Geology of the NY Botanical Garden

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Mickey Merguerian
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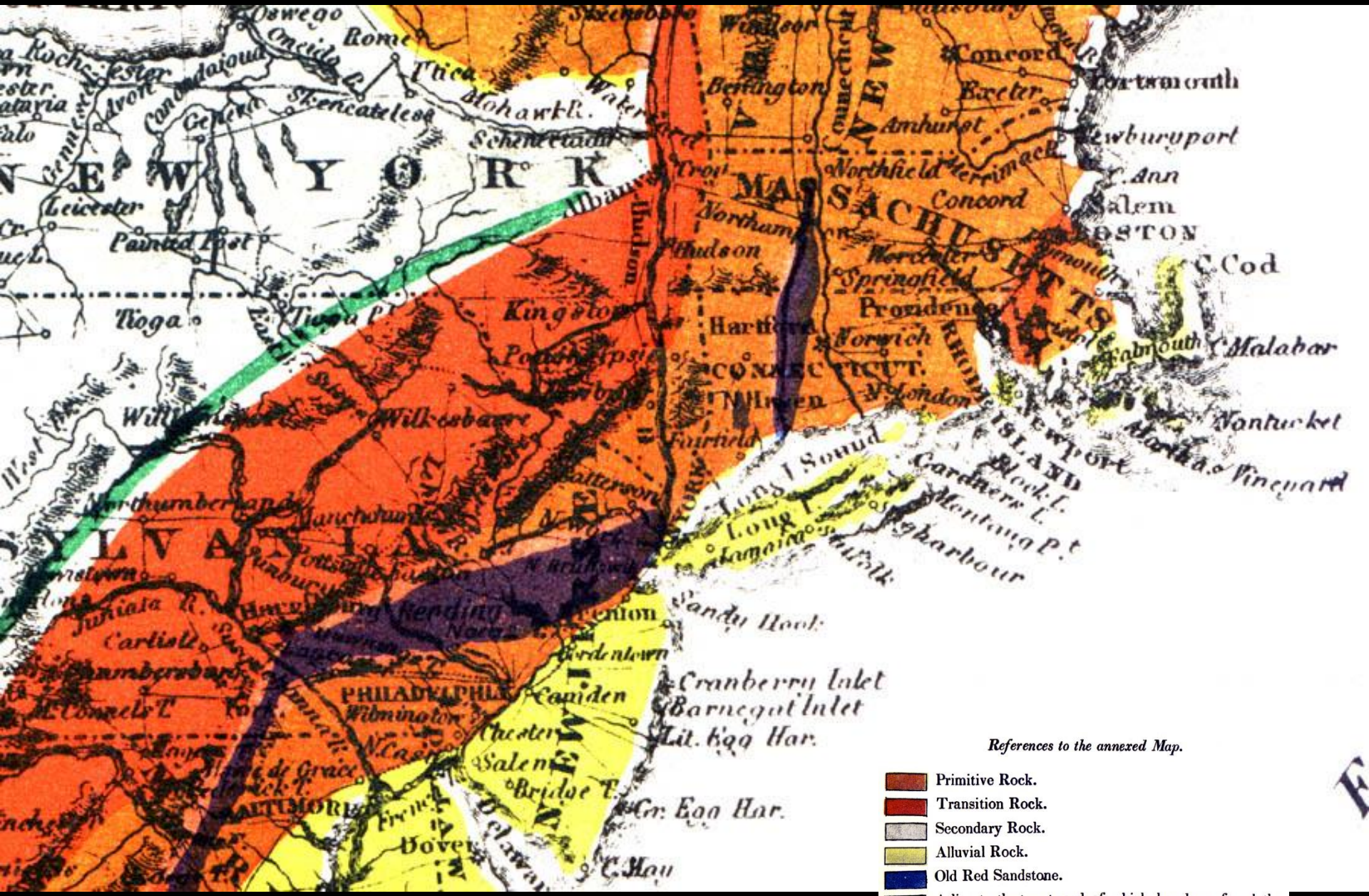
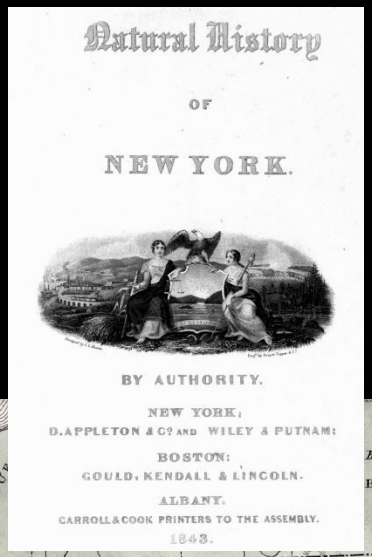
11 Dec 2024



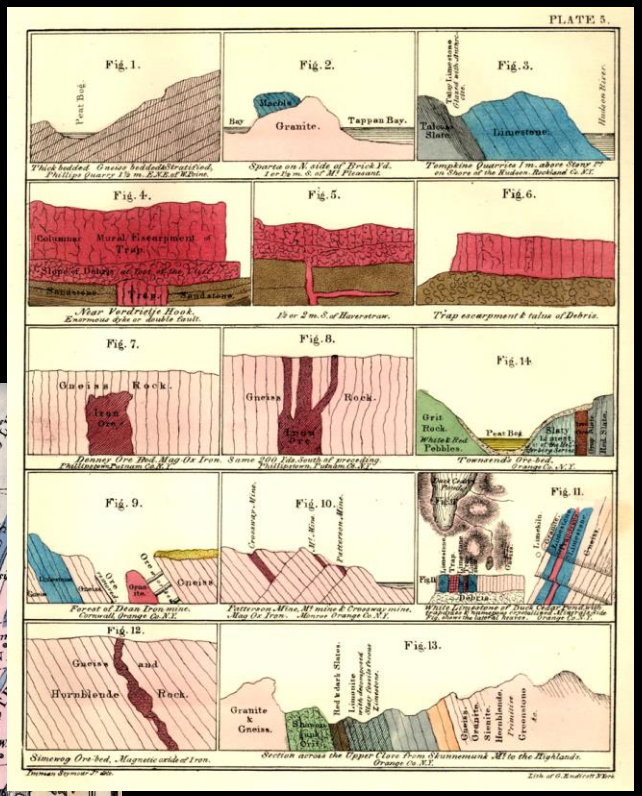
References to the annexed Map.

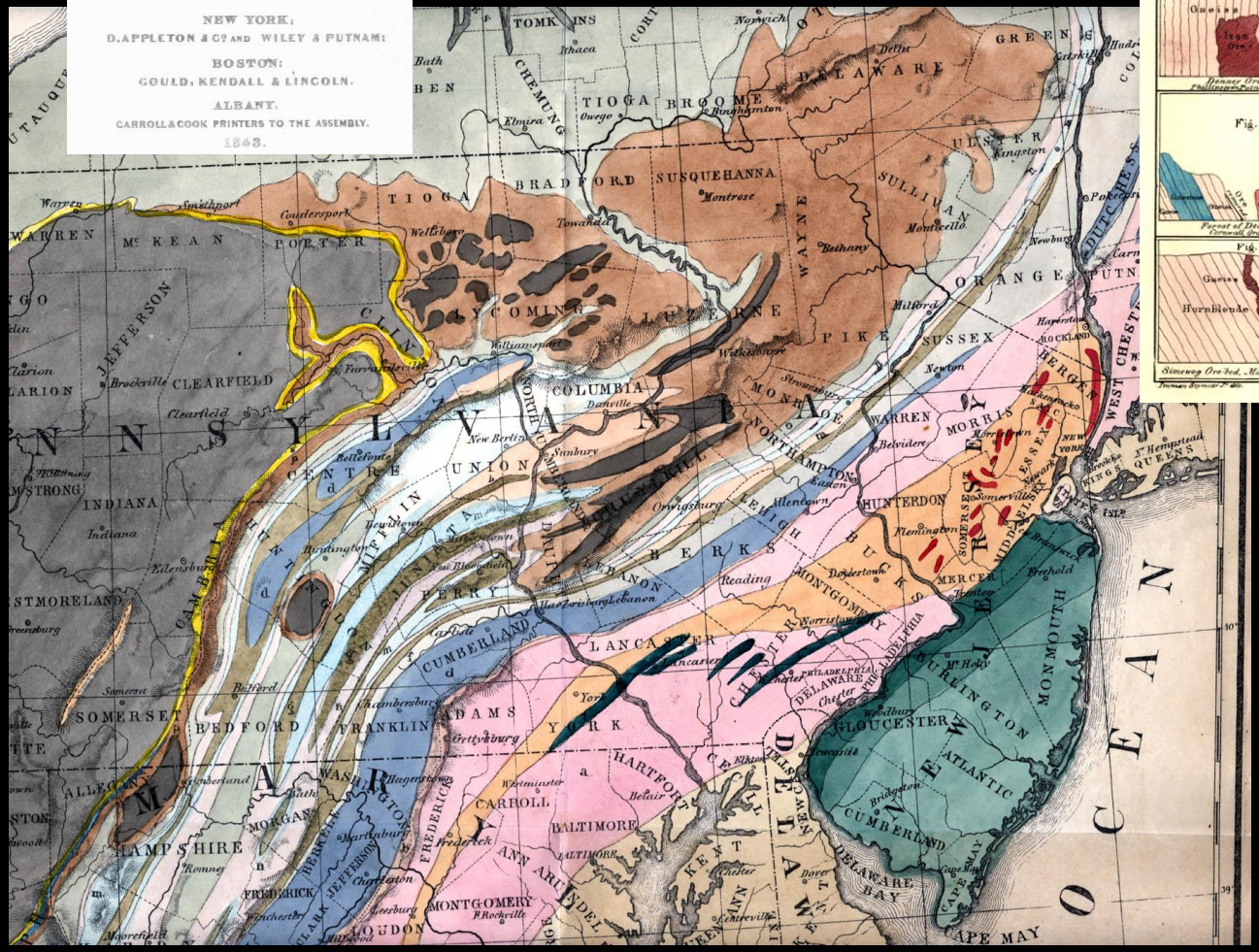
- Primitive Rock.
- Transition Rock.
- Secondary Rock.
- Alluvial Rock.
- Old Red Sandstone.
- A line to the westward of which has been found the greatest part of the Salt and Gypsum.

Maclure 1817



Natural History of New York – 5 vol. 1842-1843

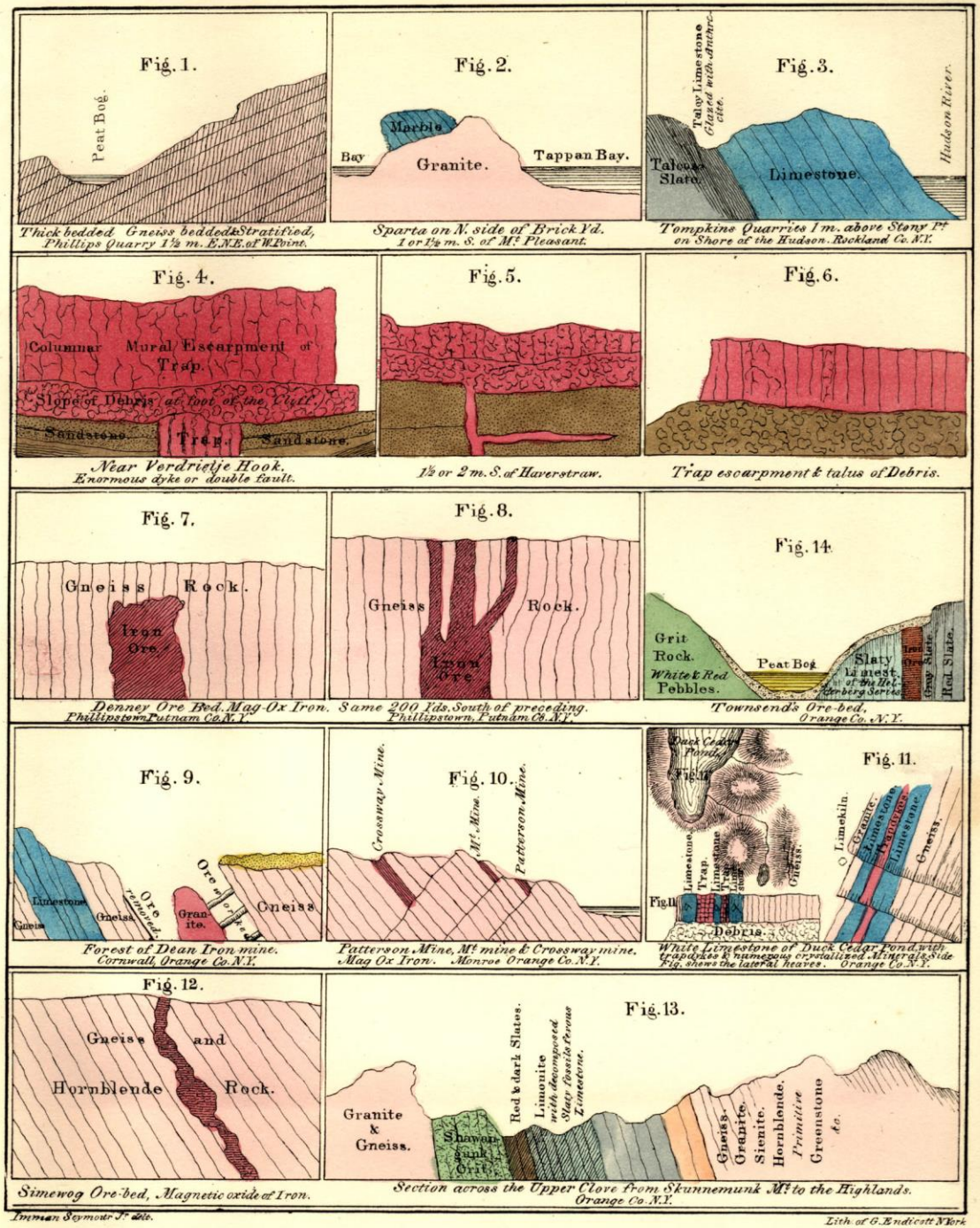




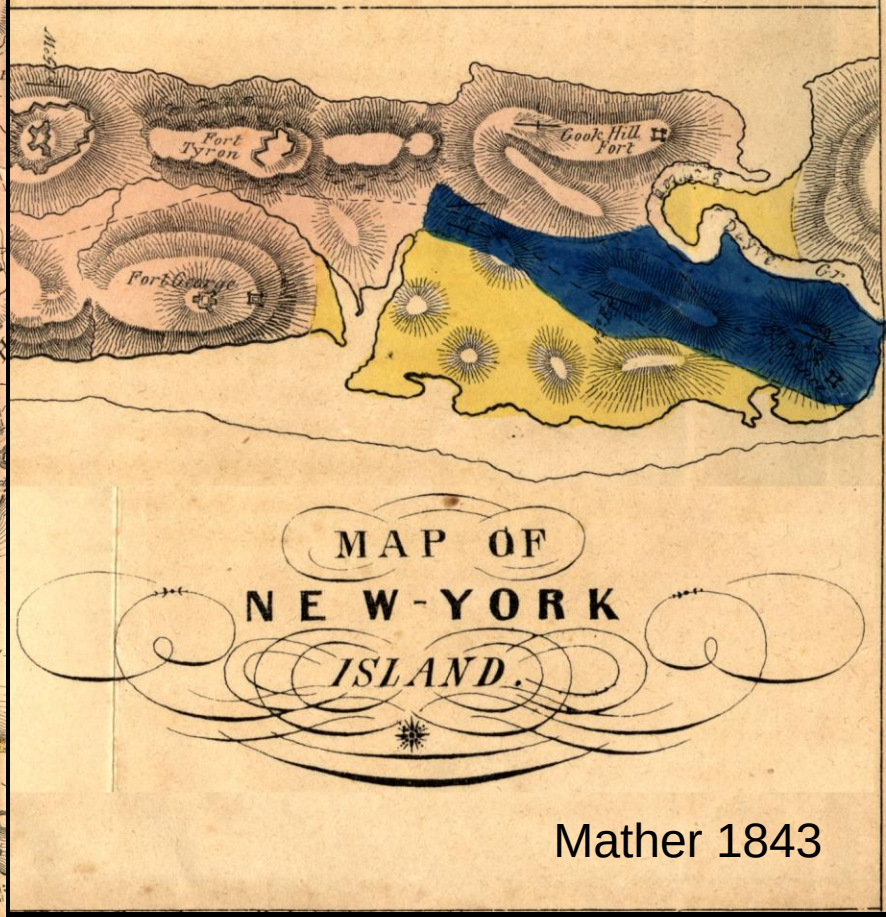
Hall
Mather
Emmons
Beck
Vanuxem

Geologic Sections

Mining Areas New York State



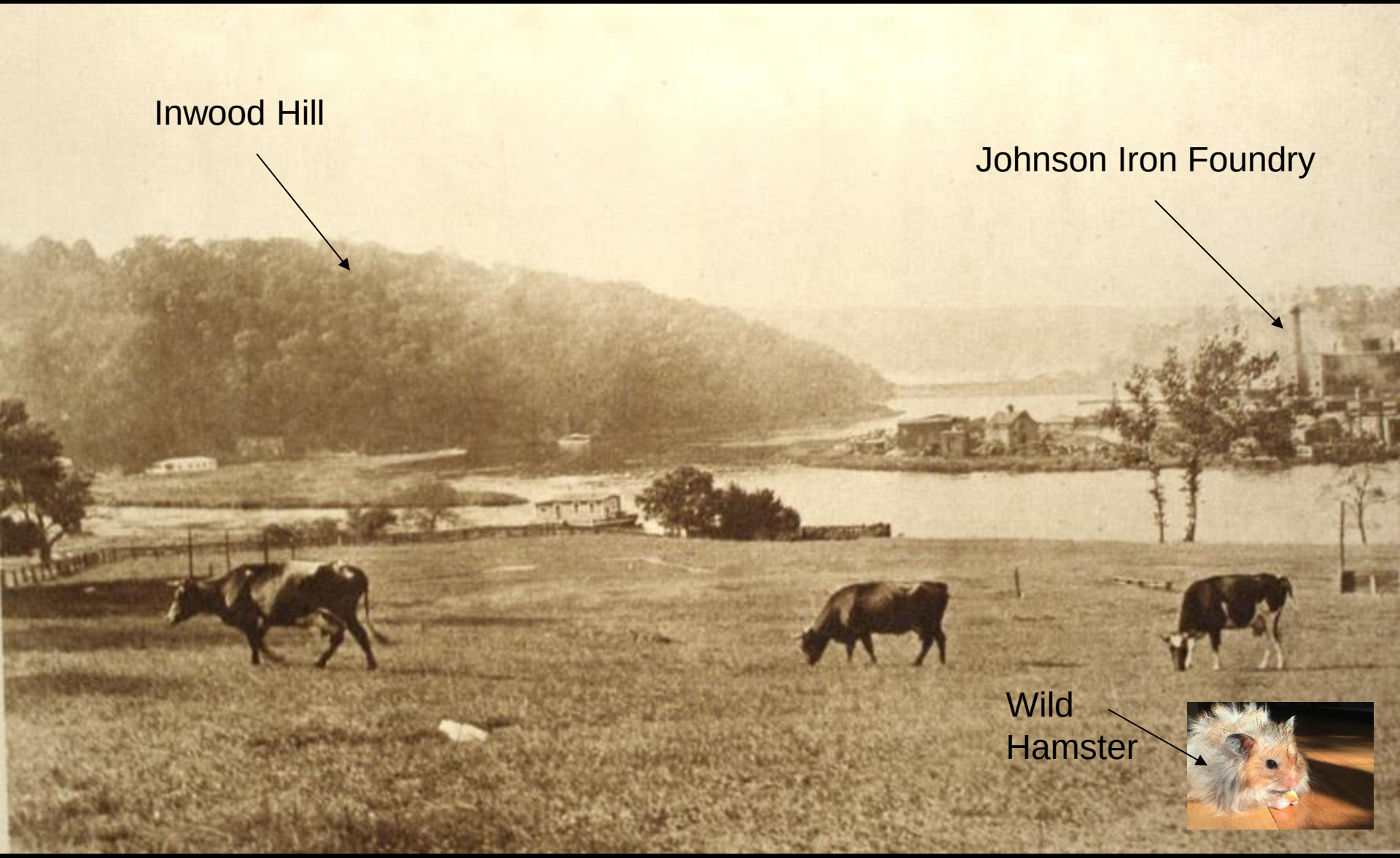
Mather 1843



Mather 1843

1650 on – Quarrying Industry
1809 – Kingsbridge Locality (Dana)
1819 – Spuyten Duyvil Widening
1840 – Cessation of Quarrying
1885-95 – Harlem Ship Canal

Mather 1843



Northern Manhattan circa 1883 (From Betts 2009)

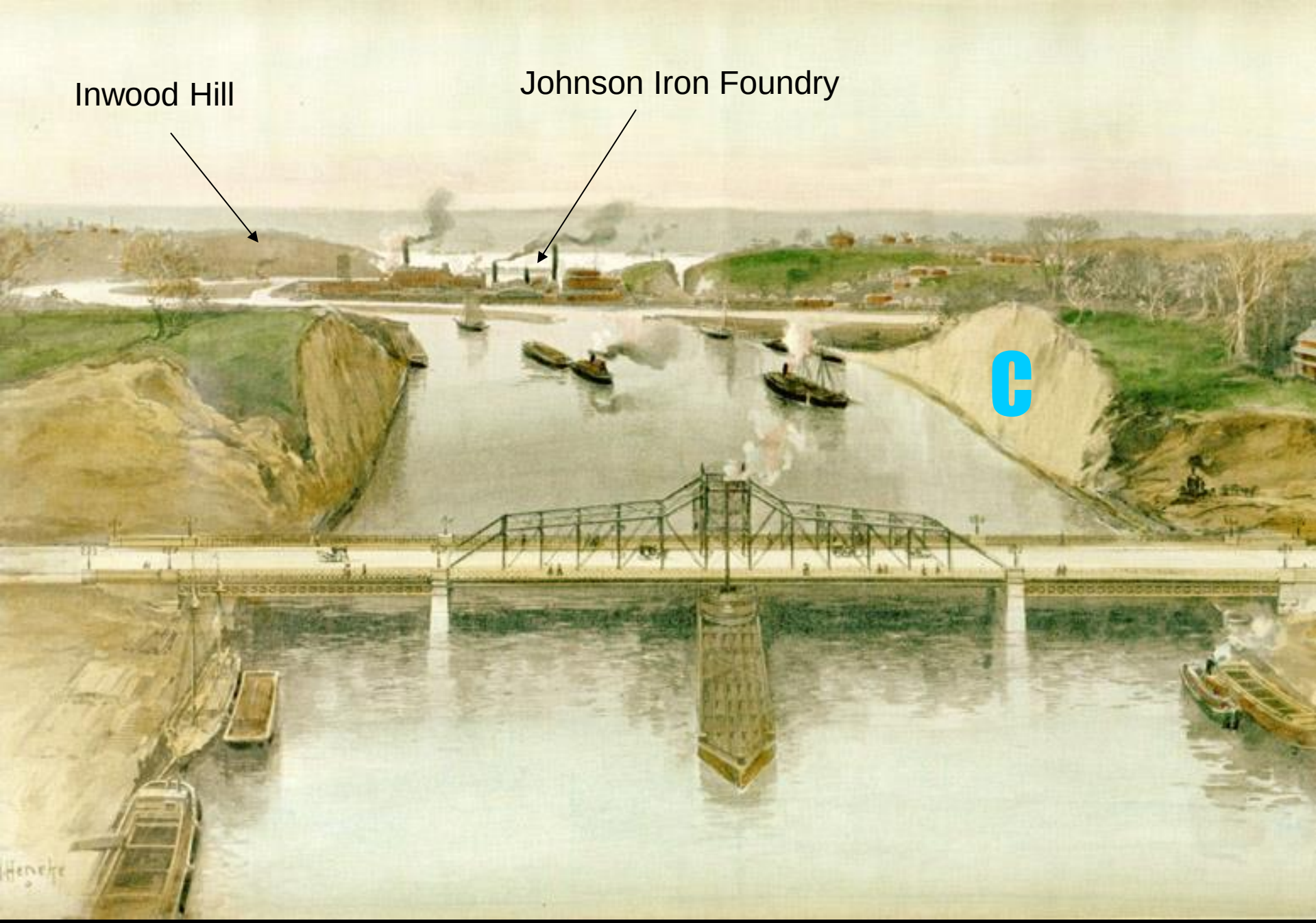
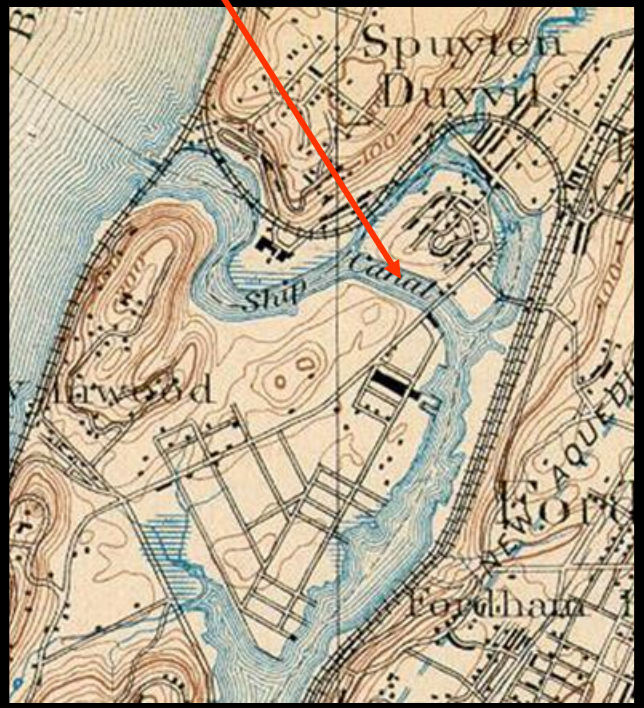


Illustration Harper's Weekly 16 Feb 1895

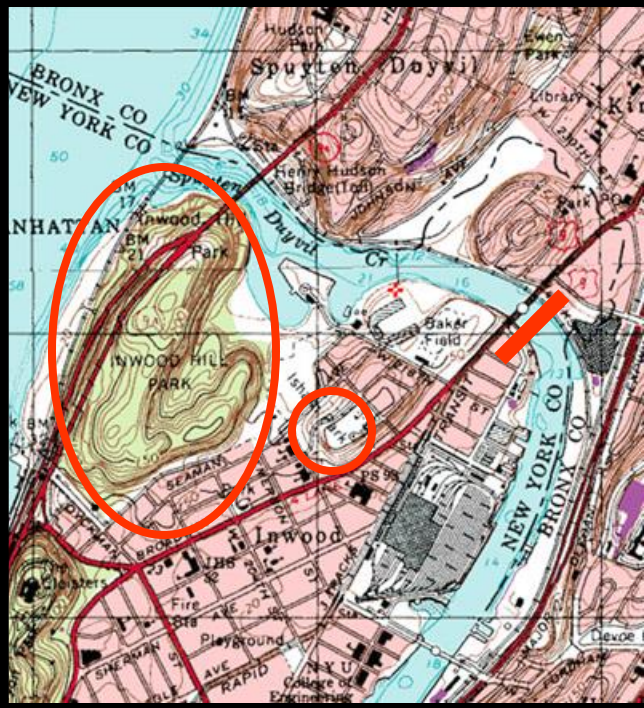
Bolton Canal

Harlem Ship Canal

1832



1897



1979

Betts 2009

New York Mineralogical Club
Harlem Ship Canal (1887)

Diopside
Kingsbridge, Manhattan
(Betts 2009)

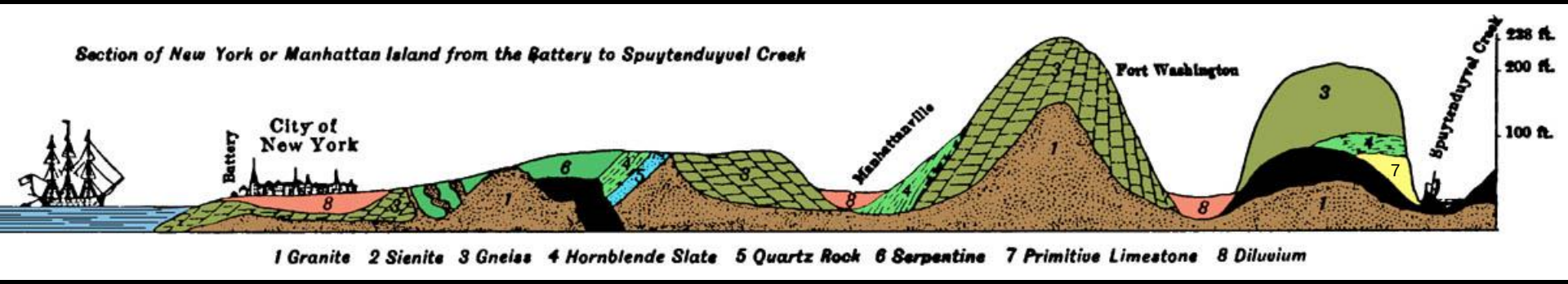
Beck (1842) Describes "white and bluish-white tremolite" up to 22 cm

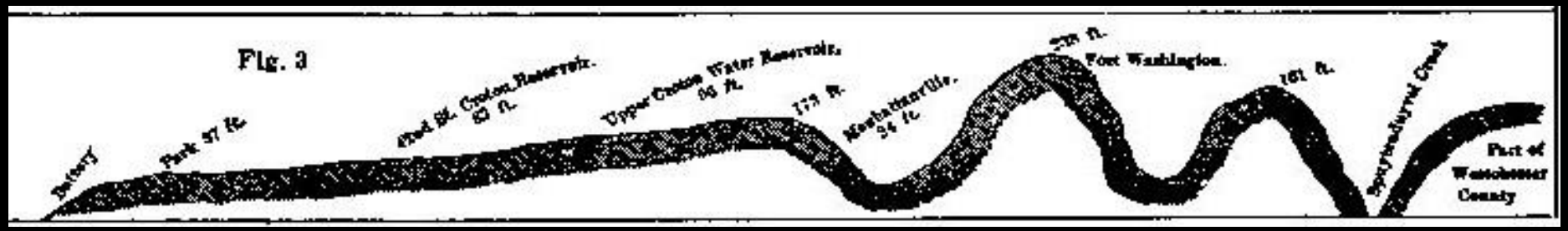
Dana (1850) Correlation of "Inwood Limestone" northward

Tremolite
Kingsbridge, Manhattan

Dravite-uvite in Marble
Tubby Hook Fill
(Betts 2009)

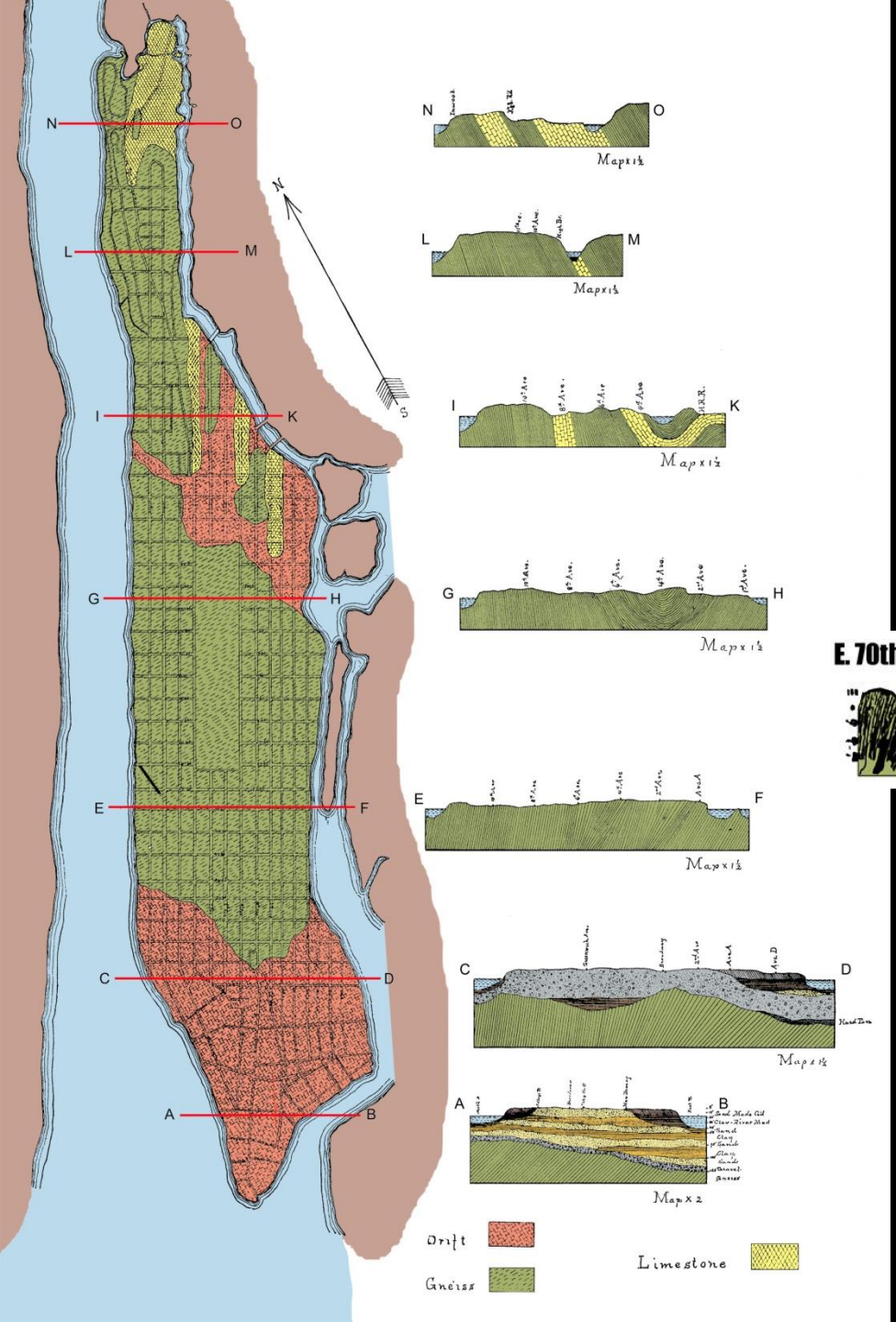
Geological Section – Manhattan Island

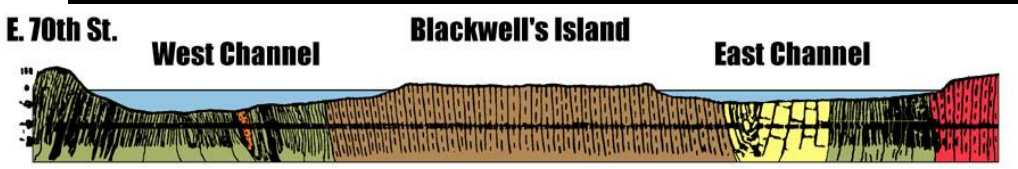




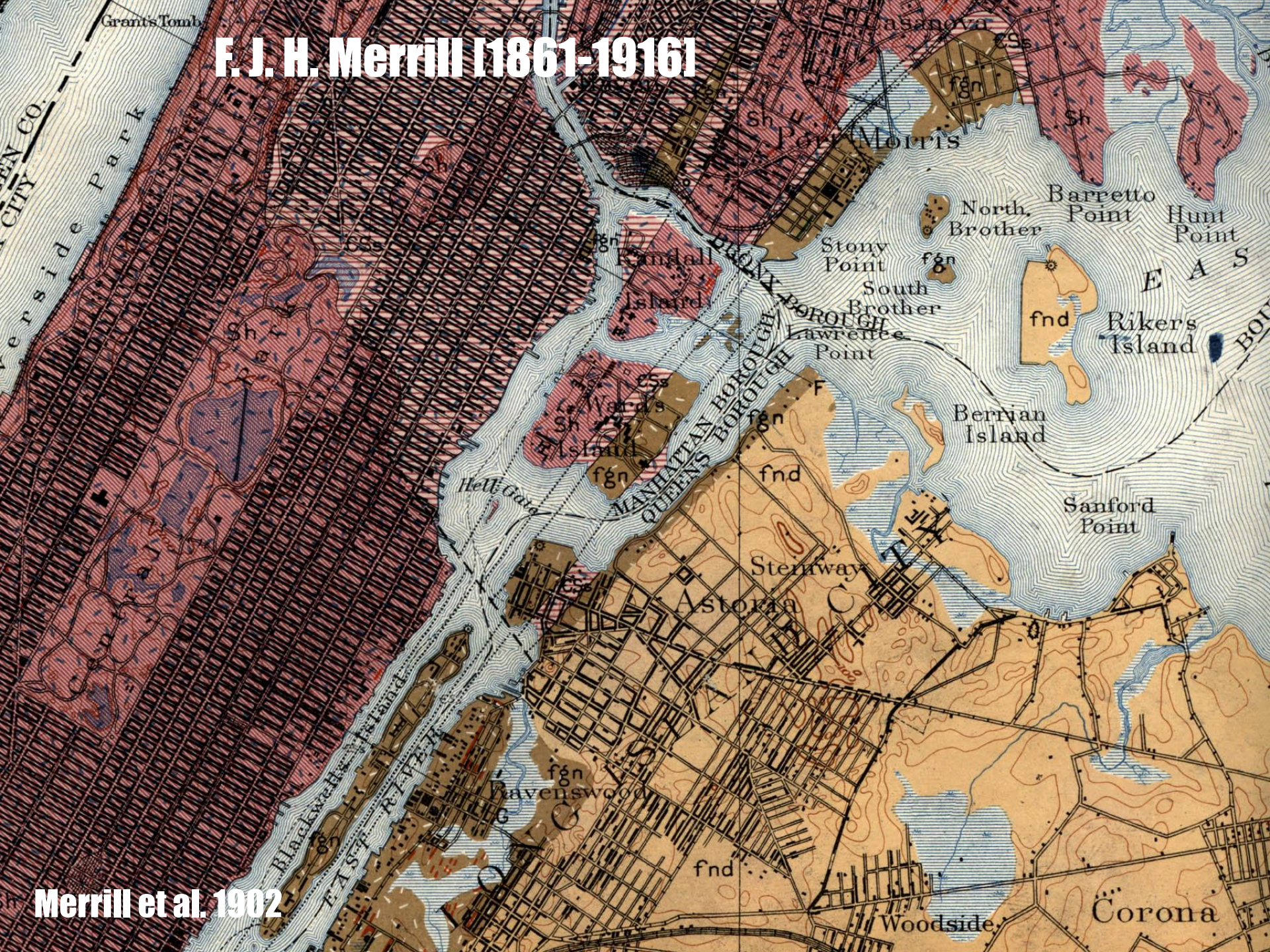
after Cozzens, 1848

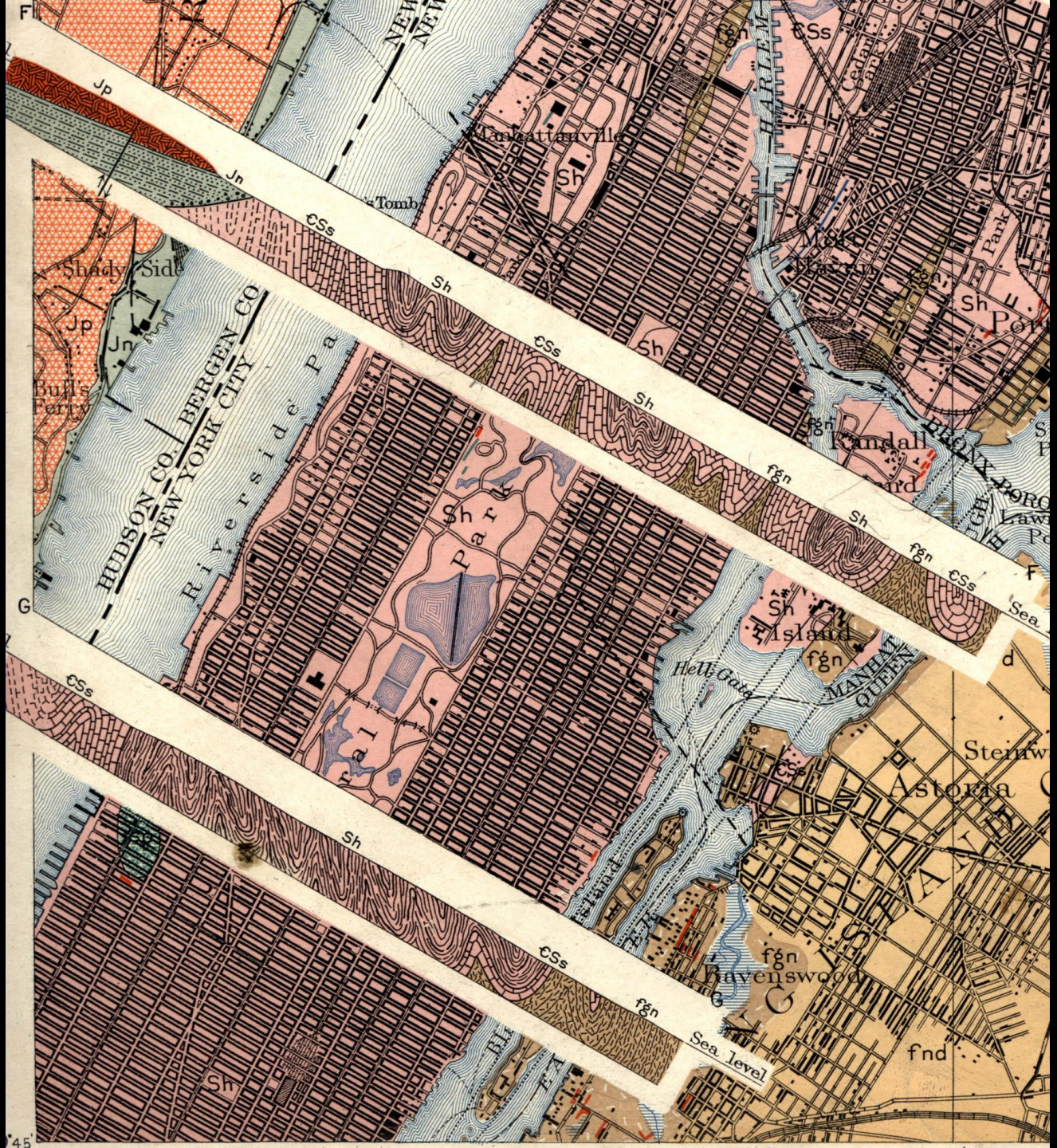
First Geologic Map of Manhattan By J.F. Kemp





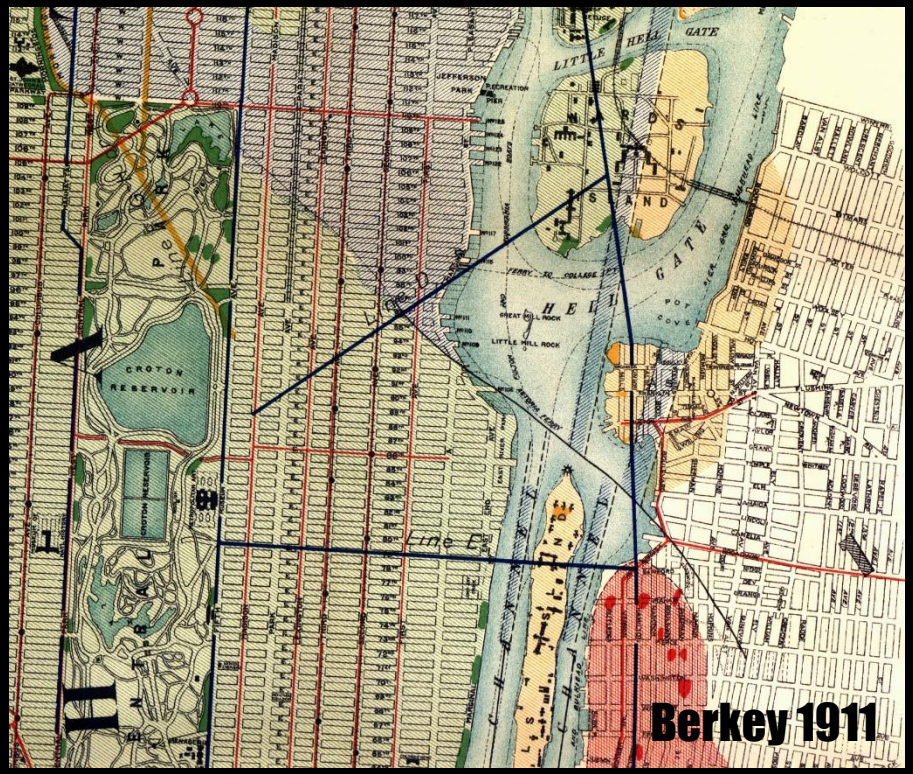
Kemp 1887, 1895


F. J. H. Merrill [1861-19161
Merrill et al. 1902
Grant's Tomb
Riverside Park
Port Morris
Barretto Point
Hunt Point
North Brother
Stony Point
South Brother
Randall Island
Wards Island
Lawrence Point
Rikers Island
Berrian Island
Sanford Point
Hell Gate
MANHATTAN BOROUGH
QUEENS BOROUGH
Steinway
Astoria
Ravenswood
Blackwell Island
Woodside
Corona
Sh
fgn
fnd
F
CS



Merrill et al 1902

Professor Charles P. Berkey [1867-1955]



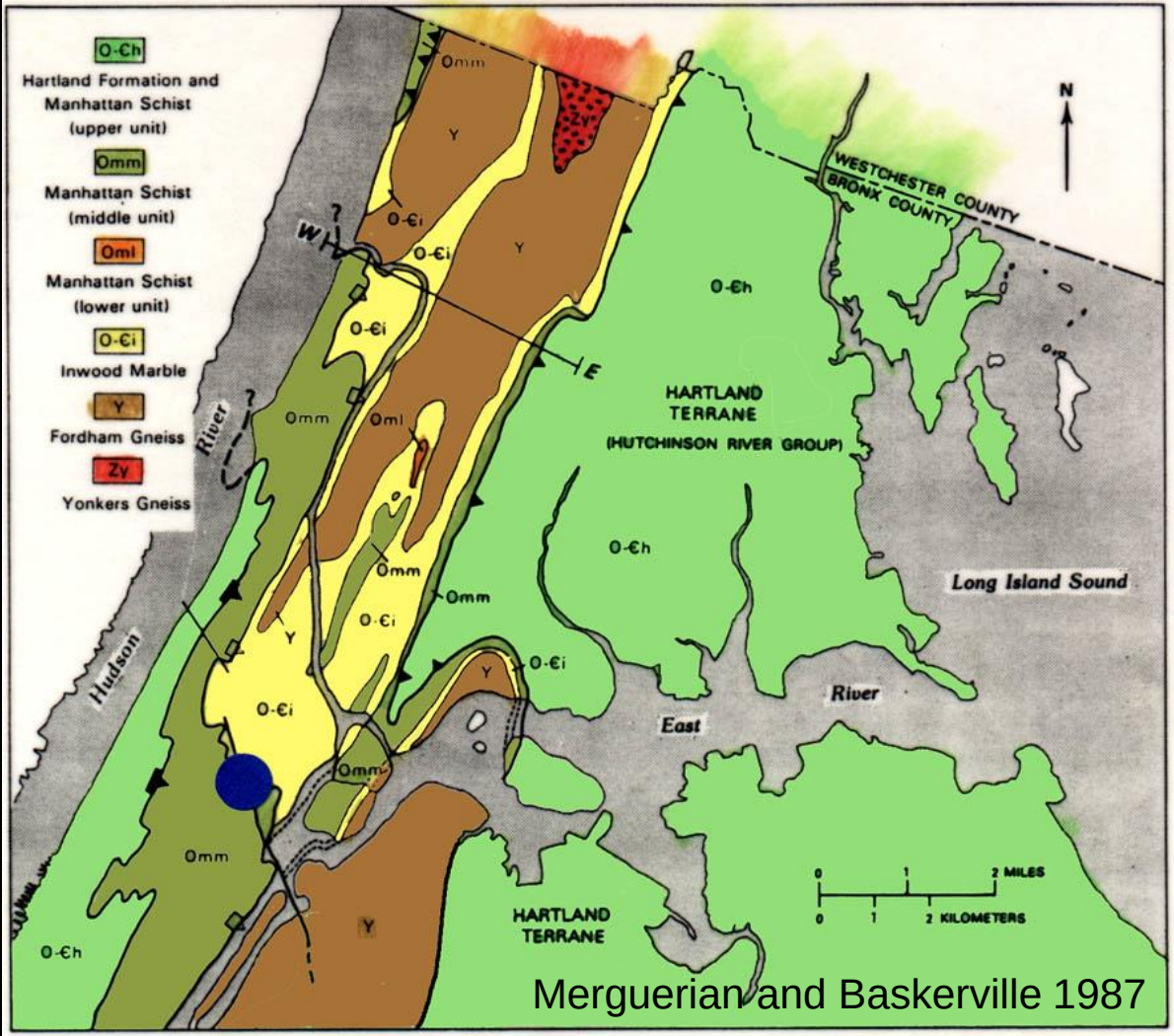
CM's Early Field Work on Manhattan Island Started in the 1960s

When NYC was Unexplored Wild Territory and CM was Limber

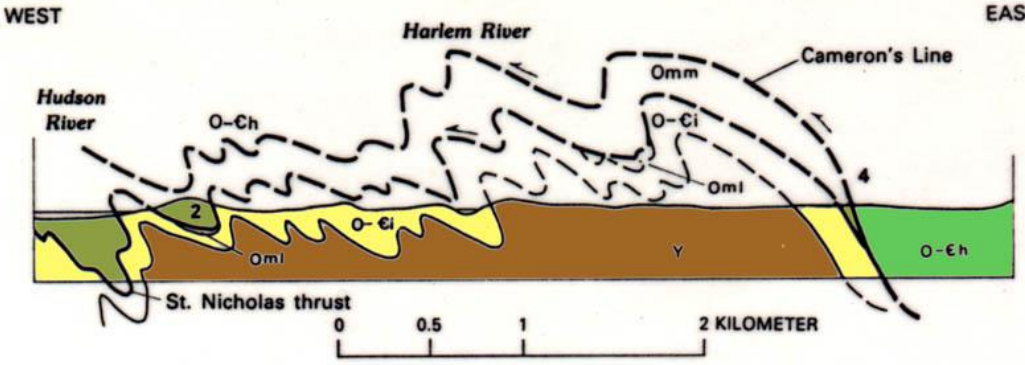
Merguerian Has Spent
(Wasted?)
Most of his Career
Mapping the Surface
and Subsurface
Geology of NYC
> 1,000 Field Stops

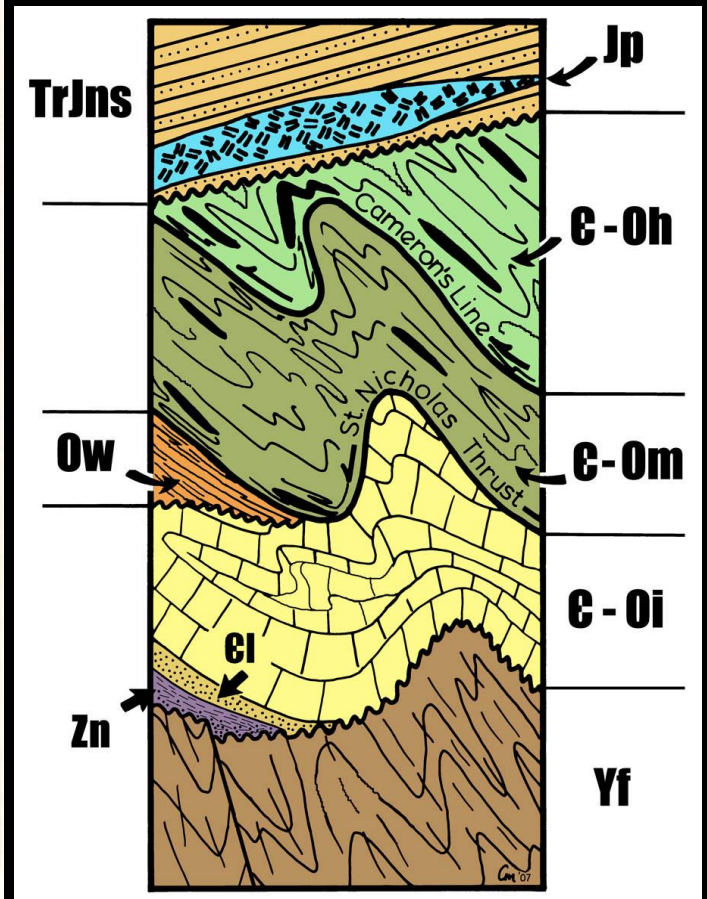
Proper Field Attire
For NYC
Field Work

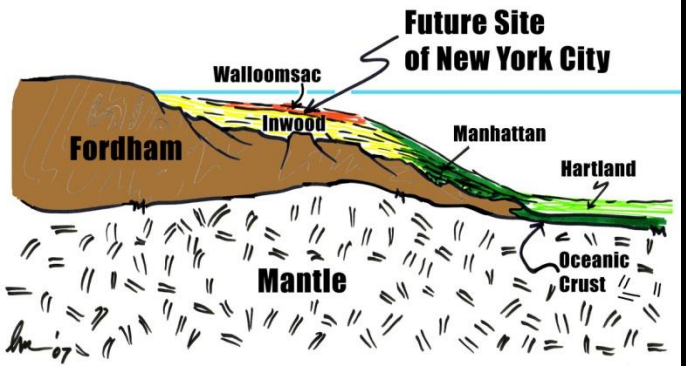
New York City

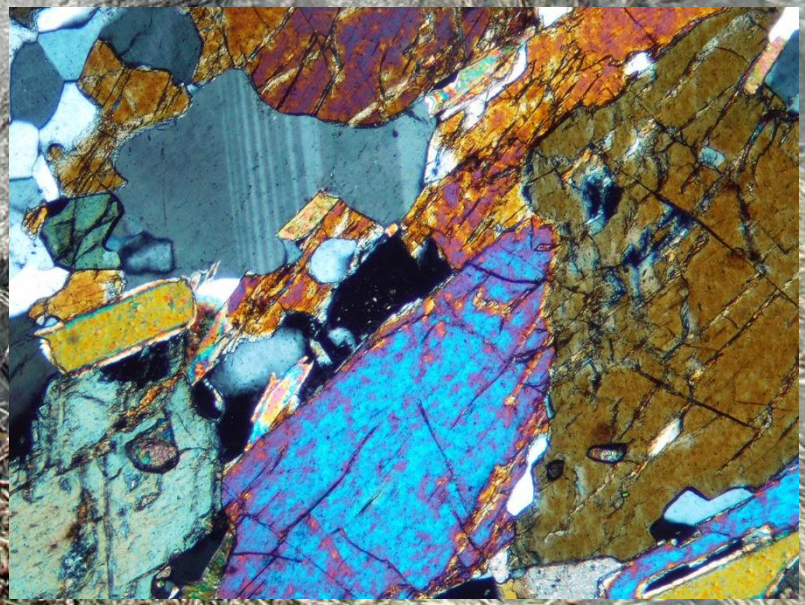


Merguerian and Baskerville 1987

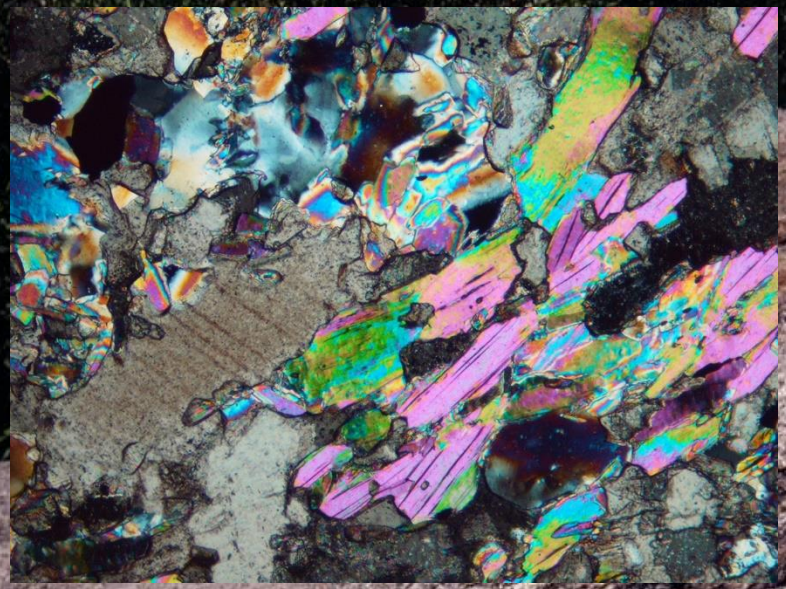


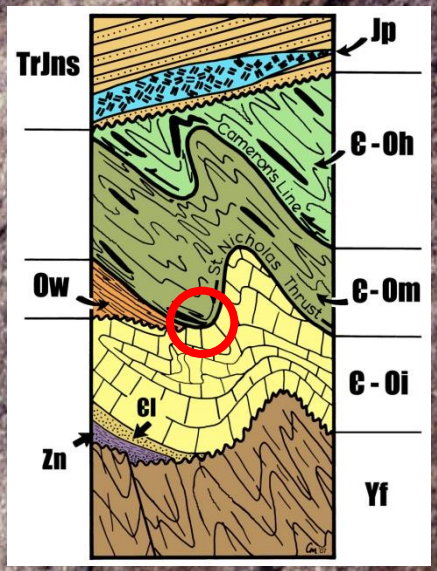




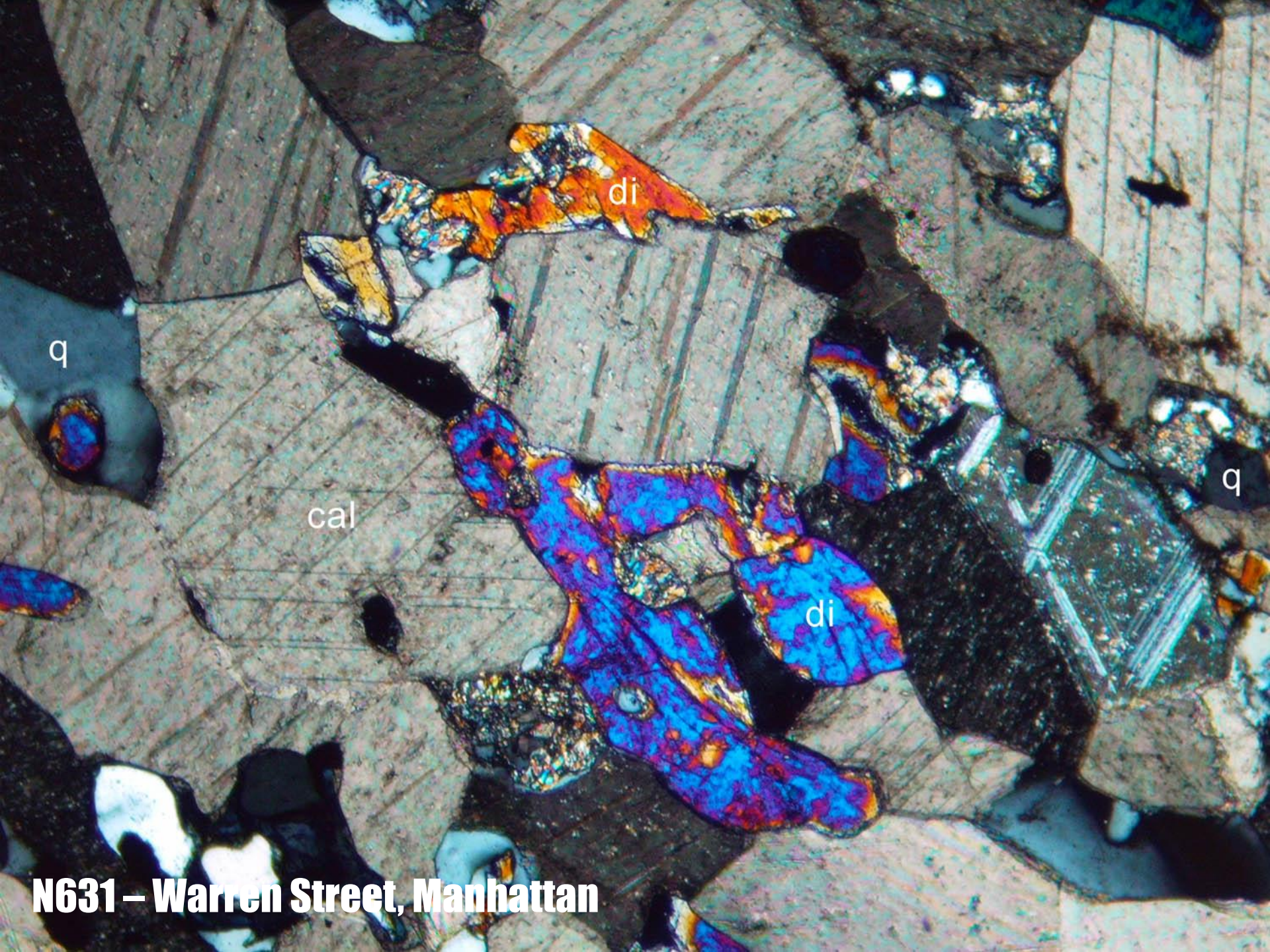


Fordham Gneiss, Echo Park, Bronx

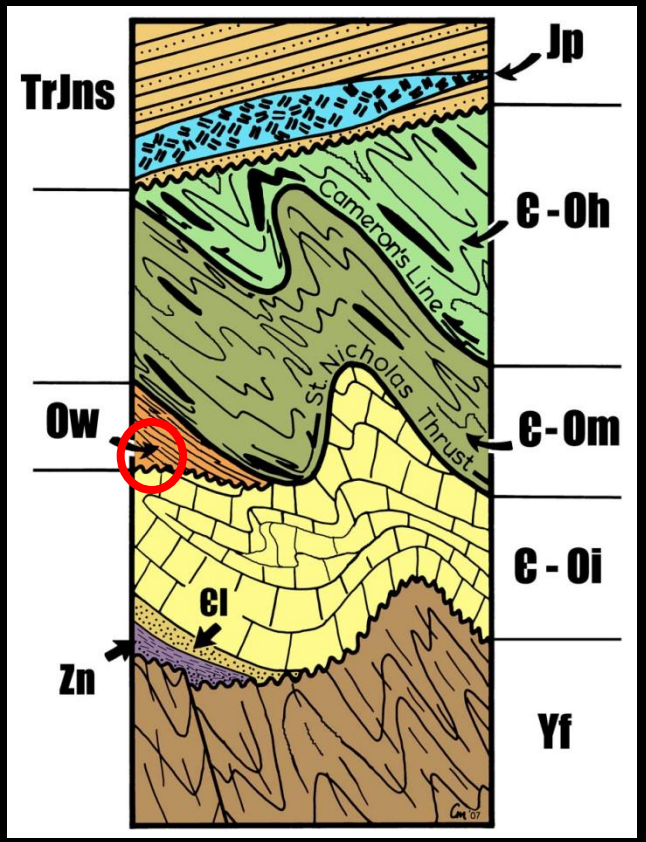




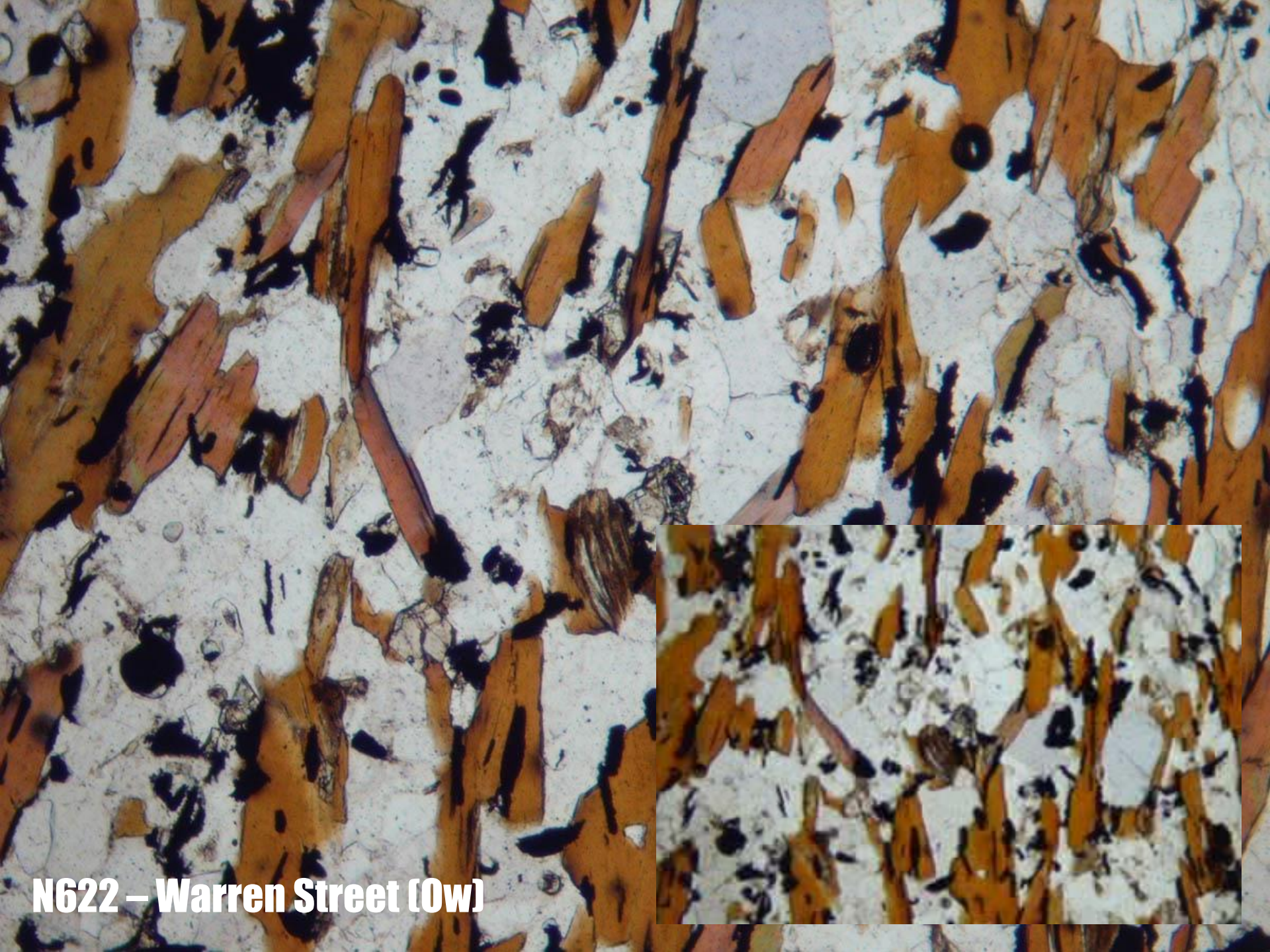
F_3 Fold in Inwood Marble, Morris Garvey Park



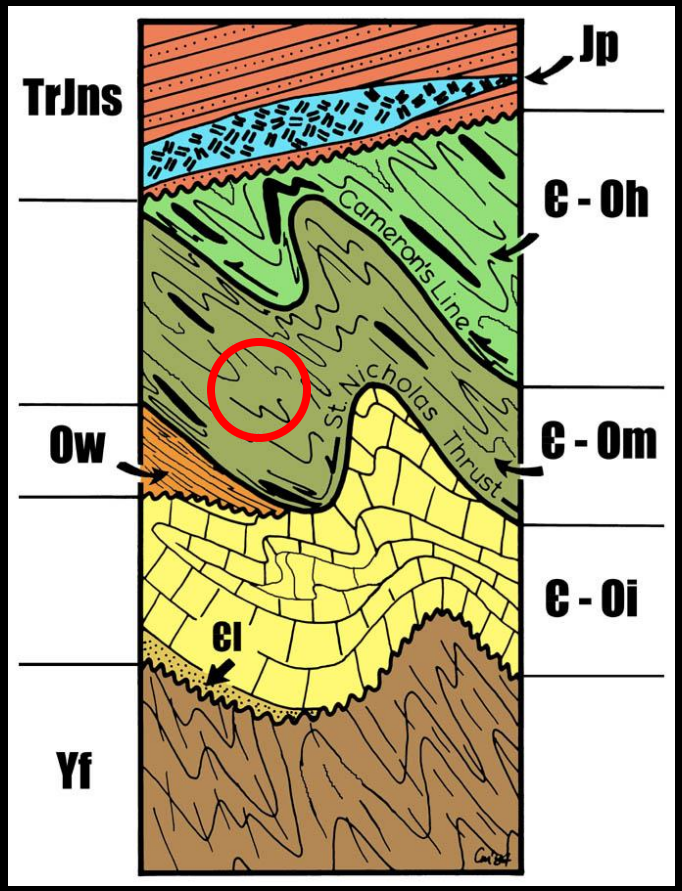
N631 – Warren Street, Manhattan



Walloomsac "Balmville" Contact, I-95, Grand Concourse, Bronx, NY

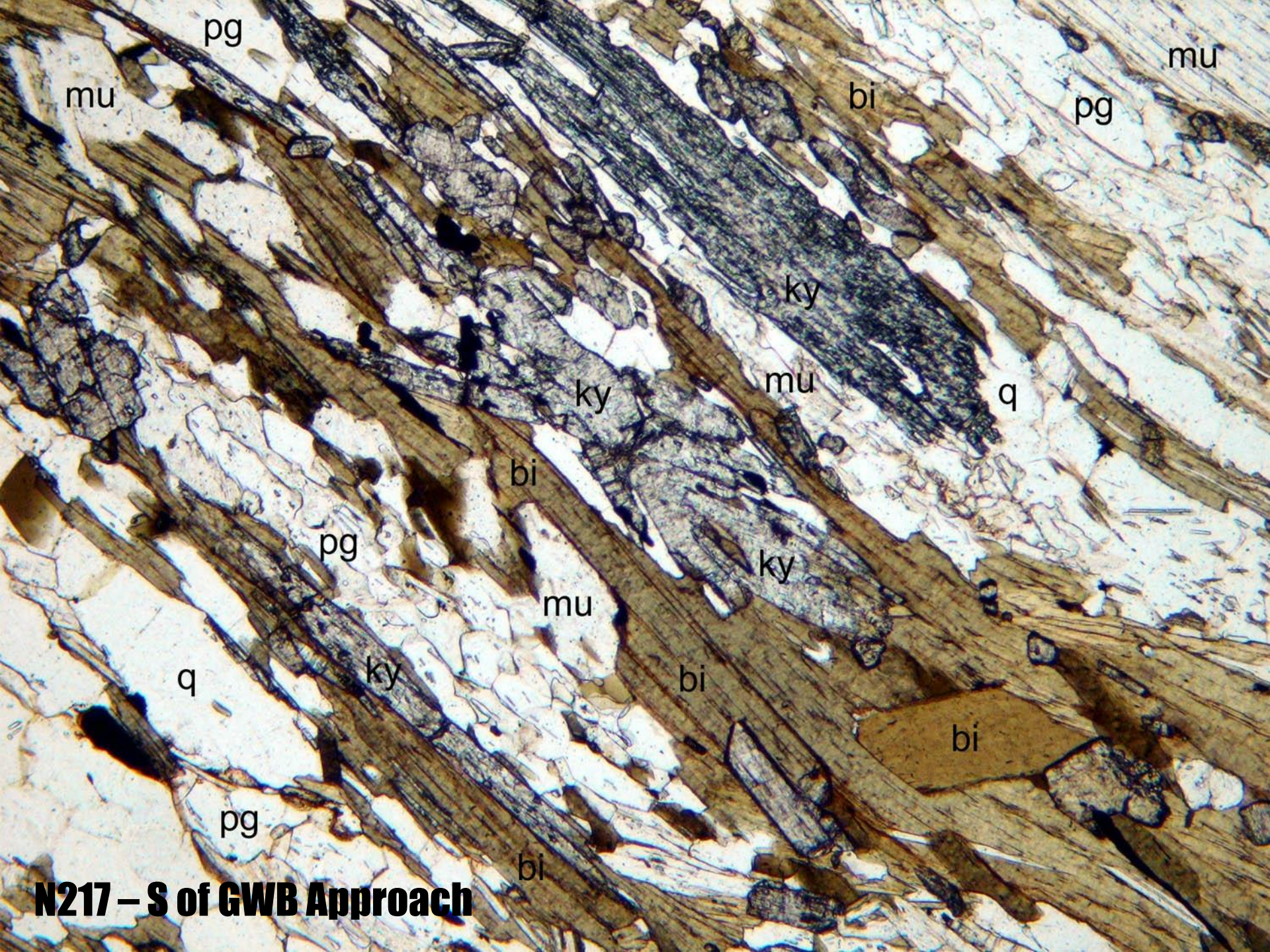


N622 – Warren Street (Ow)

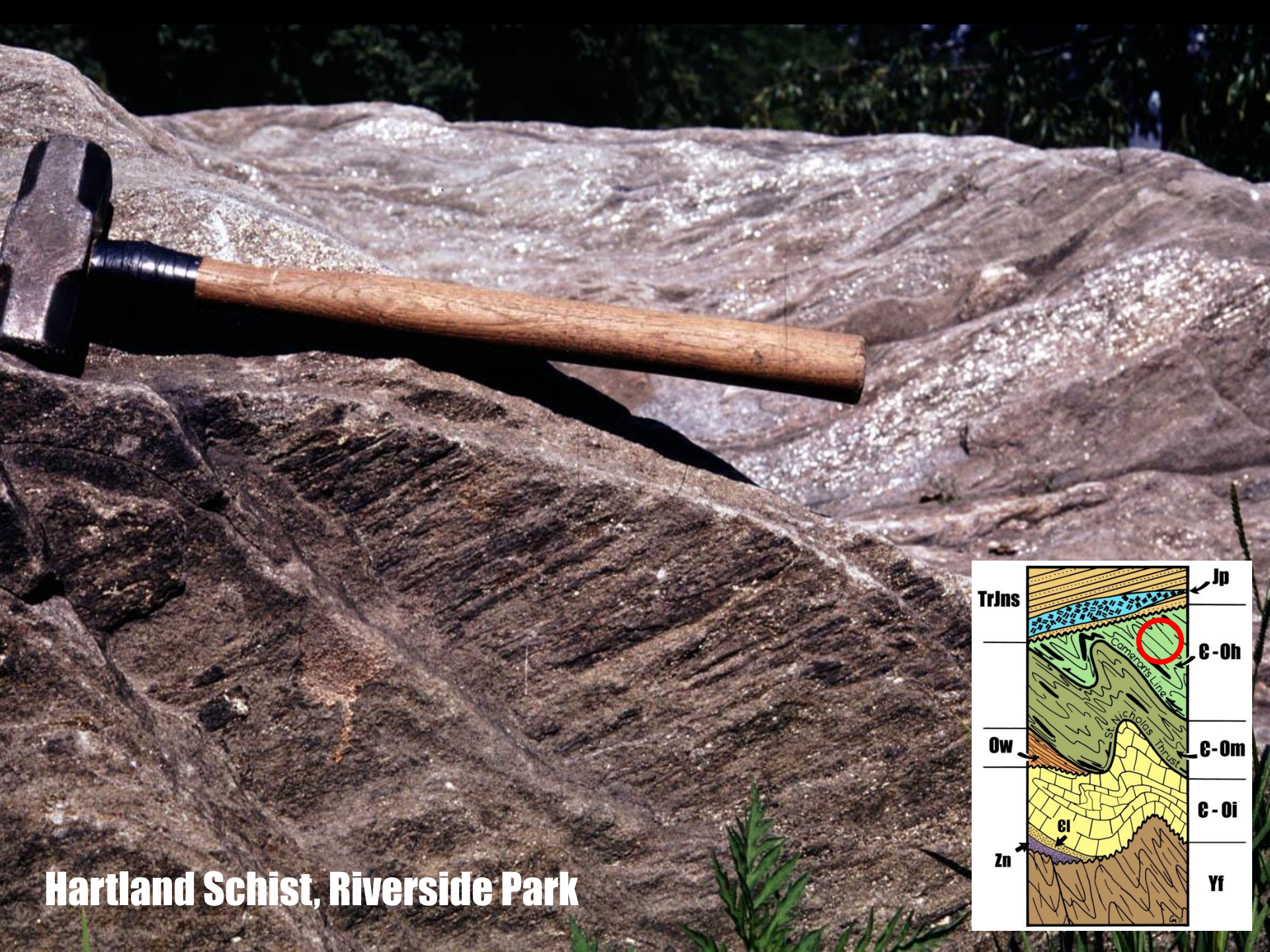


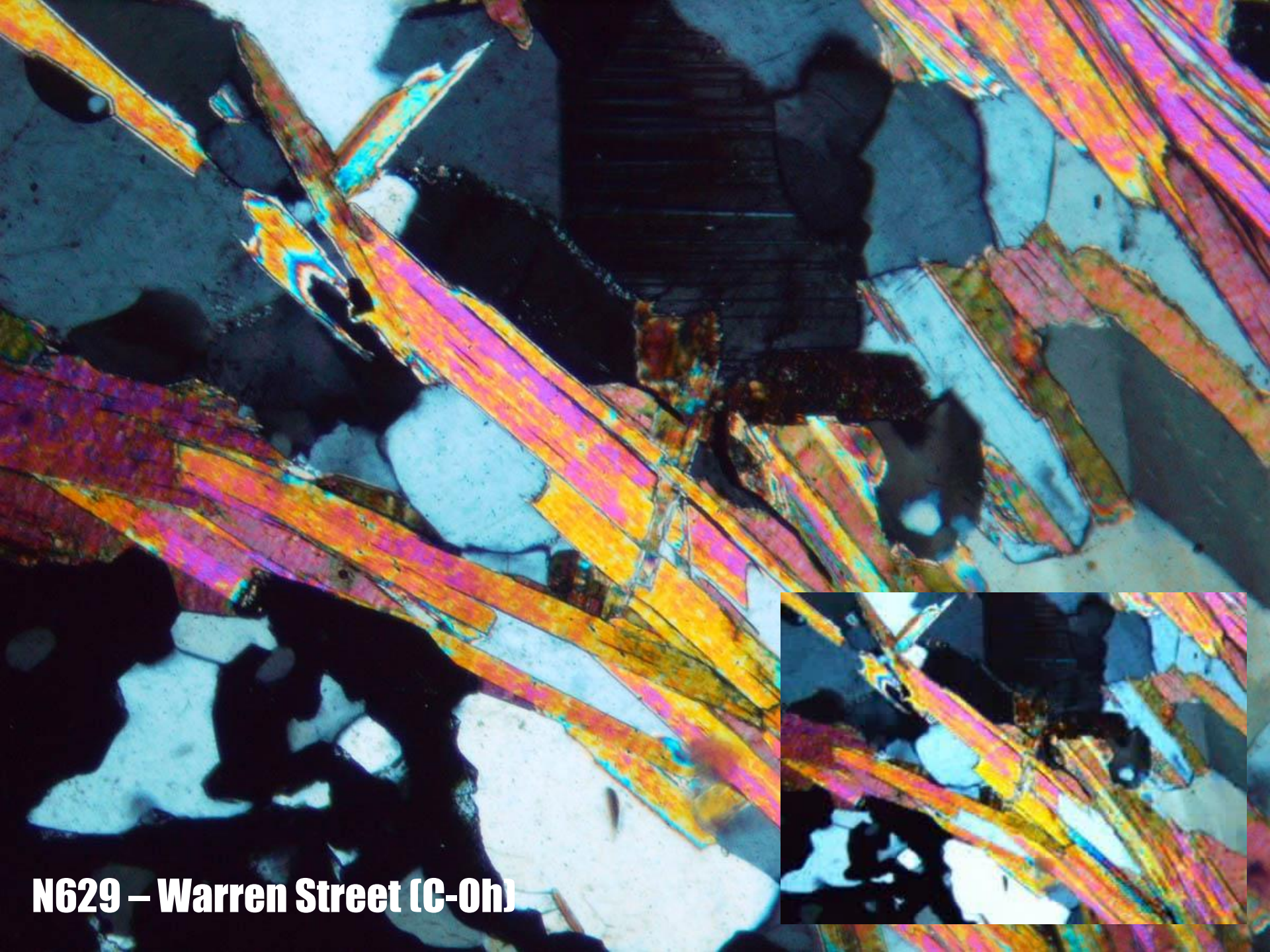
Manhattan Schist
F_3 Folds of S_2
Central Park, NYC


Manhattan Schist, Central Park
TrJns
Jp
Cameron's Line
St. Nicholas Thrust
Ow
Zn
Yf

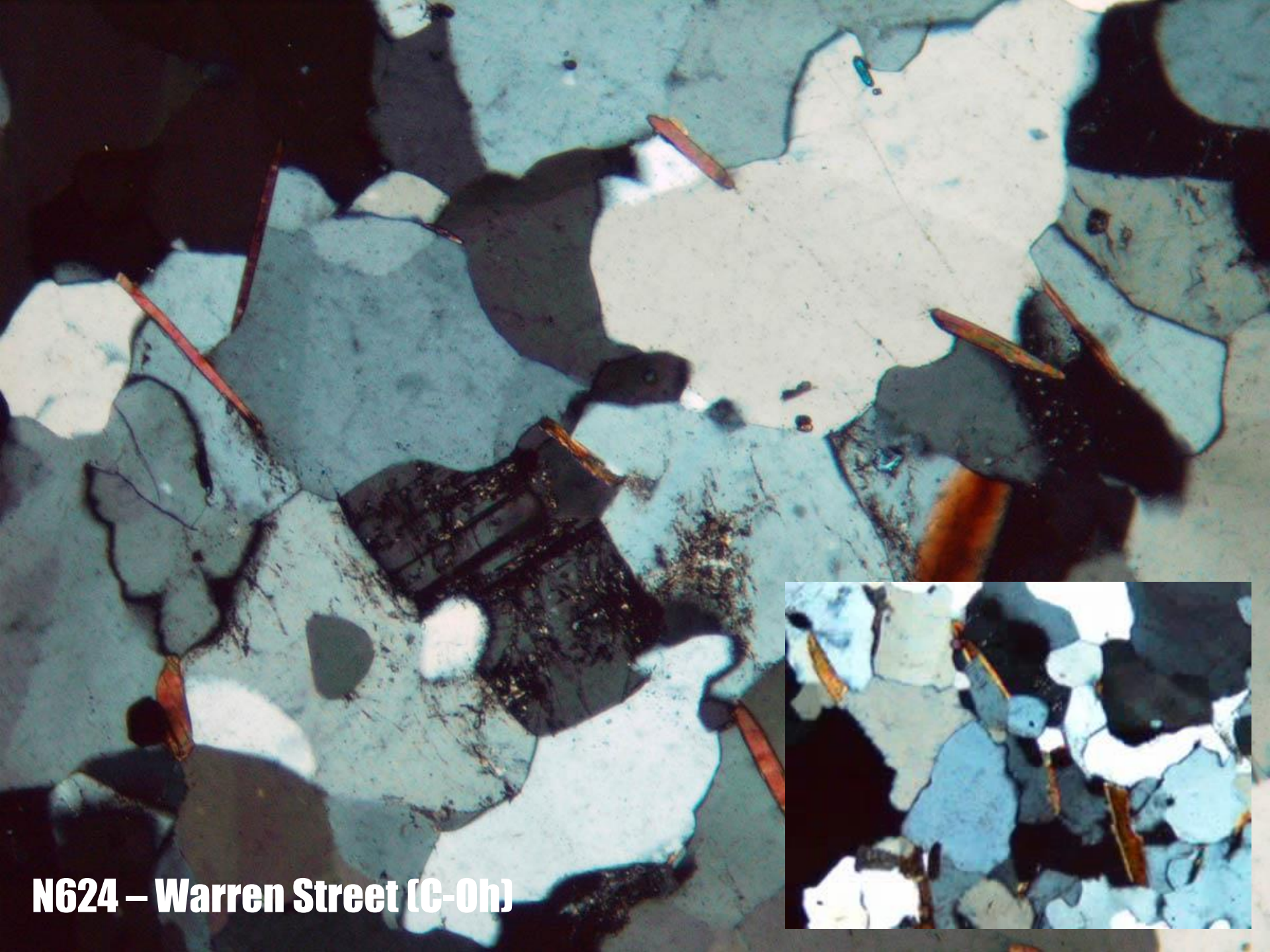


N217 – S of GWB Approach


Hartland Schist, Riverside Park
TrJns
Jp
Є - Oh
Cameron's Line
St. Nicholas Thrust
Ow
Є - Om
Є - Oi
Єl
Zn
Yf



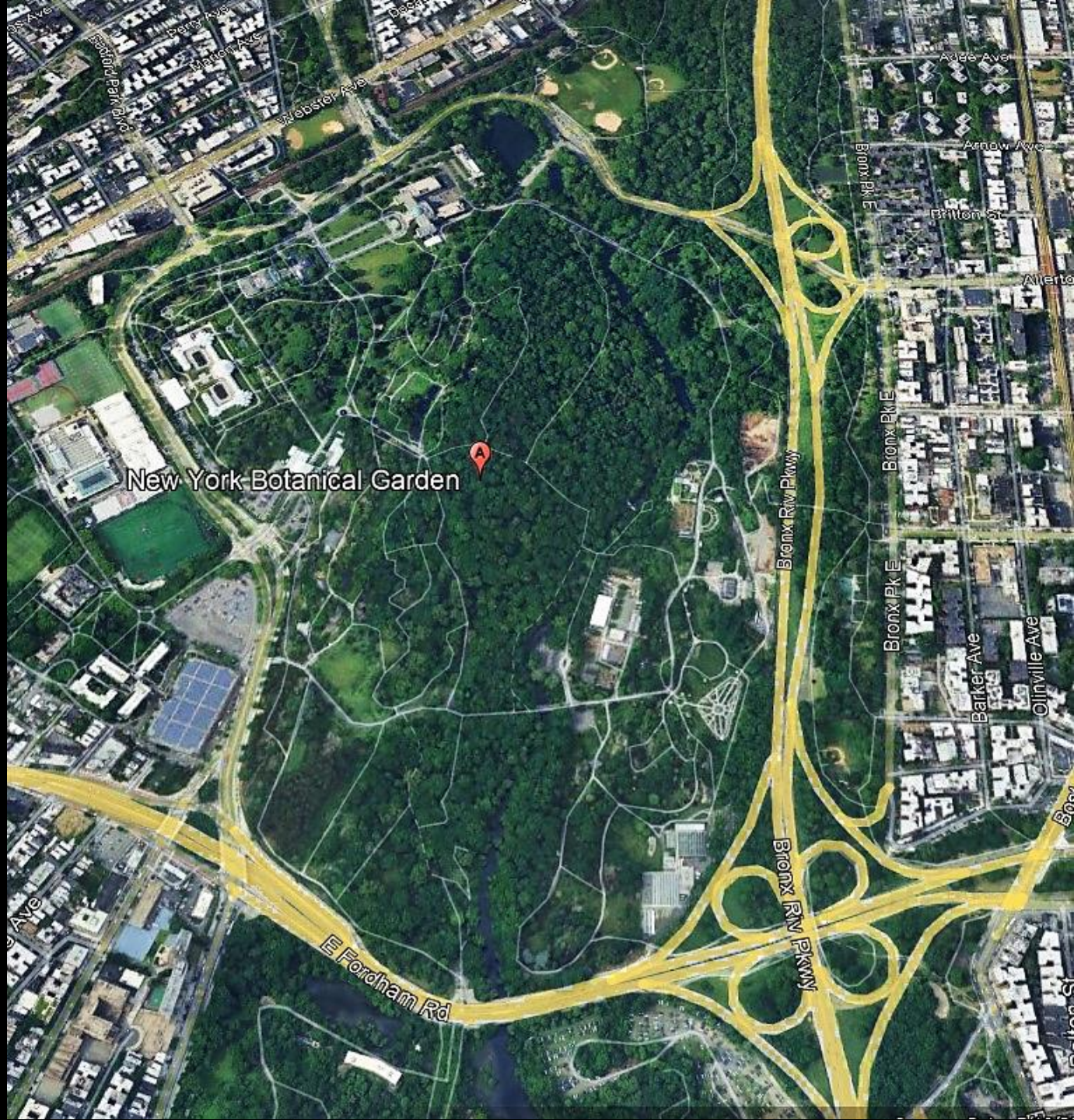
N629 – Warren Street (C-Oh)



N624 – Warren Street (C-Oh)

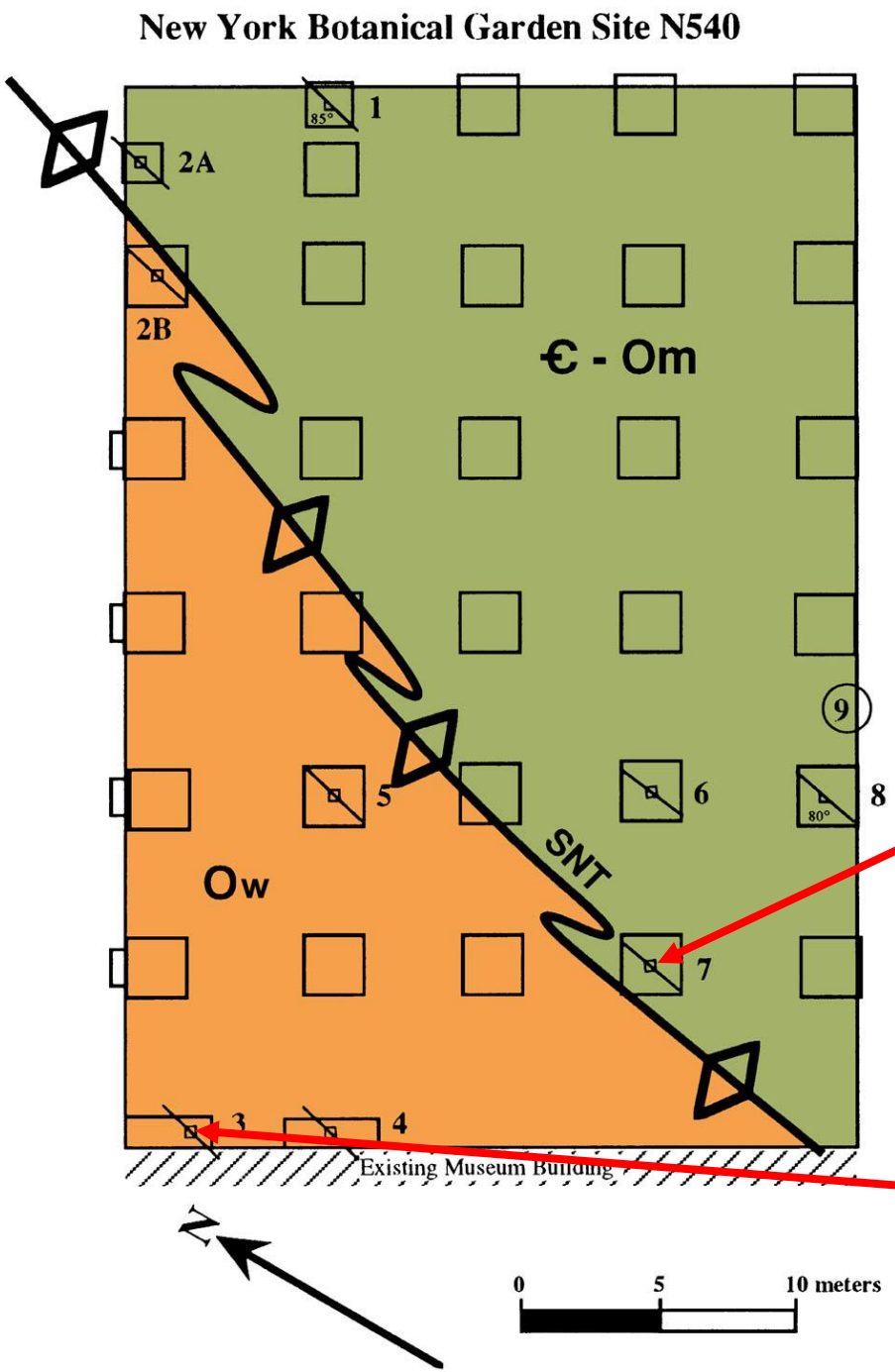
N567 - Hartland Amphibolite, Central Park

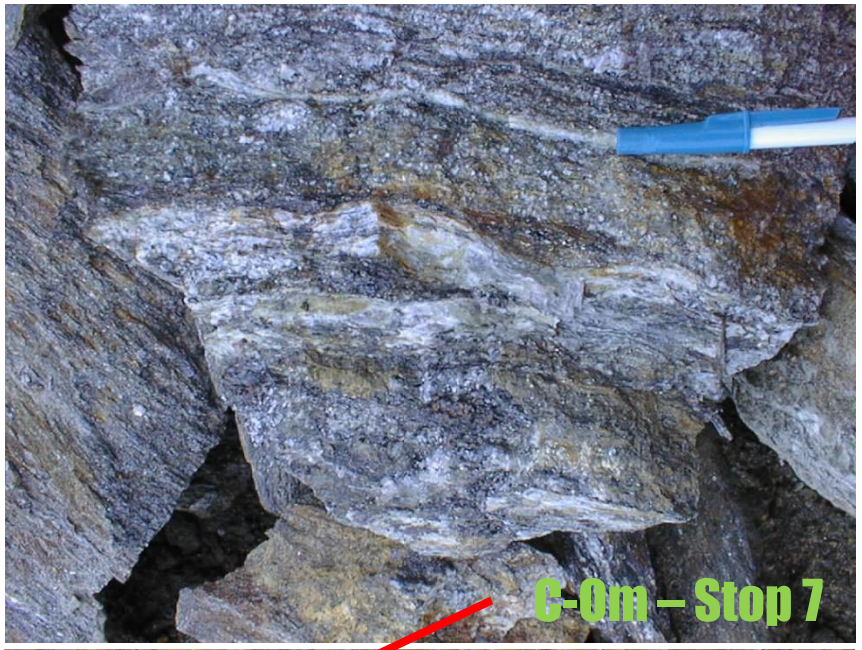
NY Botanical Garden Mapping Projects 1997-2024



DUKE

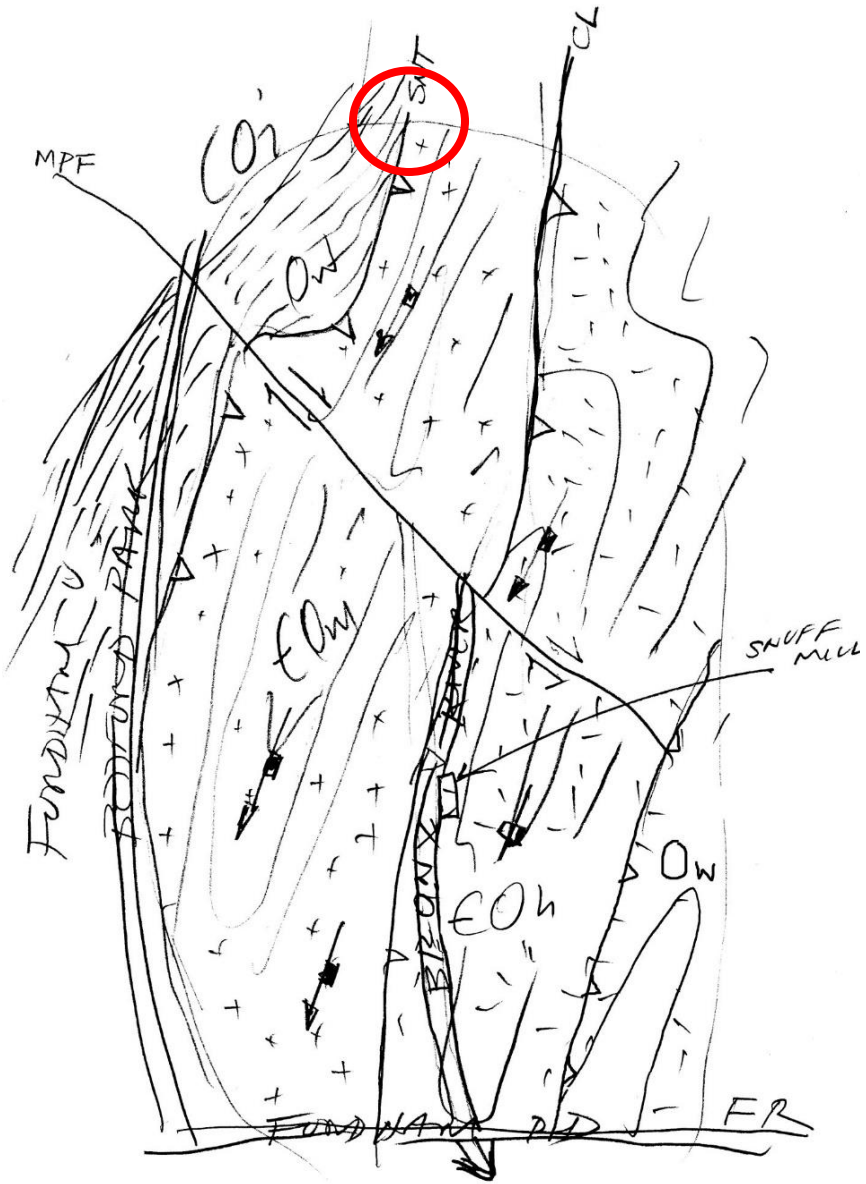

NY Botanical
Garden
Pfizer
Building
Extension
1997

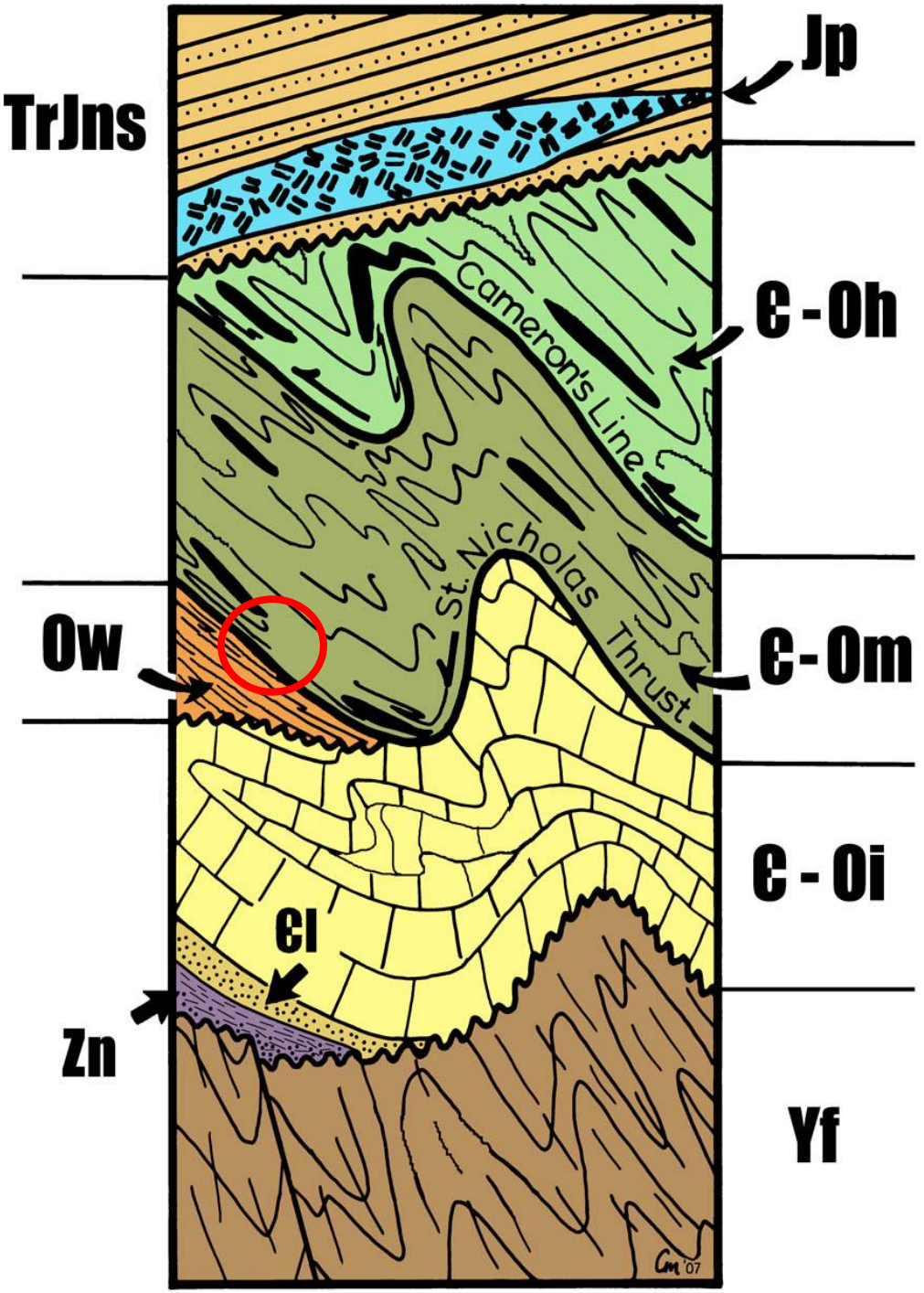




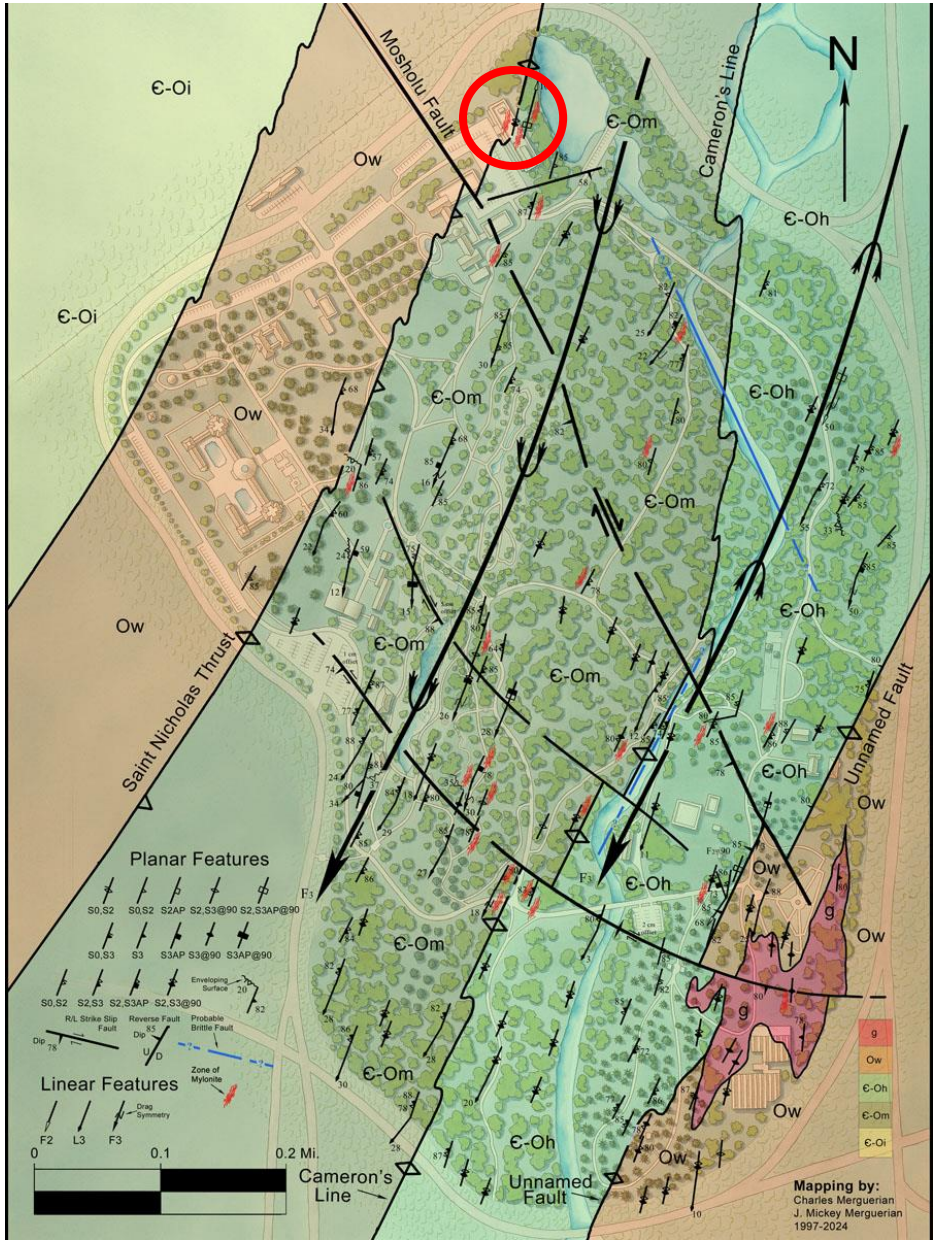
Merguerian and Sanders 1998

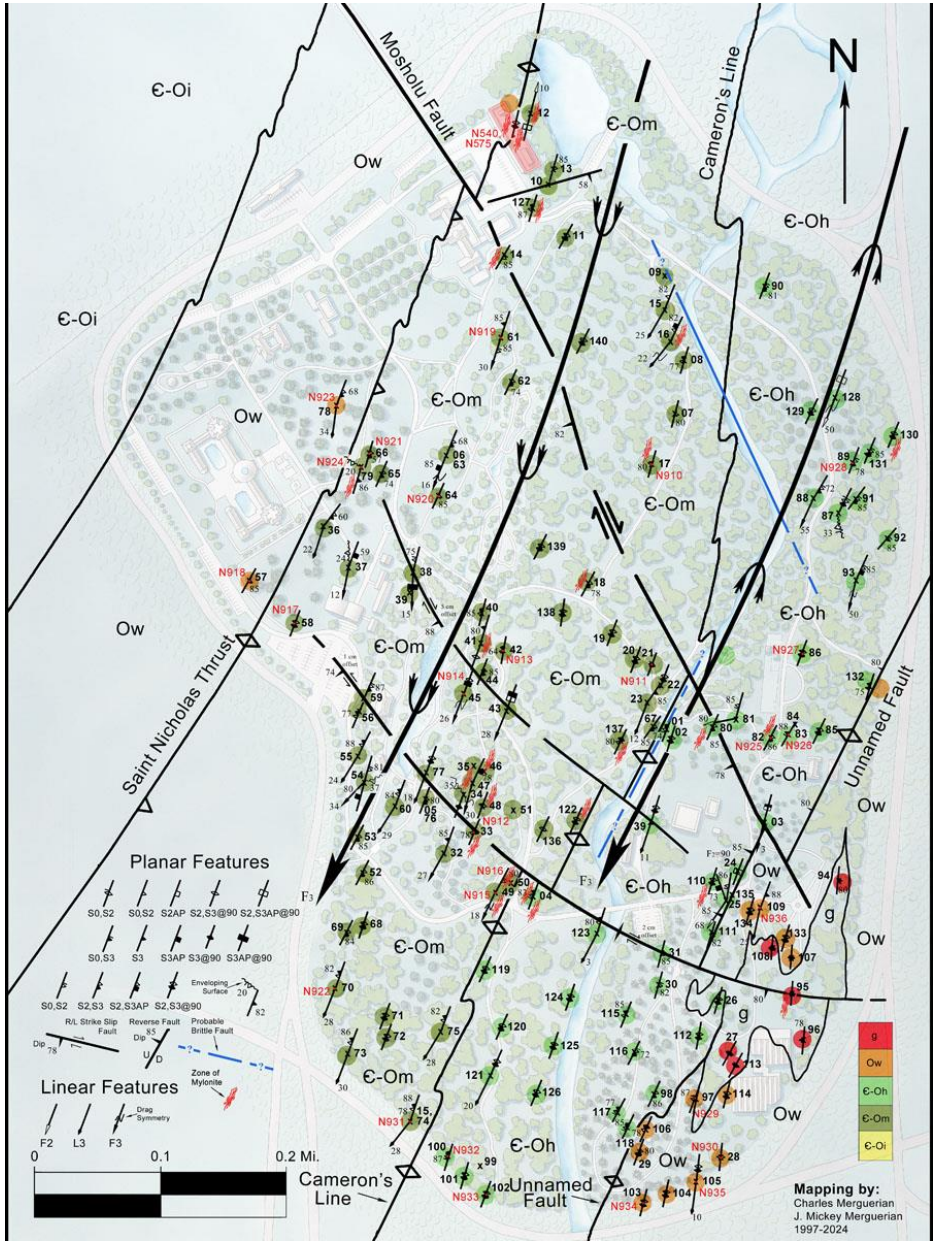
NY Botanical Garden Mapping Project 2011





NY Botanical Garden Mapping Project 2024





Petrographic Analysis of 31 Thin Sections

Petrography New York Botanical Garden				
N0910	NYBG Stop 17	COm	Myl pg bio qtz musc kf gt gneiss	massive; flaser
N0911	NYBG Stop 21	g	Pg qtz bio musc foliated granitoid	small sample
N0912	NYBG Stop 33	COma	Hbl pg qtz op amphibolite	blackish, dense; tr bio, trem
N0913	NYBG Stop 42	COm	Mig pg qtz bio musc kf gt gneiss	dissem kf; late idioblastic musc
N0914	NYBG Stop 45	COm	Mig pg qtz bio musc kf gt gneiss	mixed w/ Ow?; some rb-bio; kf in mig sweats
N0915	NYBG Stop 49	COm	Myl pg bio qtz gt kf gneiss	
N0916	NYBG Stop 50	COm	Myl pg qtz bio musc gt gneiss	
N0917	NYBG Stop 58	COm	Mig pg qtz bio gt gneiss	
N0918	NYBG Stop 57	Ow	Pg bio qtz gt ky py grph tour granofels	rb-bio; pale pink gt; fissile; v. fine textured
N0919	NYBG Stop 61	COma	Hbl (75) pg op qtz amphibolite	blackish, dense
N0920	NYBG Stop 64	COm	Myl pg bio qtz musc ky gt apa gneiss	tr kf, chl; late idioblastic musc and bio; frayed musc
N0921	NYBG Stop 66	COm	Pg bio qtz musc gt gneiss	
N0922	NYBG Stop 70	COh	Bio musc pg qtz gt schist	1 cm musc pseudomorphs after ky
N0923	NYBG Stop 78	Ow	Pg qtz bio py grph tour granofels	rb-bio; abundant py; zoned tour; fine textured
N0924A	NYBG Stop 79	COm	Pg bio qtz musc gt gneiss	fine textured; late idioblastic musc and bio
N0924B	NYBG Stop 79	COm	Pg qtz bio musc gt gneiss	gt porphs; ky? or sill?
N0924C	NYBG Stop 79	g/s	Sillimanite nodule near granitoid	in OZm
N0925	NYBG Stop 82	COh	Pg qtz bio ky gt sill musc gneiss	lustrous; ky clusters w/ bio
N0926	NYBG Stop 83	COh	Qtz pg bio musc gt granofels	foliated
N0927	NYBG Stop 86	COh	Myl bio qtz musc pg ky gt tour gneiss	
N0928	NYBG Stop 89	COh	Mig pg qtz bio musc gt schist	some kf in sweats
N0929	NYBG Stop 97	Ow	Pg bio qtz kf musc grph gt granofels	rusty weath; pale pink gt; rb-bio; mosaic texture
N0930A	NYBG Stop 28	Ow	Bio pg qtz musc grph gt schist	rusty weath; pale pink gt; rb-bio
N0930B	NYBG Stop 28	Ow	Pg qtz musc bio gt grph granofels	rusty weath; pale pink gt; rb-bio
N0931	NYBG Stop 74	COm	Qtz pg bio musc gt gneiss	red gt; khaki br bio; massive
N0932	NYBG Stop 100	COh	Myl pg qtz bio musc gt gneiss	red gt; musc porphs
N0933A	NYBG Stop 102	COh	Pg qtz bio musc granofels	foliated granitoid layer?
N0933B	NYBG Stop 102	COh	Mig musc pg qtz bio gt schist	red gt
N0934	NYBG Stop 103	Ow	Myl pg bio qtz musc gt py grph granofels	rusty weath; pale pink gt; rb-bio; fine textured; op rich
N0935	NYBG Stop 105	Ow	Mig musc bio qtz pg gt schist	rb-bio layers w/ gts; little opaques; no grph
N0936	NYBG Stop 109	Ow	Myl pg qtz bio musc gt py grph granofels	rusty weath; pale pink gt; rb-bio
TABLE 1				

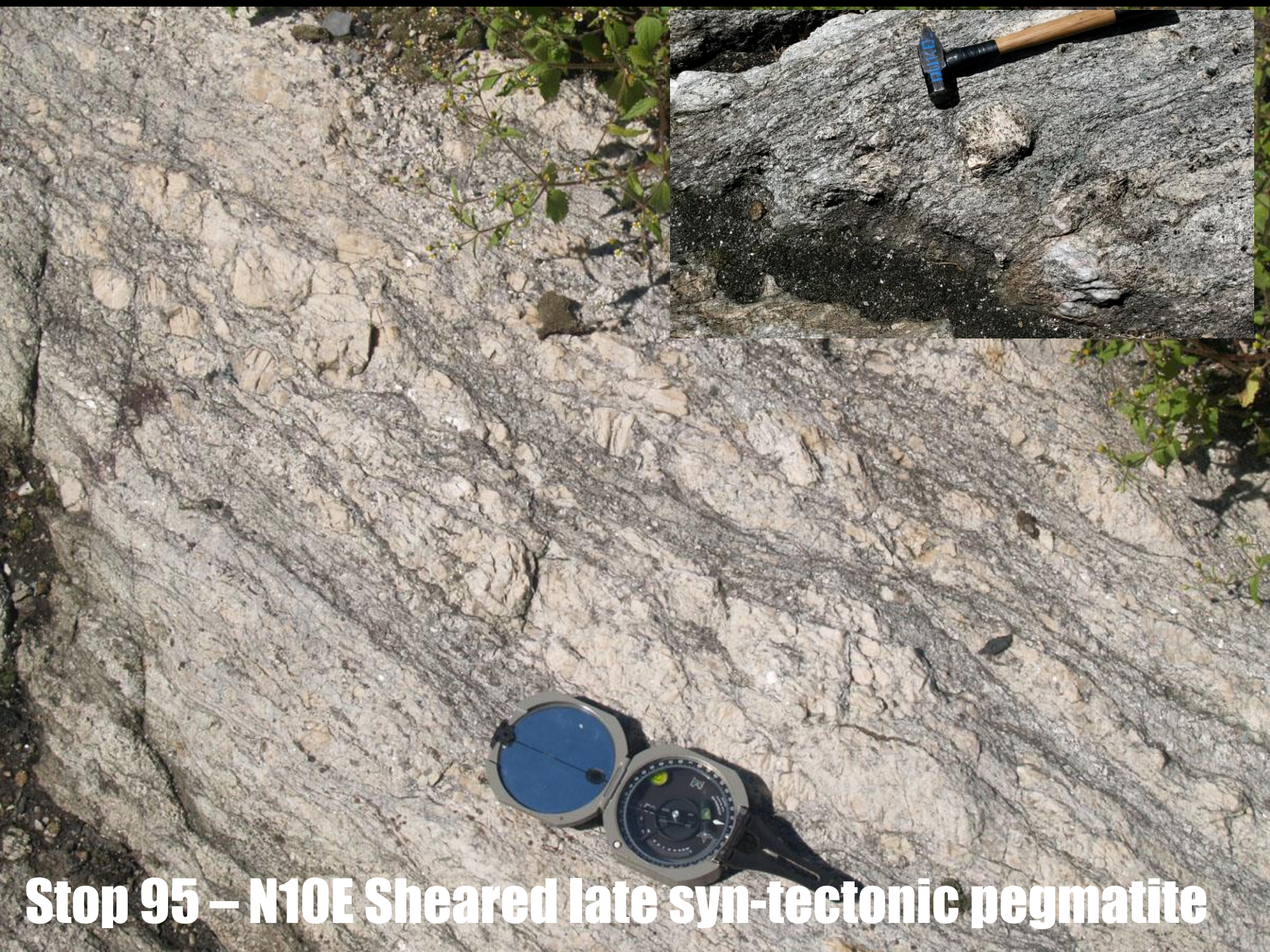
DUKE

Field Trip SE to NW >>>


Stop 105 – Ow + g (Walloomsac + granitoid)


Stop 105 – Garnetiferous Granitoid cutting Ow

Stop 106 – Sheared, Laminated Ow (Walloomsac)



Stop 95 – N10E Sheared late syn-tectonic pegmatite


Stop 81 – C-Oh F_2 Fold

Stop 84 – C-Oh cut by late syn-tectonic pegmatite

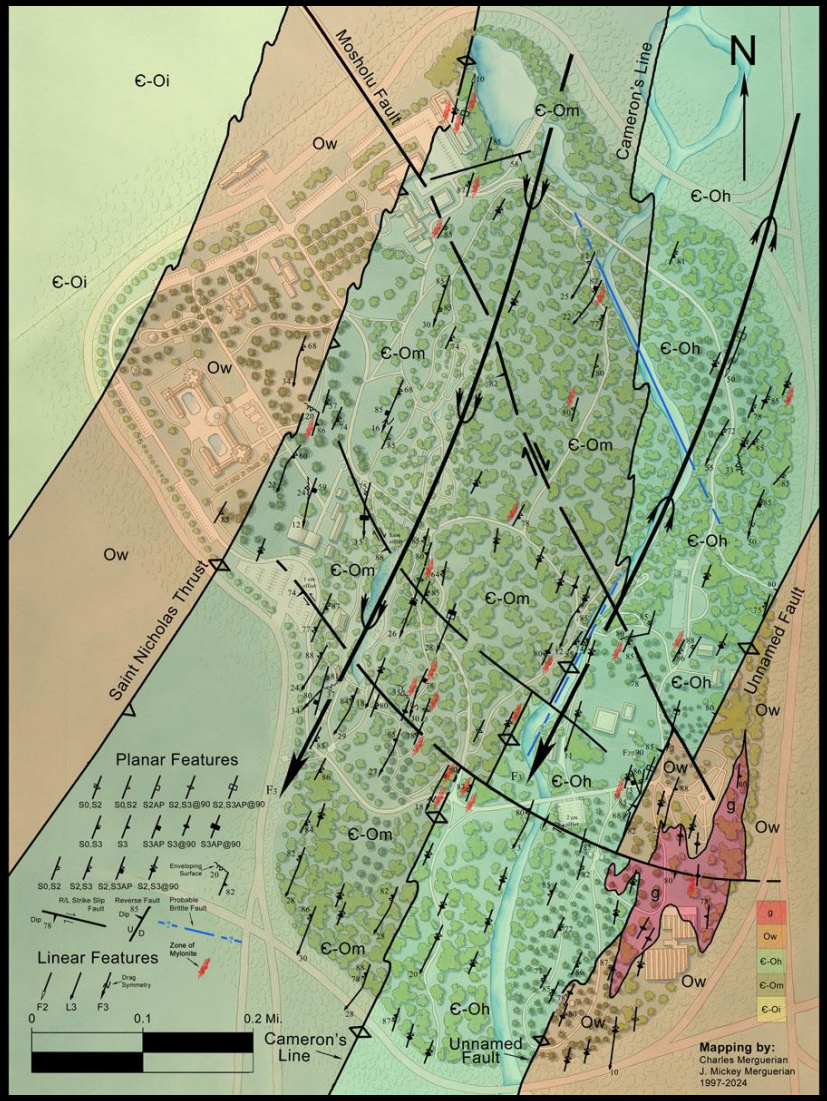
Stop 03 – Roche Moutonnee in C-Oh

Stop 38 – C-Om with Ky Nubs

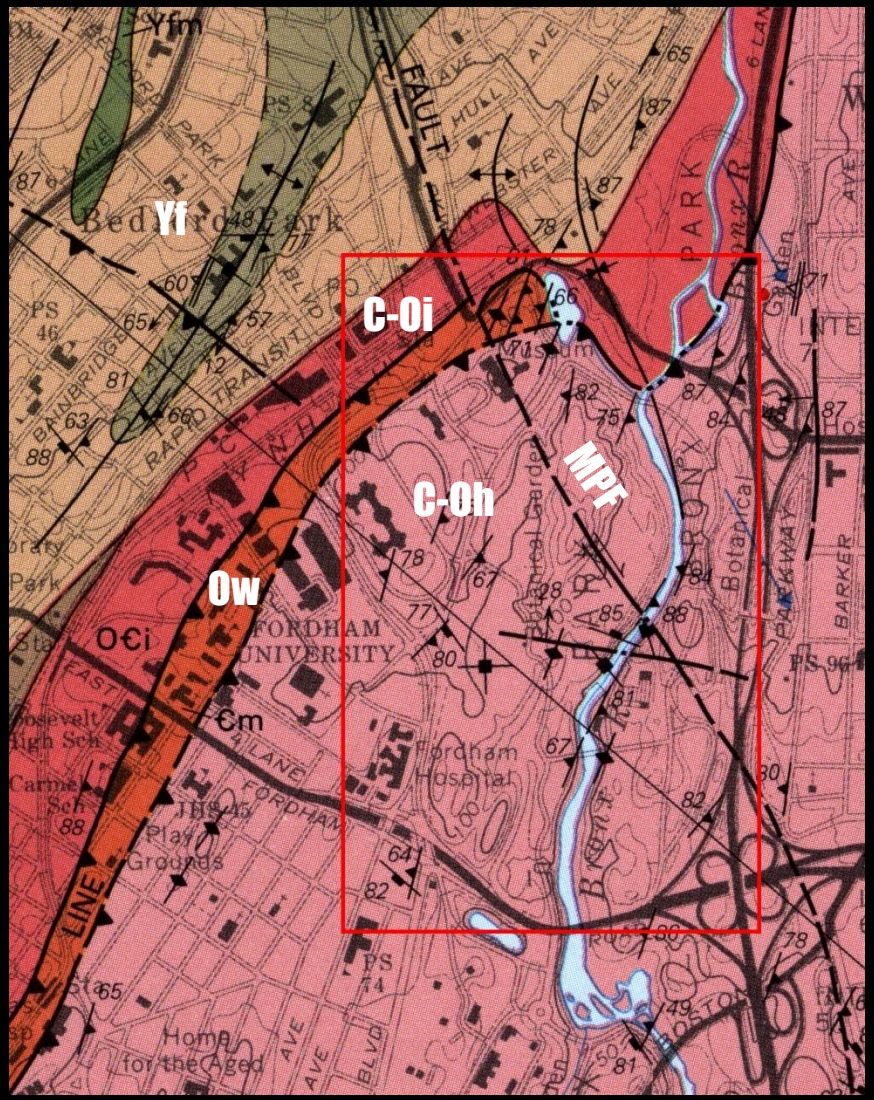
Stop 63 – C-Oma amphibolite F_3 parasitic fold

Stop 64 – C-Om Migmatite Gneiss w/ Gt and Ky

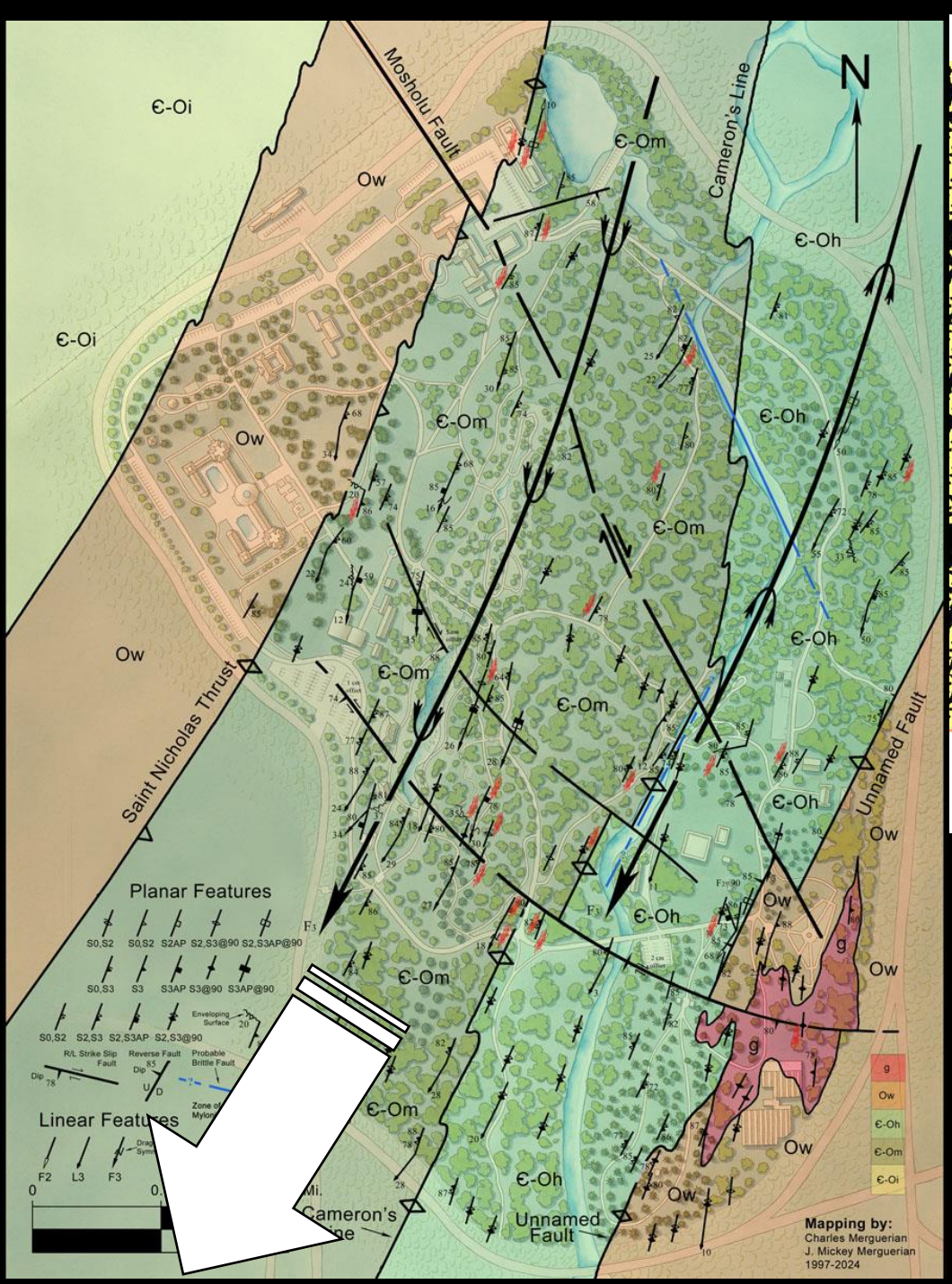
NY Botanical Garden

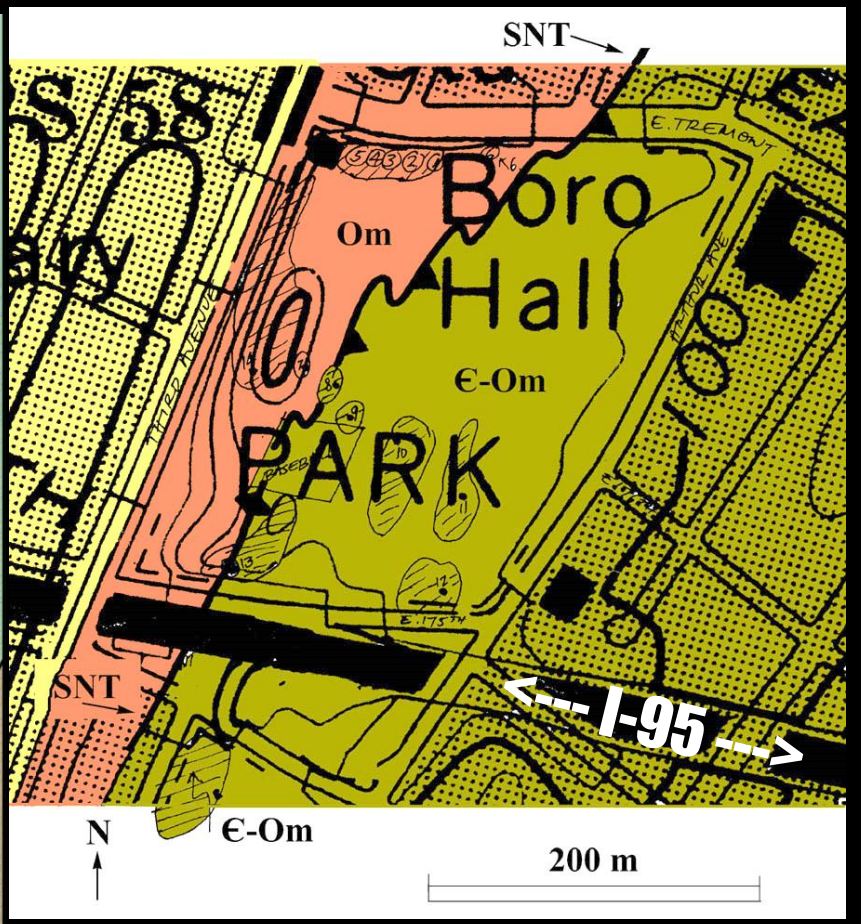


CM+MM 2024



Baskerville 1992

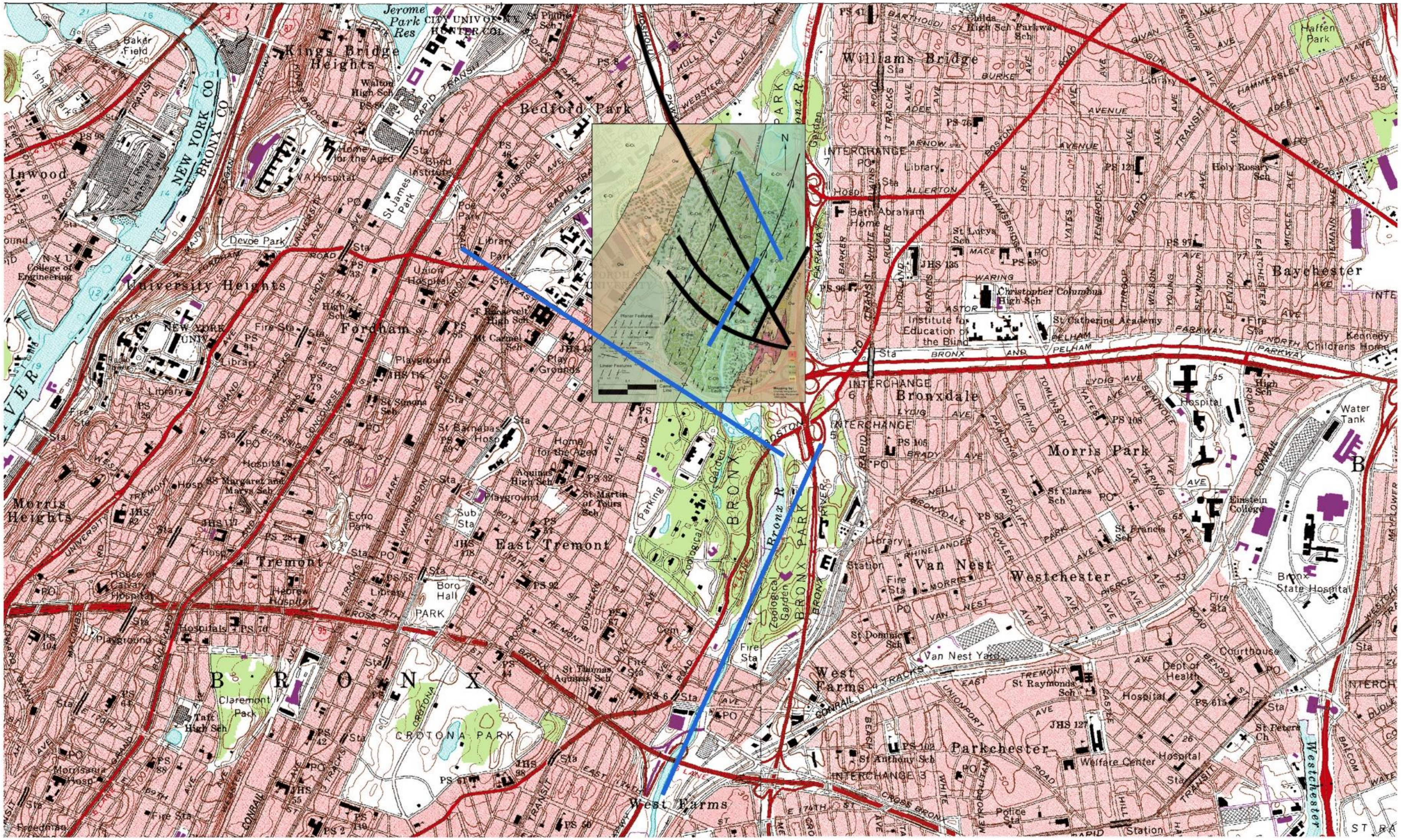




Thrust Sequence Extends SW – Wallomsac crops out 3 km SW in both Boro Hall and Crotona parks

CENTRAL PARK QUADRANGLE
NEW YORK – NEW JERSEY
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 HARLEM 15' QUADRANGLE

FLUSHING QUADRANGLE
NEW YORK
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 HARLEM 15' QUADRANGLE



<--- I-95

SCALE 1:24 000

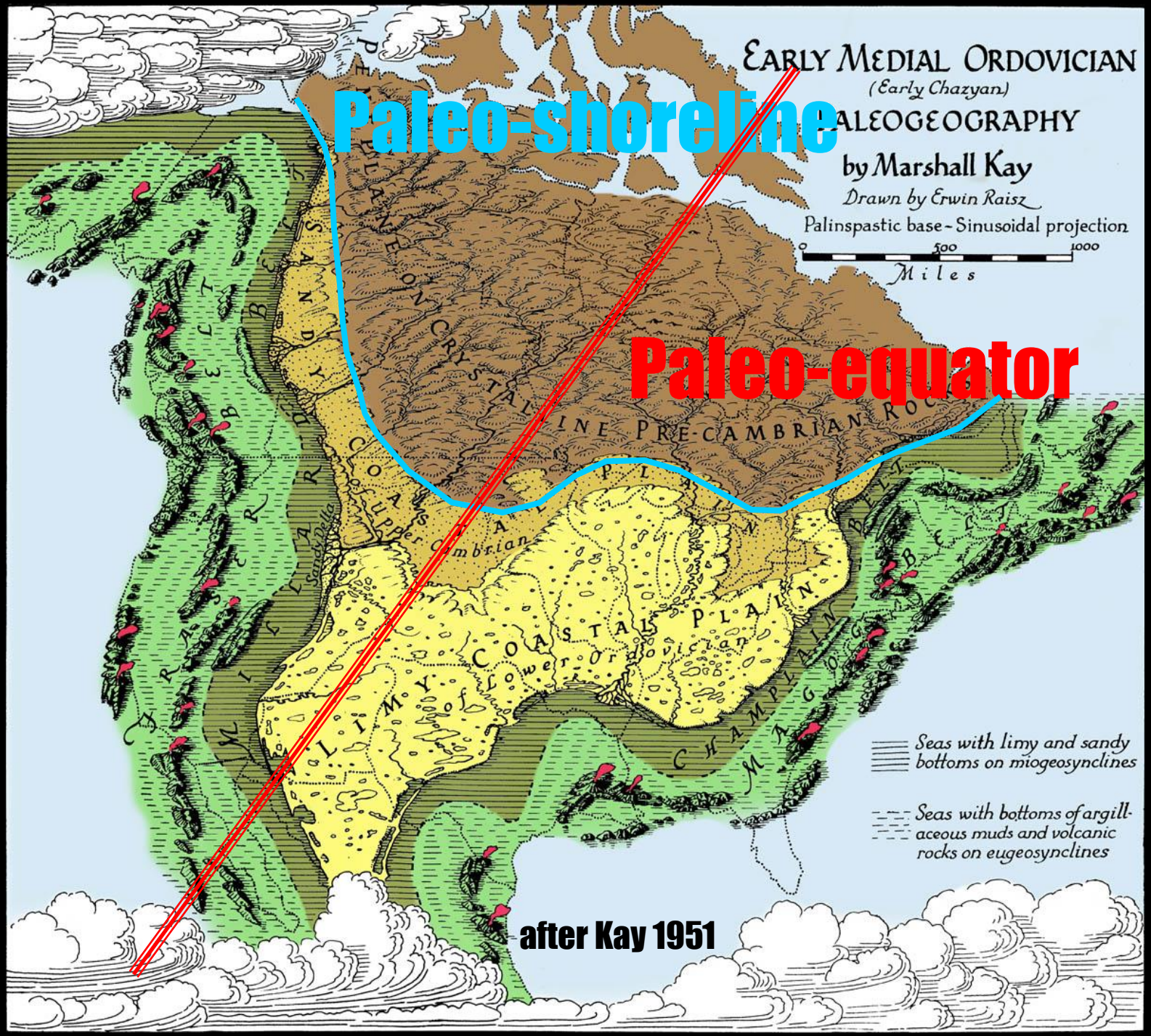
1 ½ 0 1 MILE

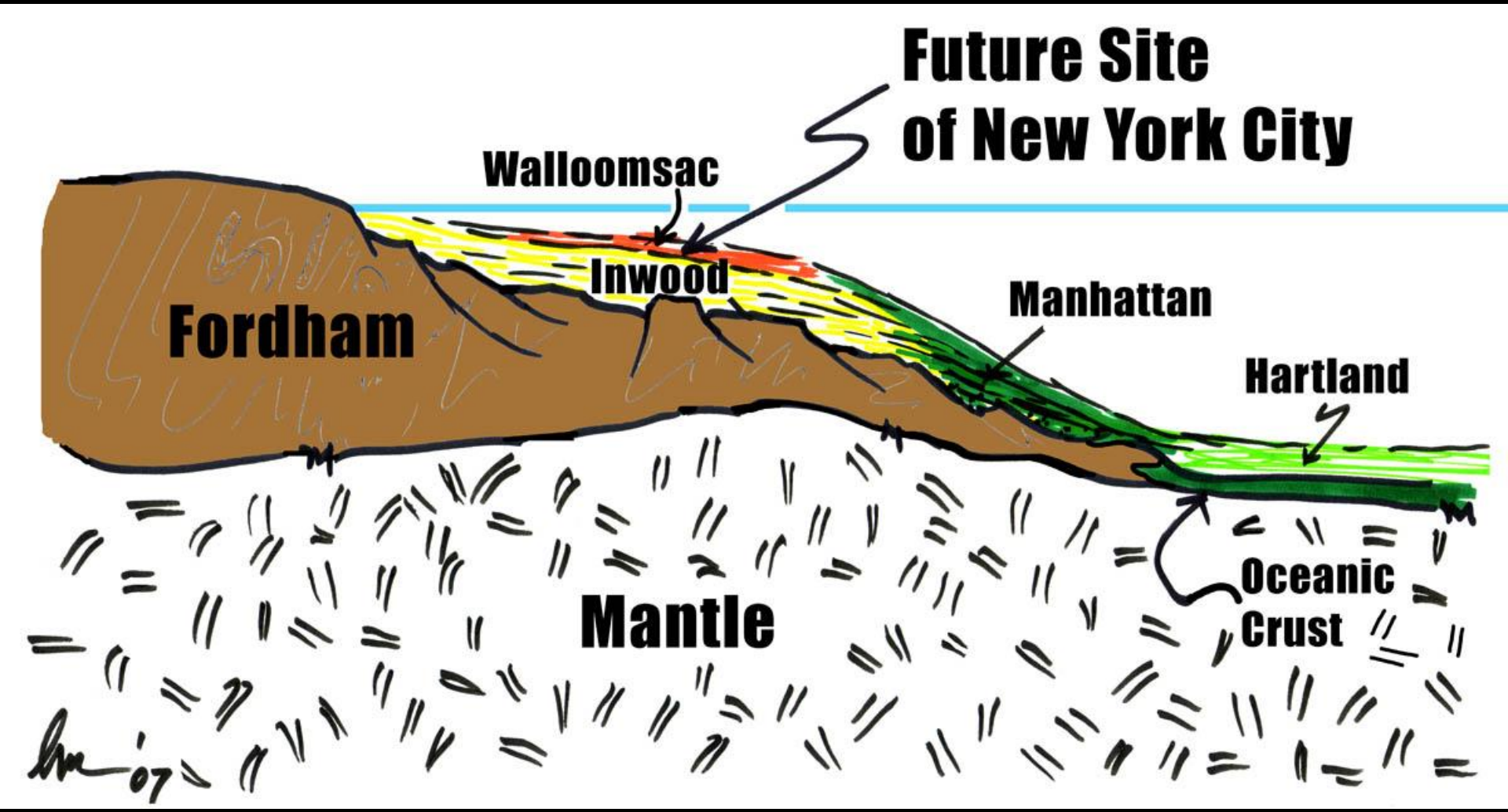
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

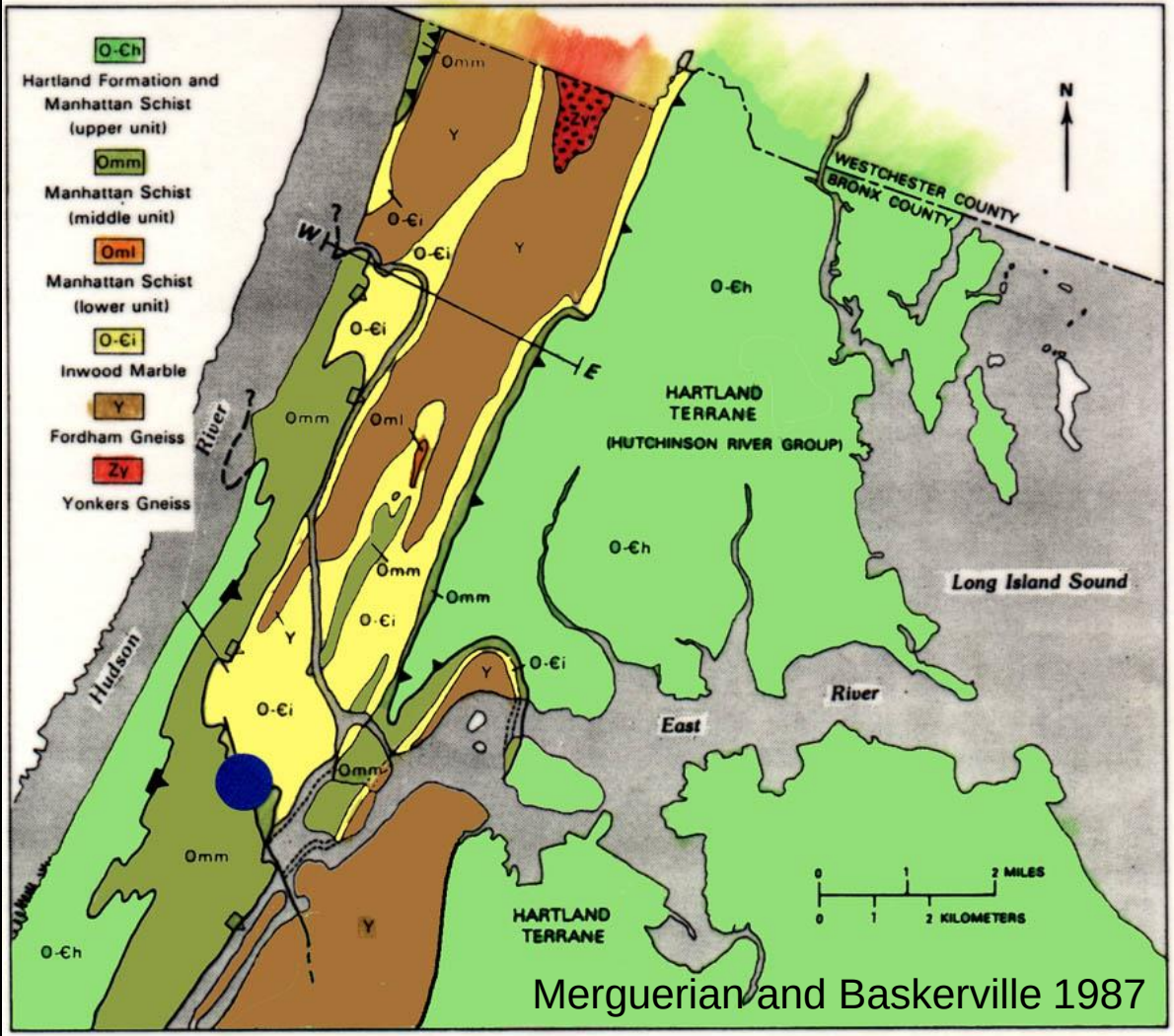
CONTOUR INTERVAL 10 FEET

DUKE

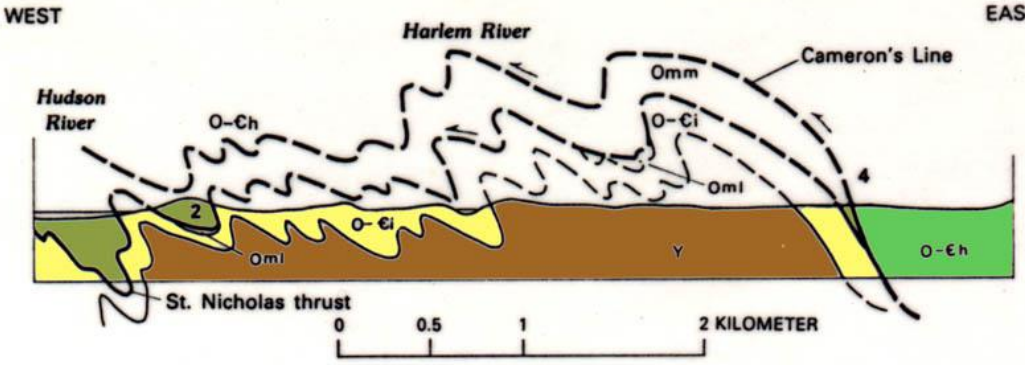

Paleo-shoreline
Paleo-equator
EARLY MEDIAL ORDOVICIAN
(Early Chazyan)
PALEOGEOGRAPHY
by Marshall Kay
Drawn by Erwin Raisz
Palinspastic base - Sinusoidal projection
500
1000
Miles
PENEPLANED CRYSTALLINE PRE-CAMBRIAN ROCKS
SANDY COASTAL PLAIN of Upper Cambrian
COASTAL PLAIN
LIMY of Lower Ordovician
CHAMPLAIN MAGEOSYNCLINE
APPALACHIAN BELT
Seas with limy and sandy bottoms on miogeosynclines
Seas with bottoms of argillaceous muds and volcanic rocks on eugeosynclines
after Kay 1951

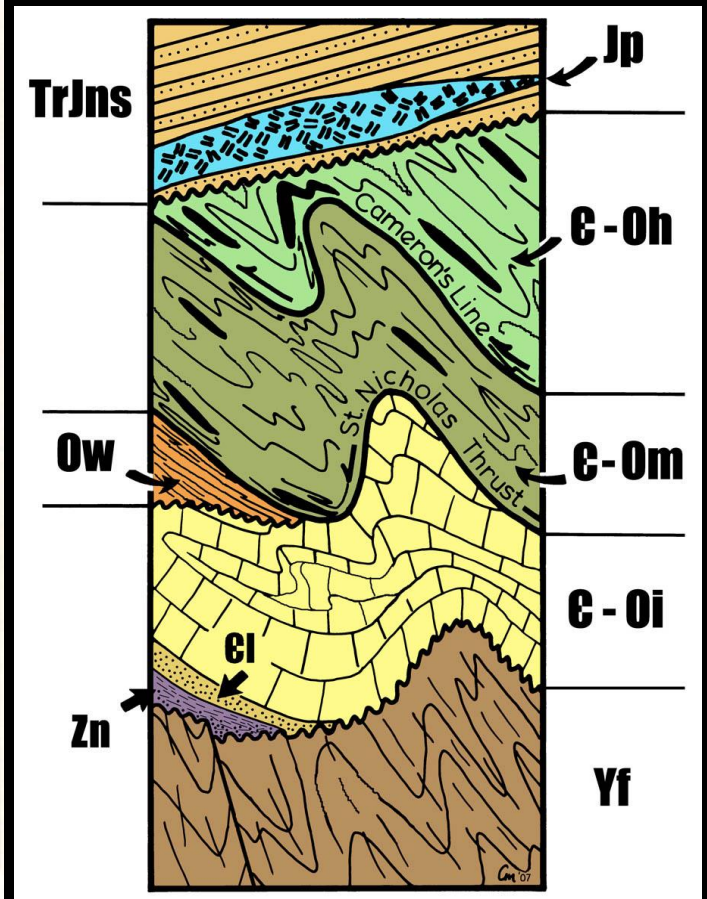

Future Site
of New York City
Walloomsac
Inwood
Fordham
Manhattan
Hartland
Oceanic
Crust
Mantle
'07

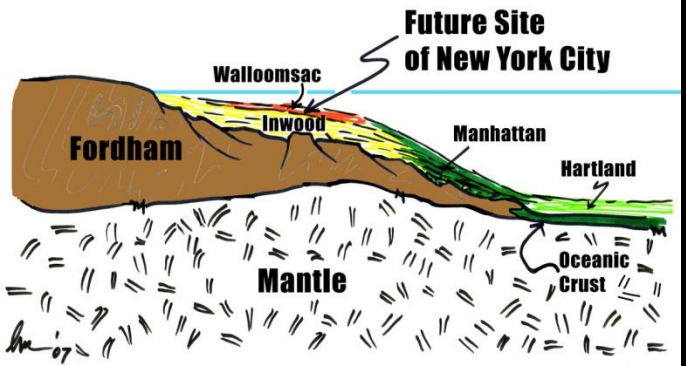
New York City



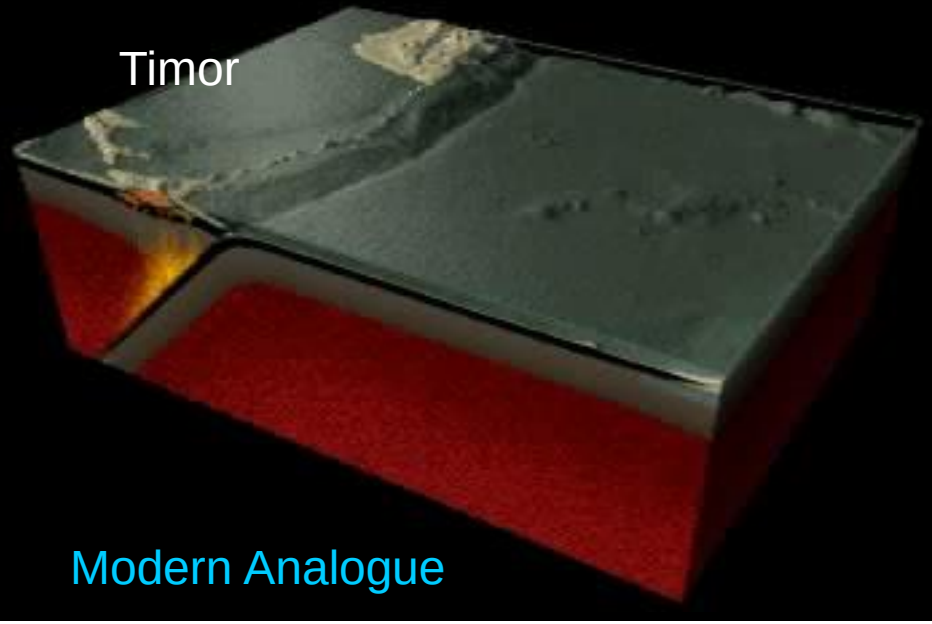
Merguerian and Baskerville 1987



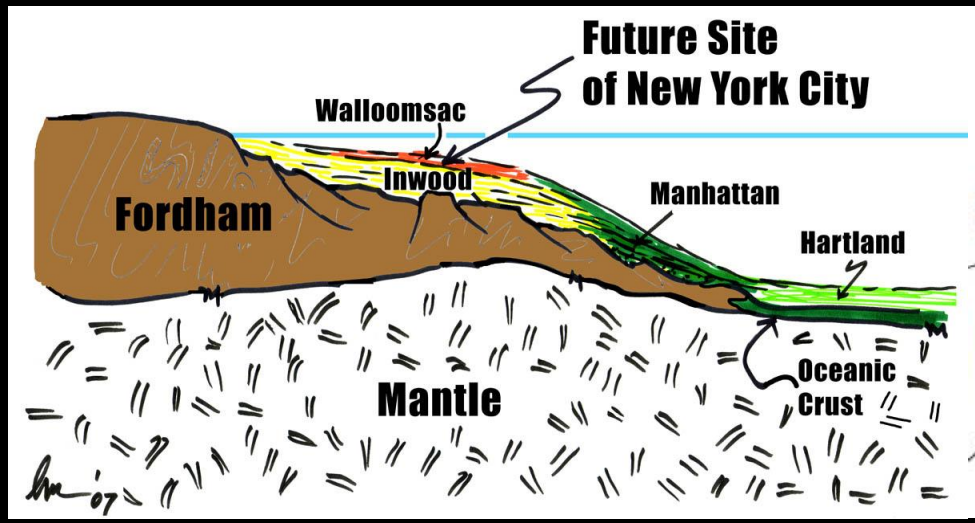


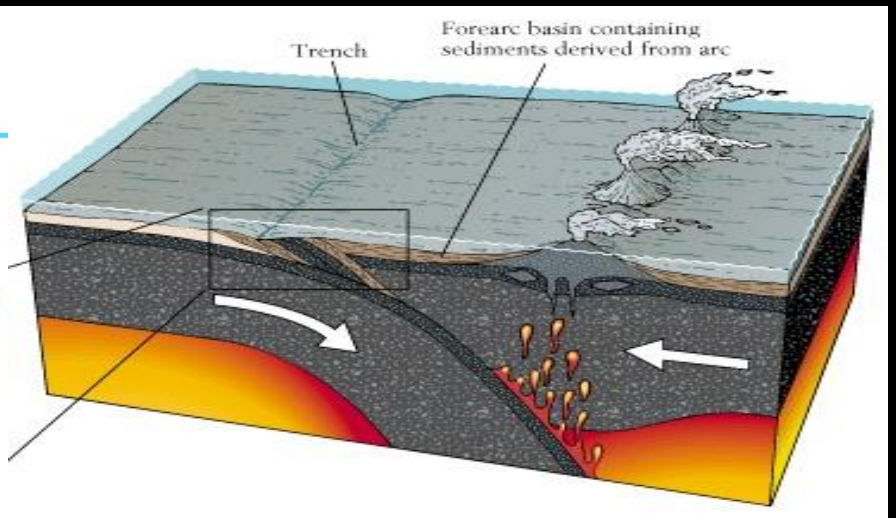


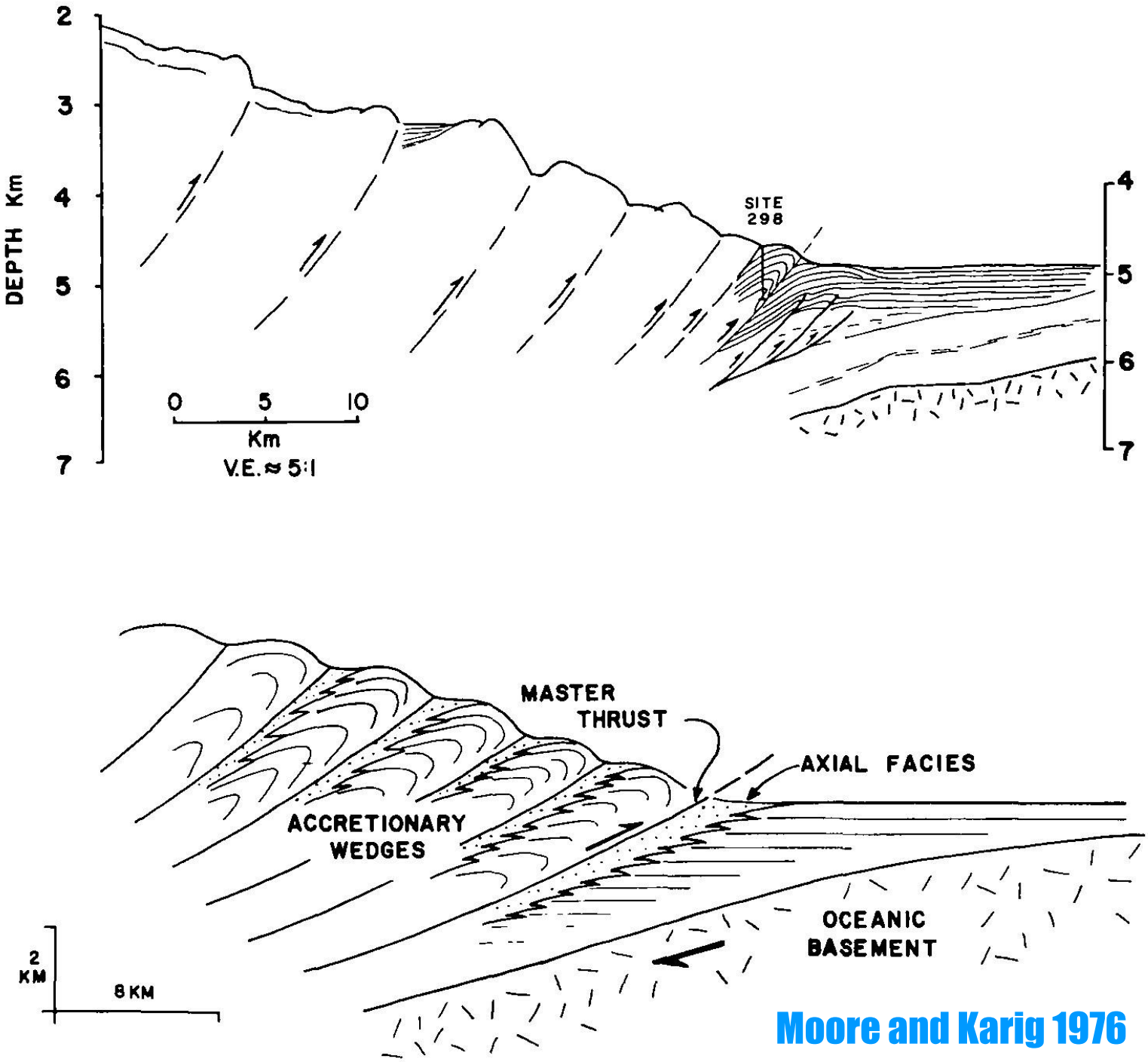
~ 450 Ma Taconian Arc – Passive Margin Collision



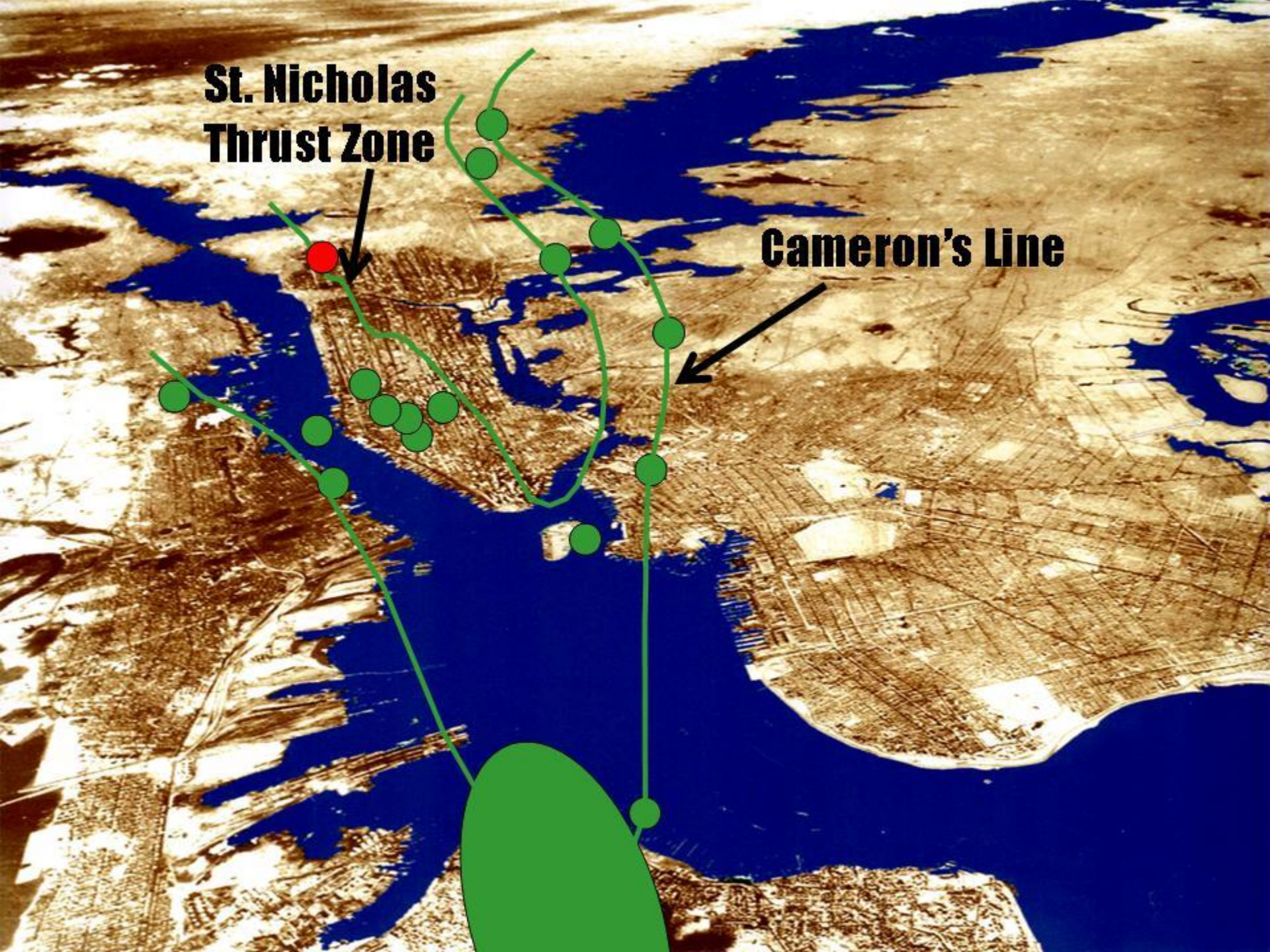
Modern Analogue







Moore and Karig 1976


St. Nicholas
Thrust Zone
Cameron's Line

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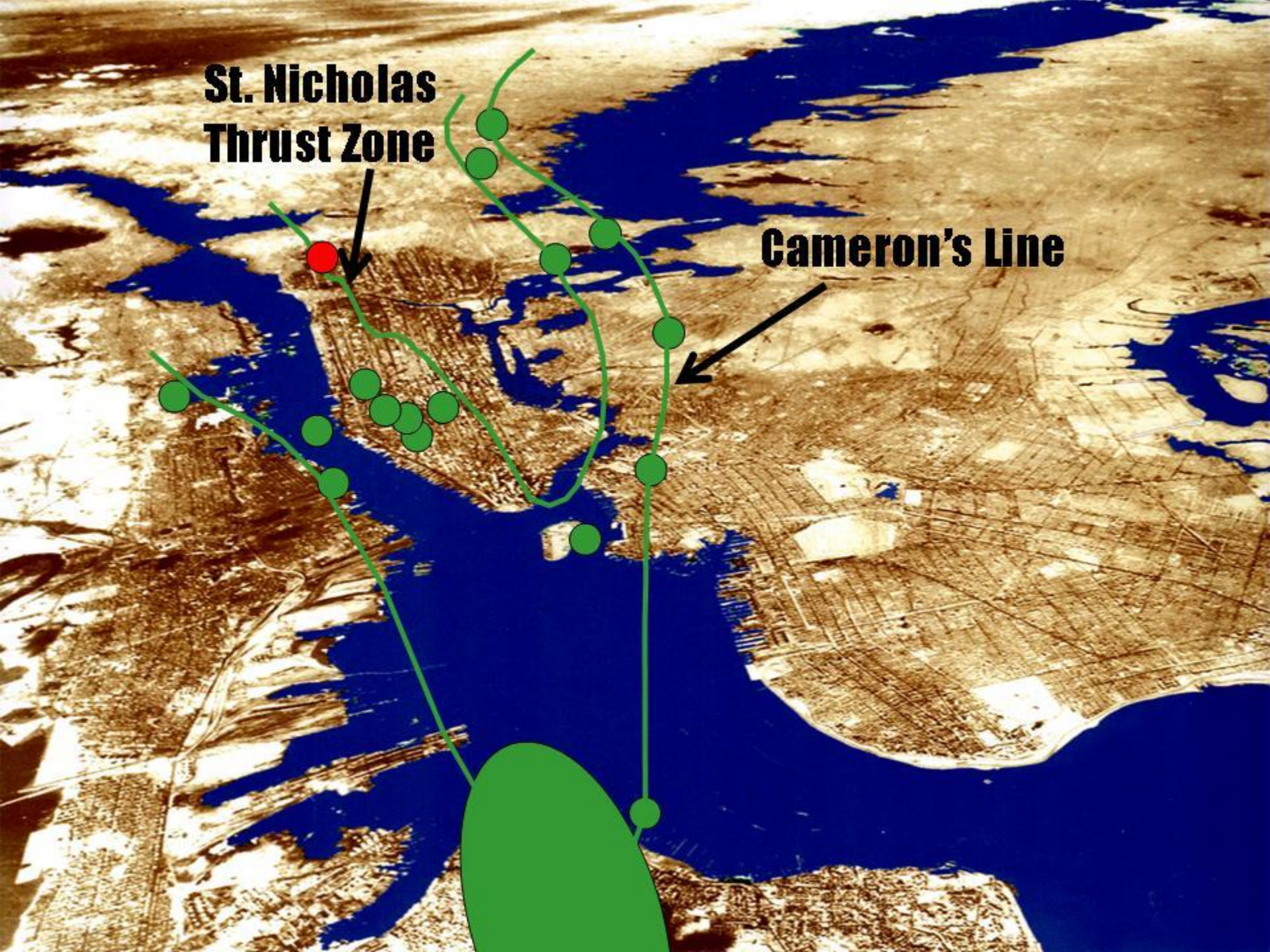
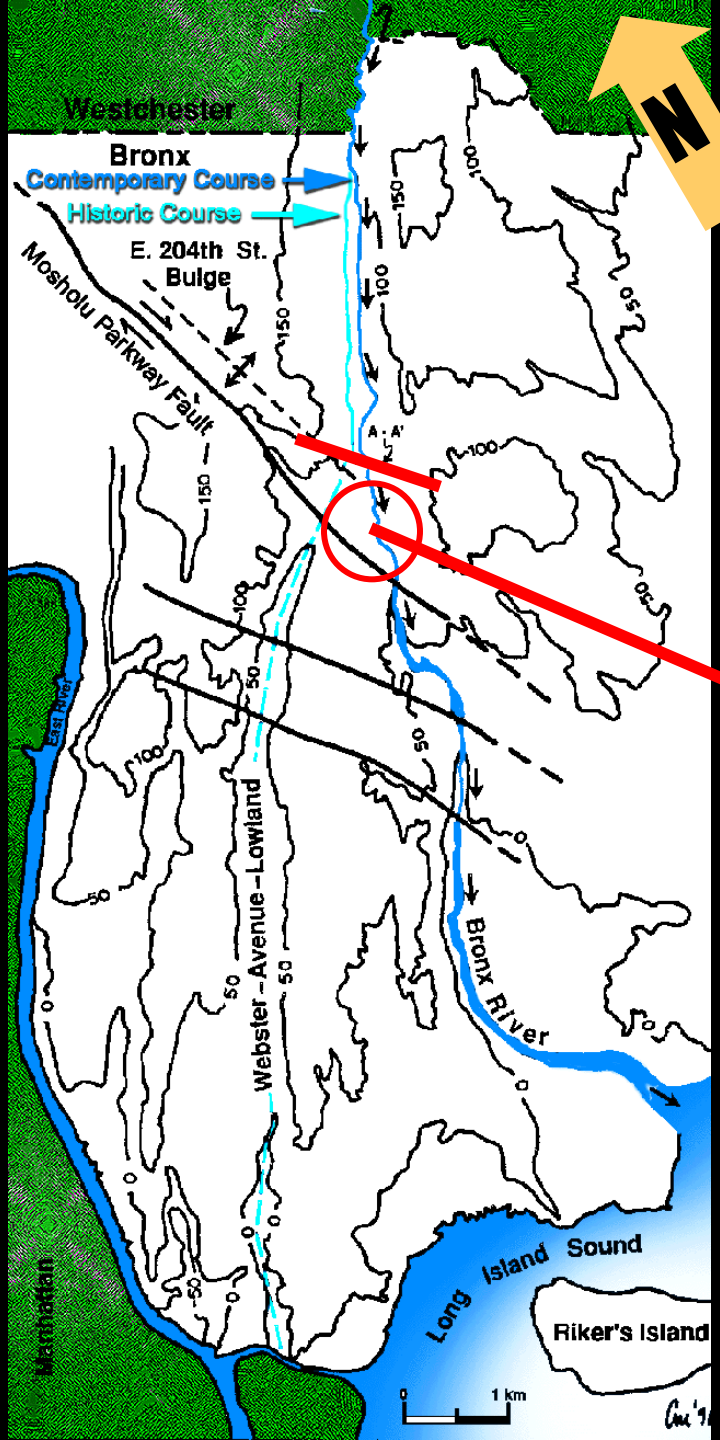
Queens Tunnel


St. Nicholas
Thrust Zone
Cameron's Line

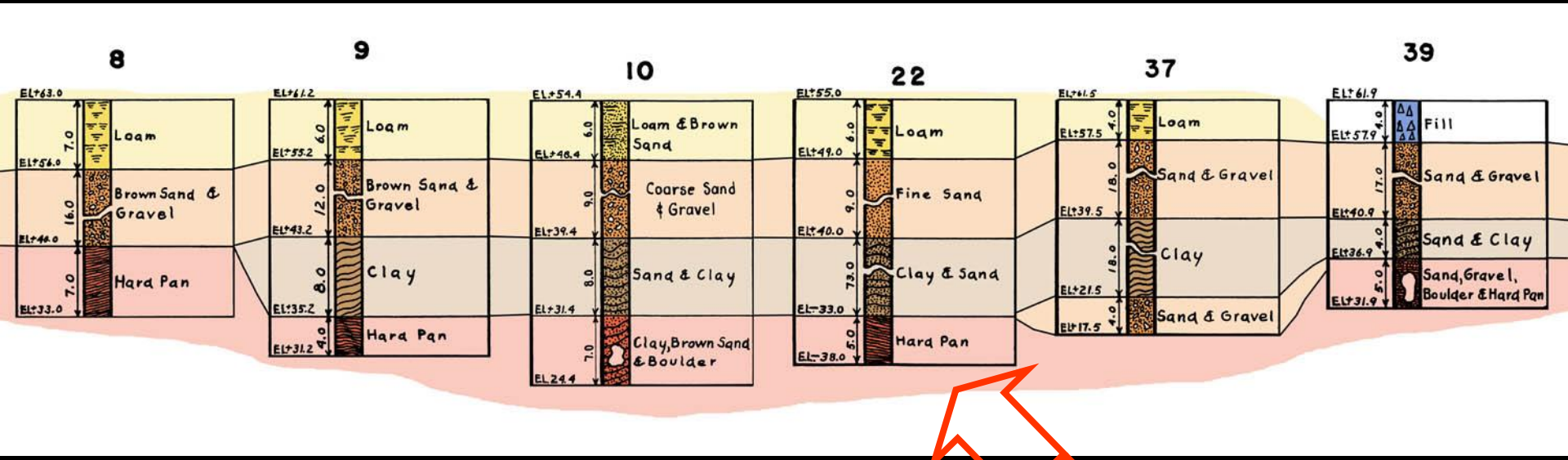

First Lift

Sheared Western Margin



Non-glaciated V-Shaped Bronx River Valley at Snuff Mill, NY Botanical Garden

Burke Avenue Profile – Bronx WPA

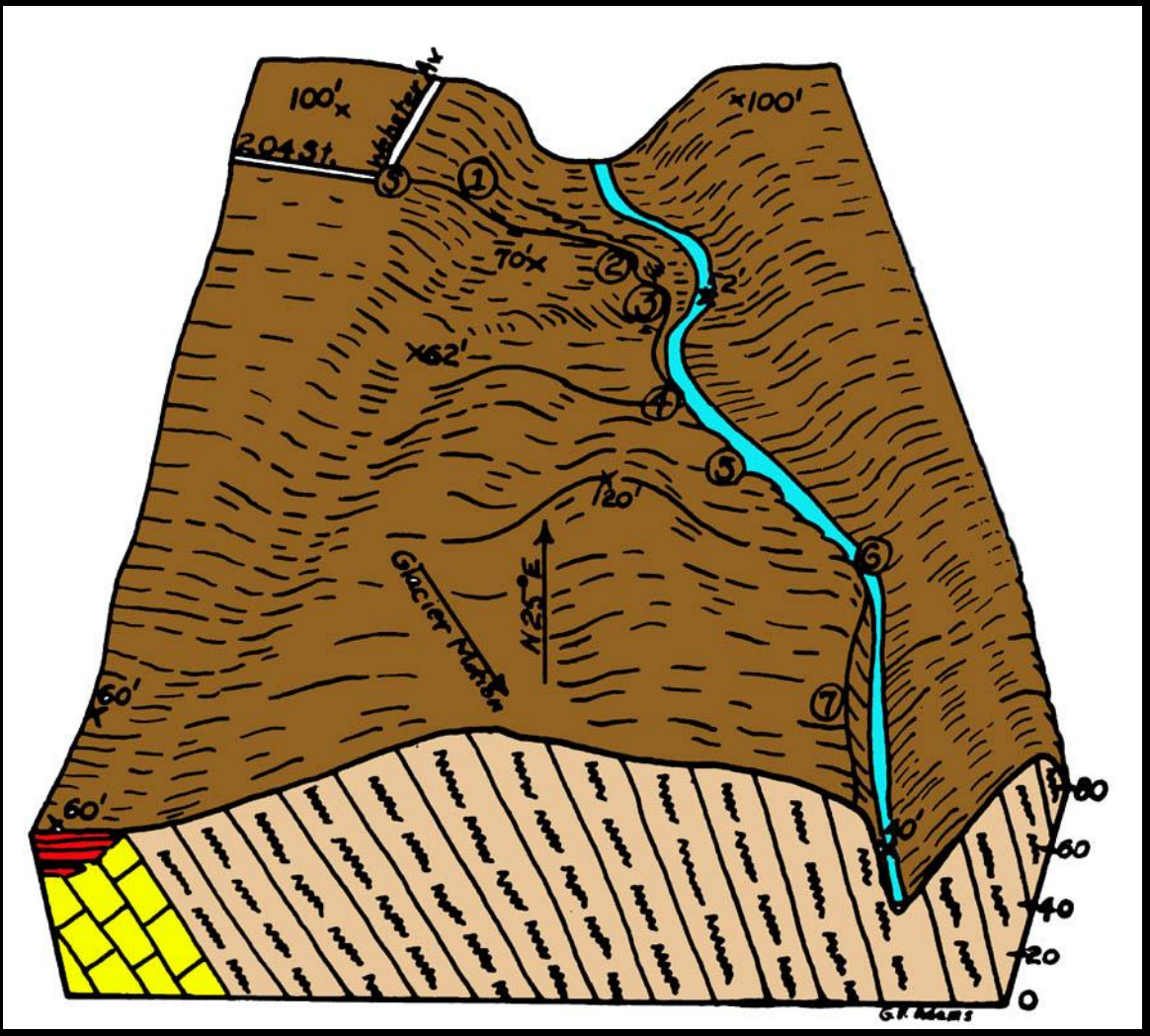


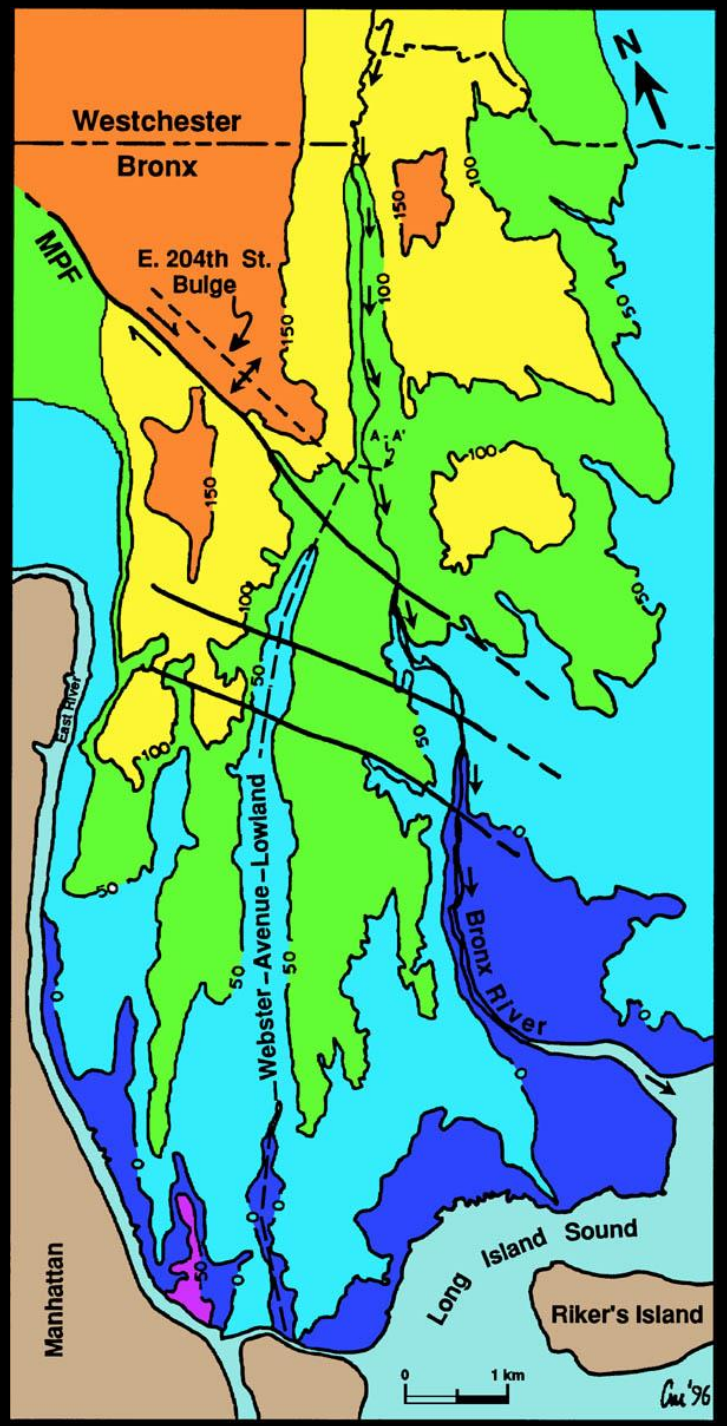
Drift

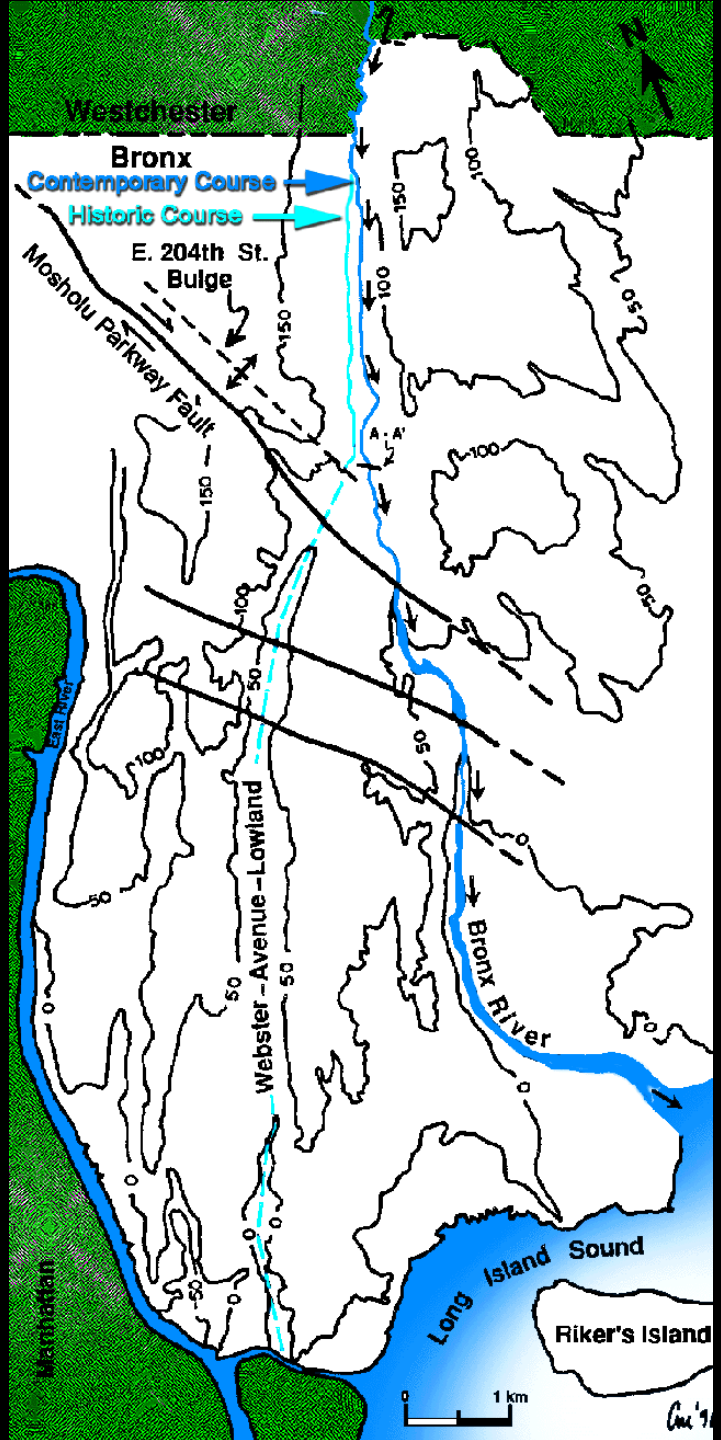
Lake Strata Overlie Glacial Drift (Till) in WPA Borings!!!

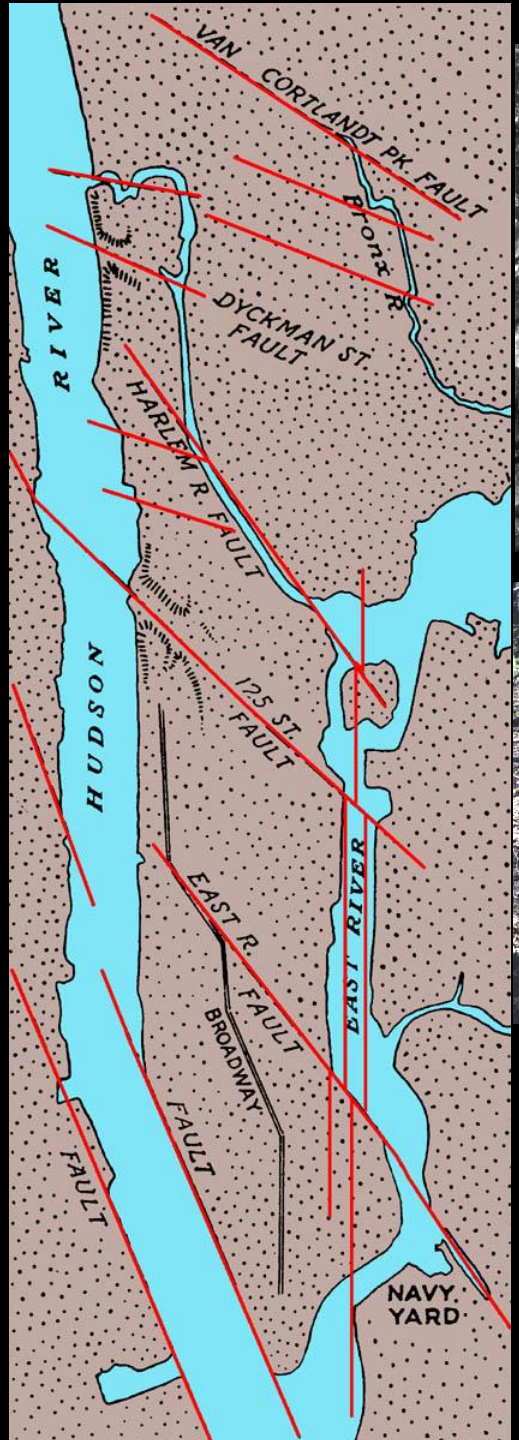
Supports Merguerian and Sanders 1998 hypothesis that diversion of Bronx River was post-glacial

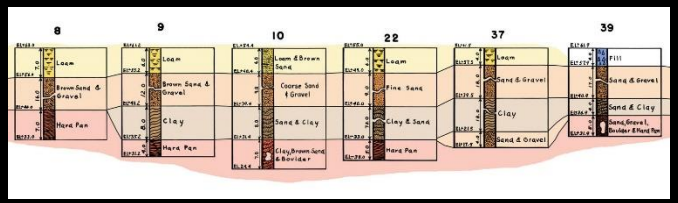
Bronx River Drainage Anomaly

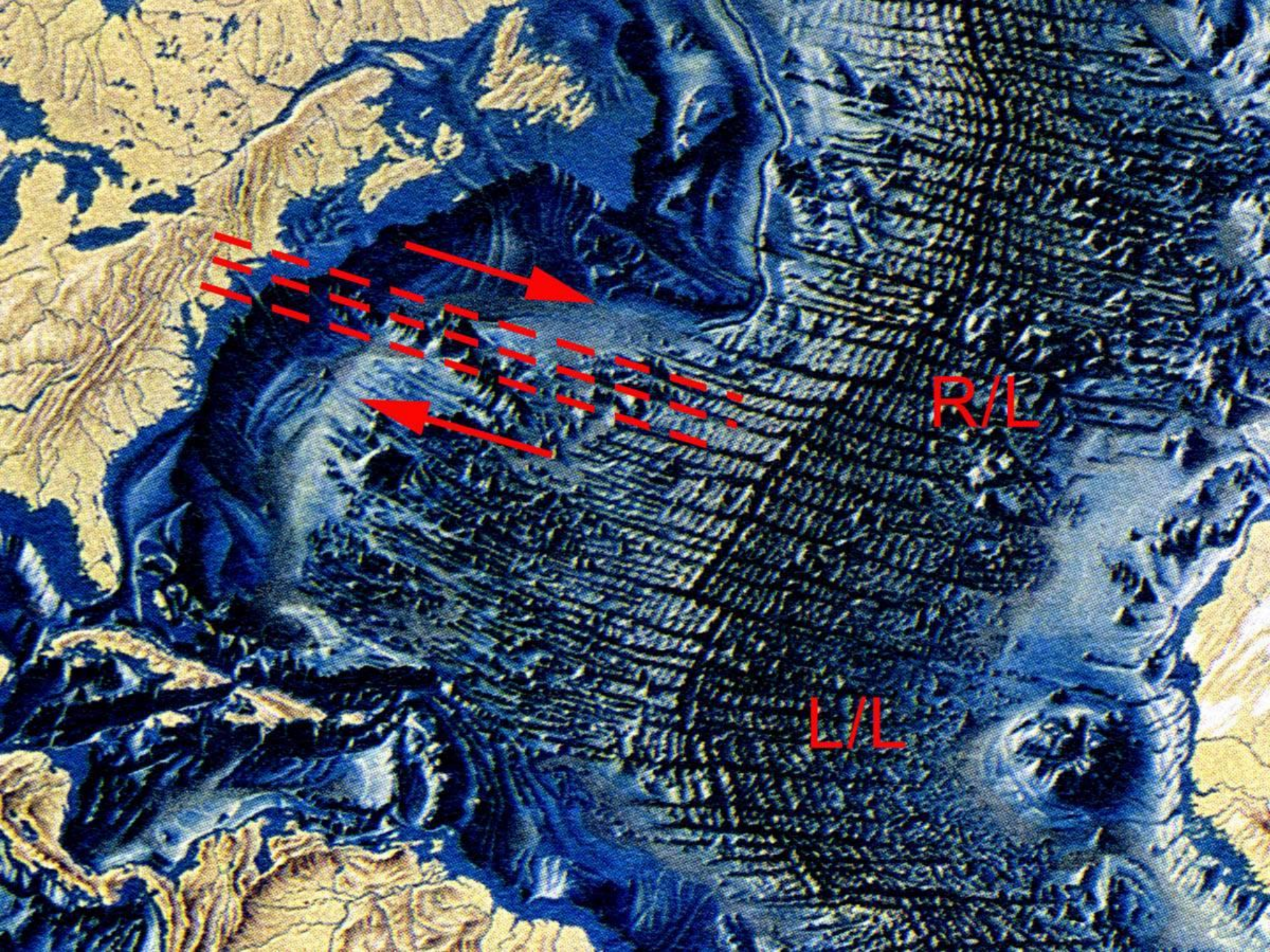





Westchester
Bronx
Contemporary Course
Historic Course
E. 204th St.
Bulge
Mosholu Parkway Fault
A
A'
Webster-Avenue-Lowland
Bronx River
East River
Manhattan
Long Island Sound
Riker's Island
0
1 km


VAN CORTLANDT PK. FAULT
Bronx R.
DYCKMAN ST. FAULT
HARLEM R. FAULT
125 ST. FAULT
EAST R. FAULT
BROADWAY FAULT
FAULT
HUDSON RIVER
EAST RIVER
NAVY YARD


8
9
10
22
37
39
Loam
Brown Sand & Gravel
Hard Pan
Clay
Sand & Clay
Fine Sand
Coarse Sand & Gravel
Sand & Gravel
Fill


R/L
L/L