New York Mineralogical Club

Geology and Mineralogy of the Inwood Marble, Northern Manhattan, NY

Charles Merguerian

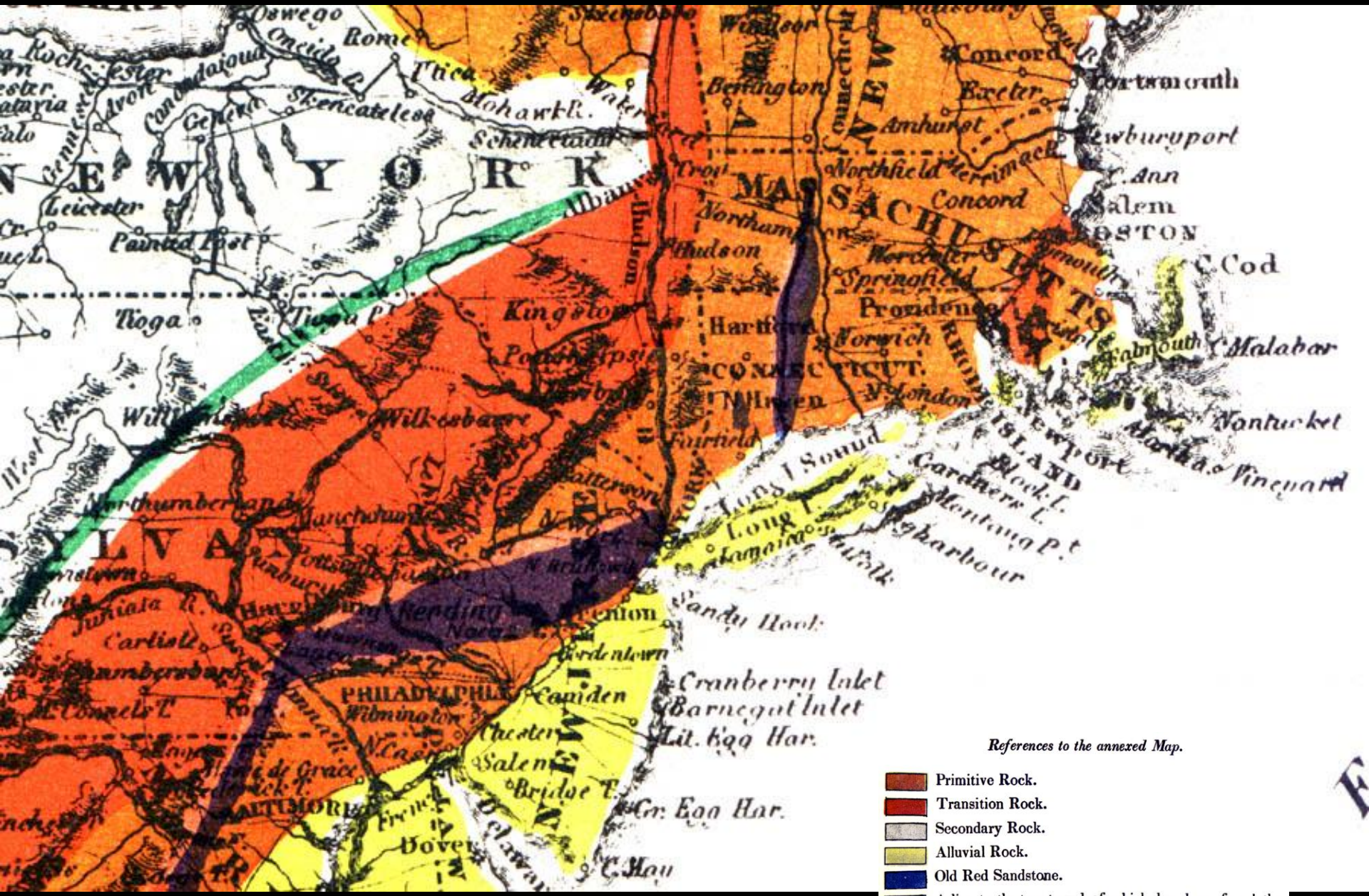
Geology Department
Hofstra University and
Duke Geological Lab

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

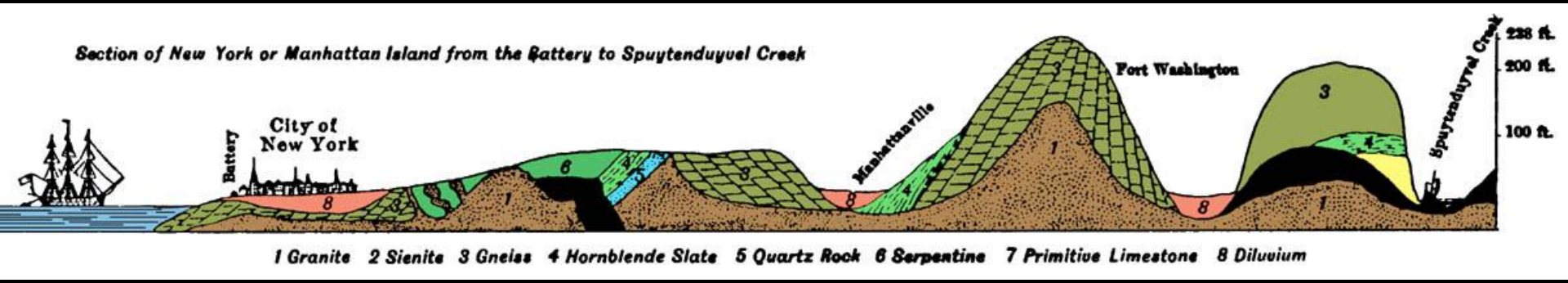
Mather 1843



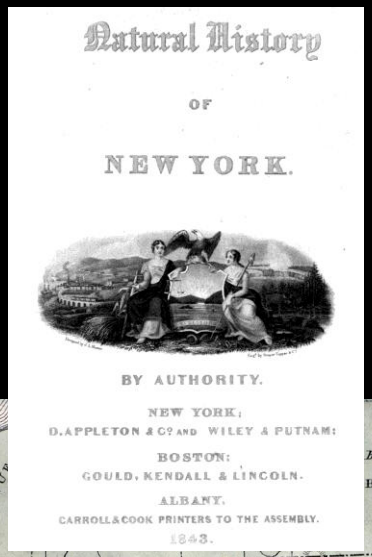
References to the annexed Map.

- 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



Cozzens 1843


Natural History

OF

NEW YORK.

BY AUTHORITY.

NEW YORK:
D. APPLETON & Co. AND WILEY & PUTNAM:

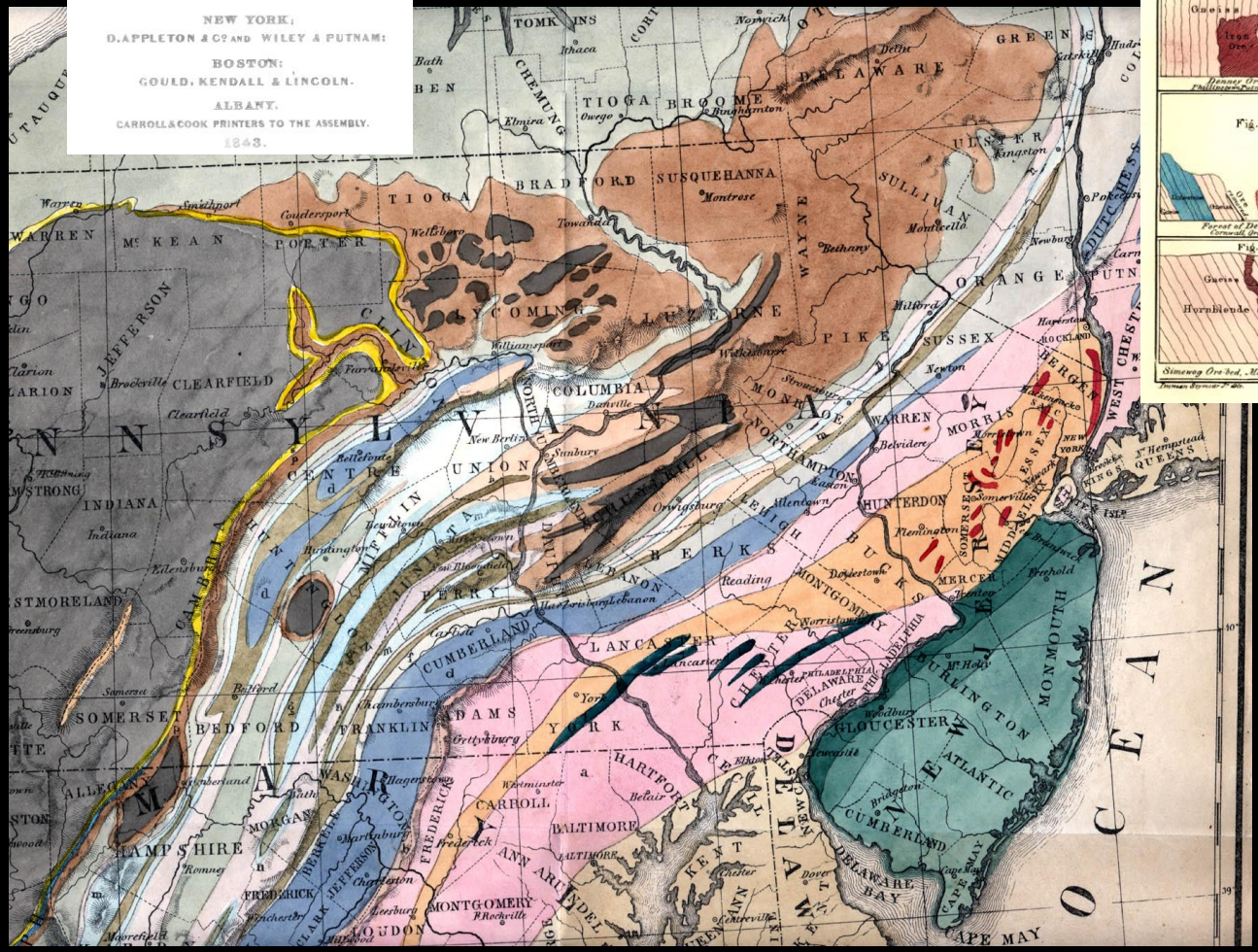
BOSTON:
GOULD, KENDALL & LINCOLN.

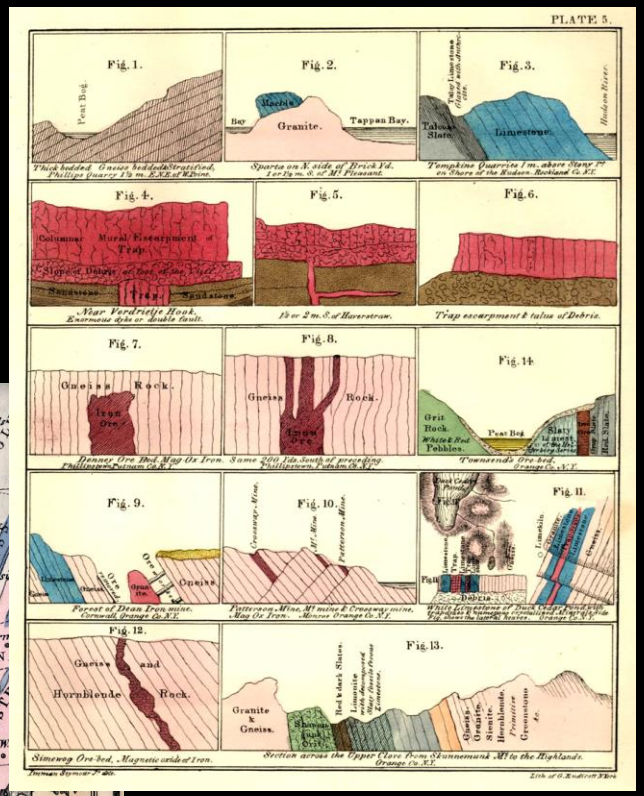
ALBANY.
CARROLL & COOK PRINTERS TO THE ASSEMBLY.

1843.

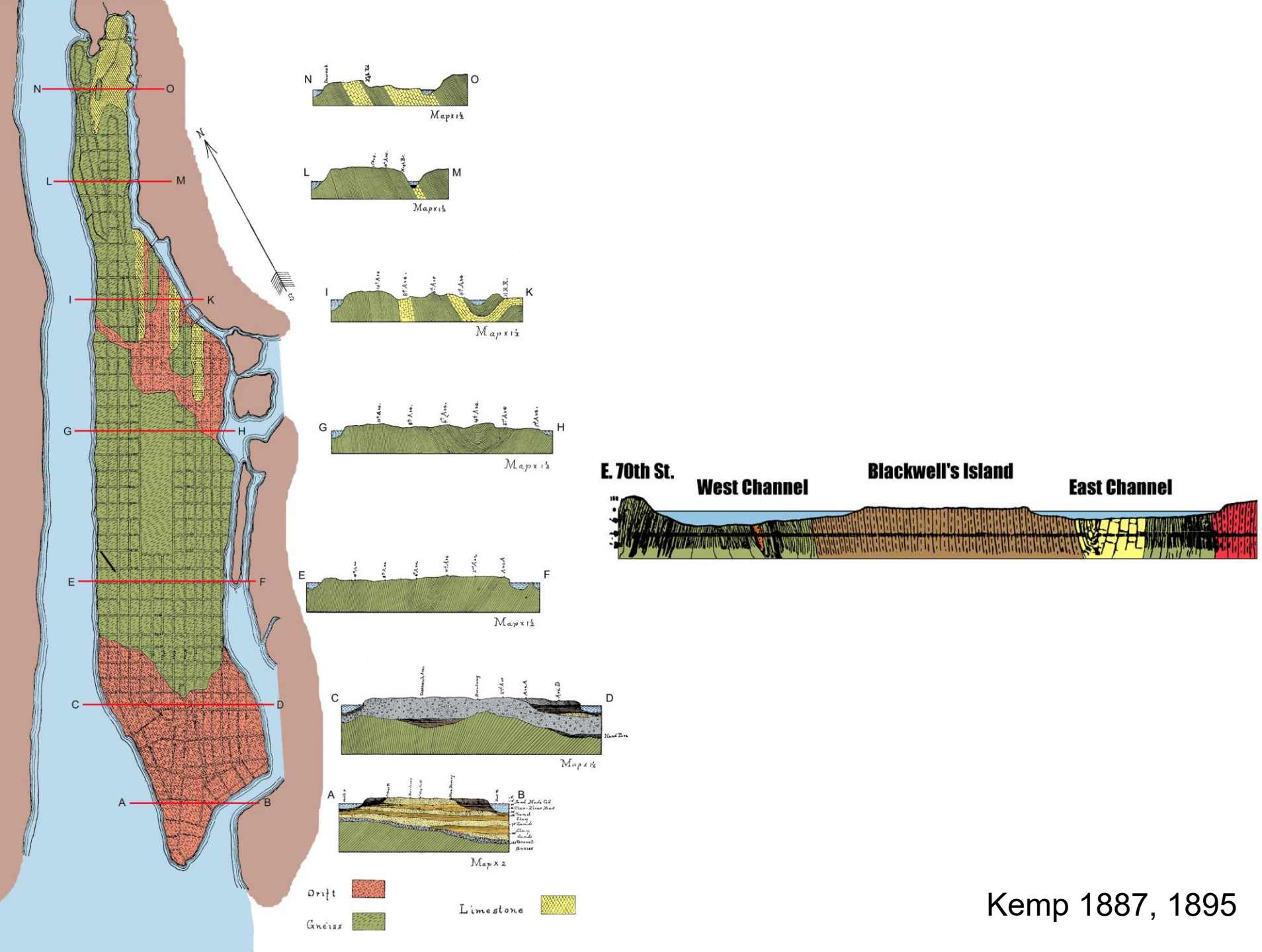
Natural History of New York

1843





Hall
Mather
Emmons
Beck
Vanuxem



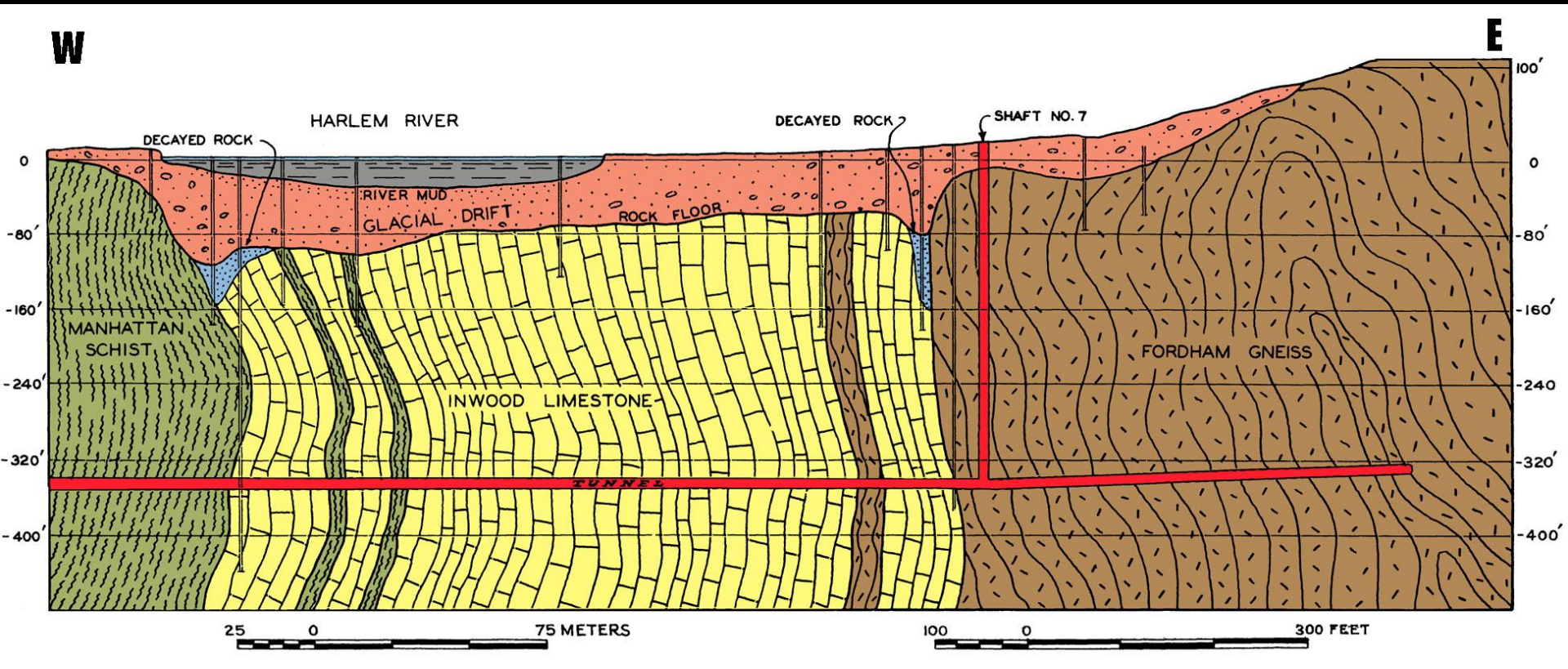
Kemp 1887, 1895

Berkey, 1911

CT1 - SE Manhattan

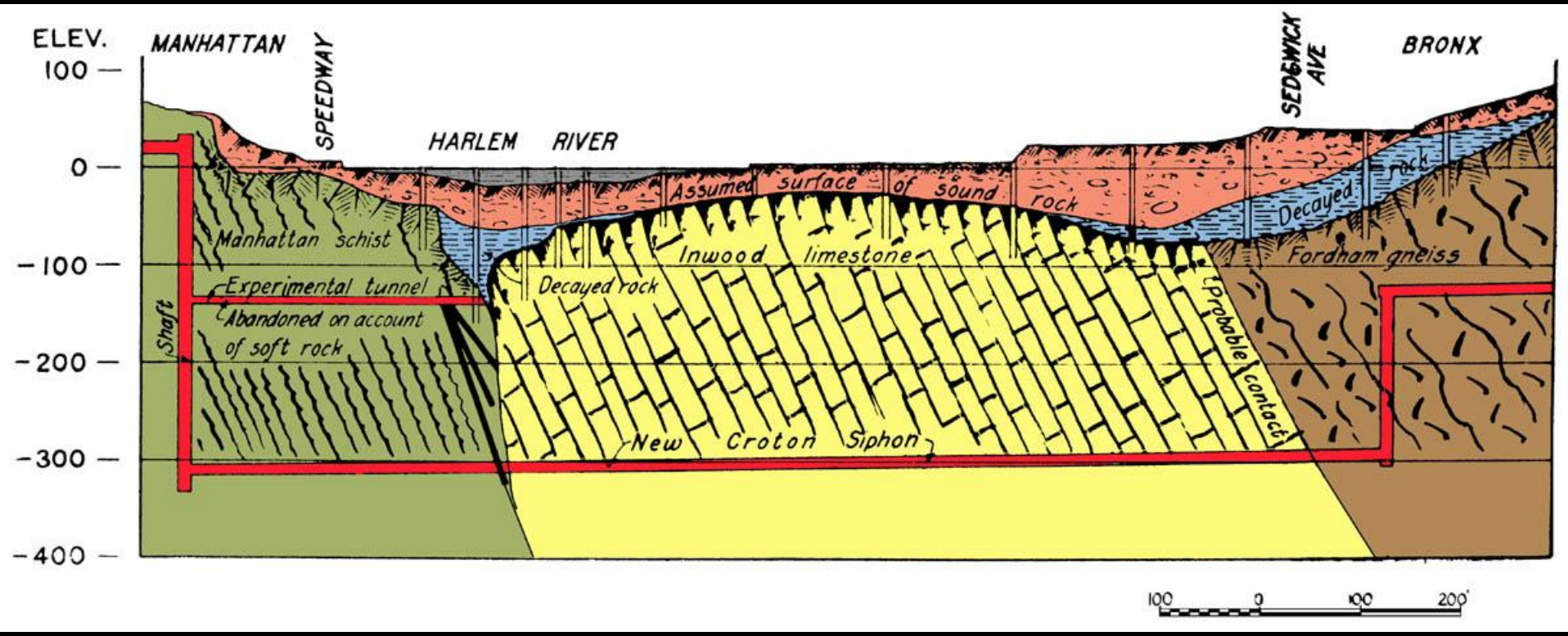
after Berkey, 1911 and 1933

Harlem River



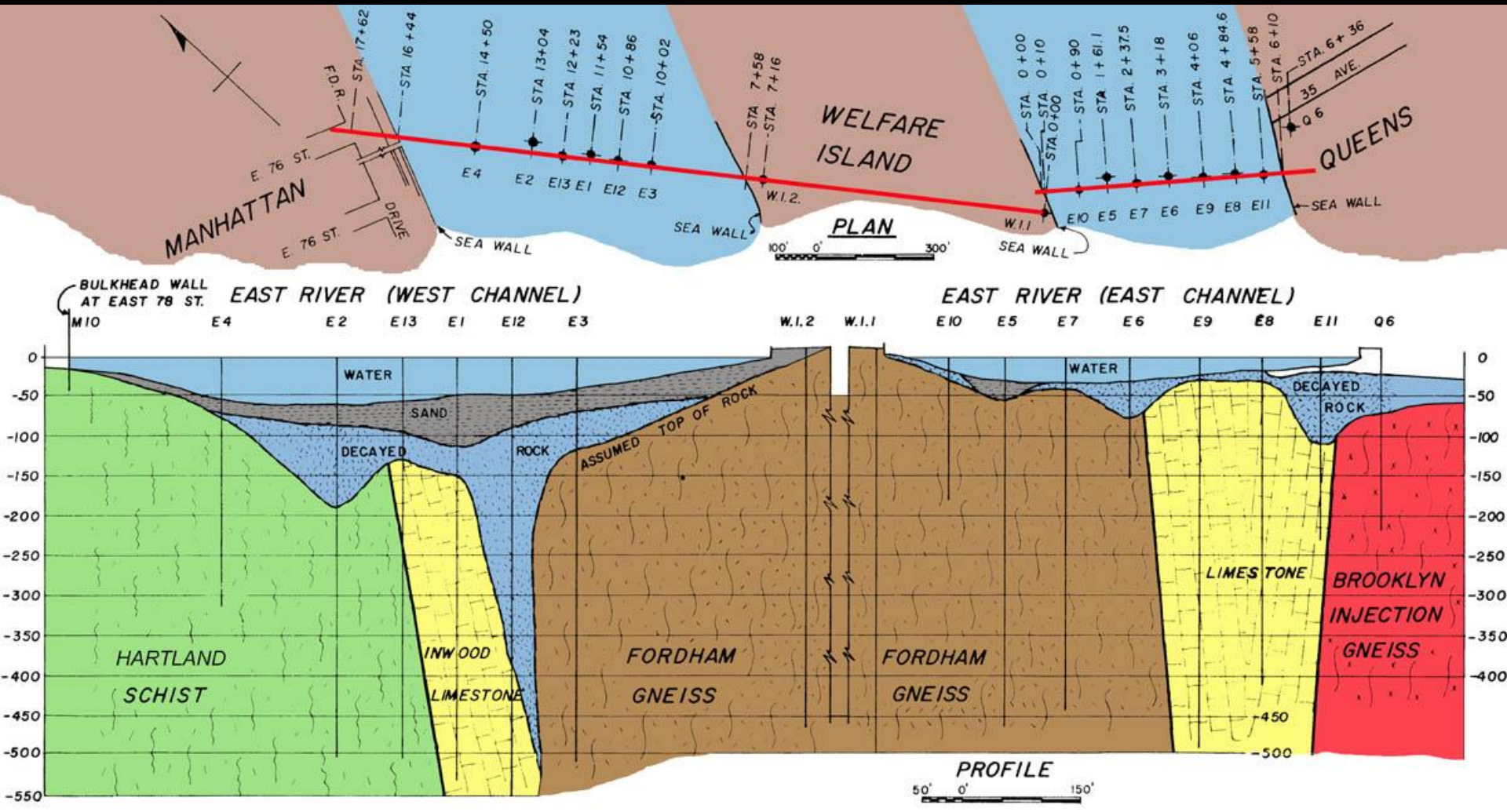
Berkey 1911, 1948

New Croton Aqueduct - Harlem River



Berkey 1911

Roosevelt “Welfare” Island

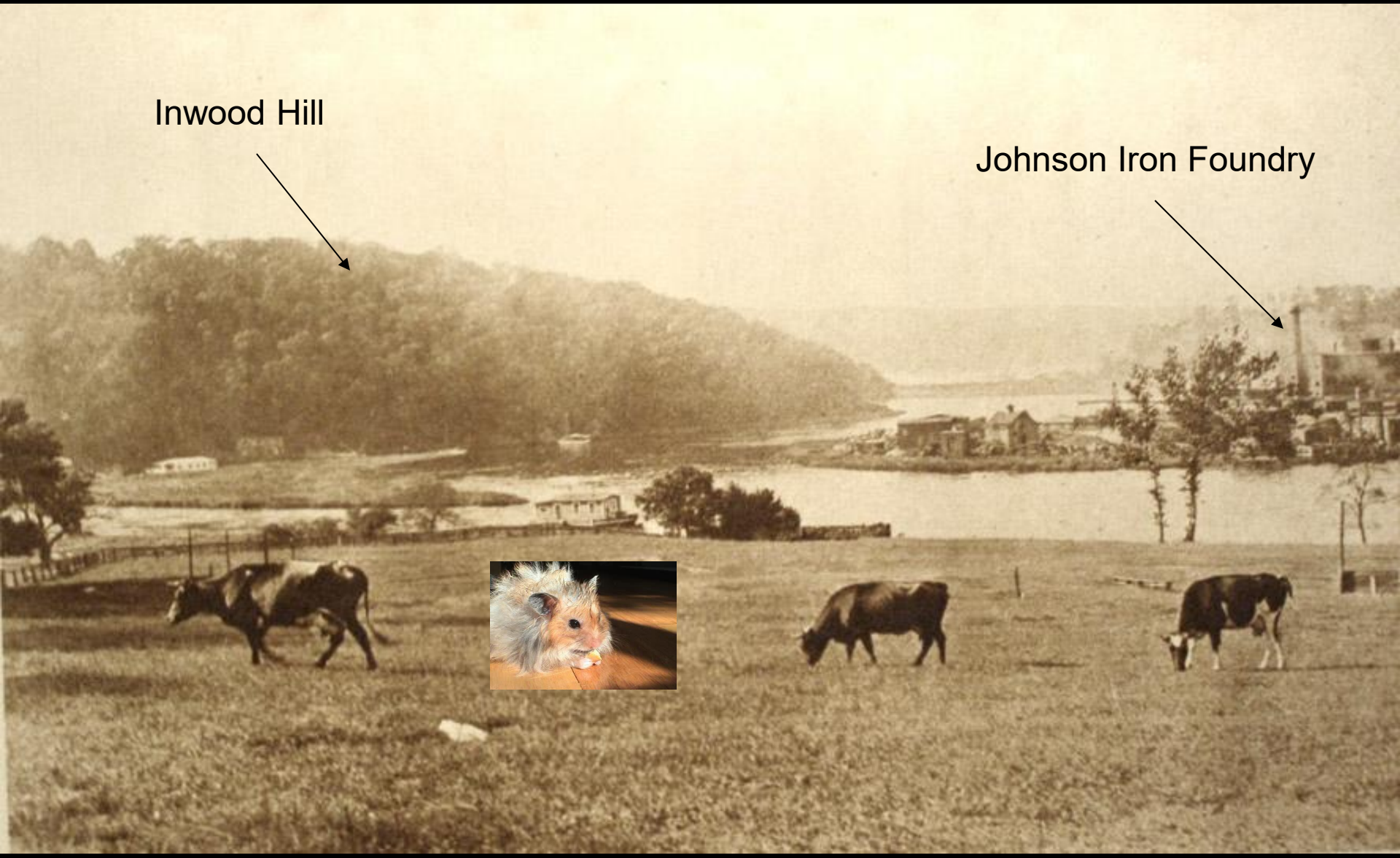


Fluhr 1969

Illustration Harper’s Weekly 16 Feb 1895


TUBBY HOOK
Fort Tryon
FORT GEORGE
Cook Hill Ft.
Spring
SPUYTEN DUYVEL CREEK
Quarry
Marble Quarry
Fort Prince Charles
KINGS BRIDGE
Kingsbridge Hotel
Farmer's Dam
205
215
225
228
I V E R

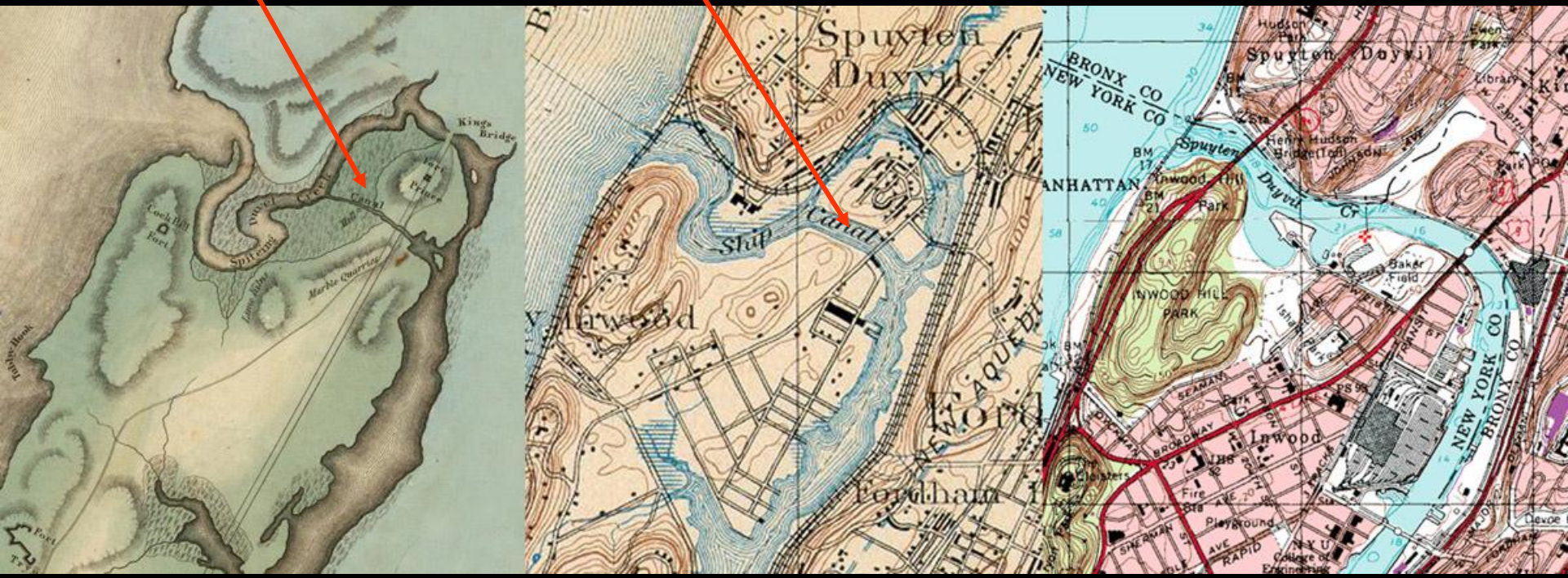
Colton 1836



Northern Manhattan circa 1883 (From Betts 2009)

Bolton Canal

Harlem Ship Canal



1832 1897 1979

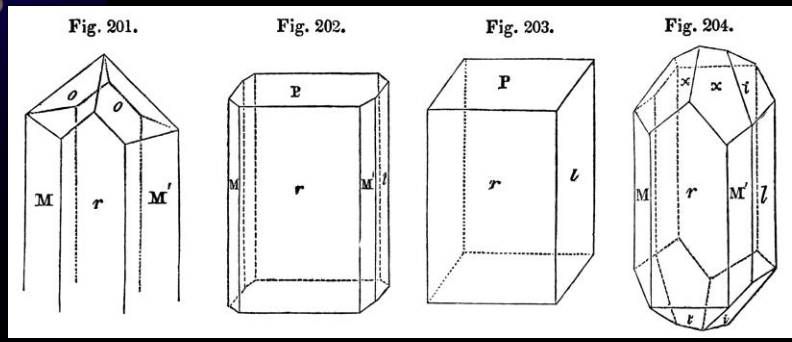
Betts 2009


New York Mineralogical Club
Harlem Ship Canal (1887)

Diopside
Kingsbridge, Manhattan
(Betts 2009)

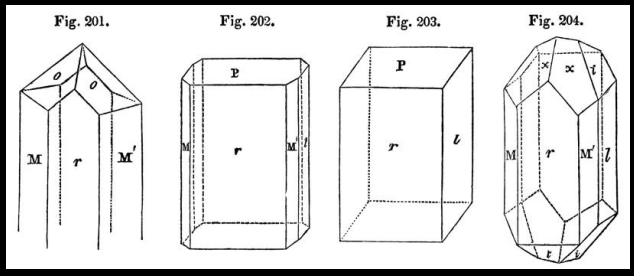
Beck (1842) Describes "white and bluish-white tremolite" up to 22 cm
Dana (1850) Correlation of "Inwood Limestone" northward

Malacolite (Diopside)
207th Street
Kingsbridge, Manhattan



Beck 1842

Malacolite (Diopside)
Inwood Section
Manhattan



Tremolite
Kingsbridge, Manhattan

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


Dravite-uvite in Marble
176th St & Amsterdam Avenue
(Betts 2009)

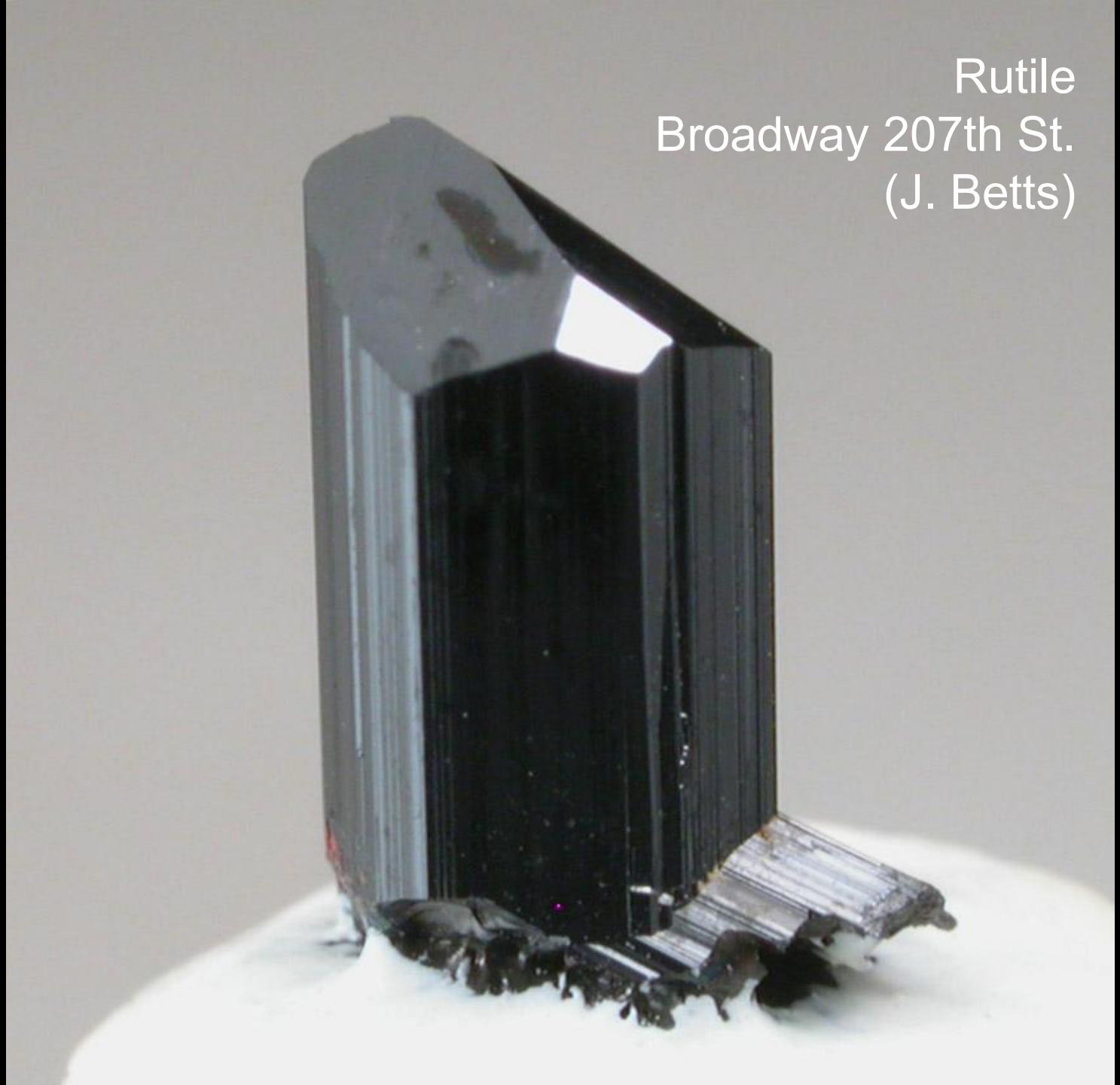
Limonite psuedo after Pyrite Broadway & 207th Street (Betts 2009)


Pyrite (4 mm)
Baker Field, NYC
(J. Betts)


Pyrite in Marble
Dyckman Street
(Betts 2009)

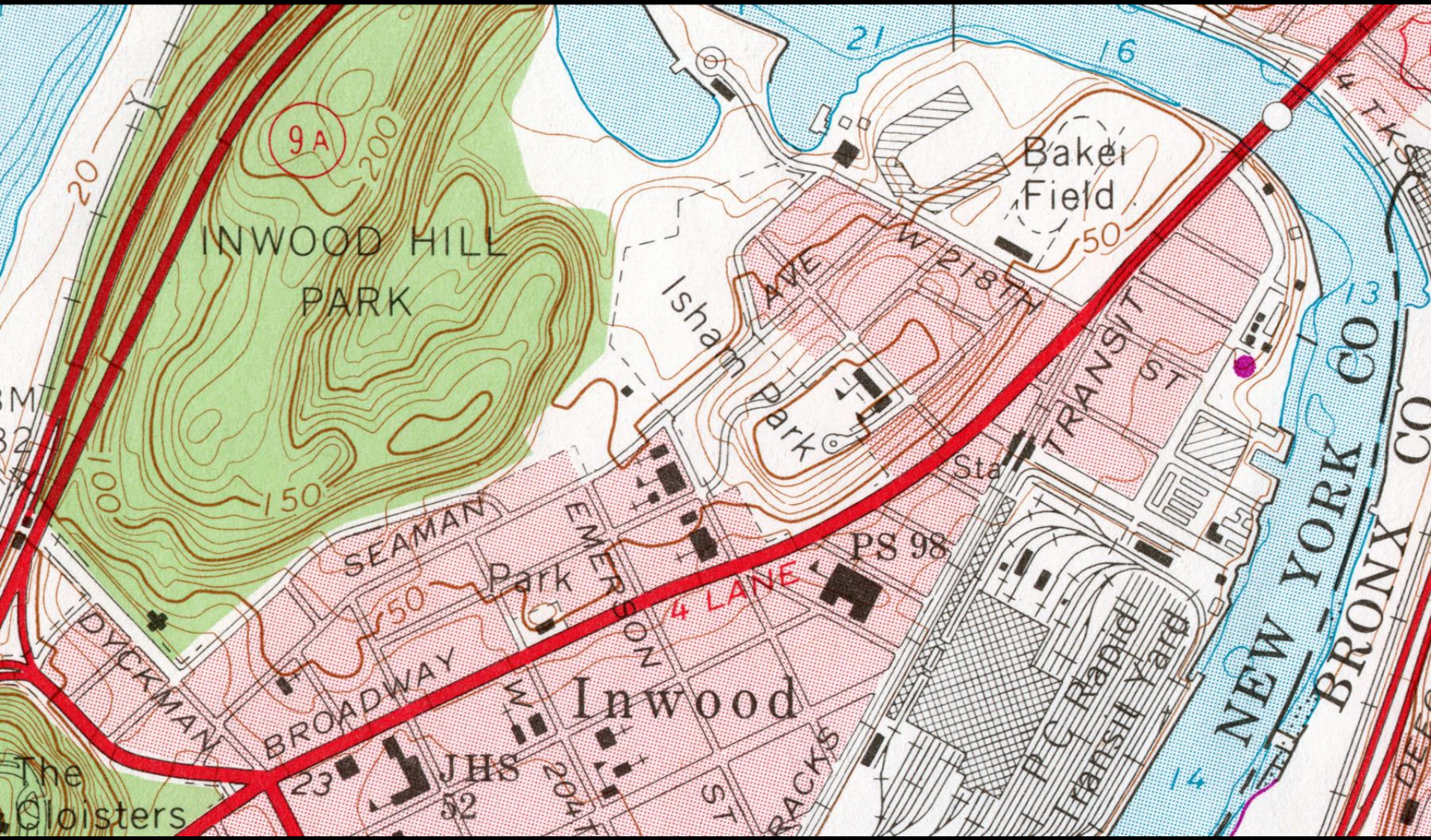

Smoky Quartz (Kunz)
Kingsbridge Ship Canal
(Betts 2009)


Rutile
Kingsbridge Ship Canal
(Betts 2009)


Rutile
Broadway 207th St.
(J. Betts)

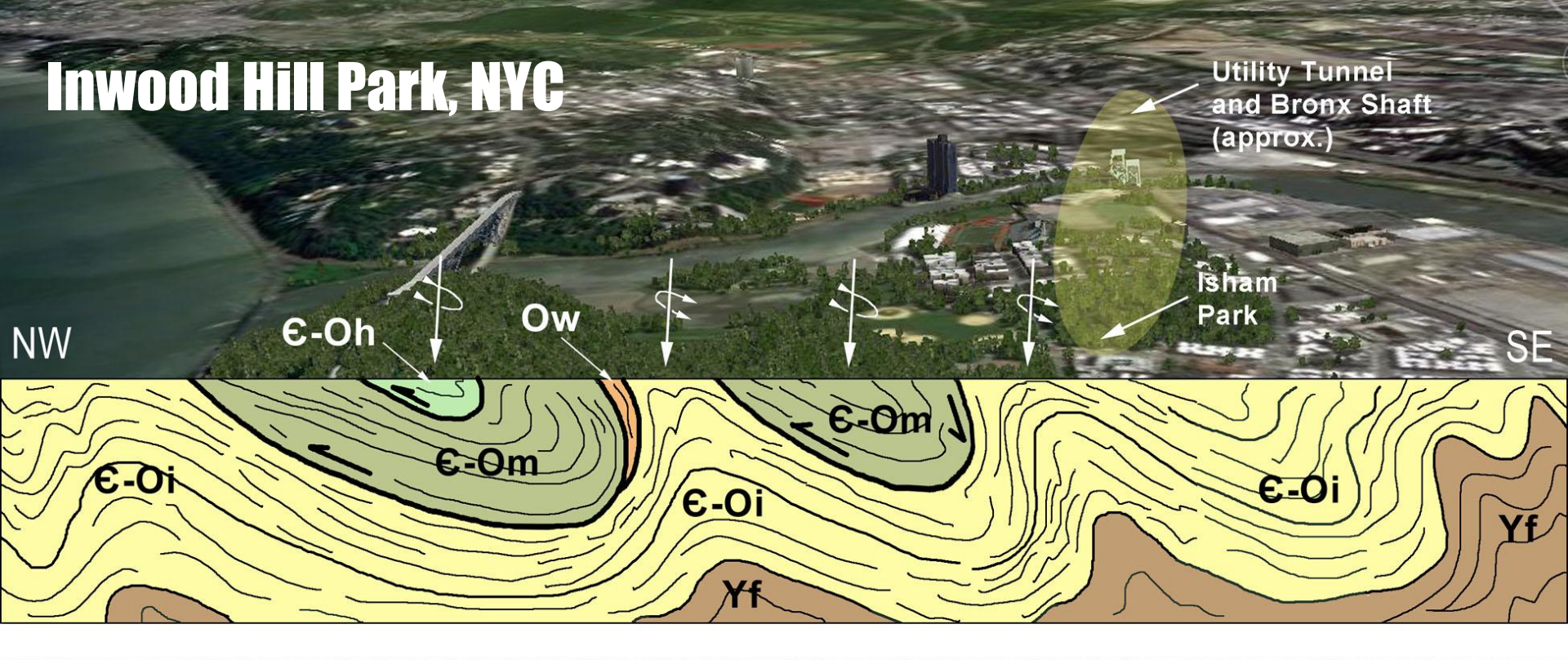

Xenotime (YPO_4)
165th and Broadway
http://www.johnbetts-fineminerals.com/jhbnyc/articles/nycminerals1.htm

Inwood Hill and Isham Parks, NYC



Isham Park, NYC


Preliminary Geological Map of Isham Park, No. Manhattan, NY
SEAMAN AVENUE
PARK TERRACE EAST
ISHAM STREET
Well-layered White to Gray Dolomitic Marble
Marble, Schist, and Calc-silicate
White to Gray Dolomitic and Calcite Marble
White Coarse-Textured Calcite Marble
S0 x S1
S2
S3
S4
S2
S3
S4
F2
F3
F4
N
0'
20'
40'
60'
80'
100'

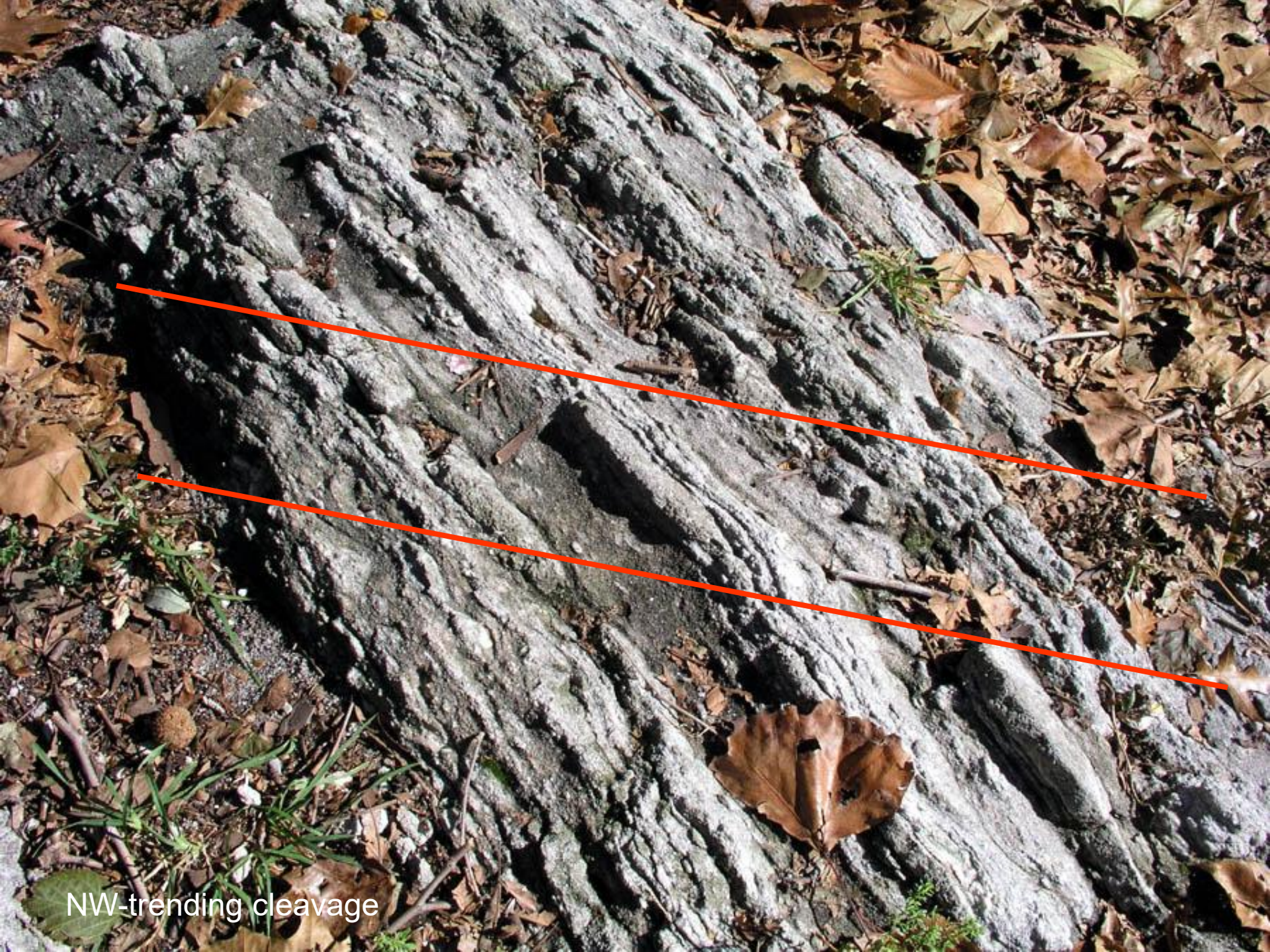

Inwood Hill Park, NYC
Utility Tunnel
and Bronx Shaft
(approx.)
Isham
Park
NW
SE
Є-Oh
Ow
Є-Om
Є-Oi
Є-Om
Є-Oi
Є-Oi
Yf
Yf

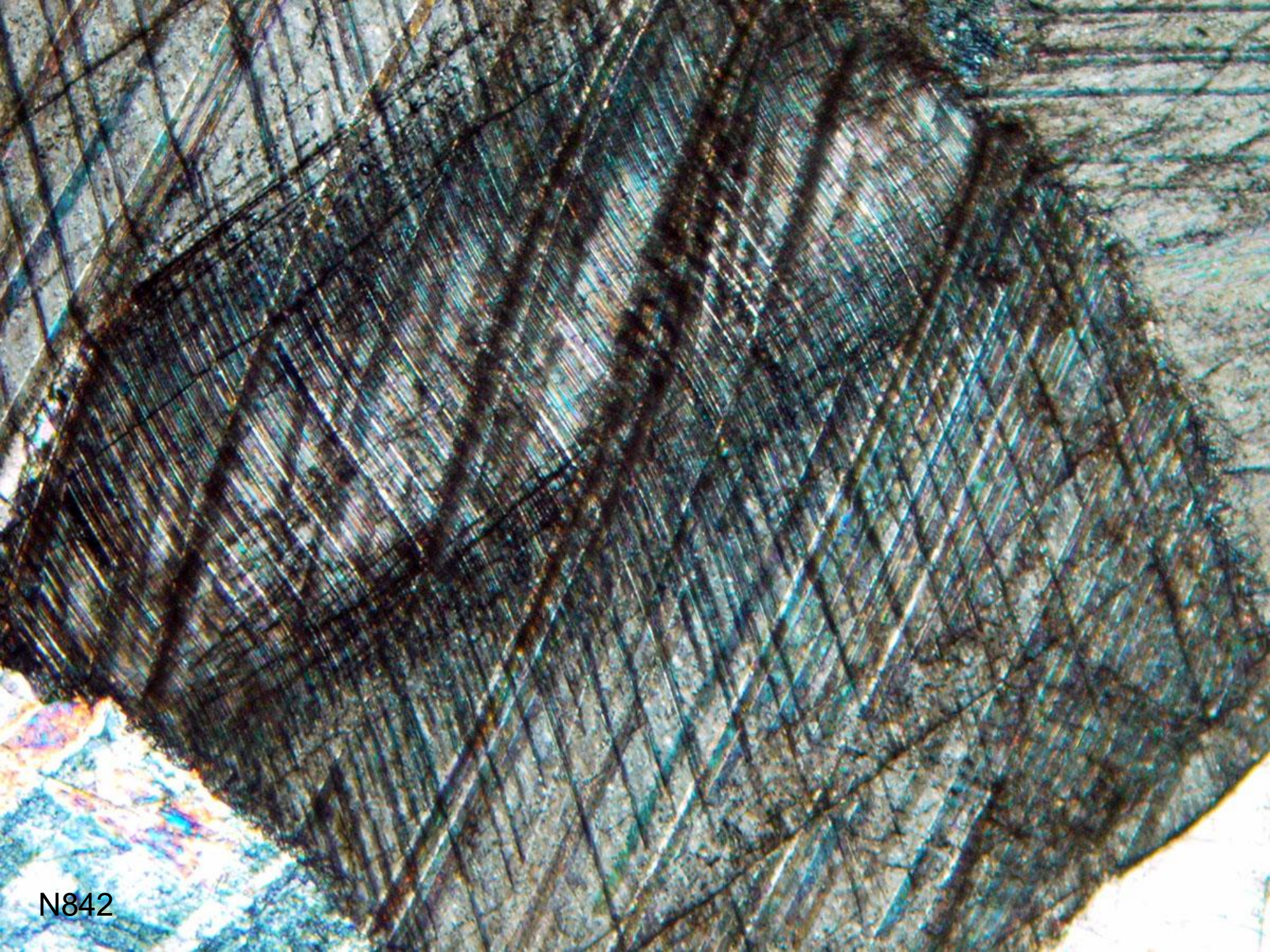

Inwood Hill Park
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Coarse-textured Calcite Marble

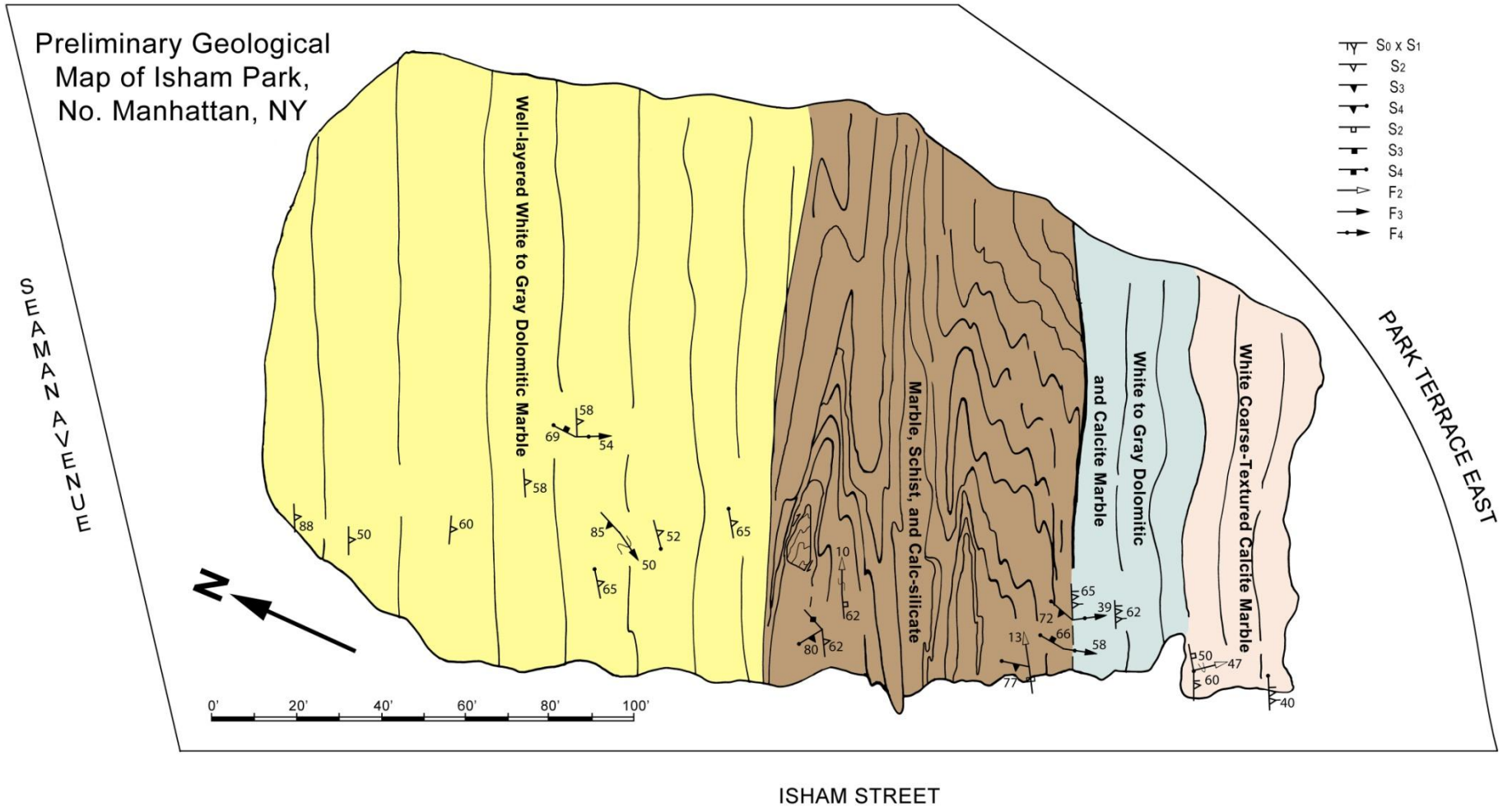
L_3 Lineated Tremolite Pseudomorphic *after* Diopside Porphyroblasts


Tremolitic Marble


NW-trending cleavage


N842

Isham Park, NYC

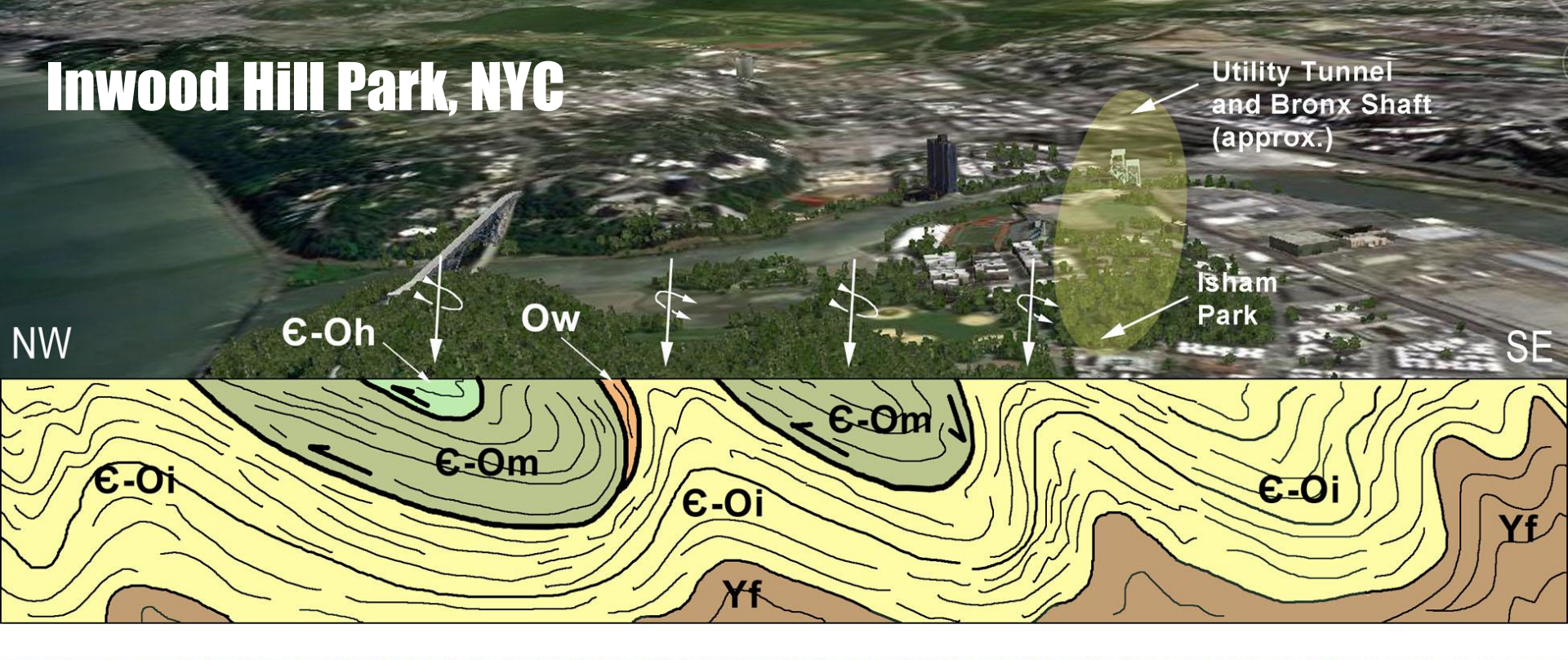


F_2 Folds in Thin Quartzite Interlayers / Sheared Schistose Boudin

North edge Isham Park

Quartzite Boudin, North edge Isham Park


SW-Plunging F3 Z-Fold


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

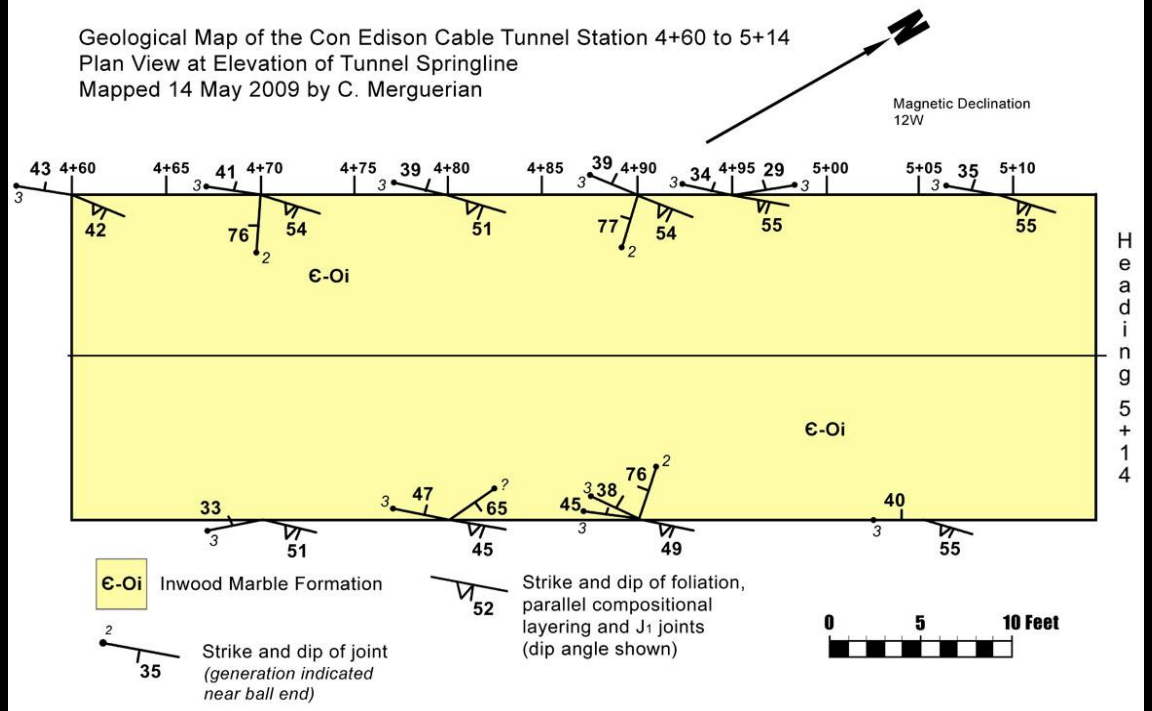

Inwood Hill Park
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

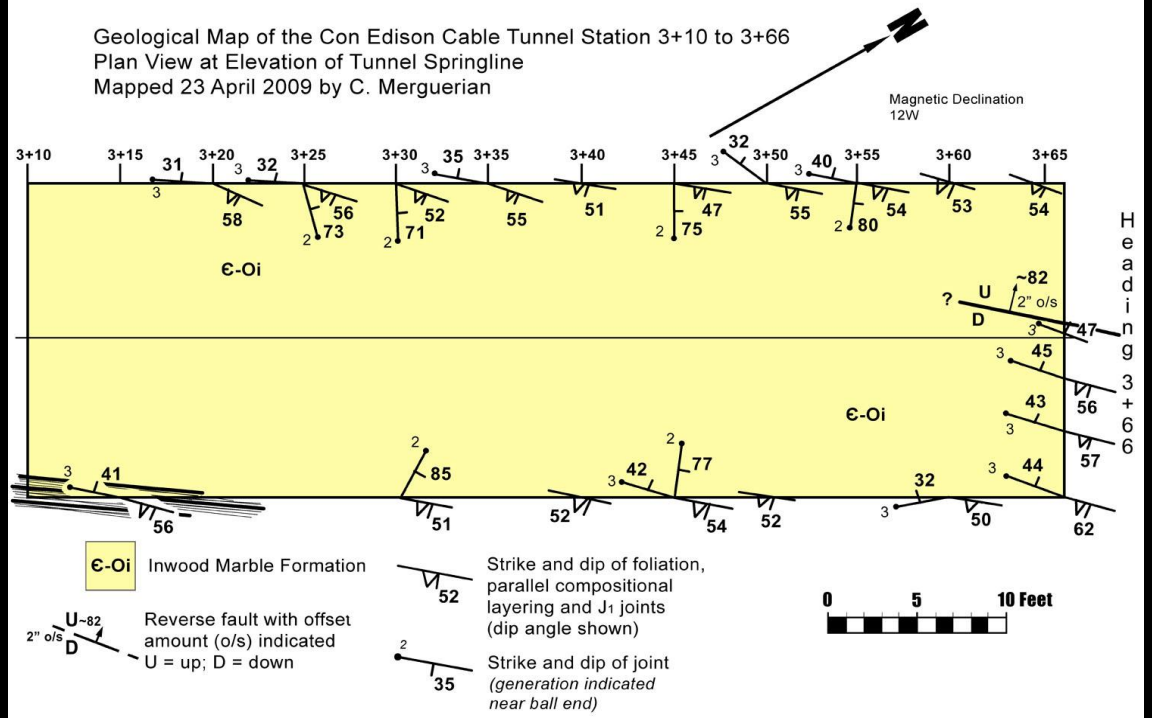
Con Edison Cable Tunnel
2009 D&B Tunnel – 700’

Harlem River Tunnel - 2009

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

Elev. -150’





View from 0+85 toward Station 2+42

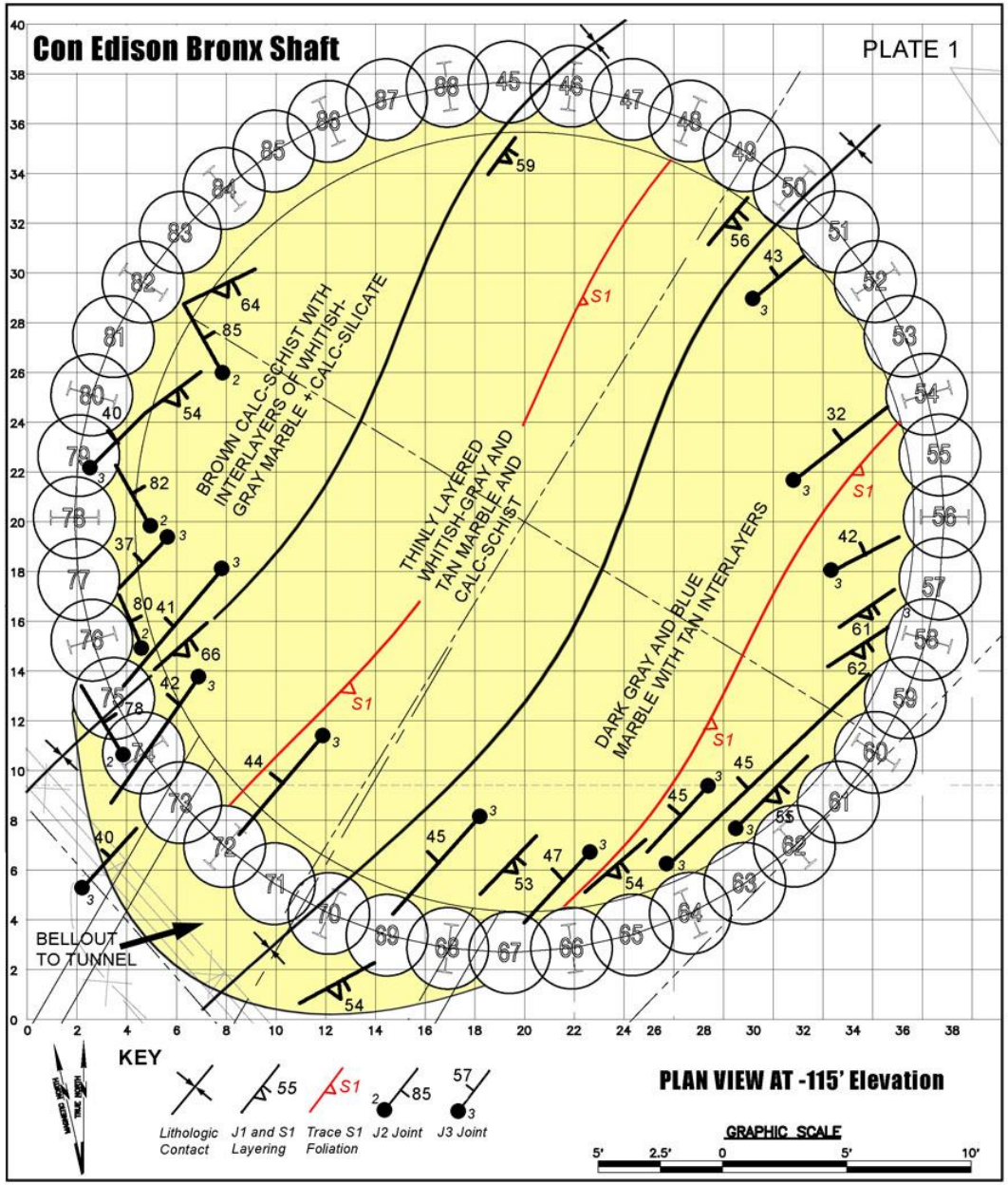

Station 2+42

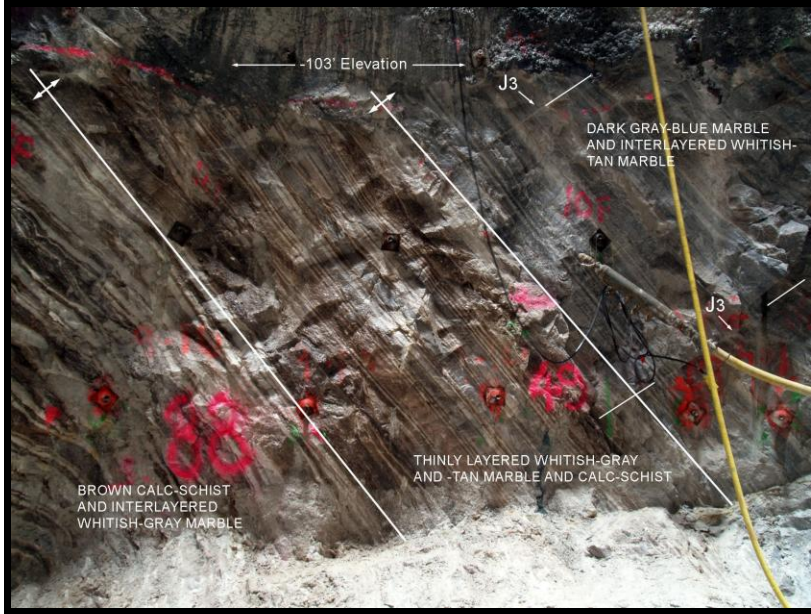

Station 3+23


Right Wall - Station 3+10

Fault along Right Wall - Station 3+23


Left Wall - Station 3+23





Elev. -115'

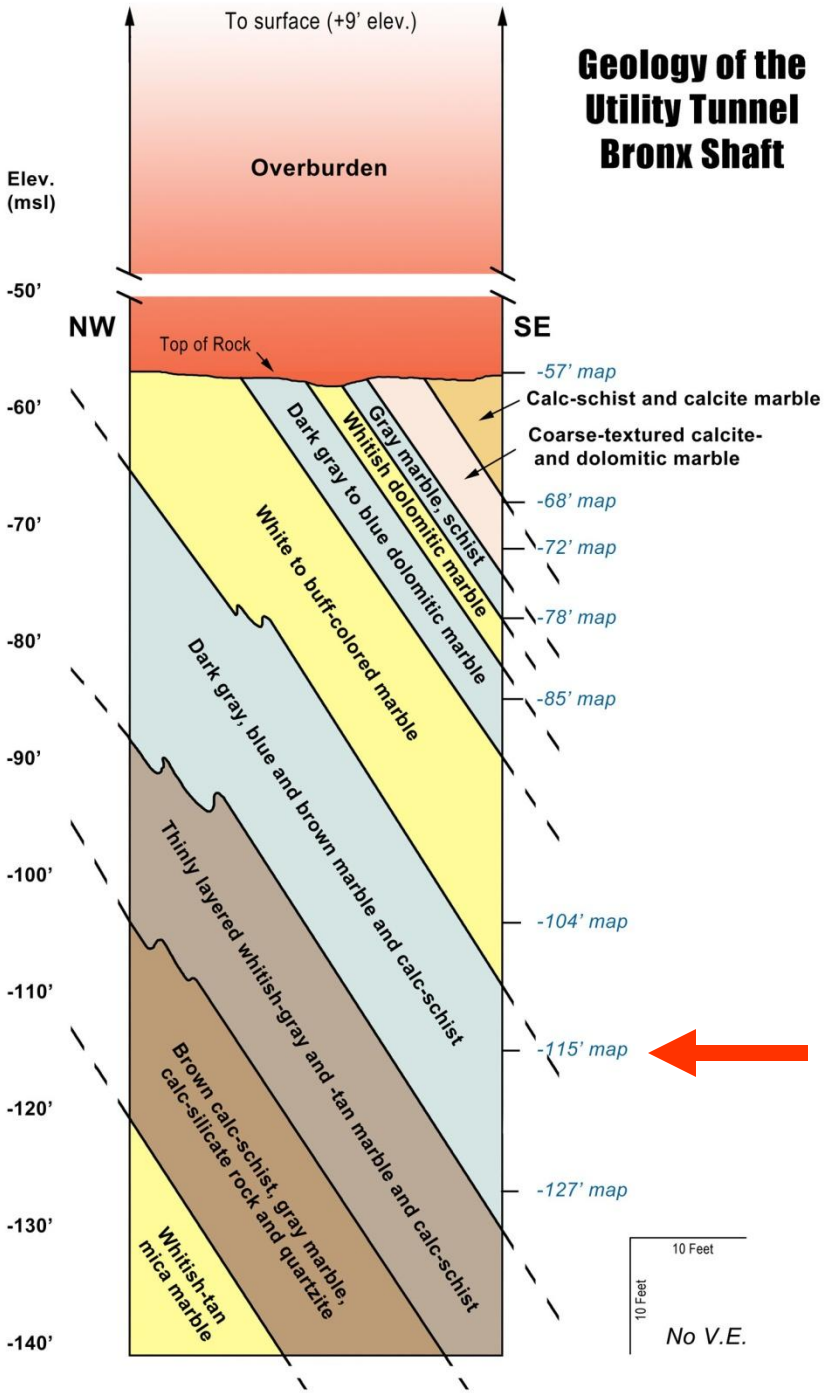
DUKE GEOLOGICAL LABORATORY
36 Fawn Lane
Westbury, NY 11590

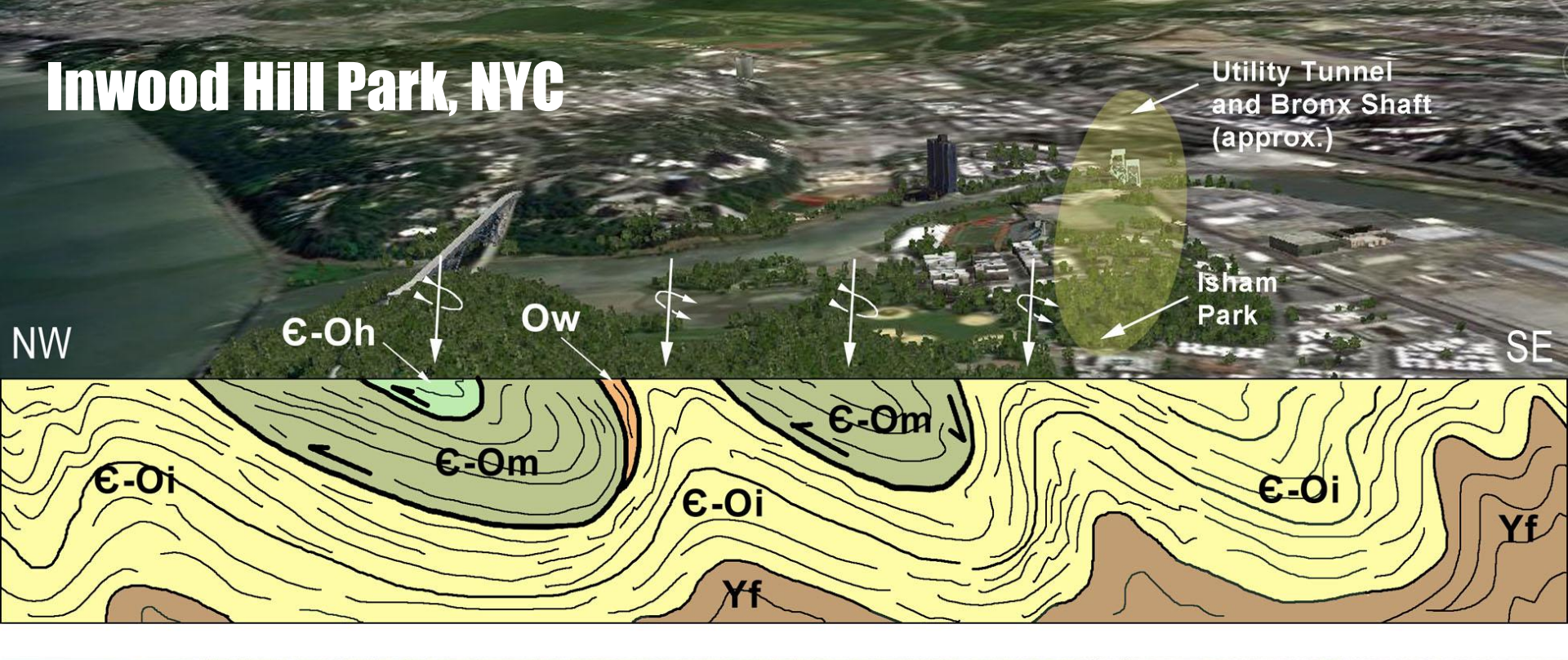
Map Prepared By:

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’




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


OK, That's It! I've Heard Enough!
Get To The Minerals!

Coloration in the Inwood Marble Facies

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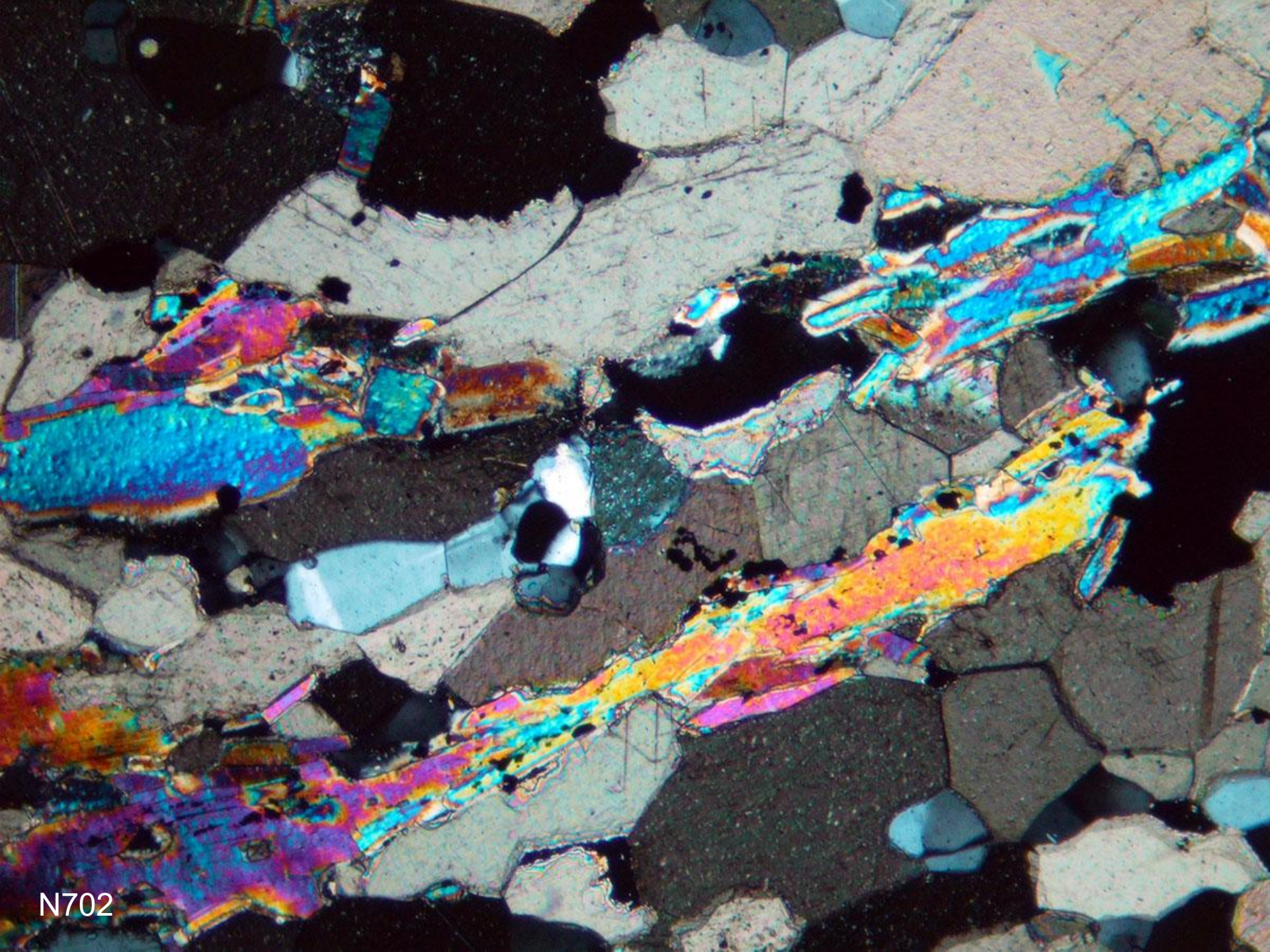
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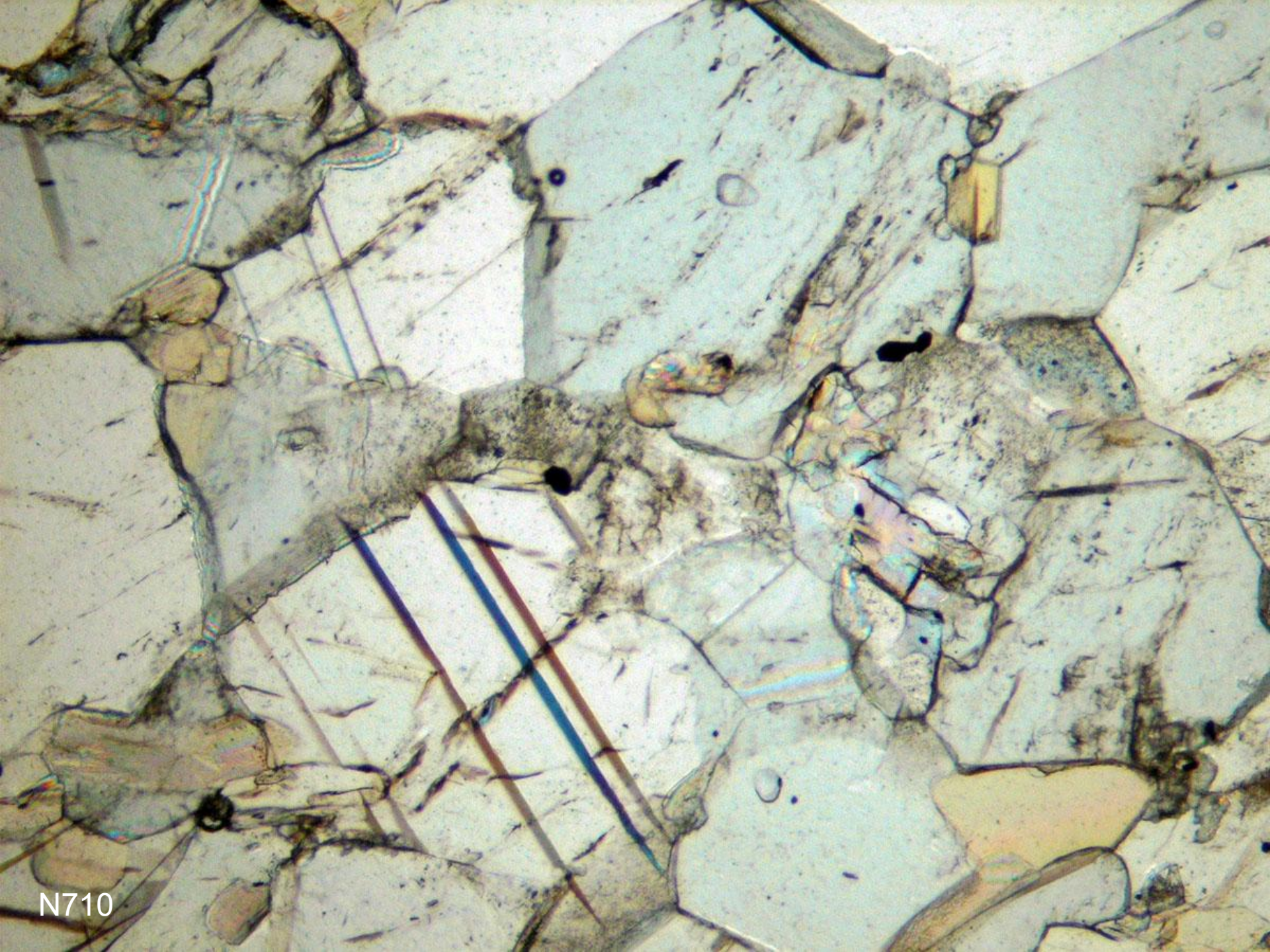
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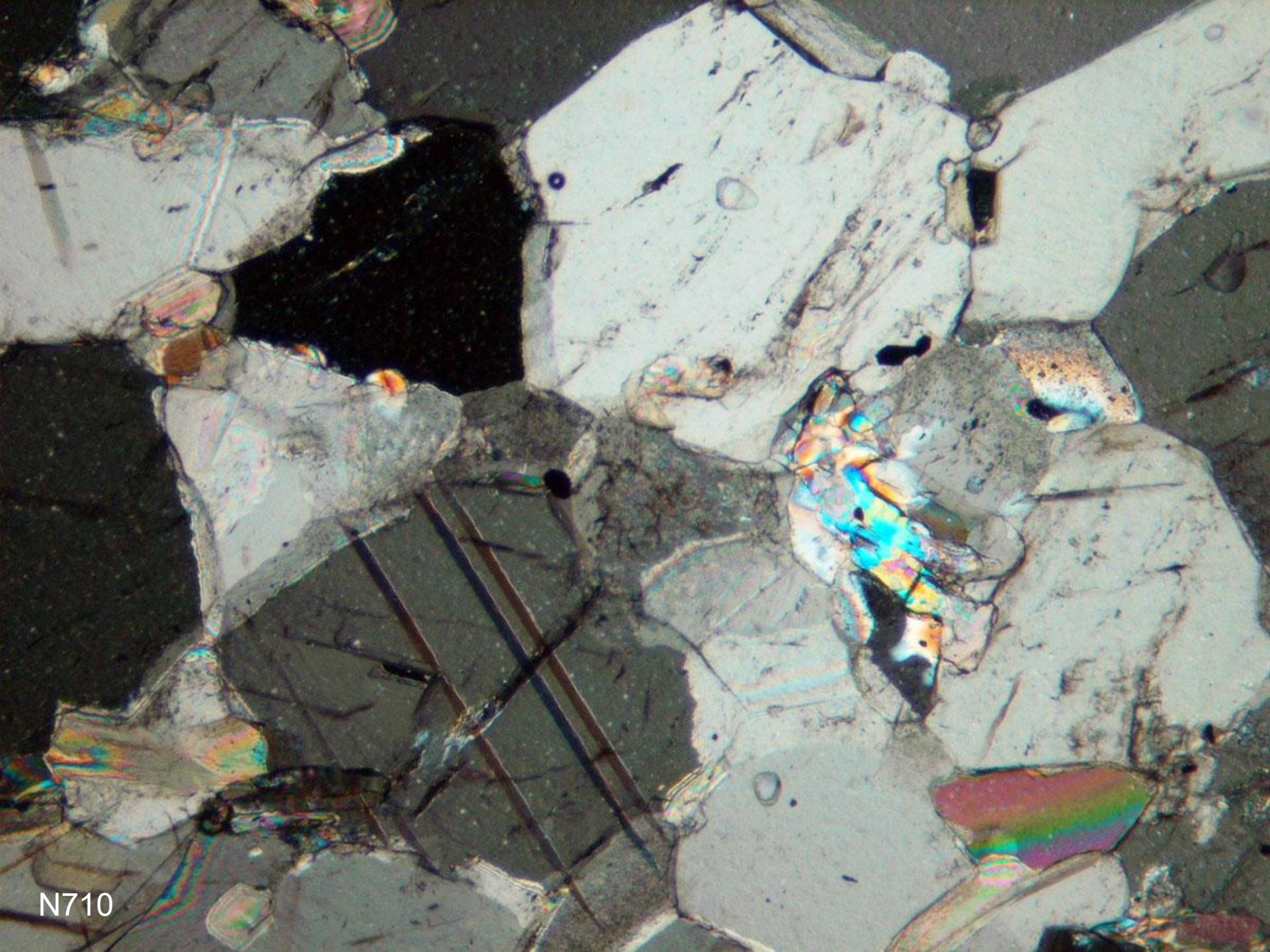
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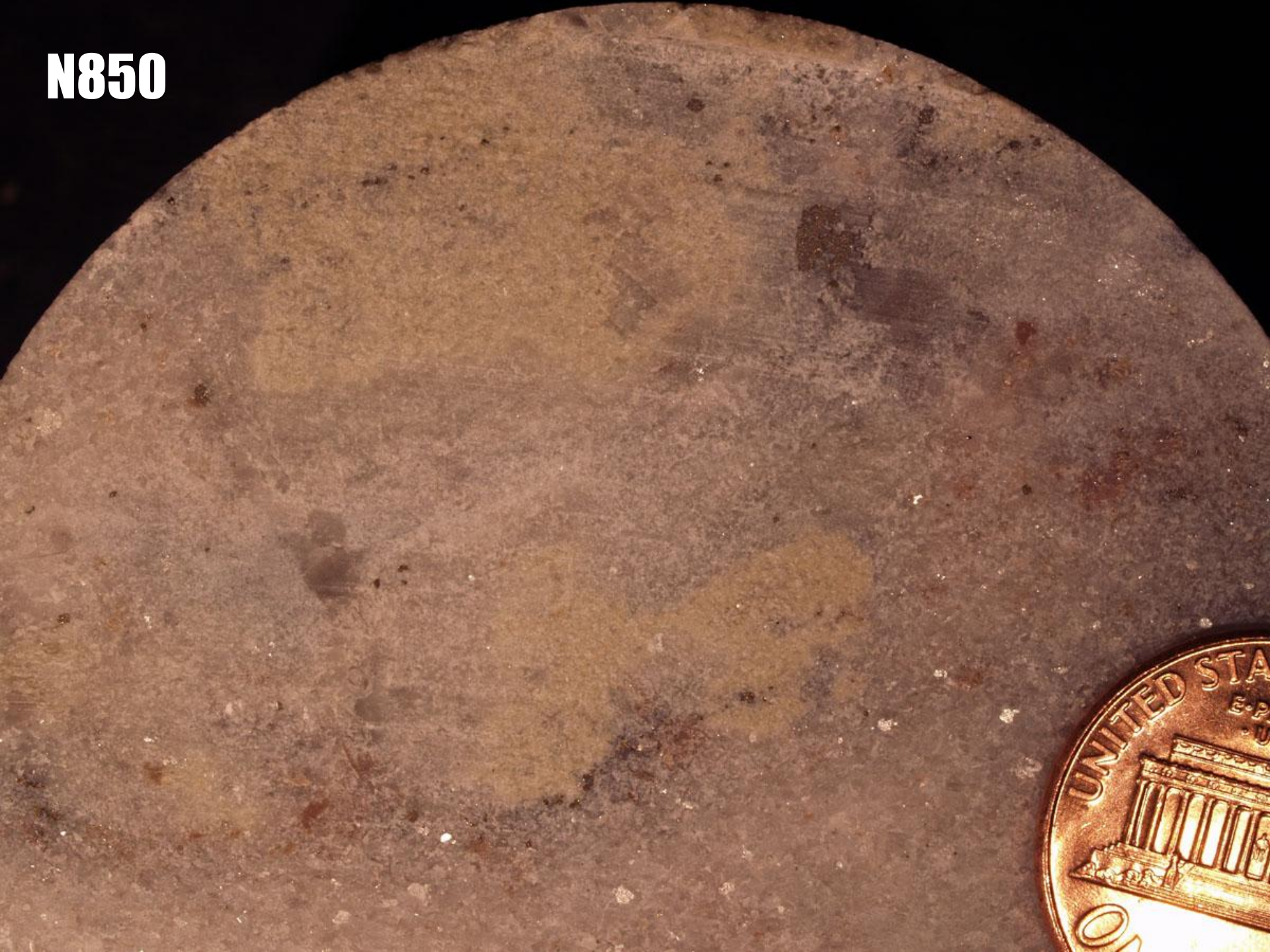
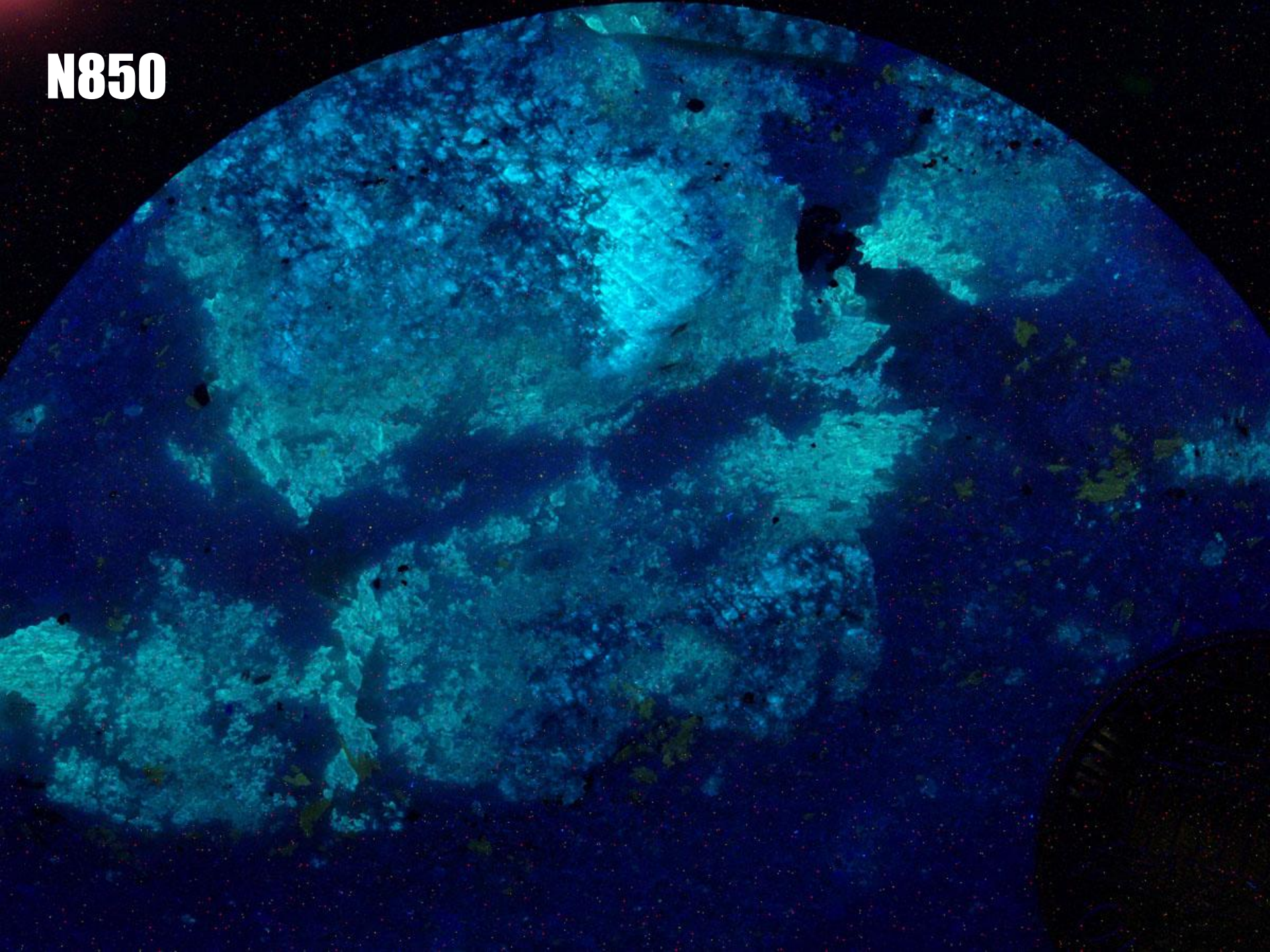
Dolo+Cal+
Diop
Py
Grph
Drv-Uv
Trem
Phlog

N850

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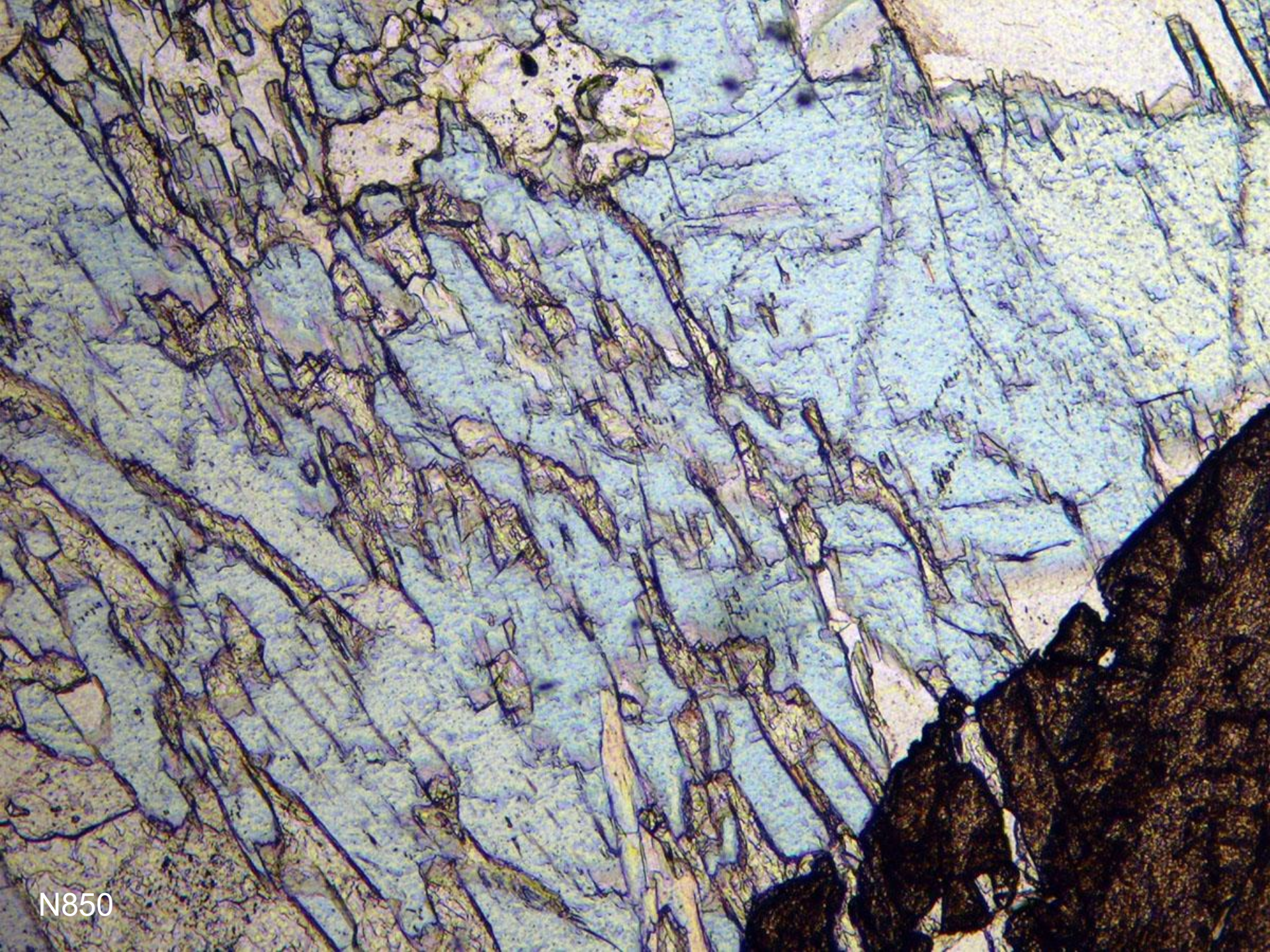
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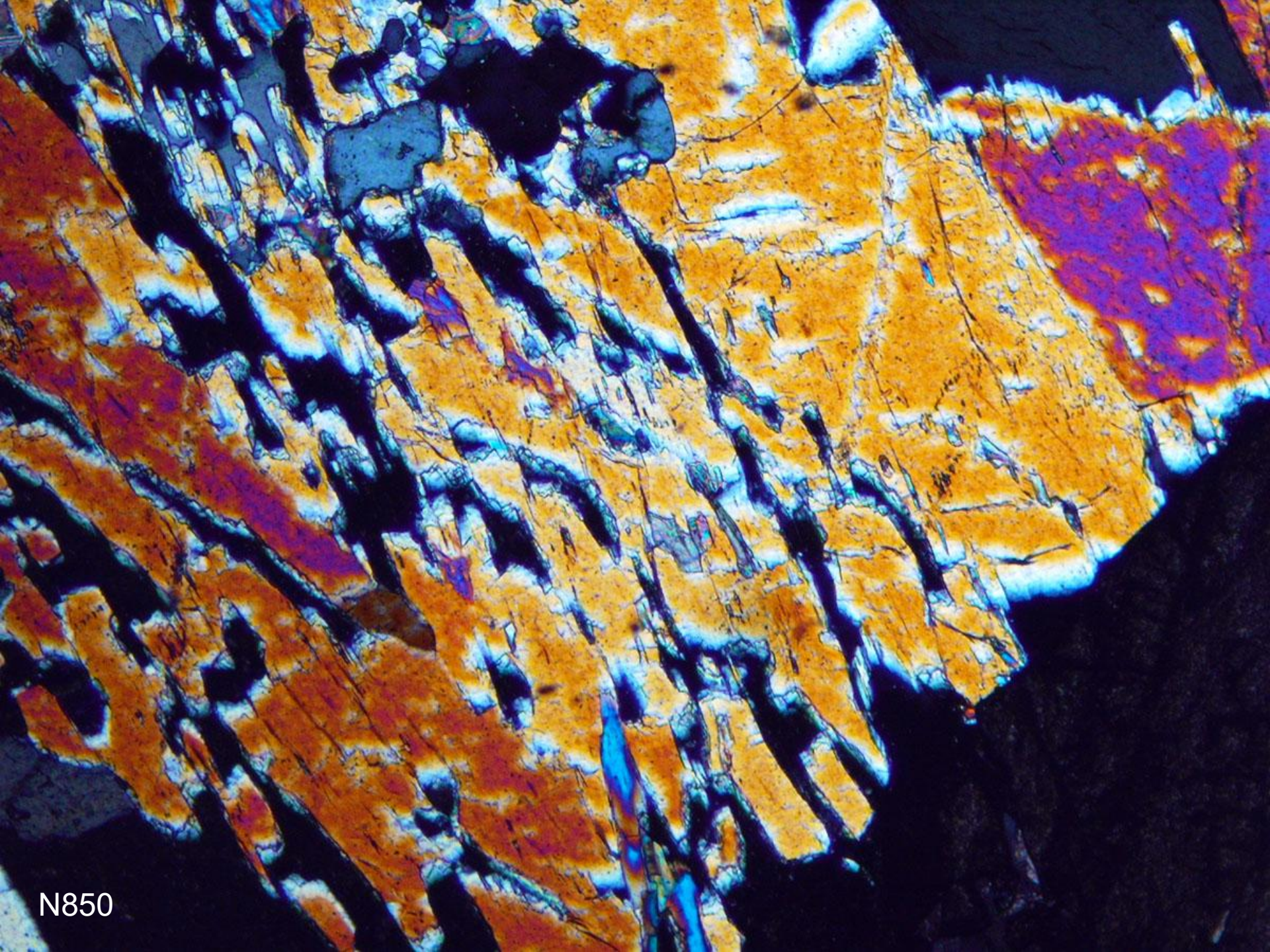
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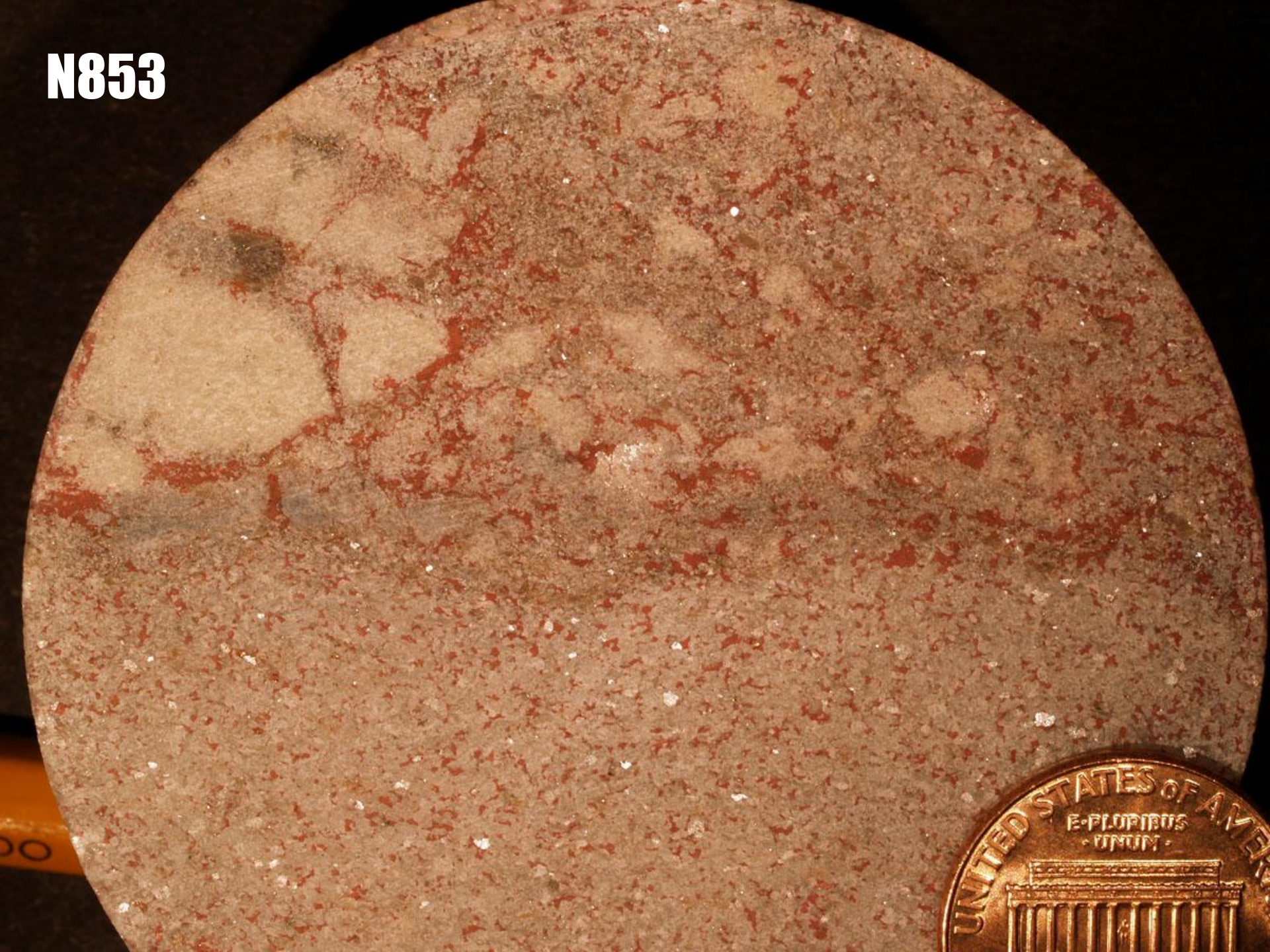
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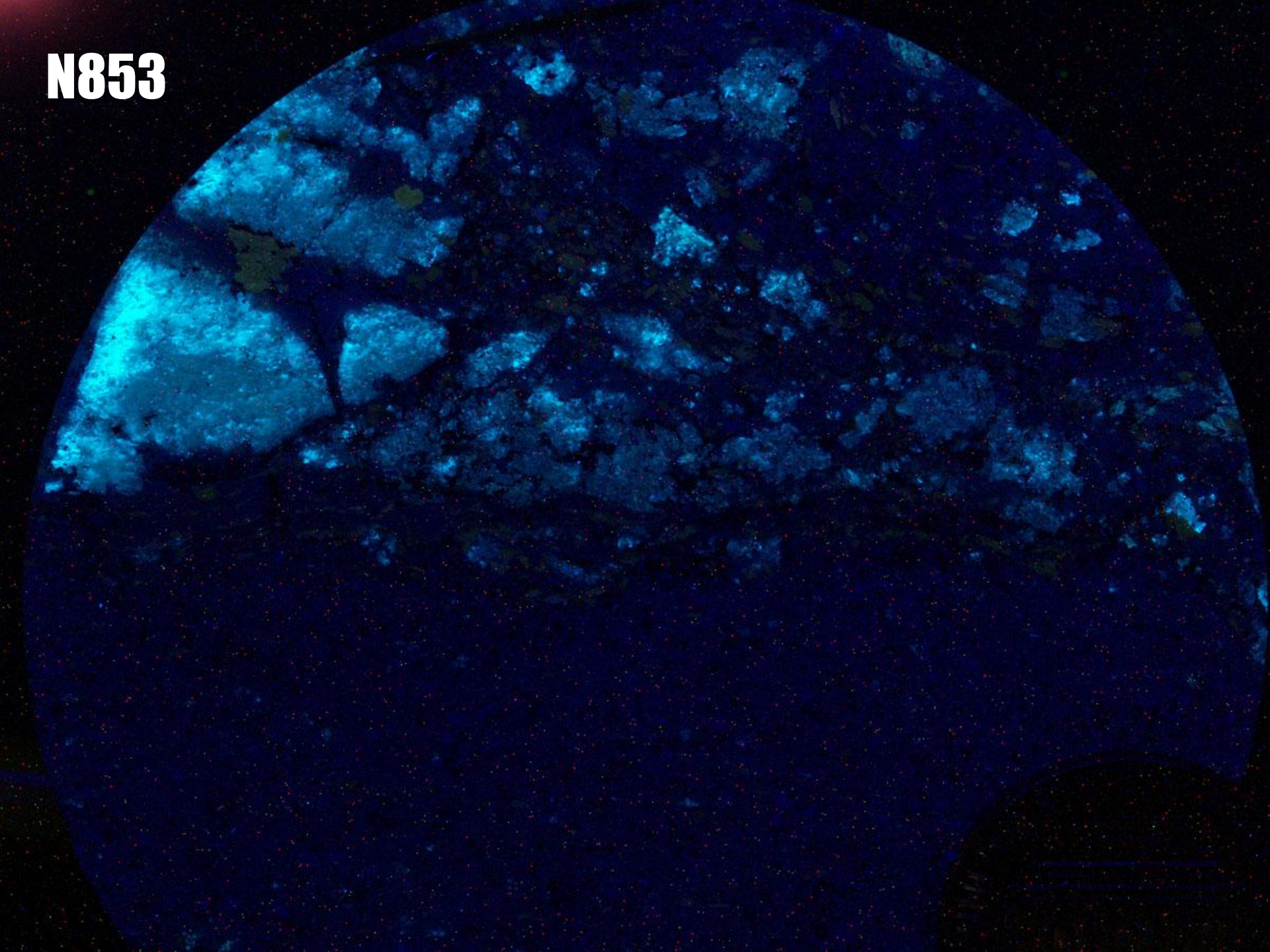
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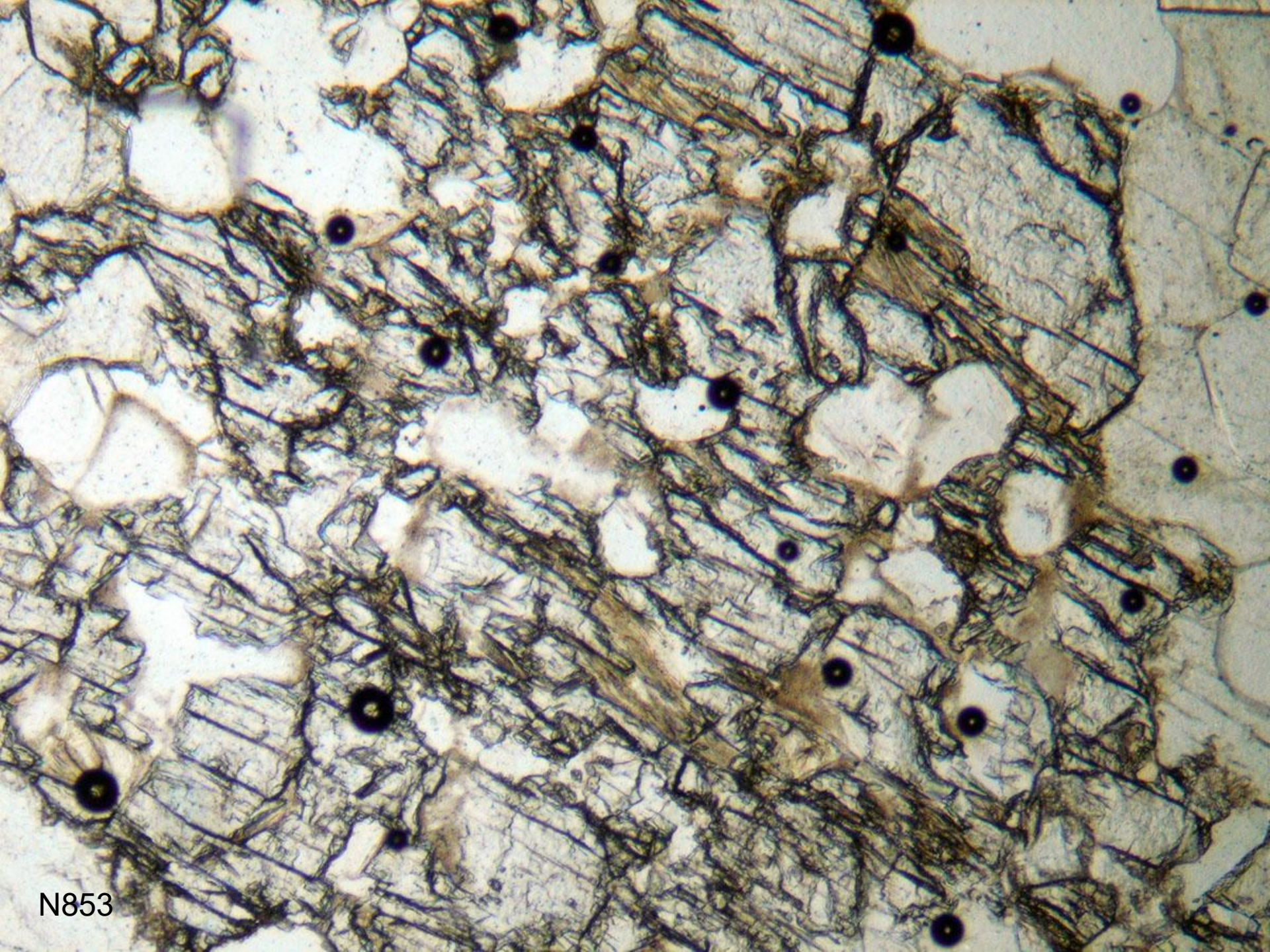
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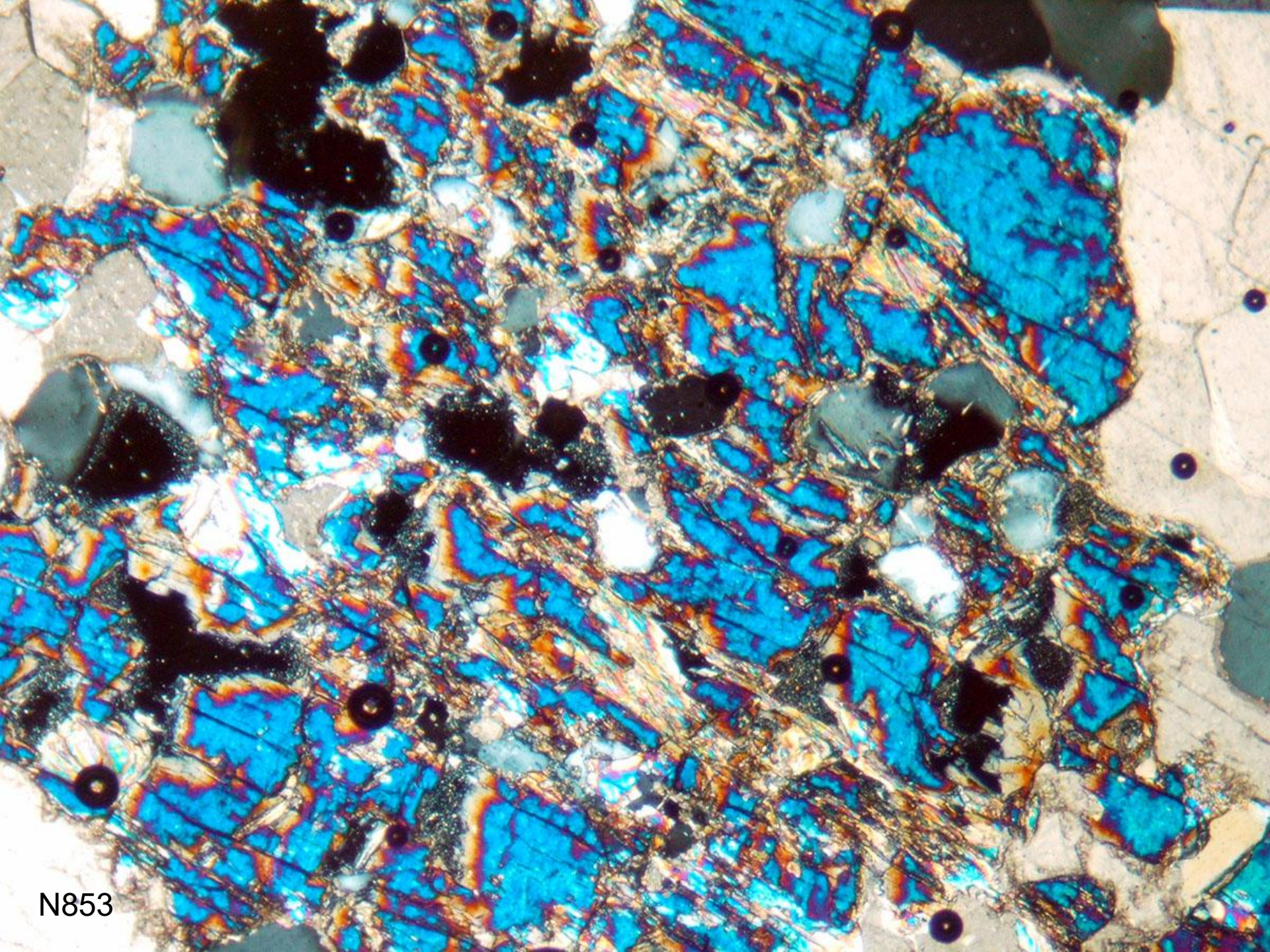
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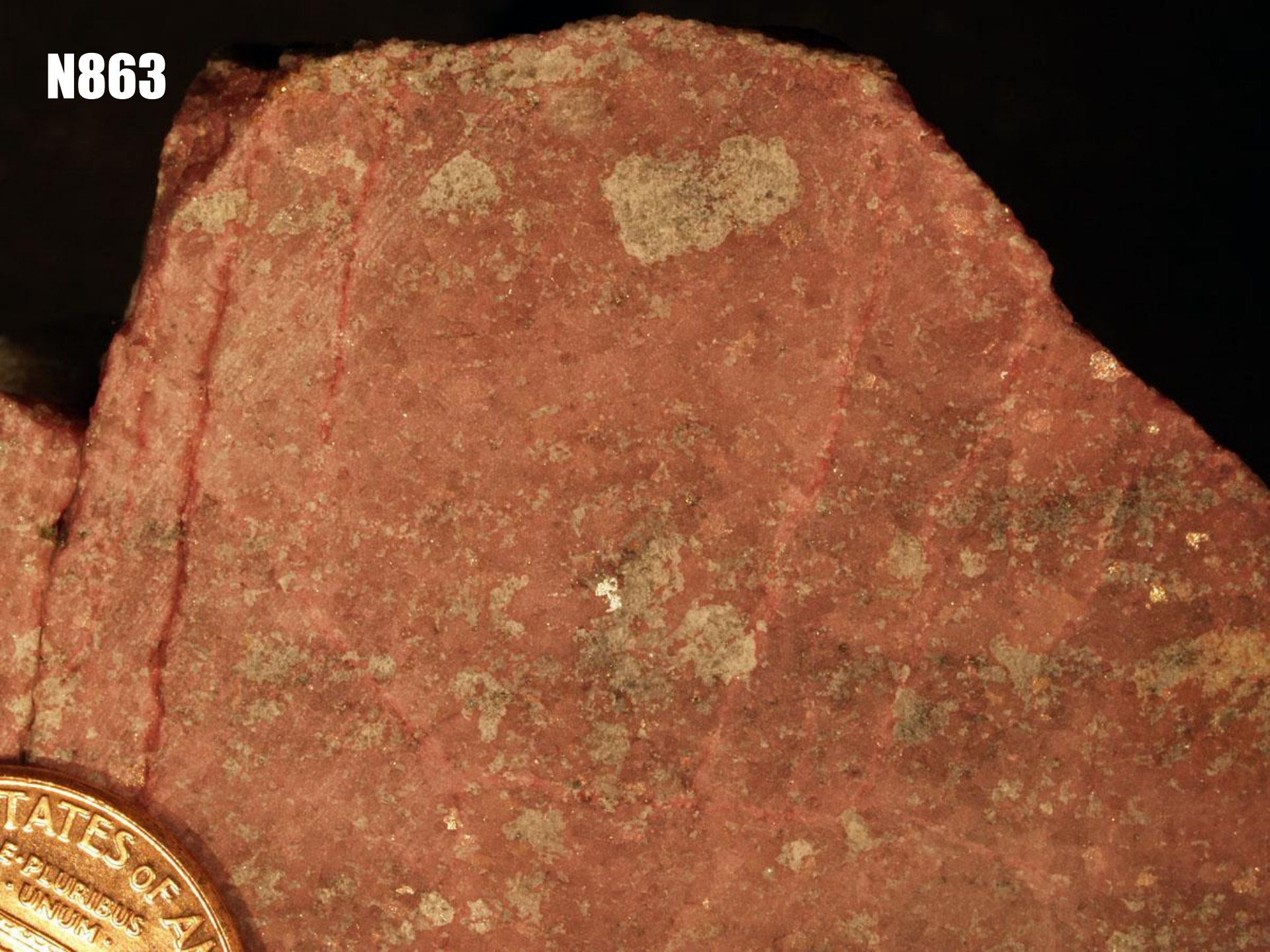
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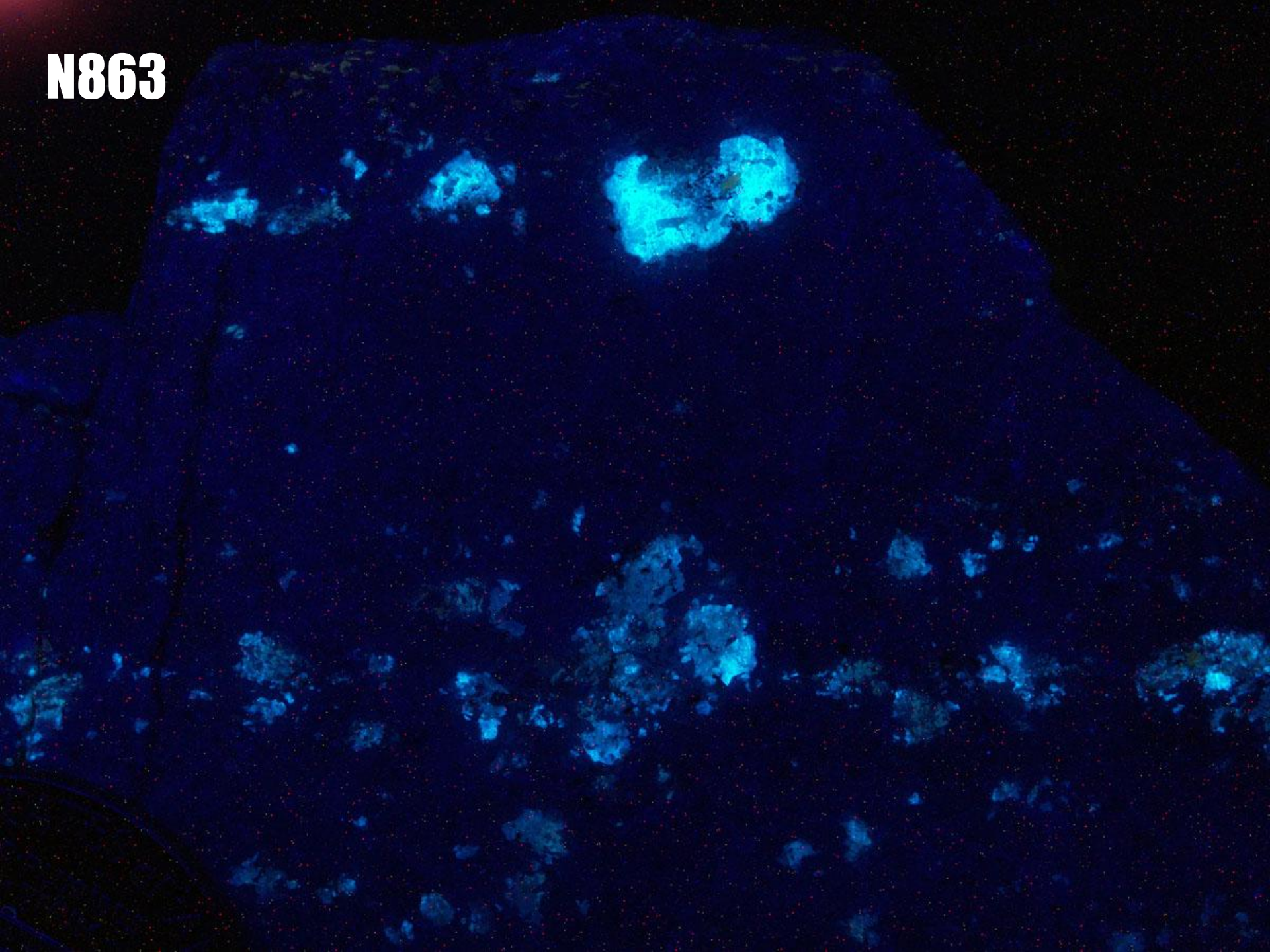
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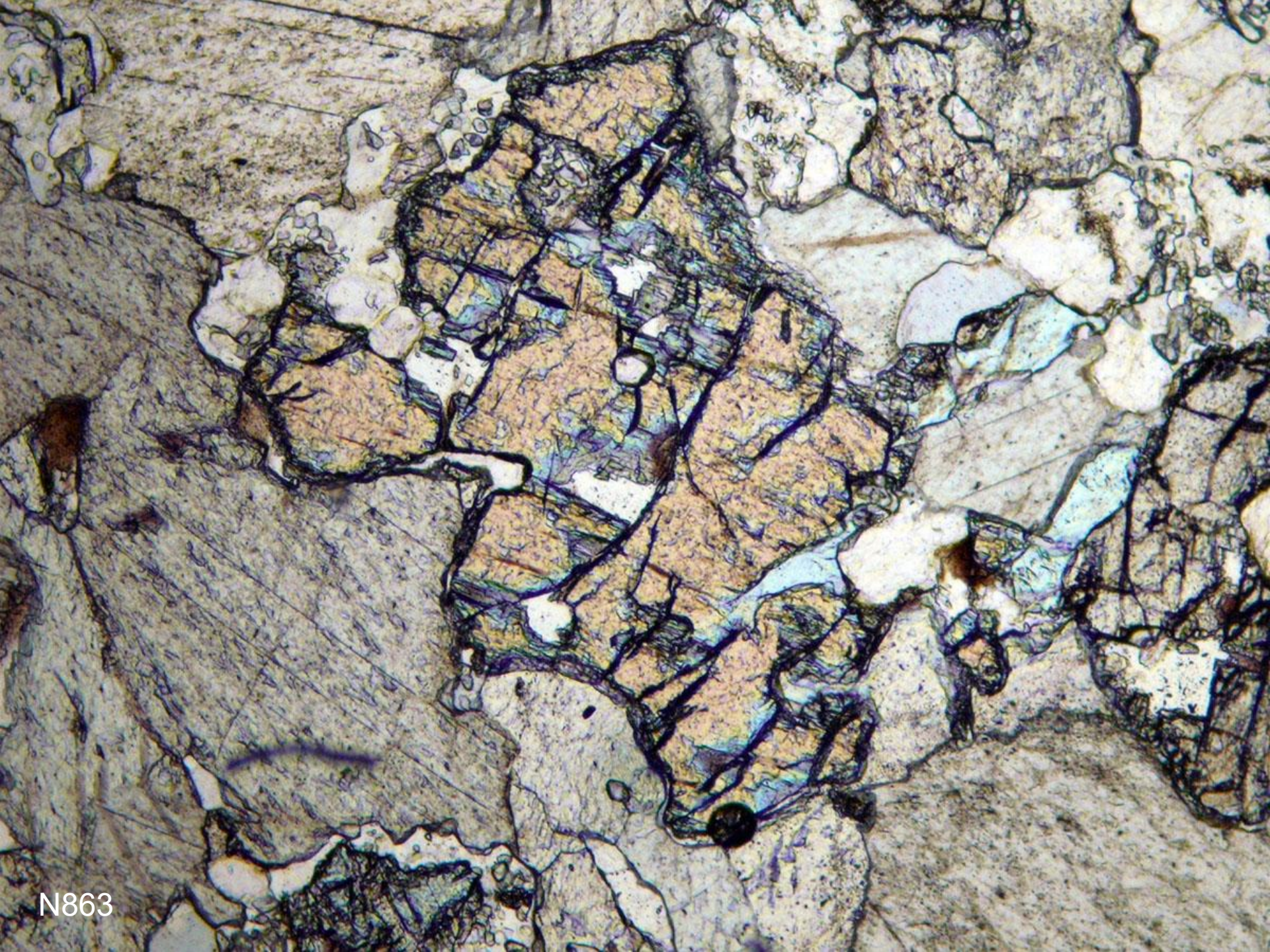
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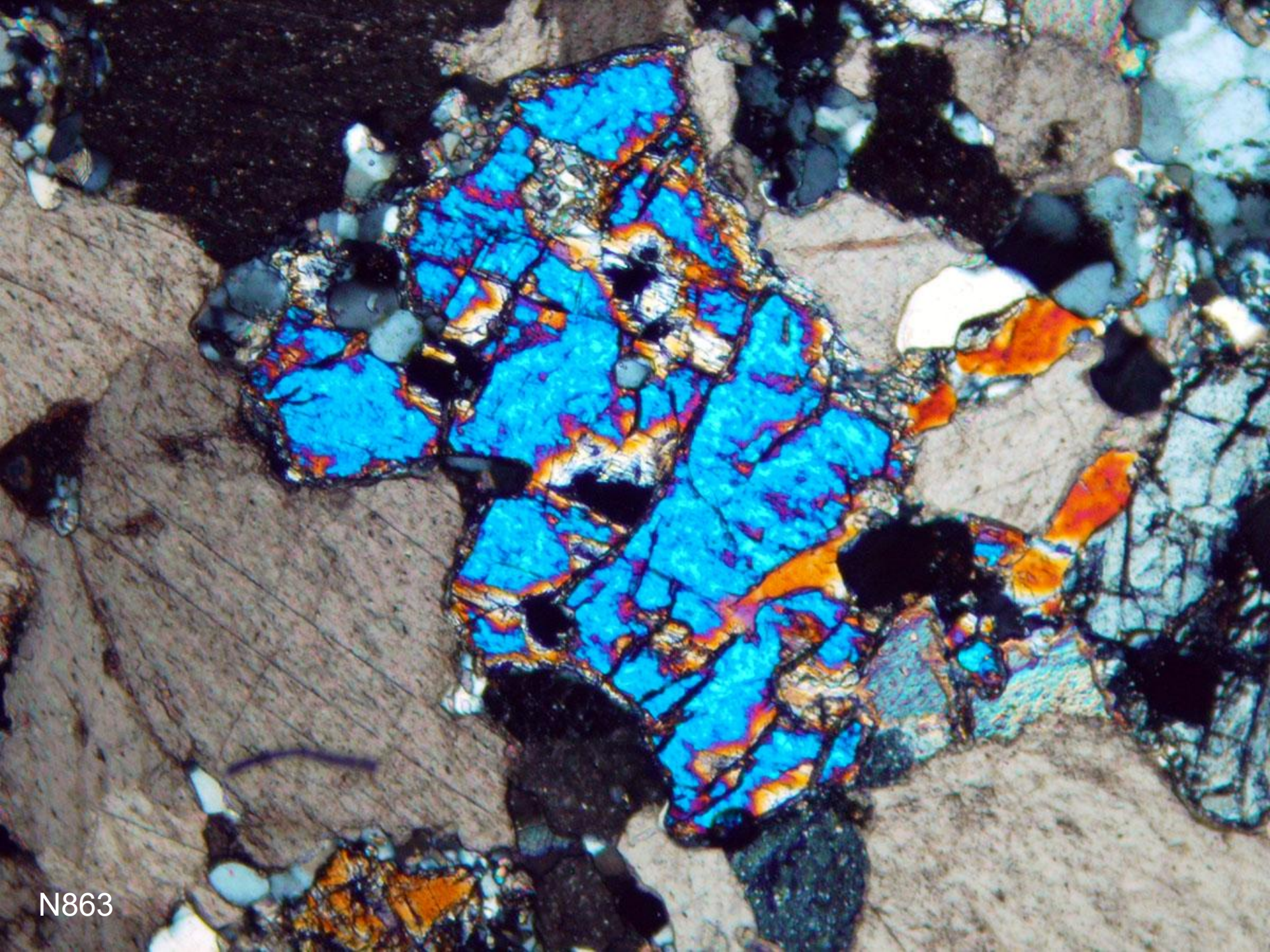
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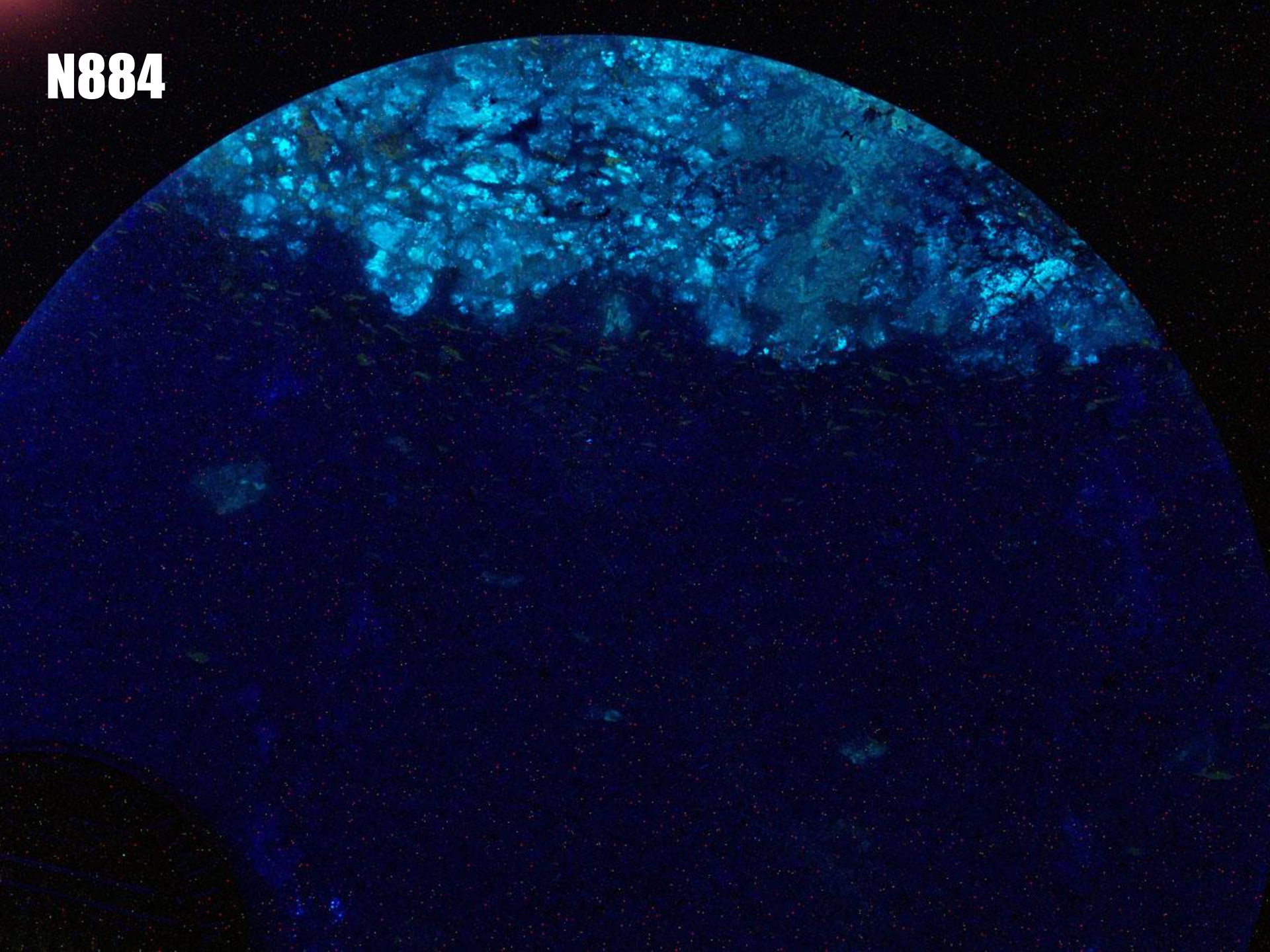
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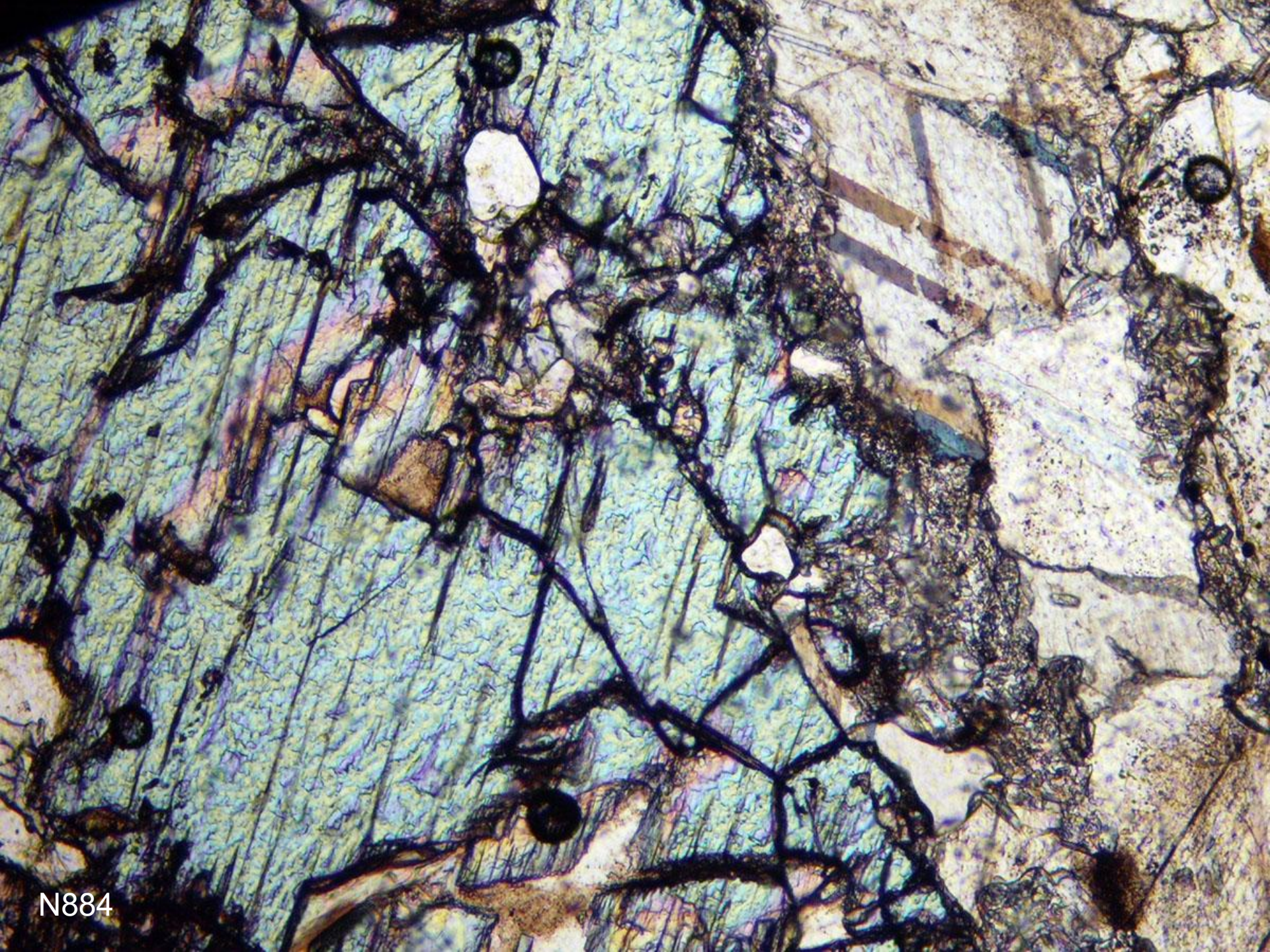
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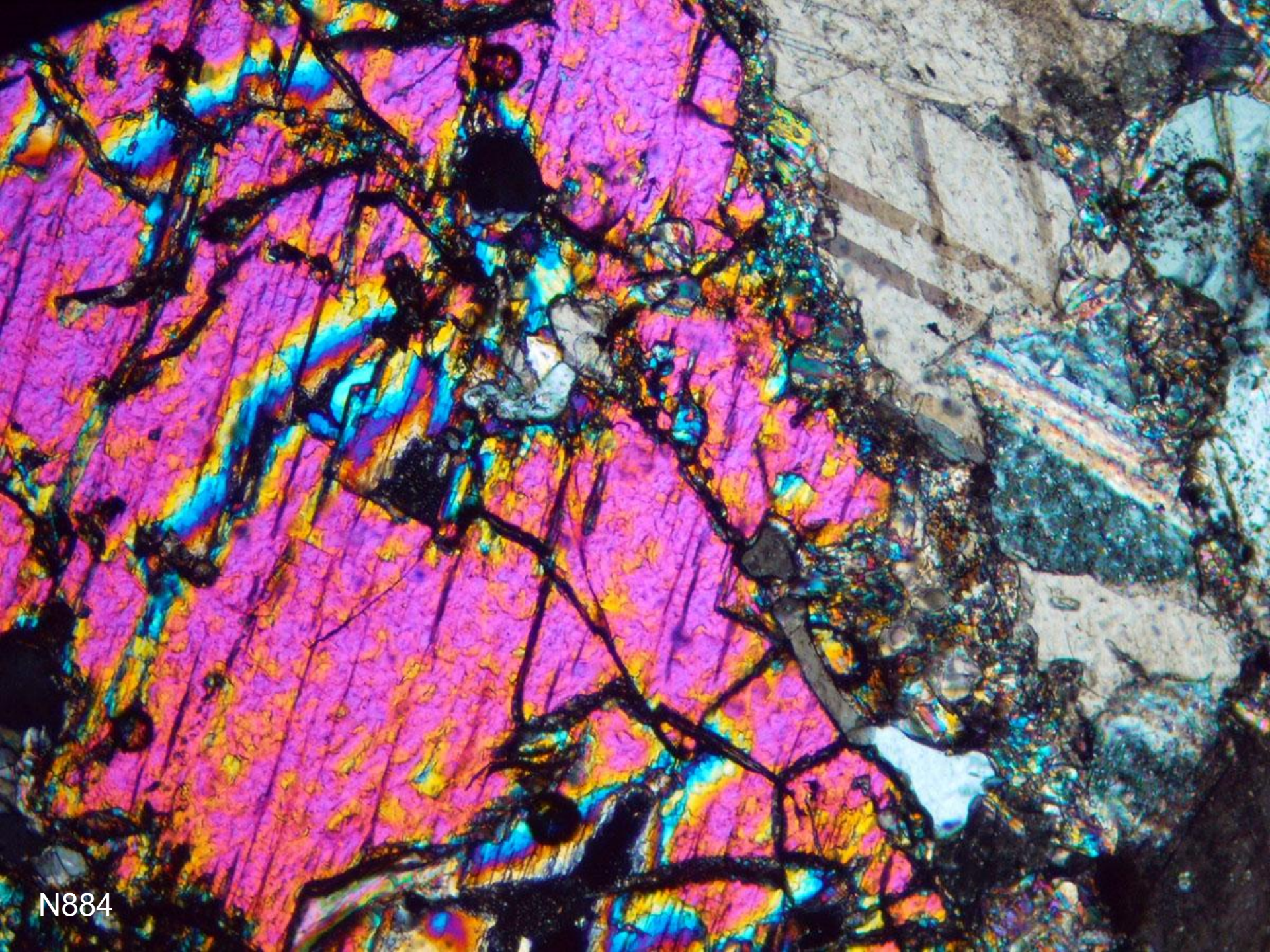
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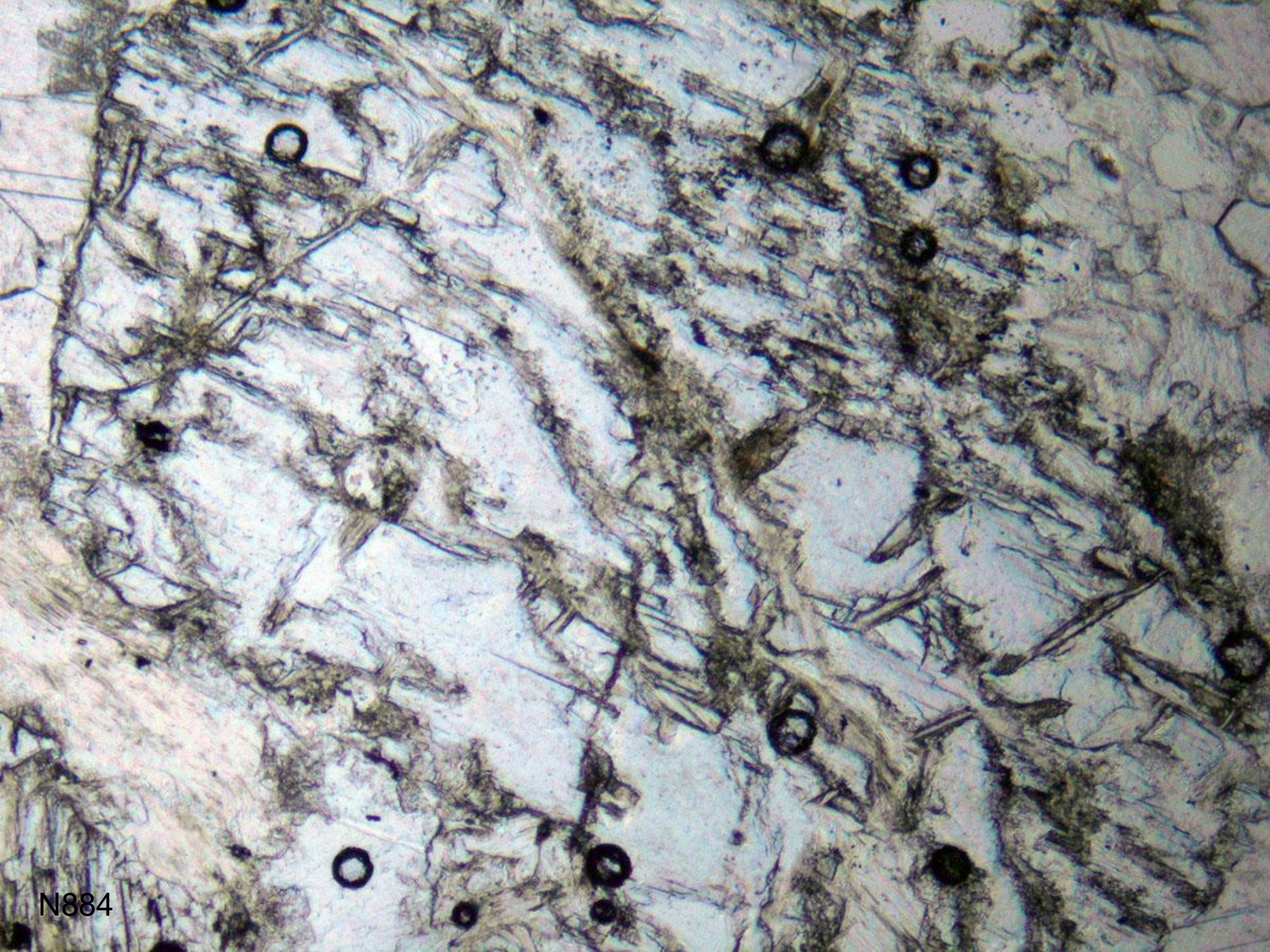
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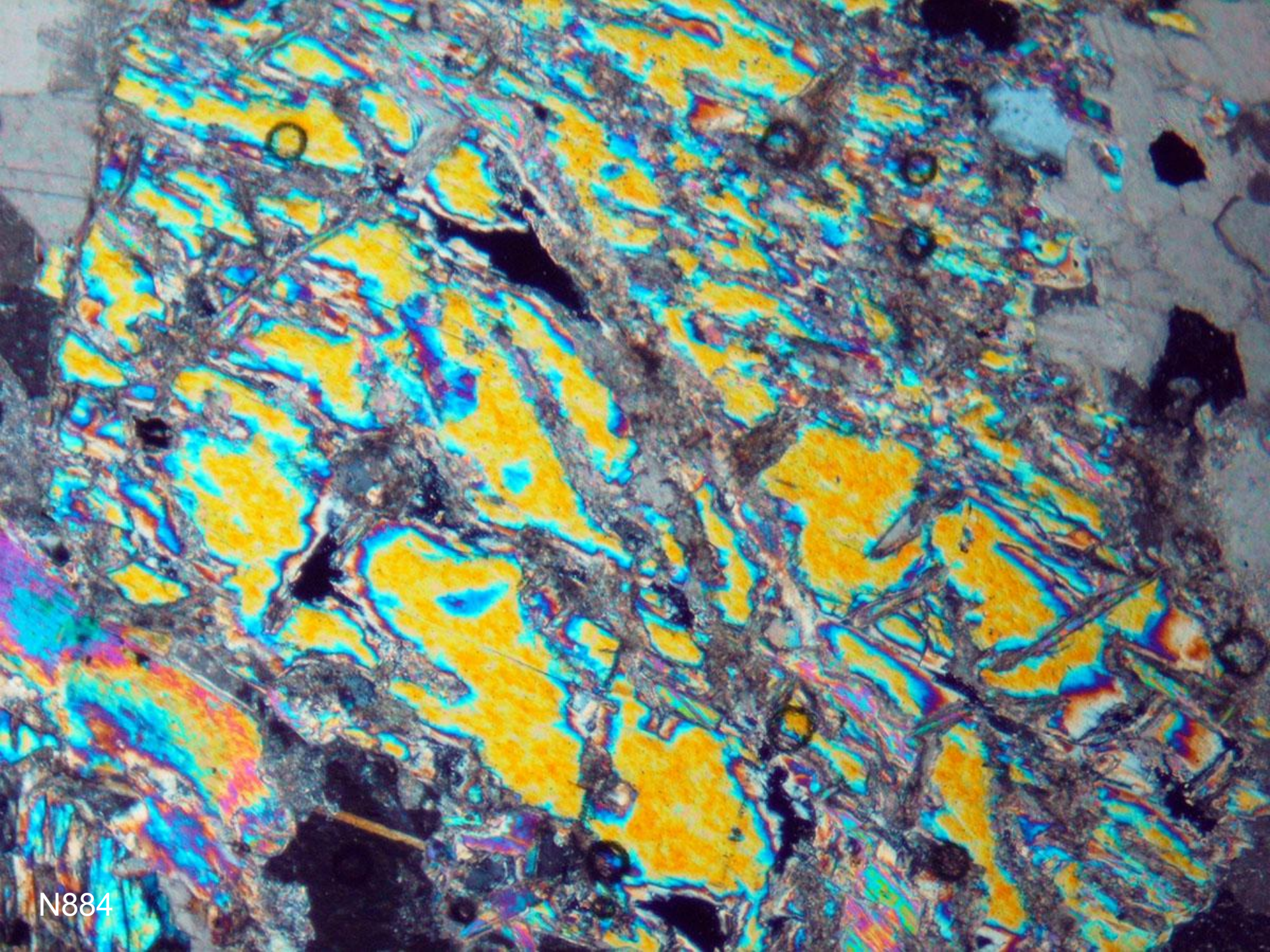
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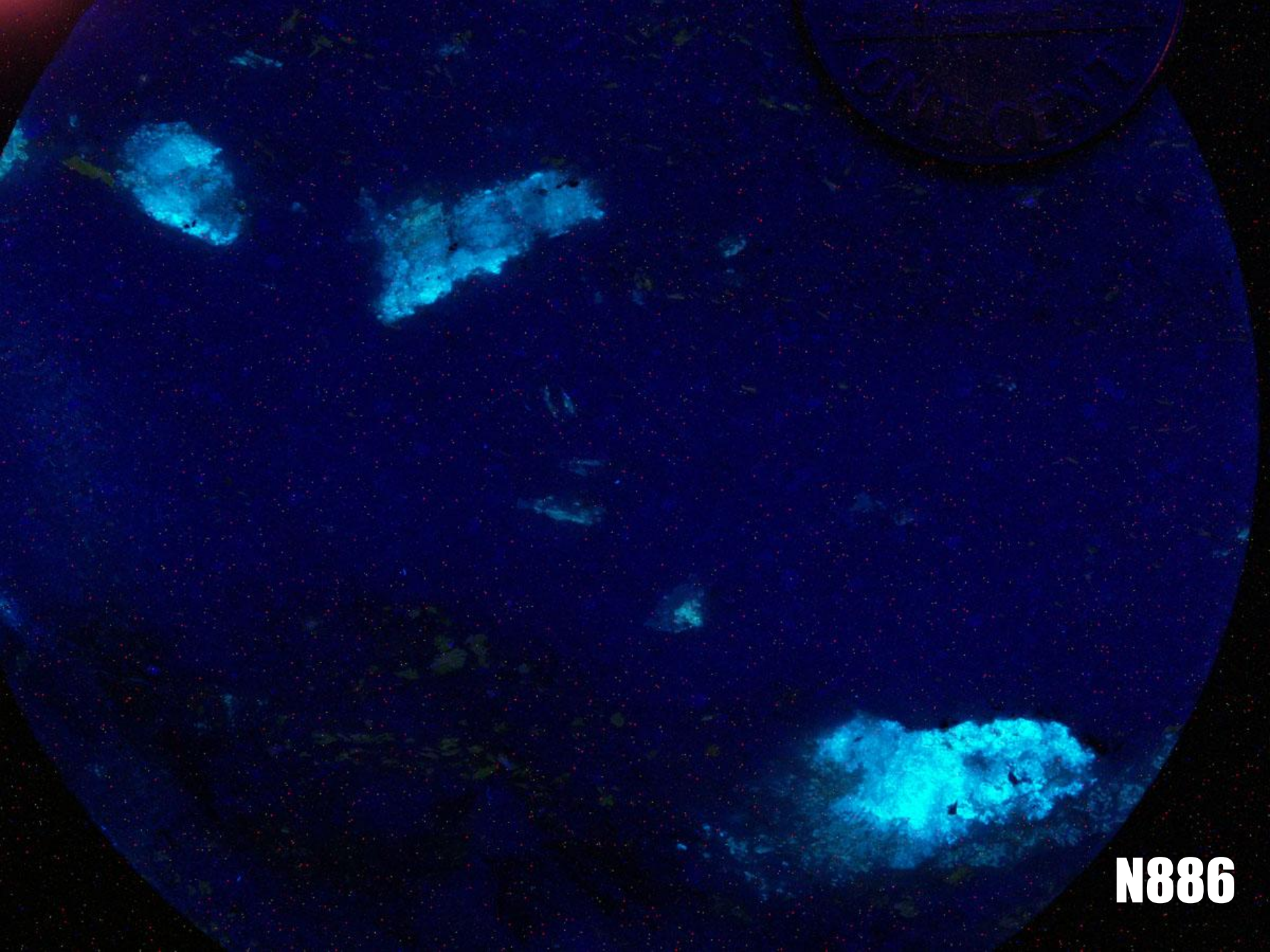
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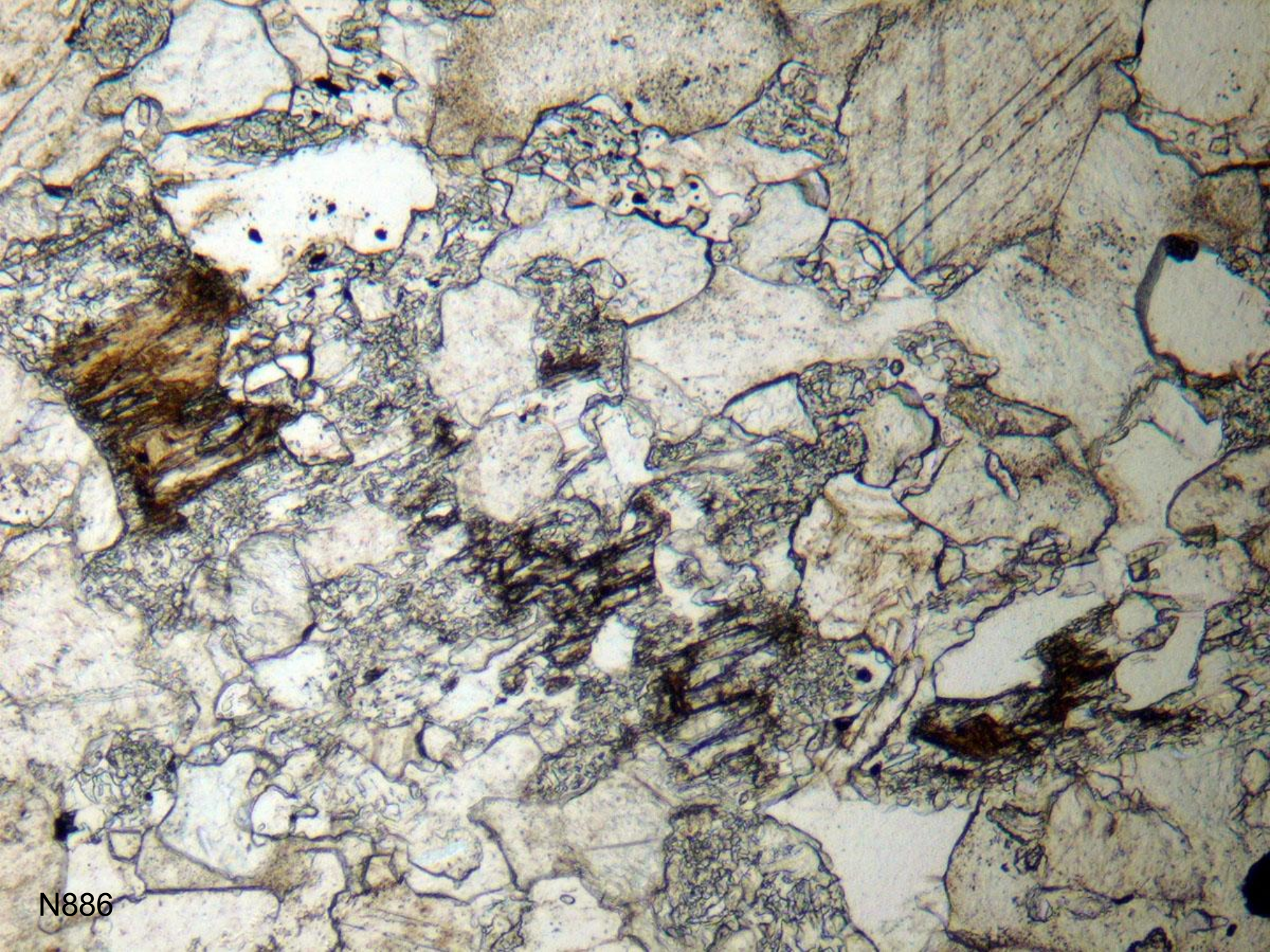
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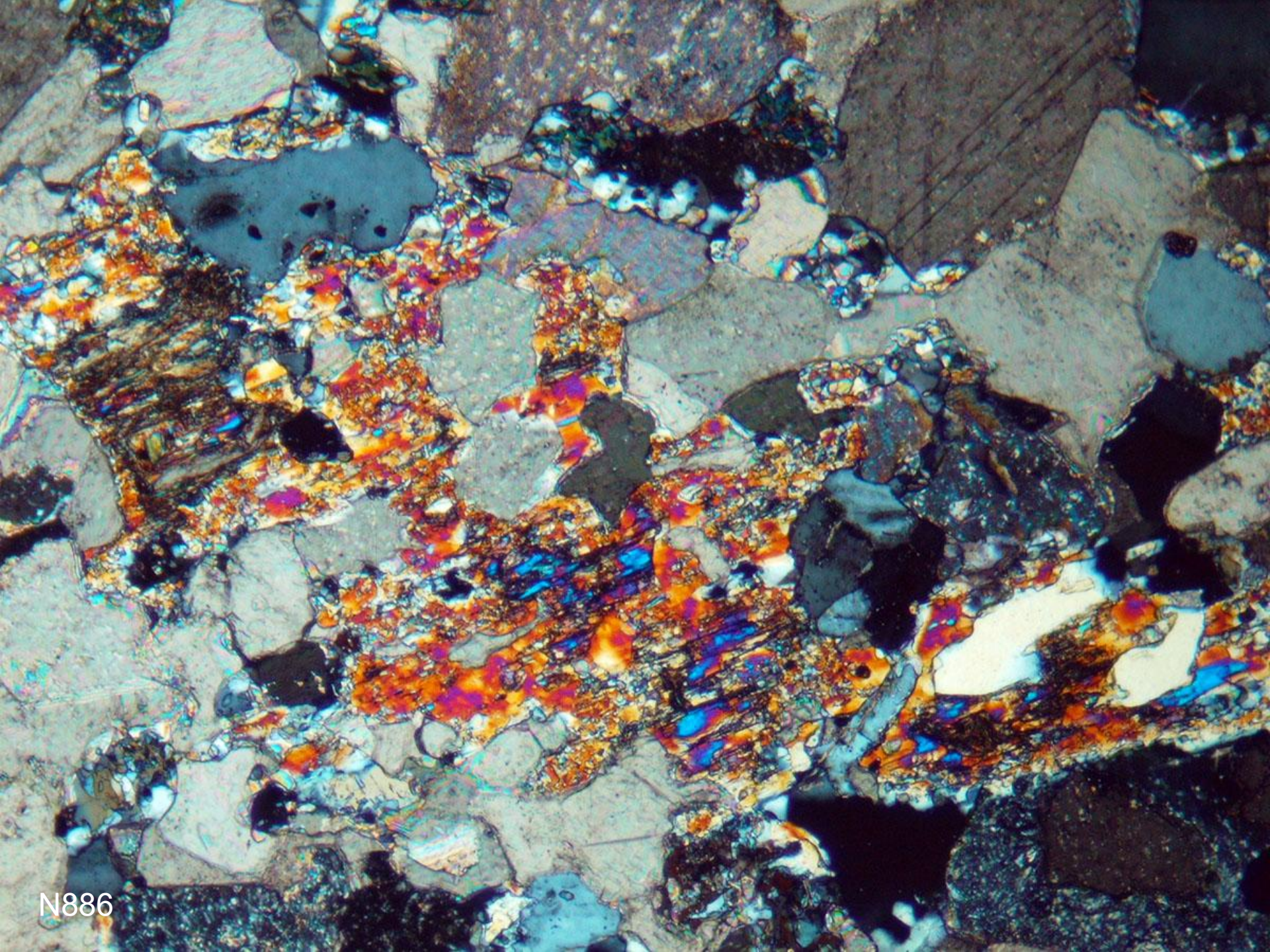
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Mineralogy of the Inwood Marble - NYC

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

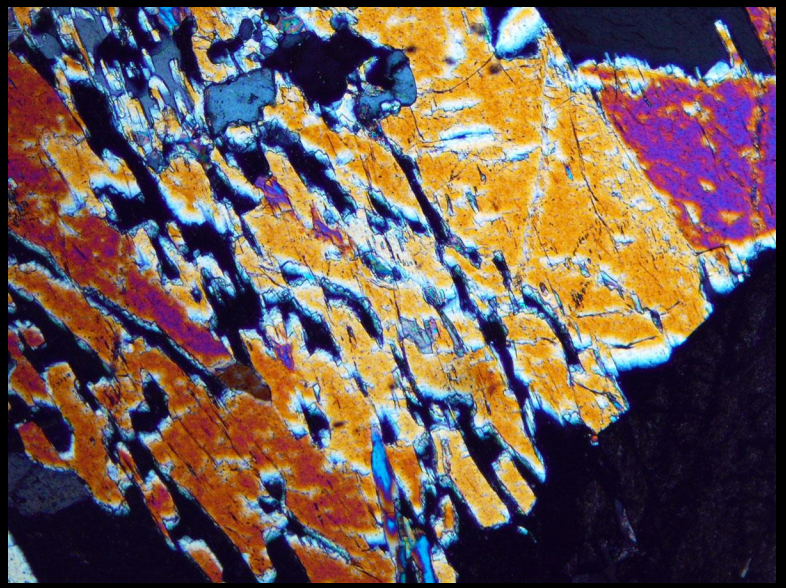
After Goodwin-Bell (2008)

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




Biting? There's No Biting in the Hamster Industry!
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