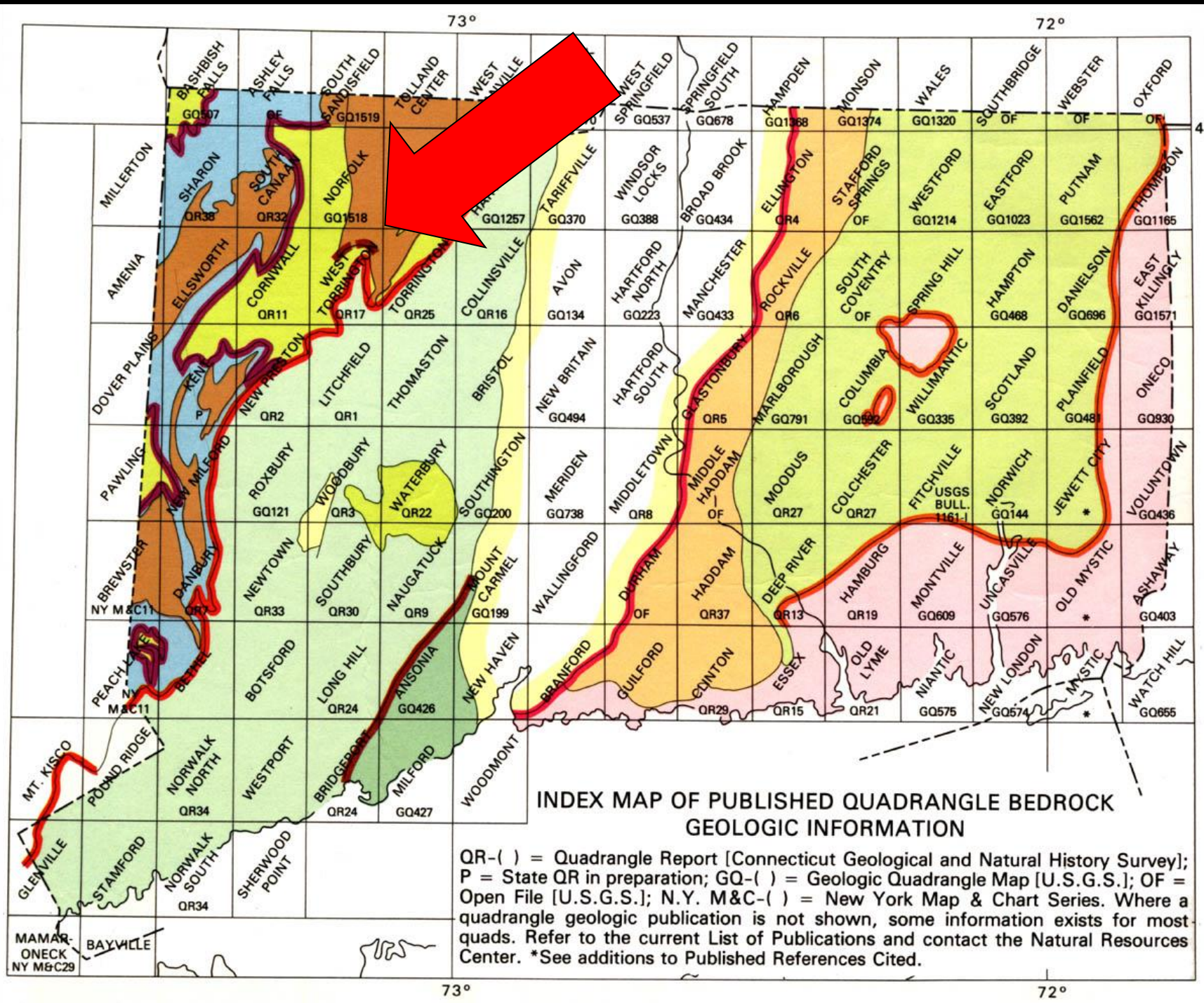
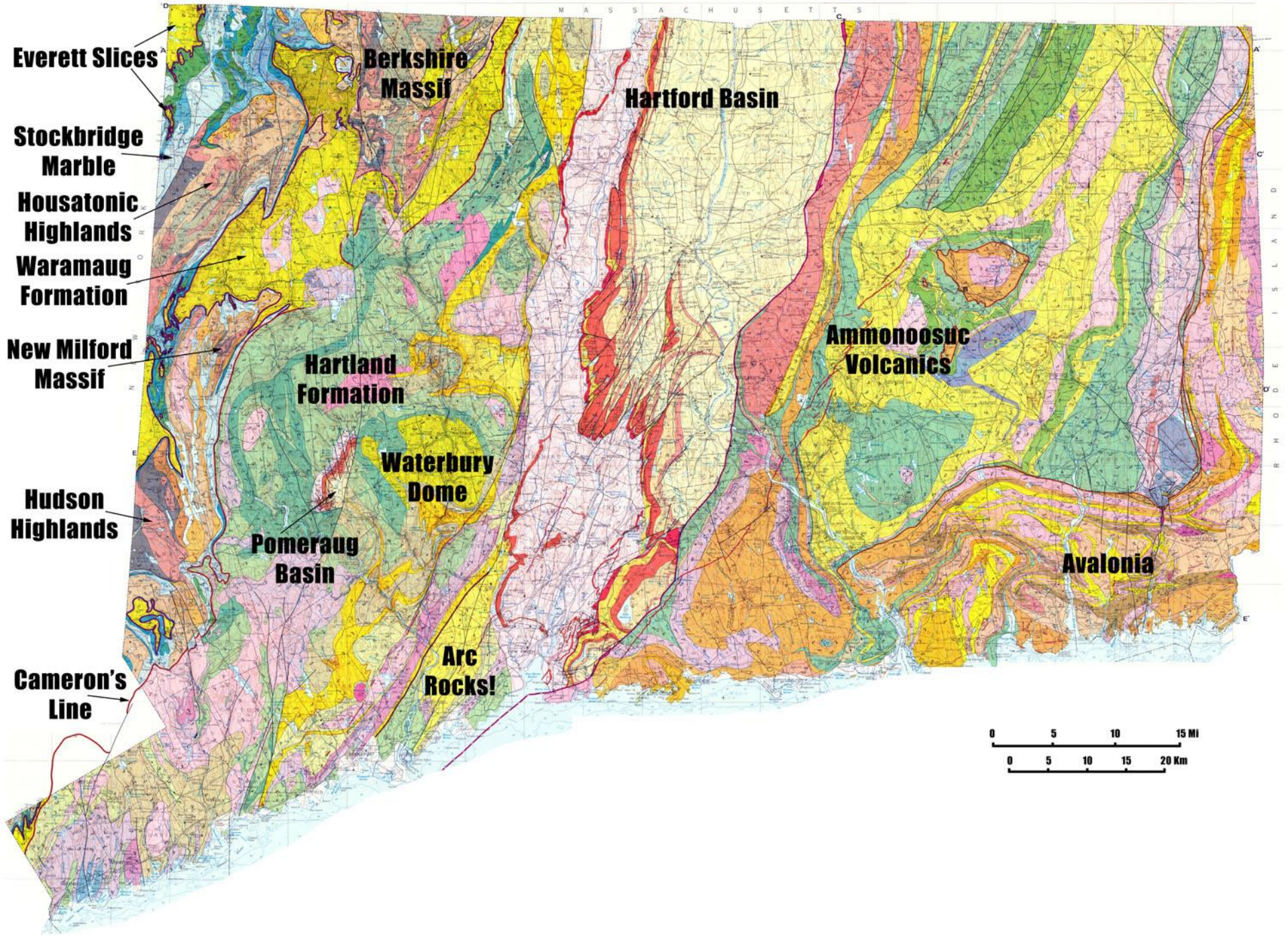
Wallrocks of the Hodges Complex and Tyler Lake Granite, West Torrington, CT

Charles Merguerian
Duke Geological Laboratory
Stone Ridge, NY


73°
72°
BASHBISH FALLS GQ507
ASHLEY FALLS OF
SOUTH SANDISFIELD GQ1519
TOLLAND CENTER
WEST SPRINGFIELD GQ537
SPRINGFIELD SOUTH GQ678
HAMPDEN GQ1368
MONSON GQ1374
WALES GQ1320
SOUTHBRIDGE OF
WEBSTER OF
OXFORD OF
MILLERTON
SHARON QR38
SOUTH CANAAN QR32
NORFOLK GQ1518
TARIFFVILLE GQ370
WINDSOR LOCKS GQ388
BROAD BROOK GQ434
ELLINGTON QR4
STAFFORD SPRINGS OF
WESTFORD GQ1214
EASTFORD GQ1023
PUTNAM GQ1562
THOMPSON GQ1165
AMENIA
ELLSWORTH
CORNWALL QR11
WEST TORRINGTON QR17
TORRINGTON QR25
COLLINSVILLE QR16
AVON GQ134
HARTFORD NORTH GQ223
MANCHESTER GQ433
ROCKVILLE QR6
SOUTH COVENTRY OF
SPRING HILL
HAMPTON GQ468
DANIELSON GQ696
EAST KILLINGLY GQ1571
DOVER PLAINS
KENT P
NEW PRESTON QR2
LITCHFIELD QR1
THOMASTON
BRISTOL
NEW BRITAIN GQ494
HARTFORD SOUTH
GLASTONBURY QR5
MARLBOROUGH GQ791
COLUMBIA GQ592
WILLIMANTIC GQ335
SCOTLAND GQ392
PLAINFIELD GQ481
ONECO GQ930
PAWLING
NEW MILFORD
ROXBURY GQ121
WOODBURY QR3
WATERBURY QR22
SOUTHINGTON GQ200
MERIDEN GQ738
MIDDLETOWN QR8
MIDDLE HADDAM OF
MOODUS QR27
COLCHESTER QR27
FITCHVILLE USGS BULL. 1161-I
NORWICH GQ144
JEWETT CITY *
VOLUNTOWN GQ436
BREWSTER NY M&C11
DANBURY QR7
NEWTOWN QR33
SOUTHBURY QR30
NAUGATUCK QR9
MOUNT CARMEL GQ199
WALLINGFORD
DURHAM OF
HADDAM QR37
DEEP RIVER QR13
HAMBURG QR19
MONTVILLE GQ609
UNCASVILLE GQ576
OLD MYSTIC *
ASHAWAY GQ403
PEACH LAKE NY M&C11
BETHEL
BOTSFORD
LONG HILL QR24
ANSONIA GQ426
NEW HAVEN
BRANFORD
GUILFORD
CLINTON QR29
ESSEX QR15
OLD LYME QR21
NIANTIC GQ575
NEW LONDON GQ574
MYSTIC *
WATCH HILL GQ655
MT. KISCO
POUND RIDGE
NORWALK NORTH QR34
WESTPORT
BRIDGEPORT QR24
MILFORD GQ427
WOODMONT
GLENVILLE
STAMFORD
NORWALK SOUTH QR34
SHERWOOD POINT
MAMARONECK NY M&C29
BAYVILLE
INDEX MAP OF PUBLISHED QUADRANGLE BEDROCK GEOLOGIC INFORMATION
QR-( ) = Quadrangle Report [Connecticut Geological and Natural History Survey]; P = State QR in preparation; GQ-( ) = Geologic Quadrangle Map [U.S.G.S.]; OF = Open File [U.S.G.S.]; N.Y. M&C-( ) = New York Map & Chart Series. Where a quadrangle geologic publication is not shown, some information exists for most quads. Refer to the current List of Publications and contact the Natural Resources Center. *See additions to Published References Cited.

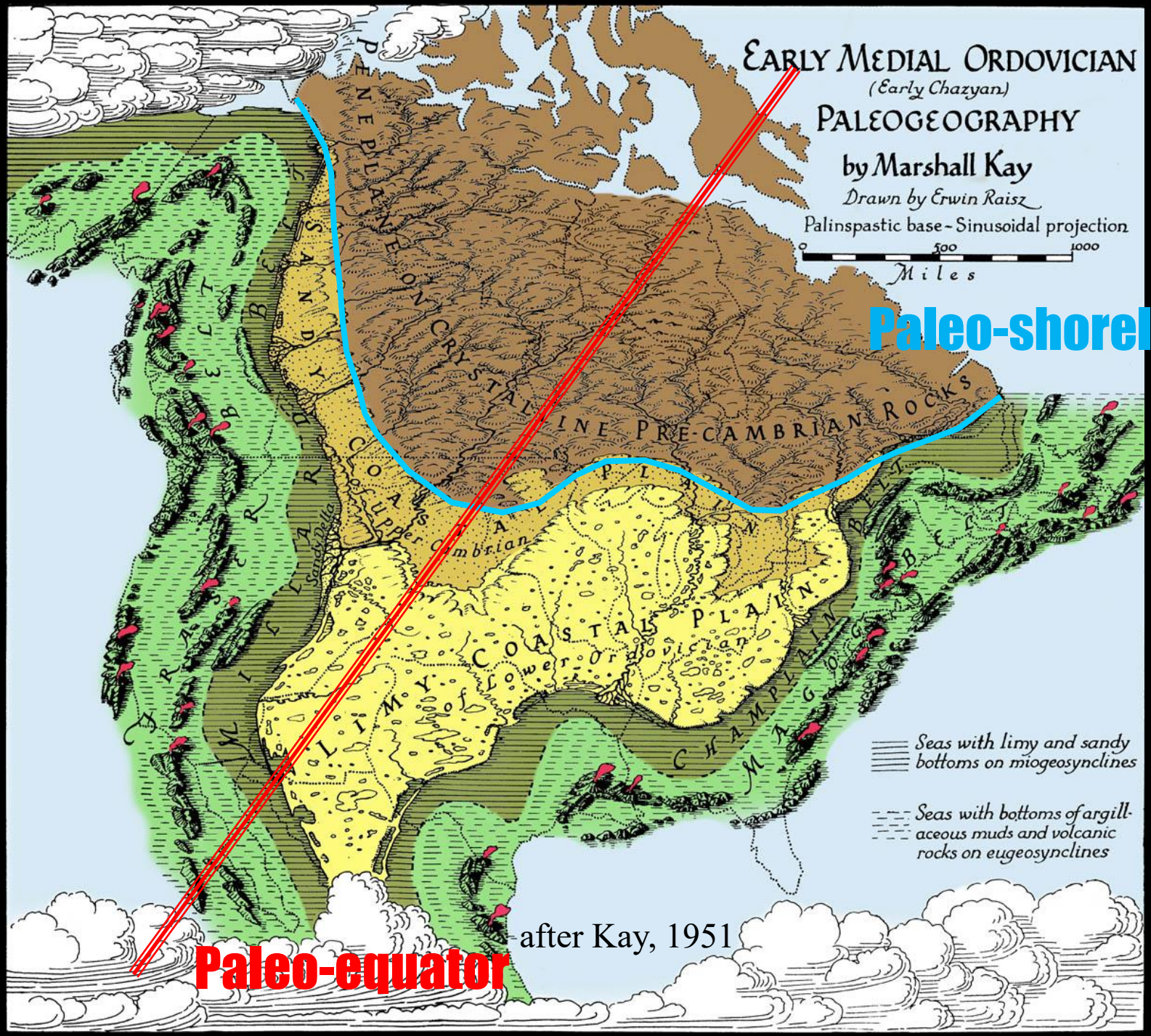

MASSACHUSETTS
NEW YORK
RHODE ISLAND
A
A'
C
C'
D
E
E'


Everett Slices
Stockbridge Marble
Housatonic Highlands
Waramaug Formation
New Milford Massif
Hudson Highlands
Cameron's Line
Berkshire Massif
Hartford Basin
Hartland Formation
Waterbury Dome
Pomeraug Basin
Arc Rocks!
Ammonoosuc Volcanics
Avalonia
0 5 10 15 Mi
0 5 10 15 20 Km

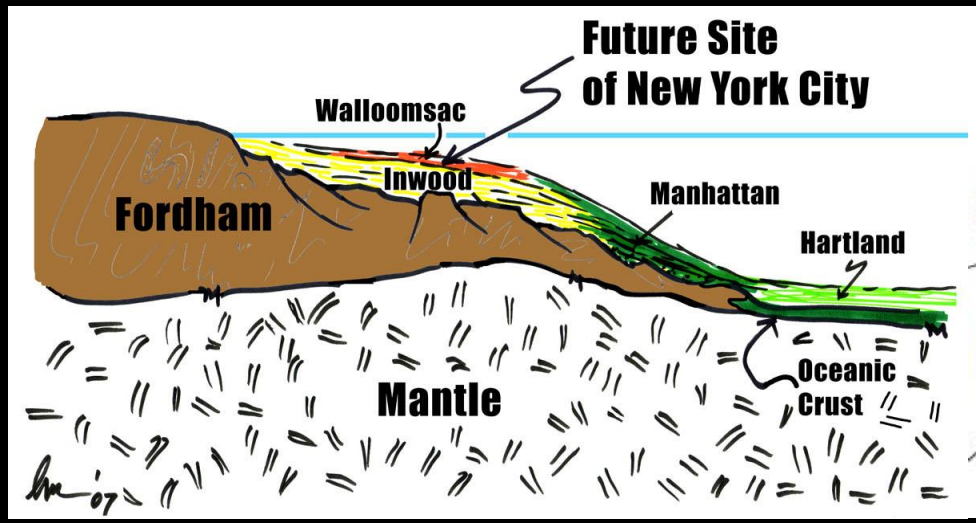
The History Channel: Super City – New York
22 September 2008

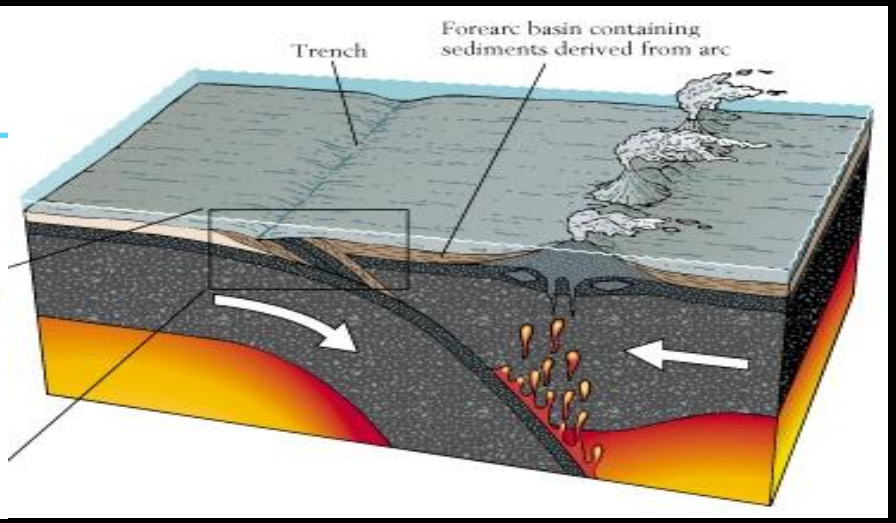

Hollywood Fat Cat Merguerian and Director of Operations Genevieve Glasson
at Hofstra Geology “Hammy” Awards Presentation (2008)

Let's Go Back In Time From Today to the Cambrian!

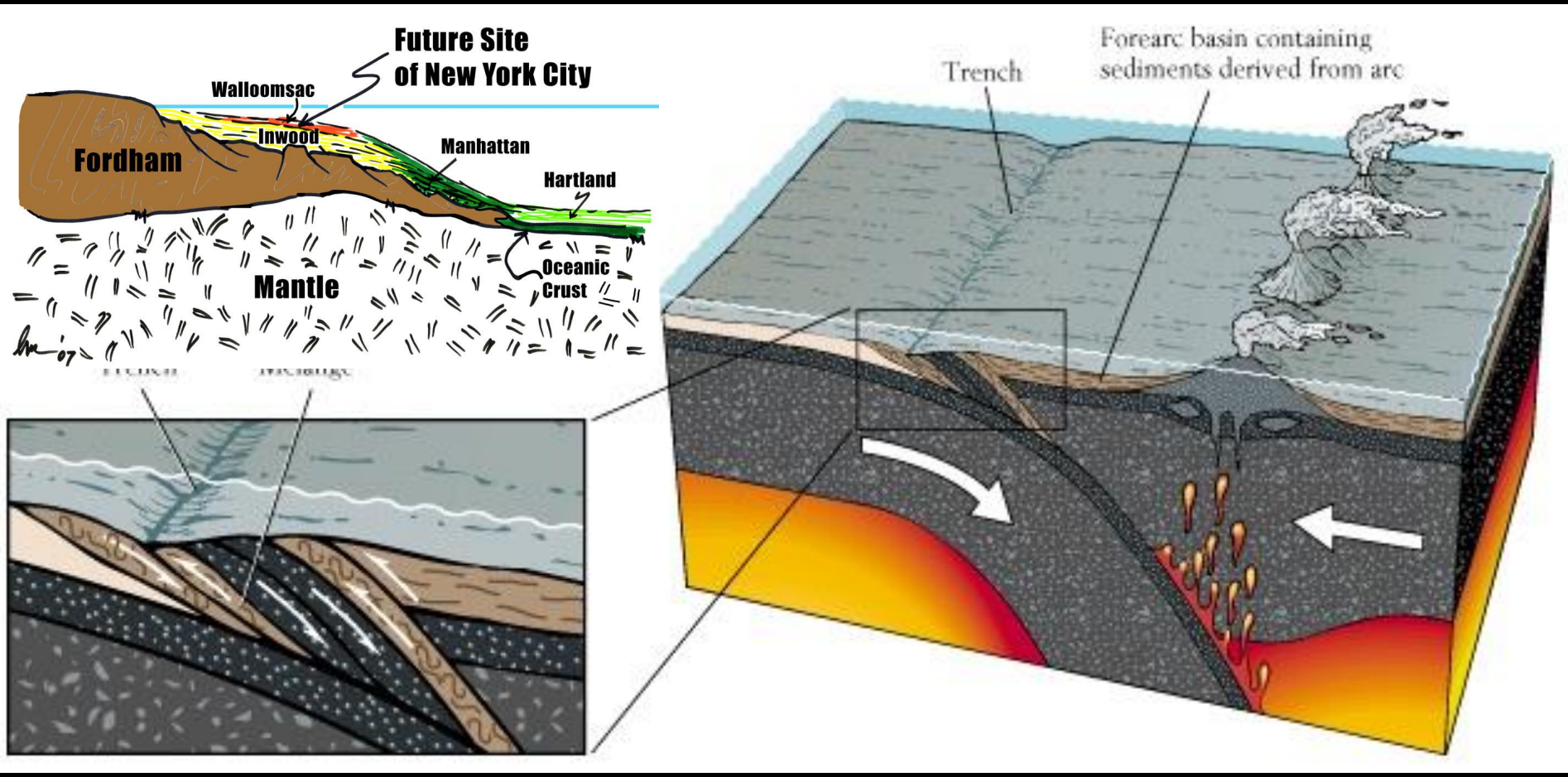

EARLY MEDIAL ORDOVICIAN
(Early Chazyan)
PALEOGEOGRAPHY
by Marshall Kay
Drawn by Erwin Raisz
Palinspastic base - Sinusoidal projection
500
1000
Miles
Paleo-shoreline
PENEPLANED CRYSTALLINE PRE-CAMBRIAN ROCKS
SANDY COASTAL PLAIN of Upper Cambrian
LIMY COASTAL PLAIN of Lower Ordovician
CHAMPLAIN MAGEOGEOSYNCLINE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

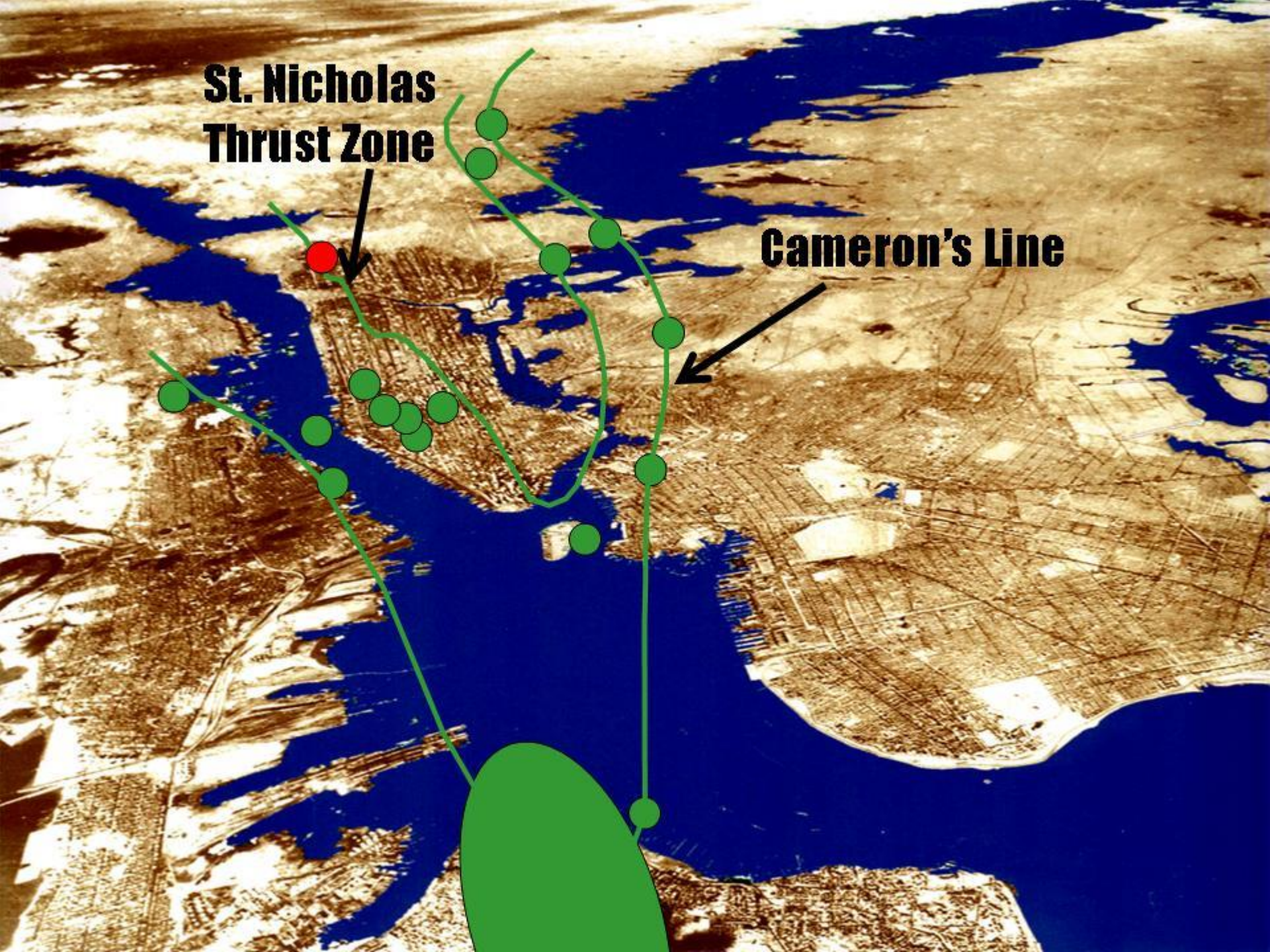
~ 450 Ma Taconian Arc – Passive Margin Collision

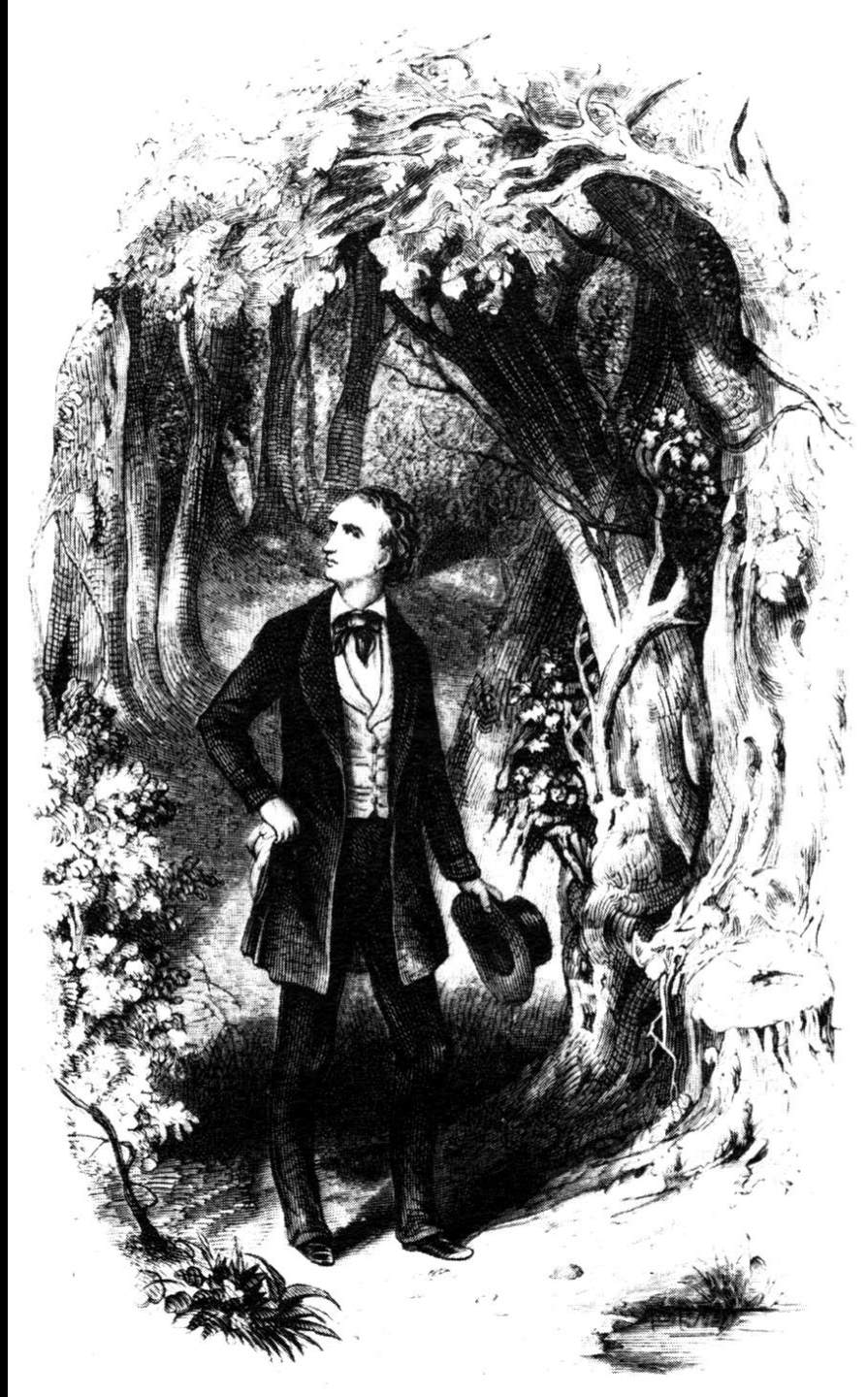




Taconian Accretionary Prism



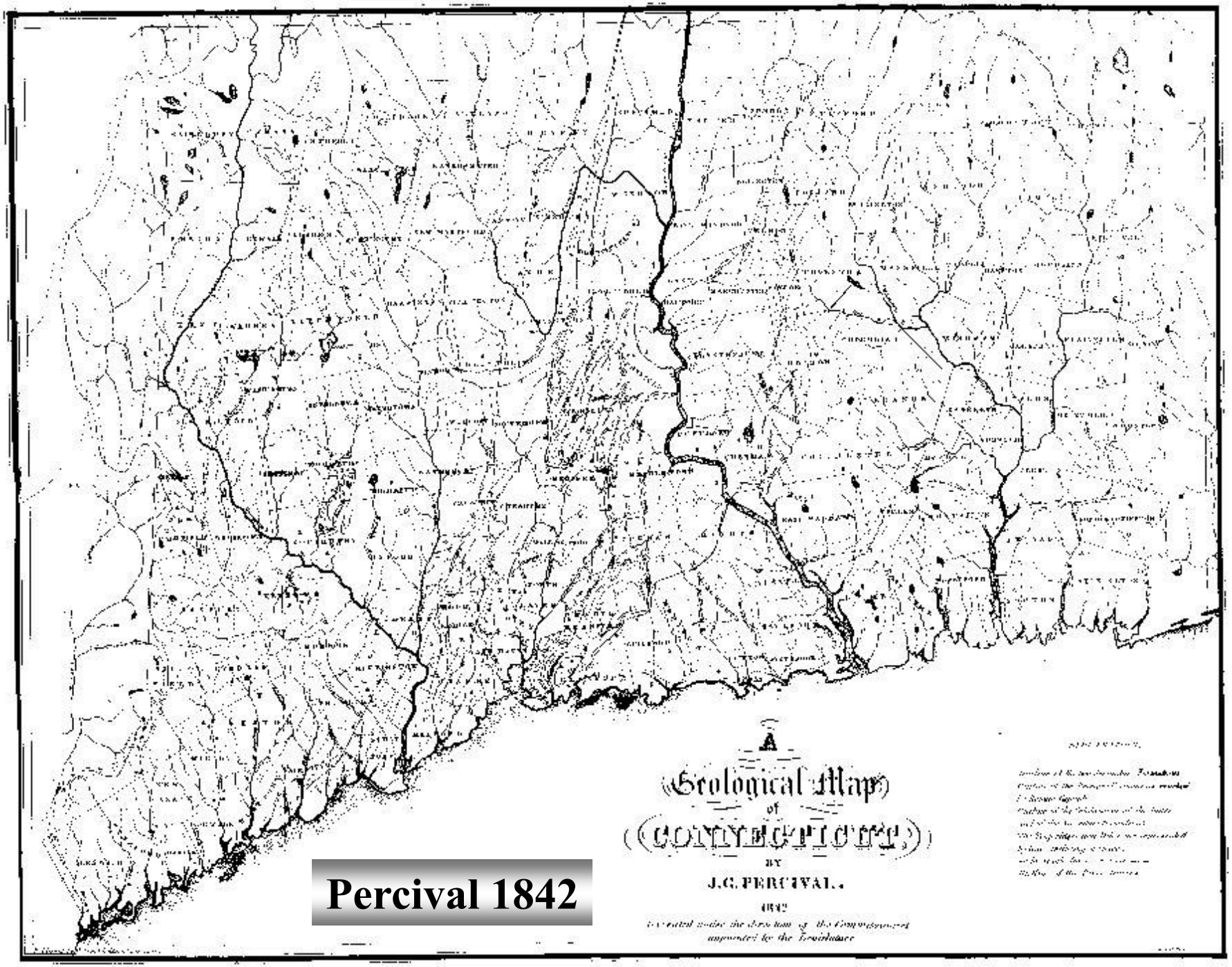

St. Nicholas
Thrust Zone
Cameron's Line



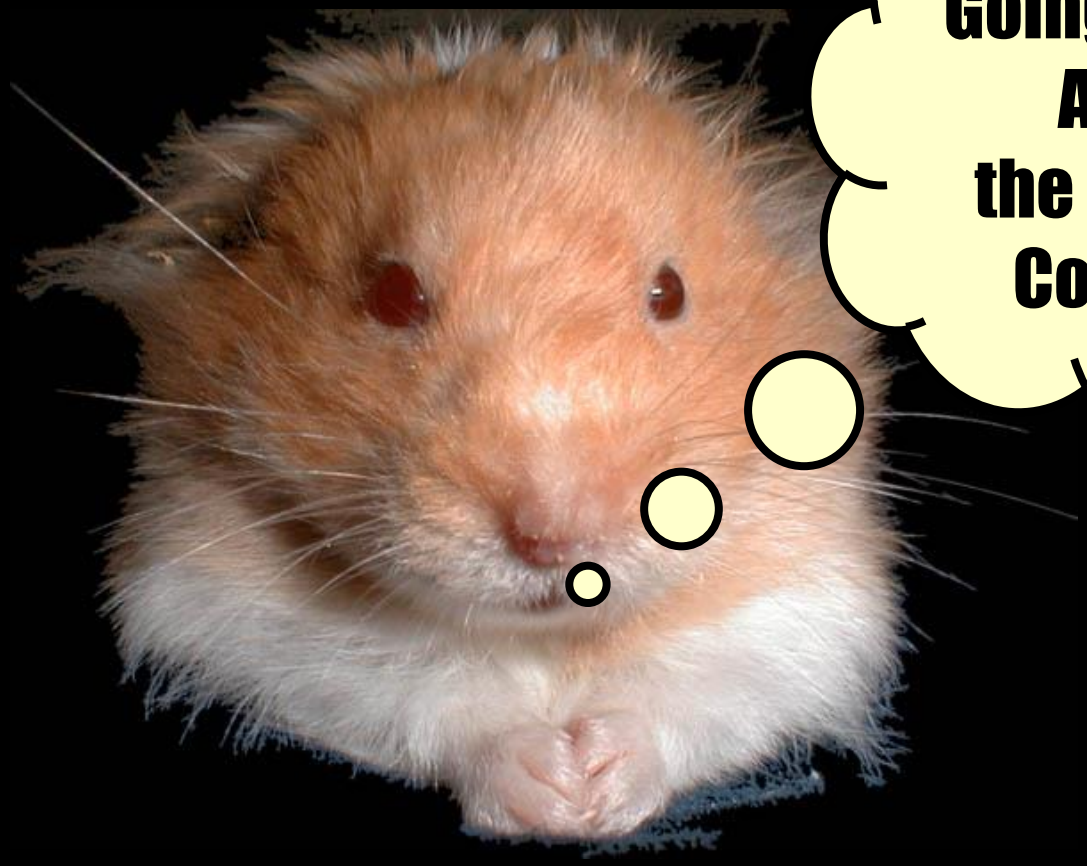
James Gates Percival [1795-1856]

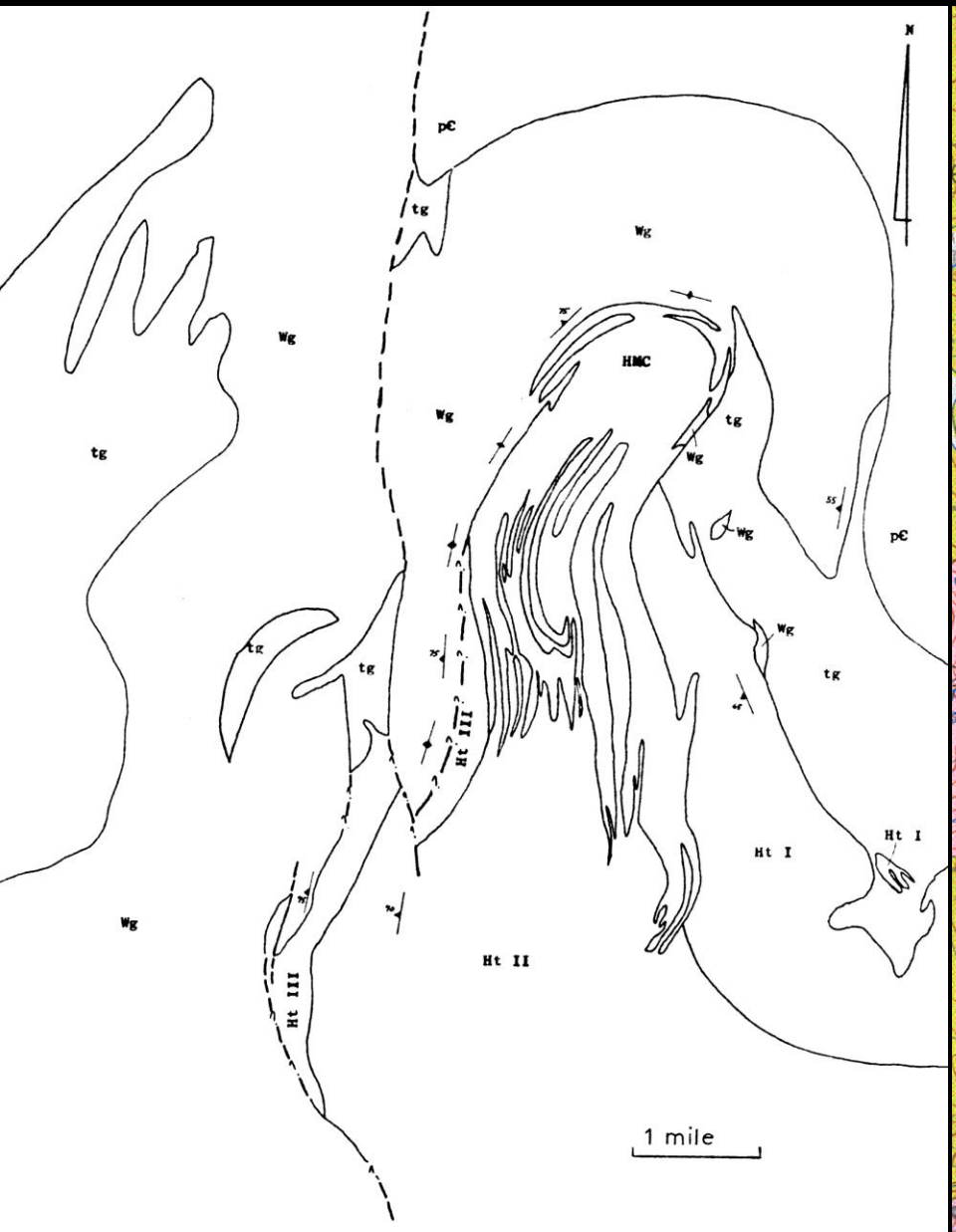
- Accomplished
- Smart Guy
- Geologist
- Naturalist
- Linguist

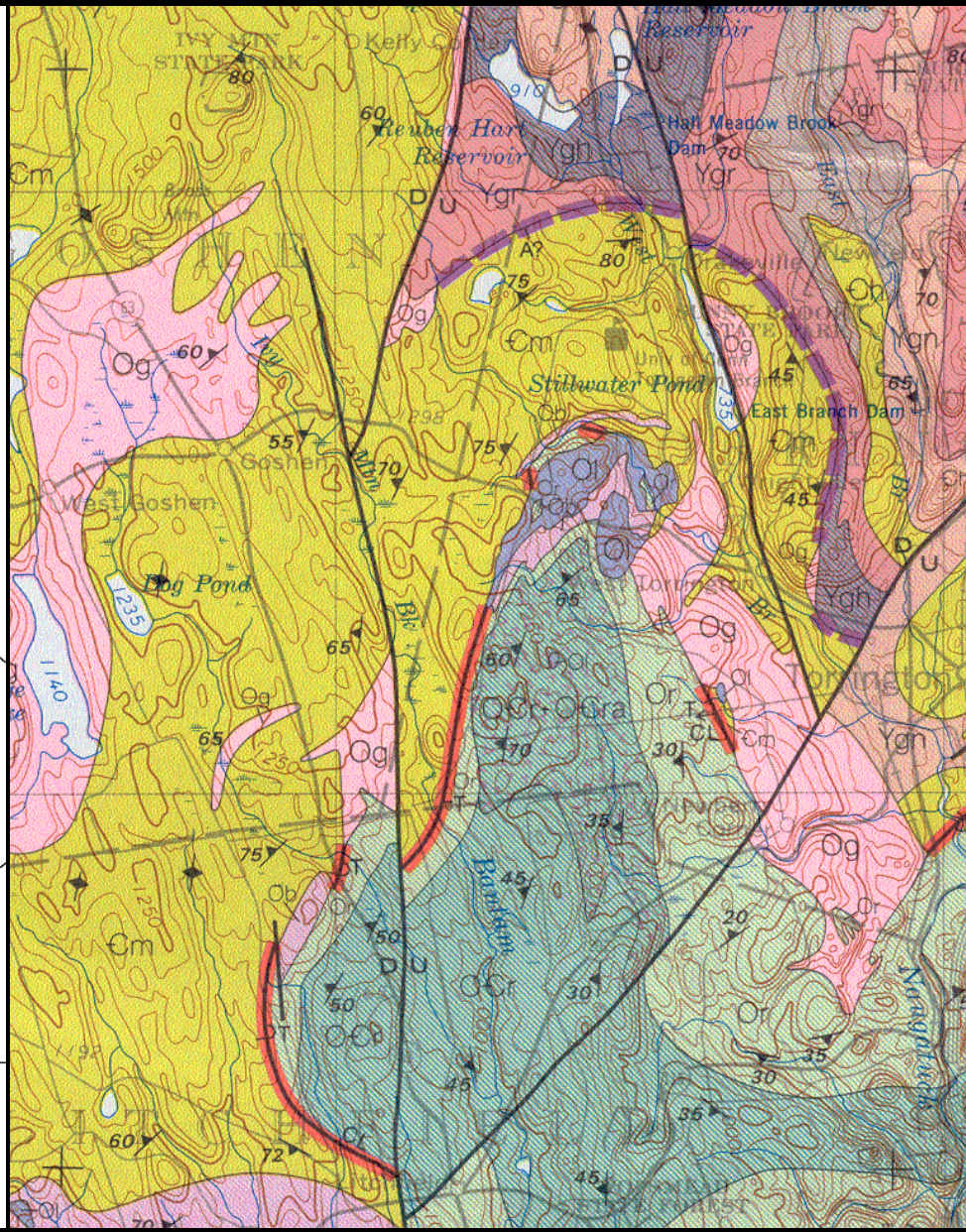
First Geological Map Connecticut (1842)



Percival 1842


Finally, He's Going to Chat About the Hodges Complex





Gates and Christensen 1965

Rodgers et al 1985

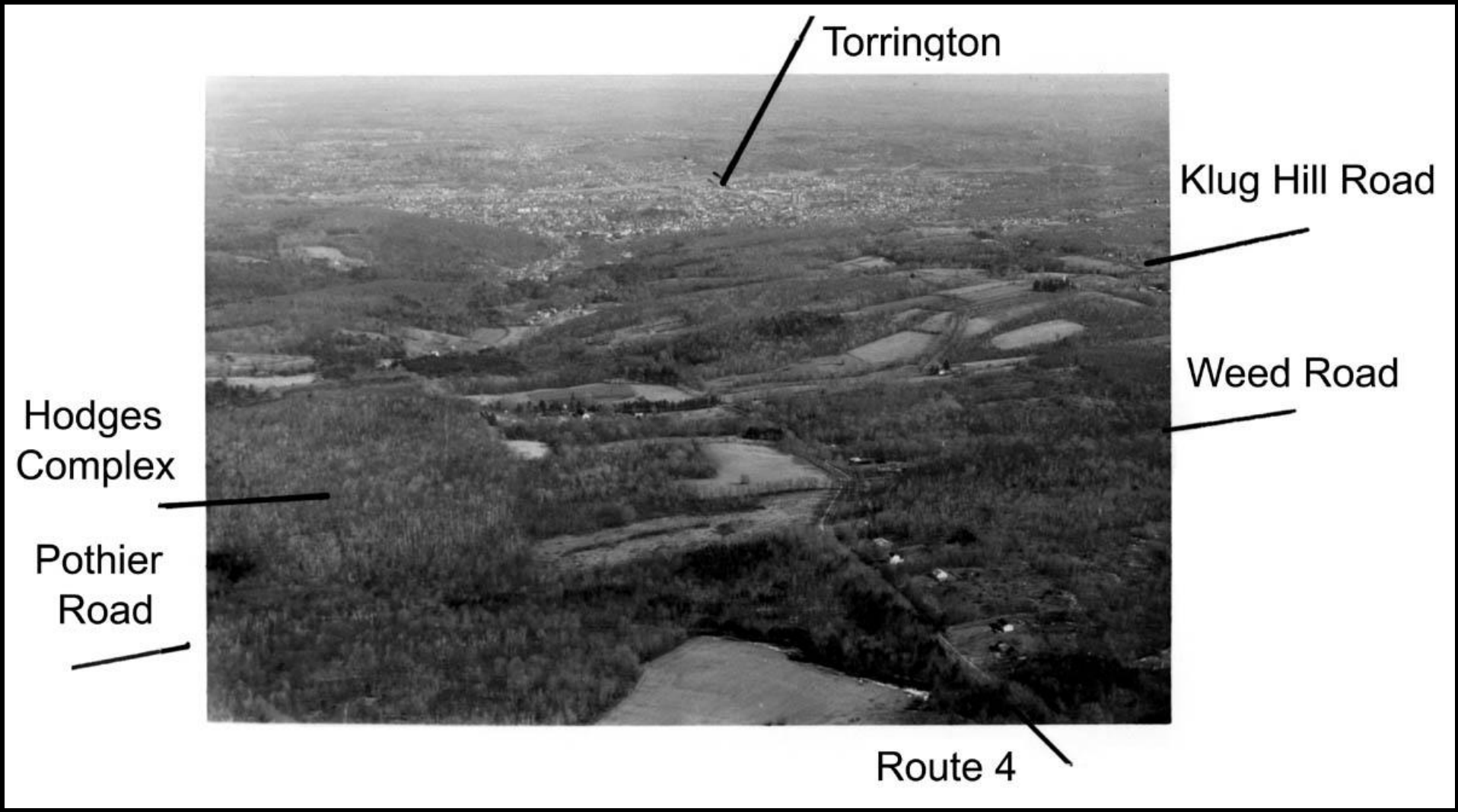
Merguerian Decapitates the Octopus 1977

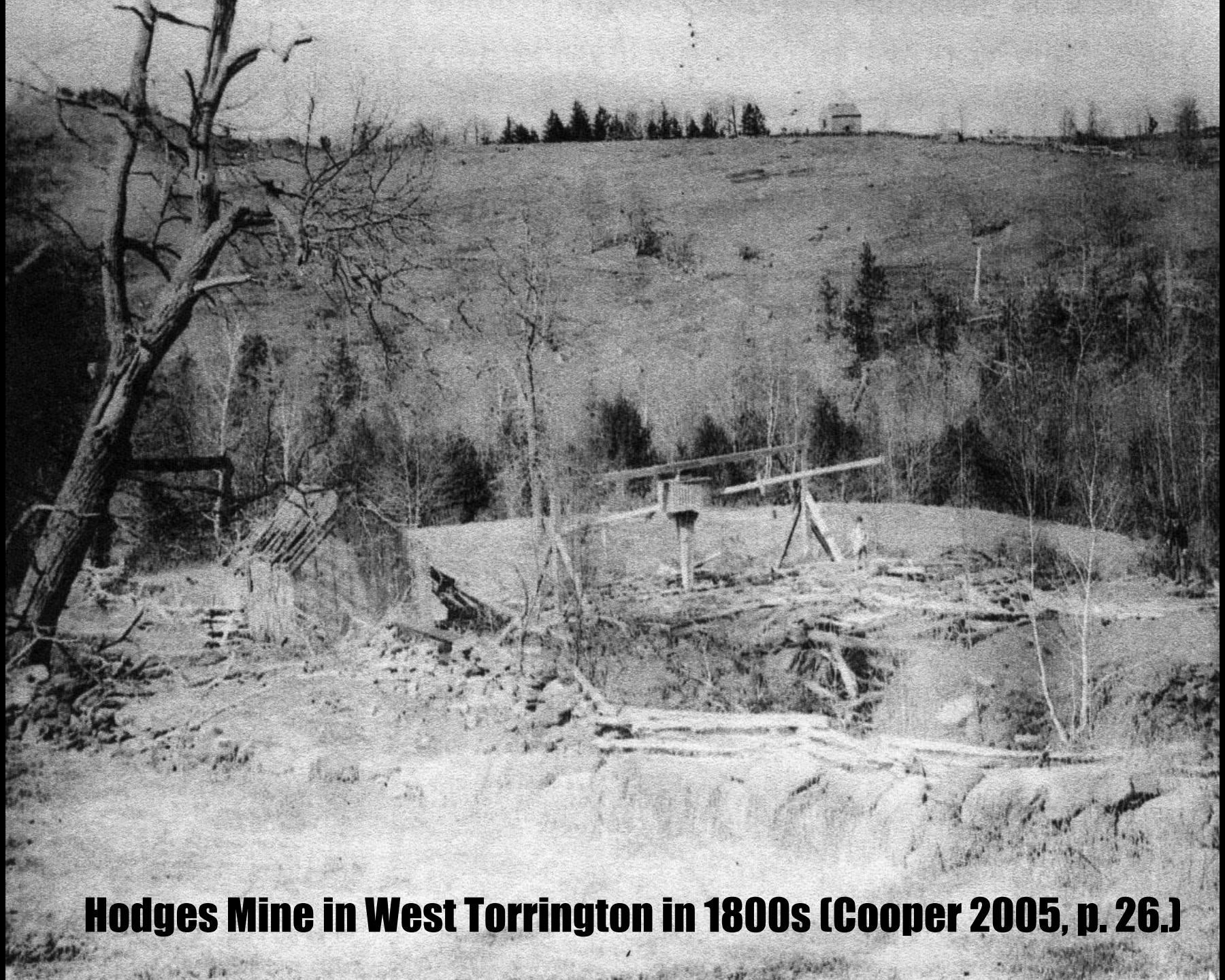
	Hornblende gabbro[1]		Amphibolite[2]	
	Range	Mean	Range	Mean
hornblende	48.2–60.6	54.7	47.6–70.2	59.5
plagioclase	21.2–34.6	26.5	19.8–29.0	26.3
biotite	9.8–20.2	13.5	0.0–1.3	0.4
opaques	0.6–6.2	2.7	0.1–2.4	1.3[3]
quartz	0.0–3.4	1.7	0.6–11.6	3.8
sphene	0.2–1.8	0.9	0.0–2.0	0.4
epidote	—	—	0.0–21.2	7.3
accessories	—	—	0.0–5.8	1.0[4]

[1] Based on modal analyses of 9 samples, 1,000 points each
[2] Based on modal analyses of 14 samples, 2,000 points each
[3] Ilmenite
[4] Chlorite and pyrite

Gates and Christensen 1965

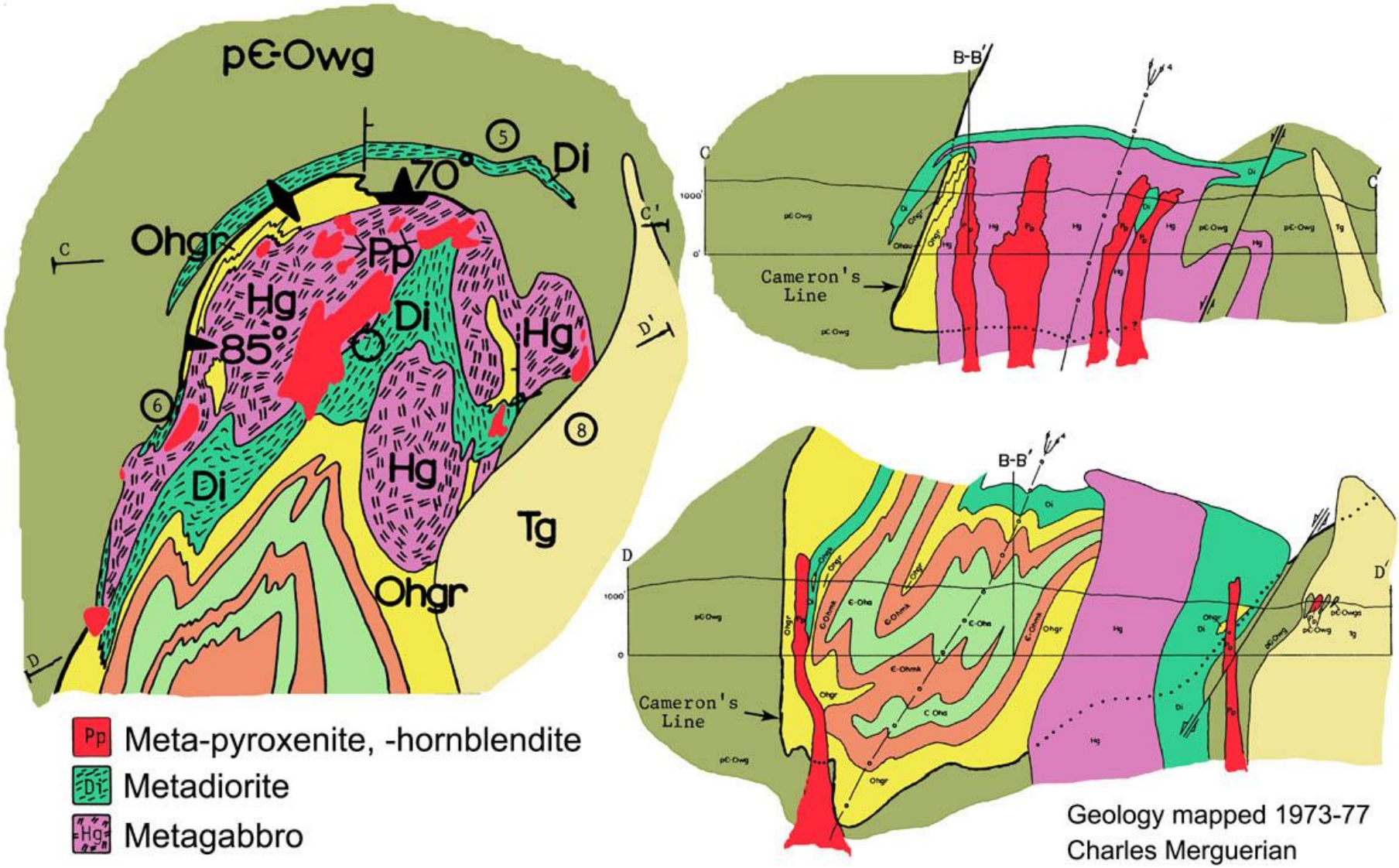
Aerial View from NW, Hodges Nickel Mine



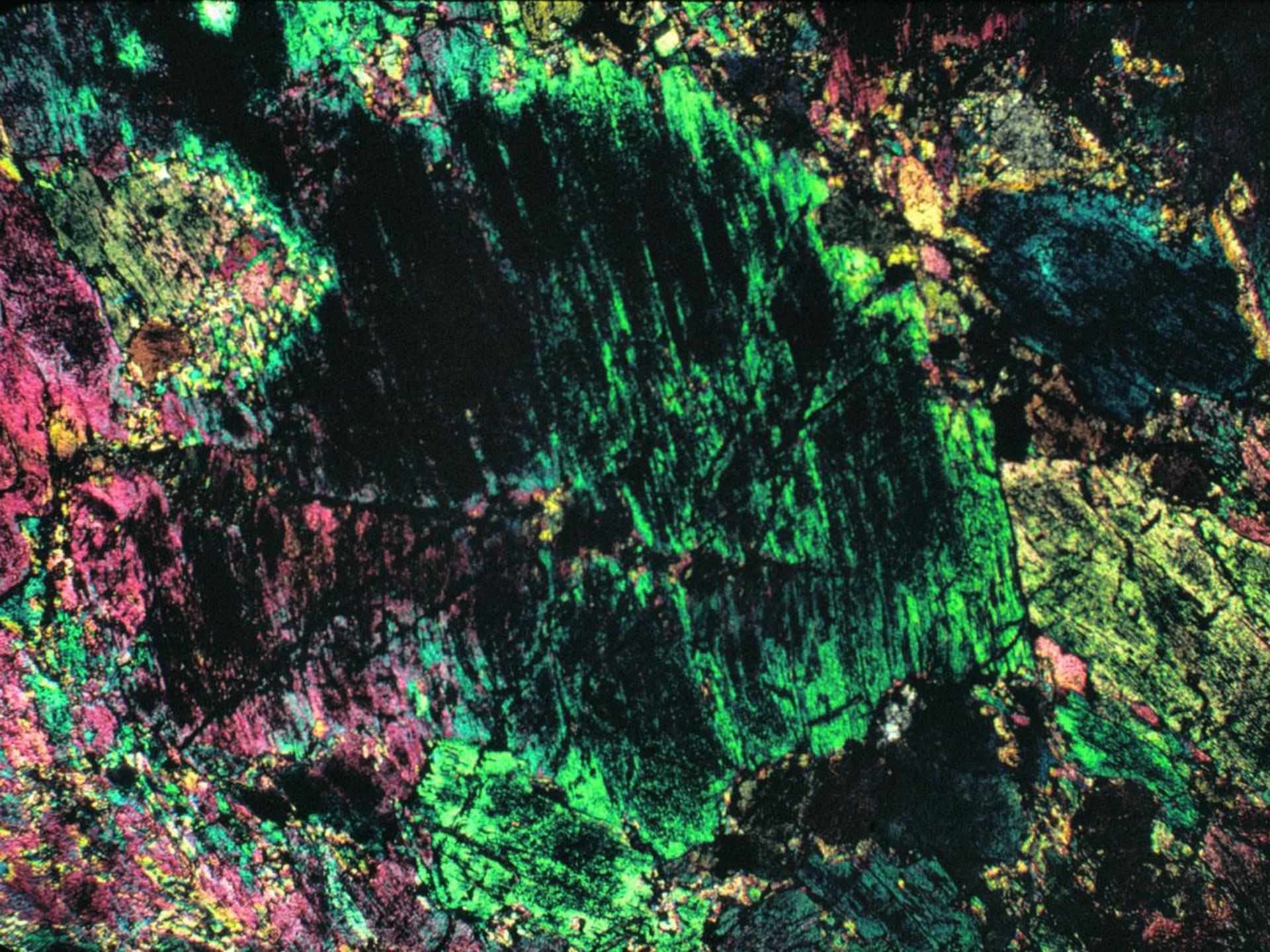


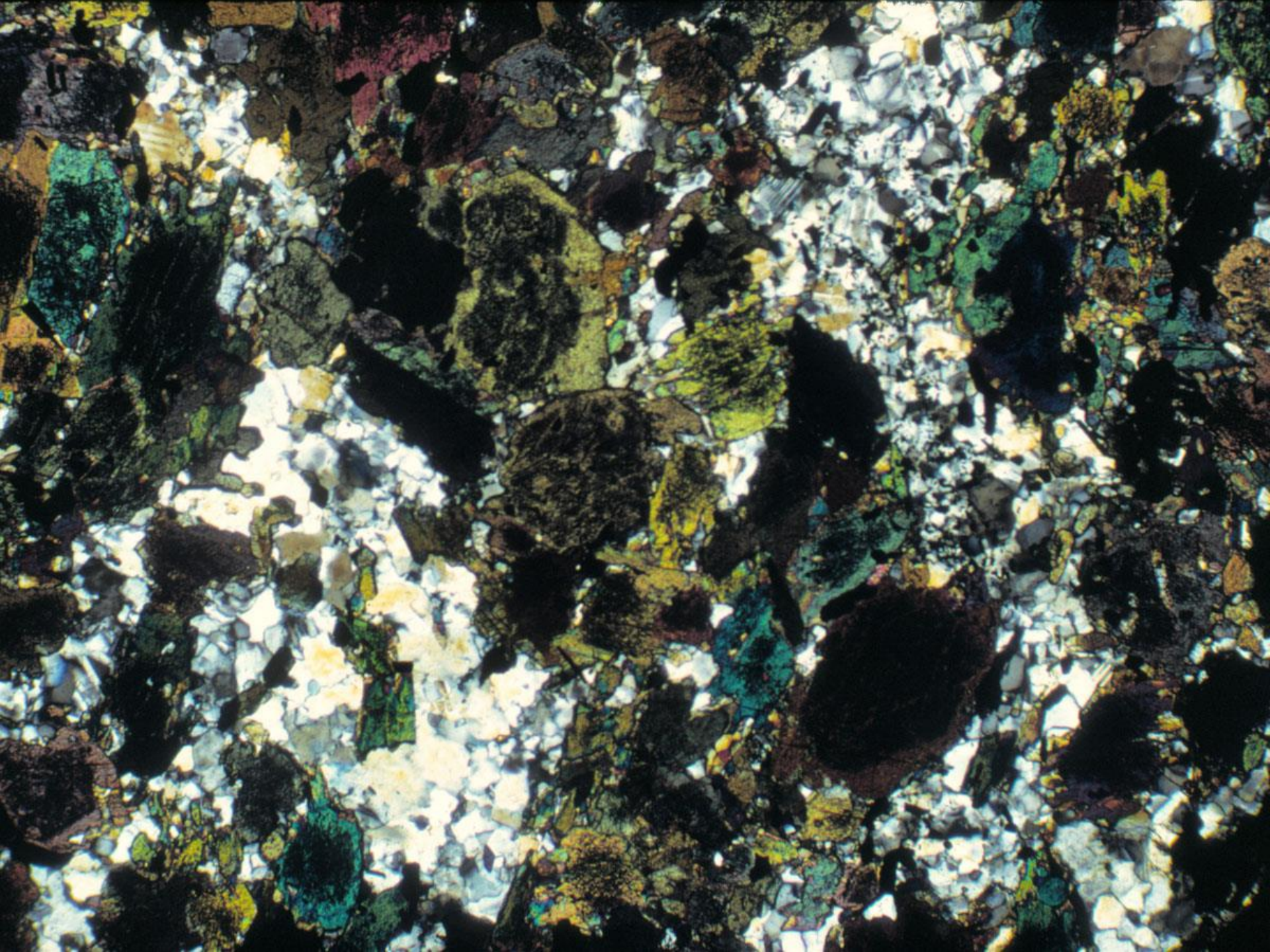
Hodges Mine in West Torrington in 1800s (Cooper 2005, p. 26.)

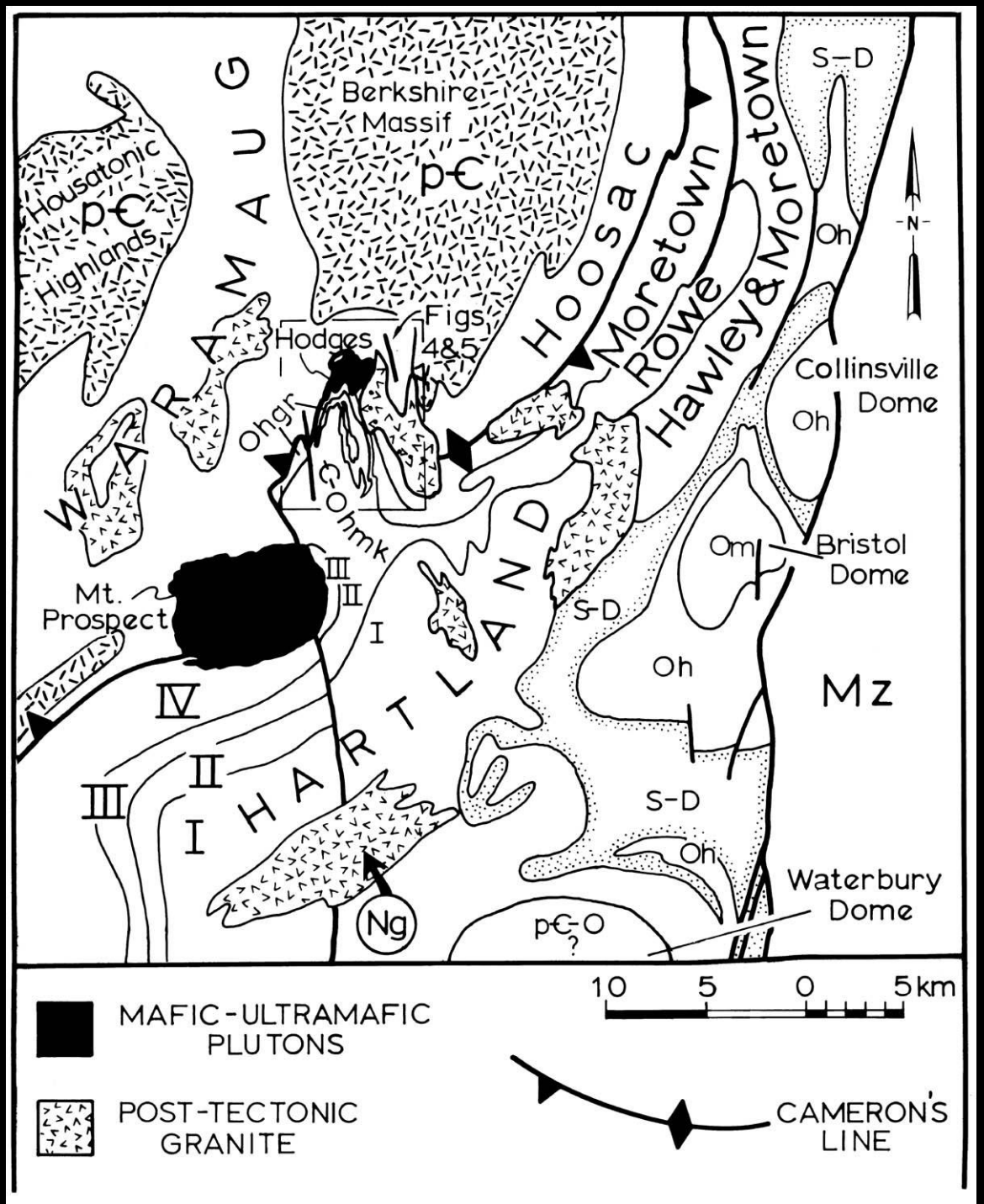
Pentlandite, Pyrrhotite, Chalcopyrite in Pyroxenite

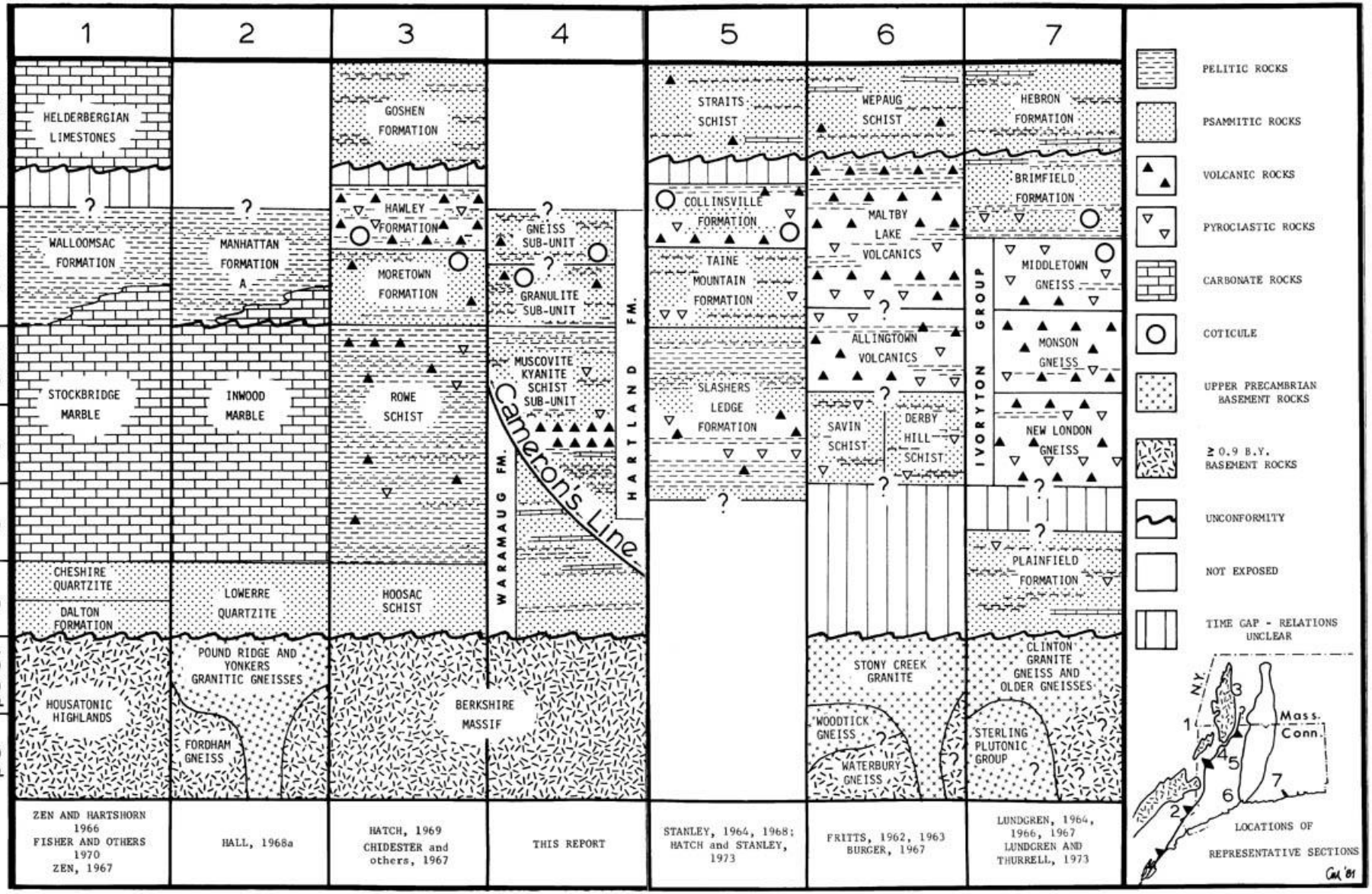

pC-Owg
Ohgr
Pp
Hg
Di
Tg
70°
85°
5
6
8
C
C'
D
D'
B-B'
Cameron's Line
1000'
0'
0
Pp Meta-pyroxenite, -hornblendite
Di Metadiorite
Hg Metagabbro
Geology mapped 1973-77
Charles Merguerian


ONE
CENT

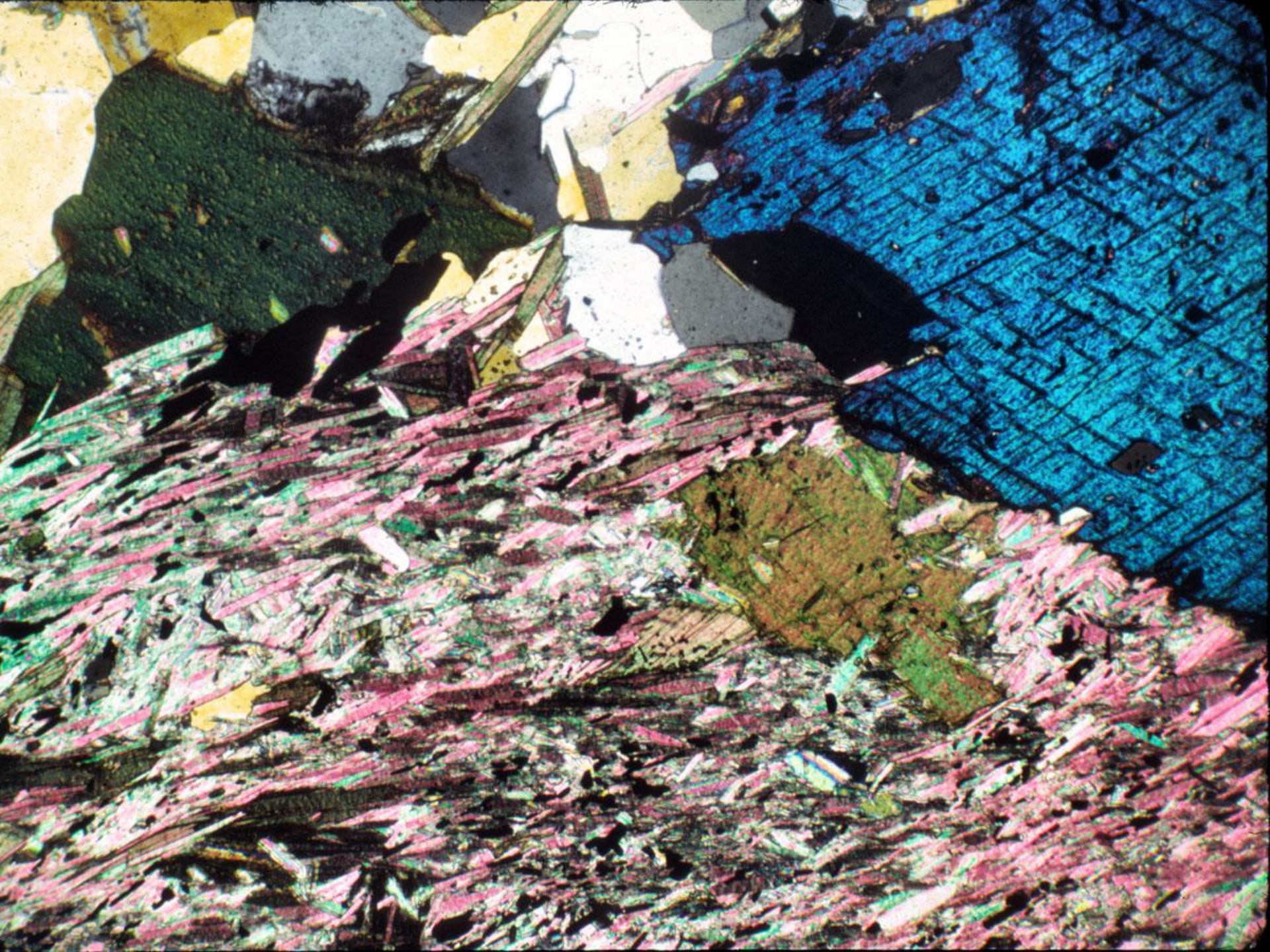


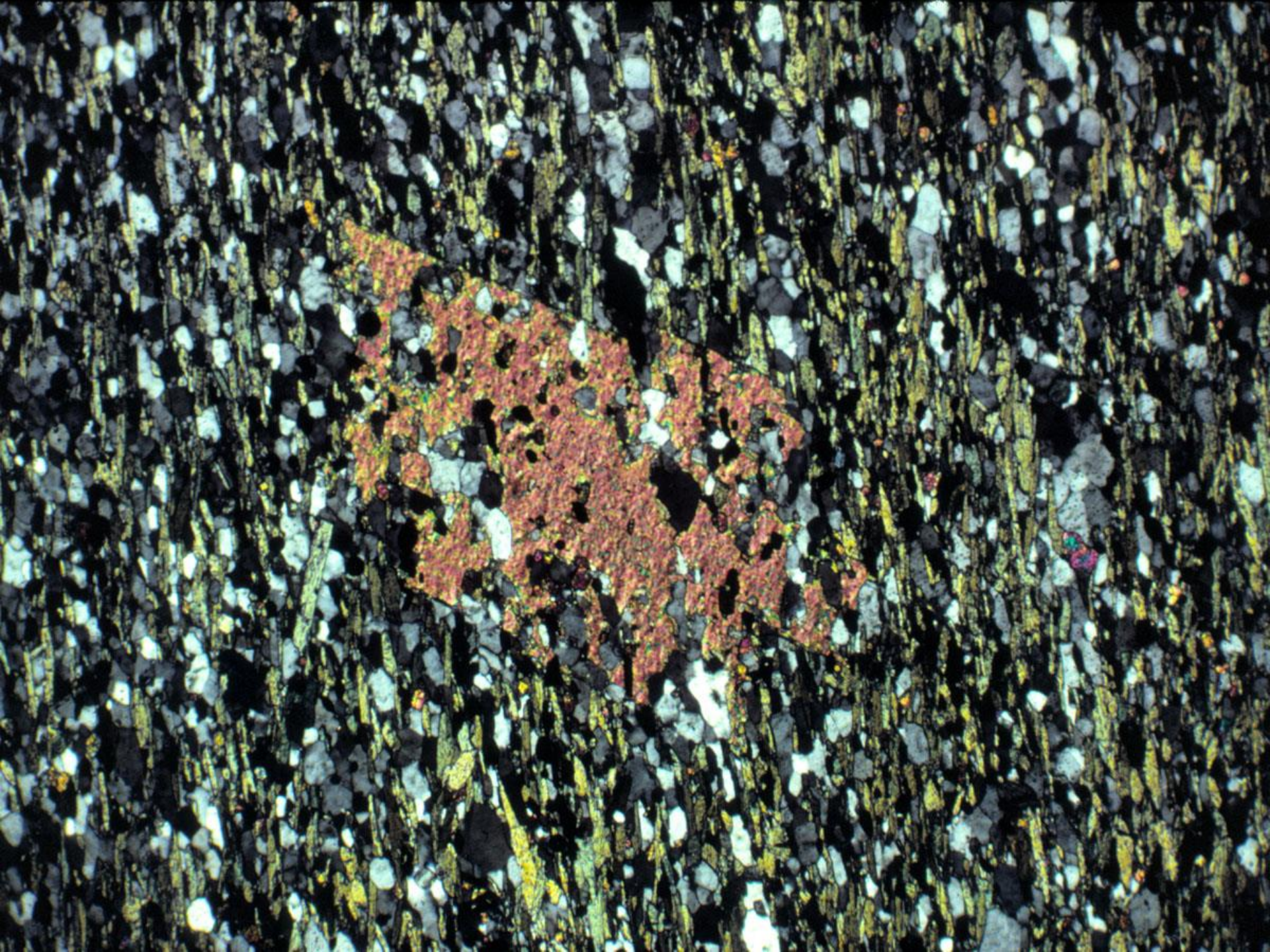



Berkshire Massif
pC
Housatonic Highlands
pC
WARRAMAUG
Hodges
Figs 4&5
Ohgr
Ohmk
Hoosac
Moretown
Rowe
Hawley & Moretown
S-D
Oh
N
Collinsville Dome
Oh
Om
Bristol Dome
Mt. Prospect
III
II
I
IV
III
II
I
HARTLAND
S-D
Oh
Mz
S-D
Oh
Ng
pC-O?
Waterbury Dome
10 5 0 5km
MAFIC-ULTRAMAFIC PLUTONS
POST-TECTONIC GRANITE
CAMERON'S LINE

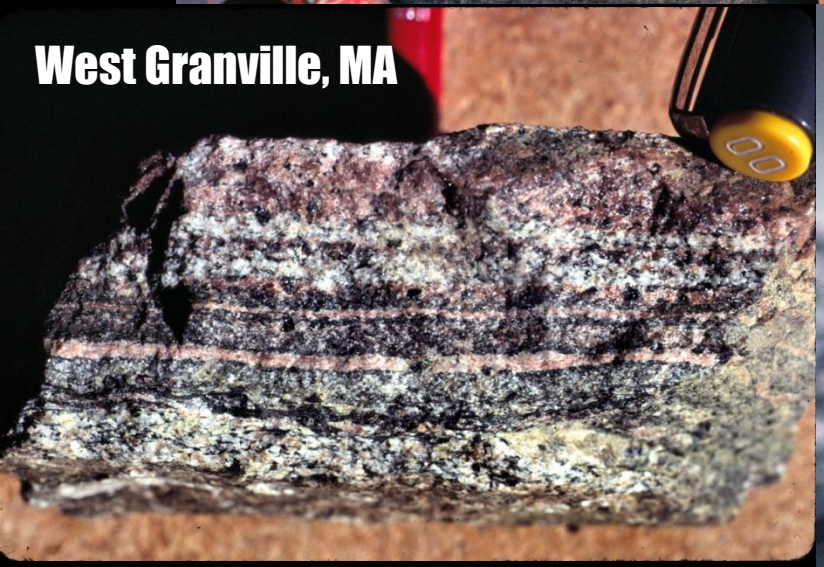


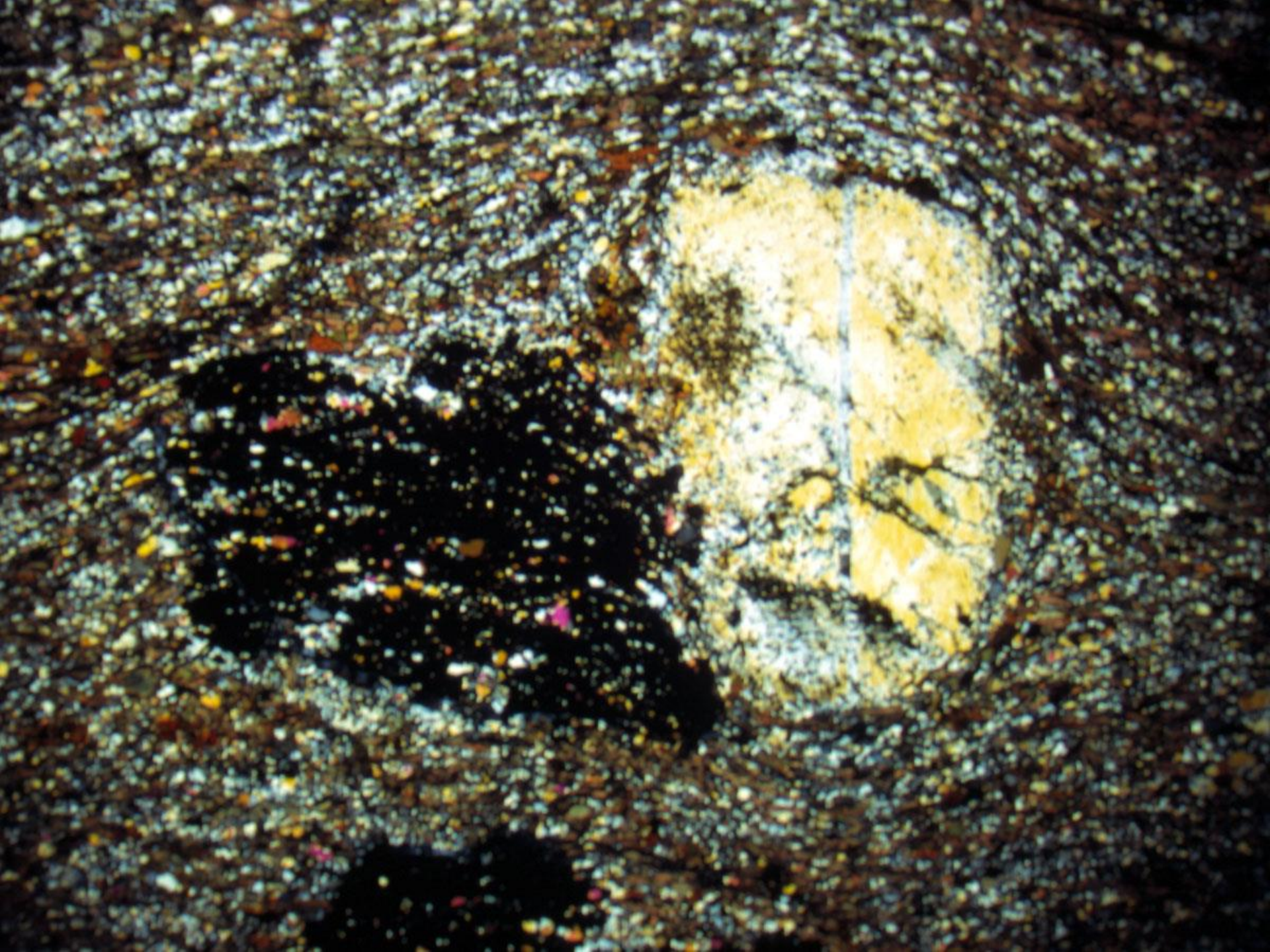
Merguerian 1977, 1985

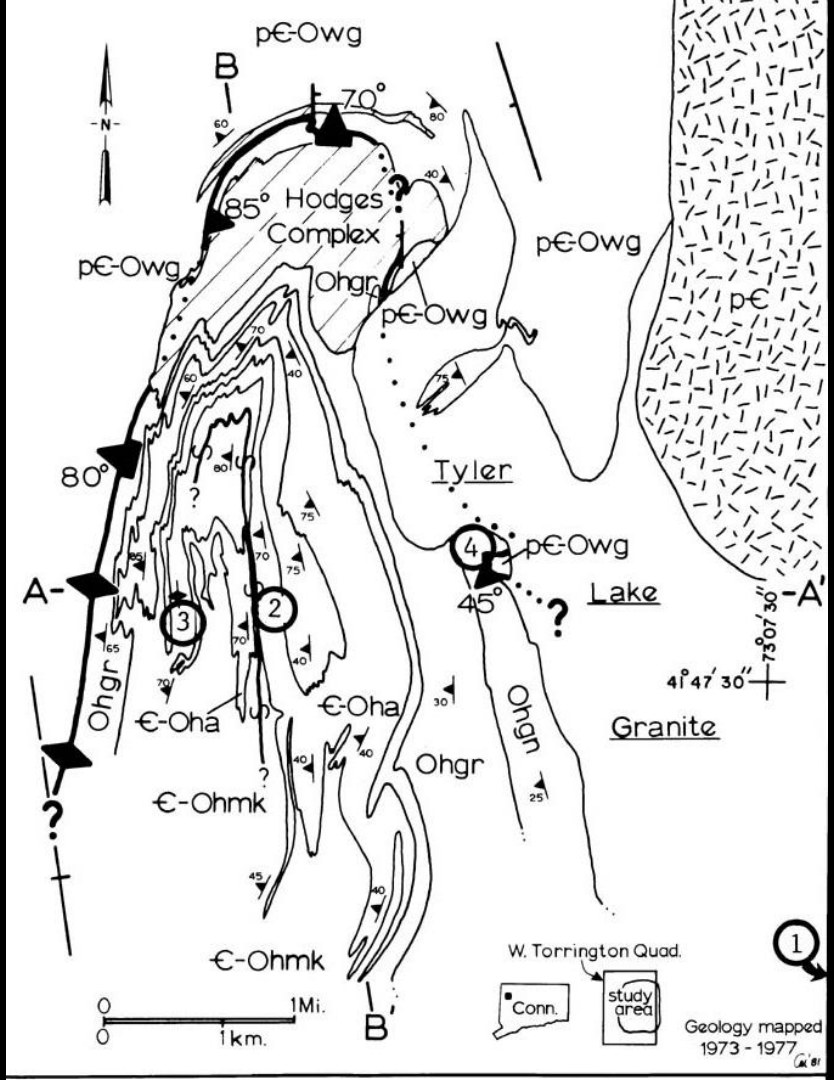


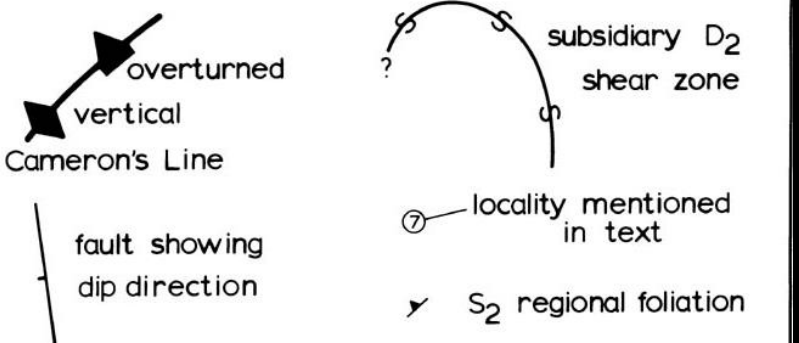


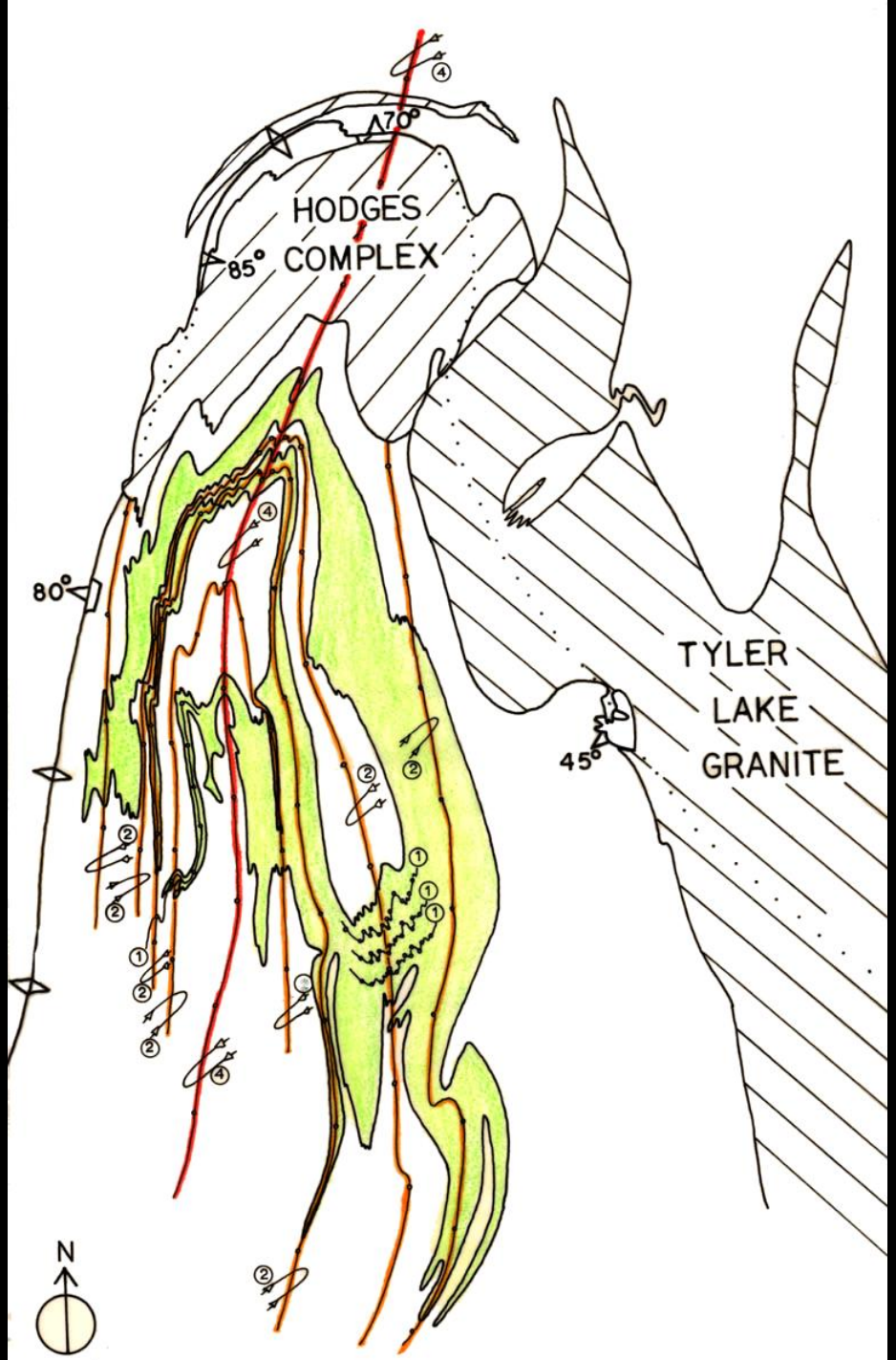
Coticules





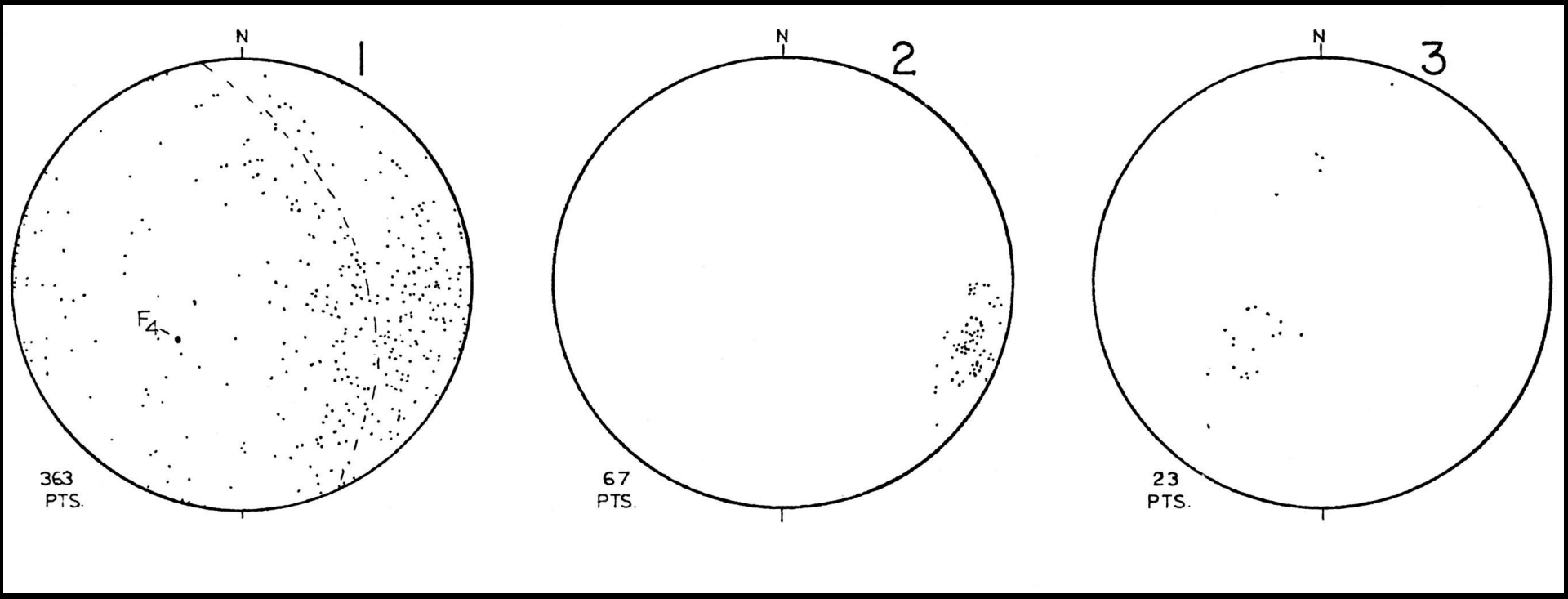

pE-Owg
B
70°
85° Hodges Complex
pE-Owg
Ohgr
pE-Owg
pE-Owg
pE
80°
Tyler
Lake
45°
pE-Owg
A
A'
73°07'30"
41°47'30"
Granite
Ohgr
Ohgn
E-Oha
E-Oha
E-Ohmk
Ohgr
E-Ohmk
B'
1Mi.
1km.
W. Torrington Quad.
Conn.
study area
Geology mapped 1973 - 1977


overturned
vertical
Cameron's Line
fault showing dip direction
subsidiary D_2 shear zone
locality mentioned in text
S_2 regional foliation


A
70°
HODGES
85° COMPLEX
80°
TYLER
LAKE
GRANITE
45°
N

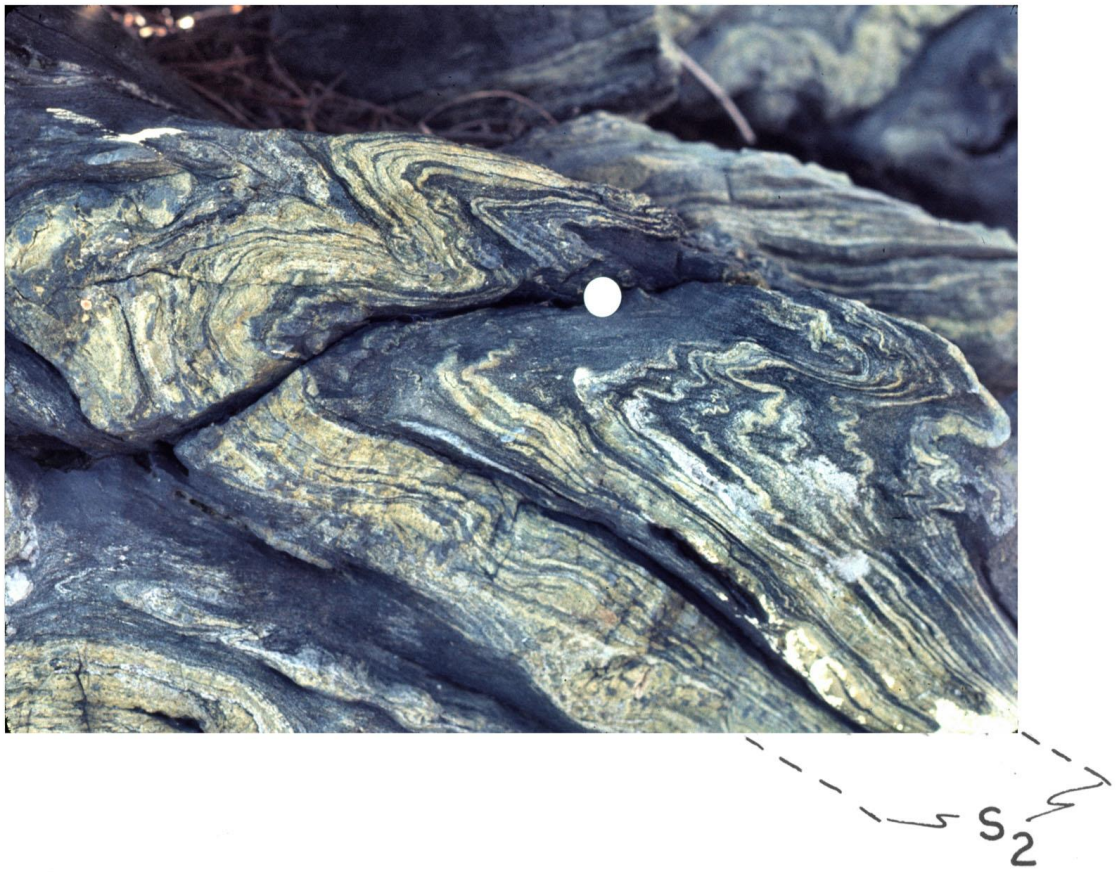
DEFORMATIONAL EVENT	LINEAR FEATURES	PLANAR FEATURES	IGNEOUS ACTIVITY	METAMORPHISM
D_1	F_1 isoclinal folds of compositional layering. L_1 quartz ribbing in gneisses and schists. Hornblende lineation in amphibolites.	S_1 gneissic layering in gneisses or hornblende-plagioclase foliation in amphibolites. Generally not recognized in schists.		? Amphibolite-grade M_1
D_2	F_2 penetrative isoclinal folds of early S_1 structures and compositional layering. L_2 mineral streaking in schists and gneisses.	S_2 regional foliation composed of oriented phyllosilicates±kyanite or sillimanite developed axial planar to F_2 folds.	? HODGES COMPLEX TYLER LAKE GRANITE *466±12 m.y.*	Amphibolite-grade M_2
D_3	F_3 shallow SW to NW plunging, open to tight, crenulate folds of the S_2 regional foliation. L_3 intersection lineation in massive rocks; crinkle axis in micaceous rocks.	S_3 crenulation or slip cleavage developed axial planar to F_3 folds. Oriented NW to WSW with shallow dips.	PEGMATITES	?
D_4	F_4 steep SW plunging dextral synformal folds of the S_2 regional foliation	S_4 crenulation cleavage, slip cleavage, or spaced schistosity developed axial planar to F_4 folds Orientation - N20°E, 75°NW.		Biotite-grade M_3 (retrograde)
D_5	F_5 open folds and warps with variable hingelines. L_5 intersection lineation.	S_5 slip cleavage and rock cleavage axial planar to F_5 folds oriented NW to W with variable dip.	?	continued retrograde

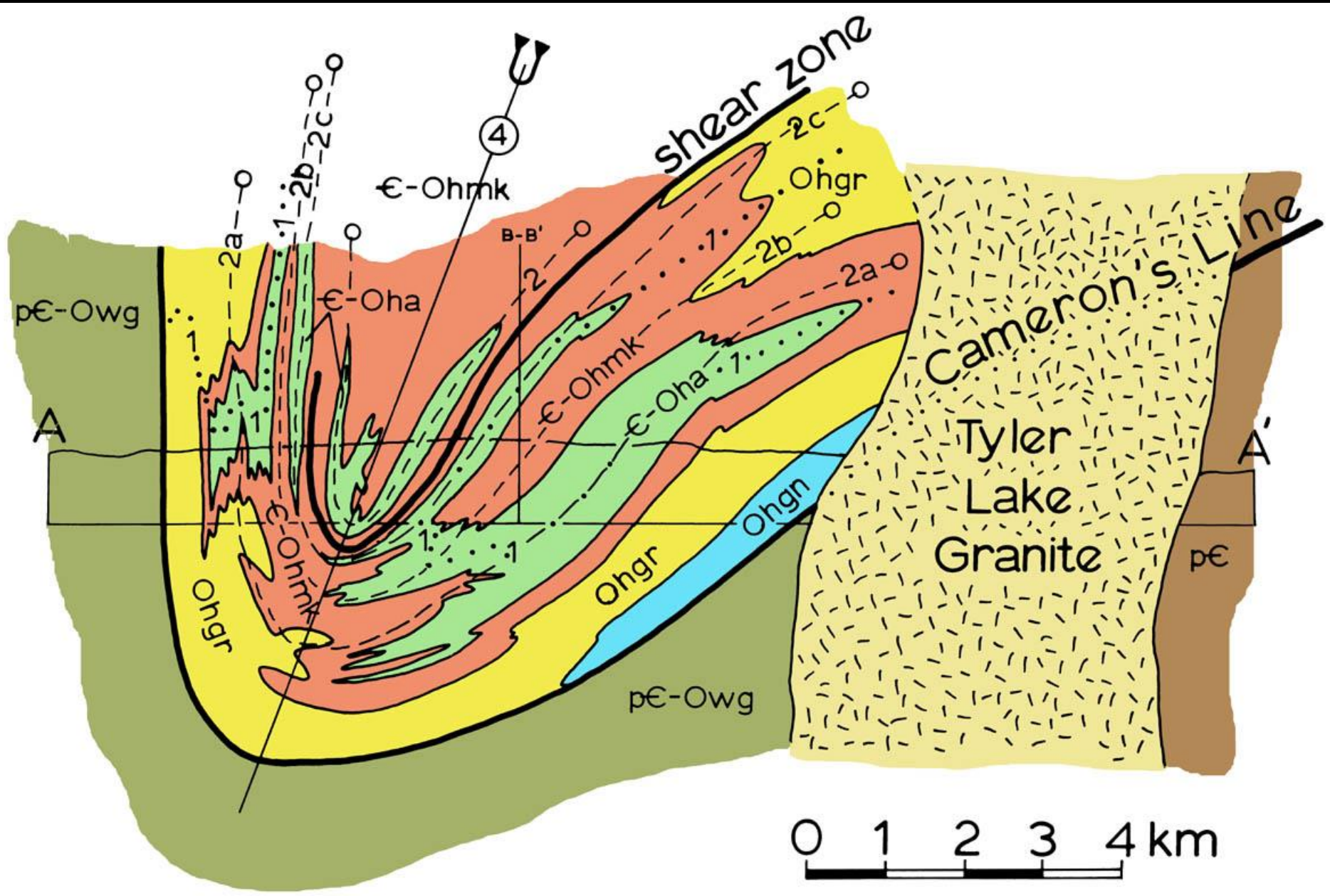
Table 1 - Linear and planar structural features and chronology of folding, igneous activity, and metamorphism in Torrington, Connecticut area.

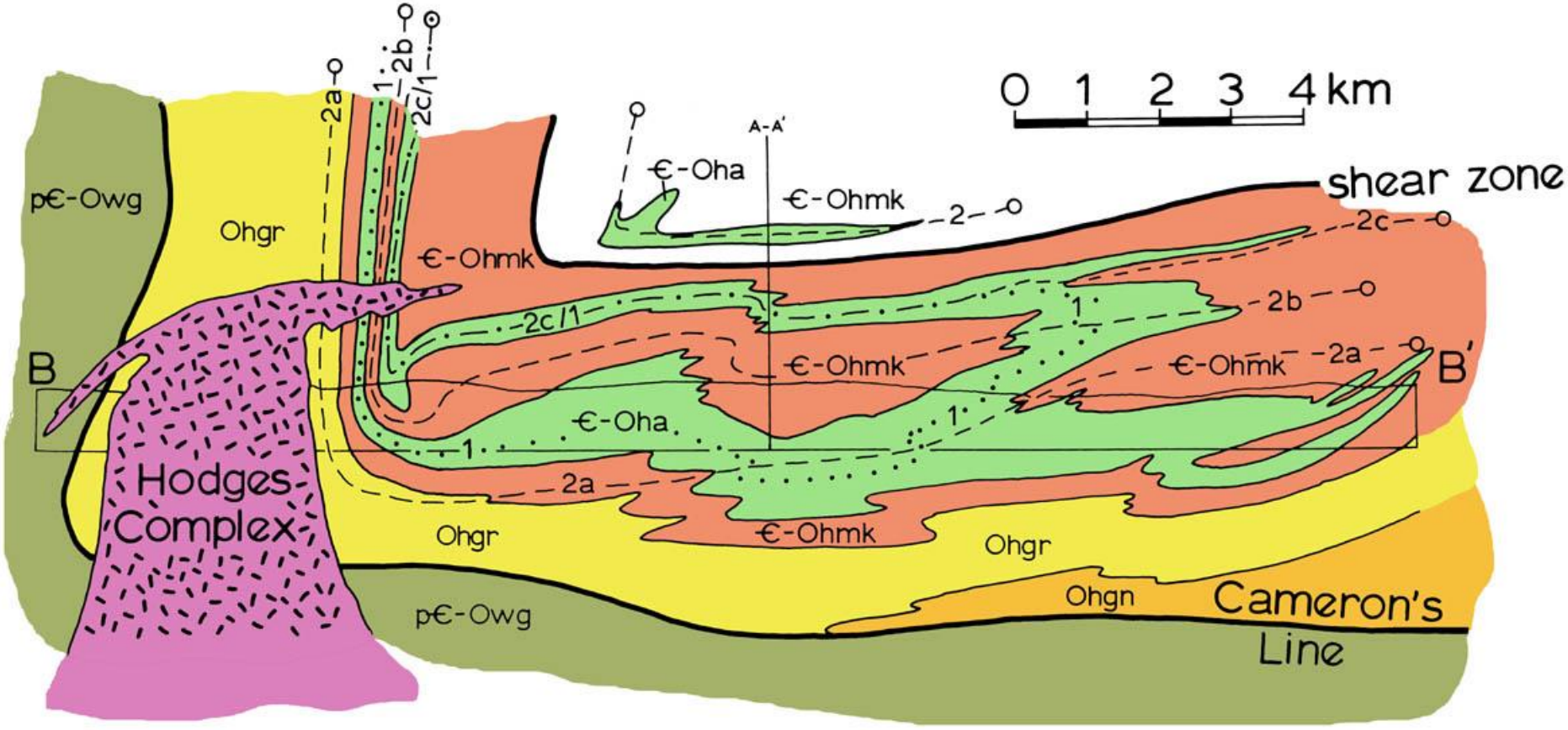

N
1
F4
363
PTS.
N
2
67
PTS.
N
3
23
PTS.


S1
S2
34
37
S1
25

SW-Plunging F_4 Folds



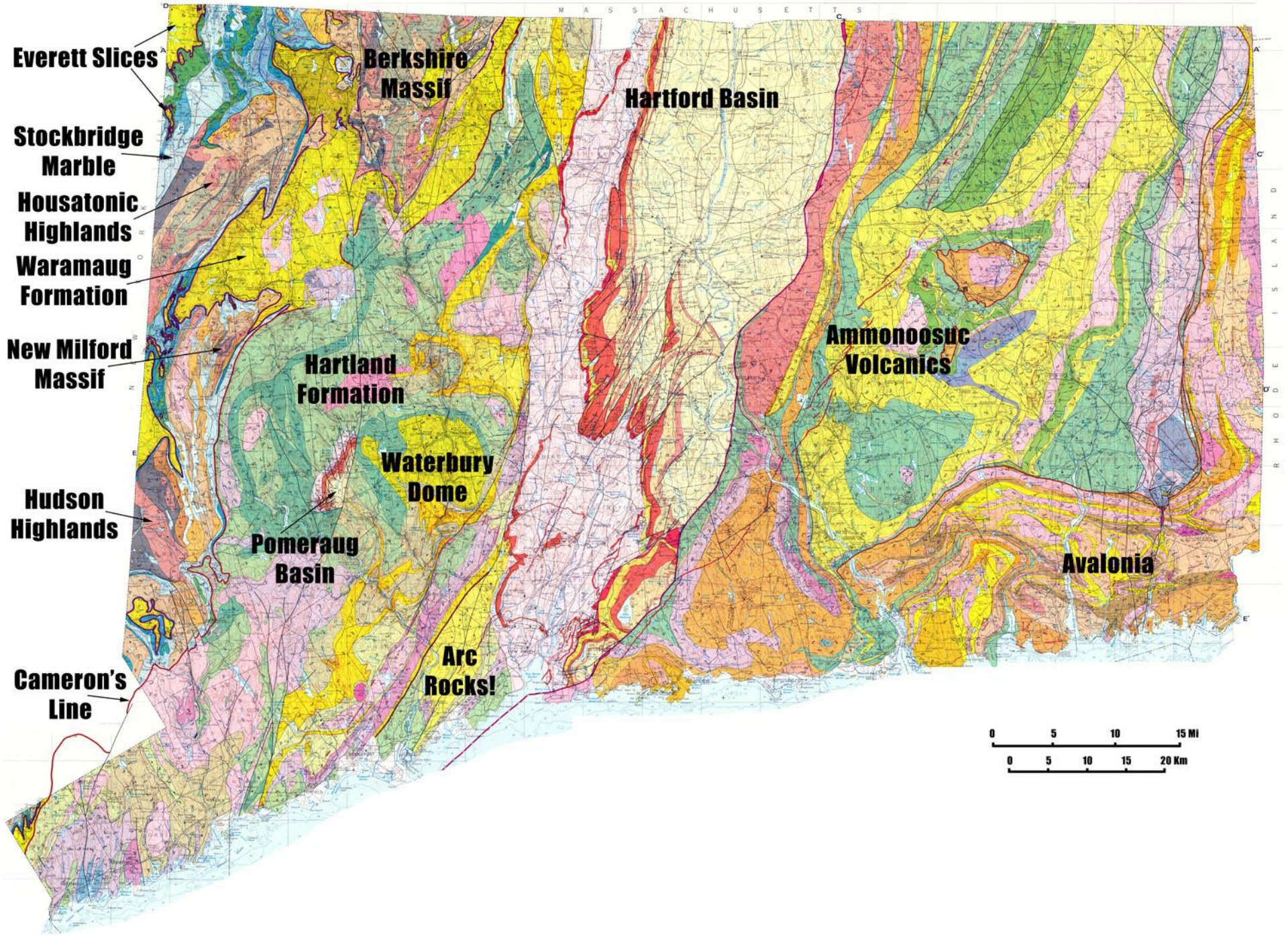

shear zone
Cameron's Line
Tyler
Lake
Granite
A
A'
B-B'
4
2a
2b
2c
1
2
pЄ-Owg
Є-Ohmk
Є-Oha
Ohgr
Ohgn
pЄ
0 1 2 3 4 km


0 1 2 3 4 km
A-A'
shear zone
pЄ-Owg
Ohgr
Є-Ohmk
Є-Oha
2a
2b
2c/1
2c
2
1
B
B'
Hodges Complex
Ohgn
Cameron's Line

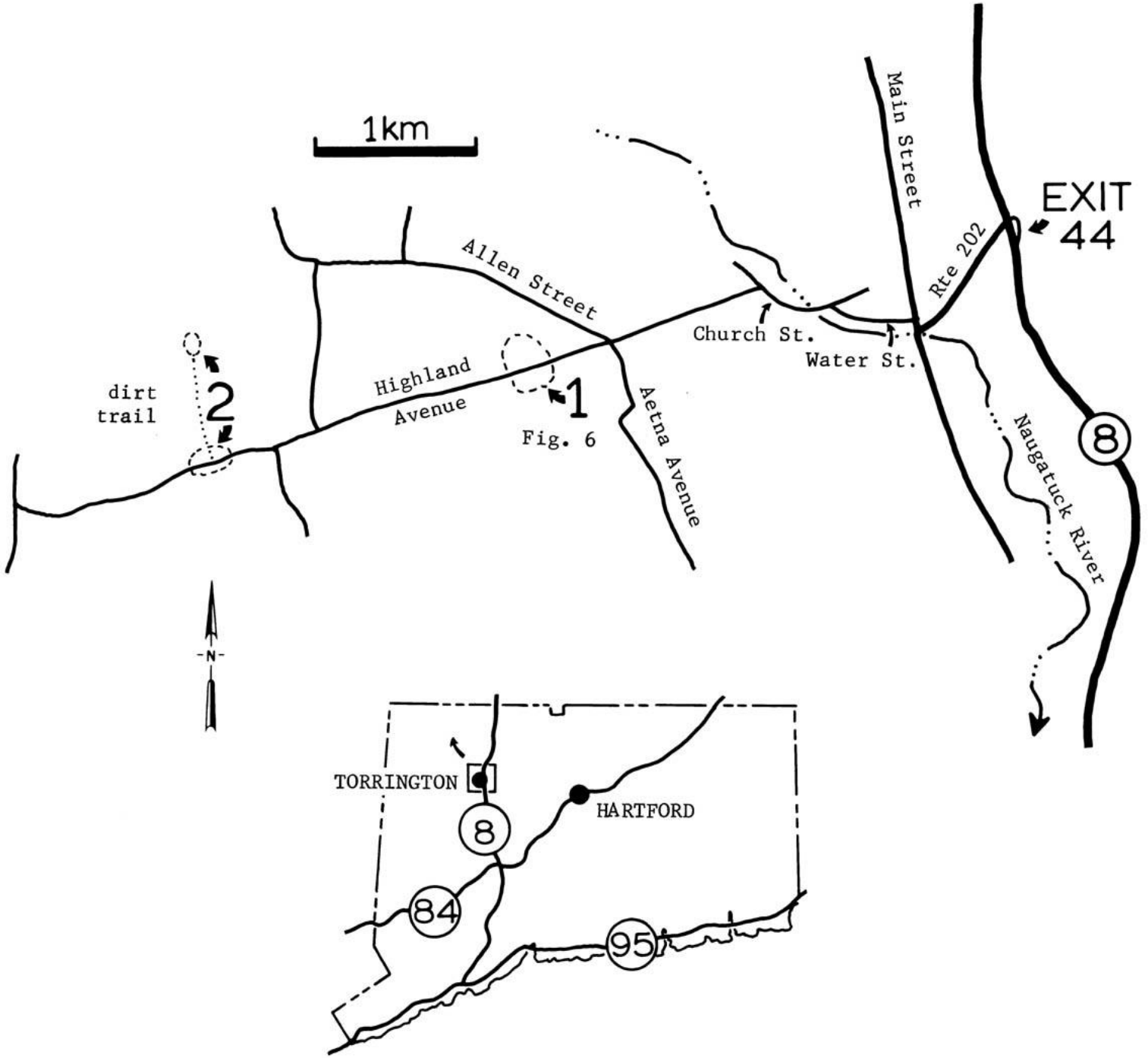
Dr. Eugene Cameron

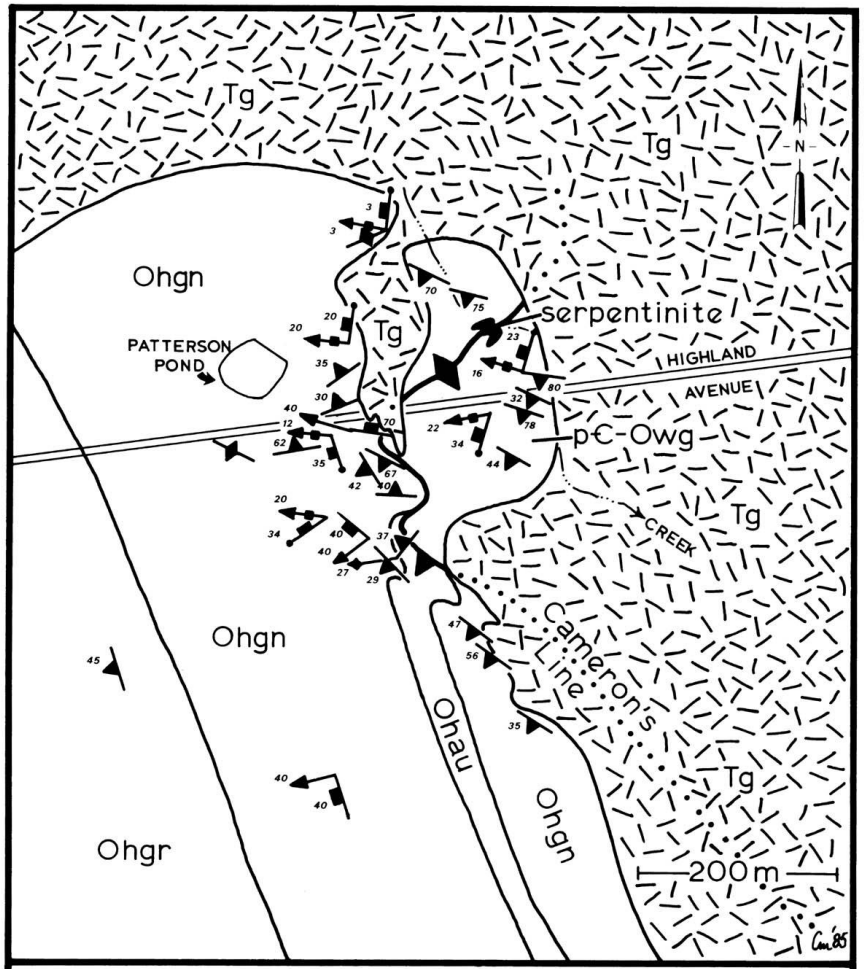
Economic Geologist
University Wisconsin

"I don't know why they called it Cameron's Line – It was John Agar Who told me about it"


Everett Slices
Stockbridge Marble
Housatonic Highlands
Waramaug Formation
New Milford Massif
Hudson Highlands
Cameron's Line
Berkshire Massif
Hartford Basin
Hartland Formation
Waterbury Dome
Pomeraug Basin
Arc Rocks!
Ammonoosuc Volcanics
Avalonia
0 5 10 15 Mi
0 5 10 15 20 Km


S2
S2
S2
S2
F1


1km
Main Street
EXIT
44
Rte 202
Allen Street
Church St.
Water St.
Highland
Avenue
dirt
trail
2
1
Fig. 6
Aetna Avenue
Naugatuck River
8
N
TORRINGTON
HARTFORD
8
84
95



Tg - Tyler Lake Granite

Hartland Formation

Ohgn - Gneiss

Ohau - Amphibolite

Ohgr - Granofels

pC-Owg - Waramaug Formation

S_2 regional foliation

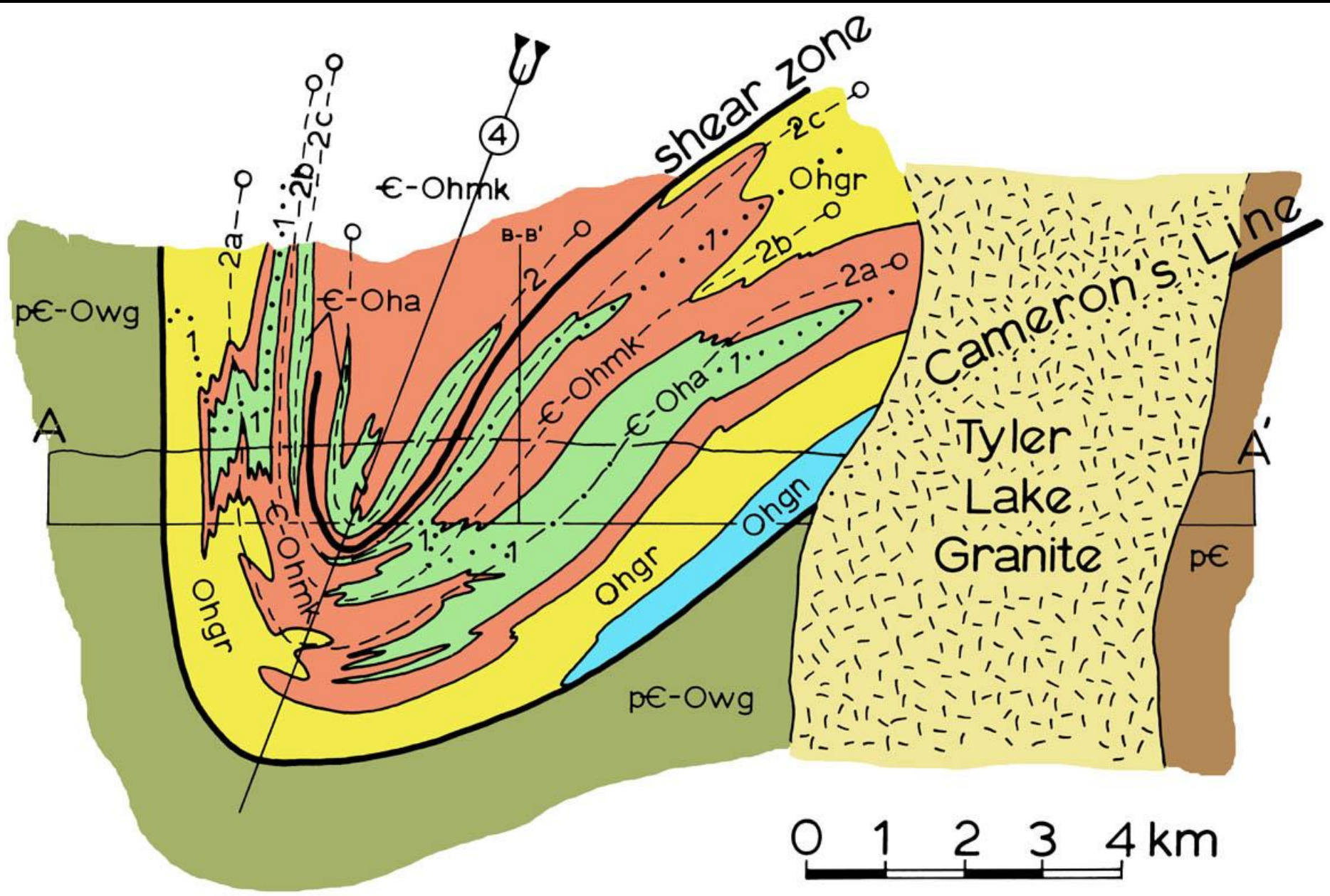
S_3 crenulation cleavage

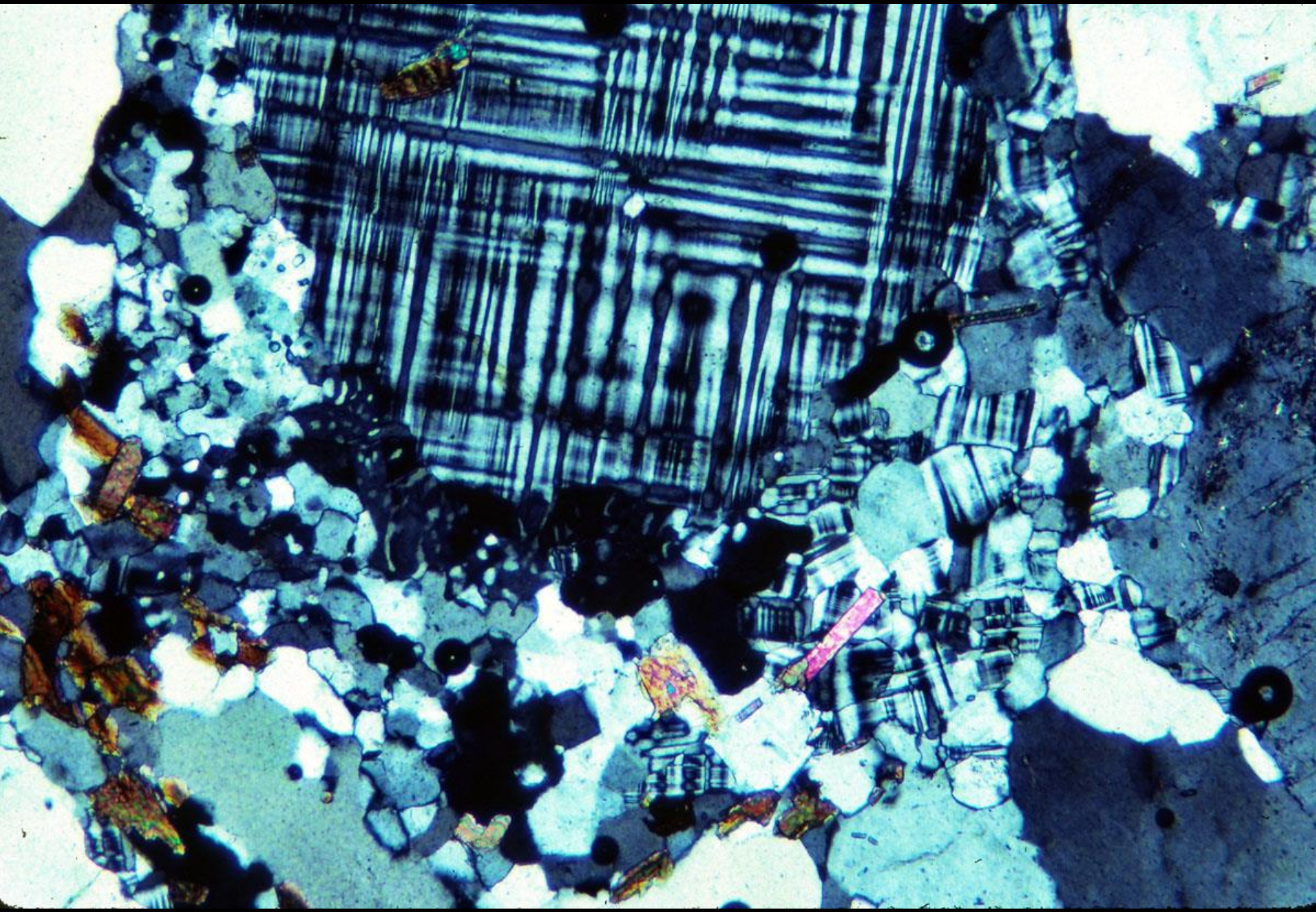
F_2 hingeline

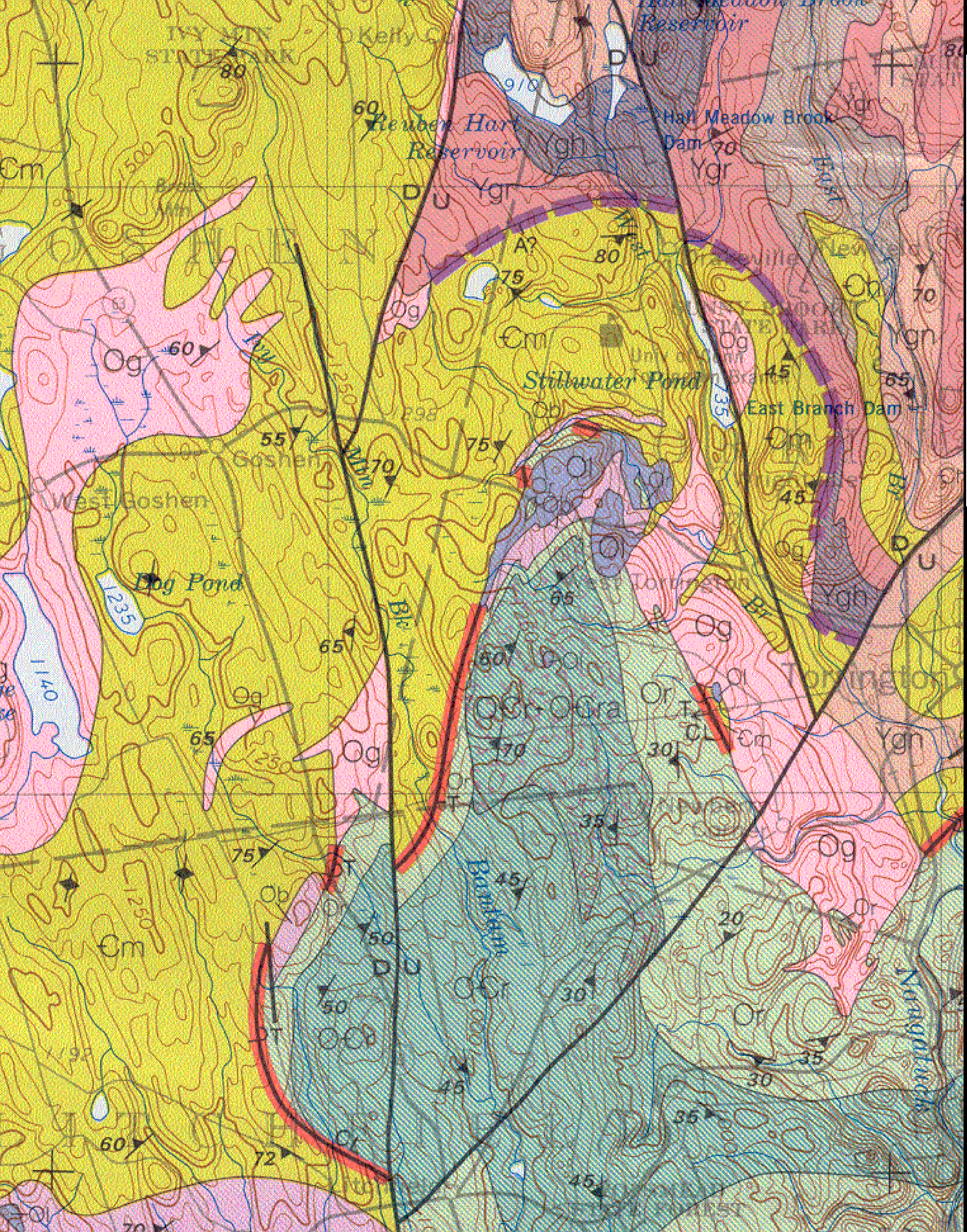
F_3 hingeline

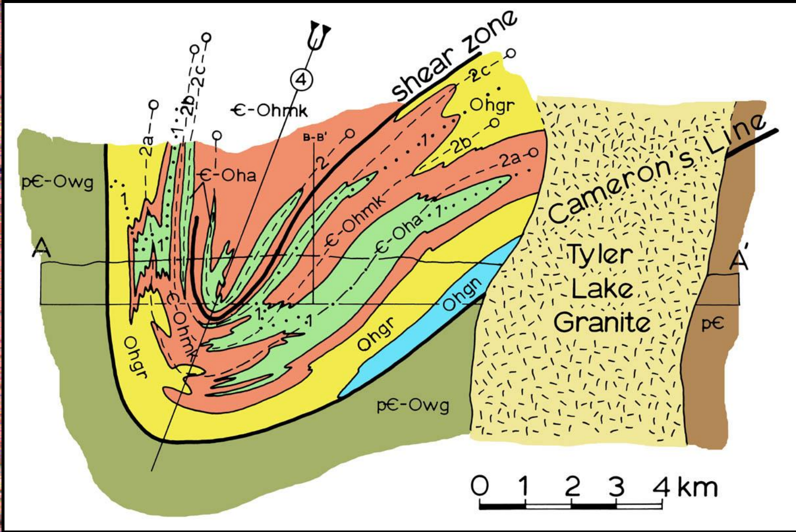
Merguerian, 1985


Merguerian 1987
S2


shear zone
Cameron's Line
Tyler
Lake
Granite
A
A'
B-B'
4
2a
2b
2c
1
2
pЄ-Owg
Є-Ohmk
Є-Oha
Ohgr
Ohgn
pЄ
0 1 2 3 4 km







Tyler Lake Granite

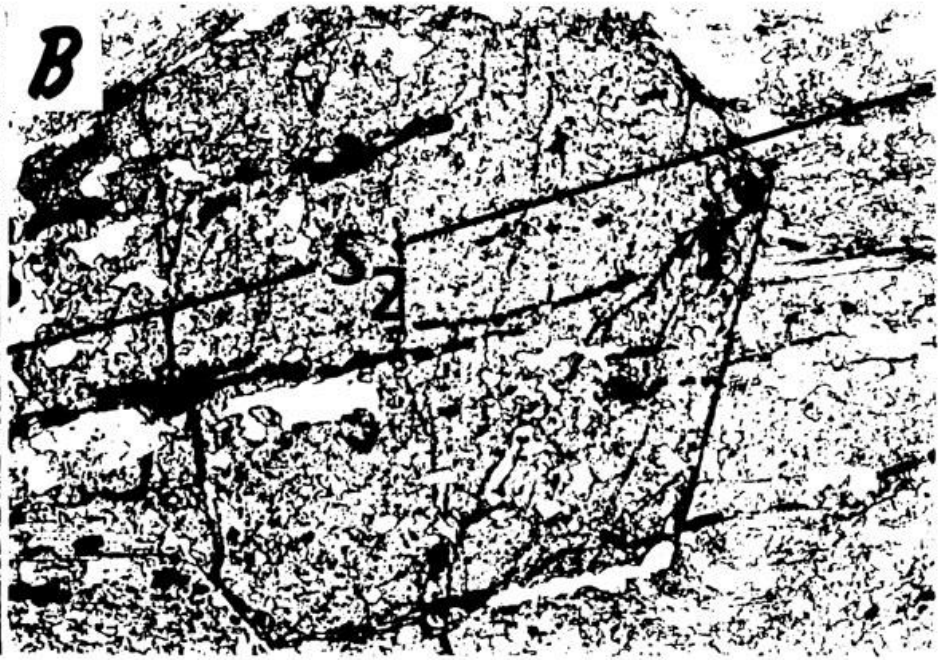
466 +/- 12 Ma

Sr 87/86 = 0.7082

Merguerian et al 1984

Hodges Contact Aureole


PL
KY
CORD



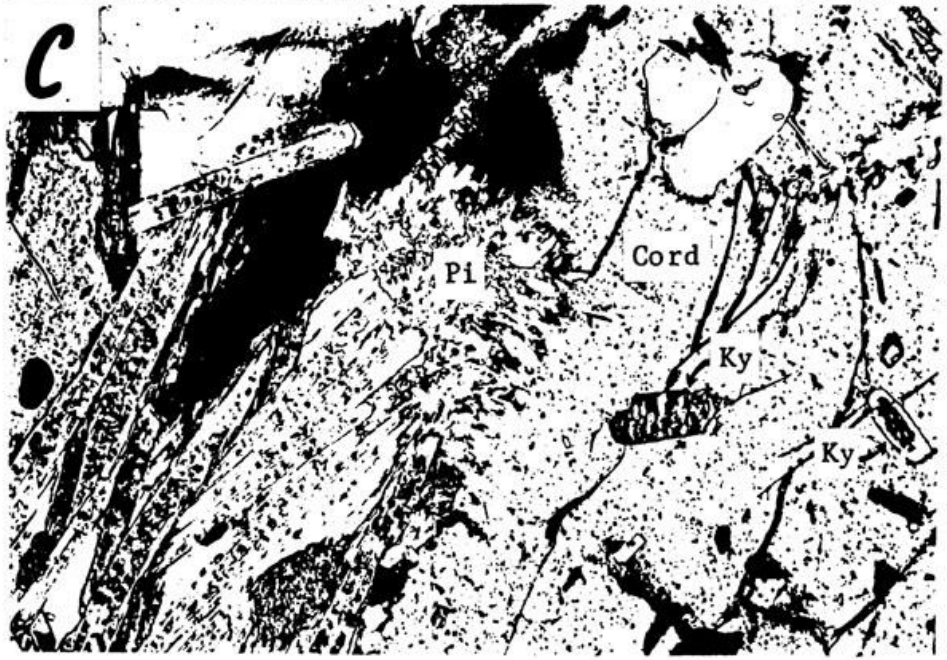
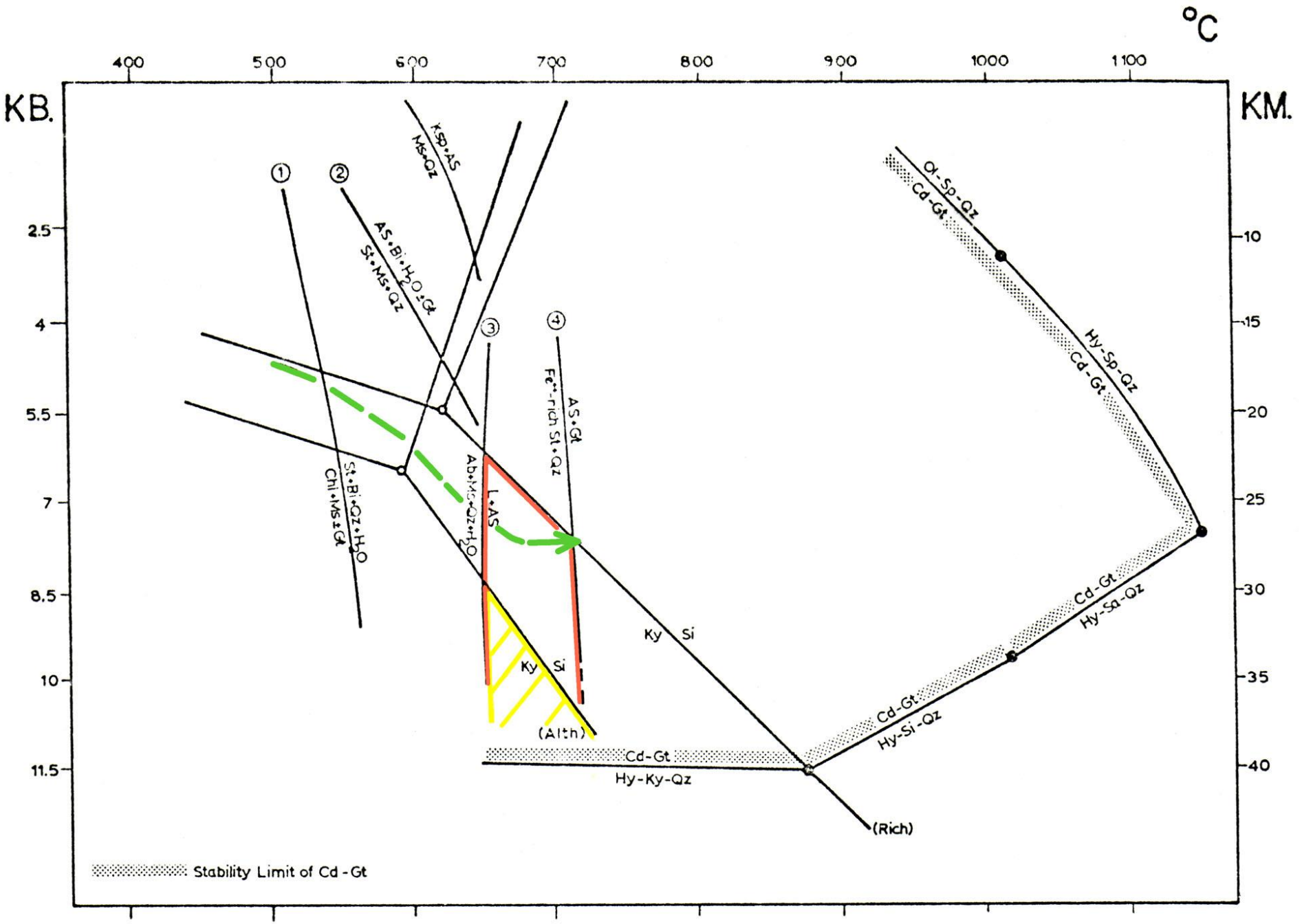
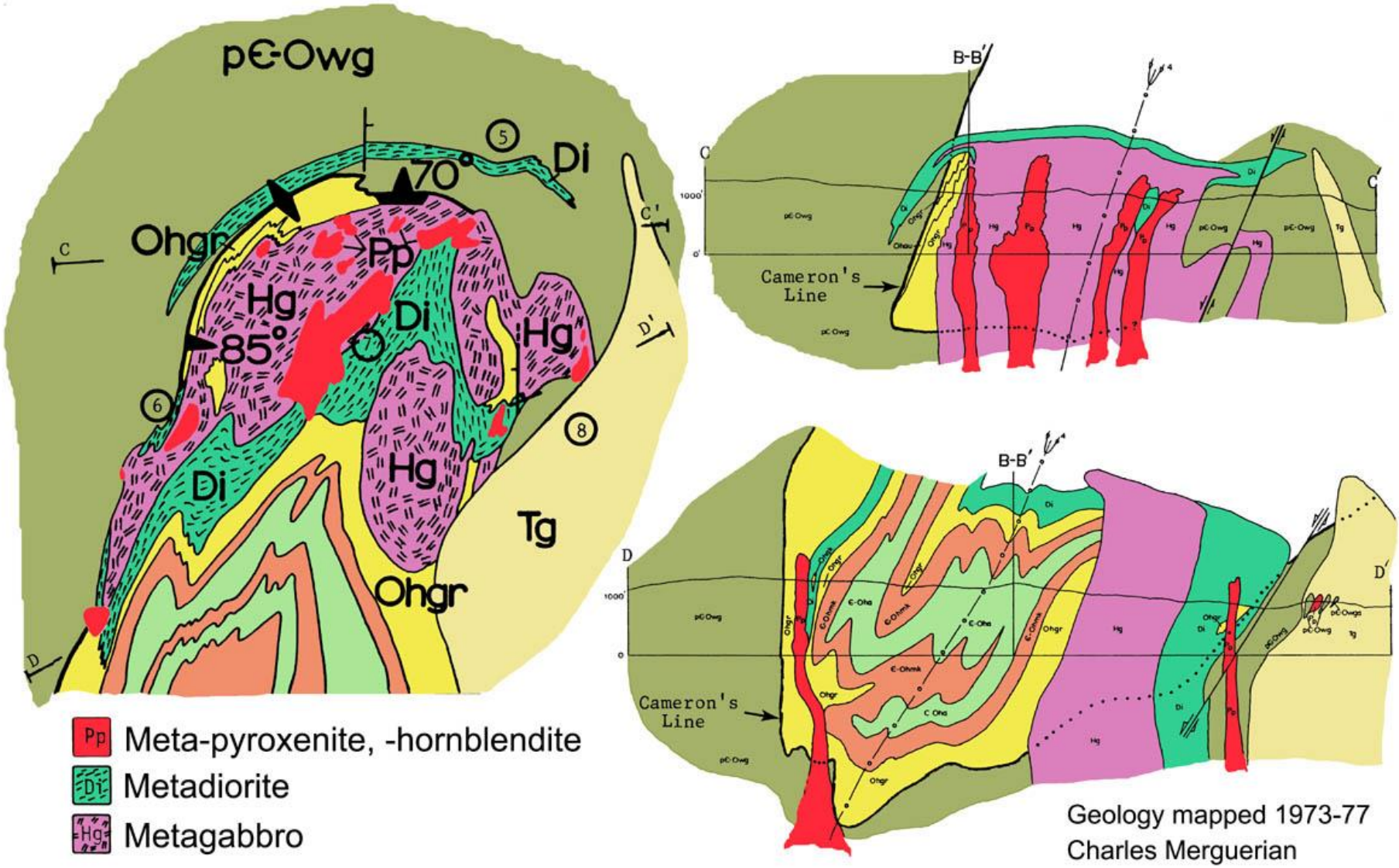
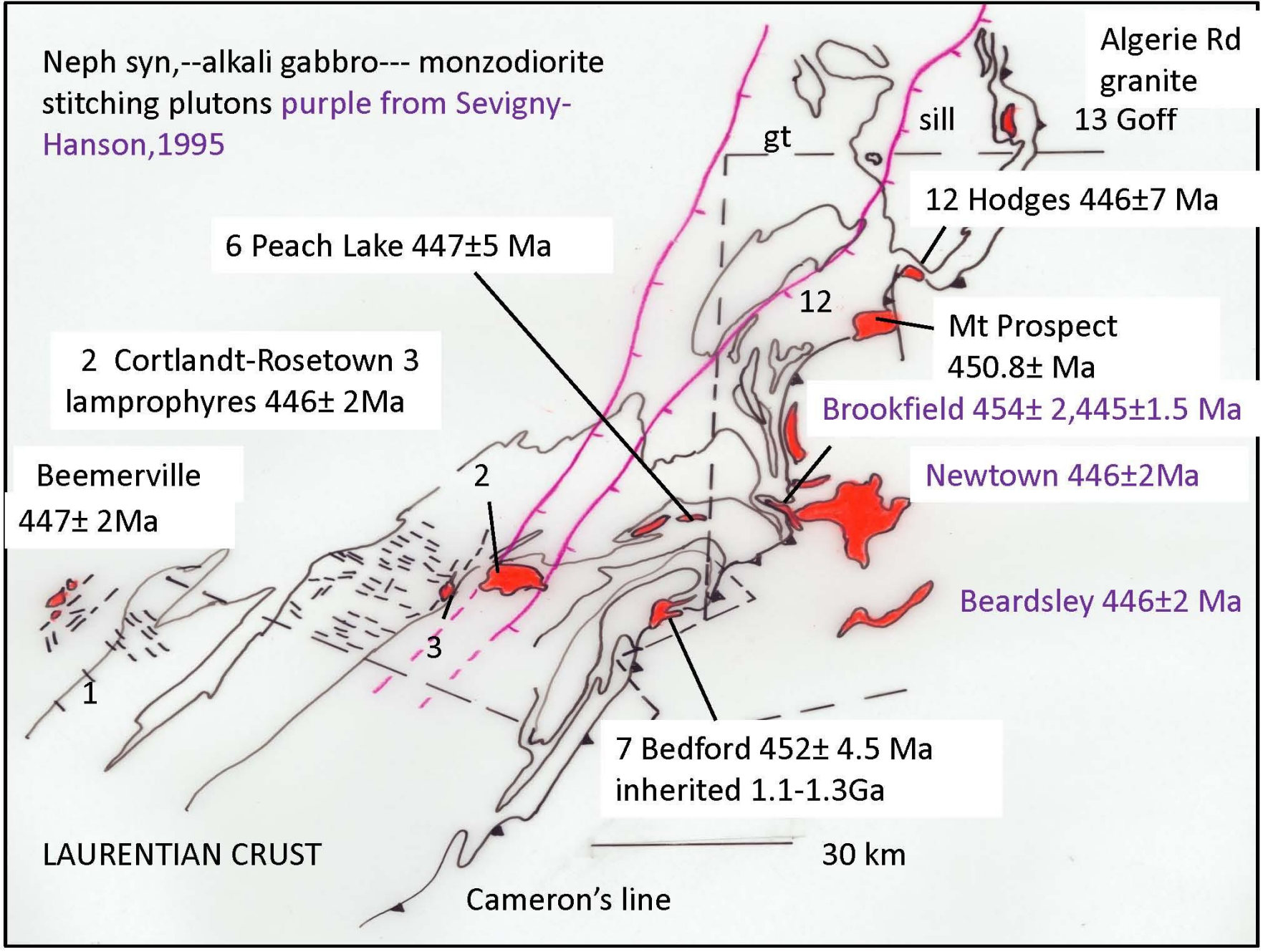


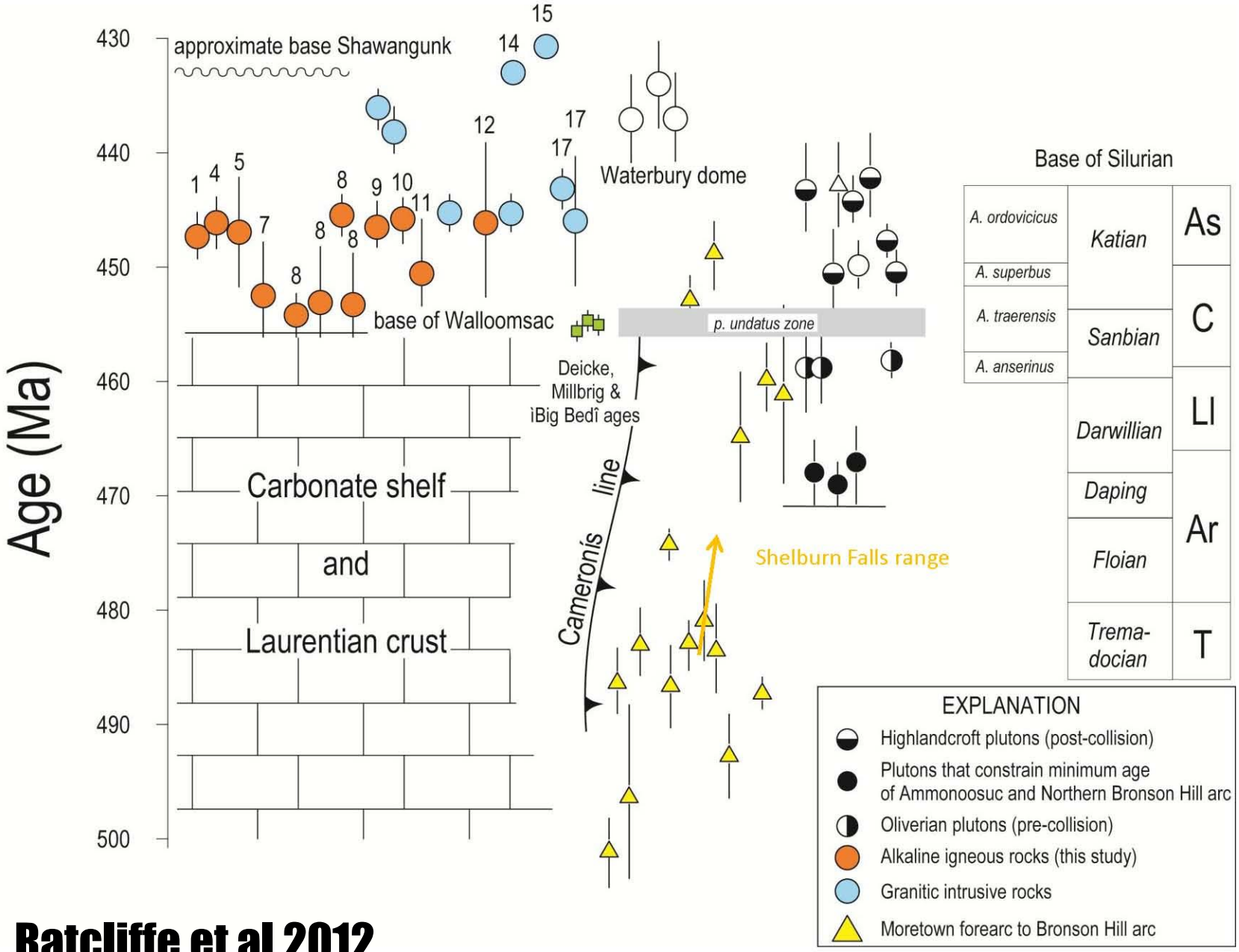
Figure 45 - a) Contact induced garnet enrichment in Hartland granofels xenolith from Stop 7. b) Garnet porphyroblast overprinting and including the penetrative S_2 foliation in Hartland amphibolite (Ohau) from contact aureole of the Hodges Complex at Stop 6. c) Cordierite (Cord) with typical pinnite (Pi) alteration coexisting with kyanite (Ky). Sample from contact of Hodges gabbro with Hartland granofels (Ohgr) on the northeast slope of Klug Hill.


°C
400
500
600
700
800
900
1000
1100
KB.
KM.
2.5
4
5.5
7
8.5
10
11.5
10
15
20
25
30
35
40
①
②
③
④
K-Sp·AS
Ms·Qz
AS·Bi·H2O·Gt
St·Ms·Qz
St·Bi·Qz·H2O
Chl·Ms±Gt
Ab·Ms·Qz·H2O
L·AS
Fe++-rich St·Qz
AS·Gt
Ky
Si
Ky
Si
(Alth)
Cd-Gt
Hy-Ky-Qz
(Rich)
Ot-Sp-Qz
Cd-Gt
Hy-Sp-Qz
Cd-Gt
Cd-Gt
Hy-Si-Qz
Cd-Gt
Hy-Sa-Qz
Stability Limit of Cd-Gt


pC-Owg
Ohgr
Pp
Hg
Di
Tg
70°
85°
5
6
8
C
C'
D
D'
B-B'
Cameron's Line
1000'
0'
0
Pp Meta-pyroxenite, -hornblendite
Di Metadiorite
Hg Metagabbro
Geology mapped 1973-77
Charles Merguerian

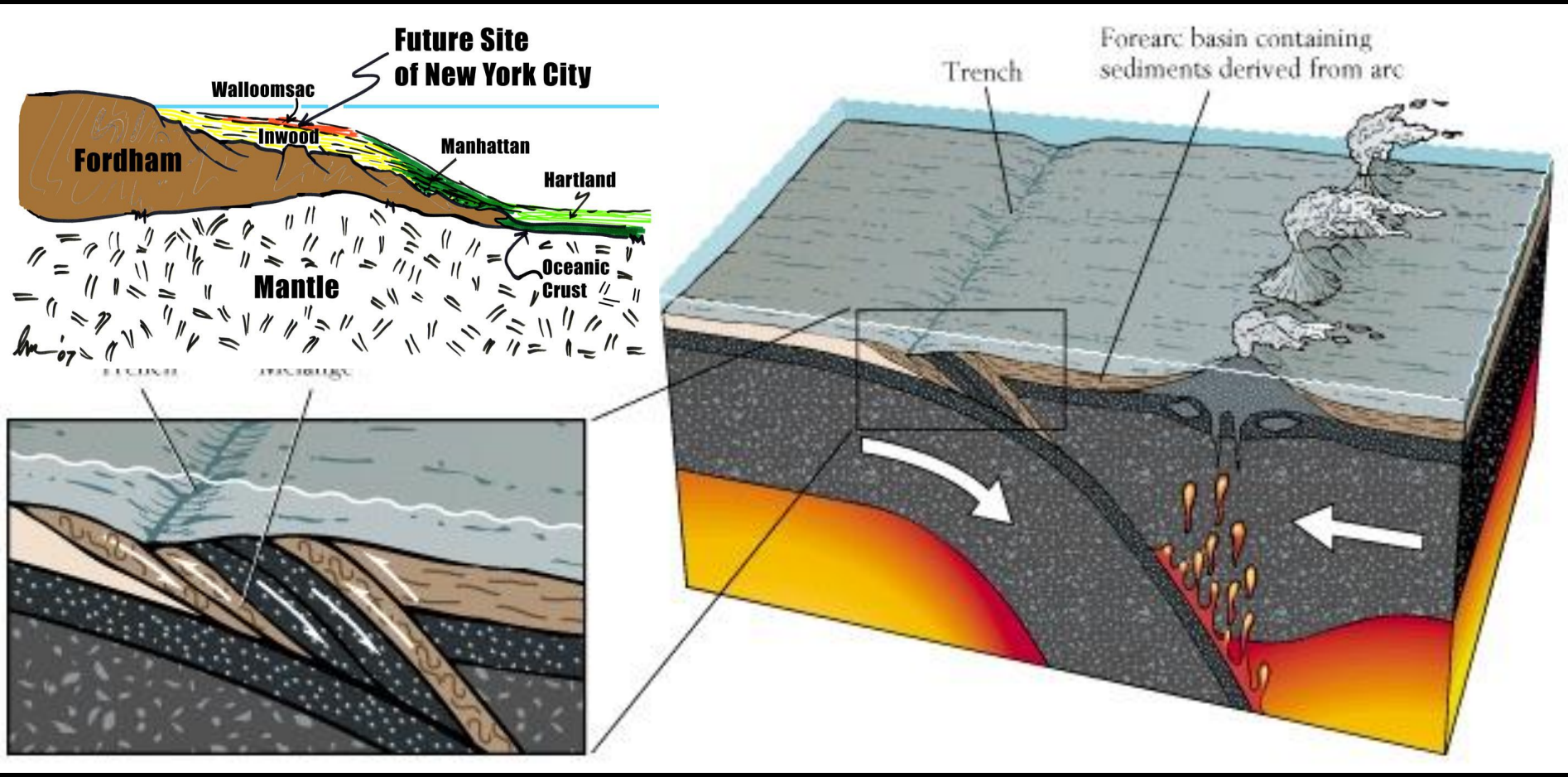


Ratcliffe et al 2012



Ratcliffe et al 2012

Taconian Accretionary Prism



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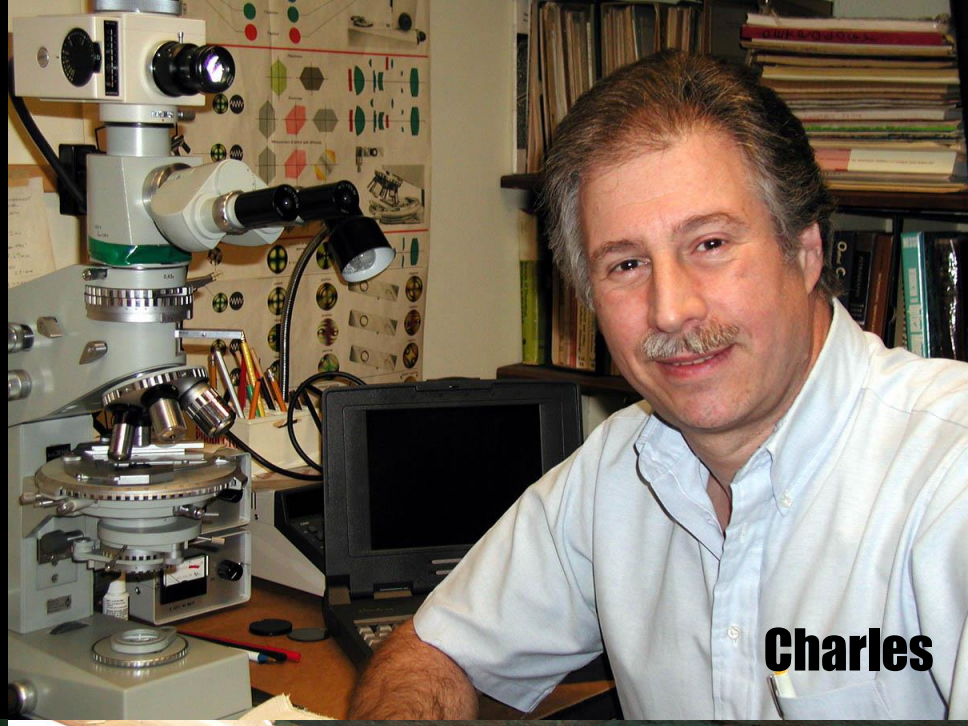

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