

New Insights into the Structural Geology of NYC

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Hofstra University



EARLY MEDIAL ORDOVICIAN
(Early Chazyan)
PALEOGEOGRAPHY

by Marshall Kay

Drawn by Erwin Raisz

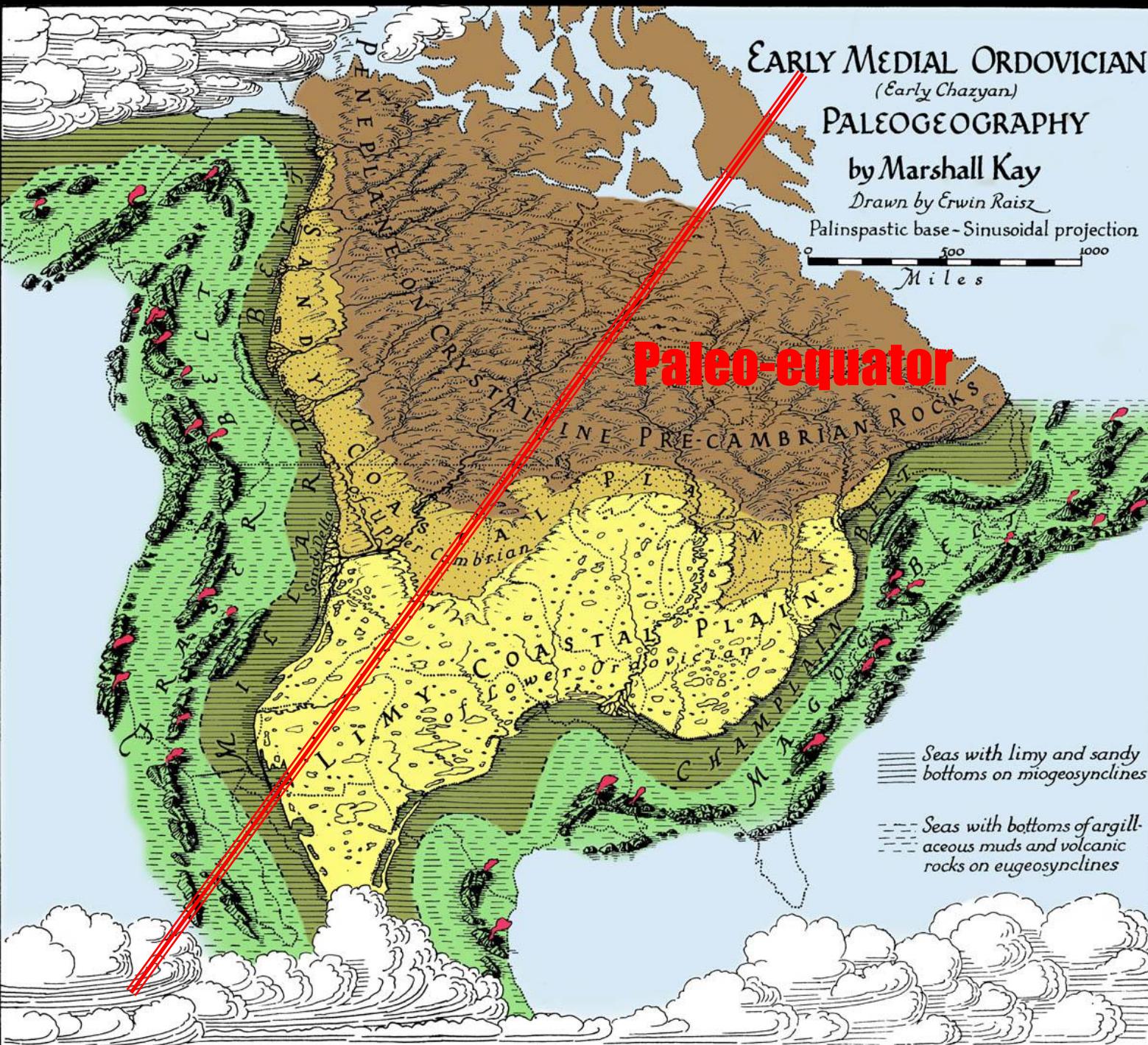
Palinspastic base - Sinusoidal projection

Miles

Paleo-equator

Seas with limy and sandy bottoms on miogeosynclines

Seas with bottoms of argillaceous muds and volcanic rocks on eugeosynclines



Tippecanoe Sauk Taconic



CARBONATE SHELF

CONTINENTAL RISE

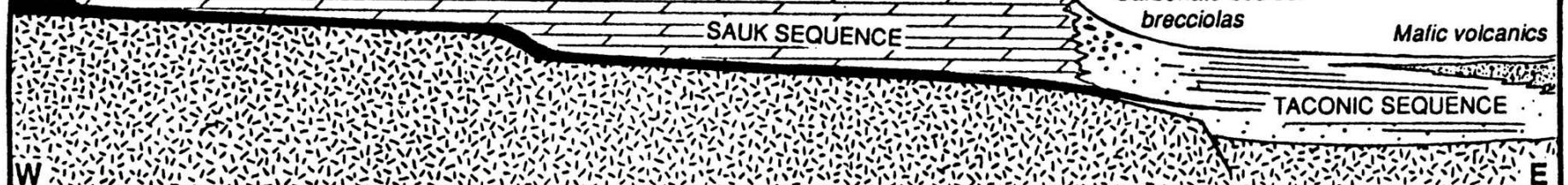
R

Sea level

SAUK SEQUENCE

Carbonate-boulder
brecciolas

Malic volcanics



EARLY MEDIAL ORDOVICIAN
(Early Chazyan)
PALEOGEOGRAPHY

by Marshall Kay

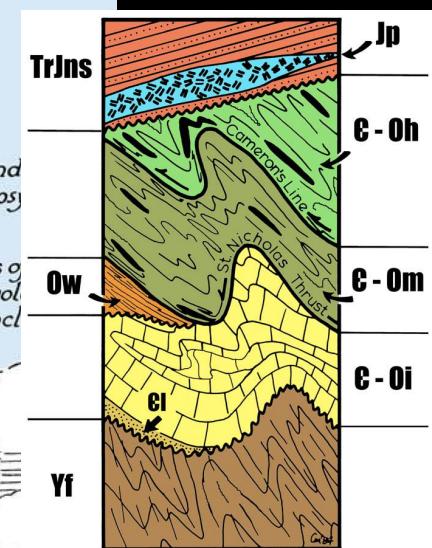
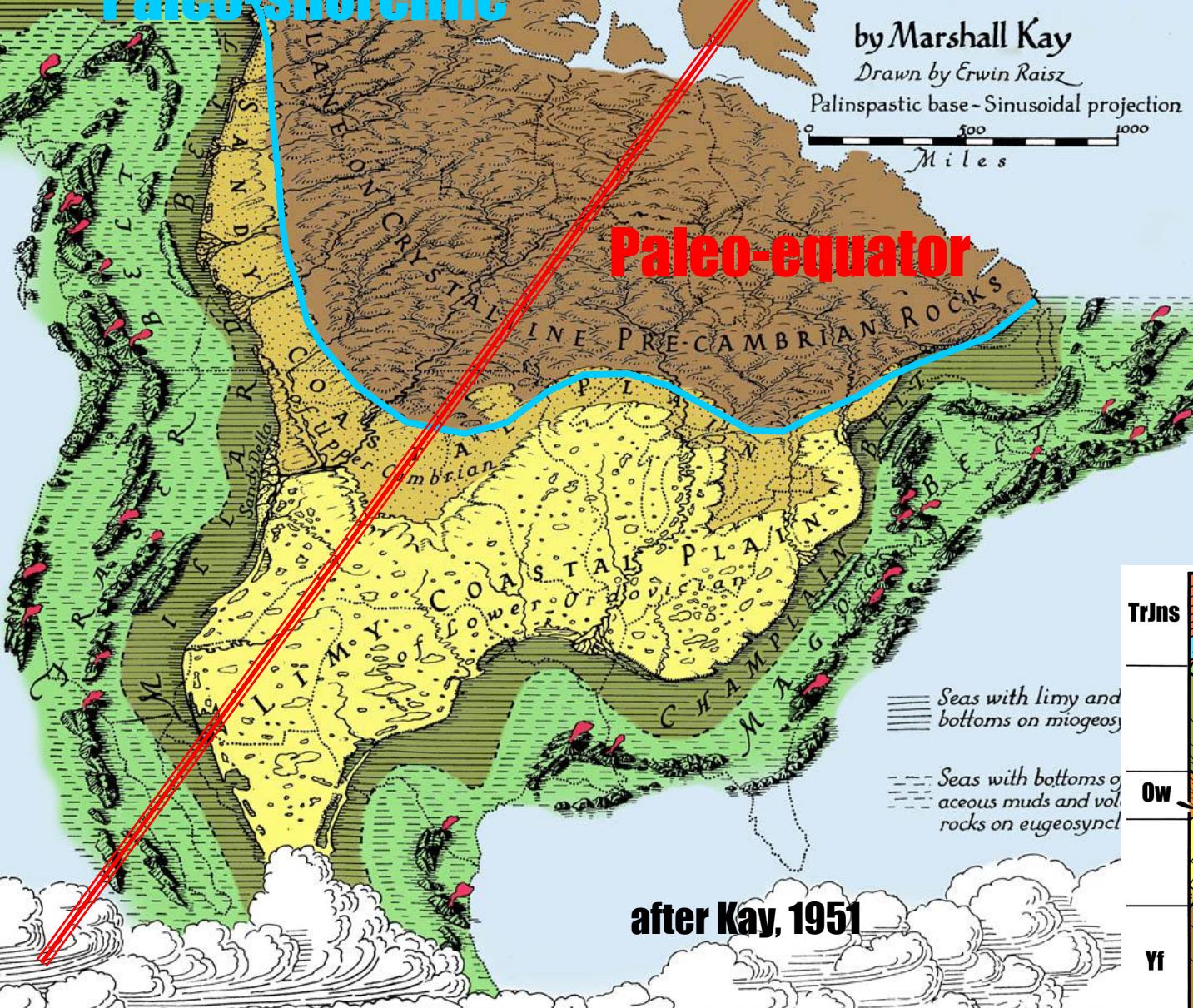
Drawn by Erwin Raisz

Palinspastic base - Sinusoidal projection

0 300 1000 Miles

Paleo-shoreline

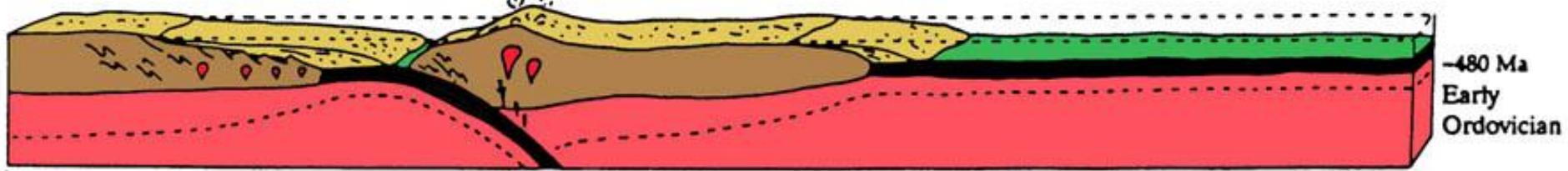
Paleo-equator



Proto North America

Taconic Island Arc

Eastern Iapetus Ocean



Continued Subduction and Final Stages of Closing of Western Iapetus Ocean

Proto North America

Iapetus Ocean

Taconic Island Arc

-480 Ma
Early
Ordovician



← NY →

Continued Subduction

Proto North America

Iapetus Ocean

-500 Ma
Early
Ordovician

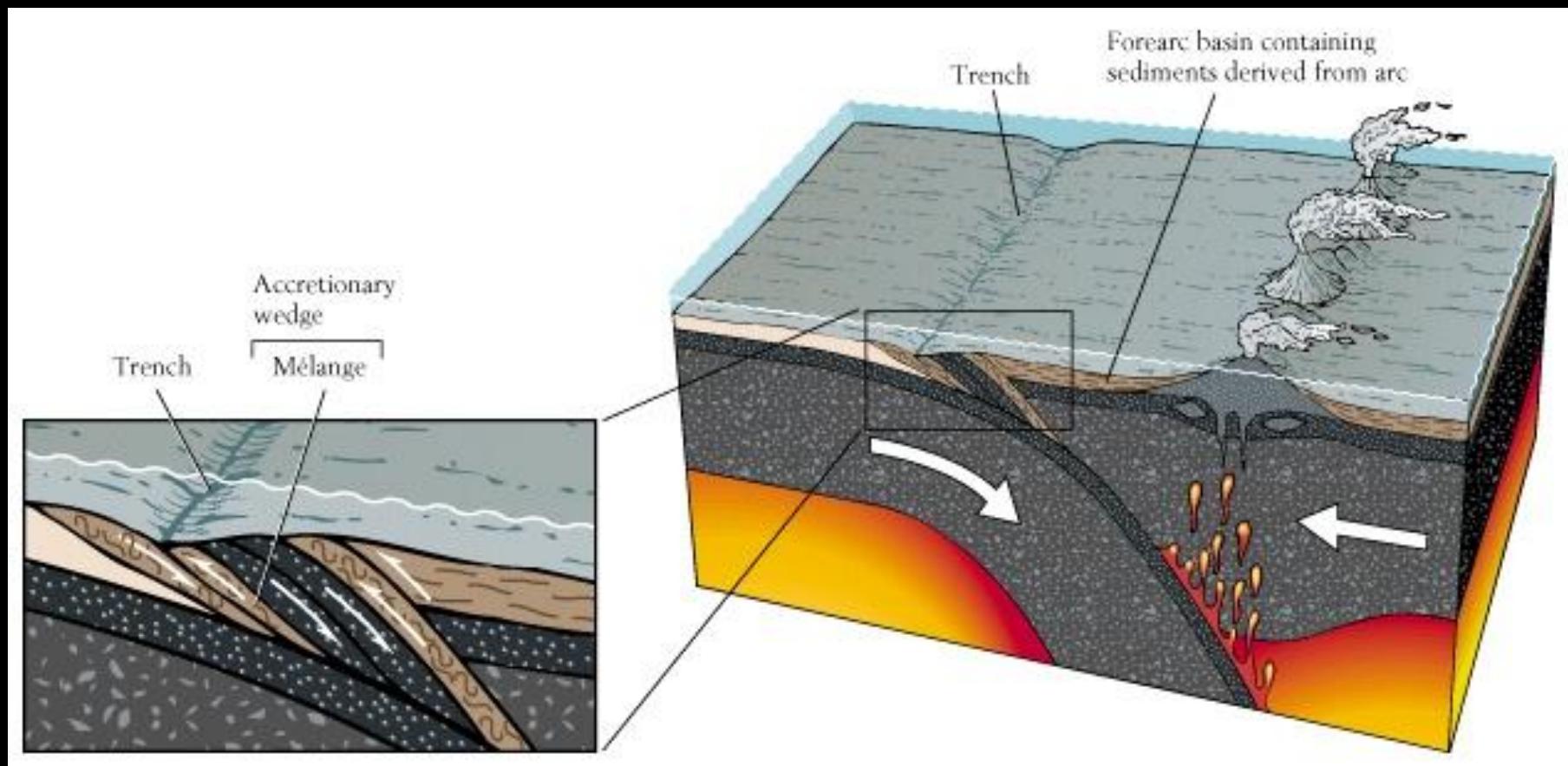


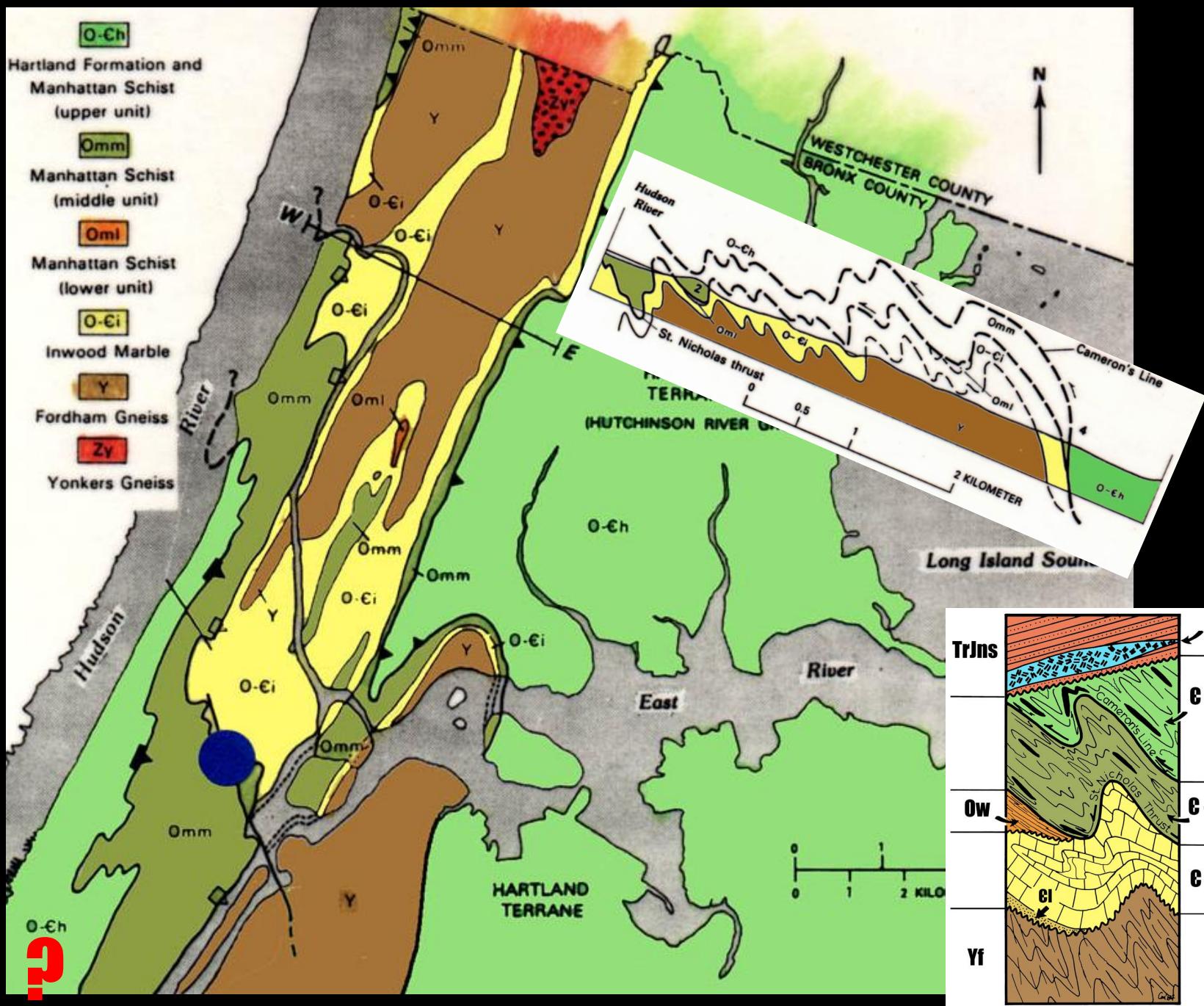
← NY →

Development of Passive Margin on Proto North America

-560 Ma
Late
Proterozoic

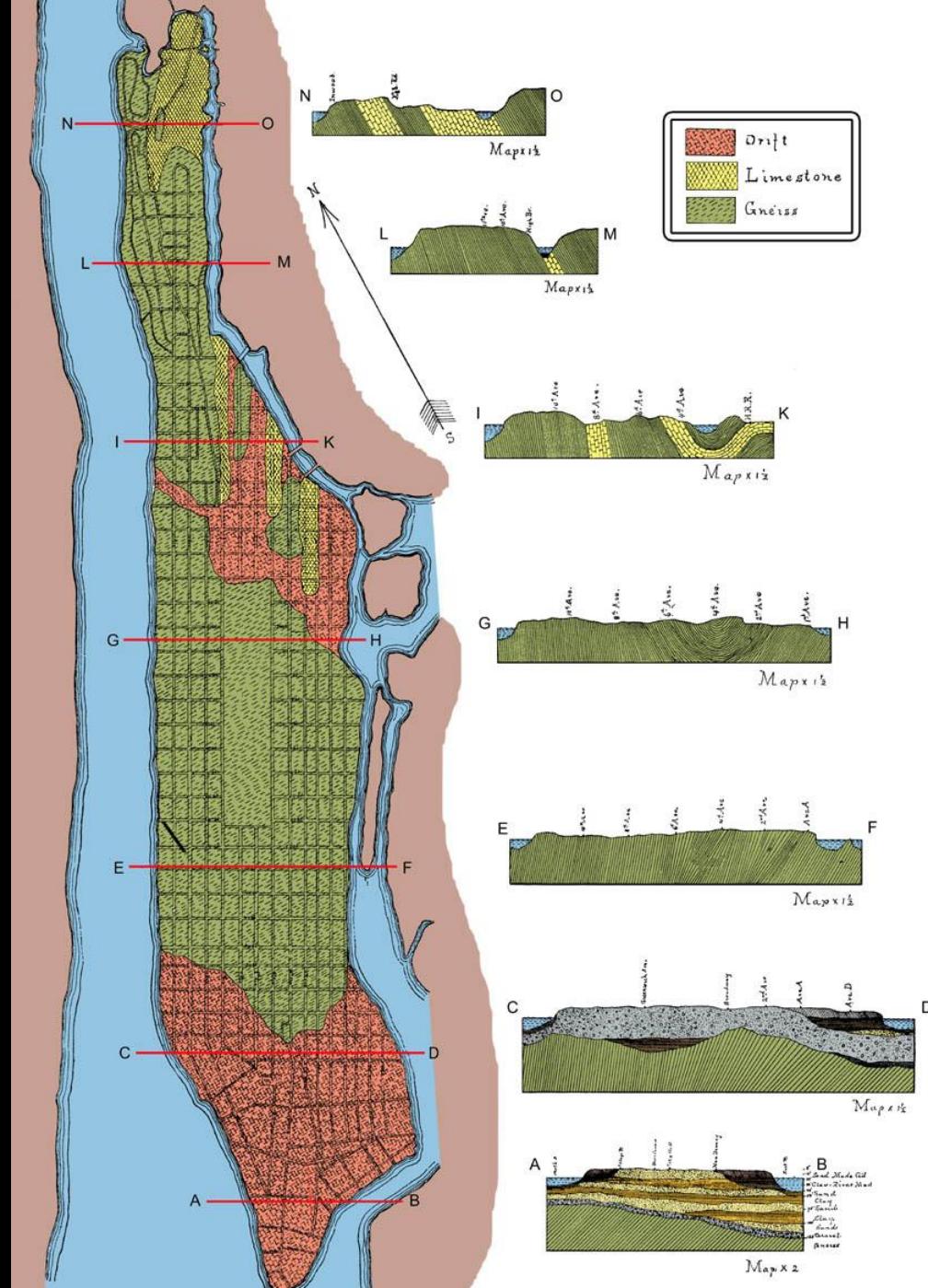
Taconian Accretionary Wedge





First Geologic Map of Manhattan

after Kemp, 1887





Merguerian's Early Field Work on Manhattan Island





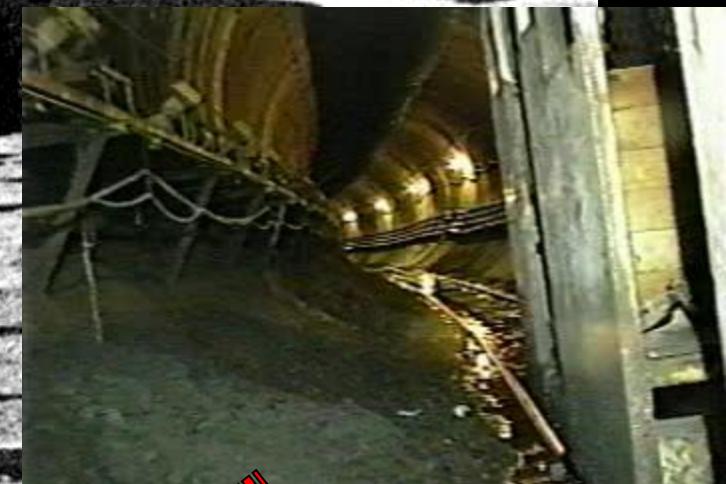
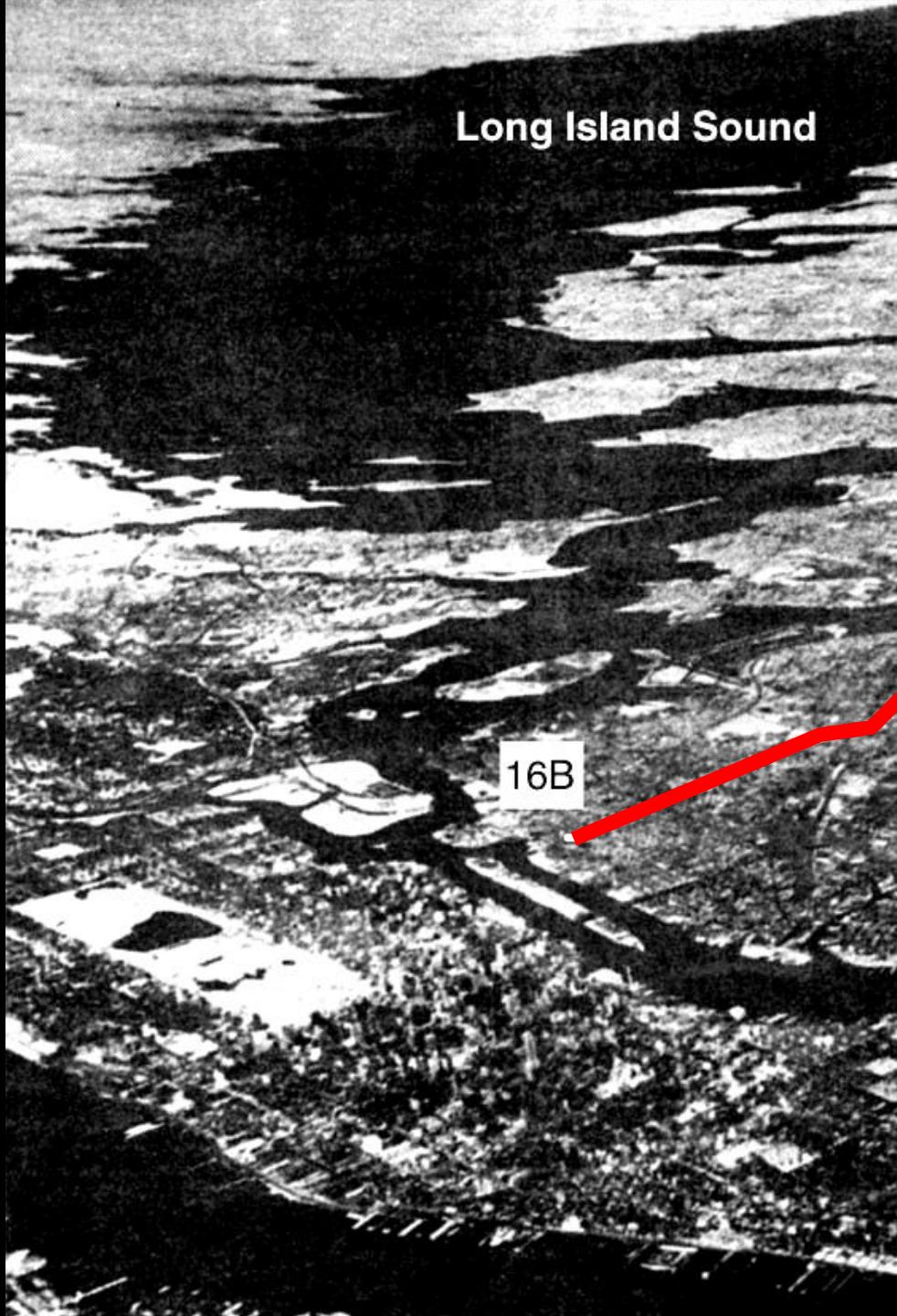
**Proper Field Attire
For NYC**

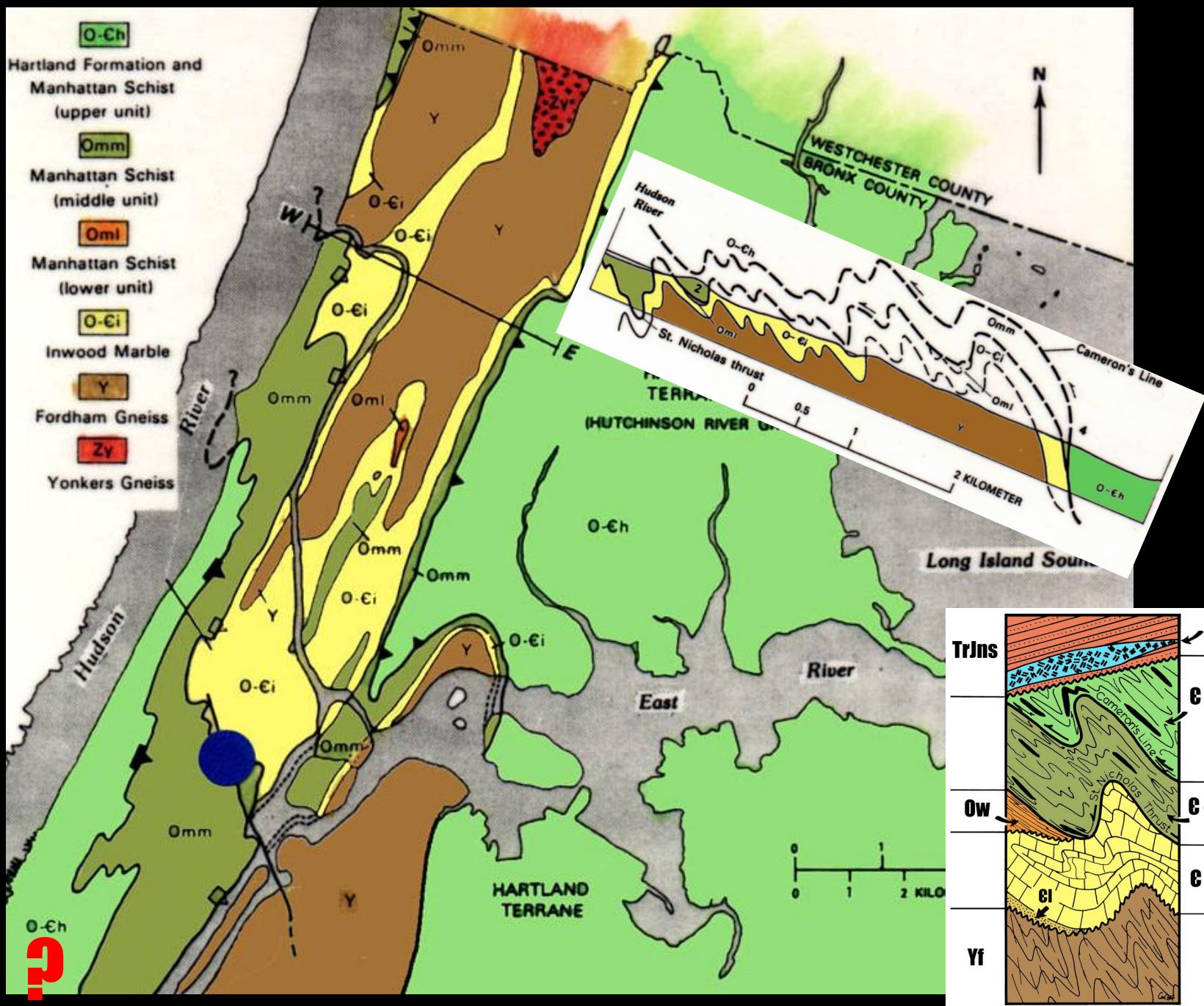
Queens Tunnel Construction 1996-1999





Merguerian's Field Office

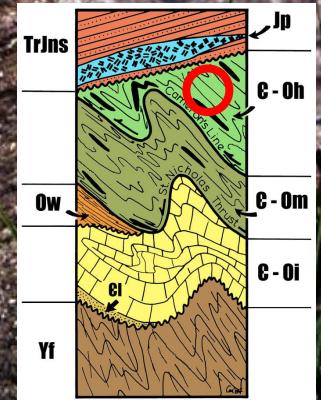




Taconic

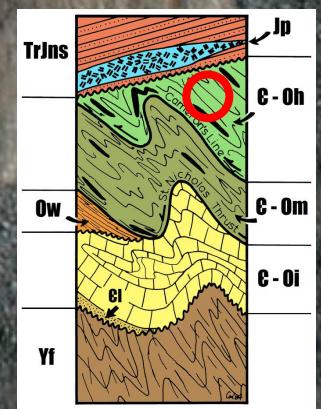


Hartland Schist, Riverside Park



Taconic

N296 Hartland Granofels



Taconic

Hartland Amphibolite N567



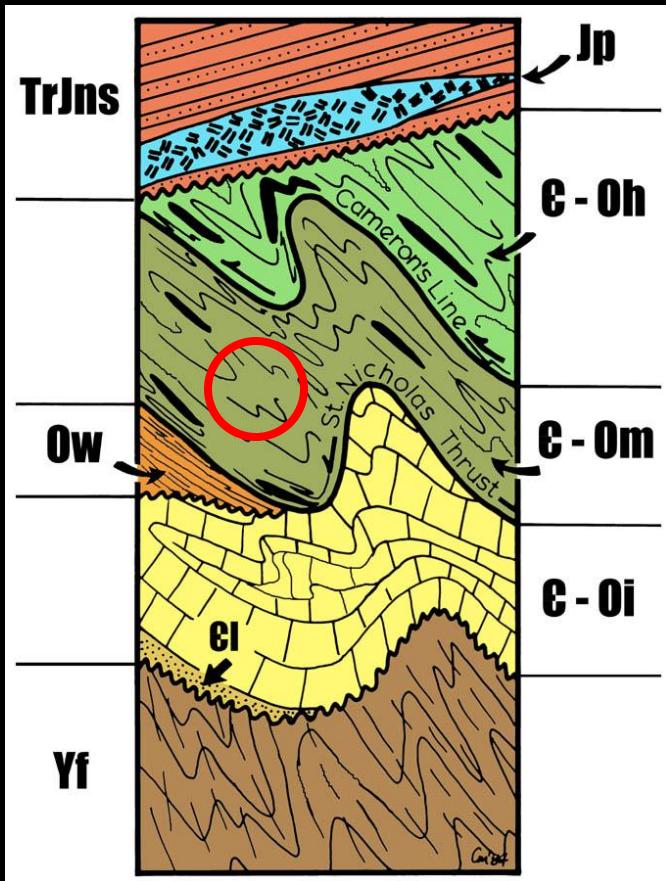


N125 – 112th Street, Riverside Park

Manhattan Schist

F_3 Folds of S_2

Central Park, NYC

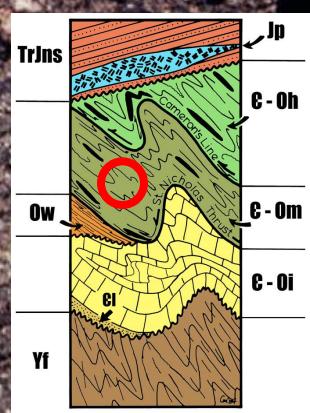


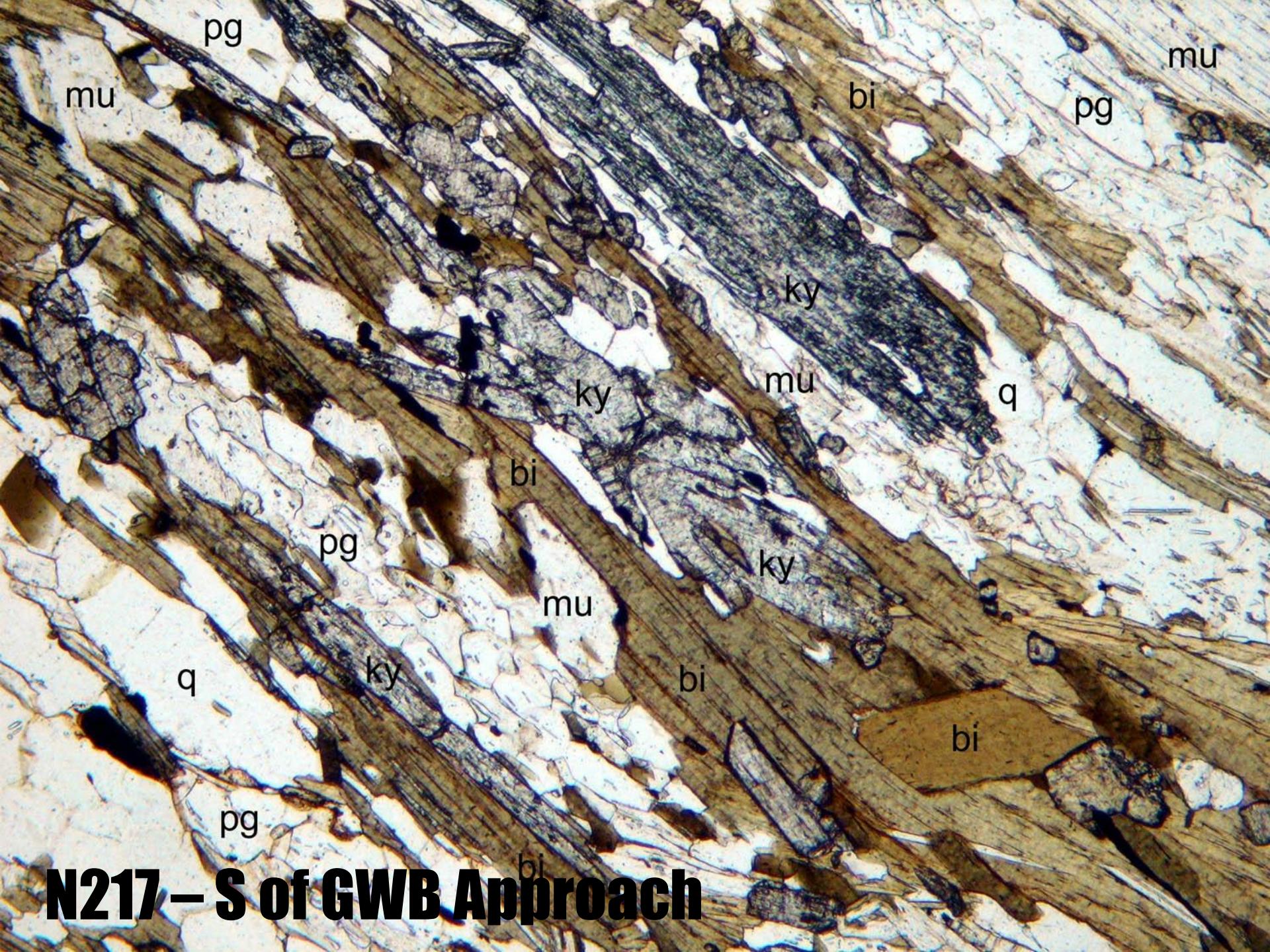
Taconic



Taconic

N283 - Mt Morris Park Kyanite Nodule

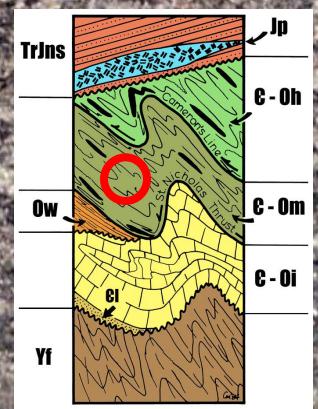




N217 – S of GWB Approach

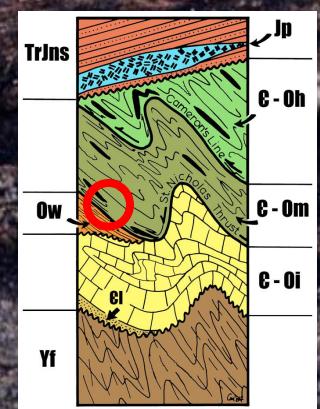
Taconic

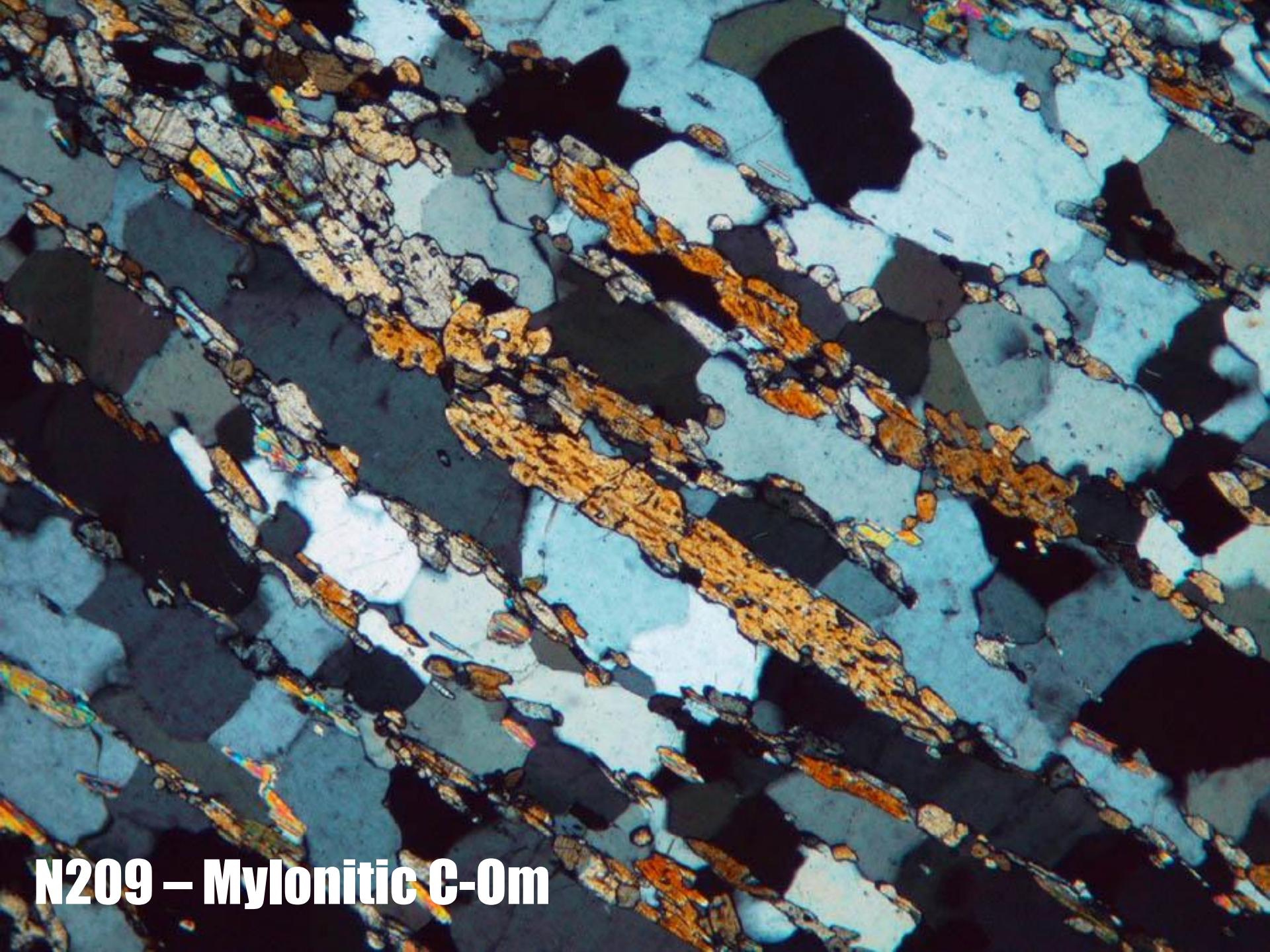
N172 – Mornside Park Kyanite Layer Folded by F_3



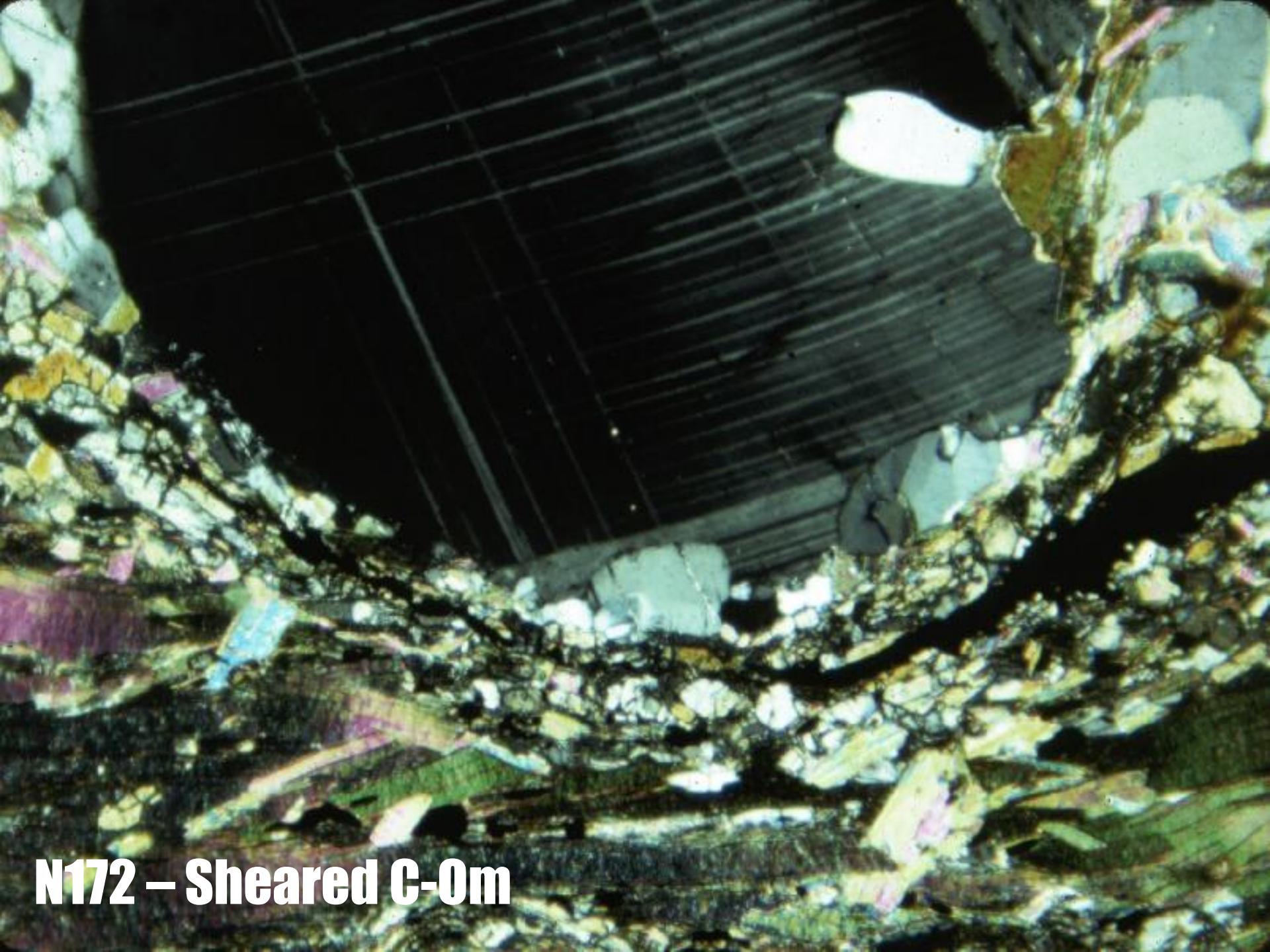
Taconic

Sheared Manhattan Schist, St. Nicholas Park



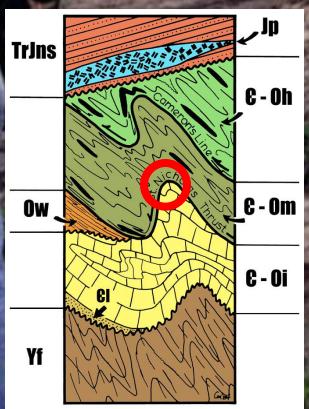
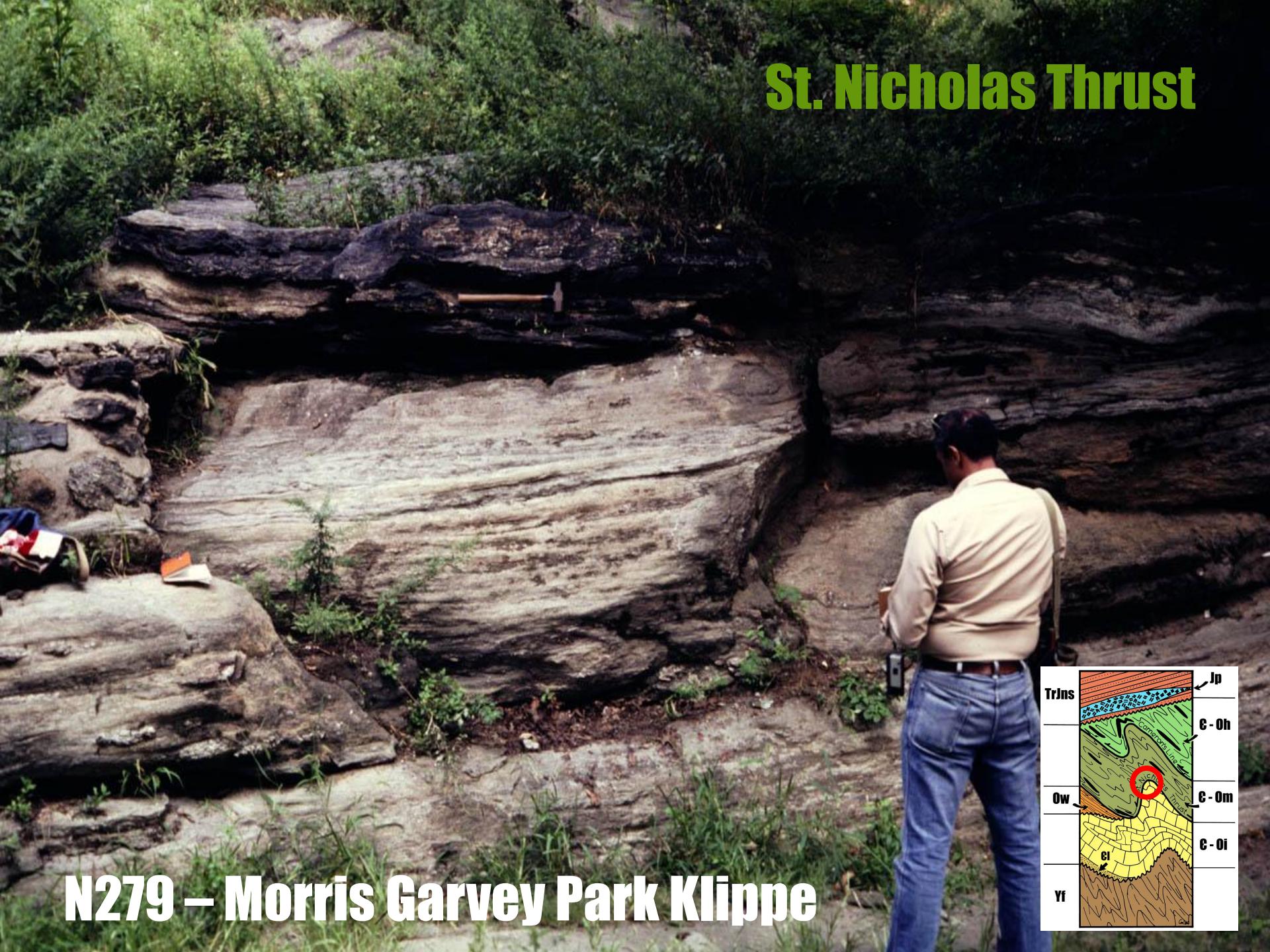


N209 – Mylonitic C-Om

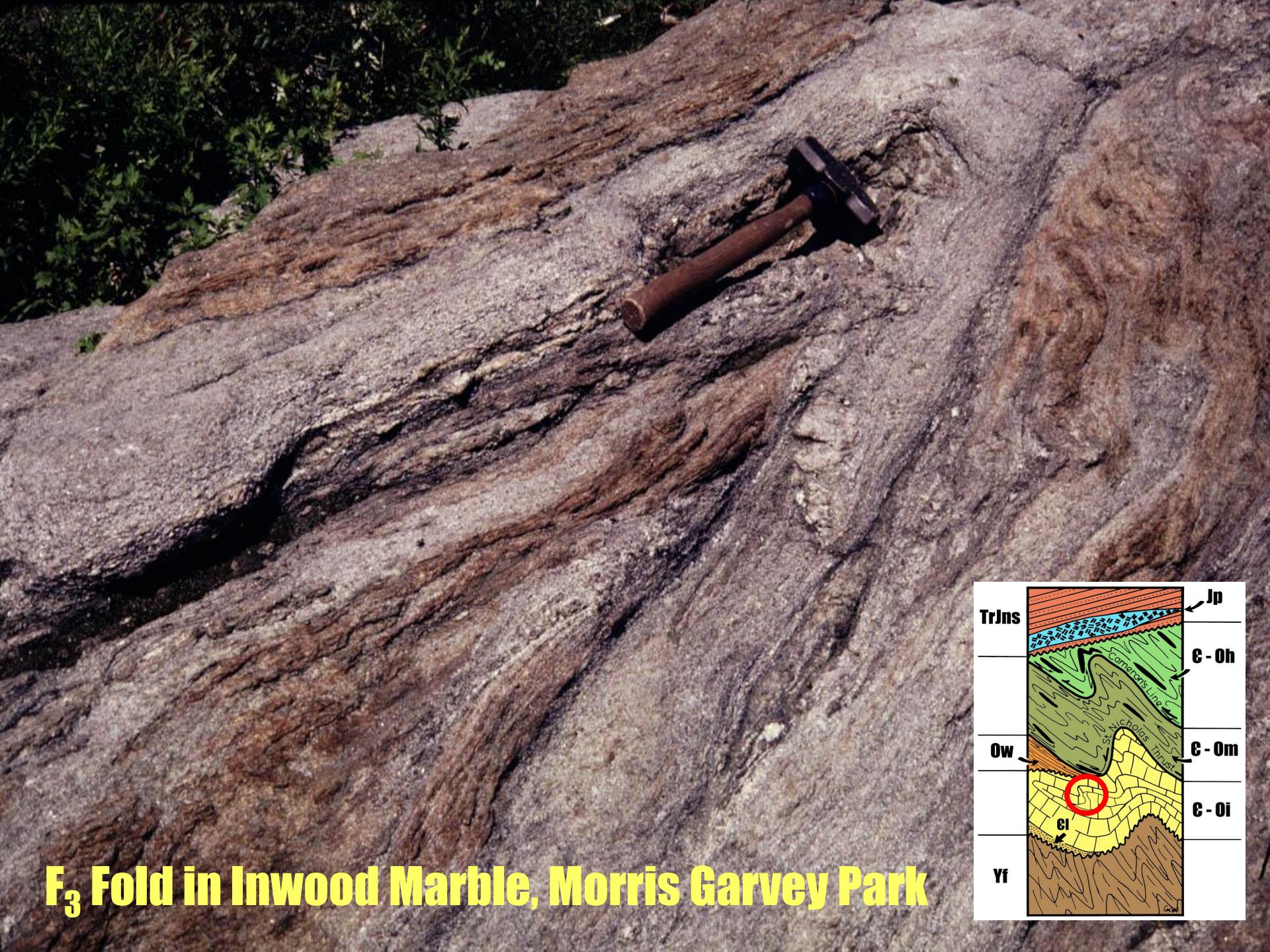


N172 – Sheared C-0m

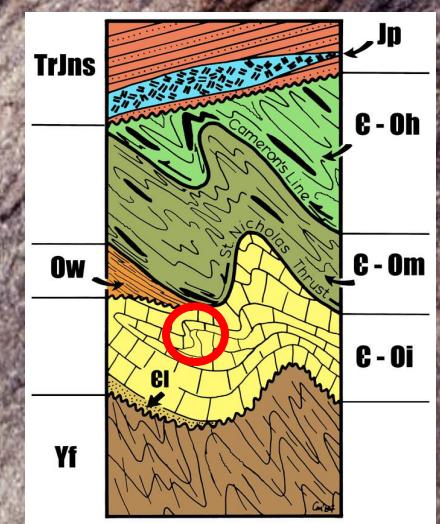
St. Nicholas Thrust



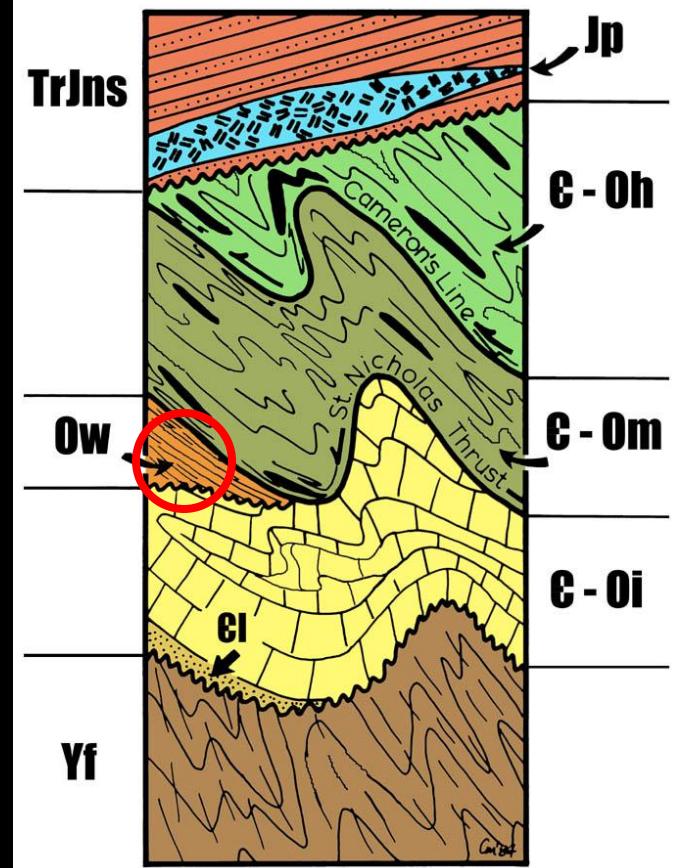
N279 – Morris Garvey Park Klippe



F₃ Fold in Inwood Marble, Morris Garvey Park

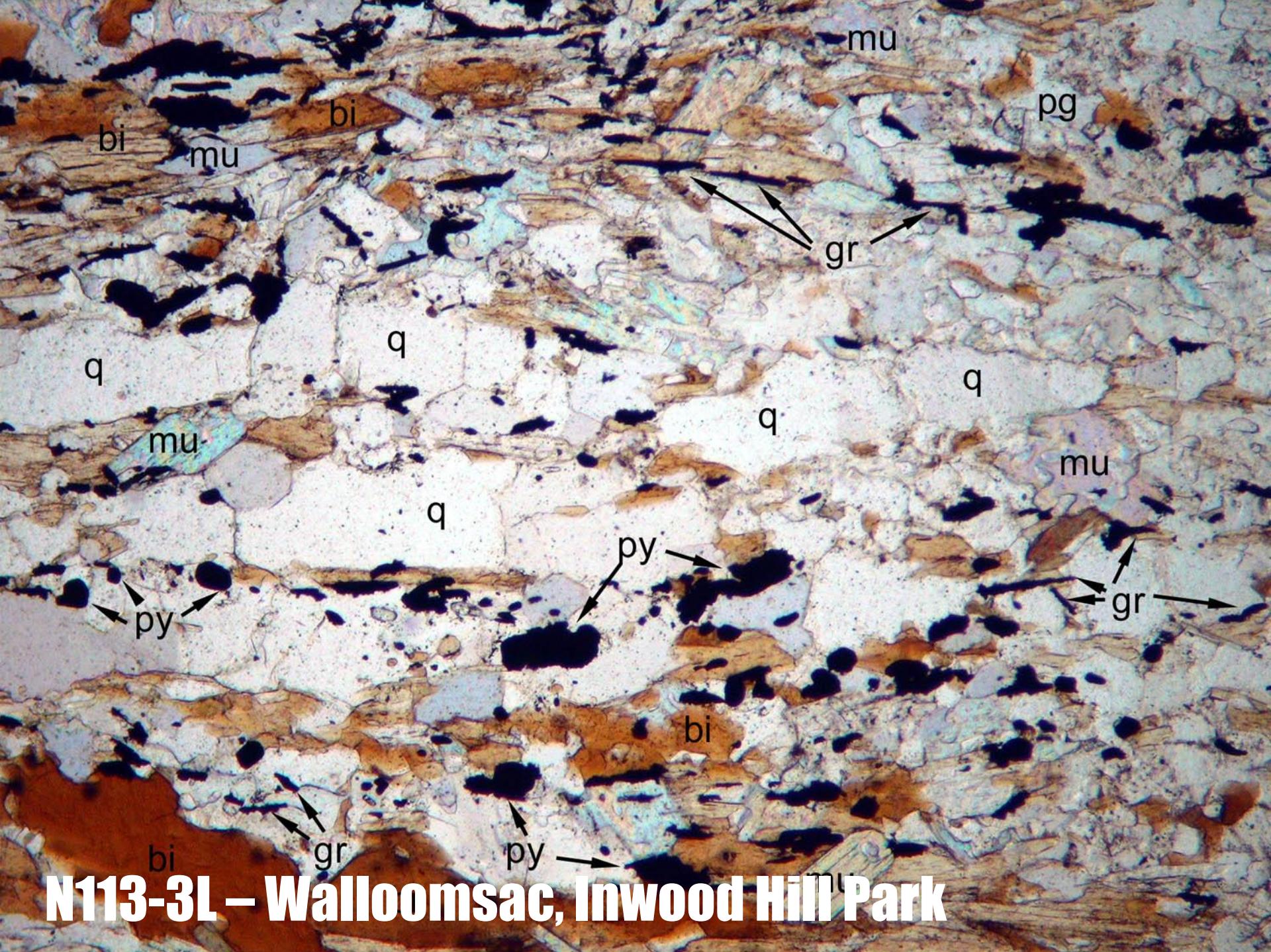


Tippecanoe



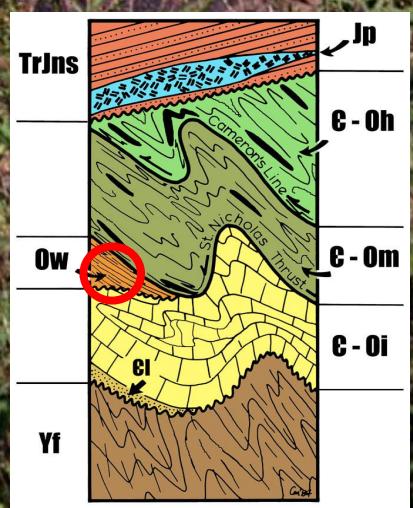
Walloomasac “Balmville” Contact, Grand Concourse, Bronx, NY

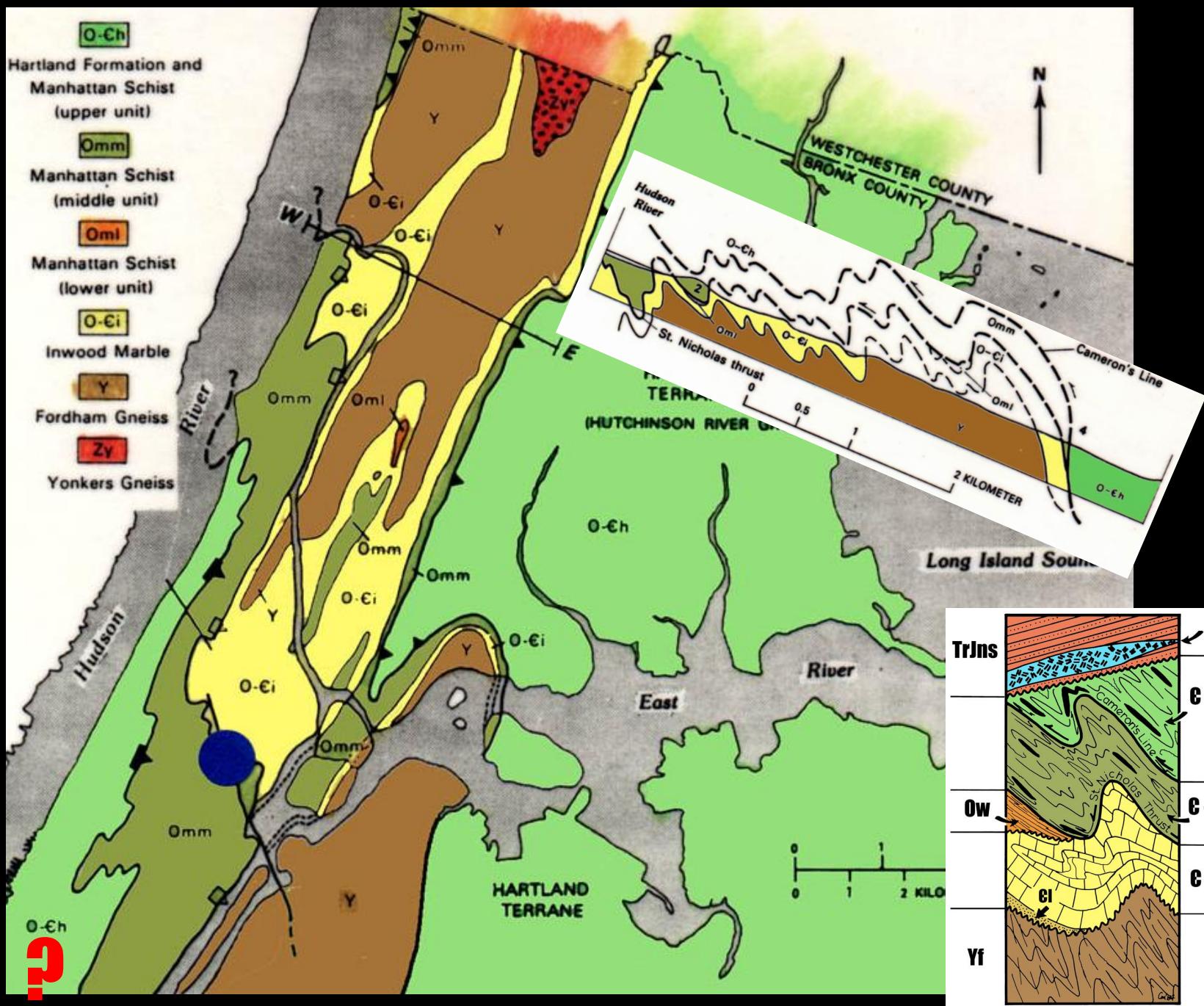




Tippecanoe

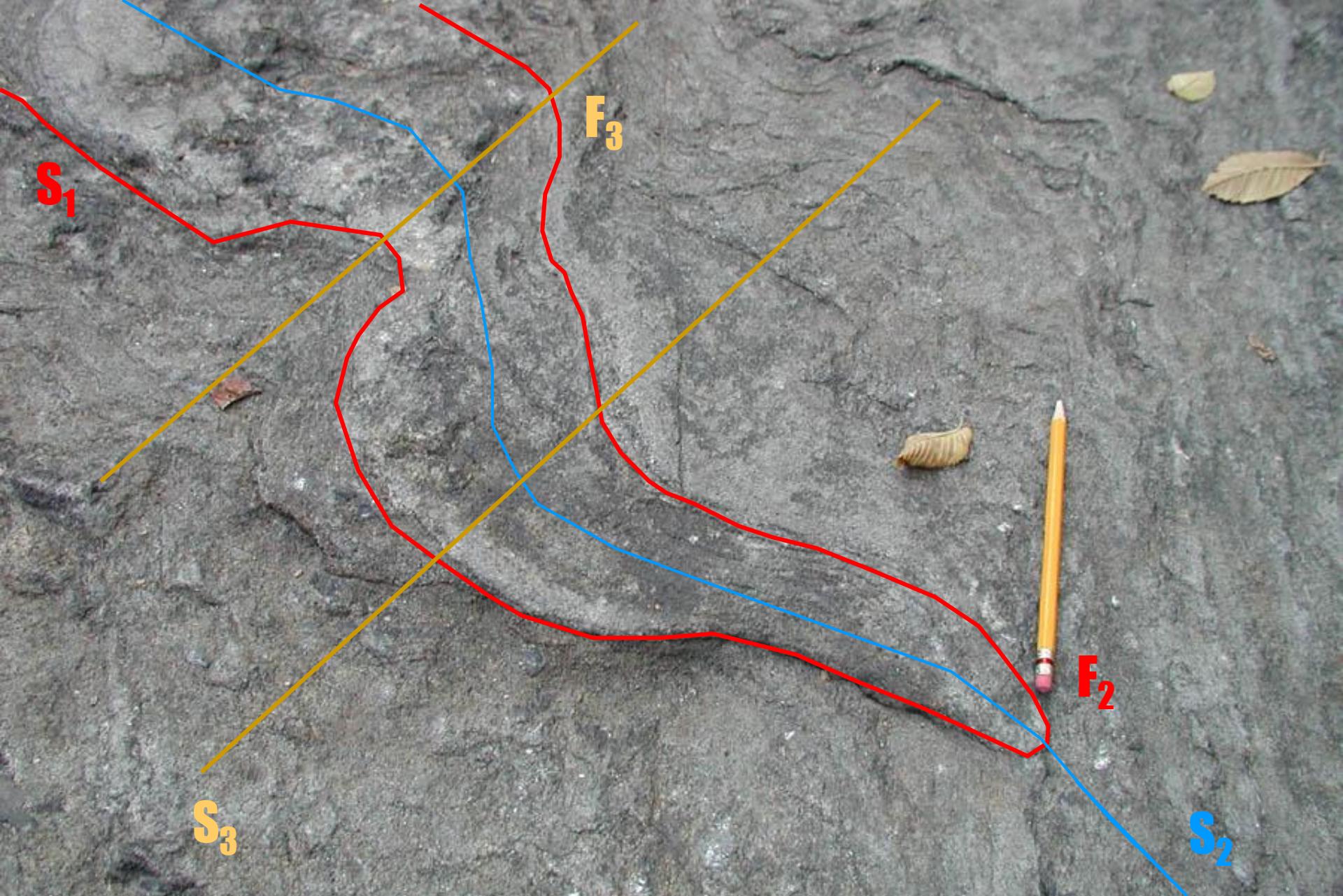
N289 - Pyritiferous Walloomsac



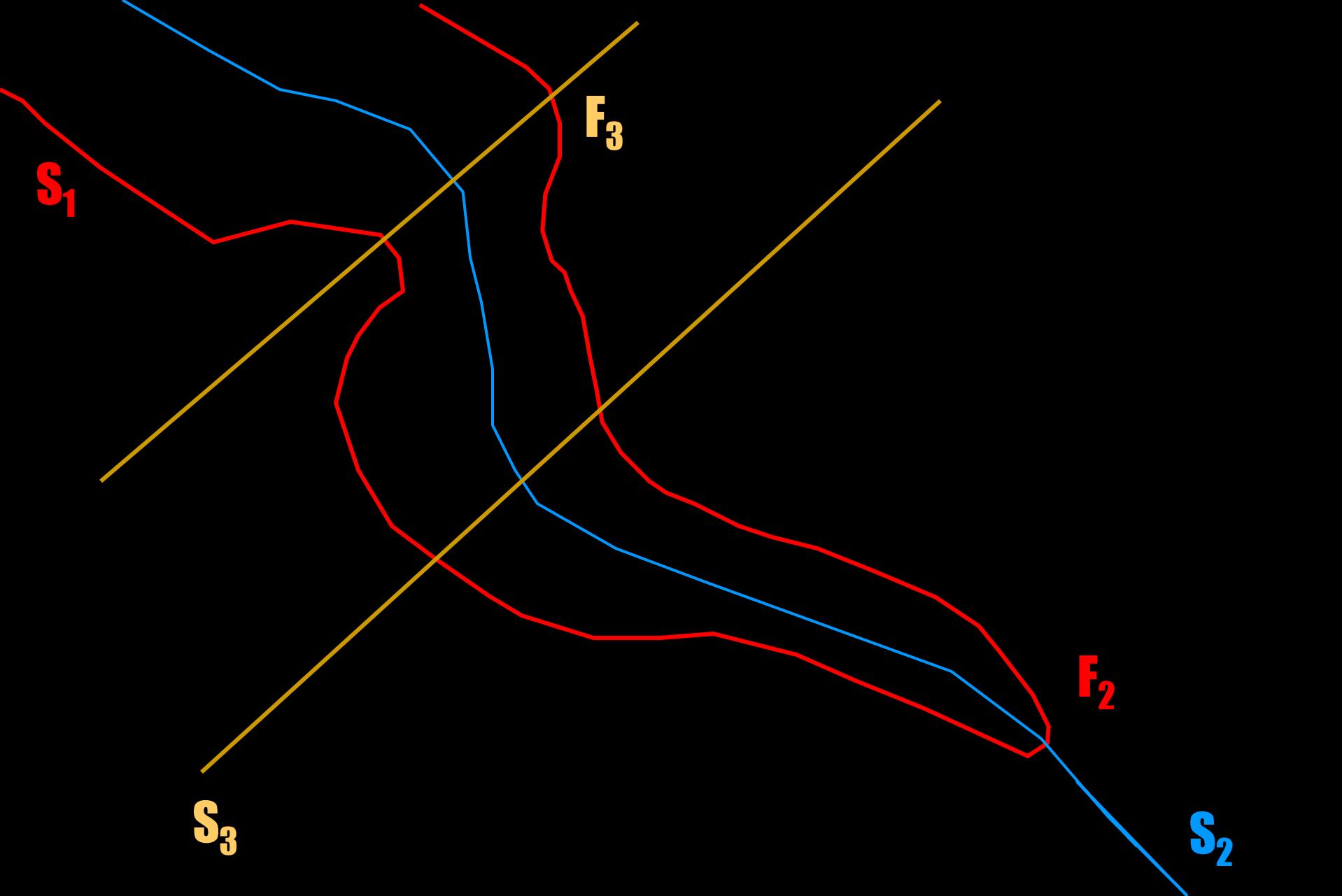


Polydeformed Bedrock





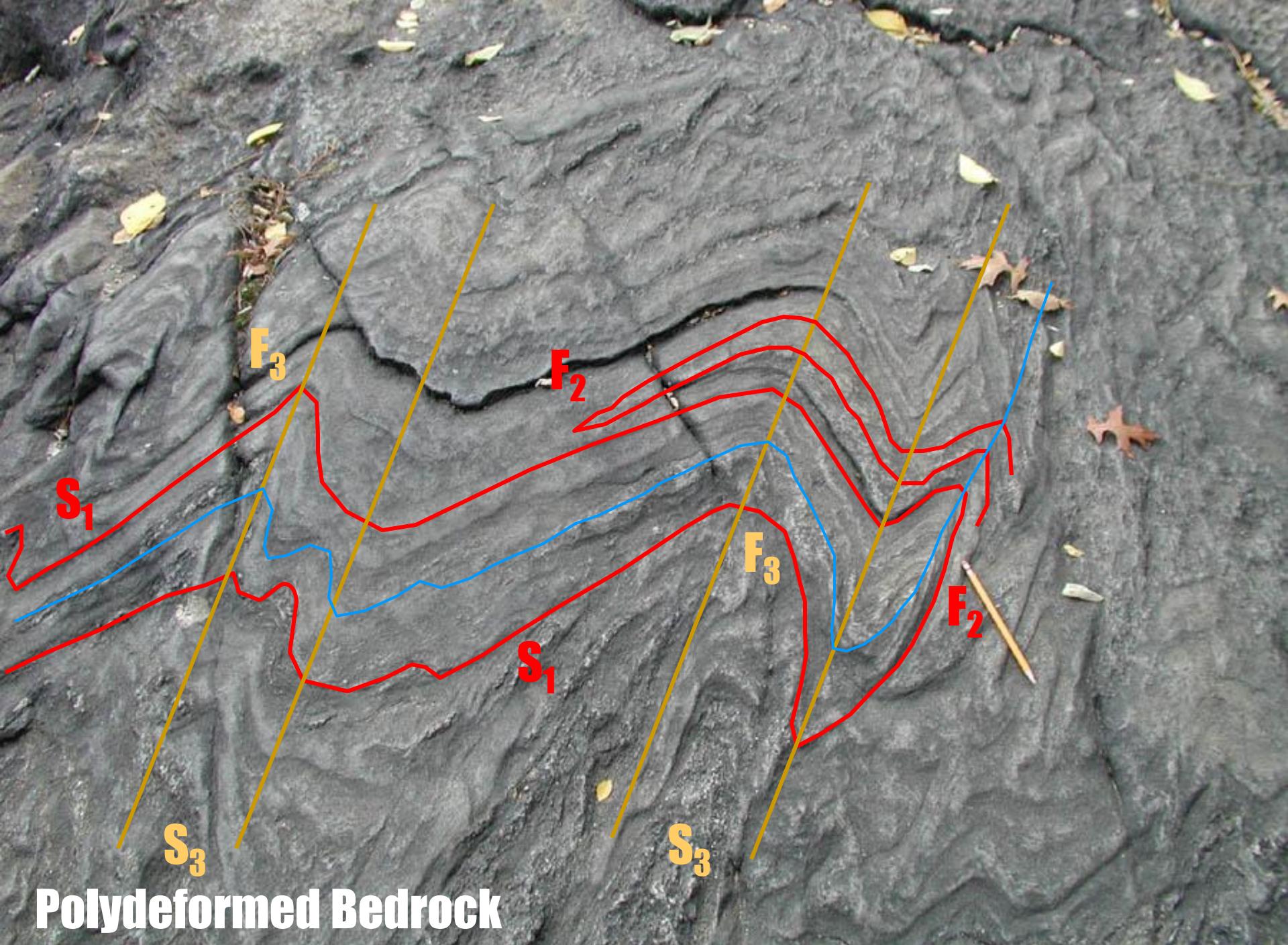
Polydeformed Bedrock

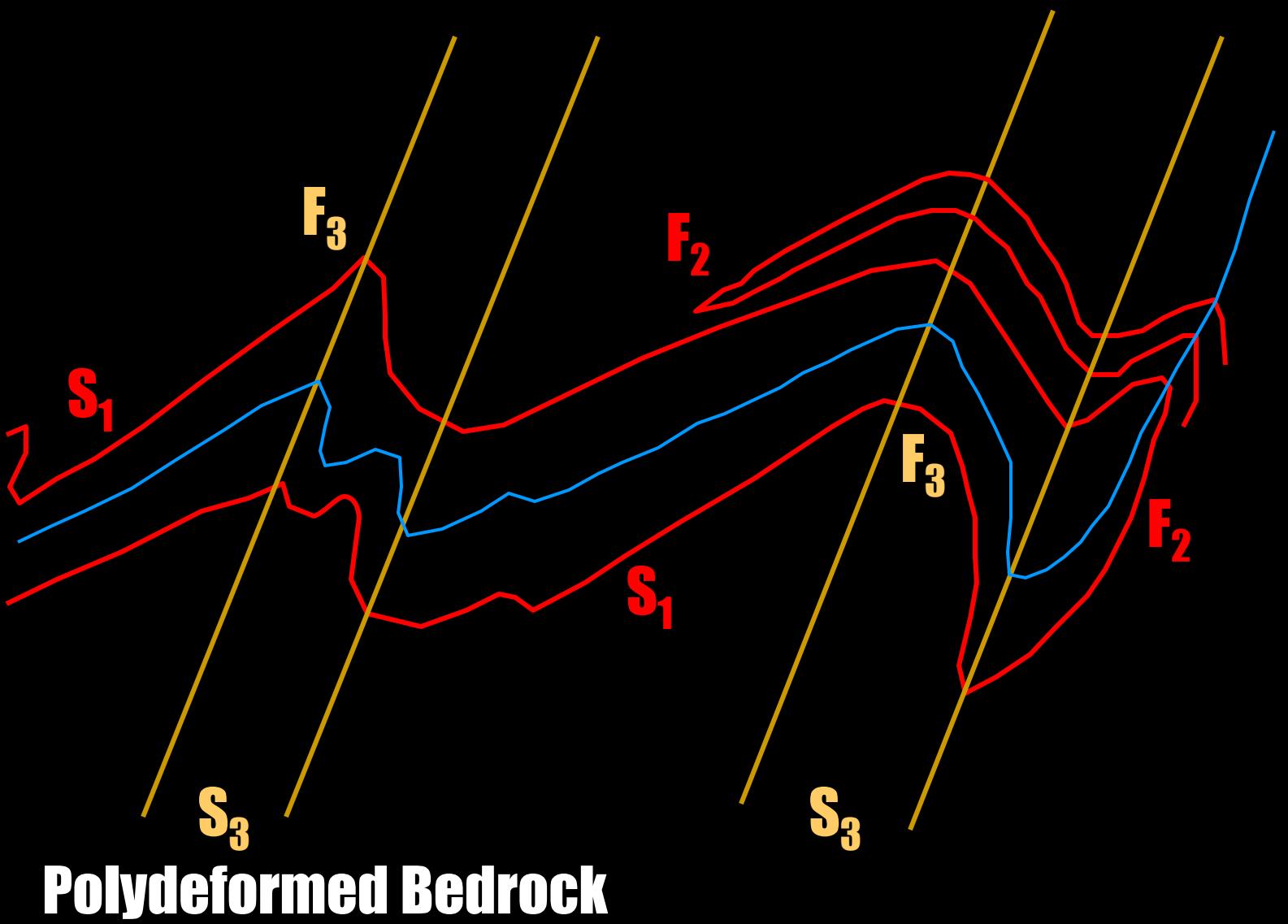


Polydeformed Bedrock

F_3

Polydeformed Bedrock



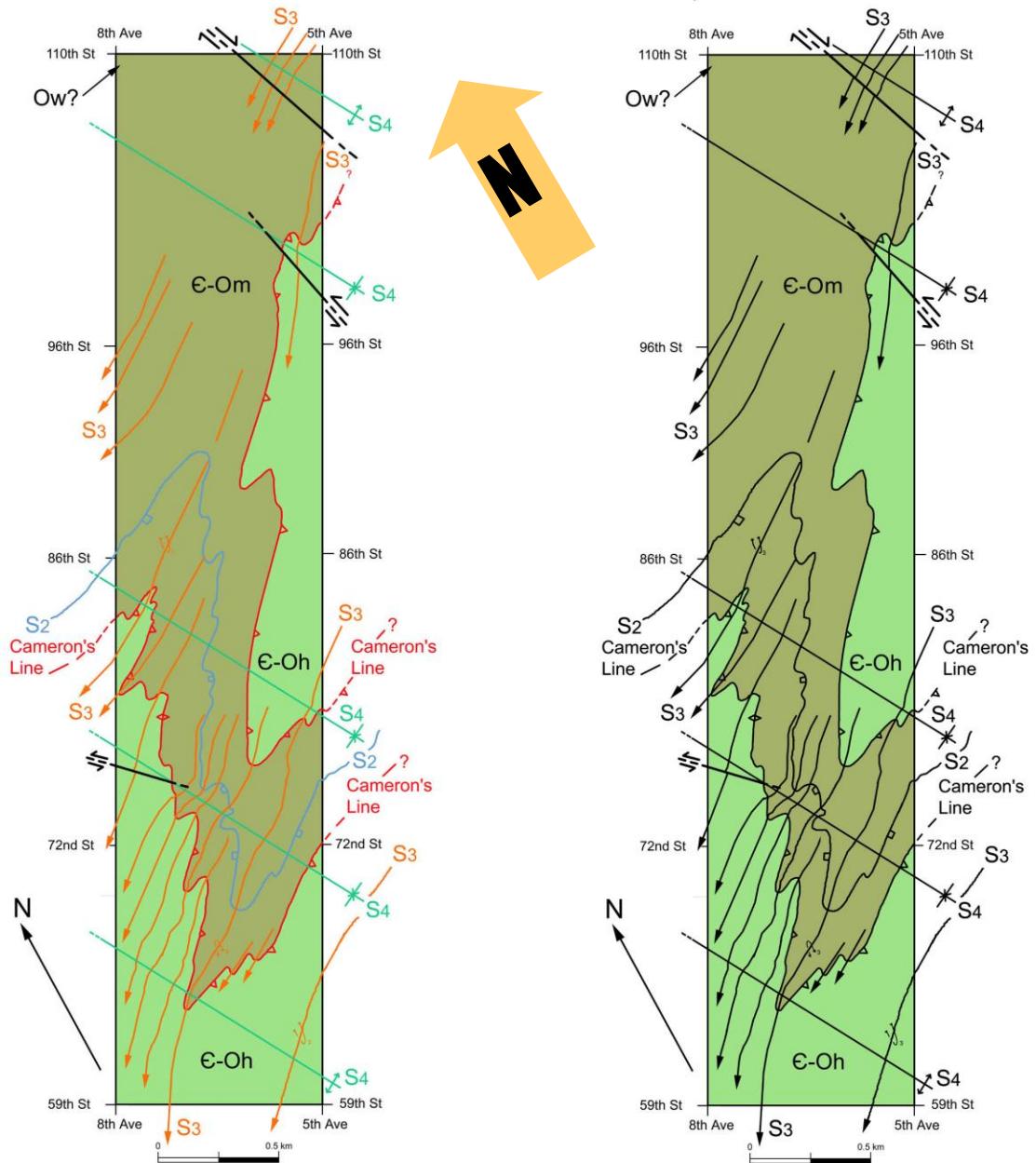




PRELIMINARY GEOLOGICAL MAP OF CENTRAL PARK, NYC

Cameron's Line in Central Park

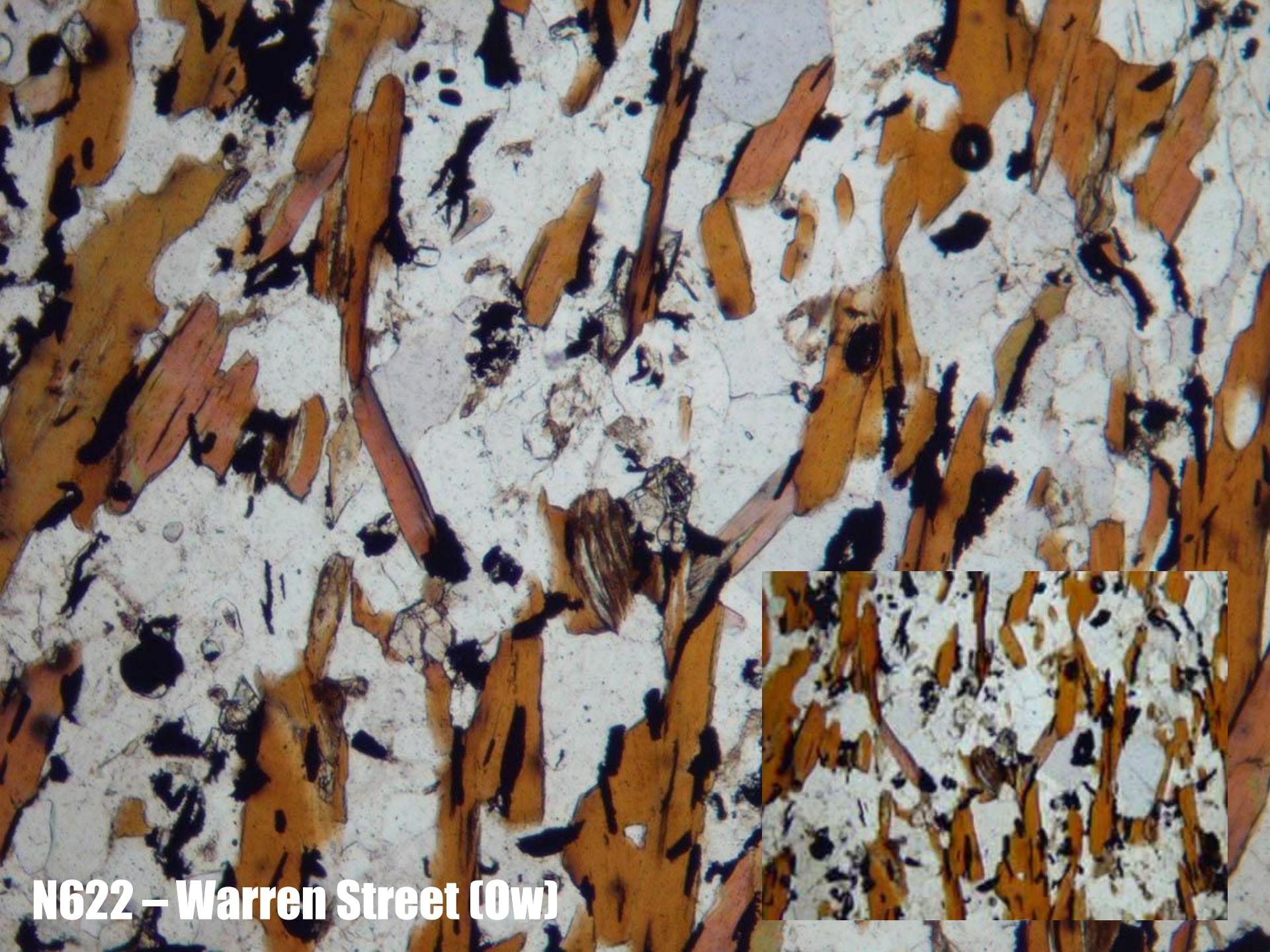
Merguerian and Merguerian,
2004



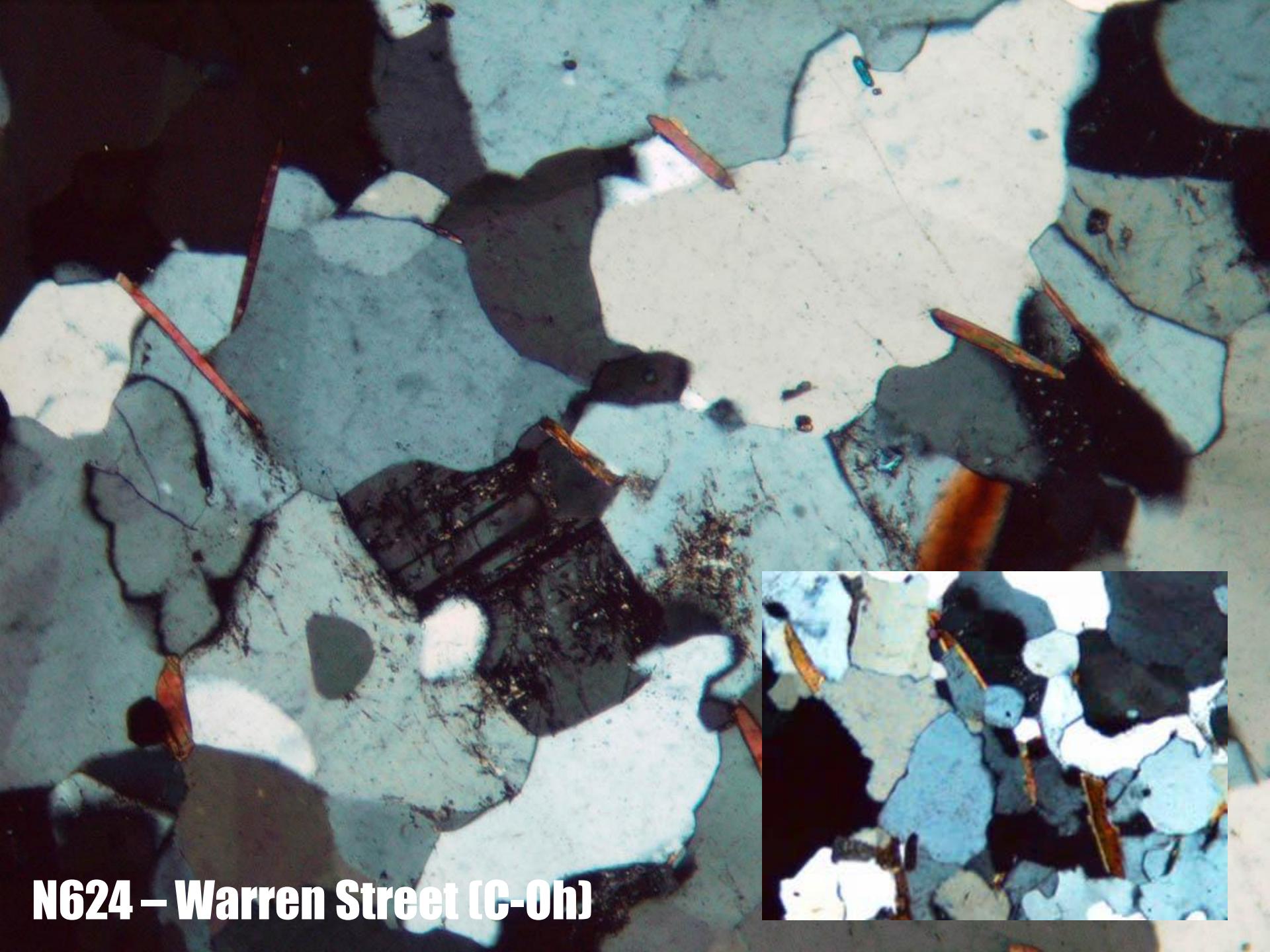
Four Main Localities South of Canal Street

All Display
Sheared
Walloomsac
Rocks

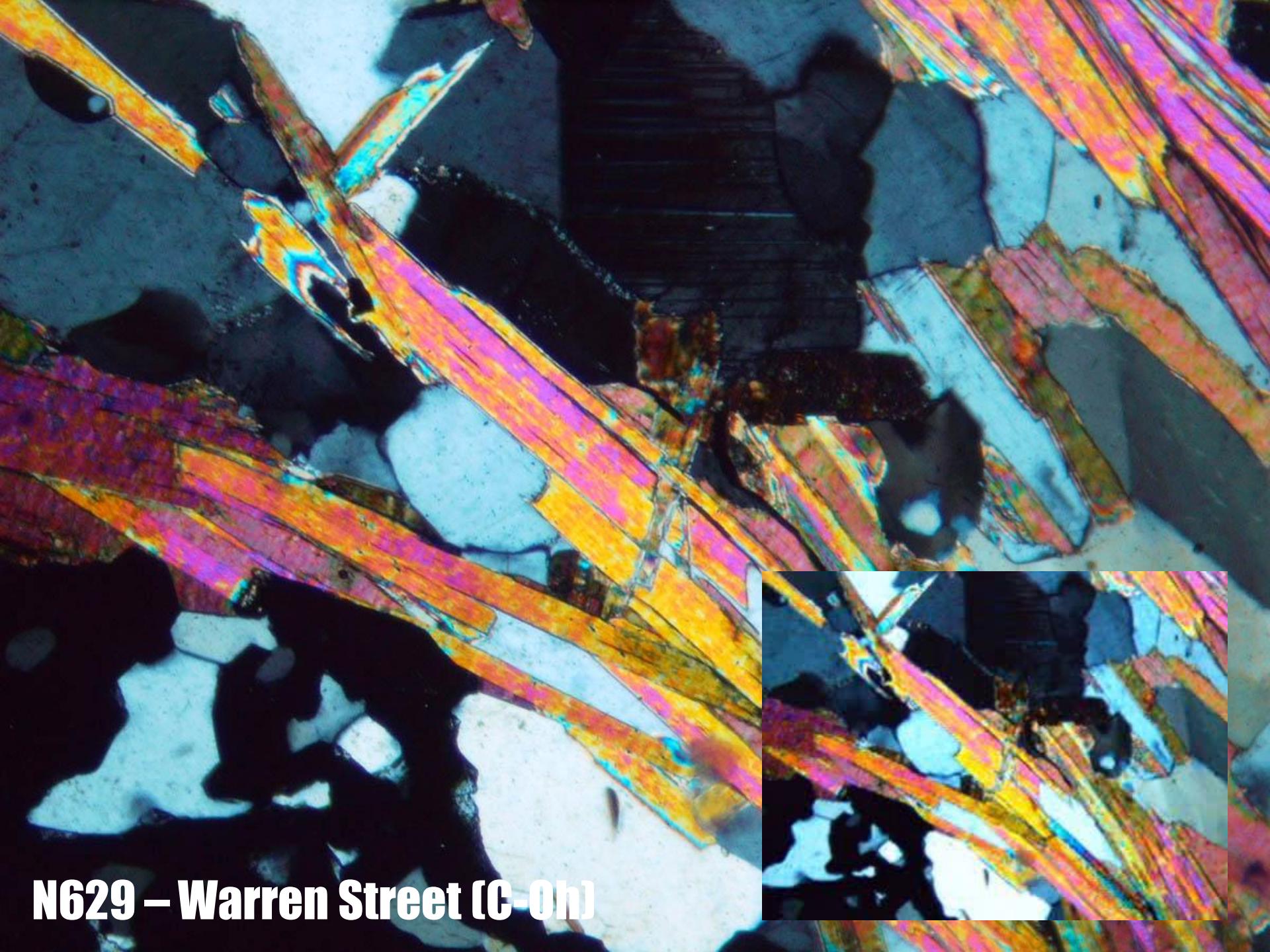




N622 – Warren Street (0w)



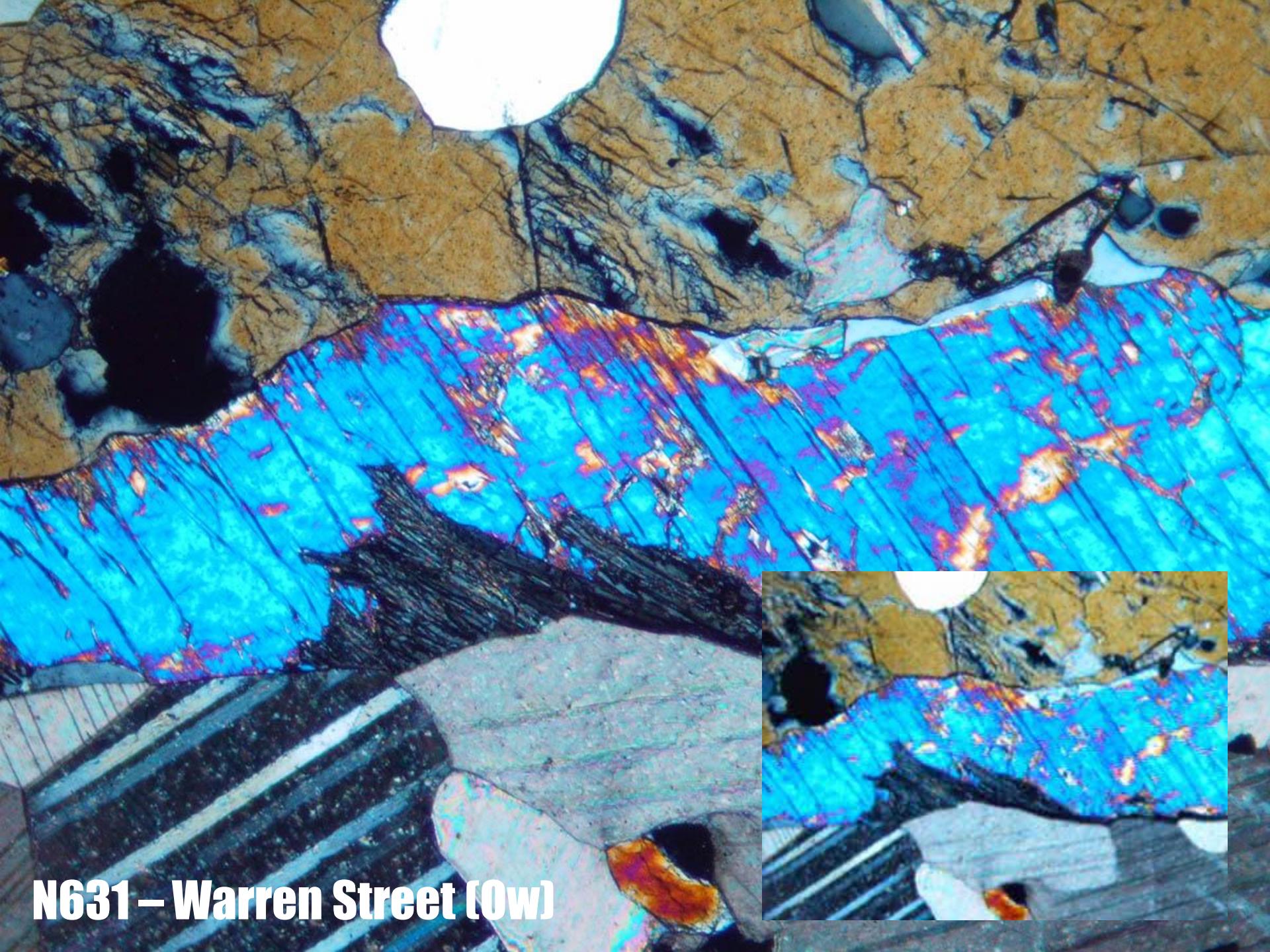
N624 – Warren Street (C-0h)



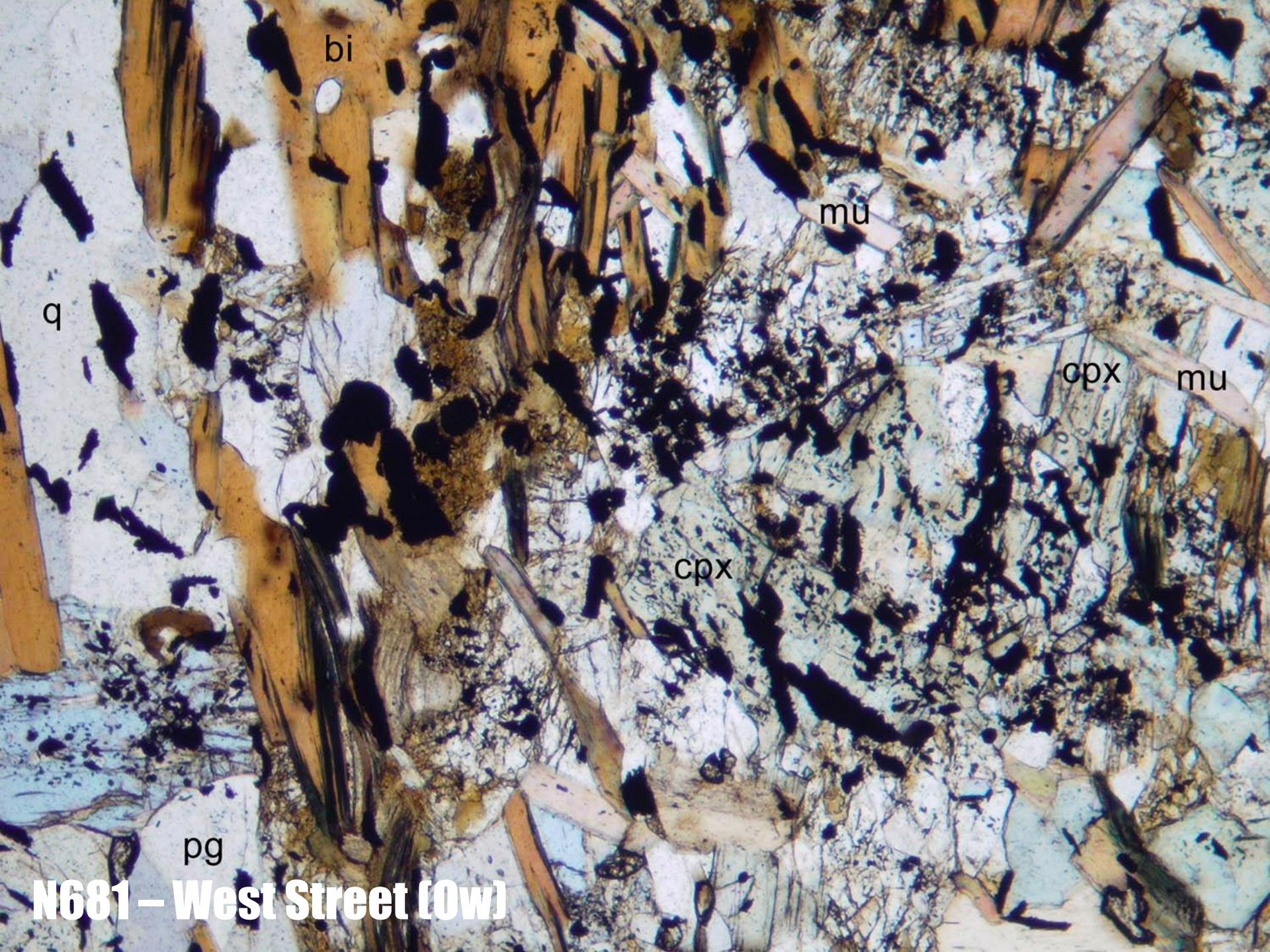
N629 – Warren Street (C-O_h)



N631 – Warren Street (0w)



N631 – Warren Street (0w)

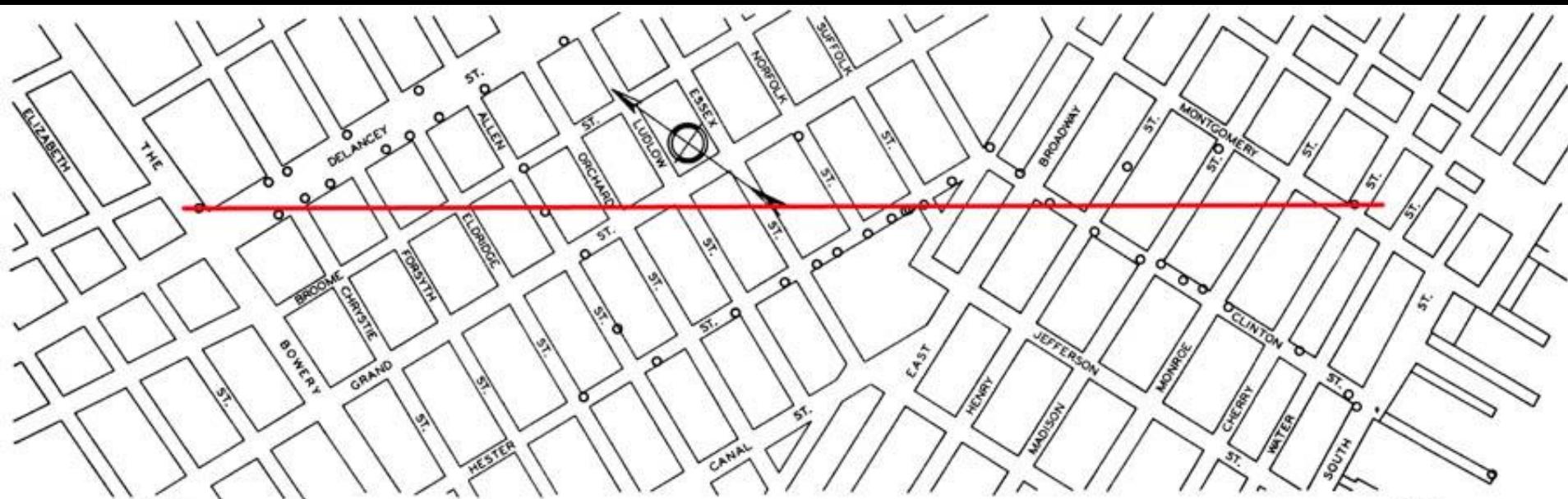


N681 – West Street (0w)



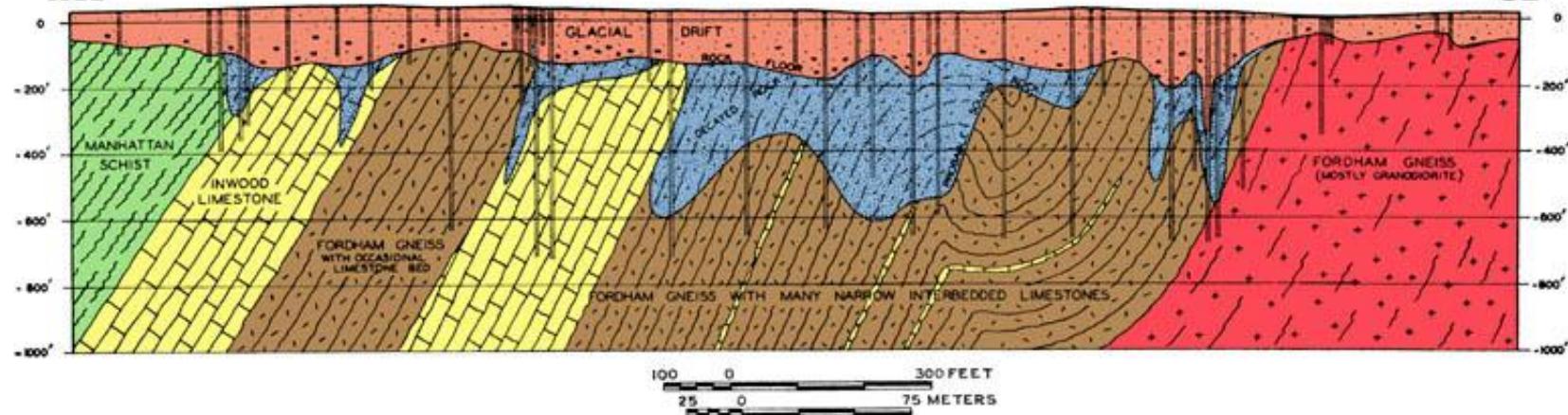
Berkey, 1911

SE Manhattan



NW

SE

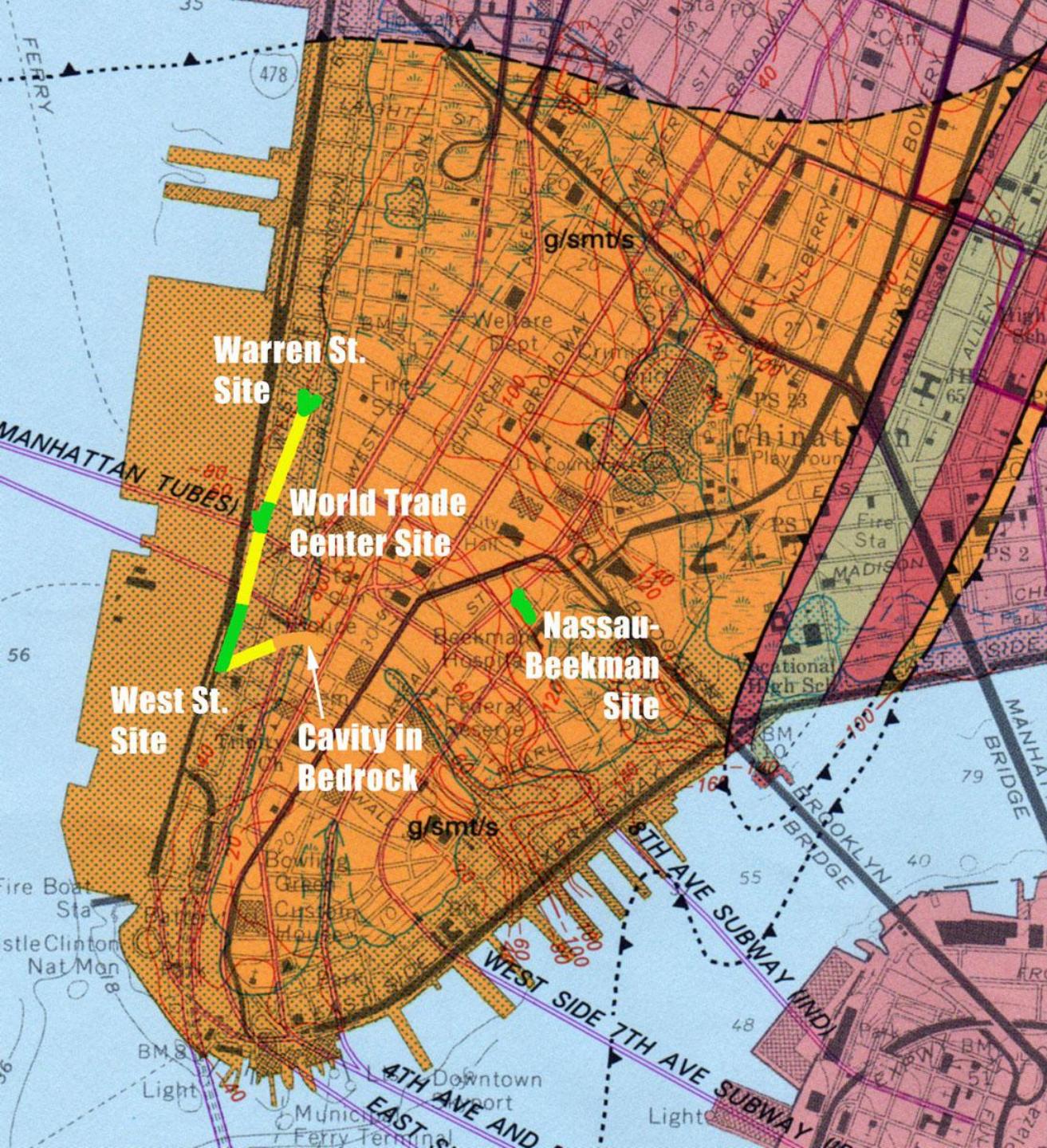


CT 1

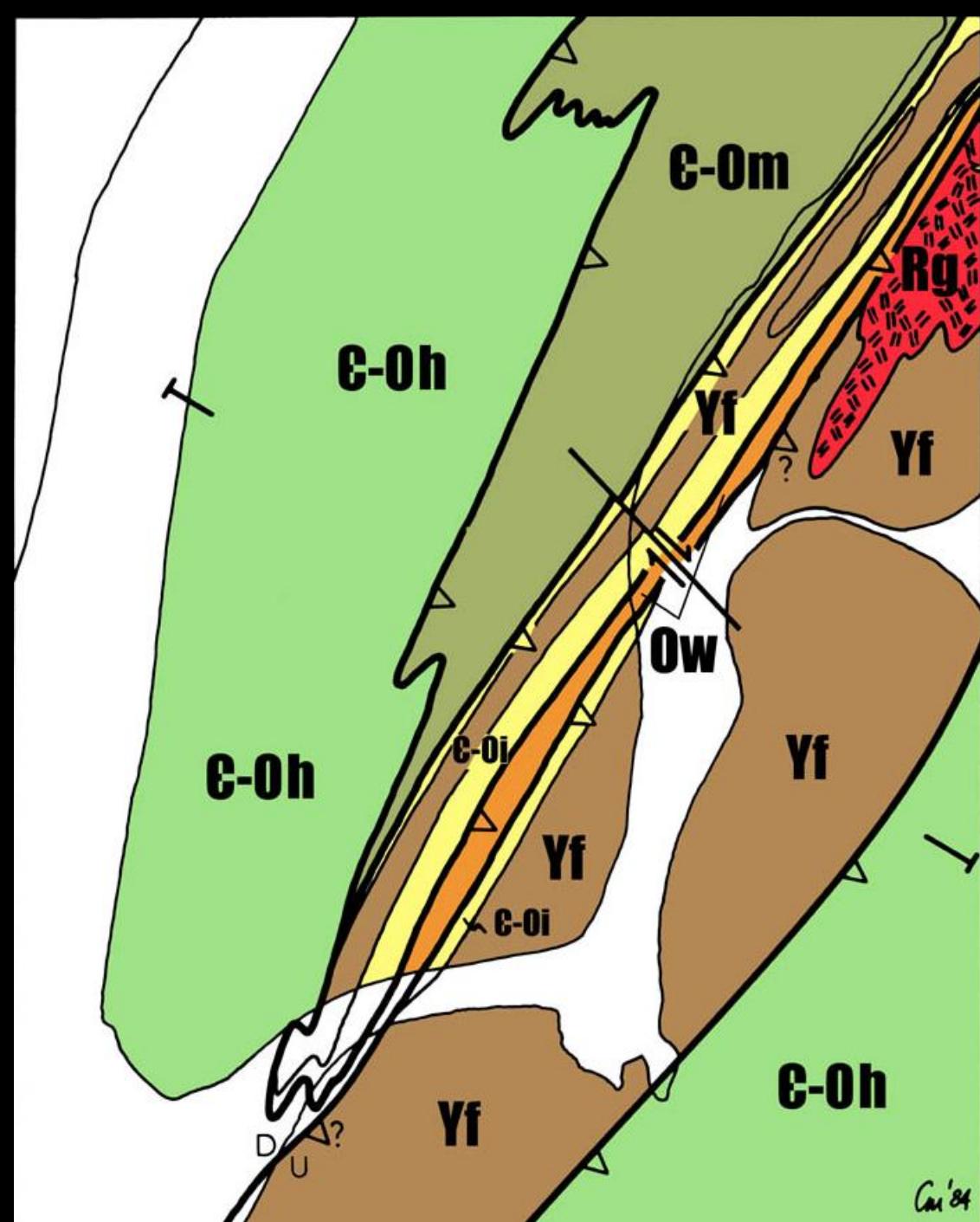
after Berkey, 1911 and 1933

Four Main Localities South of Canal Street

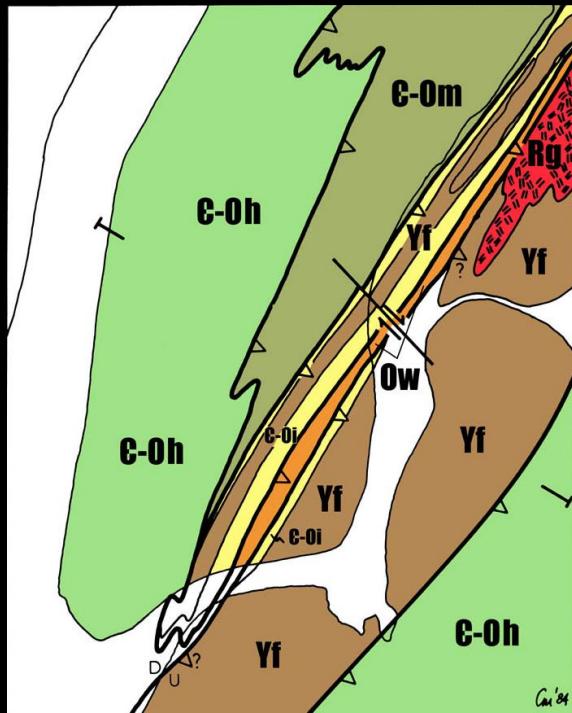
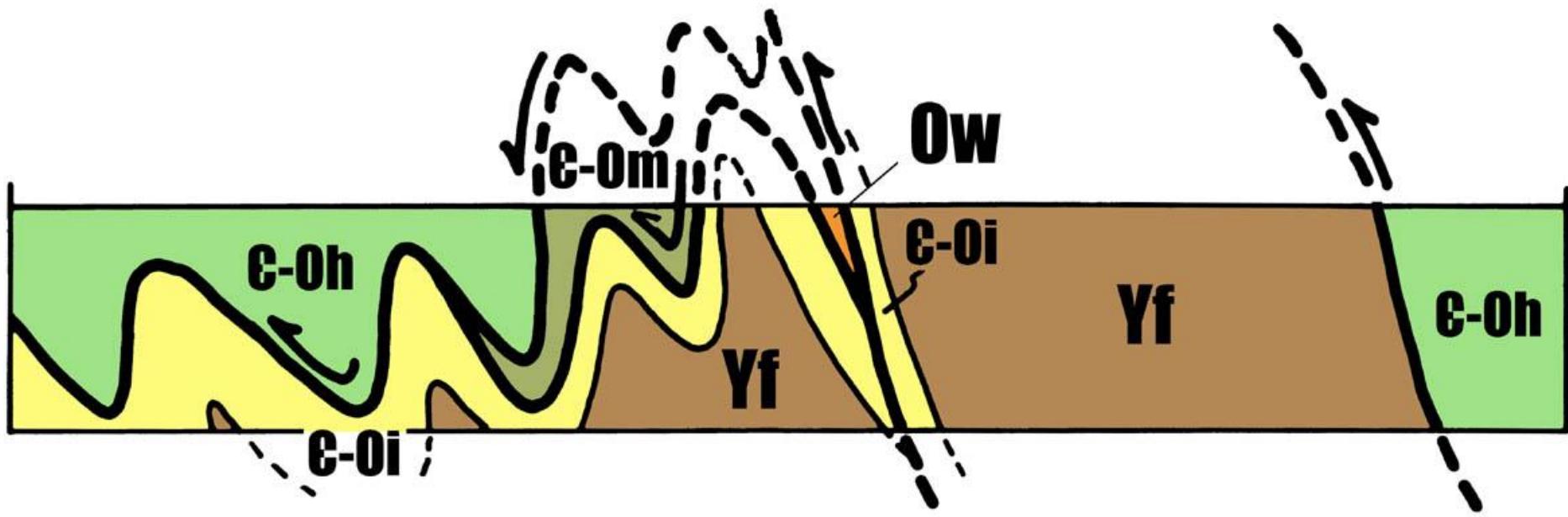
All Display
Sheared
Walloomsac
Rocks



Interpretive Geologic Map of SE Manhattan, Brooklyn, and Queens Based on Borings

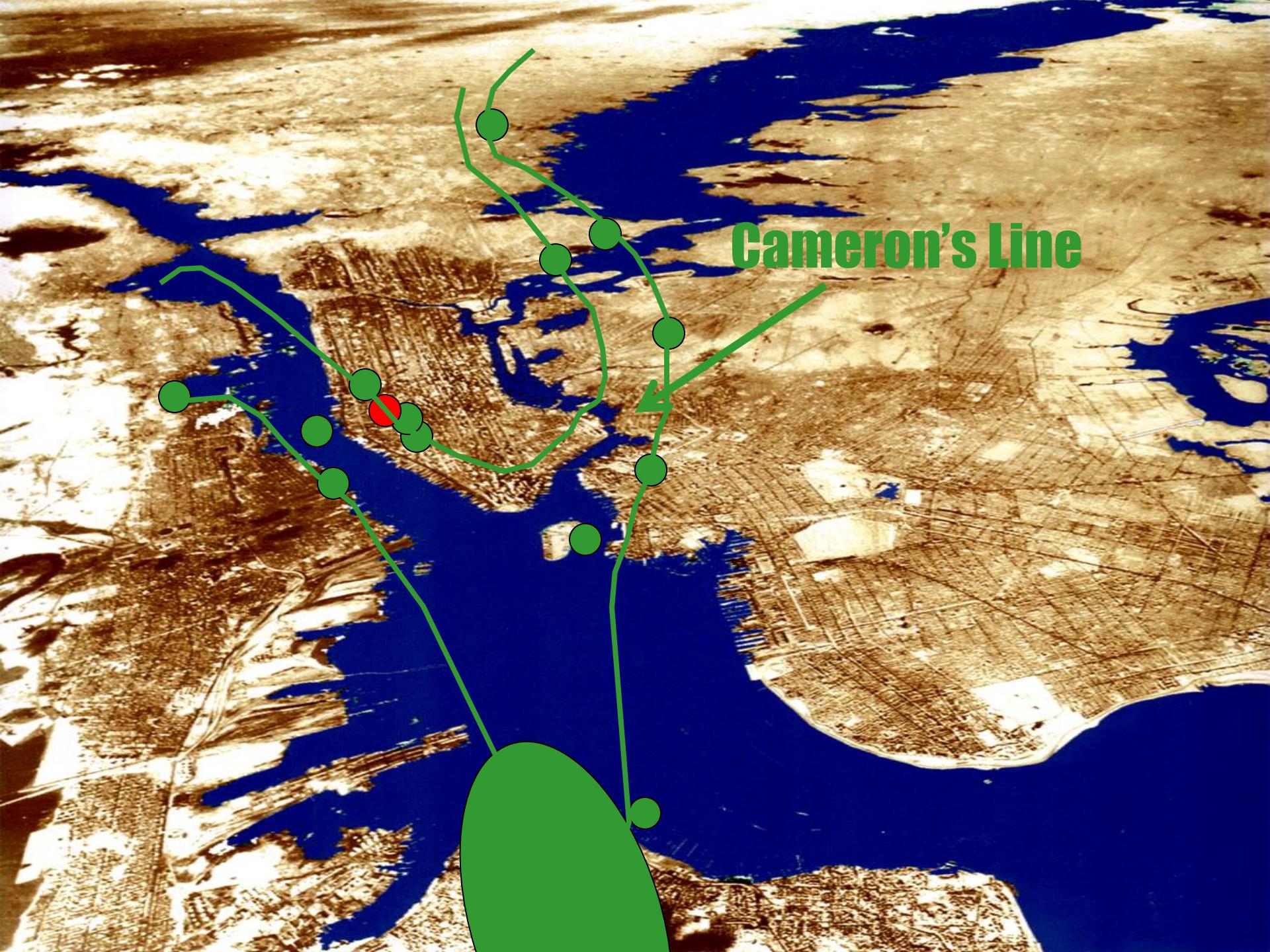


Merguerian, 1984



**Interpretive NW-SE
Geologic Section Based
on Berkey 1910 Boring Data**

Merguerian, 1984



Cameron's Line



Thanks For Coming



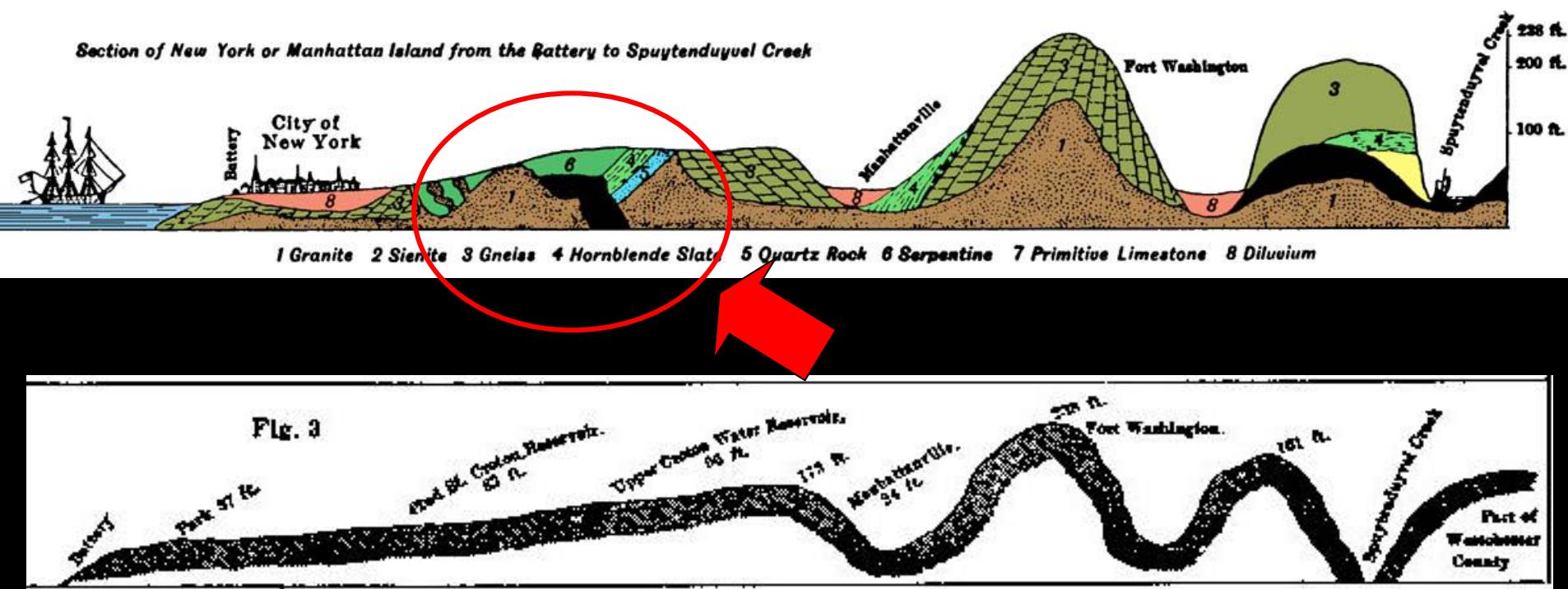
Newly Discovered Ophiolite Scrap in the Hartland Formation of Midtown Manhattan

Charles Merguerian
Geology Department
Hofstra University

Cheryl J. Moss
Mueser-Rutledge
Consulting Engineers

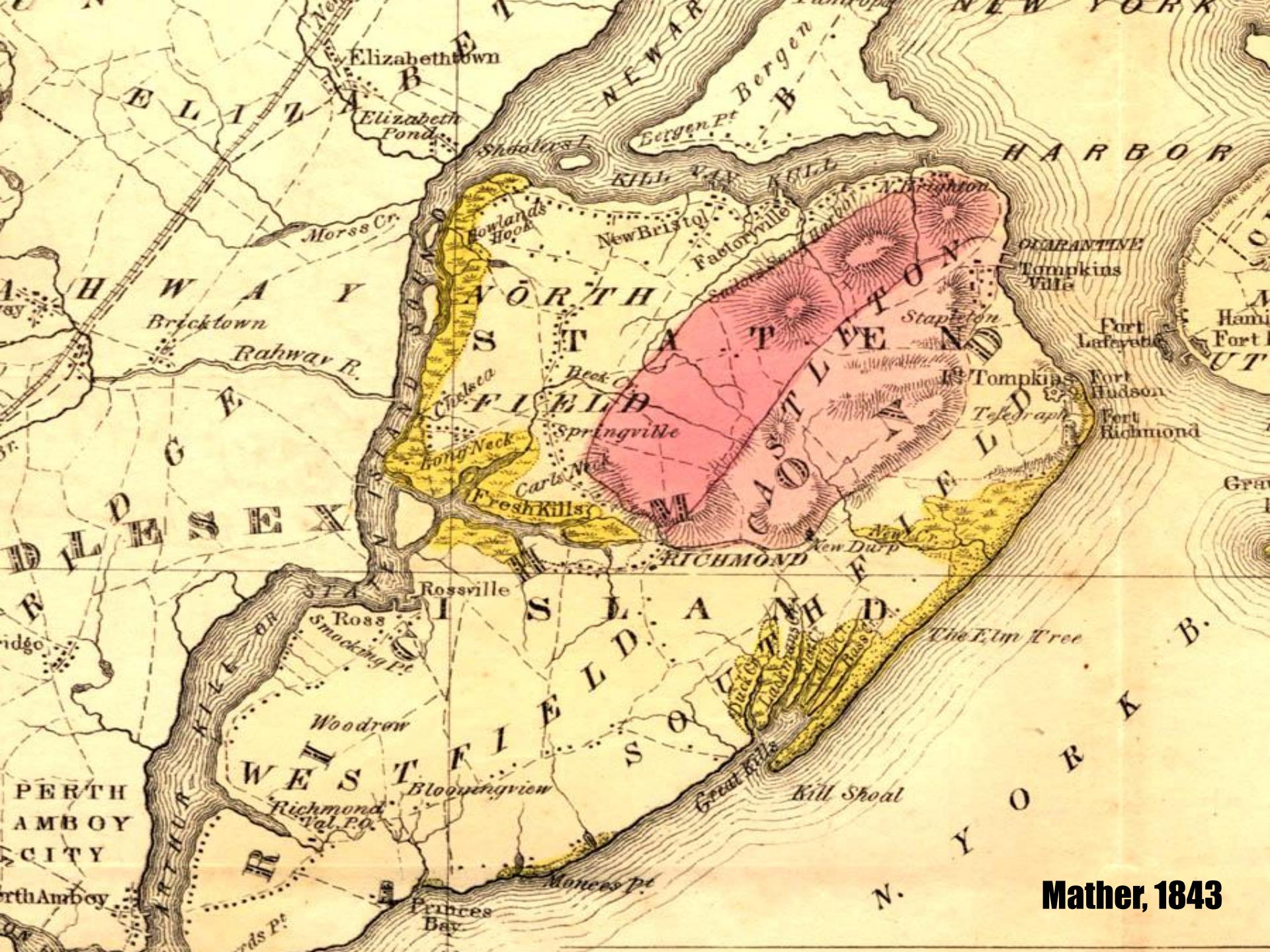


Manhattan Island Serpentinite at 59th Street



Also Discussed by Gratacap (1887) and Merrill et al (1902)

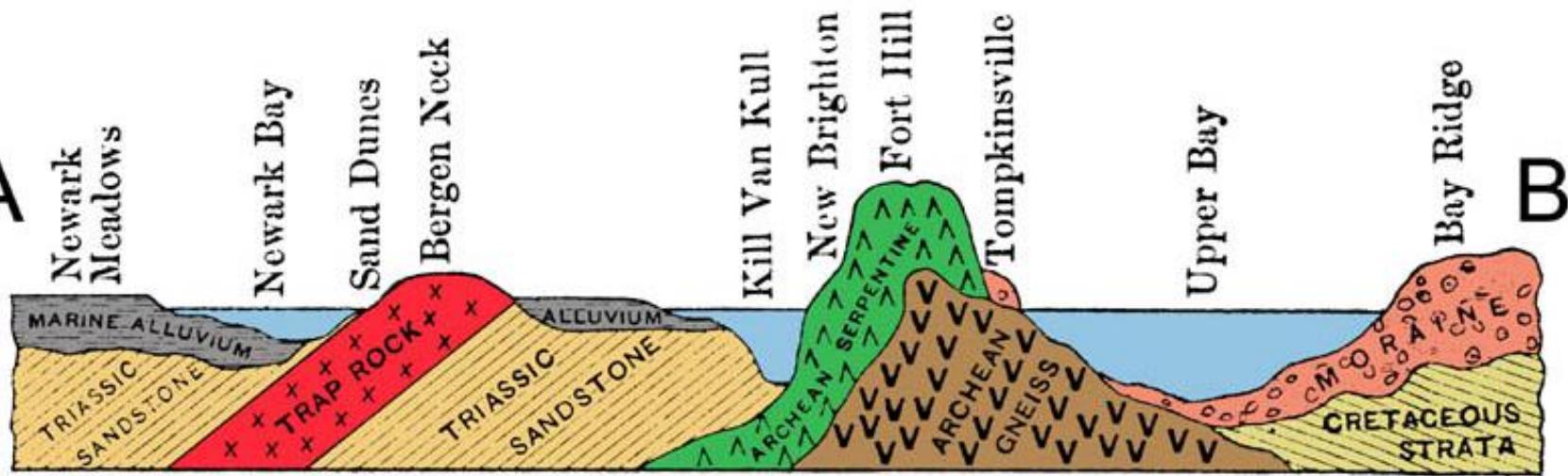
after Cozzens, 1843



Mather, 1843

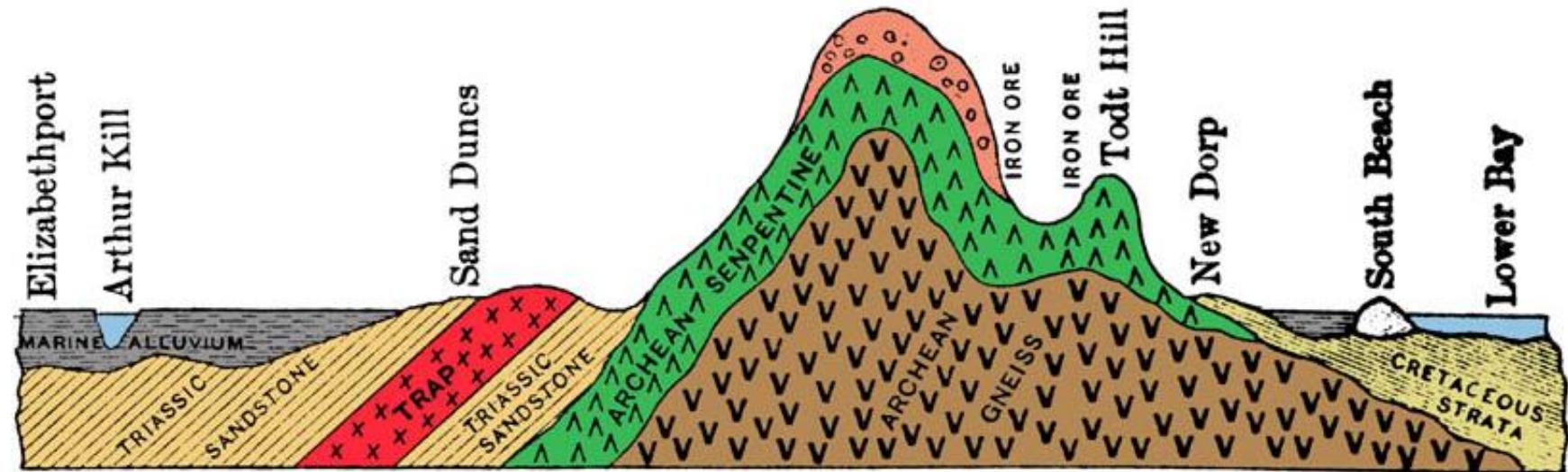
Staten Island Serpentinite

A



B

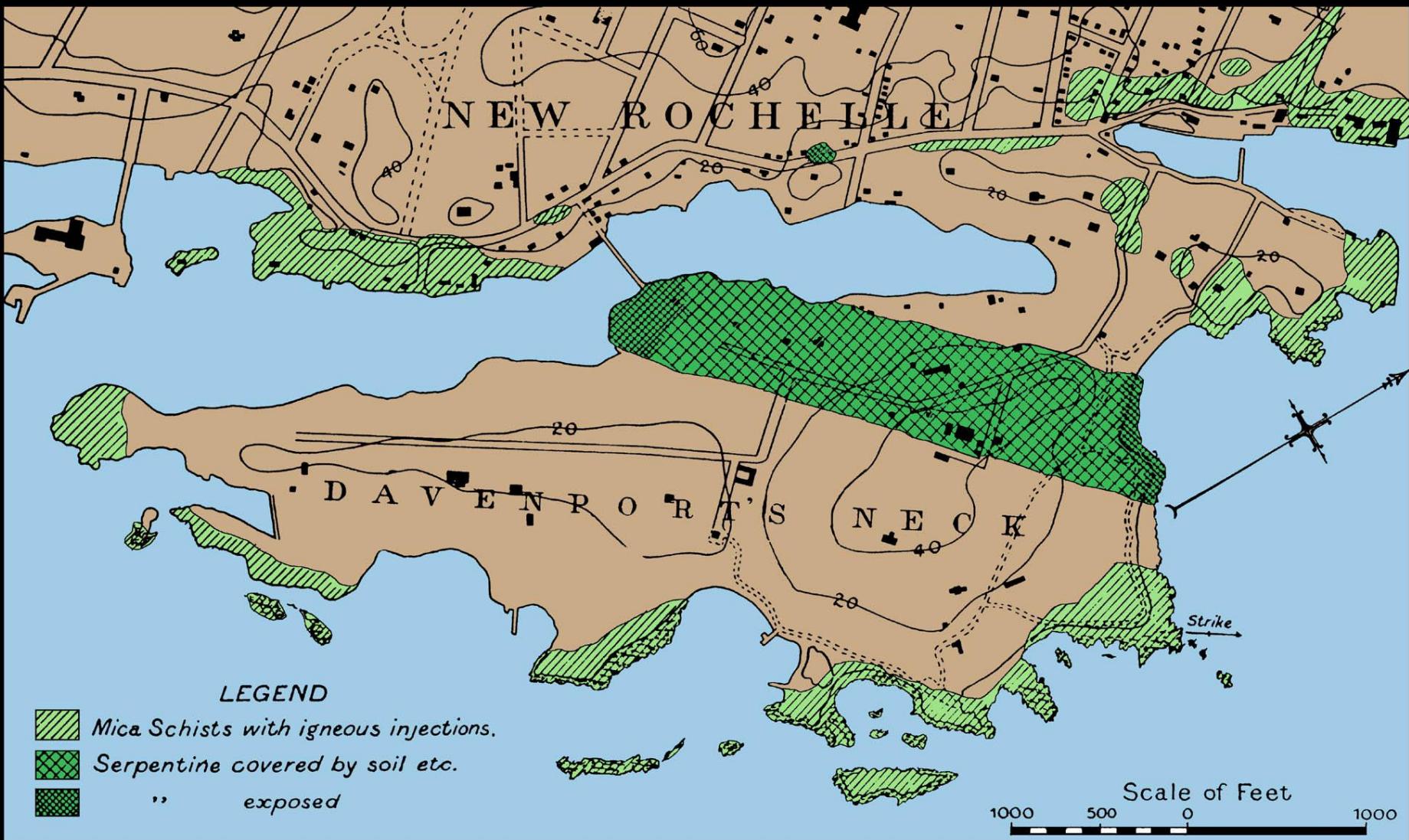
C



D

after Britton, 1881

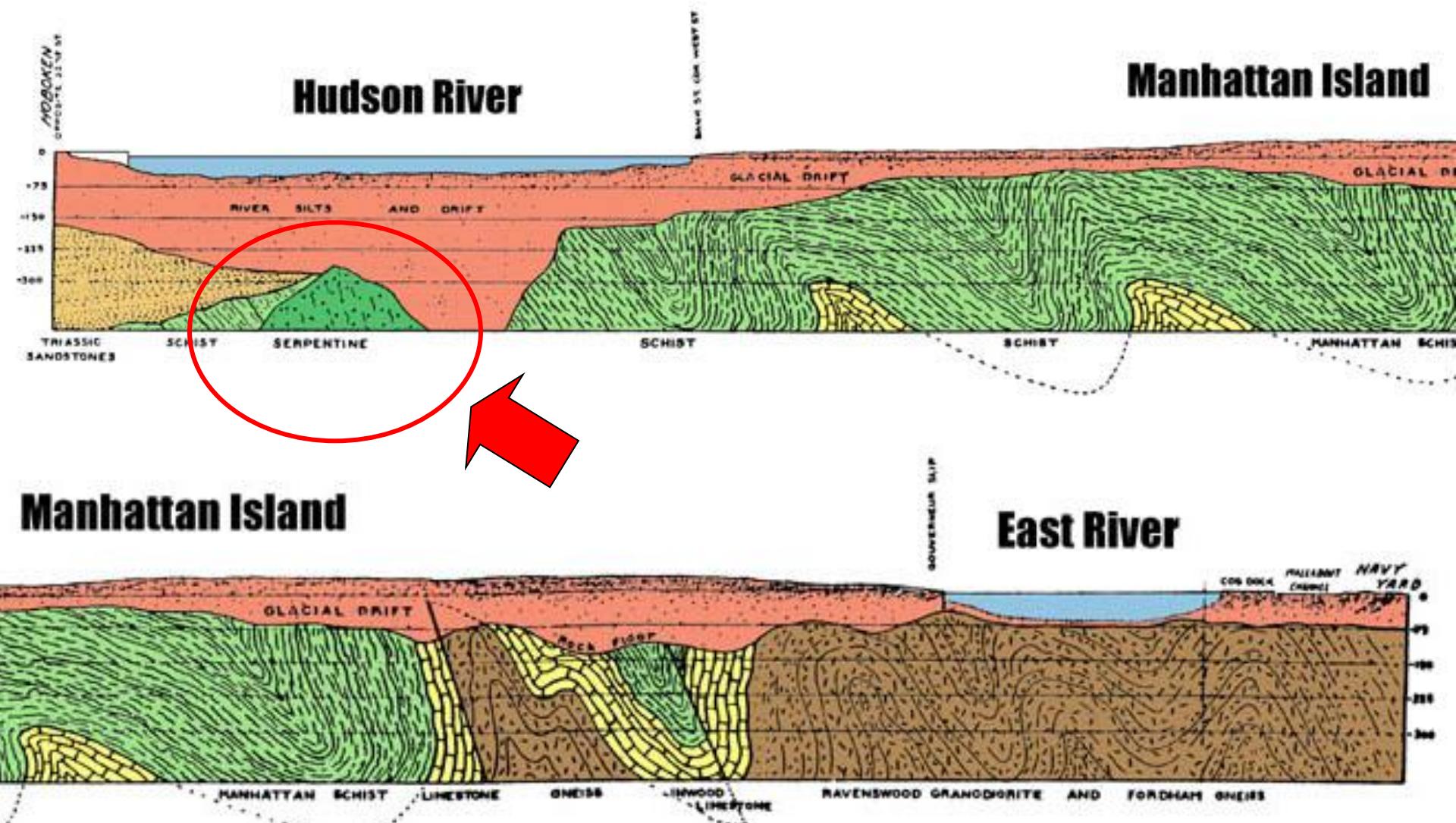
Davenport Neck Serpentinite



Similar in Size and Setting to Rye Body!

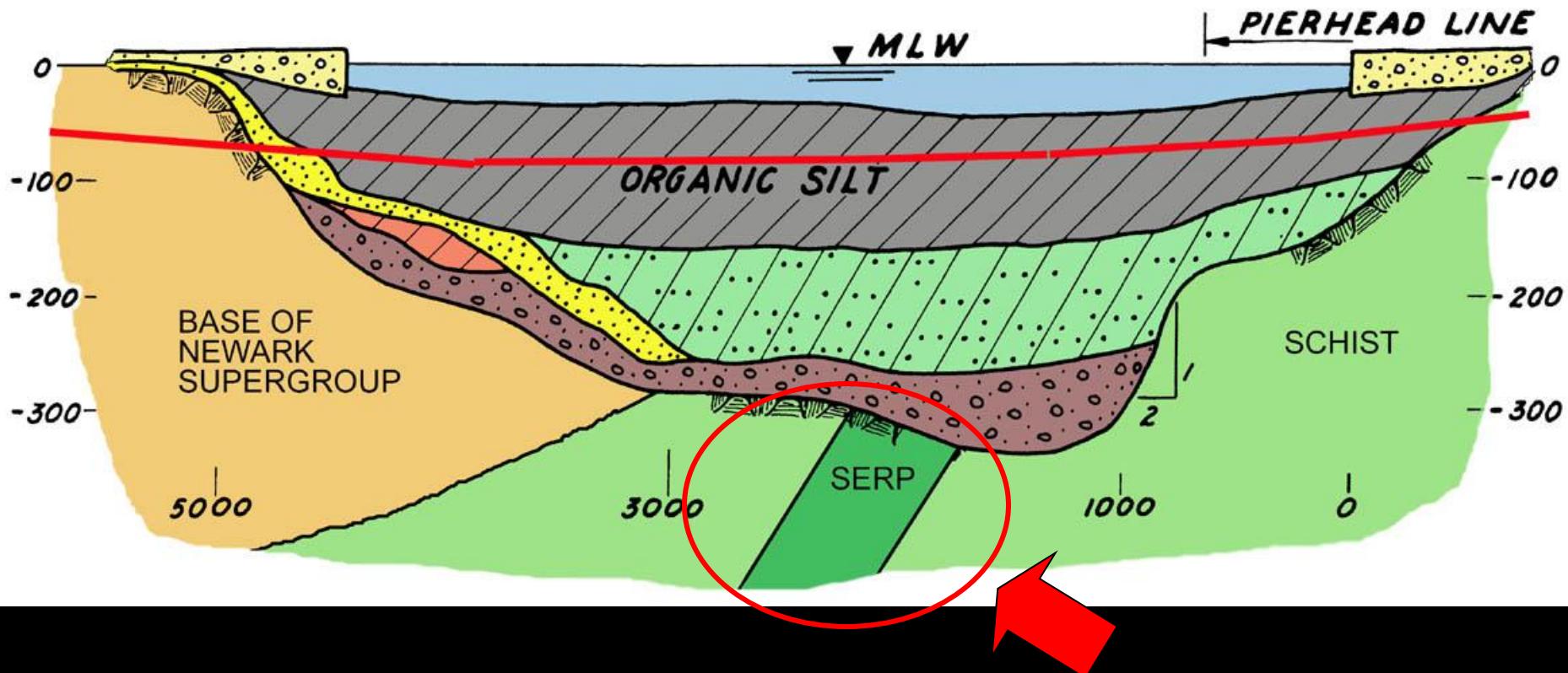
Merrill, 1898

Hudson River - Hoboken NJ Serpentinite



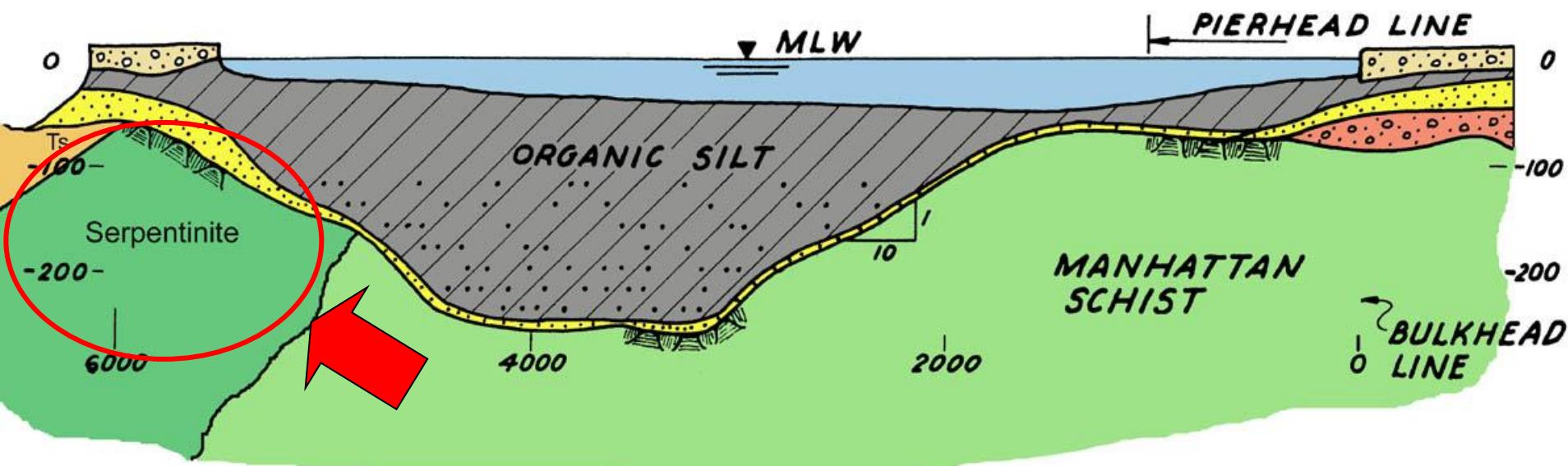
after Berkey, 1910

Pennsylvania Railroad Serpentinite Hudson Crossing at 34th Street



Base diagram after Mueser-Rutledge Consultants
after Berkey 1910, 1933

Holland Tunnel Serpentinite



Base diagram after Mueser-Rutledge Consultants
Some data from Worzel and Drake (1959)

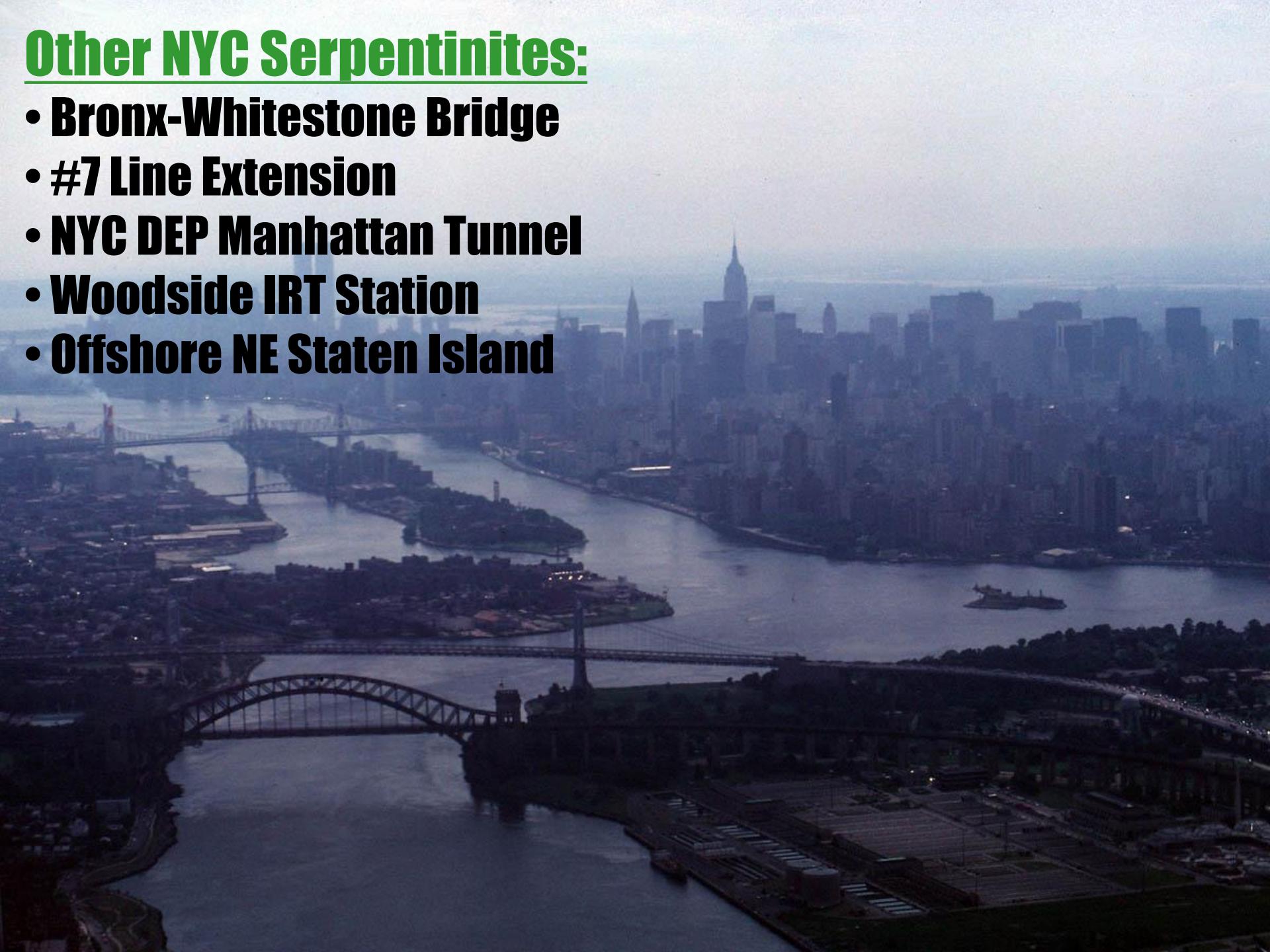
Brooklyn Tunnel Serpentinite Zone



Brooklyn Tunnel – Sta. 128+30

Other NYC Serpentinites:

- Bronx-Whitestone Bridge
- #7 Line Extension
- NYC DEP Manhattan Tunnel
- Woodside IRT Station
- Offshore NE Staten Island



1 Bryant Park Serpentinite



December 2004



First Look

Excavation Continues - Zoned Ellipsoidal Mass



Serpentinite Core

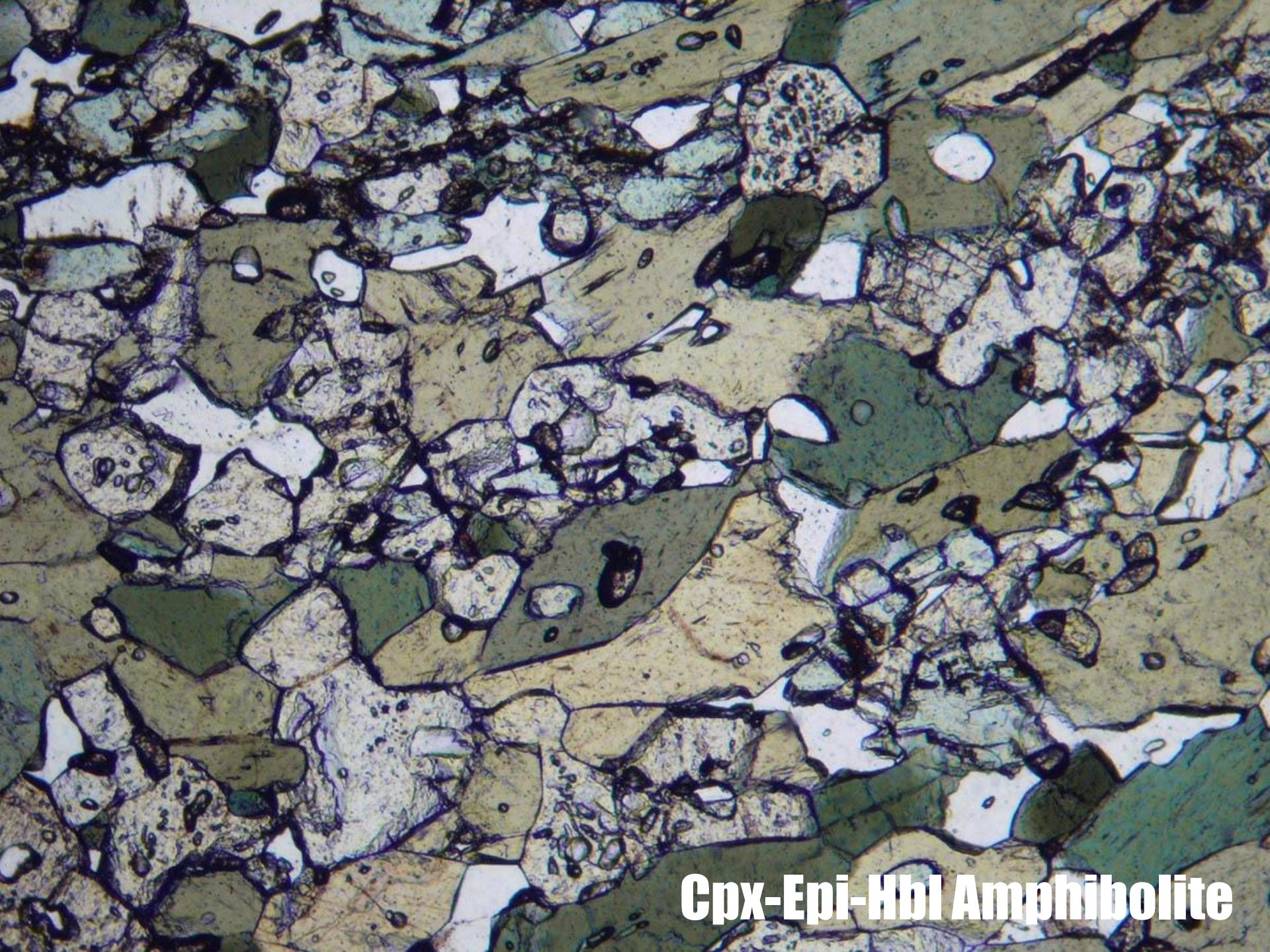




Talc-Chlorite-Biotite Shear Envelope

Sheared Western Margin Gently Plunging Slicks

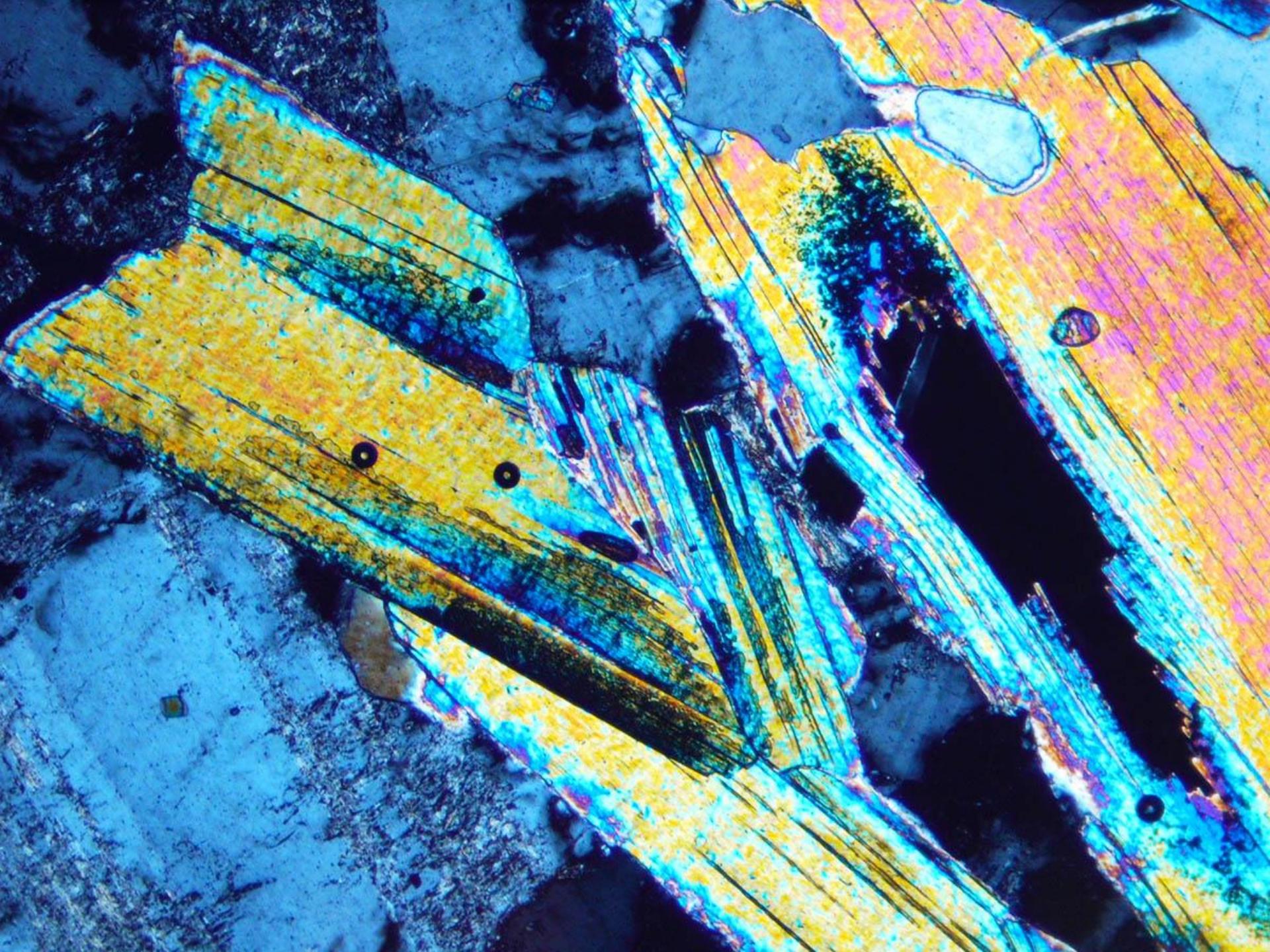


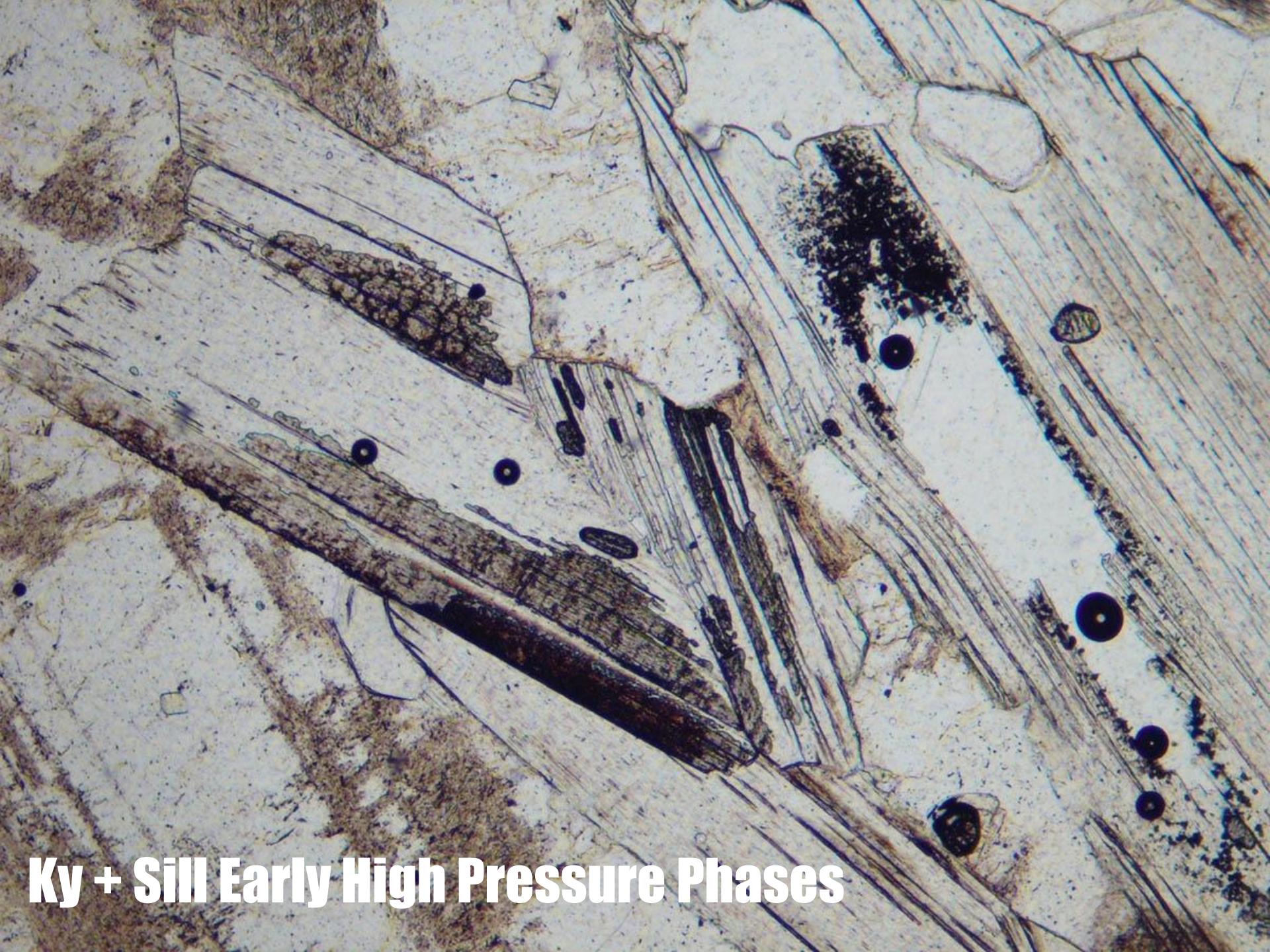


Cpx-Epi-Hbl Amphibolite



Grades Outward to Pelitic Schist





Ky + Sill Early High Pressure Phases



Last Look

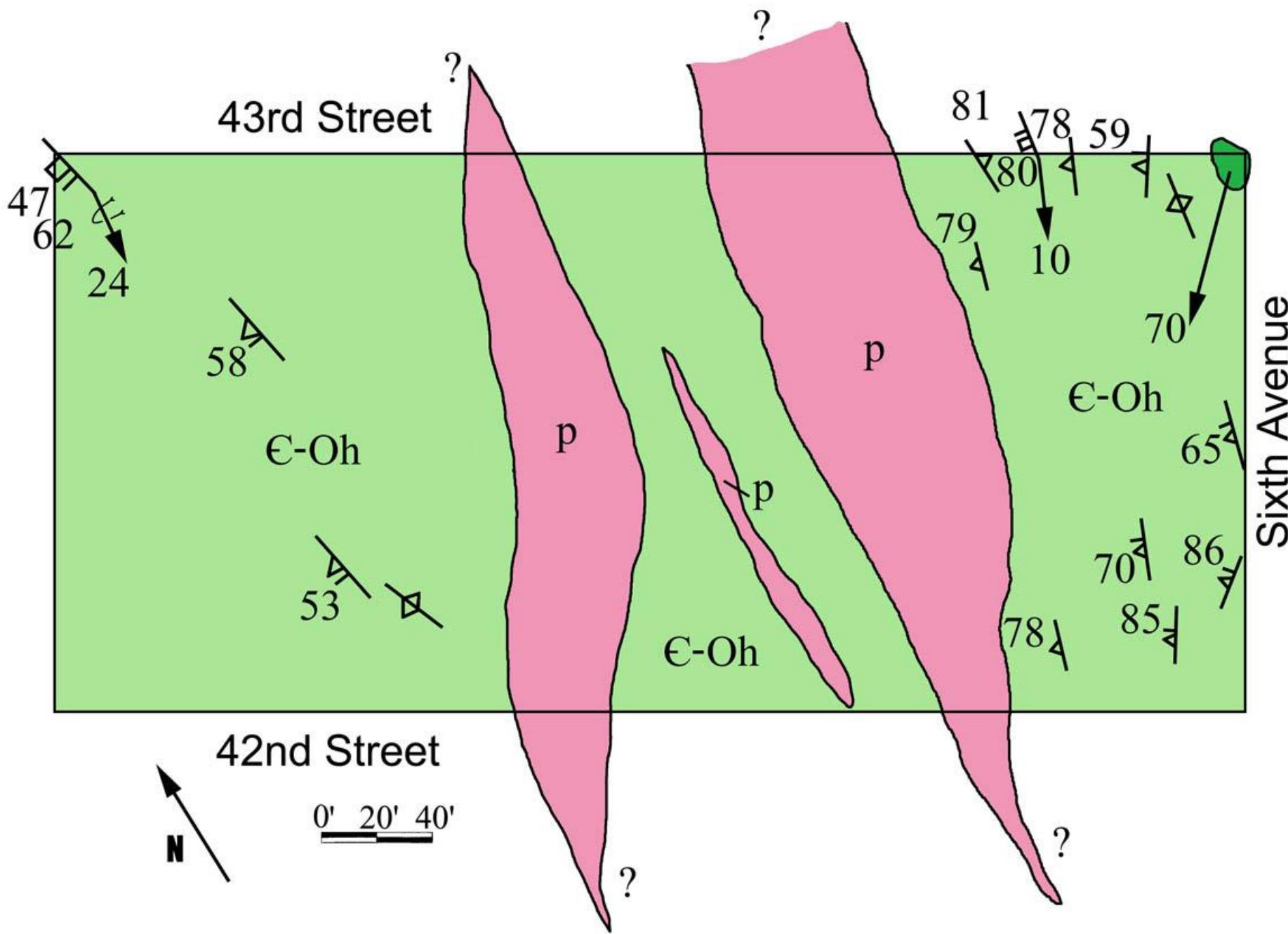
**Cigar-Shaped
Mass with
Steep Plunge
Southward**

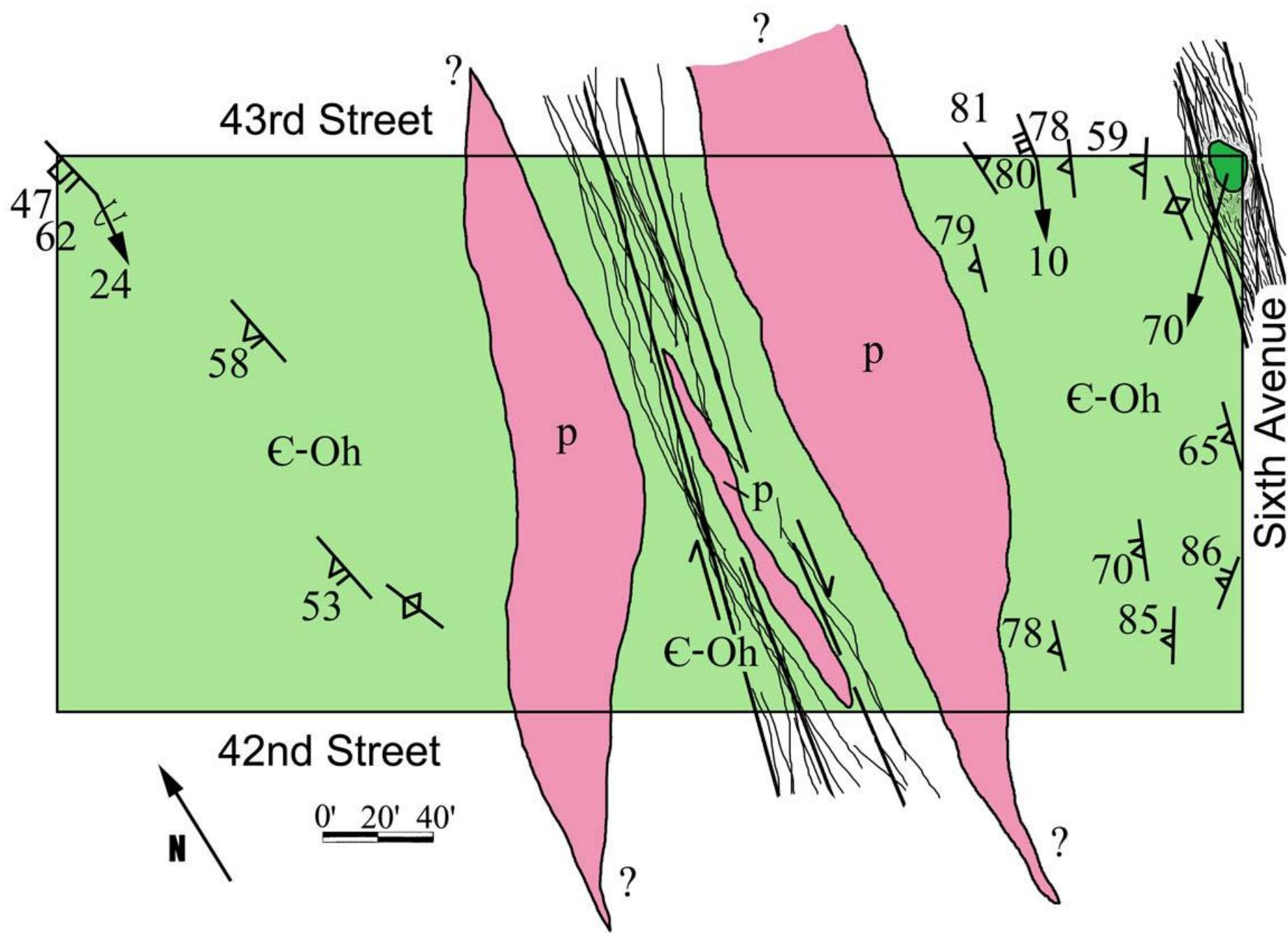
**Base Not
Exposed**

**>10 m Long
Dimension**

70°





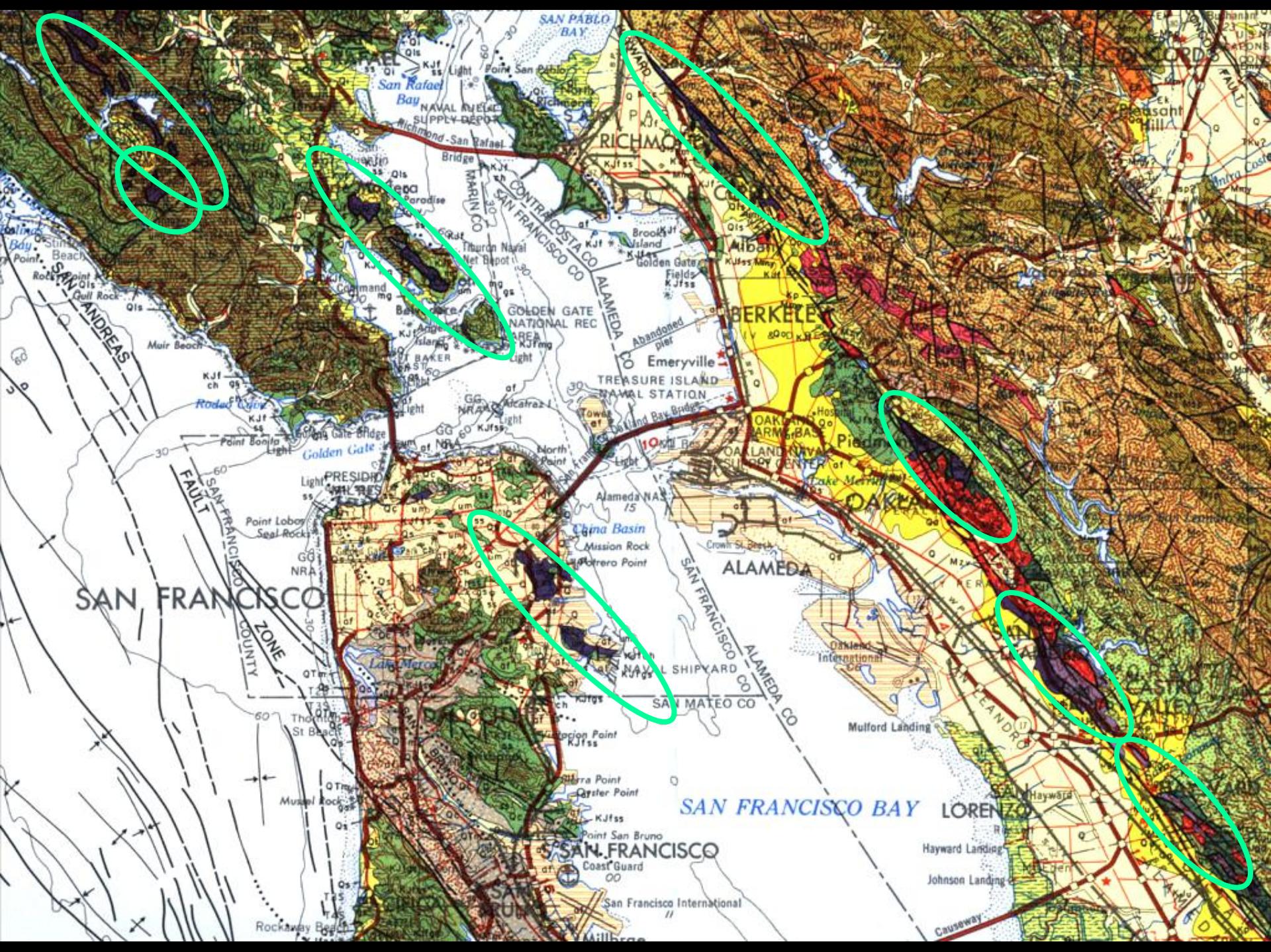


California Coast Ranges

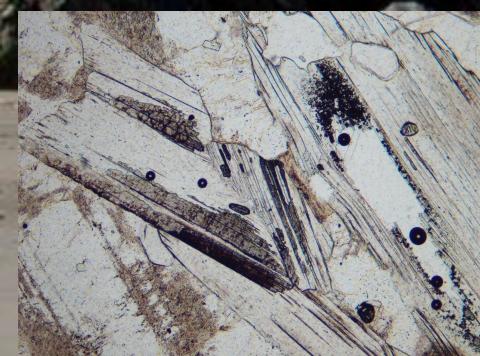


Knockers





Franciscan Complex



Serpentinite



24 May 2004

Taconic Arc – Passive Margin Collision

