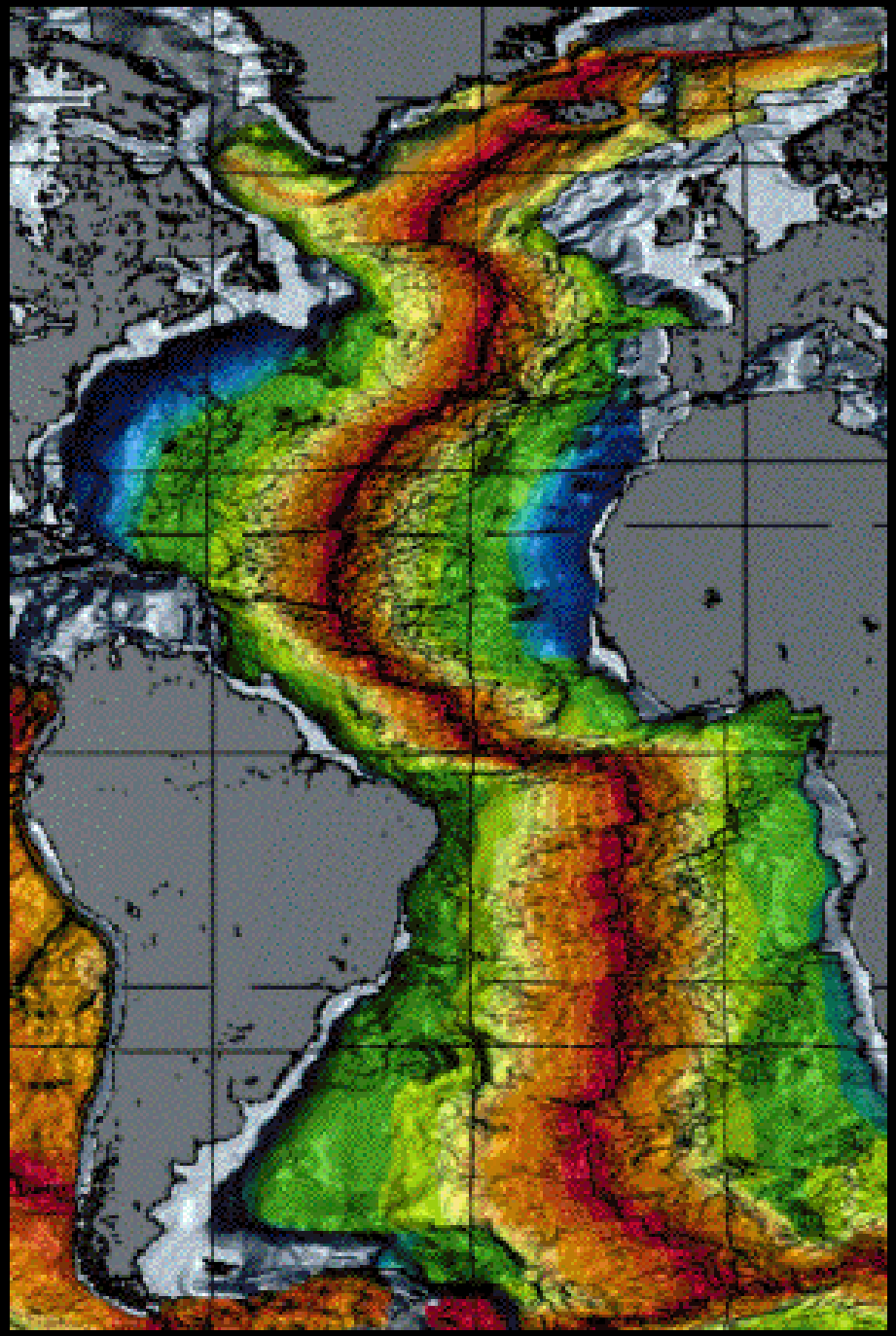
Geology and Minerals of the Queens Tunnel

Charles Merguerian

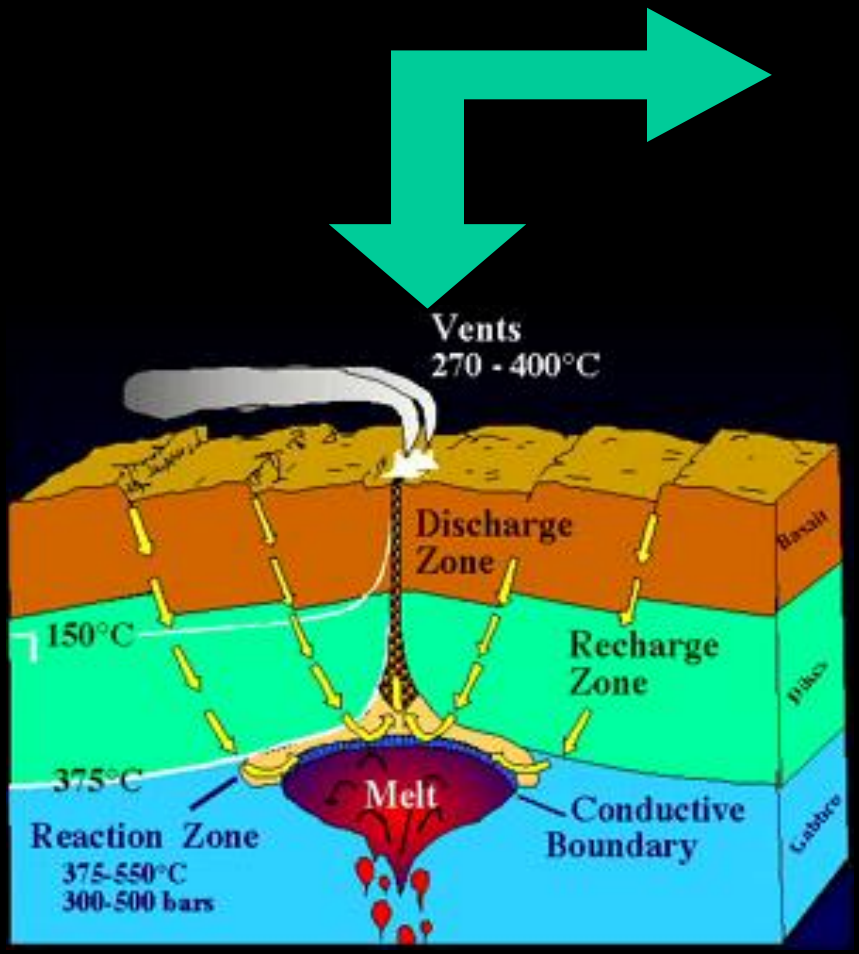
HOFSTRA UNIVERSITY

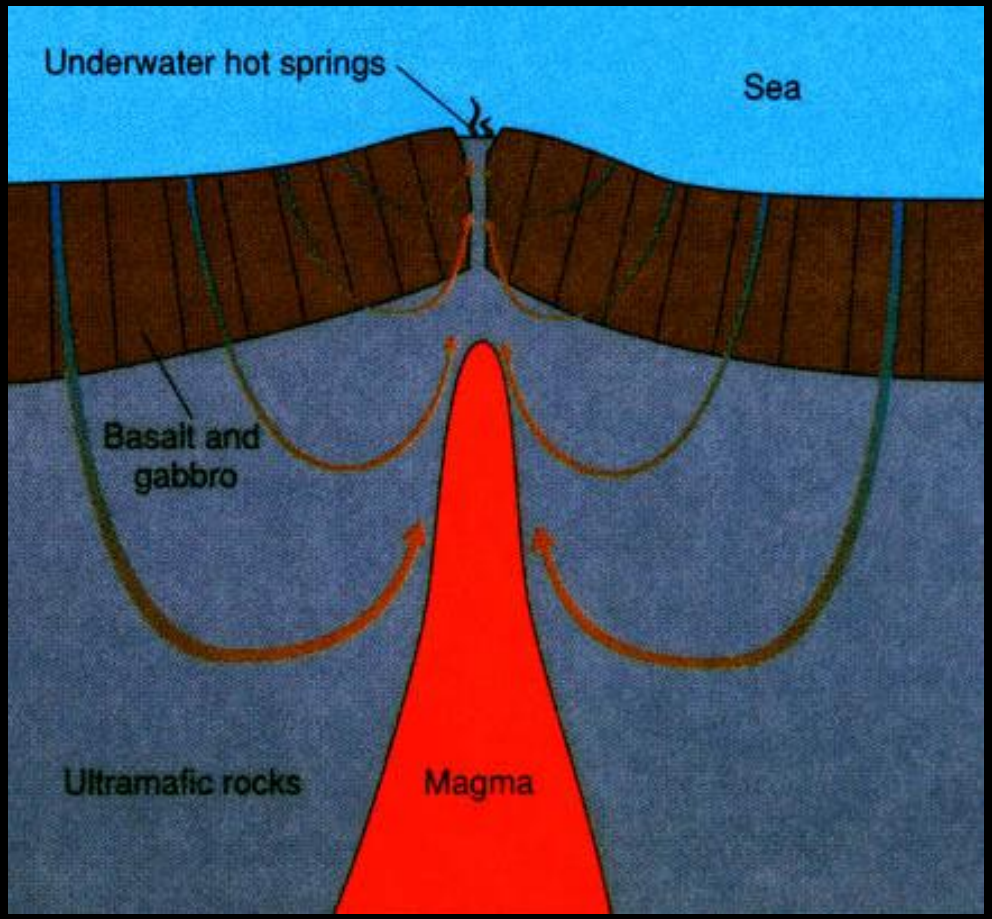
New York
State Museum
Mineral Show
21 February 2004



Ocean Floor Environment

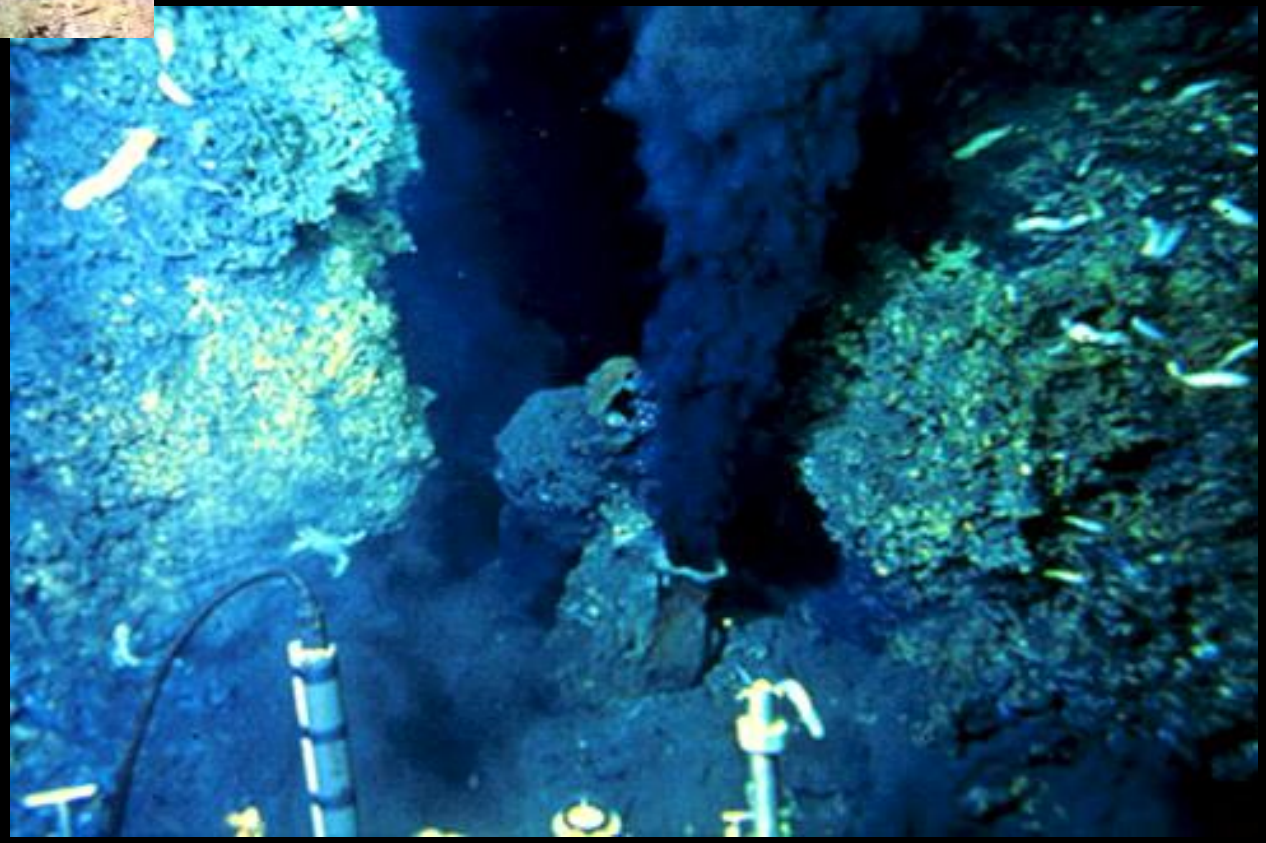
Mid-Atlantic Ridge

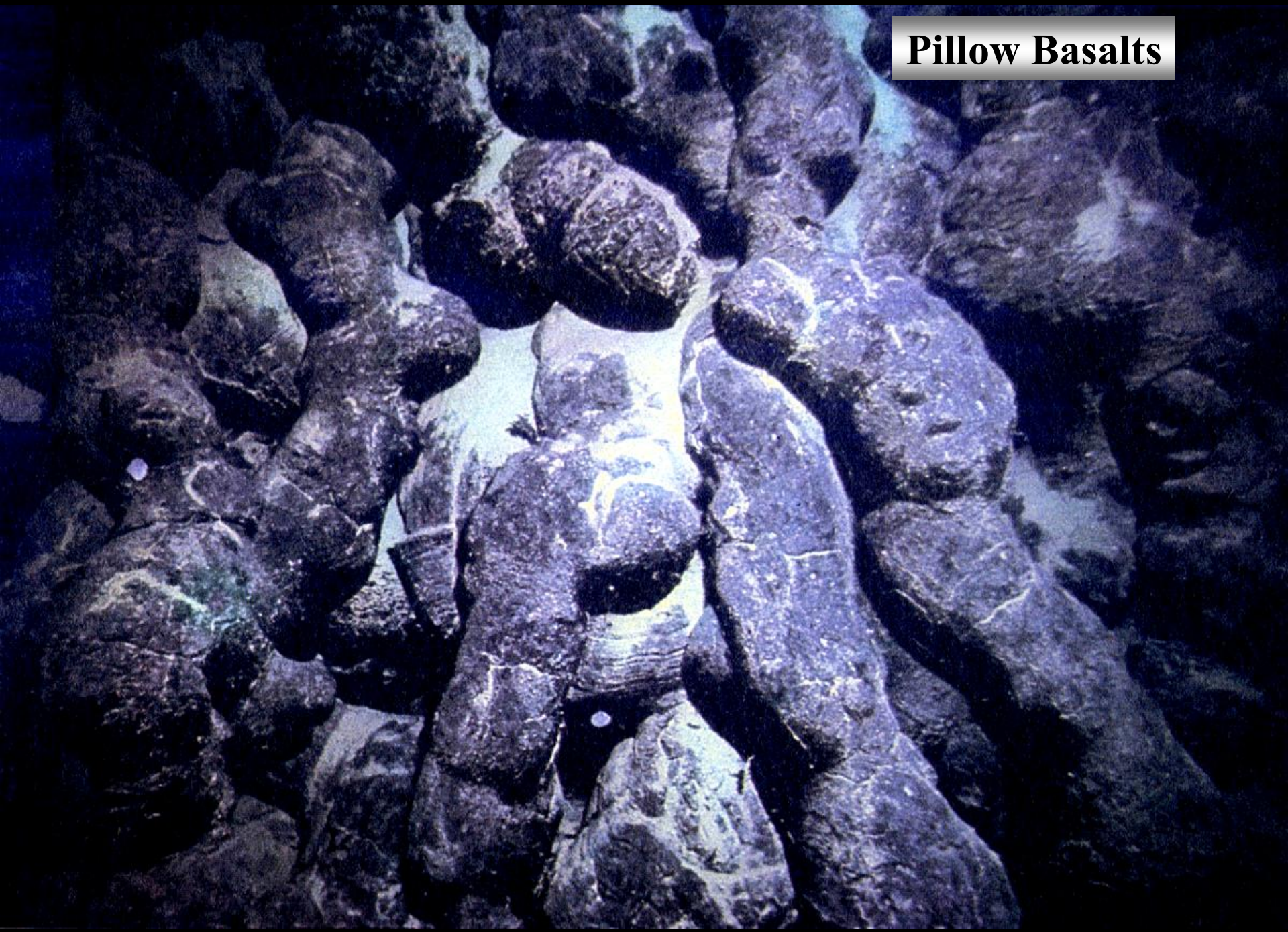




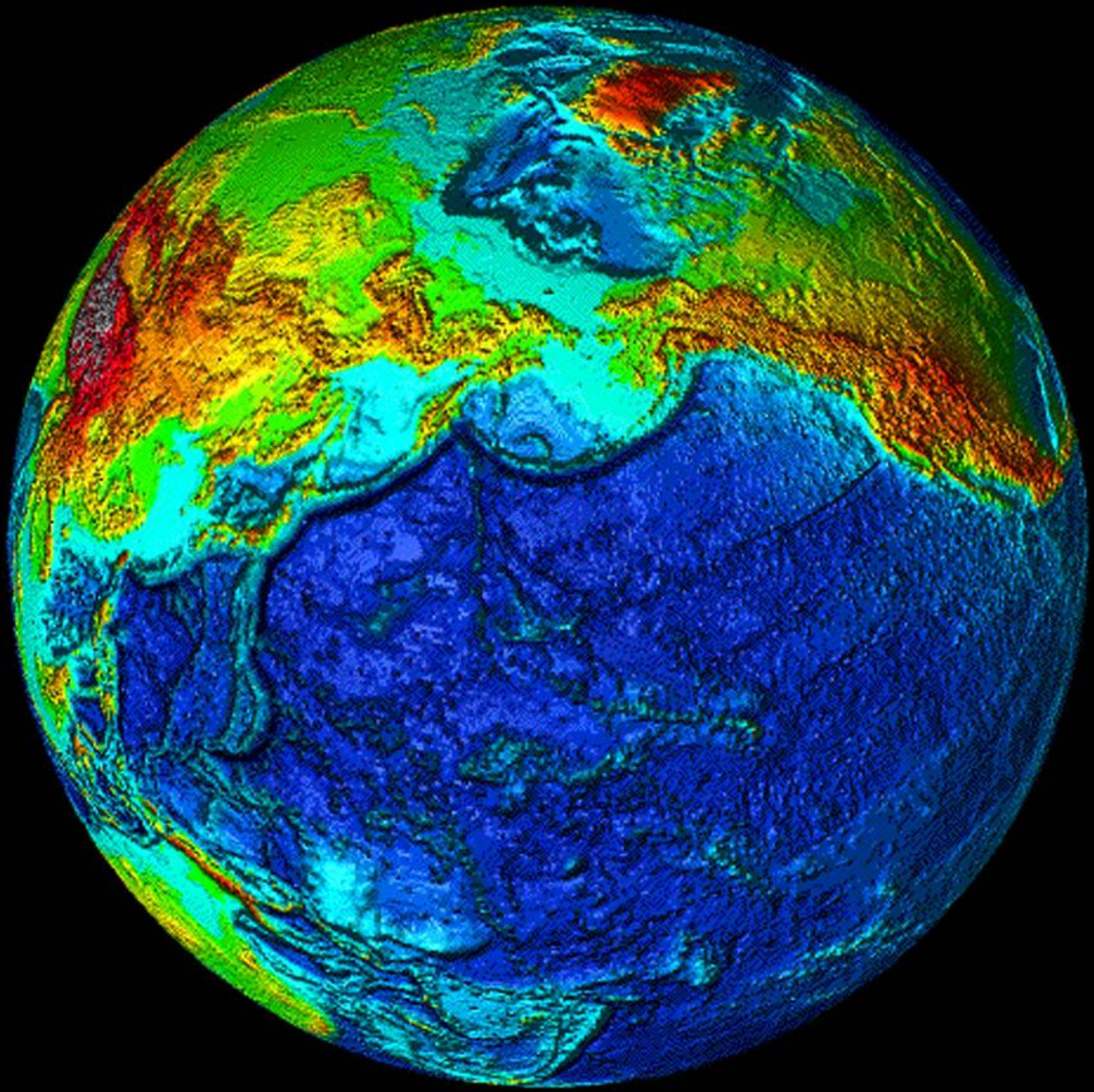
Remarkable Geologic and Biologic Activity at Active Ridge Crests

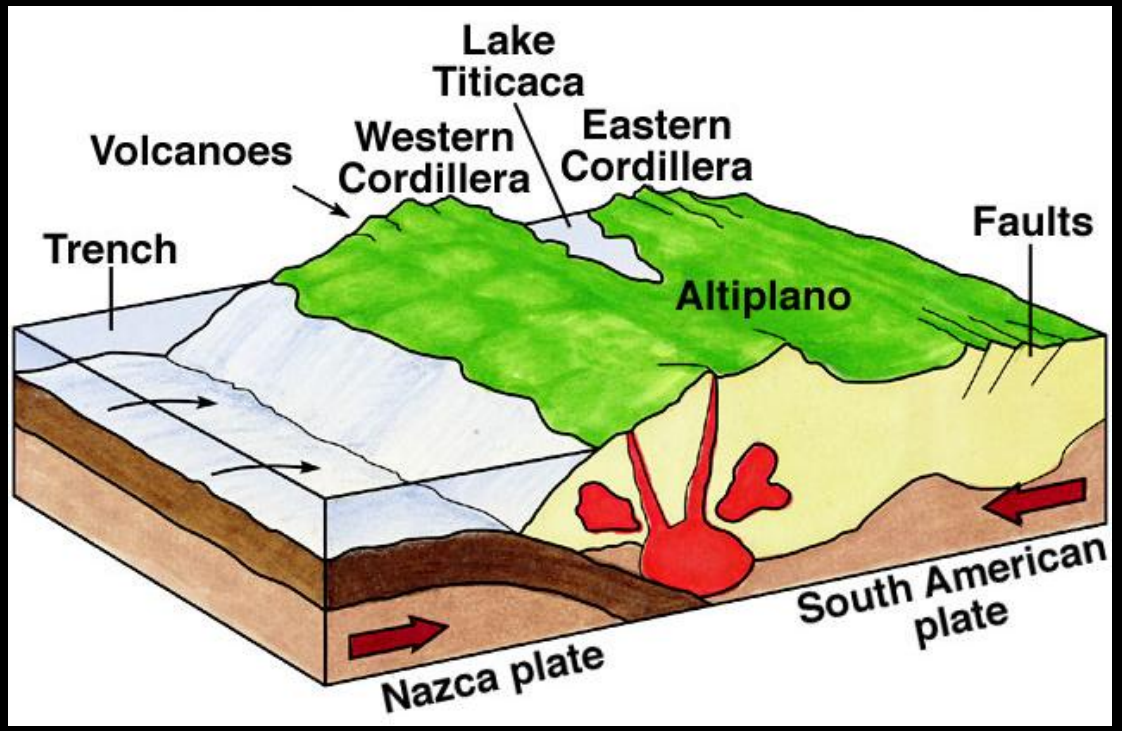
Black Smokers

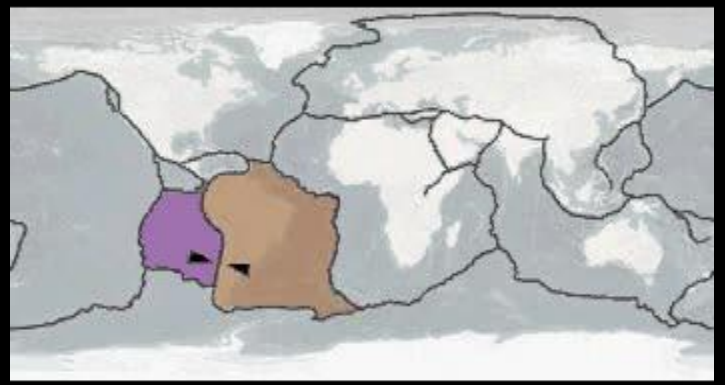


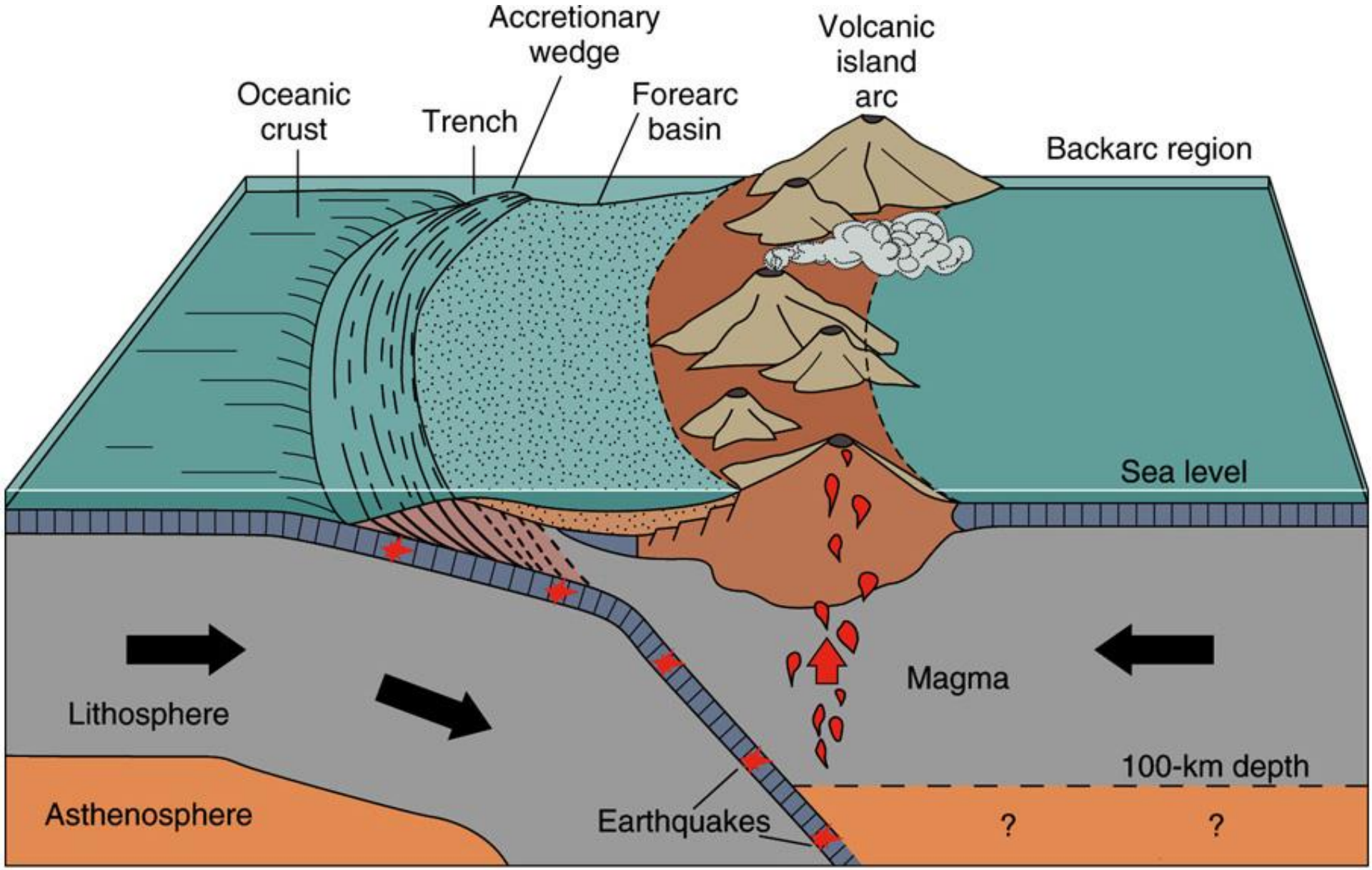

Pillow Basalts

Pillow Lavas, Upper New St., Paterson, NJ




Lake
Titicaca
Volcanoes
Western
Cordillera
Eastern
Cordillera
Faults
Trench
Altiplano
South American
plate
Nazca plate

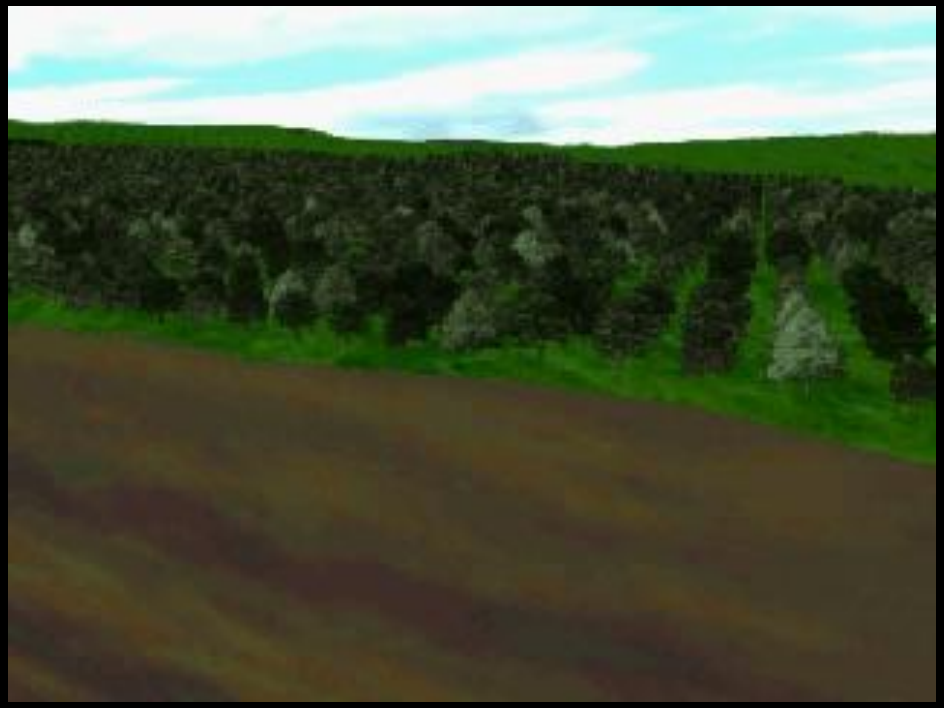



Accretionary wedge
Volcanic island arc
Oceanic crust
Trench
Forearc basin
Backarc region
Sea level
Lithosphere
Magma
100-km depth
Asthenosphere
Earthquakes
?
?


Mt. Fuji, Japan

Mt. Fuji, 1957 Rodan Birthplace

Down We Go




Classic Minerals of New York City
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Olde New York

W. G. LEVISON, PHOTO. PLATE No. 89 (1901)

EXCAVATION IN MANHATTAN SCHIST

Riverside Drive, 92nd to 93rd St., Manhattan Island, New York City

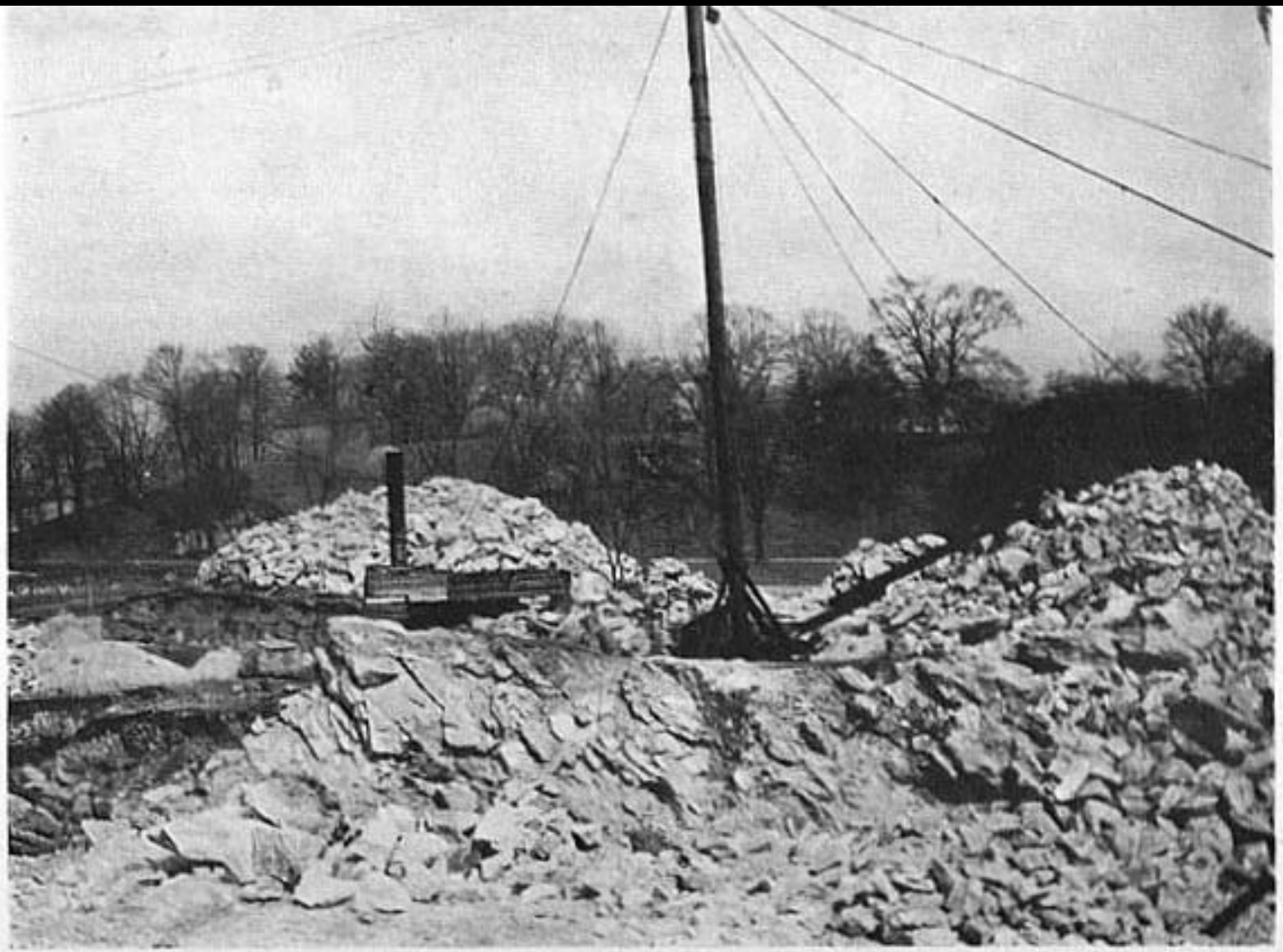


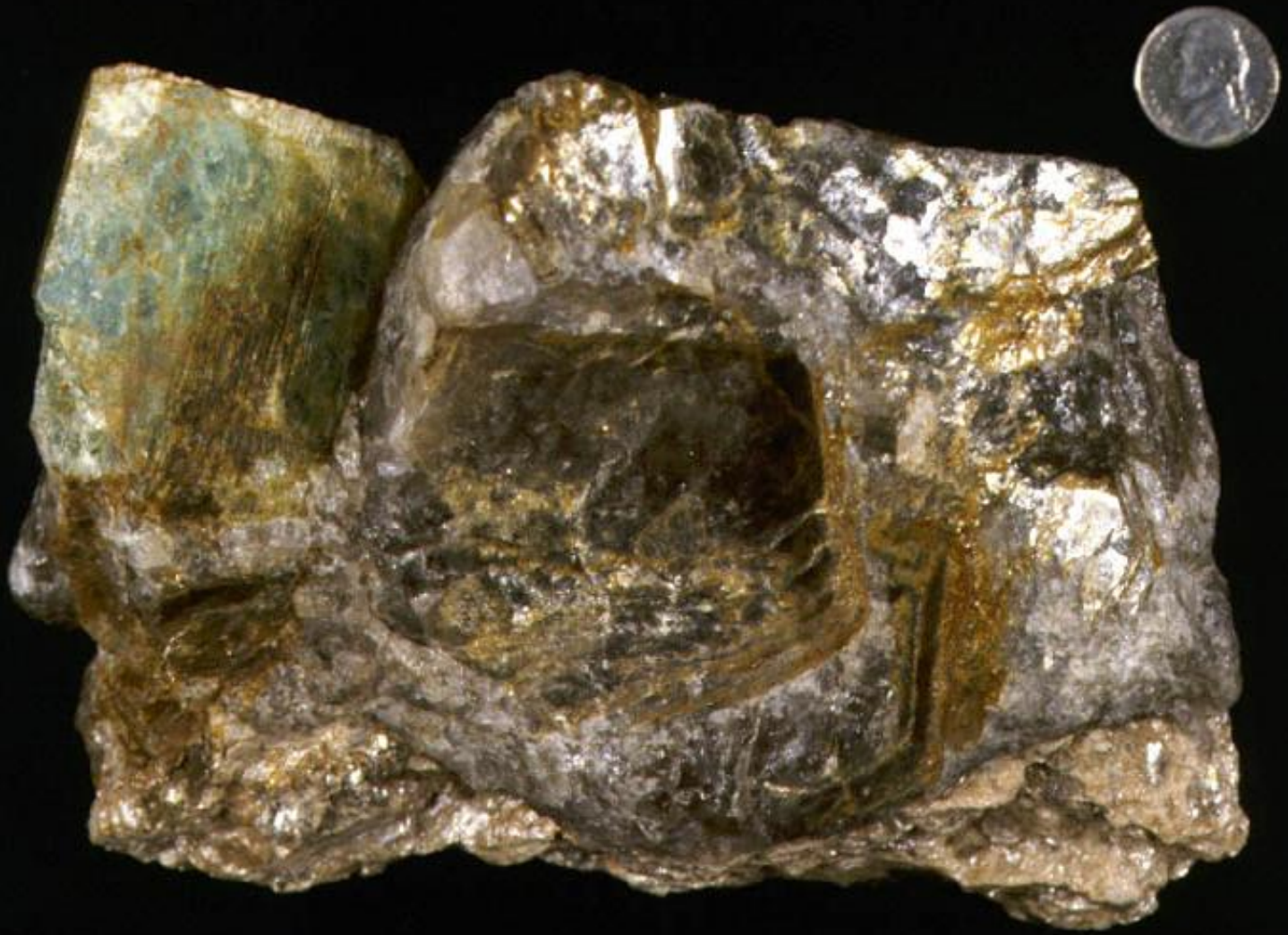
PLATE No. 90 (1913)

EXCAVATION IN INWOOD LIMESTONE

Broadway and 207th St., Manhattan Island, New York City


THE AMERICAN MVSEVM OF NATVRAL HISTORY
FOVNDED 1869

Beryl – 157th Street and Broadway

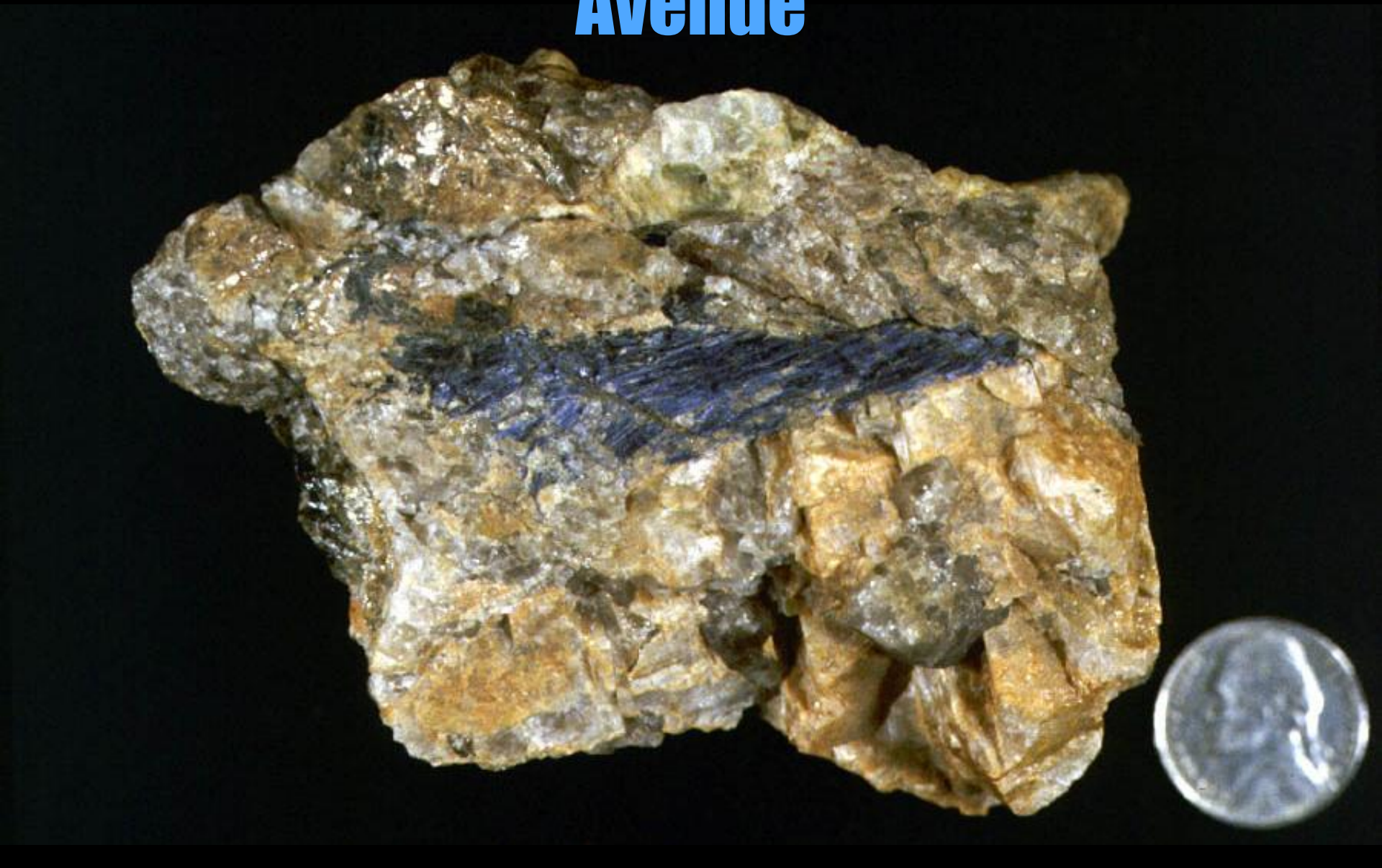


Chrysoberyl – 93rd Street and Riverside Drive

Tourmaline – 170th Street and Amsterdam Avenue

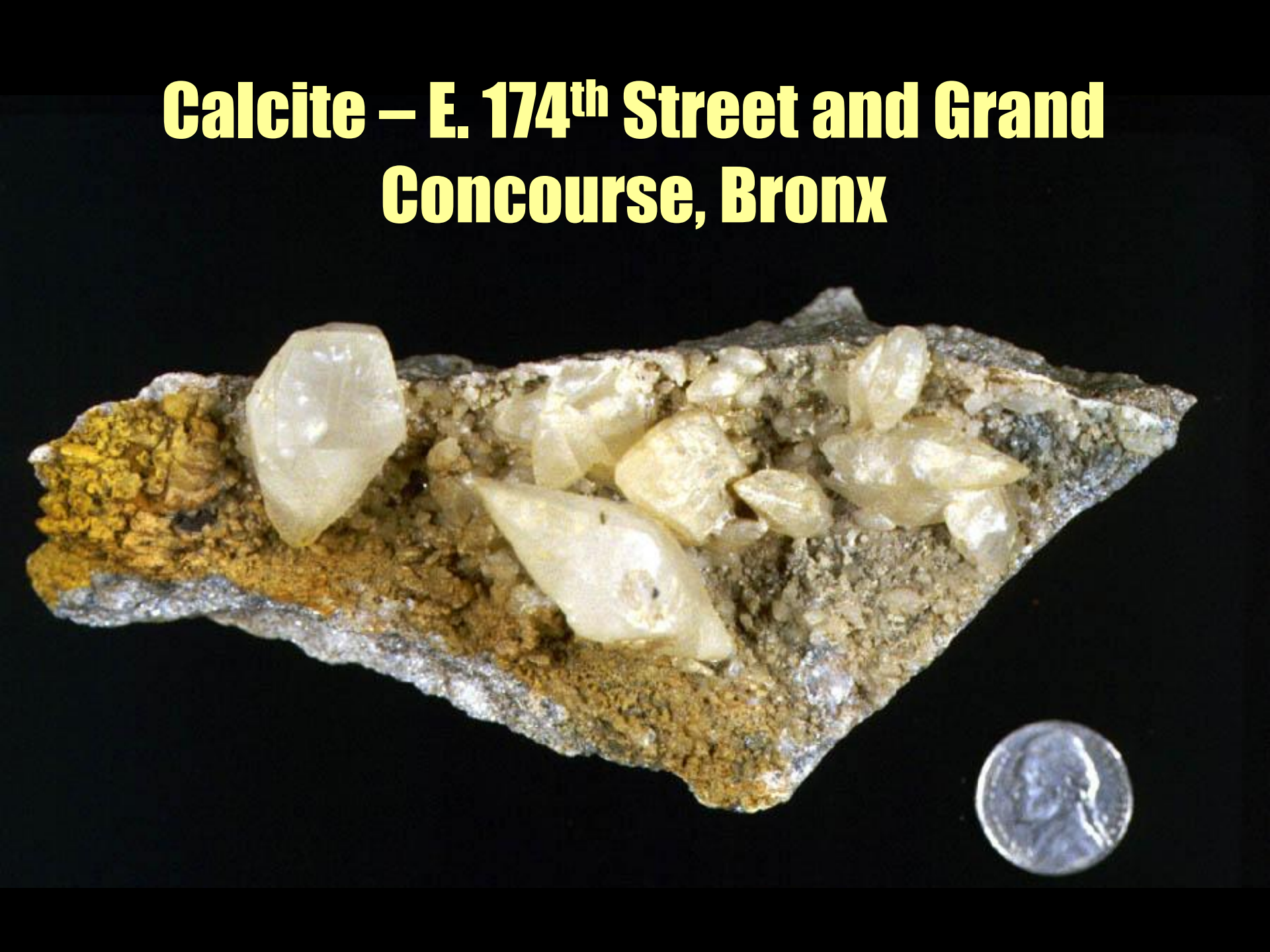
Calcite – E. 174th Street and Grand Concourse, Bronx

Dumortierite – 118th Street and Fifth Avenue

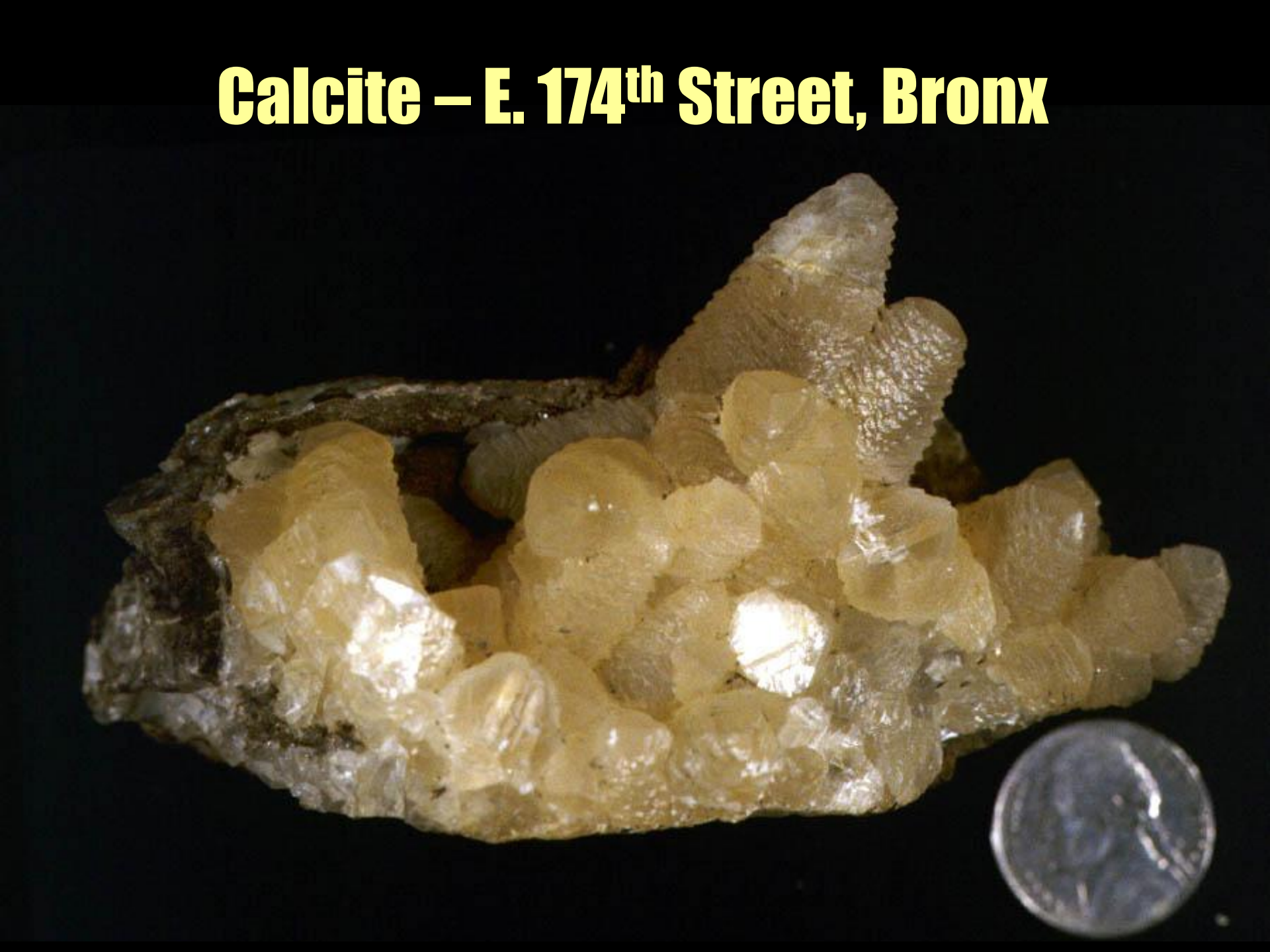


Famous “Sewer” Garnet

Calcite – E. 174th Street and Grand Concourse, Bronx



Calcite – E. 174th Street, Bronx



Kyanite – 61st Street /Central Park West

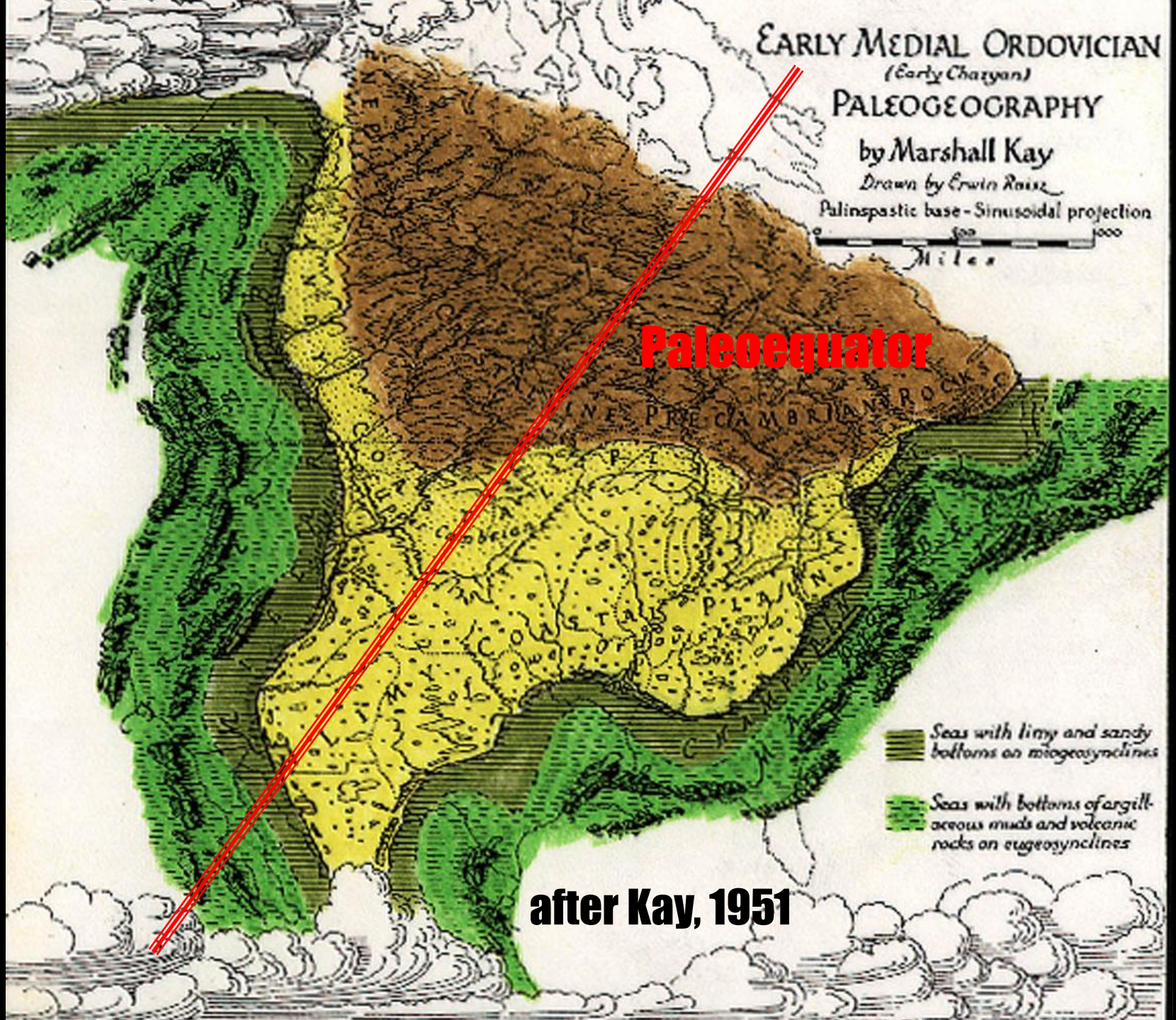
Chabazite and Stilbite – 45th Street and Second Avenue

Beryl – 190th Street and Amsterdam

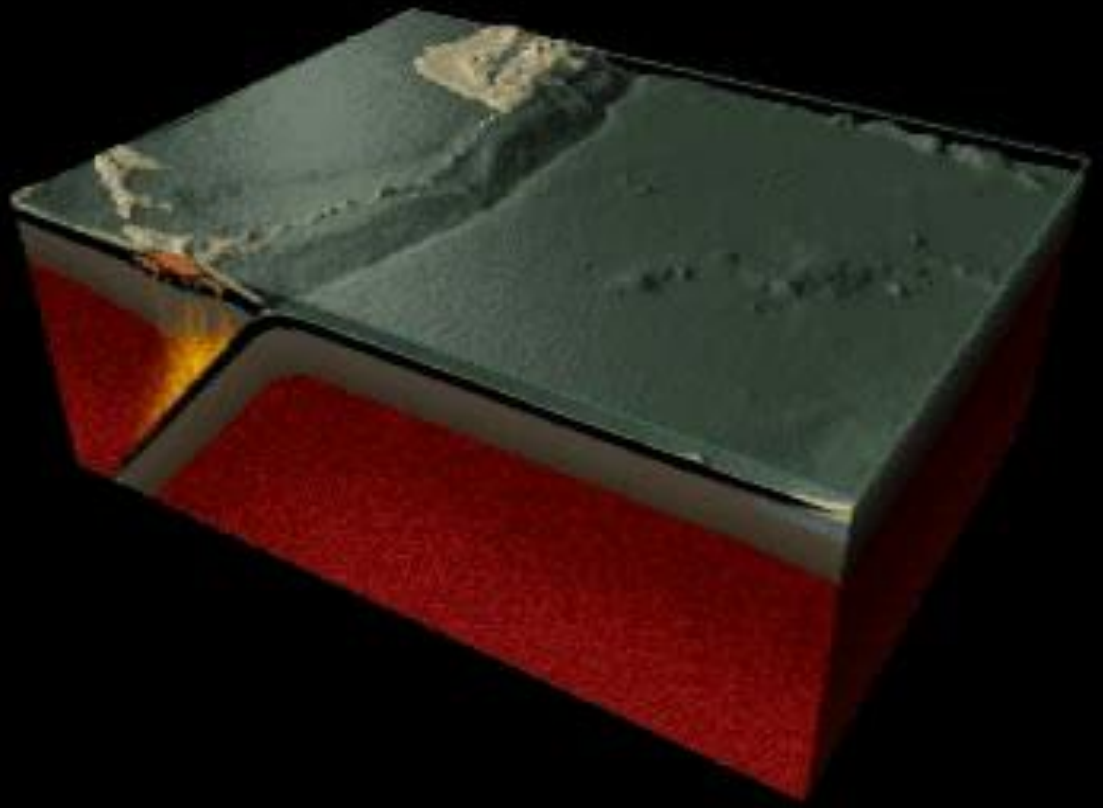
Quartz – Westchester Avenue, Bronx

Stilbite – 45th Street, between First and Second Aveues

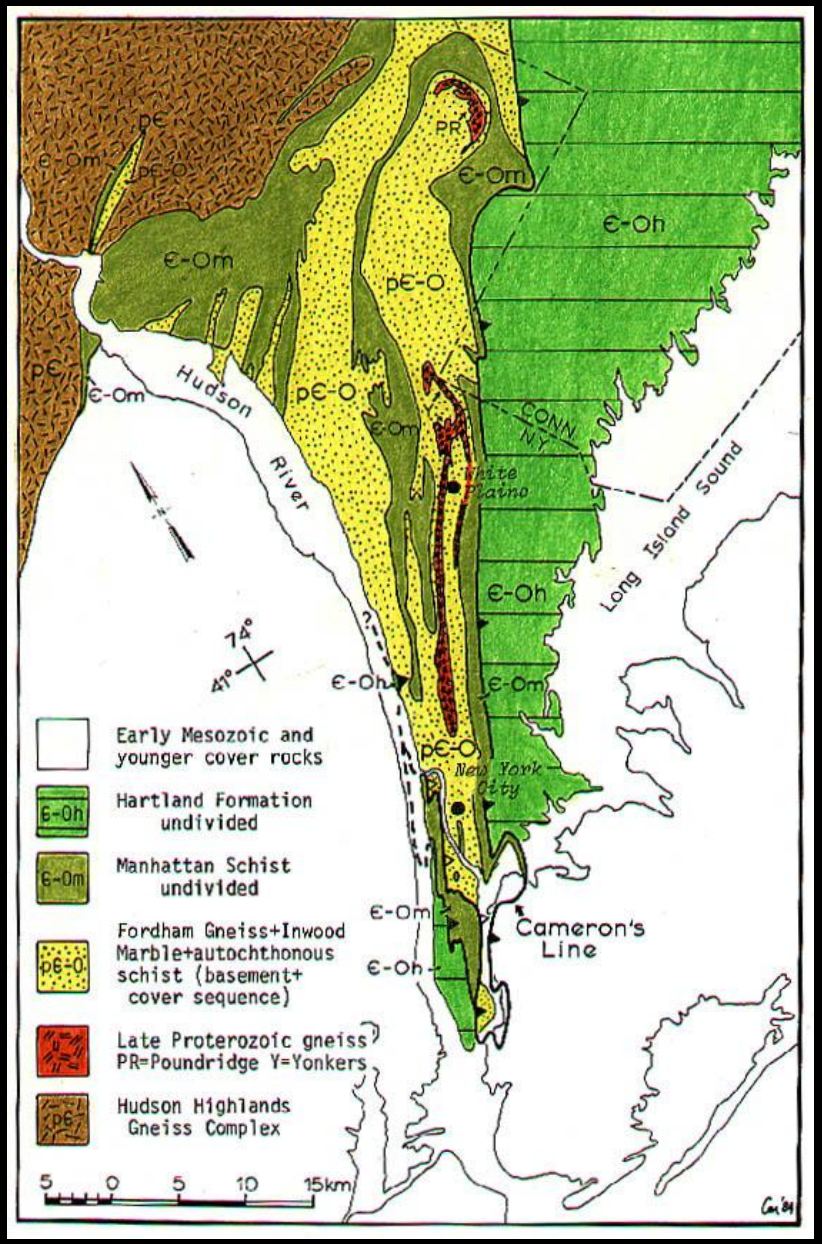
Mineralized Brittle Fault Zones of the Queens Tunnel

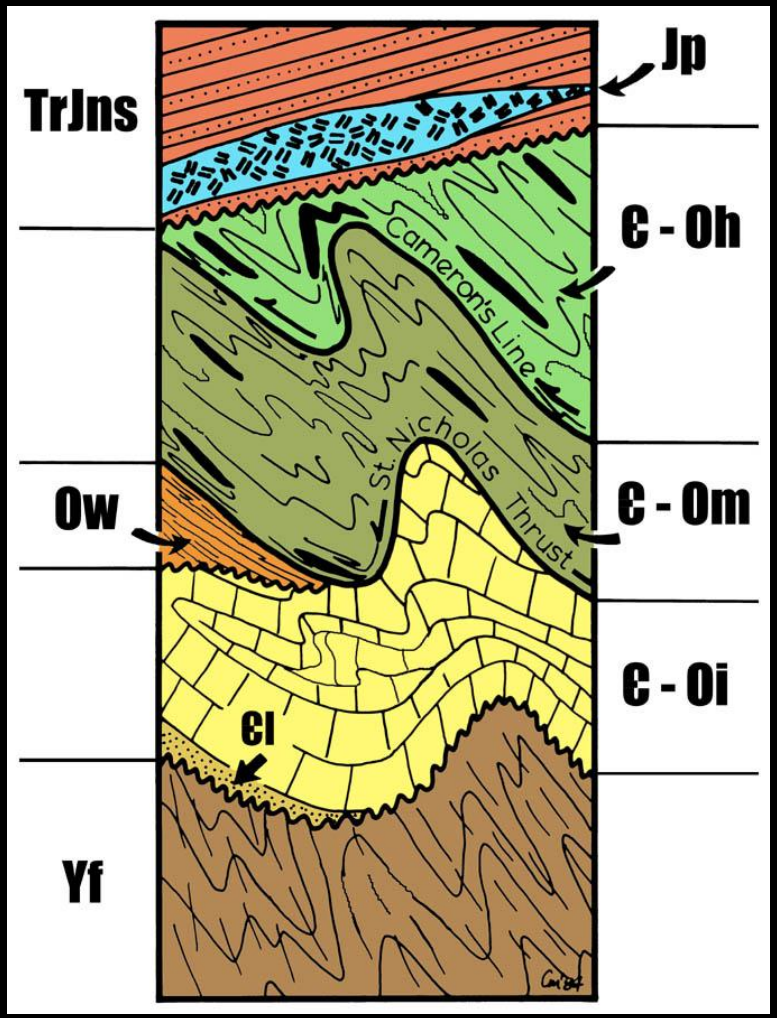

EARLY MEDIAL ORDOVICIAN
(Early Chazyan)
PALEOGEOGRAPHY
by Marshall Kay
Drawn by Erwin Raisz
Palinspastic base - Sinusoidal projection
Miles
Paleoequator
Seas with limy and sandy bottoms on miogeosynclines
Seas with bottoms of argillaceous muds and volcanic rocks on eugeosynclines
after Kay, 1951

Taconic Arc – Passive Margin Collision

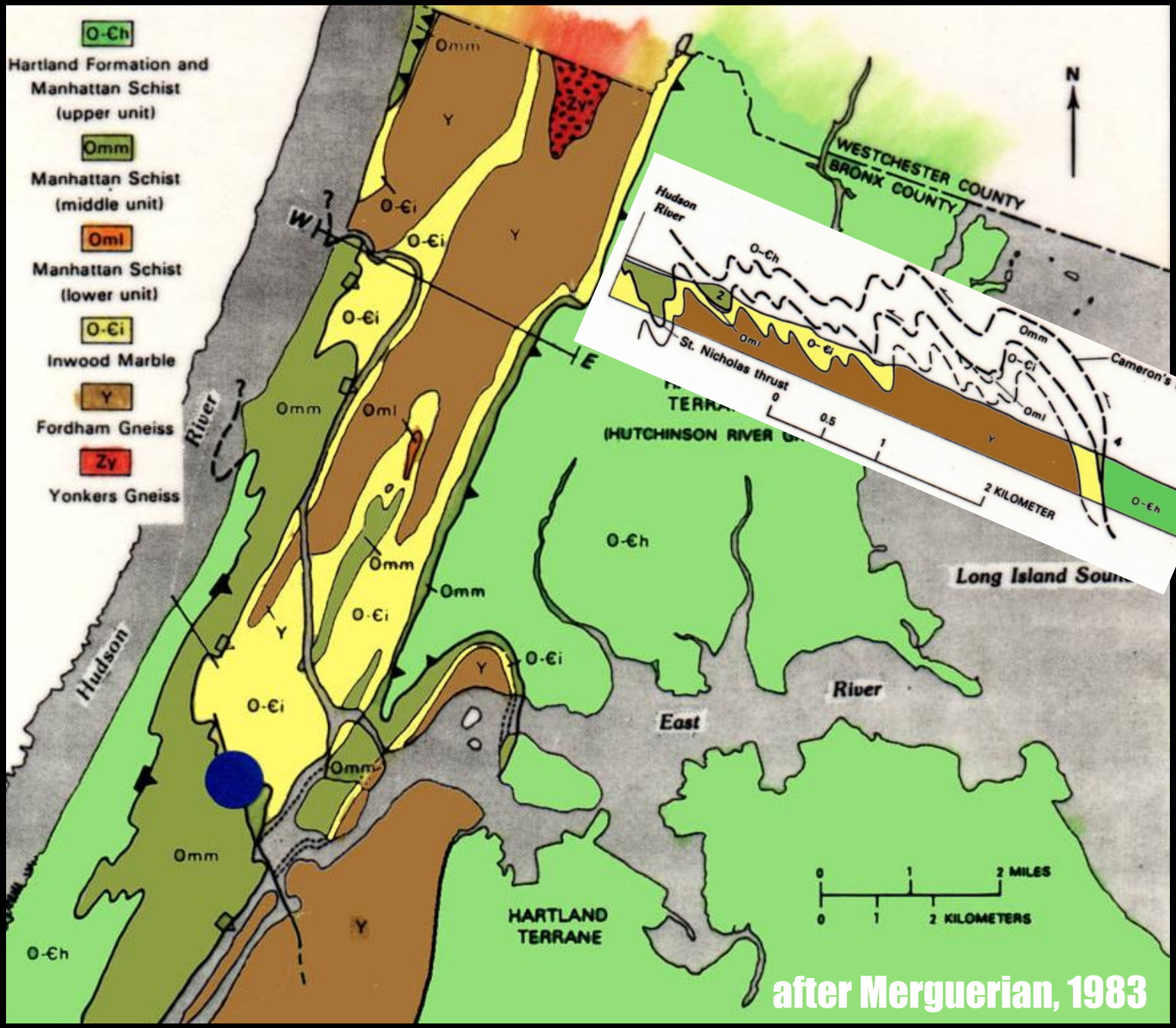


Geology of the New York City Area

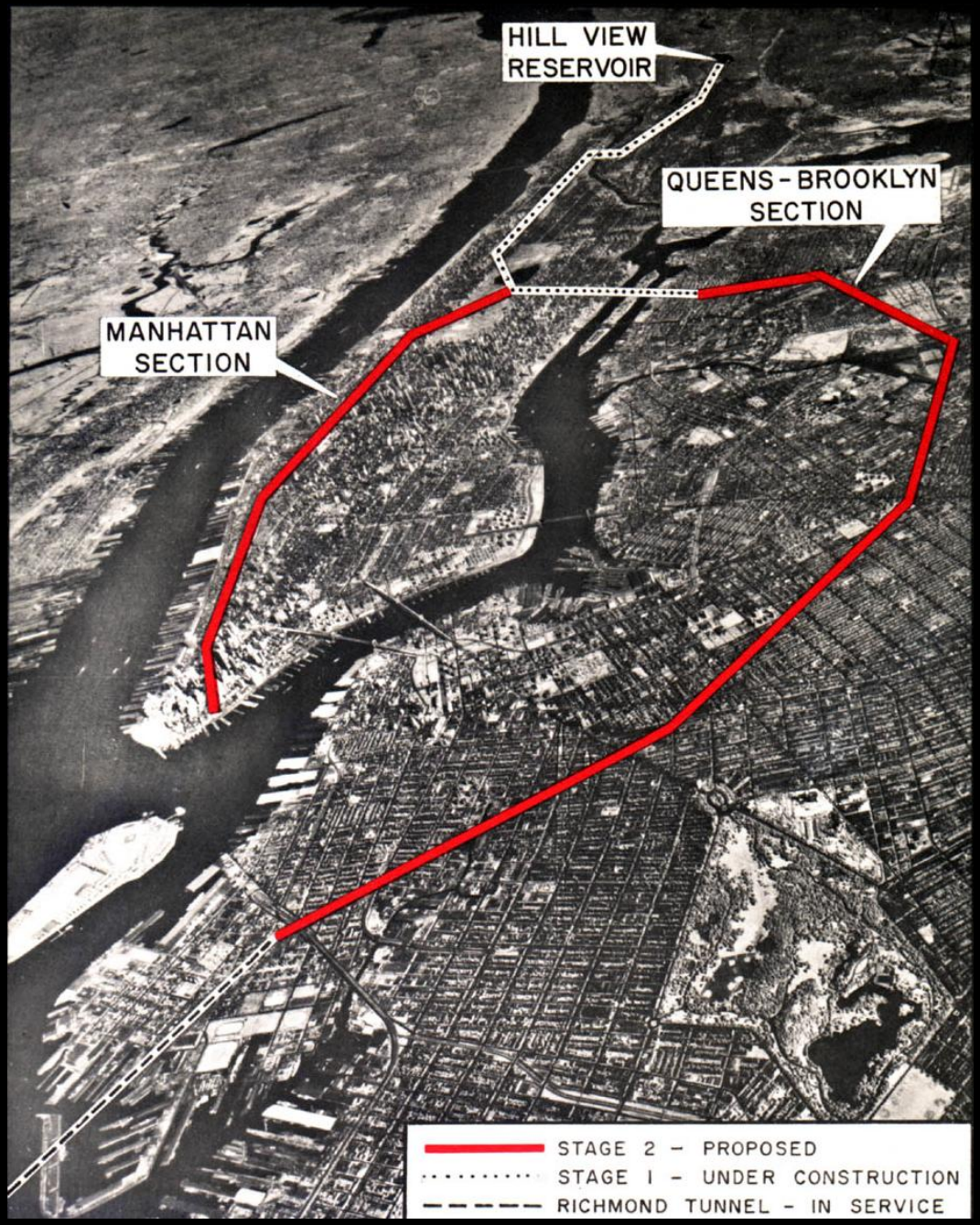


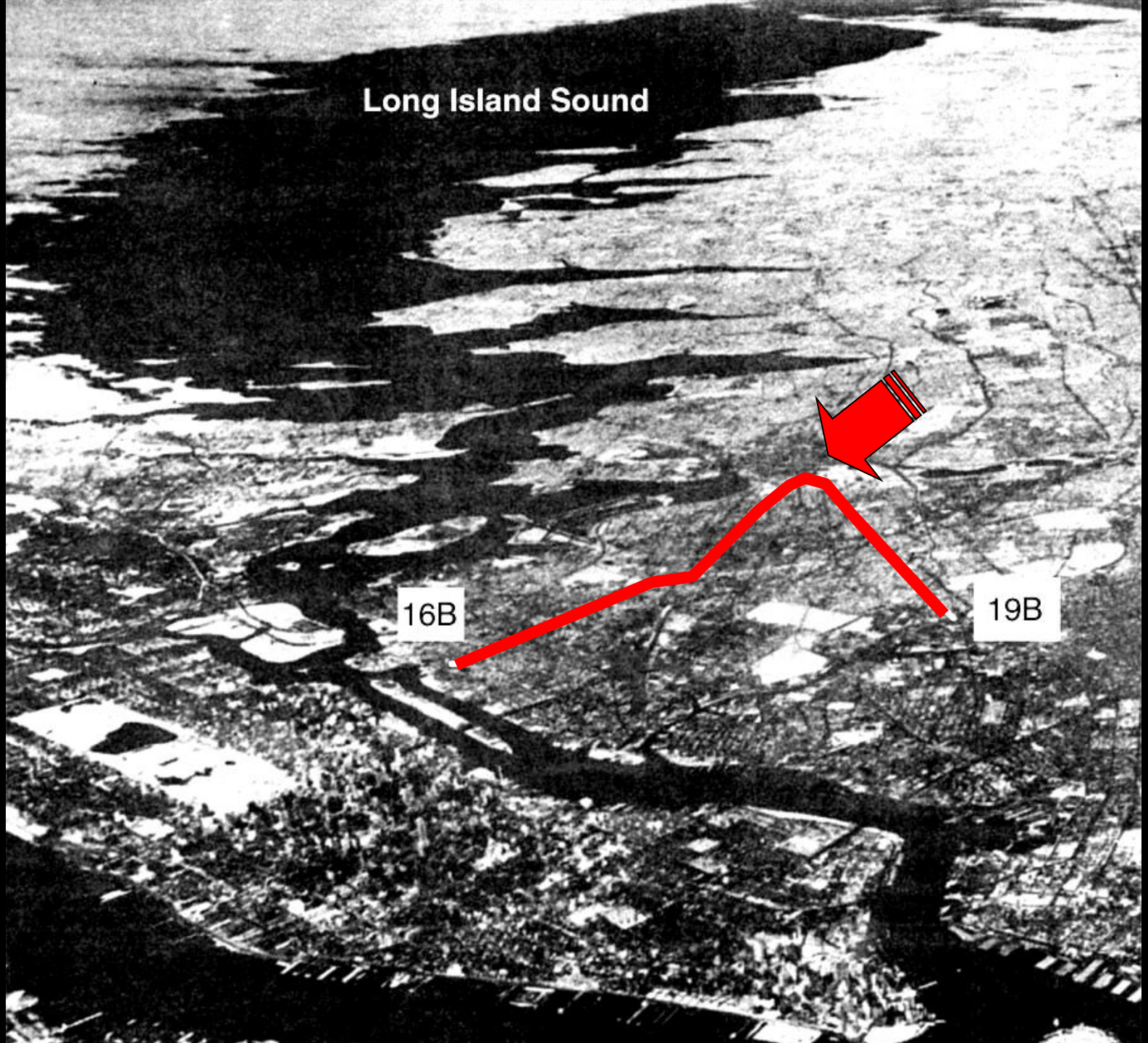


after Merguerian, 1983


O-Ch
Hartland Formation and Manhattan Schist (upper unit)
Omm
Manhattan Schist (middle unit)
Oml
Manhattan Schist (lower unit)
O-Ci
Inwood Marble
Y
Fordham Gneiss
Zy
Yonkers Gneiss
N
WESTCHESTER COUNTY
BRONX COUNTY
Hudson River
O-Ch
Oml
O-Ci
Omm
Y
St. Nicholas thrust
Cameron's Line
0
0.5
1
2 KILOMETER
O-Ch
TERRANE
(HUTCHINSON RIVER
Long Island Sound
Hudson River
East River
HARTLAND TERRANE
0 1 2 MILES
0 1 2 KILOMETERS
after Merguerian, 1983

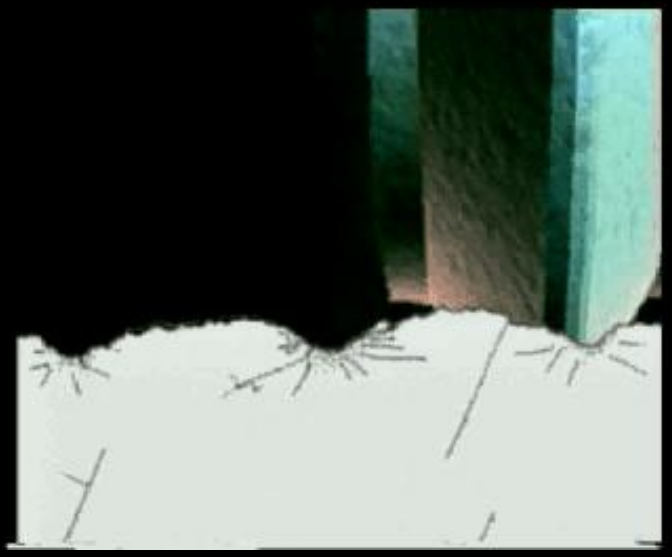
NYC Water Tunnel System City Tunnel #3 Stage 2

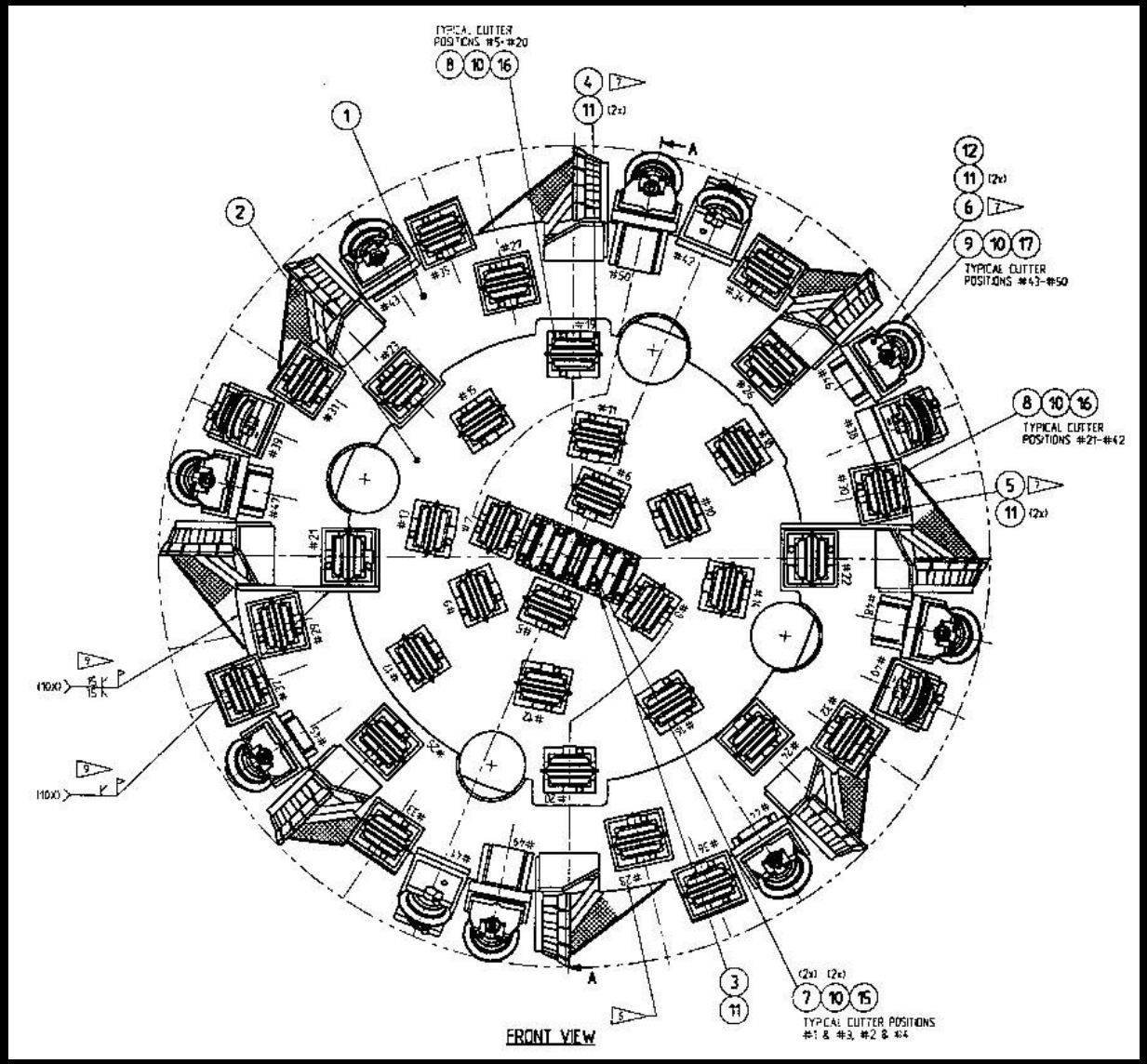


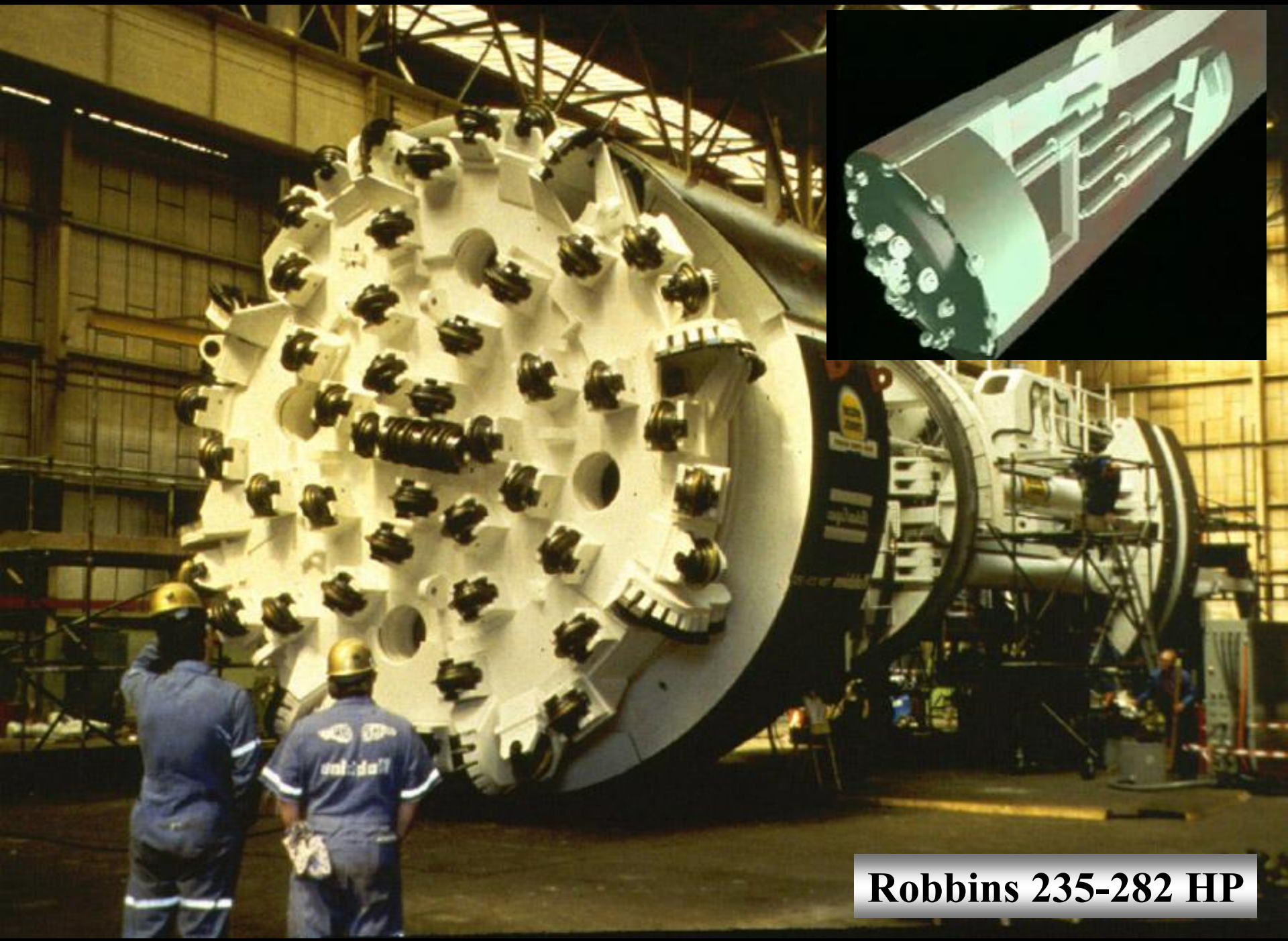

Long Island Sound
16B
19B

Robbins 235-282 HP TBM

TBM Chip Production







Robbins 235-282 HP

Blocky Ground

Excellent Kerf Pattern in Hard Rock

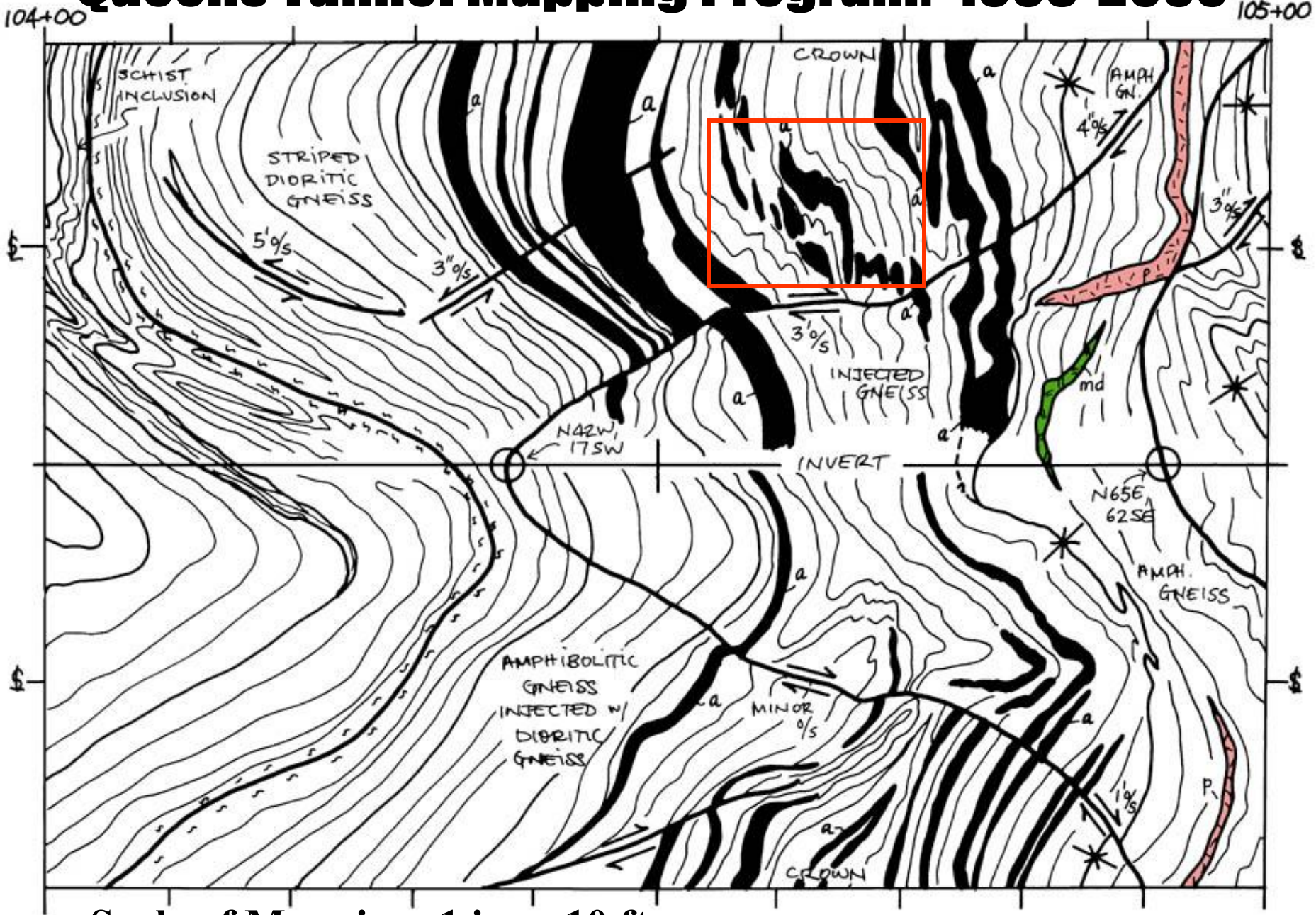
Hamburg Germany Herrenknecht TBMs


TBM excavation of ~25,000 linear feet of hard rock tunnel to 23’ 2” diameter at depths of ~750’


Sorenberg Switz Herren TBM

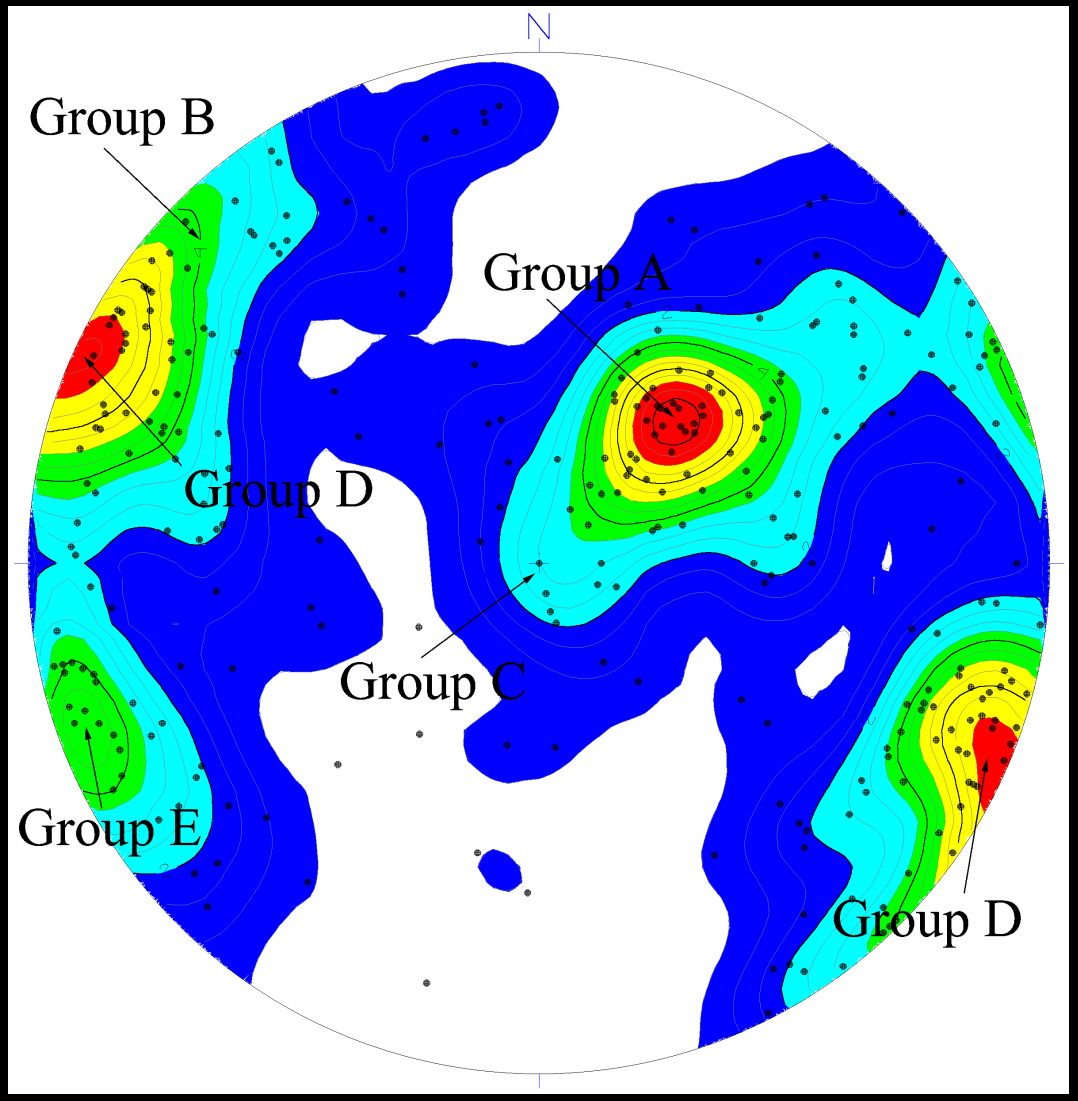
In the Belly of the Beast

Queens Tunnel Mapping Program: 1998-2000

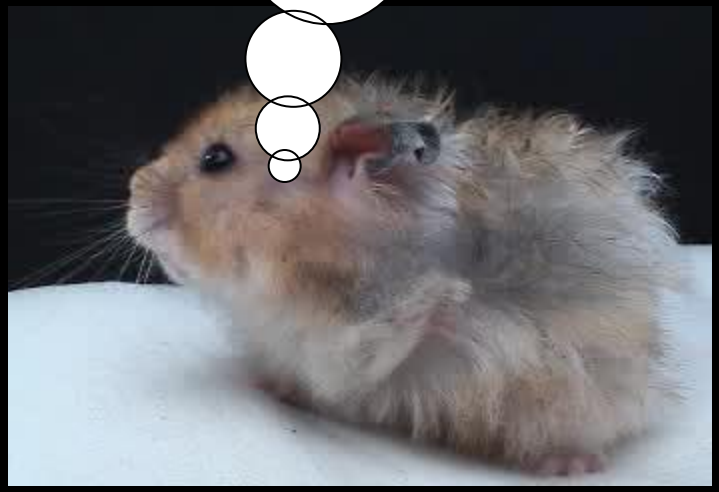


- **Scale of Mapping: 1 in. = 10 ft**


104+55
104+60
104+65

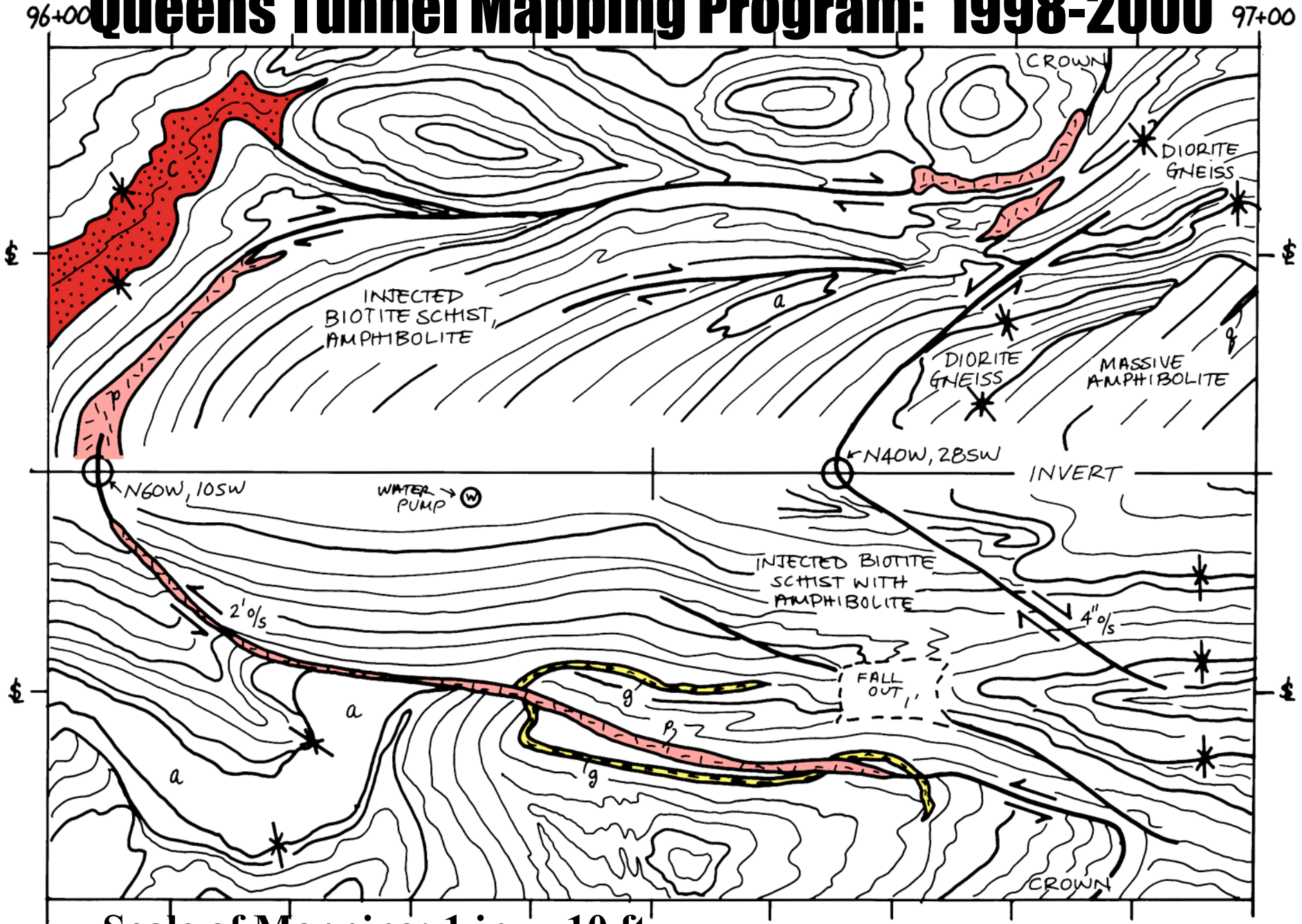


So, tell them about the Faults!



QT Faults

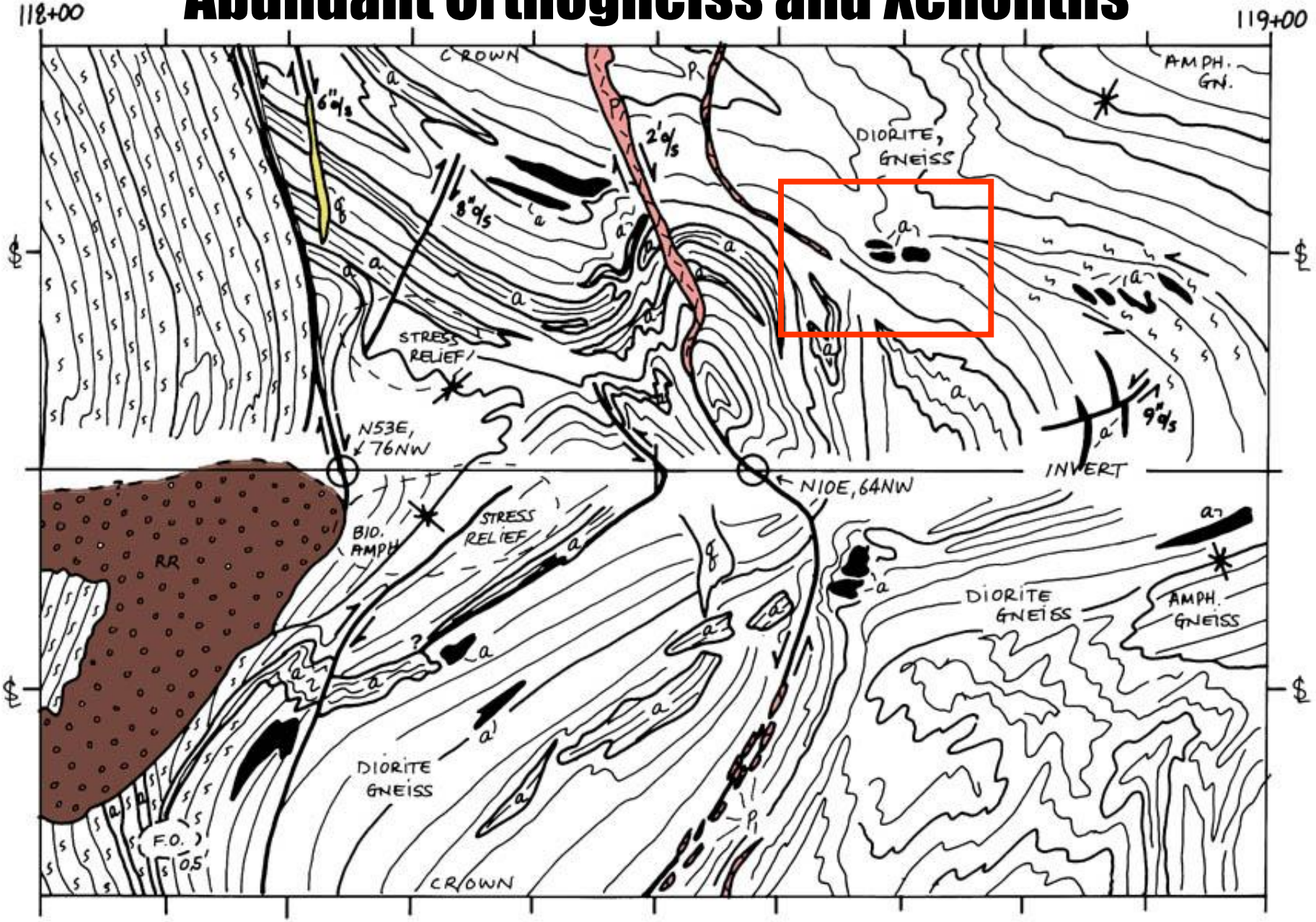
Queens Tunnel Mapping Program: 1998-2000



- **Scale of Mapping: 1 in. = 10 ft**

Subhorizontal Shear Zones

Abundant Orthogneiss and Xenoliths



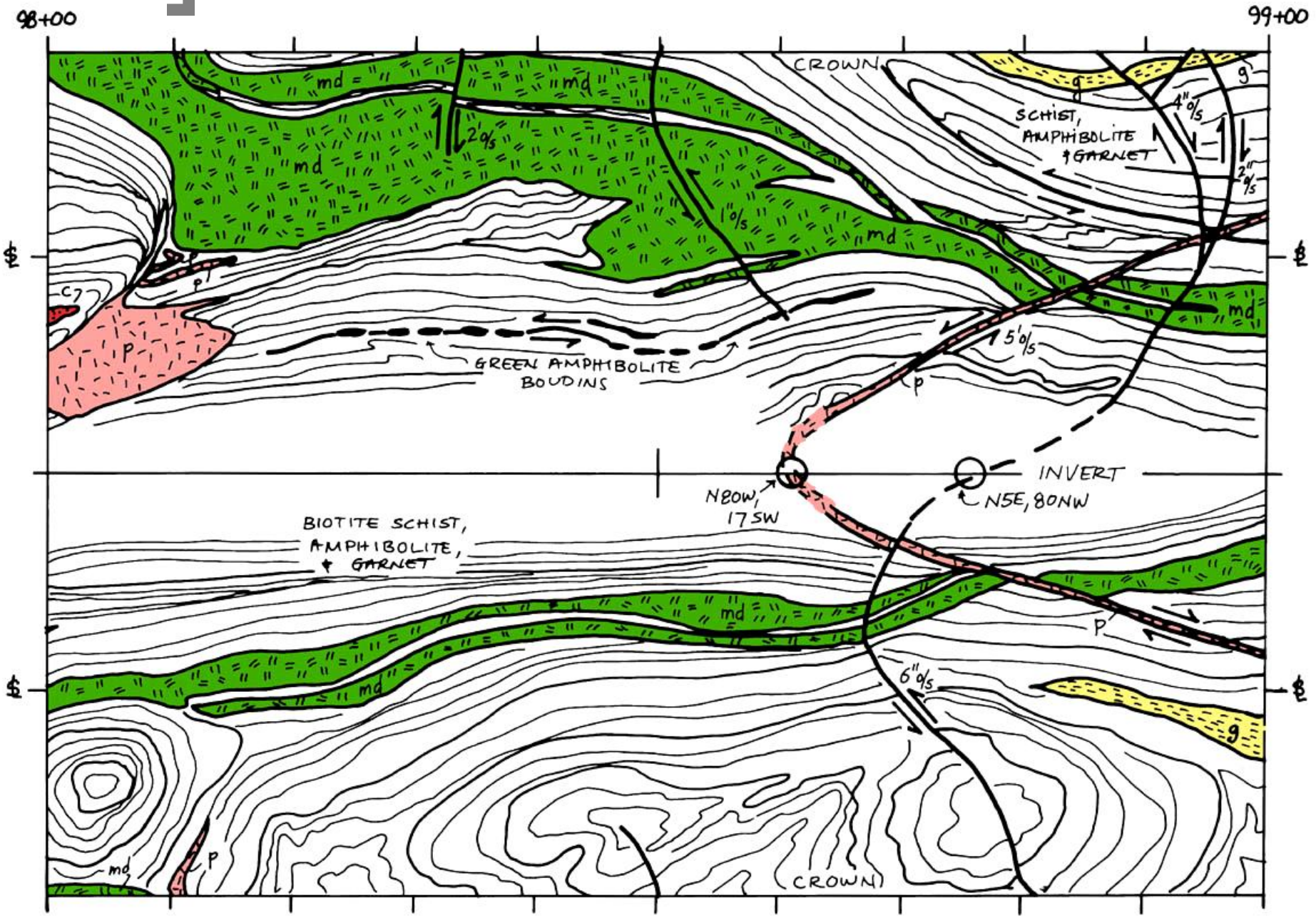
- **Scale of Mapping: 1 in. = 10 ft**


ADJ
118+
118

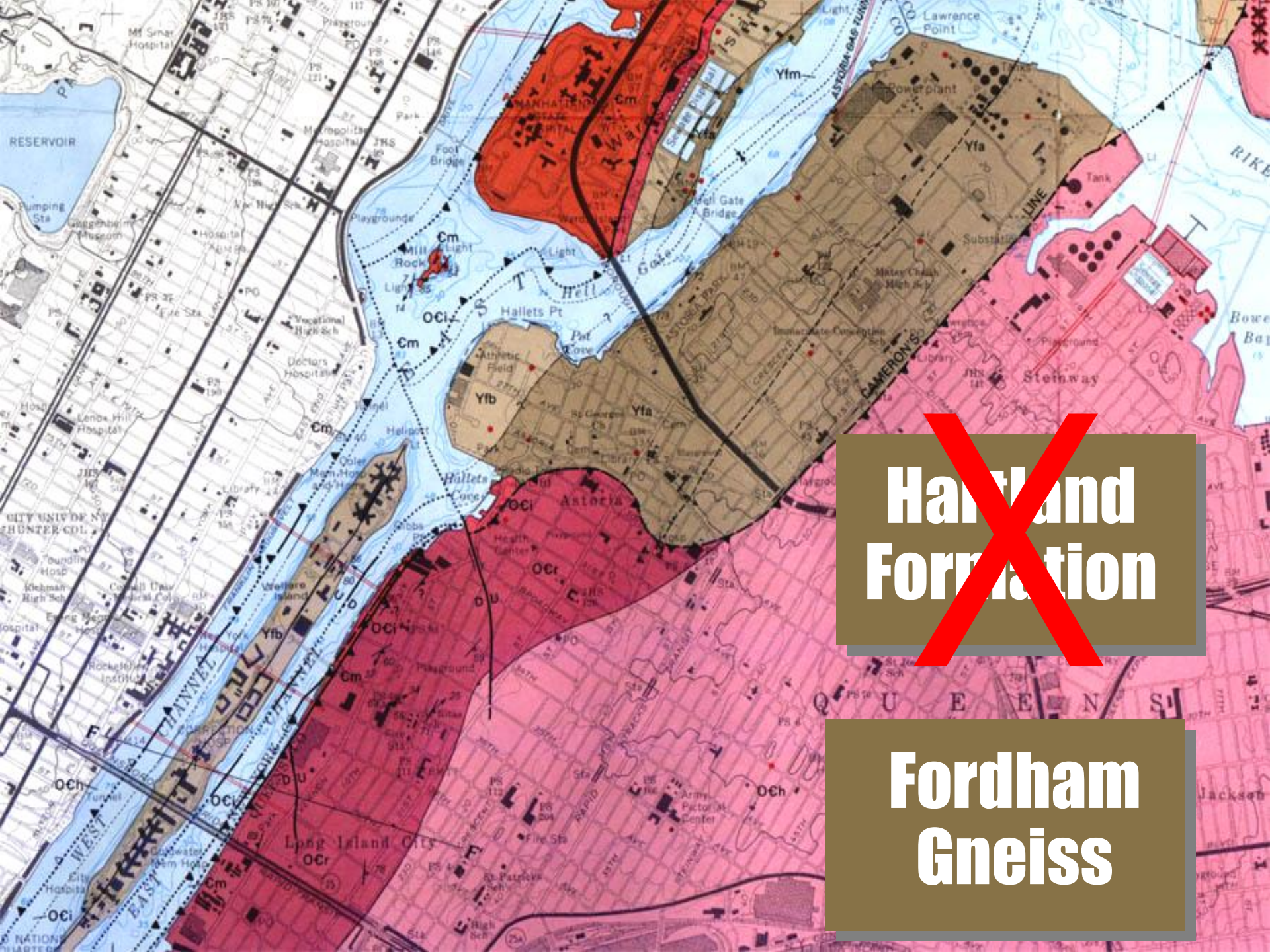

QT117 - Station 118+20, Left Wall
Abrupt change from steeply- to gently dipping foliation along steep D3 shear zone.

Crush Breccia NNE Fault

Queens Tunnel Sta. 93+60


98+00
99+00
CROWN
SCHIST, AMPHIBOLITE & GARNET
4"o/s
2"o/s
1"o/s
2'o/s
15'o/s
6"o/s
md
p
g
GREEN AMPHIBOLITE BOUDINS
INVERT
N80W, 17SW
N5E, 80NW
BIOTITE SCHIST, AMPHIBOLITE, & GARNET
CROWN


NNW-Trending "Manhattanville" Strike-Slip Faults
Splays and Conjugate Joints
Queens Tunnel Sta. 75+85


Hartland Formation
Fordham Gneiss

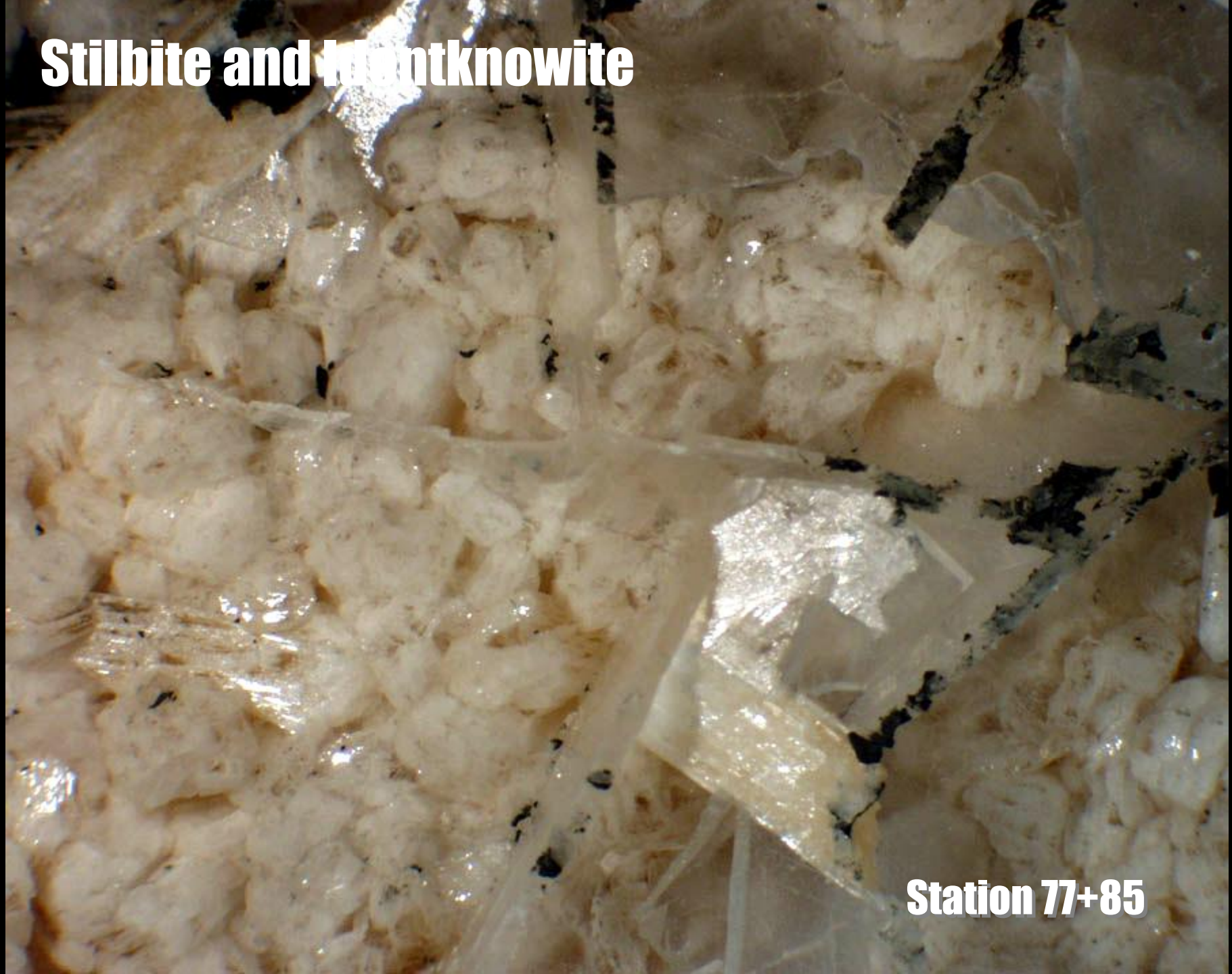
Let's Take a Peek at Some Minerals from Fault Zones


Apophyllite Stilbite
Station 190+15


Analcime Apophyllite Stilbite
Station 190+15


Stilbite on Heulandite
Station 77+85


Stilbite on Heulandite
Station 77+85


Stilbite and
ntknowite
Station 77+85


Stilbite var. Epidesmine
Station 77+85


Calcite and Pyrite on Stilbite var. Epidesmine
Station 77+85


Pyrite Calcite Apophyllite on Prehnite
Station 150+00

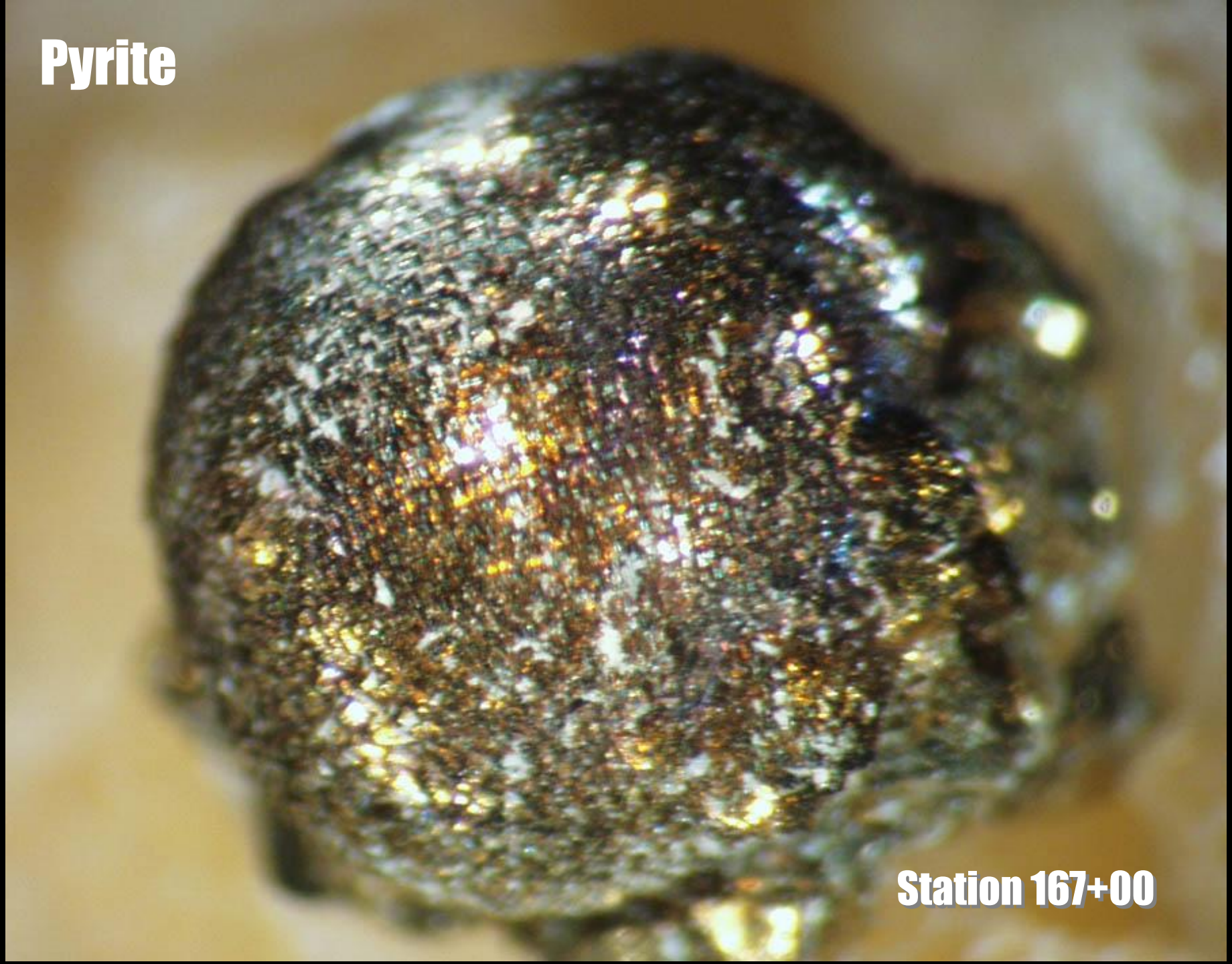

Chabazite on Calcite on Stilbite
Station 162+30


Chabazite on Calcite on Stilbite
Station 162+30


Chabazite on Calcite on Stilbite
Station 162+30


Chabazite on Calcite
Station 162+30

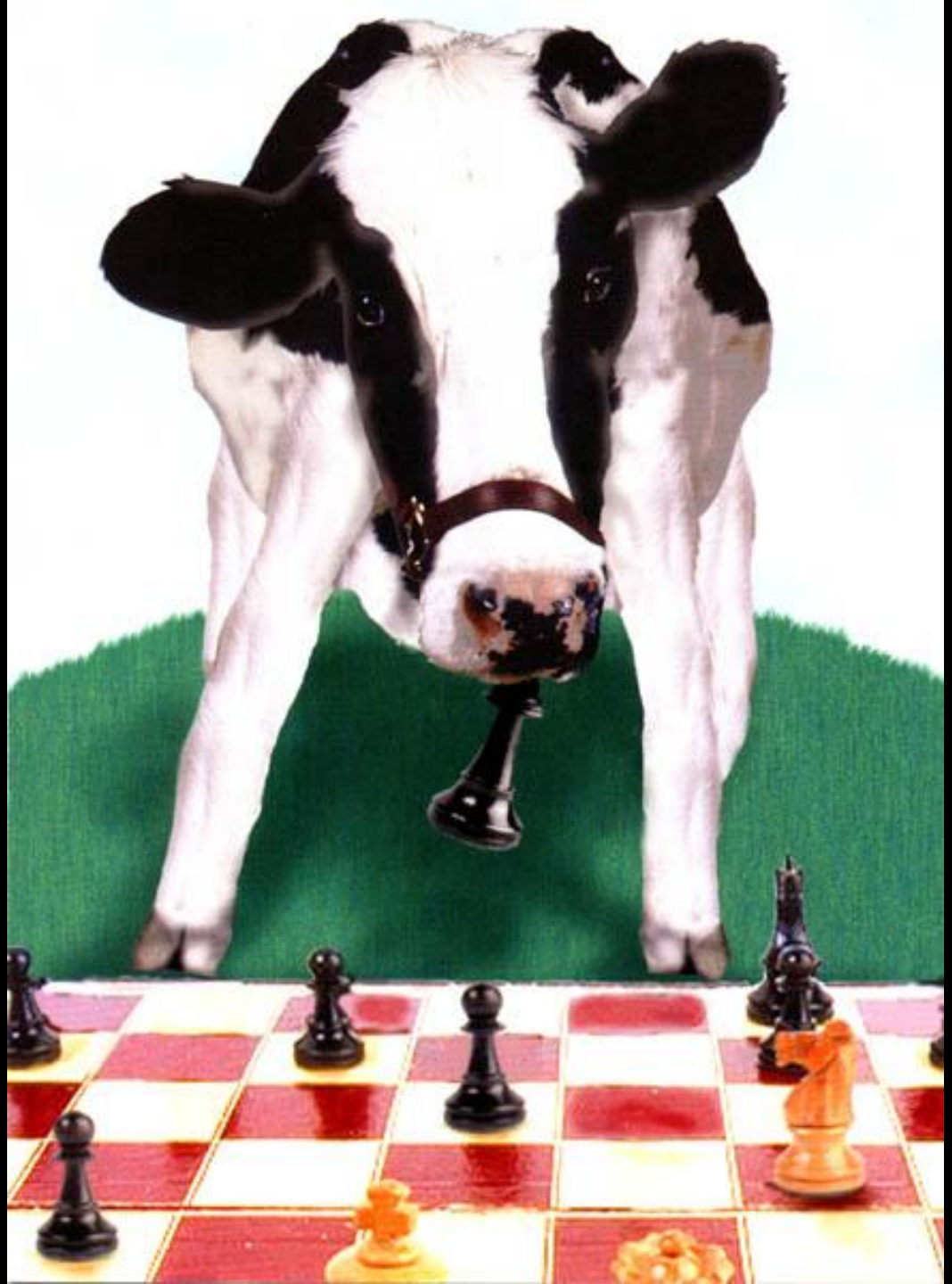

Pyrite on Stilbite
Station 167+00


Pyrite
Station 167+00


Calcite on Pyrite
Station 167+00


Pyrite on Stilbite
Station 169+37


Hammieite
www.dukelabs.com



Moo Chess Gracias!

www.dukelabs.com

Well, Time to Clean Up
And Get to Work
On Those Rocks
In the Lab Upstairs


Extra Clips