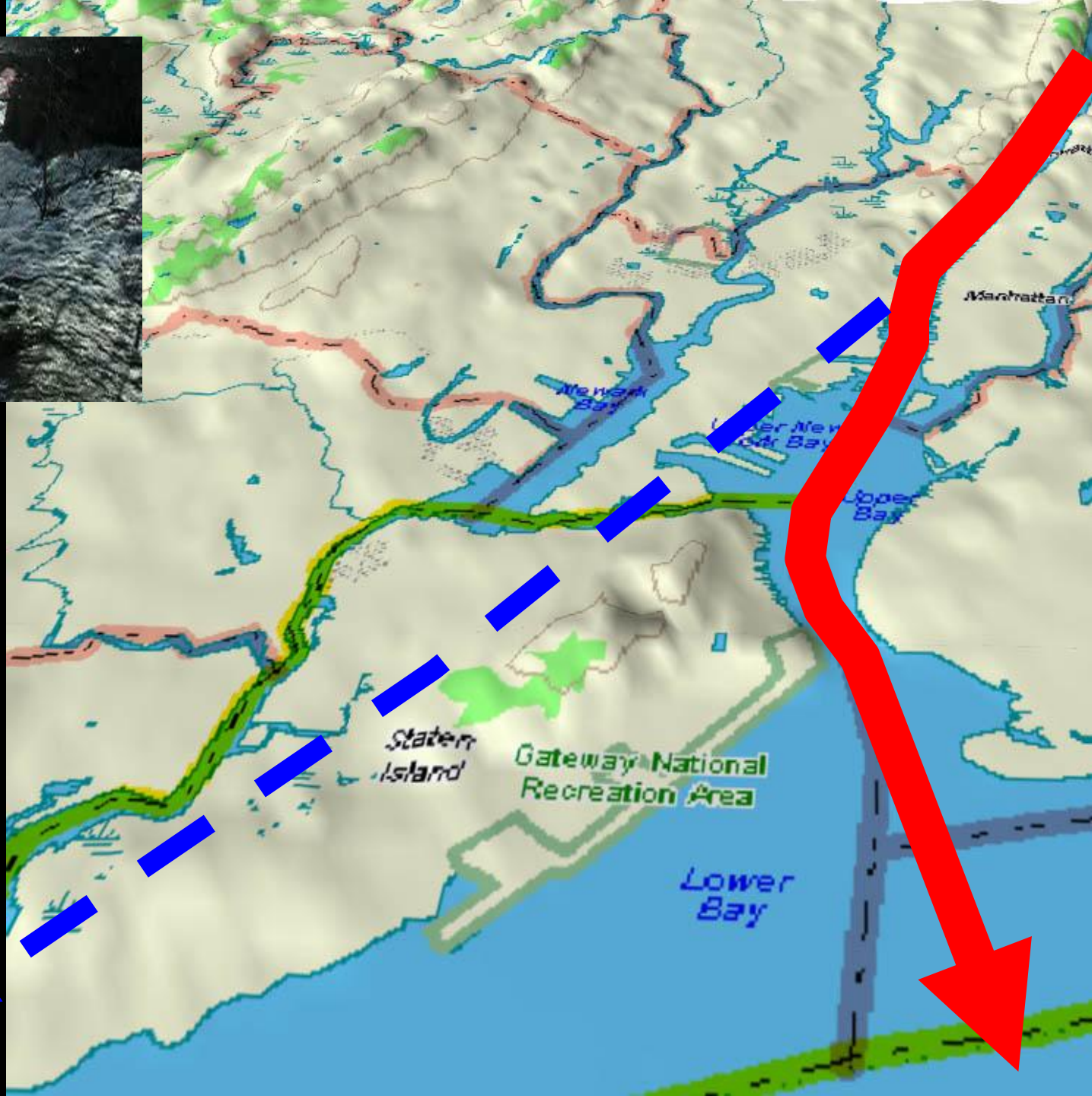
Glacial Lake Strata and the Harbor Hill Moraine

Woodfordian Drainage Through The Narrows

Berkey (1933)



Hudson Abandons Former Channels – Floods Through Narrows

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