Structural Geology and Metamorphism of the Inwood Marble, NYC, NY

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Harlem River Tunnel - 2009

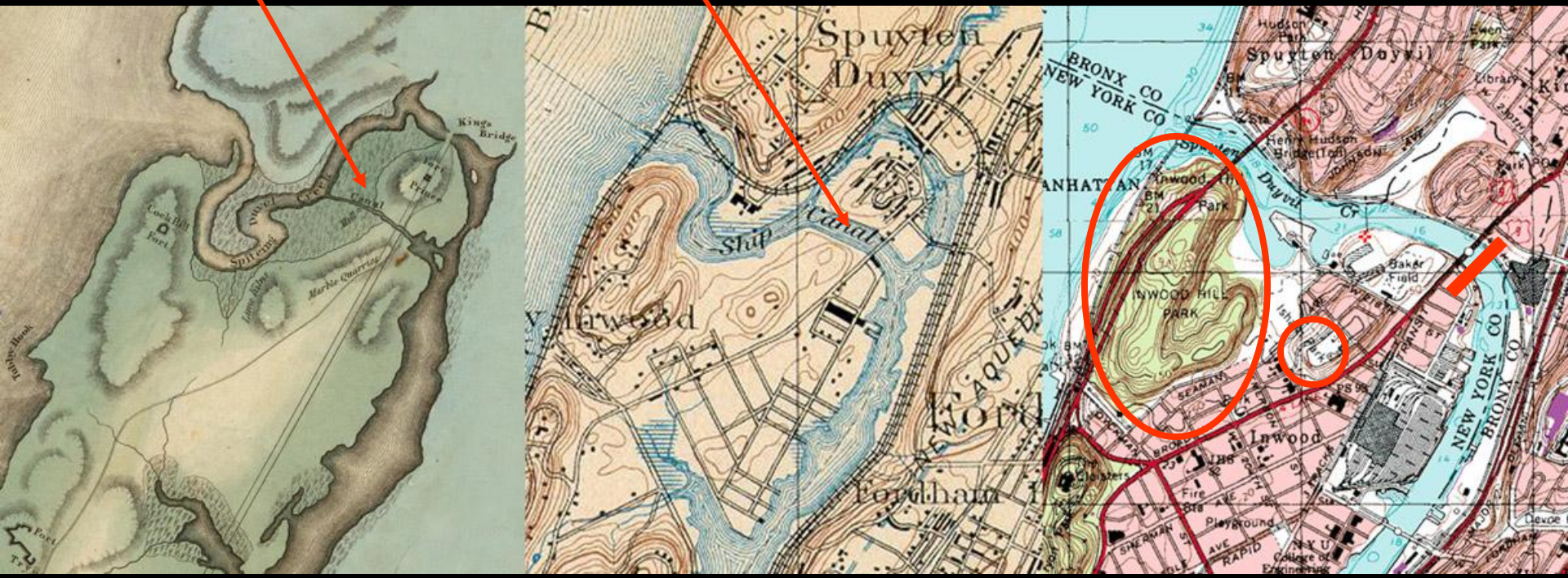
Mather 1843

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

Mather 1843

Bolton Canal

Harlem Ship Canal



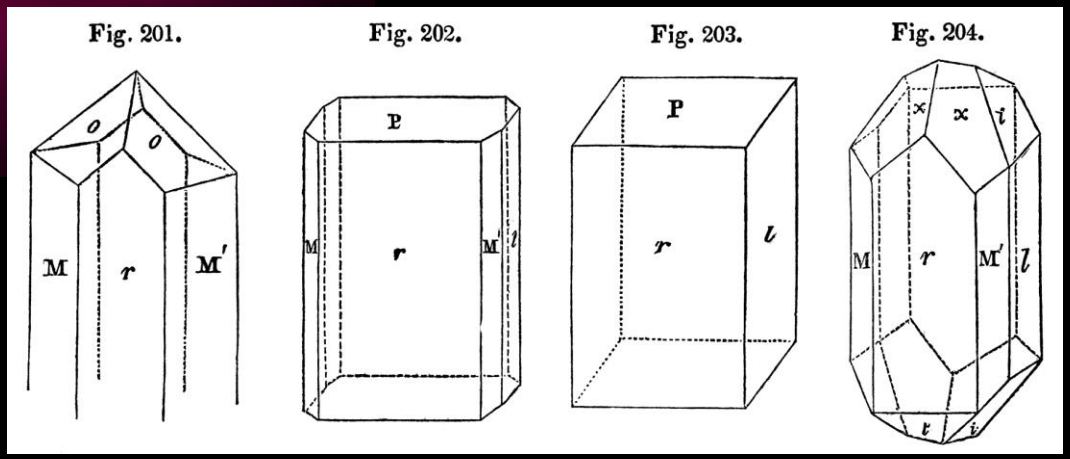
1832 1897 1979

Betts 2009

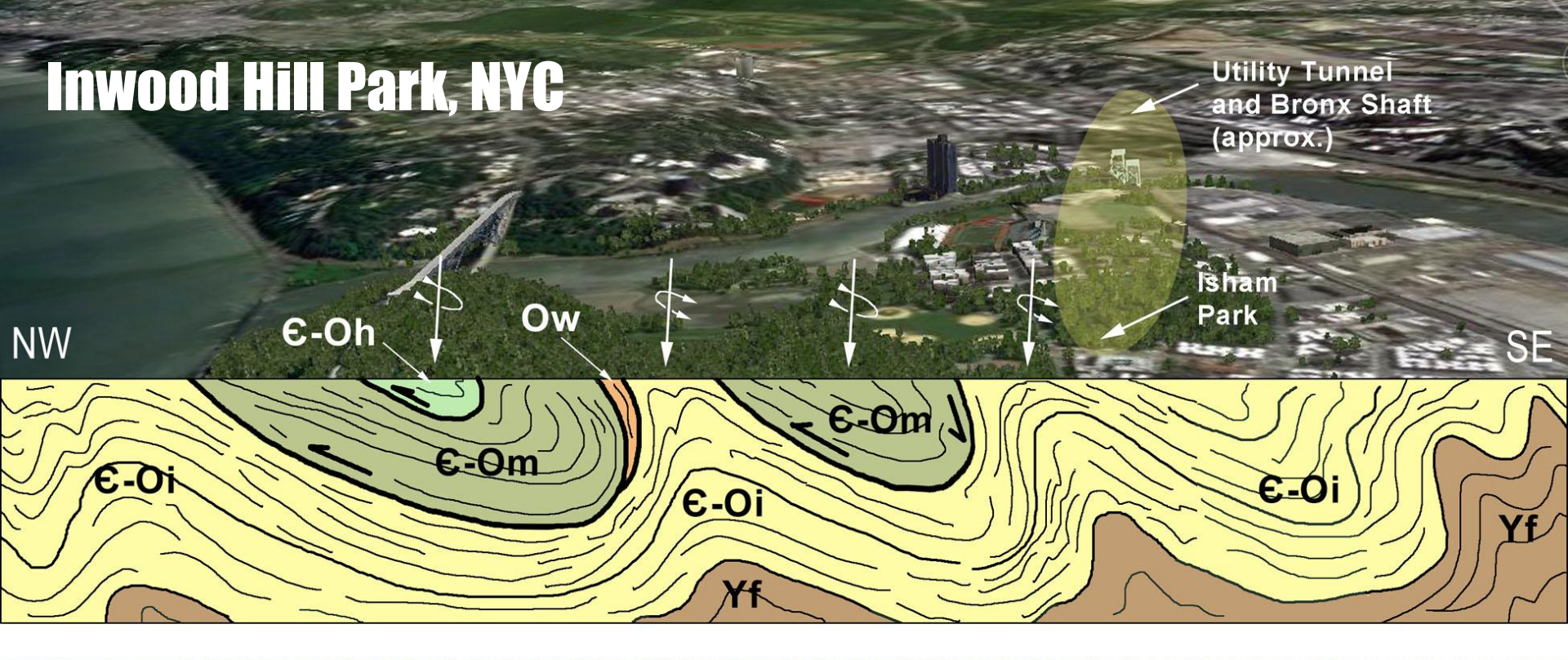

New York Mineralogical Club
Harlem Ship Canal (1887)

Diopside
Kingsbridge, Manhattan
(Betts 2009)

Beck (1842) Describes "white and bluish-white tremolite" up to 22 cm
Dana (1850) Correlation of "Inwood Limestone" northward



Beck 1842


Inwood Hill Park, NYC
Utility Tunnel
and Bronx Shaft
(approx.)
Isham
Park
NW
SE
Є-Oh
Ow
Є-Om
Є-Oi
Є-Om
Є-Oi
Є-Oi
Yf
Yf


Inwood Hill Park
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Isham Park, NYC

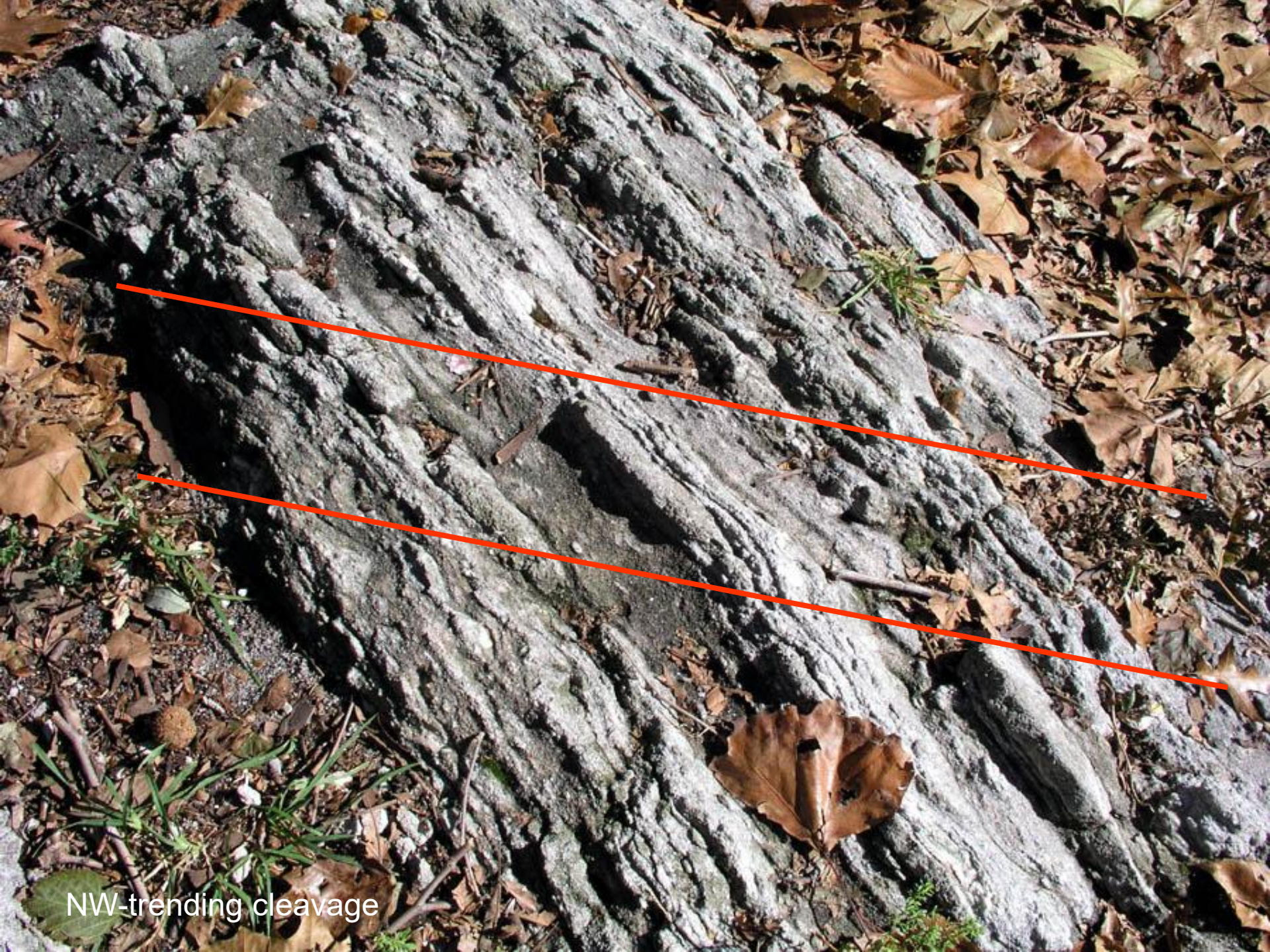
Isham Park, NYC

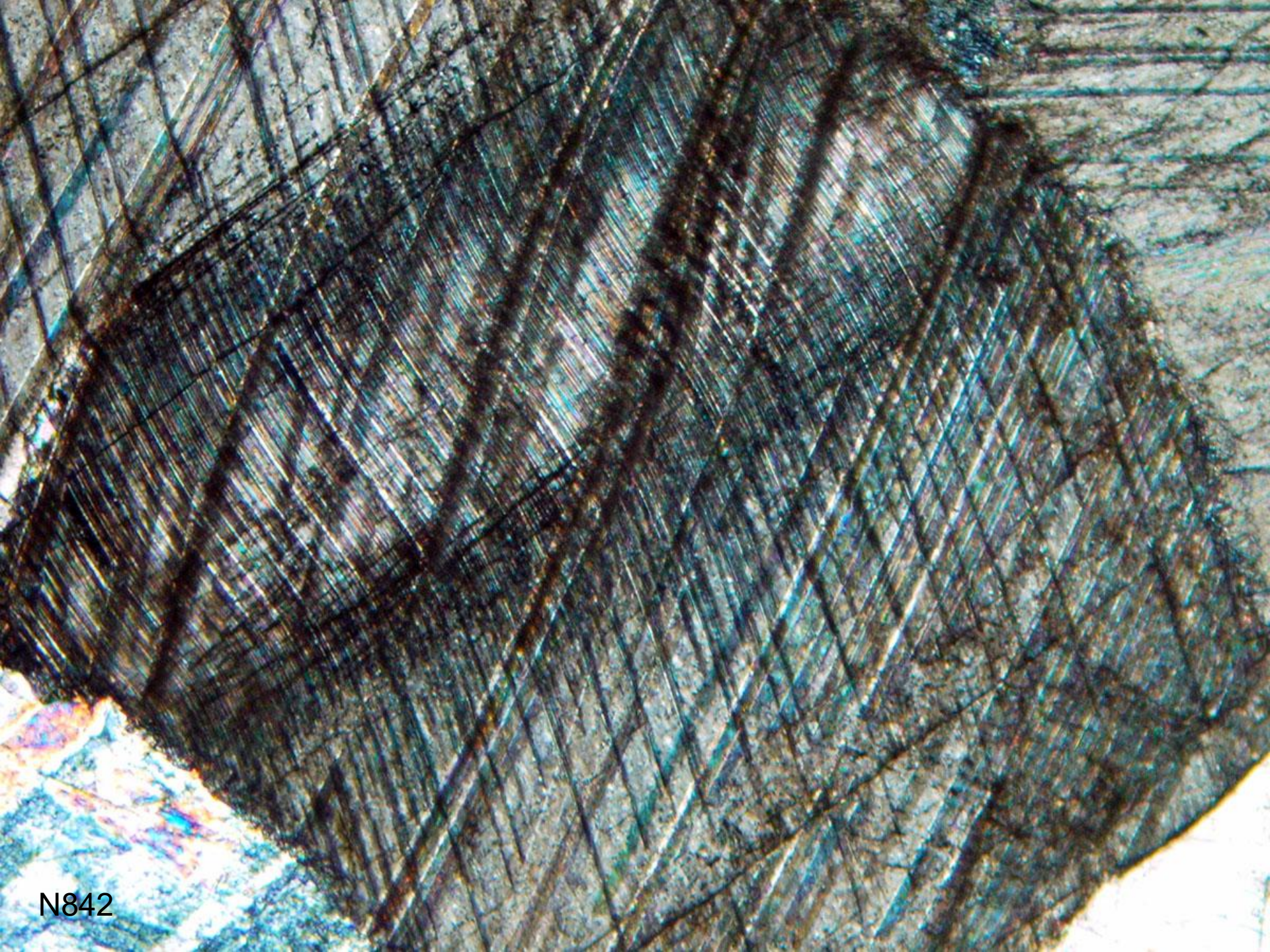
Hofstra University Geology 151 Class Project

Coarse-textured Calcite Marble

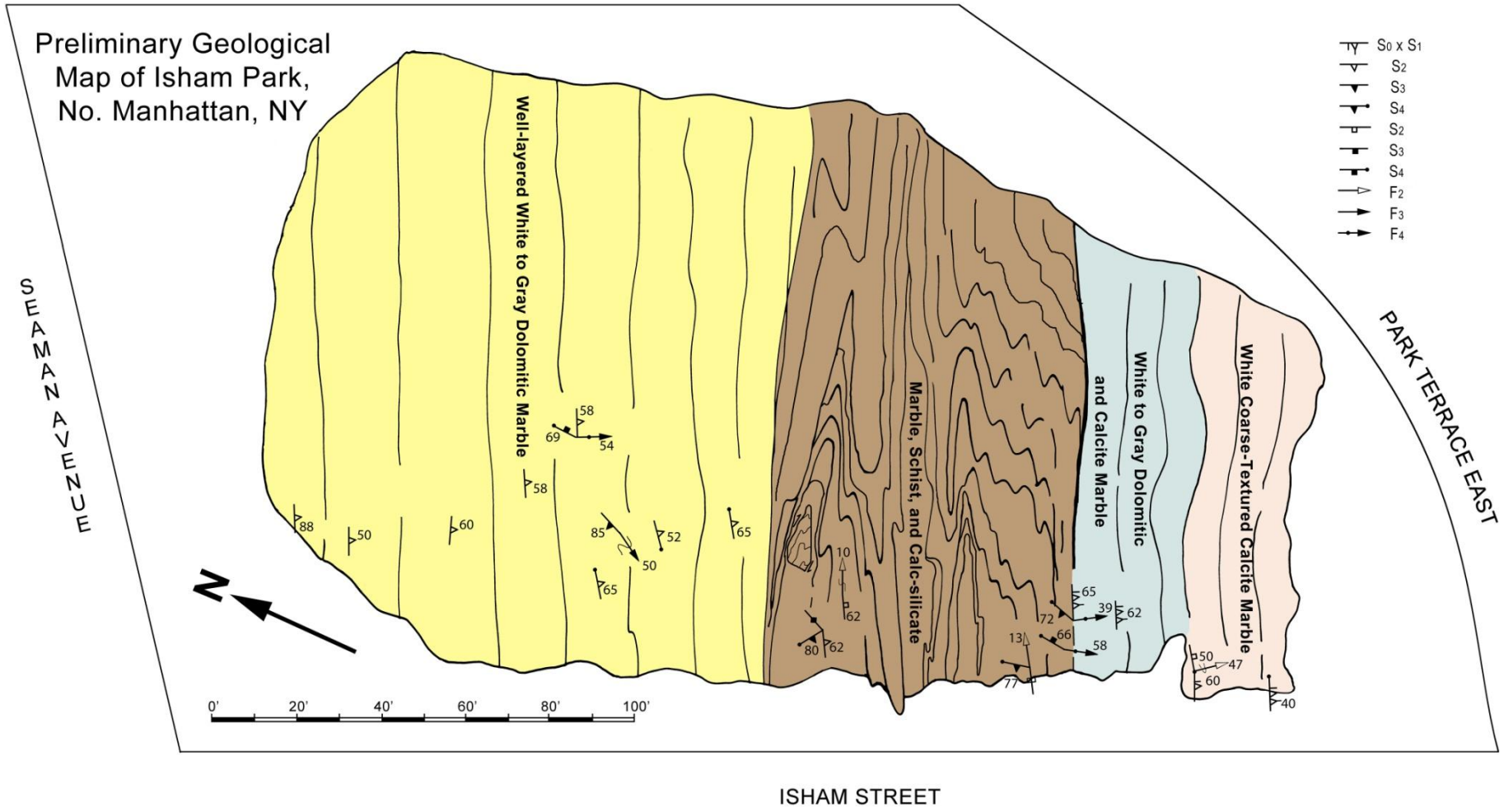
L_3 Lineated Tremolite Pseudomorphic *after* Diopside Porphyroblasts


Tremolitic Marble


NW-trending cleavage


N842

Isham Park, NYC



F_2 Folds in Thin Quartzite Interlayers / Sheared Schistose Boudin

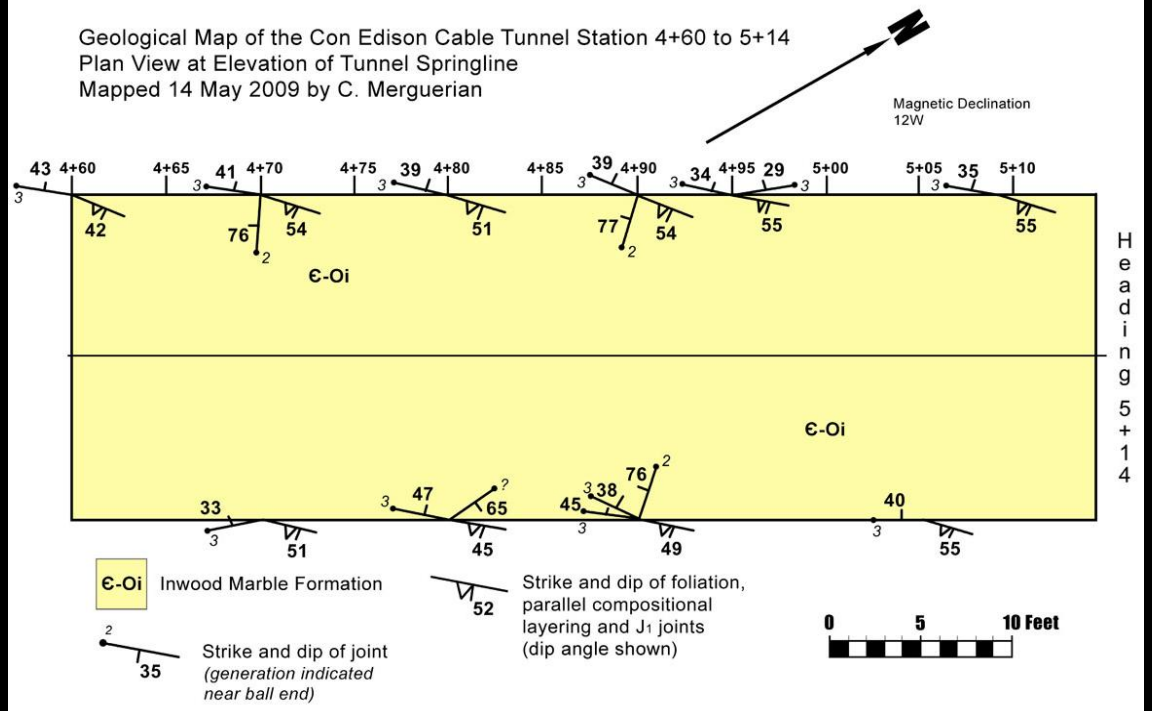
North edge Isham Park

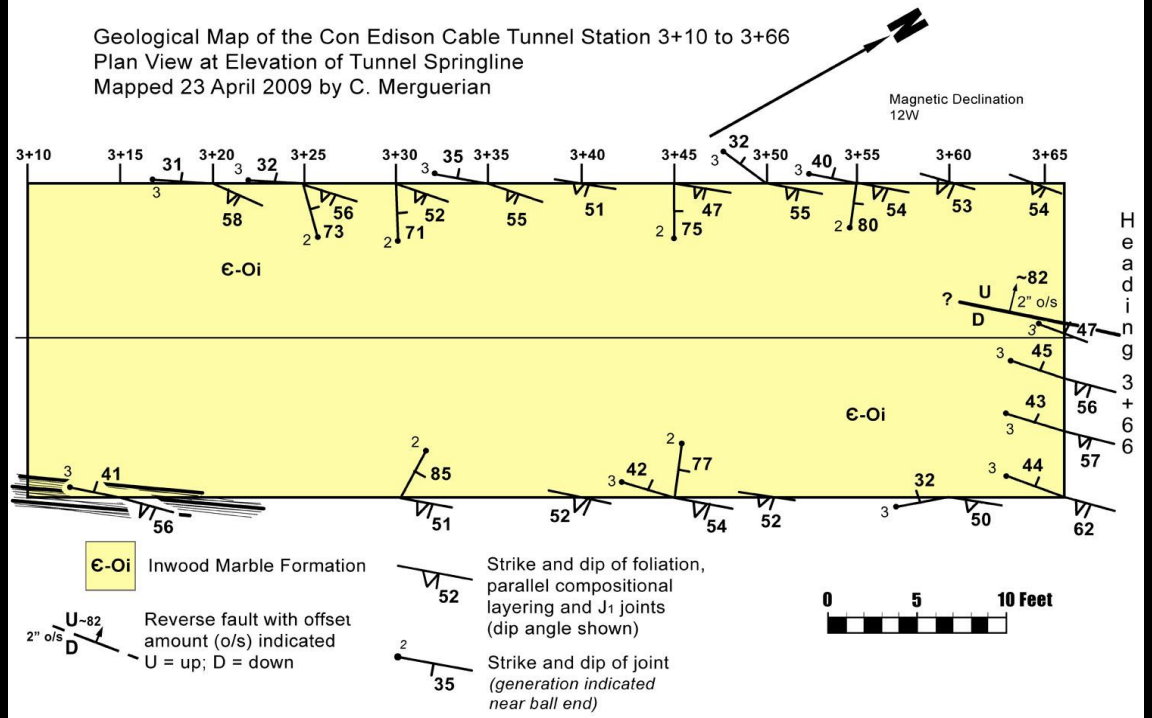
Quartzite Boudin, North edge Isham Park

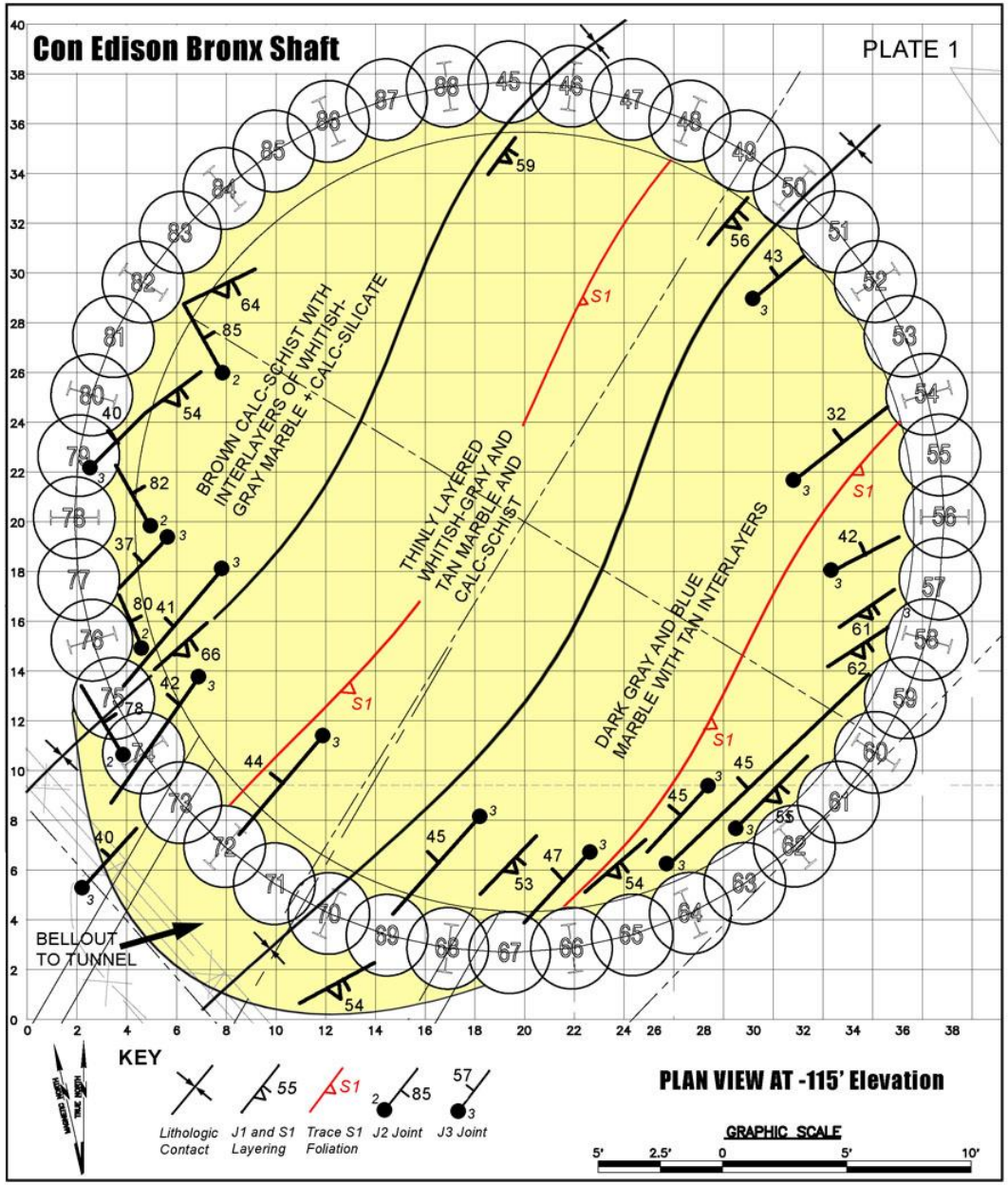

SW-Plunging F3 Z-Fold

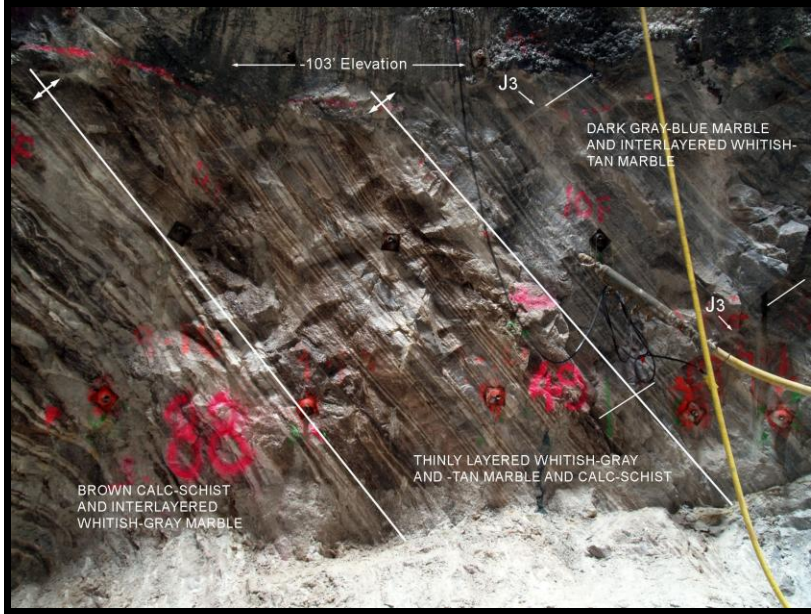
Con Edison Cable Tunnel
2009 D&B Tunnel – 700’

Elev. -150’









Elev. -115'

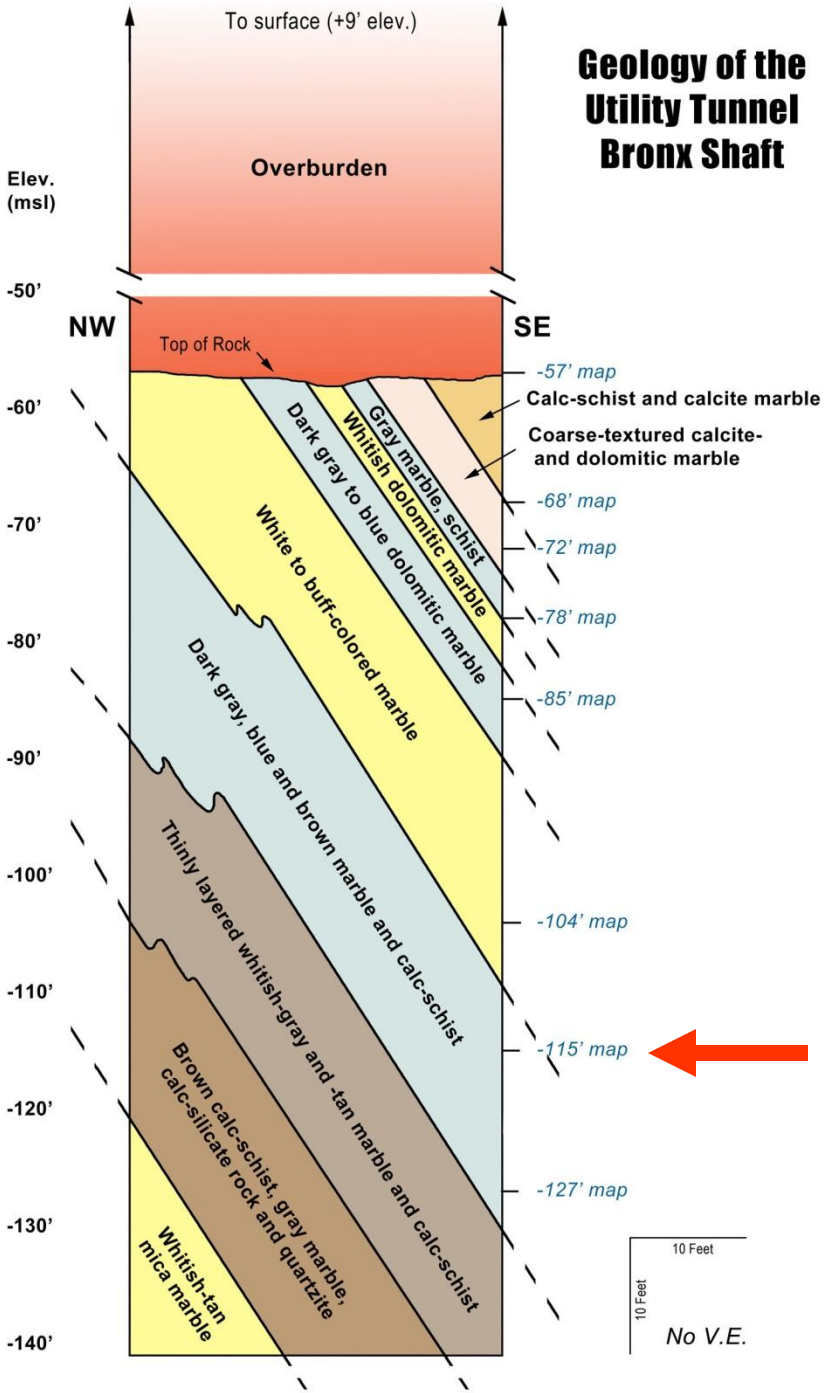
DUKE GEOLOGICAL LABORATORY
36 Fawn Lane
Westbury, NY 11590

Map Prepared By:

Date: 22 September 2009

Sub-unit	Thickness (Feet)
1 - Calc-schist and calcite marble	> 6’; top not exposed
2 - Coarse-textured calcite- and dolomitic marble	4.0
3 - Dark gray marble and calc-schist	3.0
4 - White to buff-colored dolomitic marble	2.0
5 - Dark gray to blue dolomitic marble	5.0
6 - White to buff-colored marble	11.0
7 - Dark gray, blue and brown marble, calc-schist	11.0
8 - Thinly layered whitish-gray and -tan marble and calc-schist	10.5
9 - Brown calc-schist, gray marble, calc-silicate rock and quartzite	11.5
10 - Whitish-tan micaceous marble	>11.5’; base not exposed

Aggregate thickness exposed > 75.5’



Coloration in the Inwood Marble

Whitish to tan = marble ± sericite ± phlogopite ± tremolite

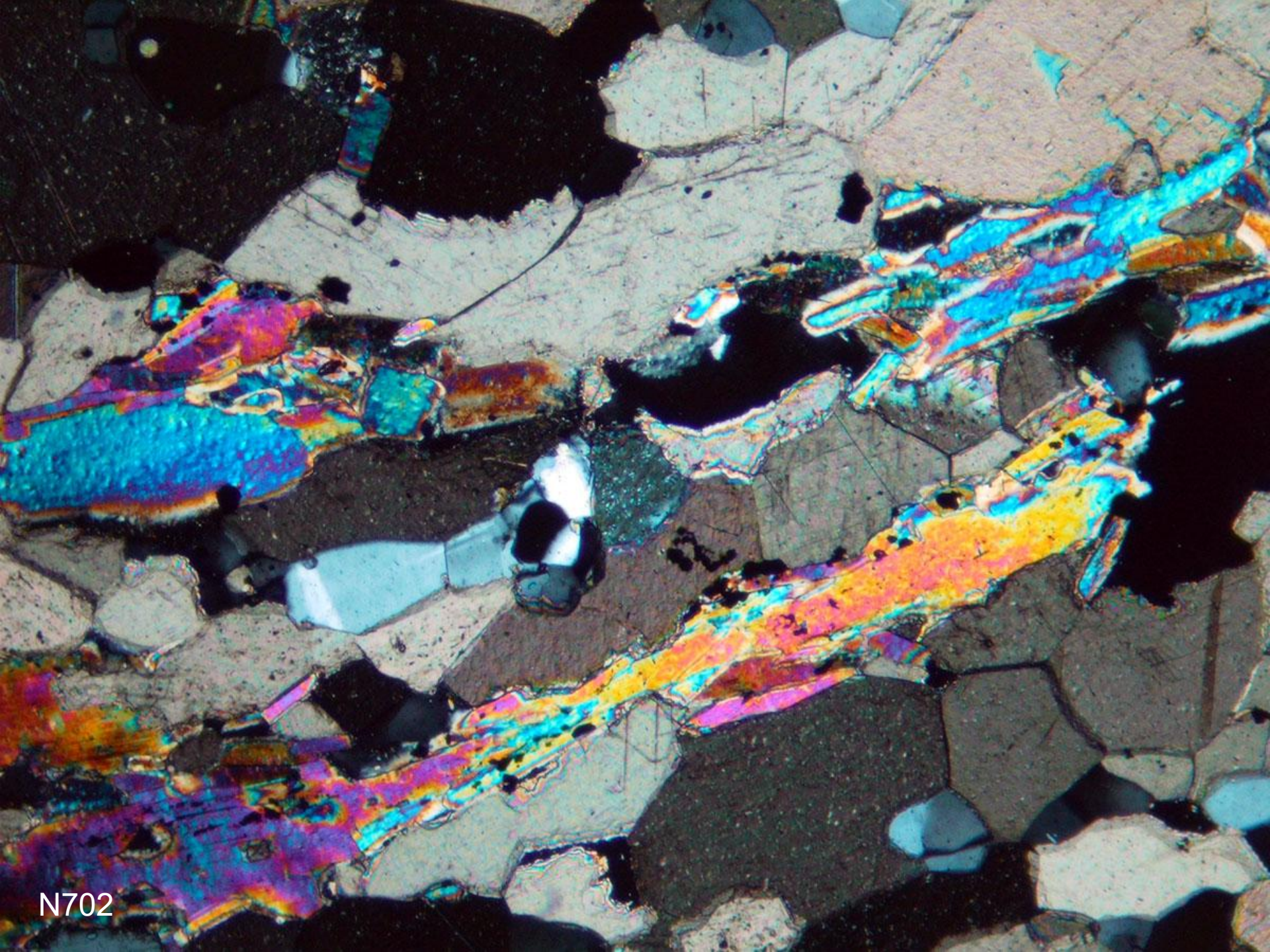
Greenish = marble ± diopside ± chlorite

Dark gray to blue = marble ± graphite ± pyrite ± rutile

Brown to peach-colored = marble ± phlogopite
± tourmaline (dravite-uvite)
± pyrite ± graphite


Dolo+Cal+
Diop
Py
Grph
Drv-Uv
Trem
Phlog


ONE
CENT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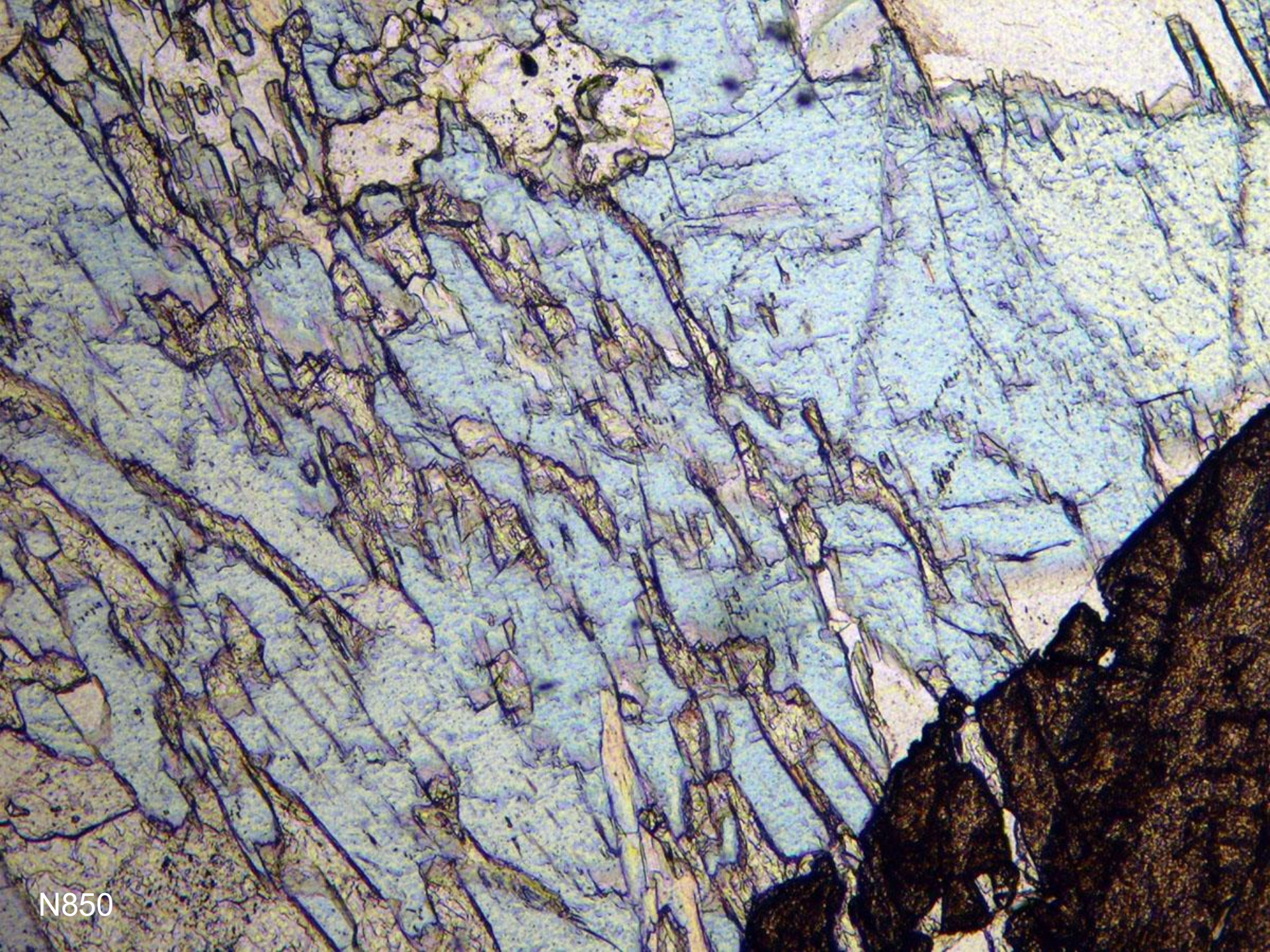
E PLURIBUS UNUM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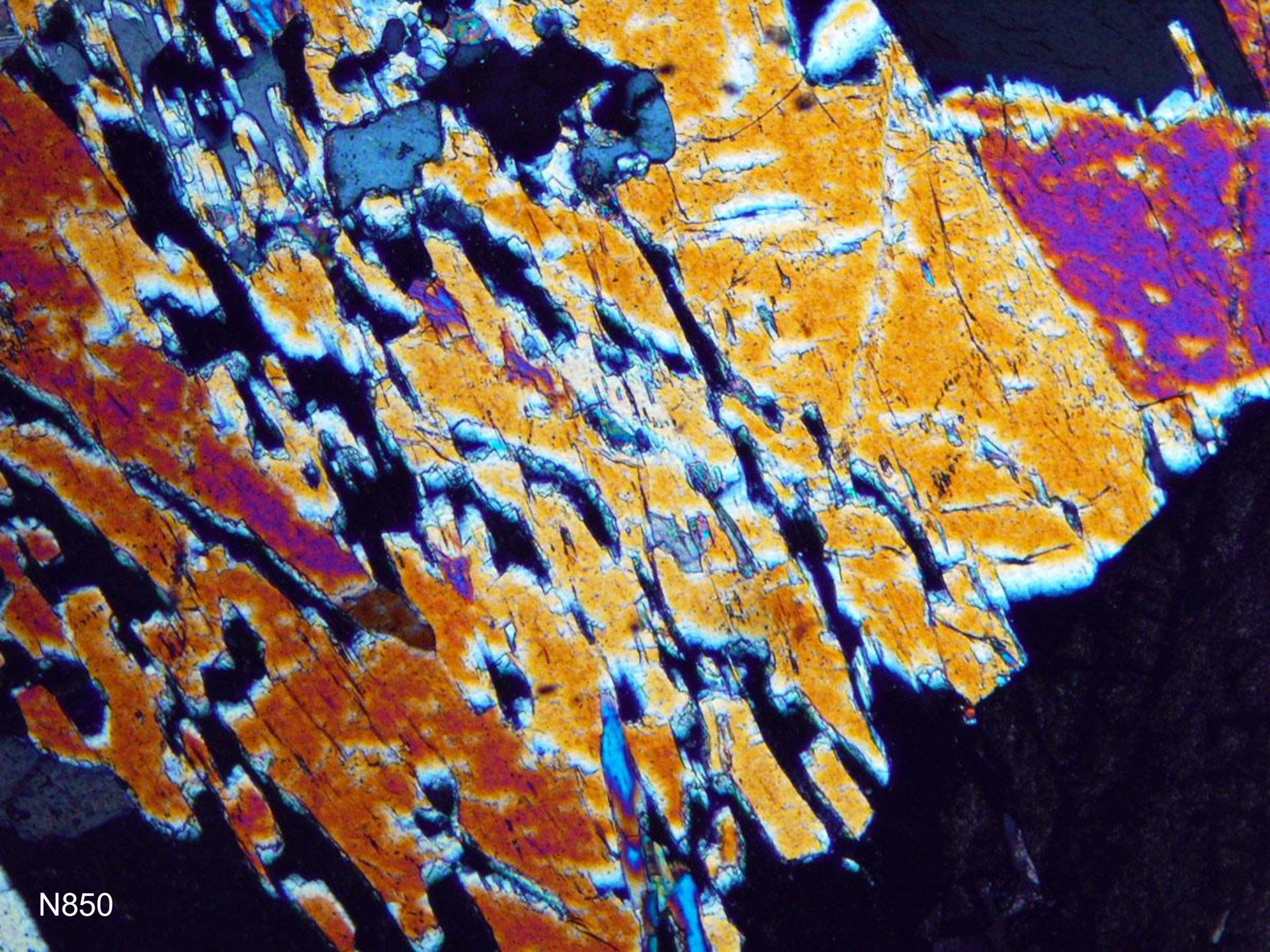
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Mineralogy of the Inwood Marble - NYC

Actinolite (acc. Baskerville, 1992)
Apatite [*]
Calcite [*]
Chalcopyrite [*]
Chlorite [*]
Chondrodite
Diopside [*]
Dolomite [*]
Fosterite
Graphite [*]
Garnet (var. Grossular) [*]
Microcline [*]
Phlogopite [*]
Plagioclase [*]
Pyrite [*]
Pyrrhotite [*]
Quartz (milky and smoky varieties) [*]
Rutile (acicular xls in mica acc. Gratacap 1909)
Sericite [*]
Sphalerite
Sphene [*]
Talc
Tourmaline (Dravite-uvite acc. Betts 2009) [*]
Tremolite [*]
Vesuvianite/Idocrase [*]
Wollastonite
Zoisite [*]

[*] = Reported phase found in this study Fosterite etc. (blue) = Phase yet not found
[*] = Phase detected in this study only

Possible Reactions – Metacarbonate Rocks

After Goodwin-Bell (2008)

Tremolite-in: 5 dolomite + 8 quartz + H_2O = tremolite + 3 calcite + 7 CO_2

Diopside-in: tremolite + 3 calcite + 2 quartz = 5 diopside + 3 CO_2 + H_2

Diopside + Dolomite-in: tremolite + 3 calcite = dolomite + 4 diopside + H_2O + CO_2

Fosterite-in: diopside + 3 dolomite = 2 fosterite + 4 calcite + 5 CO_2