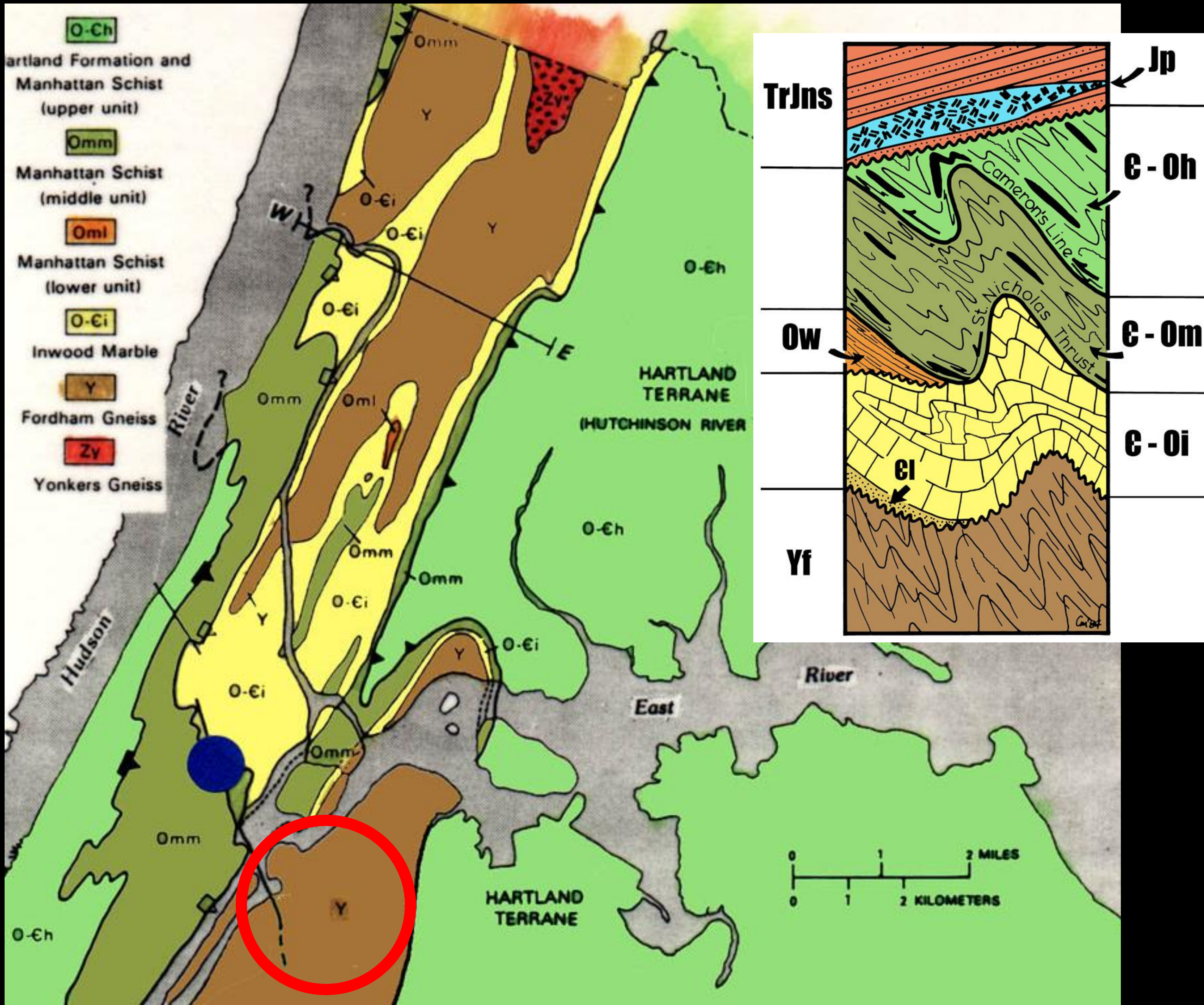
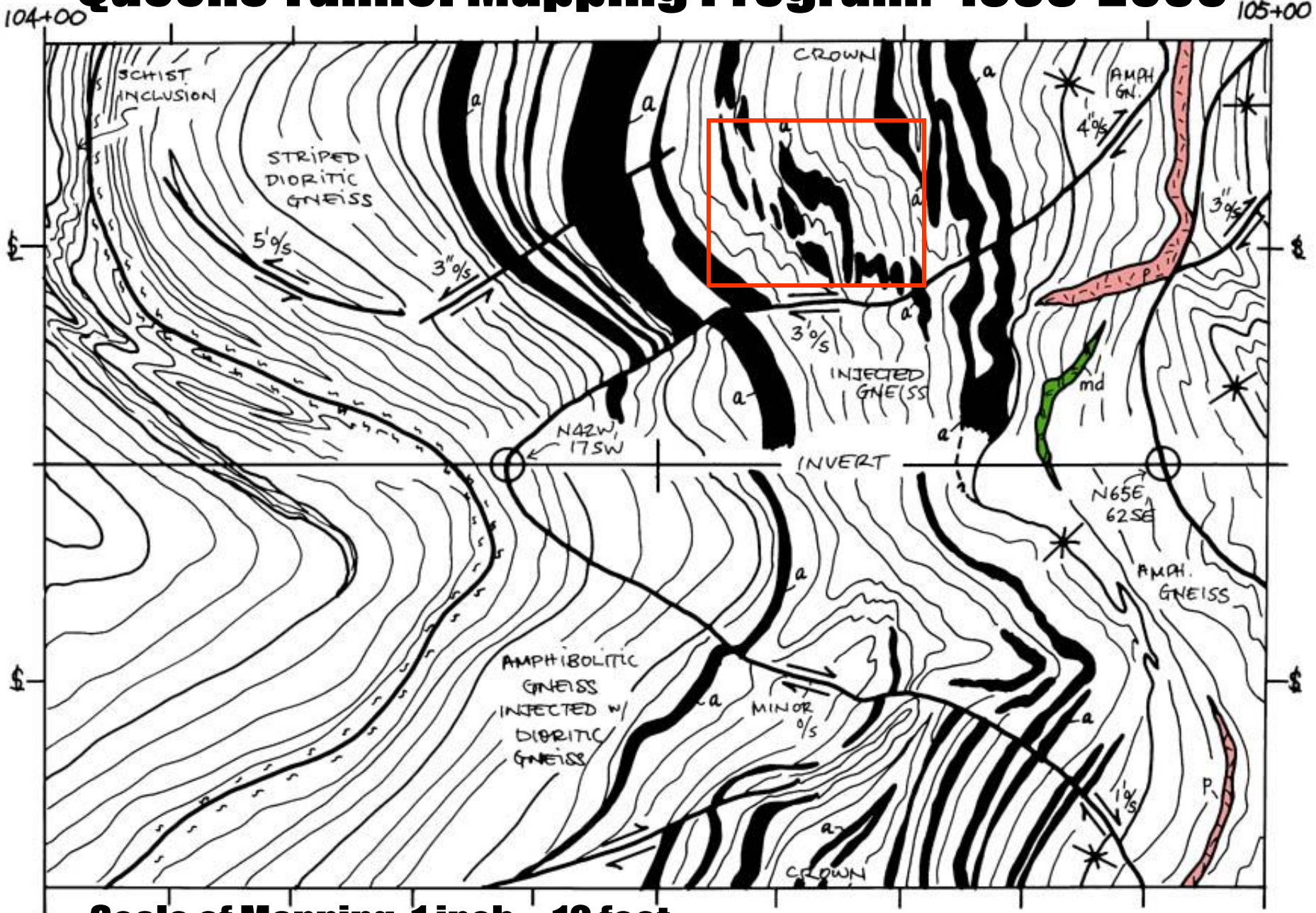
Brittle Fault Chronology of New York City

Charles Merguerian

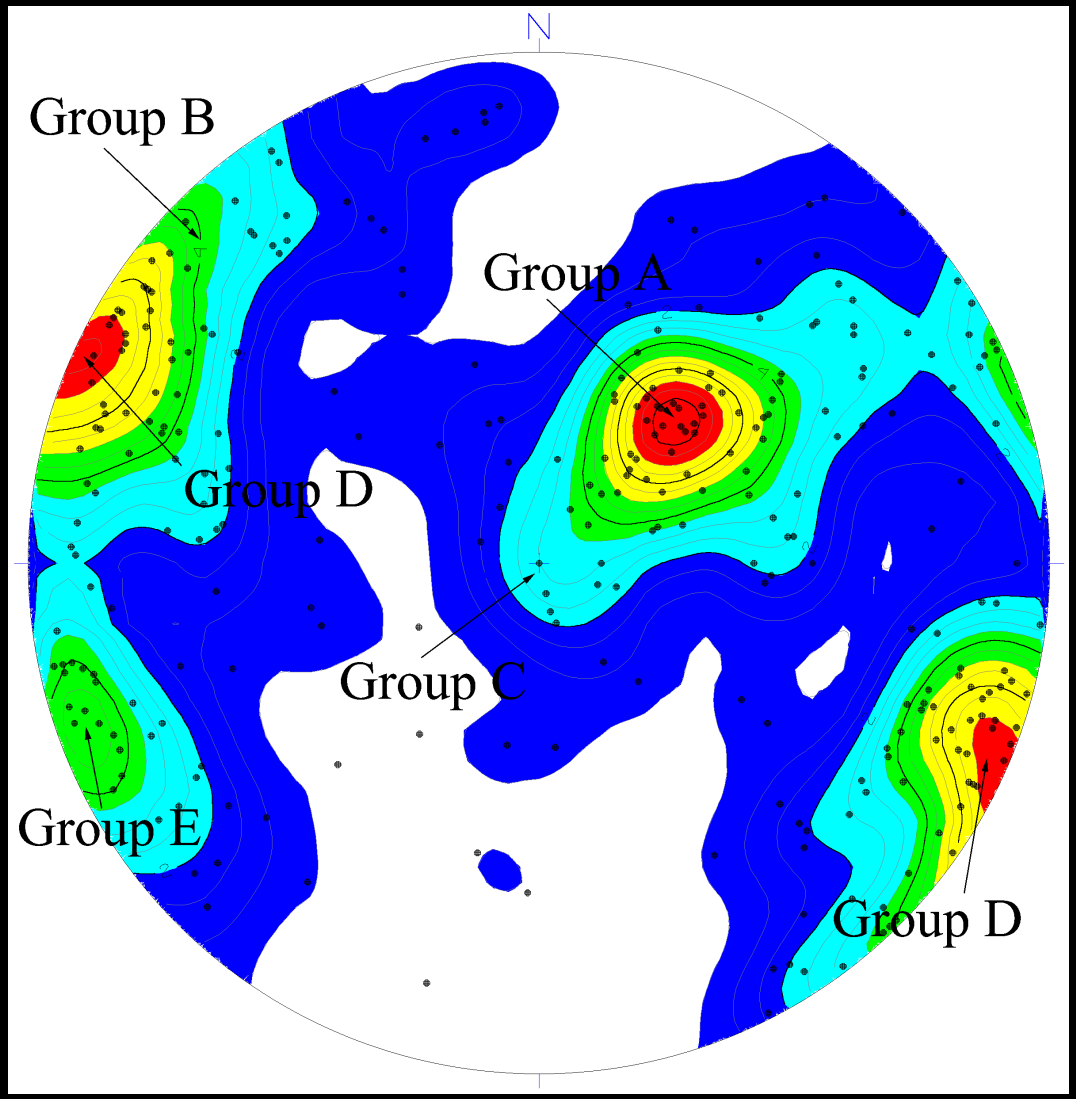

O-Ꞓh
artland Formation and
Manhattan Schist
(upper unit)
Omm
Manhattan Schist
(middle unit)
Oml
Manhattan Schist
(lower unit)
O-Ꞓi
Inwood Marble
Y
Fordham Gneiss
Zy
Yonkers Gneiss
Hudson
River
W
E
HARTLAND
TERRANE
(HUTCHINSON RIVER
East
River
HARTLAND
TERRANE
0 1 2 MILES
0 1 2 KILOMETERS
TrJns
Jp
Ꞓ - Oh
Cameron's Line
St. Nicholas Thrust
Ow
Ꞓ - Om
Ꞓ - Oi
ꞒI
Yf

Queens Tunnel Mapping Program: 1998-2000



- Scale of Mapping: 1 inch = 10 feet

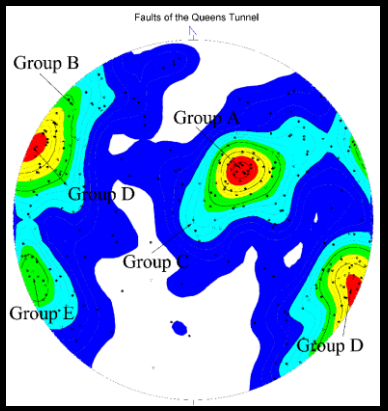

104+55
104+60
104+65



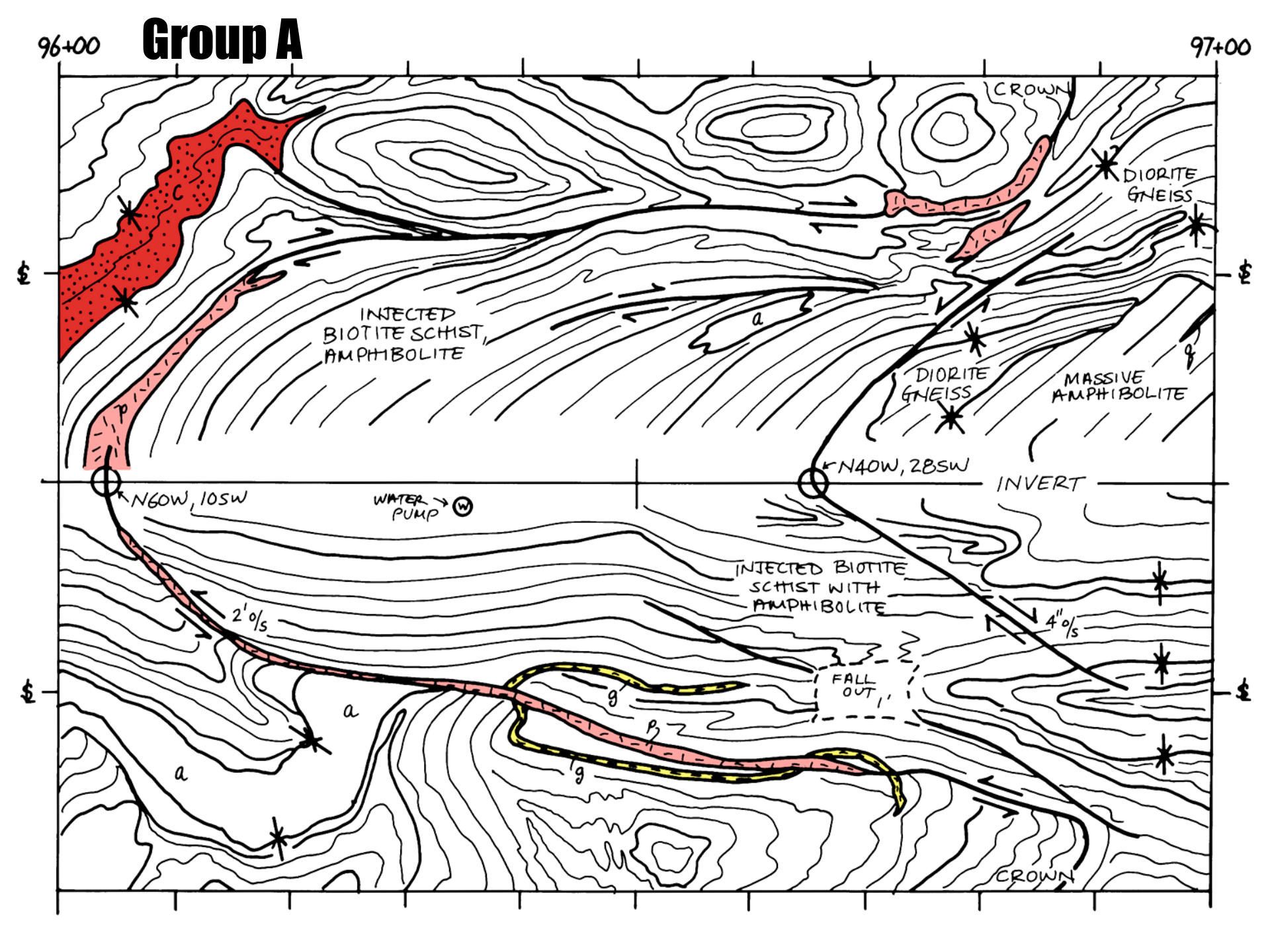
So, tell them about the QT Faults!

Queens Tunnel Faults

Gently-dipping Faults of Group A



- NW strike and gentle SW dip
- Normal and reverse offset
- Typically reactivate older, D_4 ductile shears
- Thin zones of fault breccia and crush zones
- Commonly contain sheared pegmatite
- Laterally extensive features that persist for 100s of feet
- Abruptly terminate by ramping steeply into crown and invert
- Wet features that resulted in collapsed tunnel heading


Group A
96+00
97+00
CROWN
DIORITE GNEISS
INJECTED BIOTITE SCHIST, AMPHIBOLITE
DIORITE GNEISS
MASSIVE AMPHIBOLITE
N40W, 28SW
INVERT
N60W, 10SW
WATER PUMP
INJECTED BIOTITE SCHIST WITH AMPHIBOLITE
2'0/s
4"0/s
FALL OUT
CROWN

Queens Tunnel Station 196+85

Steeply-dipping Brittle Faults of Group B

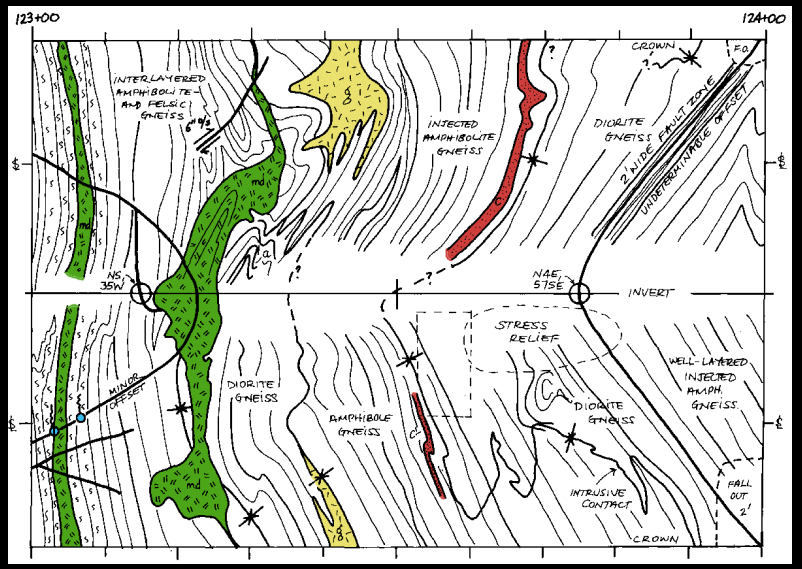
- ENE strike and steep NW and SE dips
- Reactivate Group A faults and older ductile shears
- Thin zones of fault breccia and crush zones
- Cut by subhorizontal fractures (Group C) and younger faults

Subhorizontal Brittle Faults of Group C

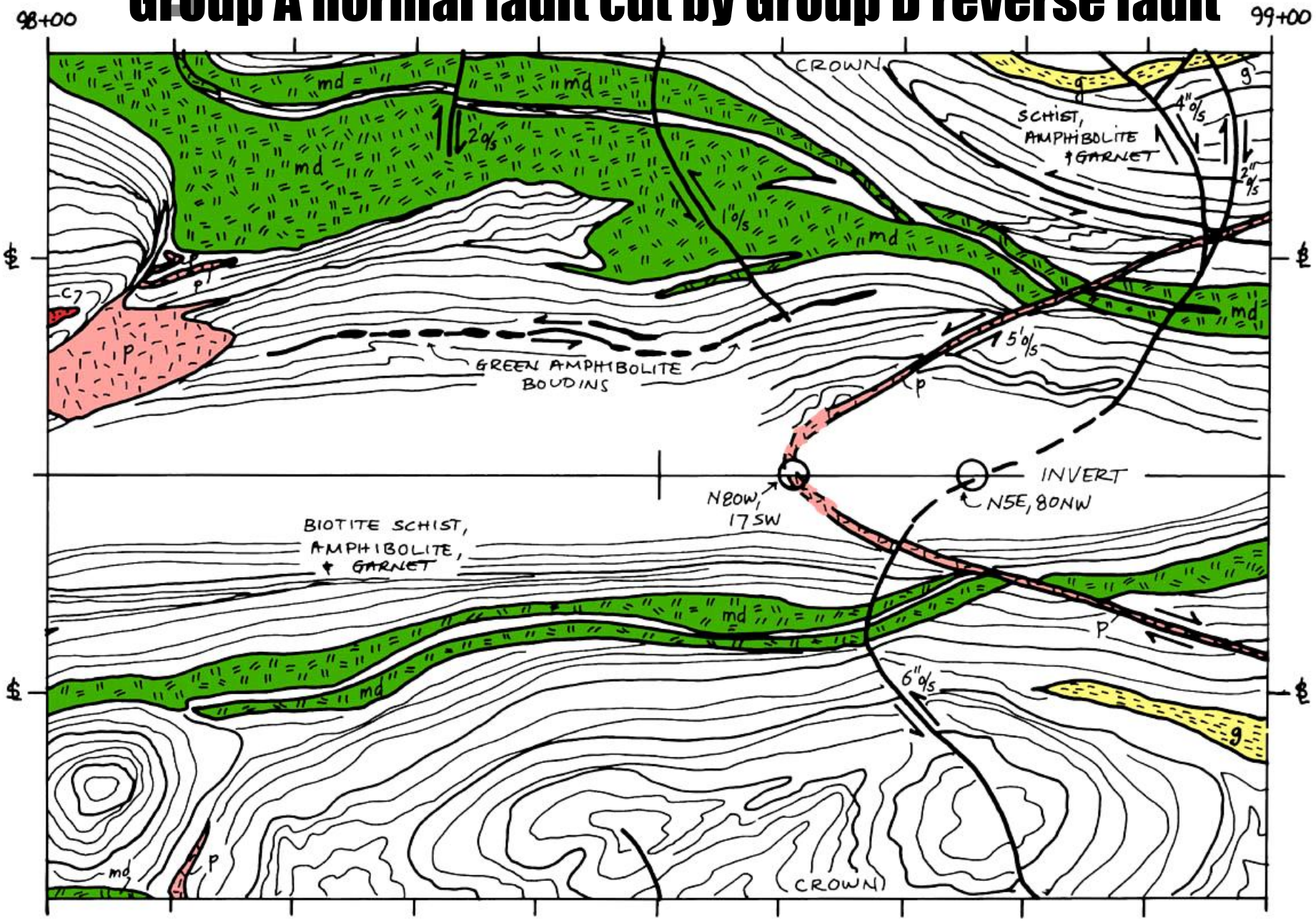
- Cut Group A and B faults and older ductile shears
- Thin zones of fault breccia and crush zones
- Cut by Group D and younger faults

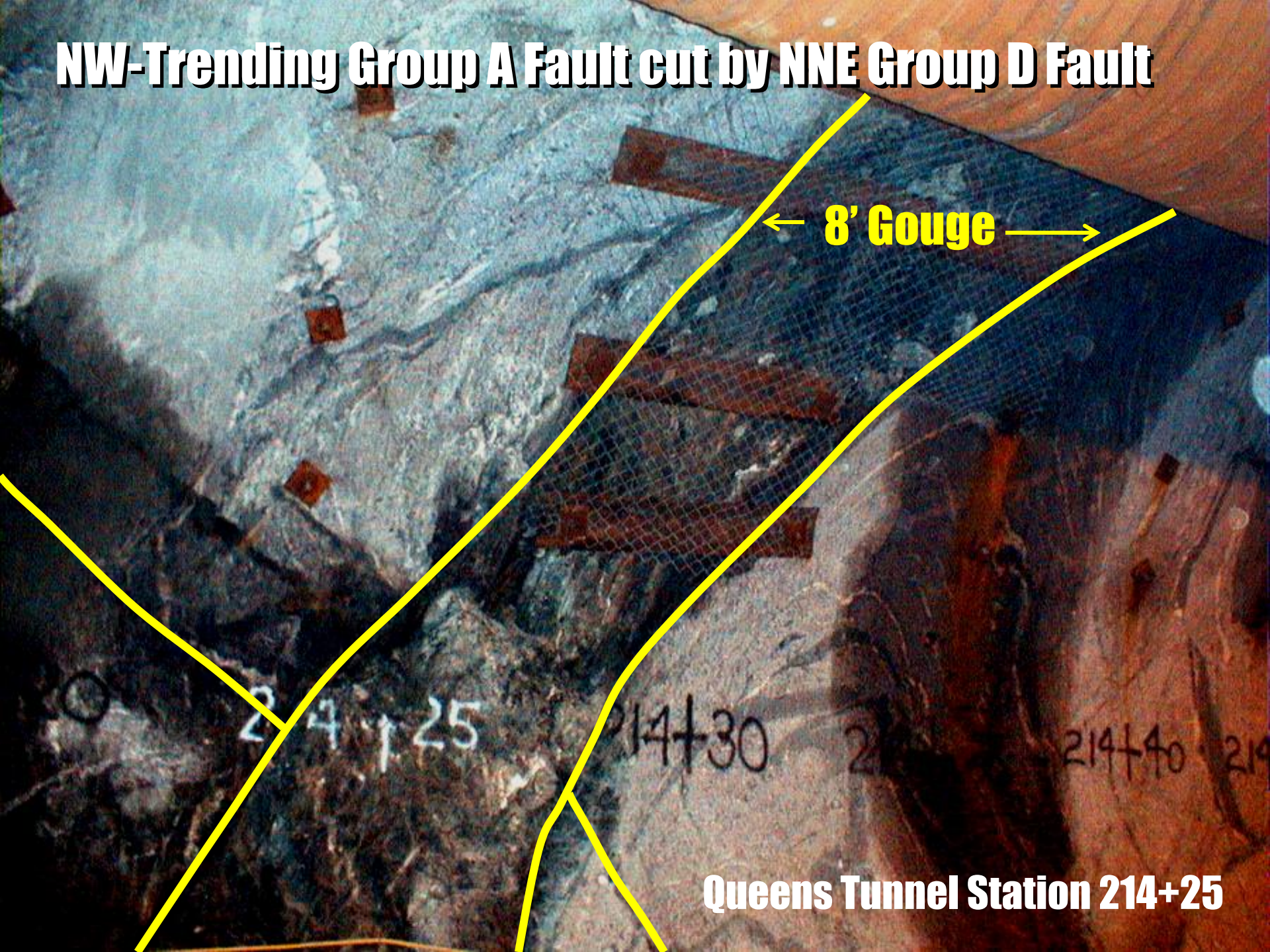
NNE-Trending Fault System of Group D

- NNE strike and steep dips; dip-slip mechanisms
- Structural control – parallel to regional S_3 schistosity
- Thick zones of fault gouge and breccia
- Clay- and zeolite-rich gouge zones
- Stilbite – Calcite – Chabazite – Analcime - Apophyllite
- Relatively young – they cut 295 Ma rhyodacite dikes



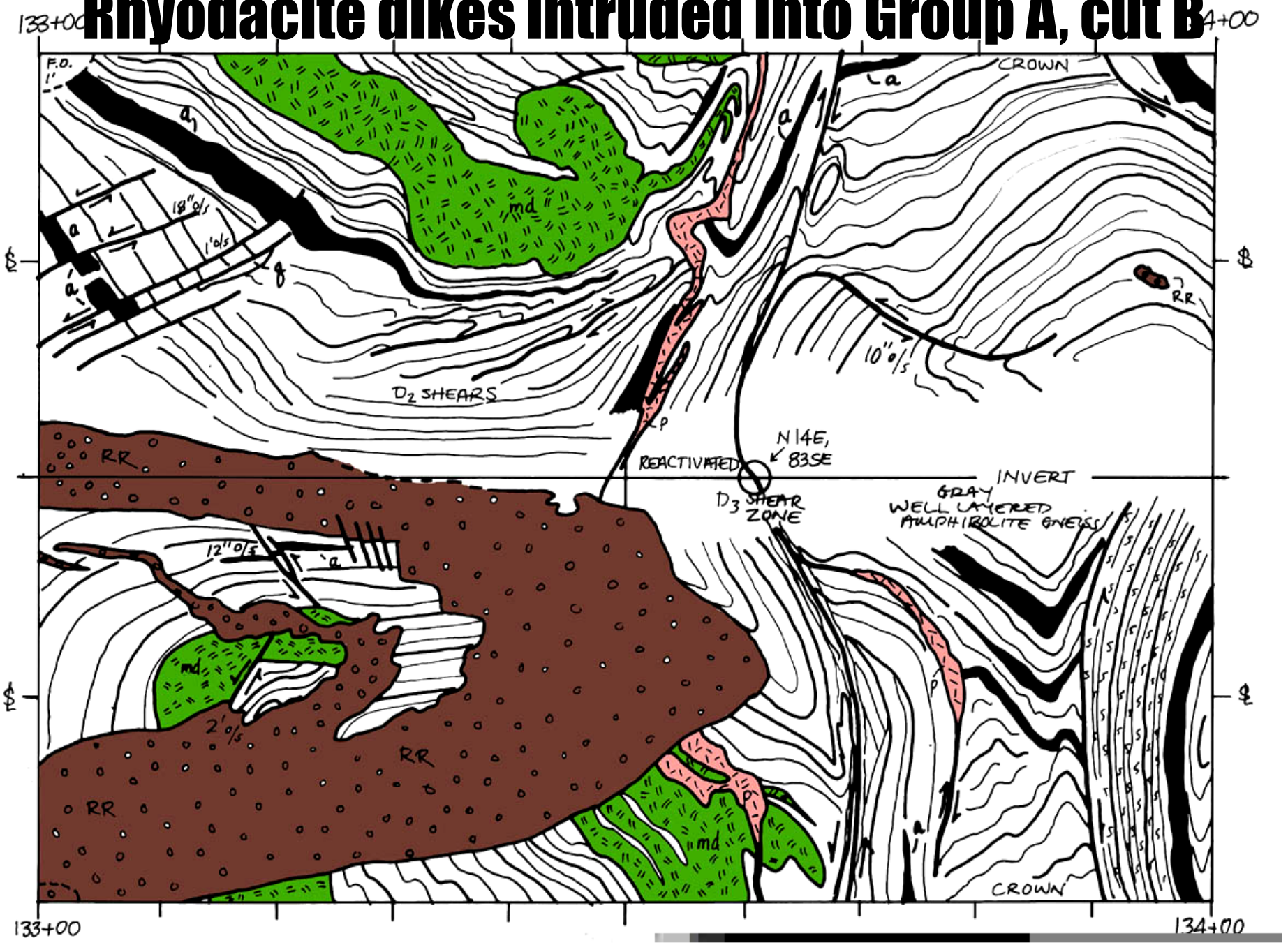
Group A normal fault cut by Group D reverse fault

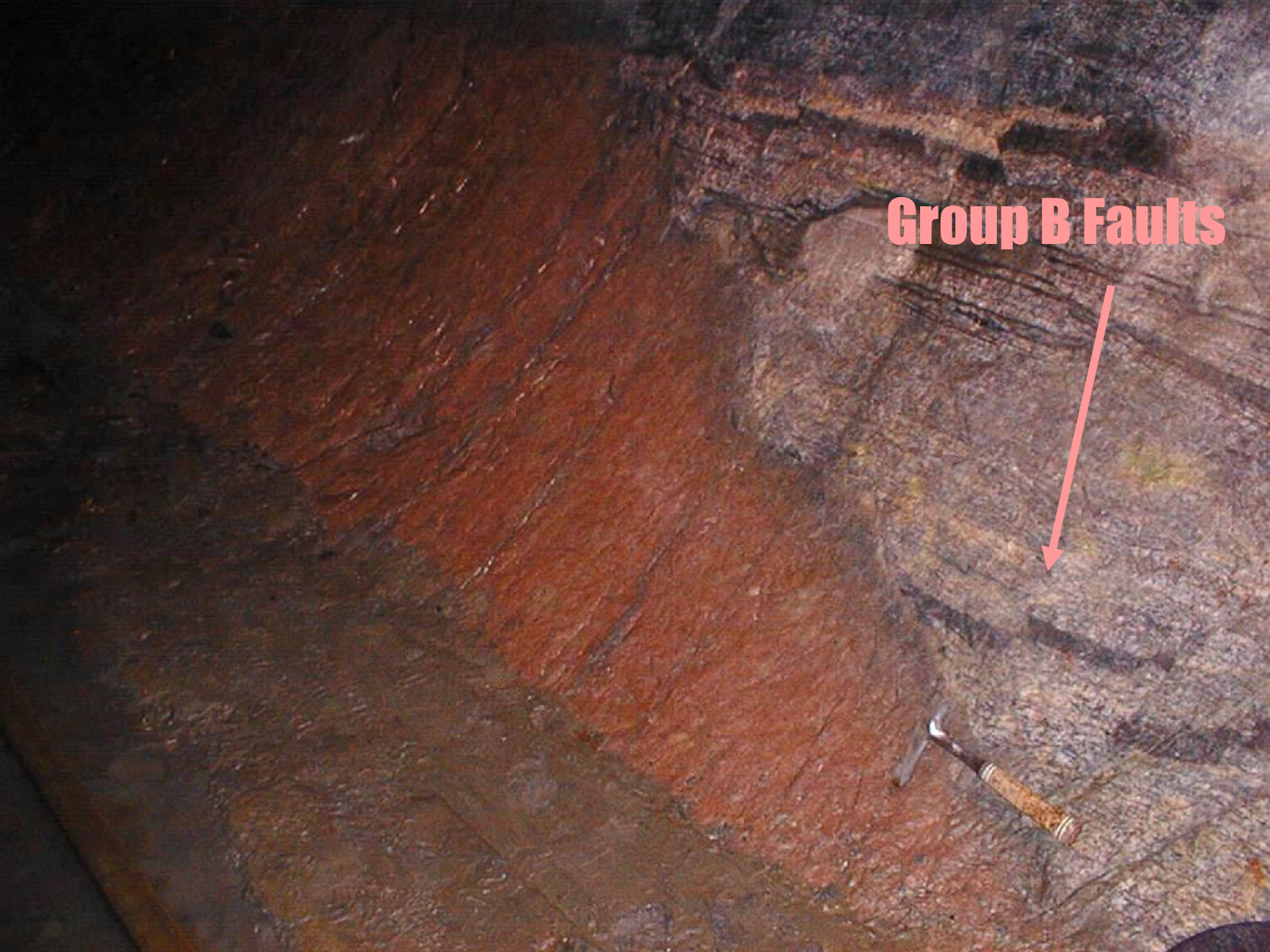



NW-Trending Group A Fault cut by NNE Group D Fault
8' Gouge
214+25
214+30
214+40
Queens Tunnel Station 214+25

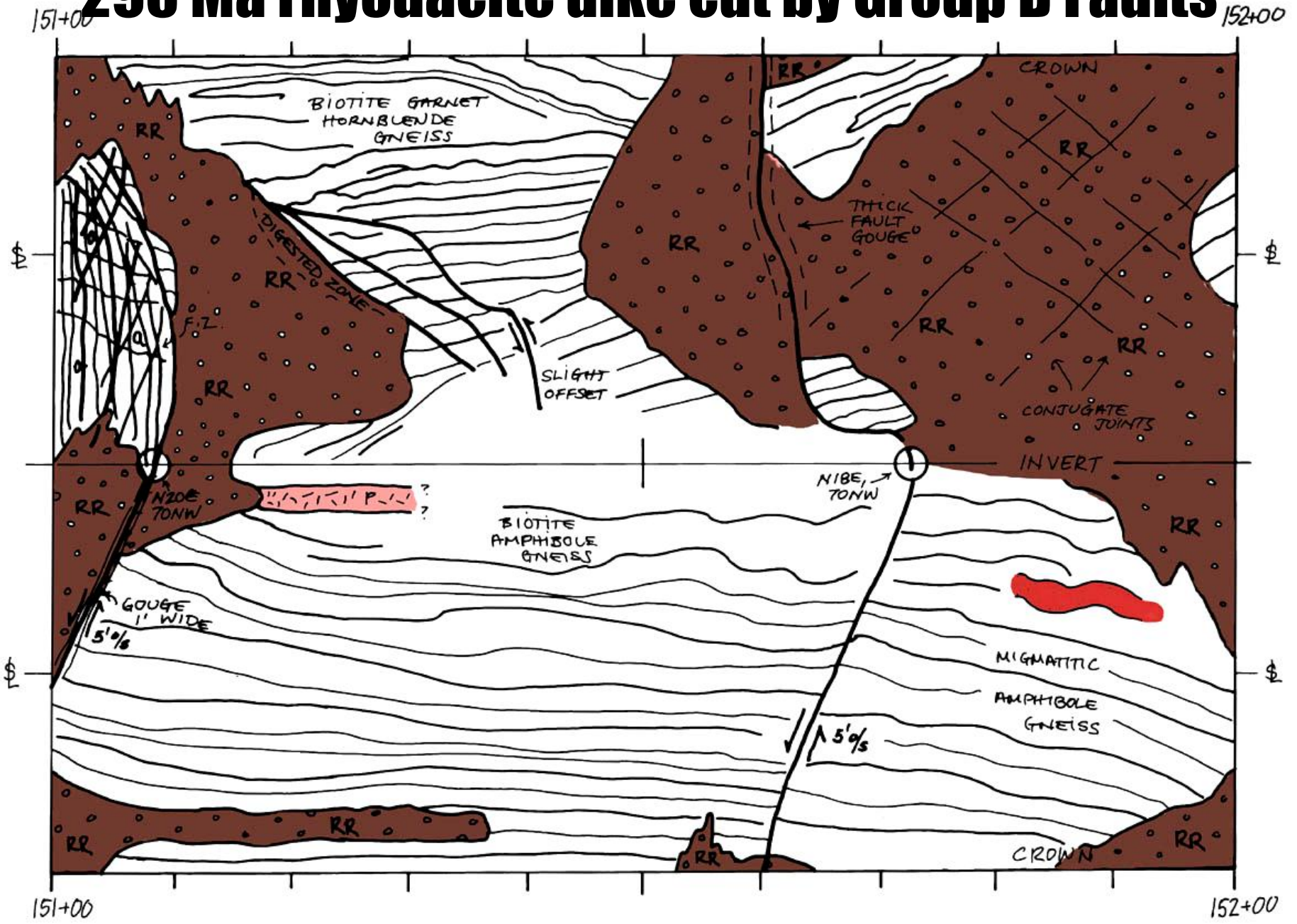

Station 130+40, Right Wall
Multidirectional cooling joints in rhyodacite

Rhyodacite dikes intruded into Group A, cut B




Group B Faults

295 Ma rhyodacite dike cut by Group D Faults

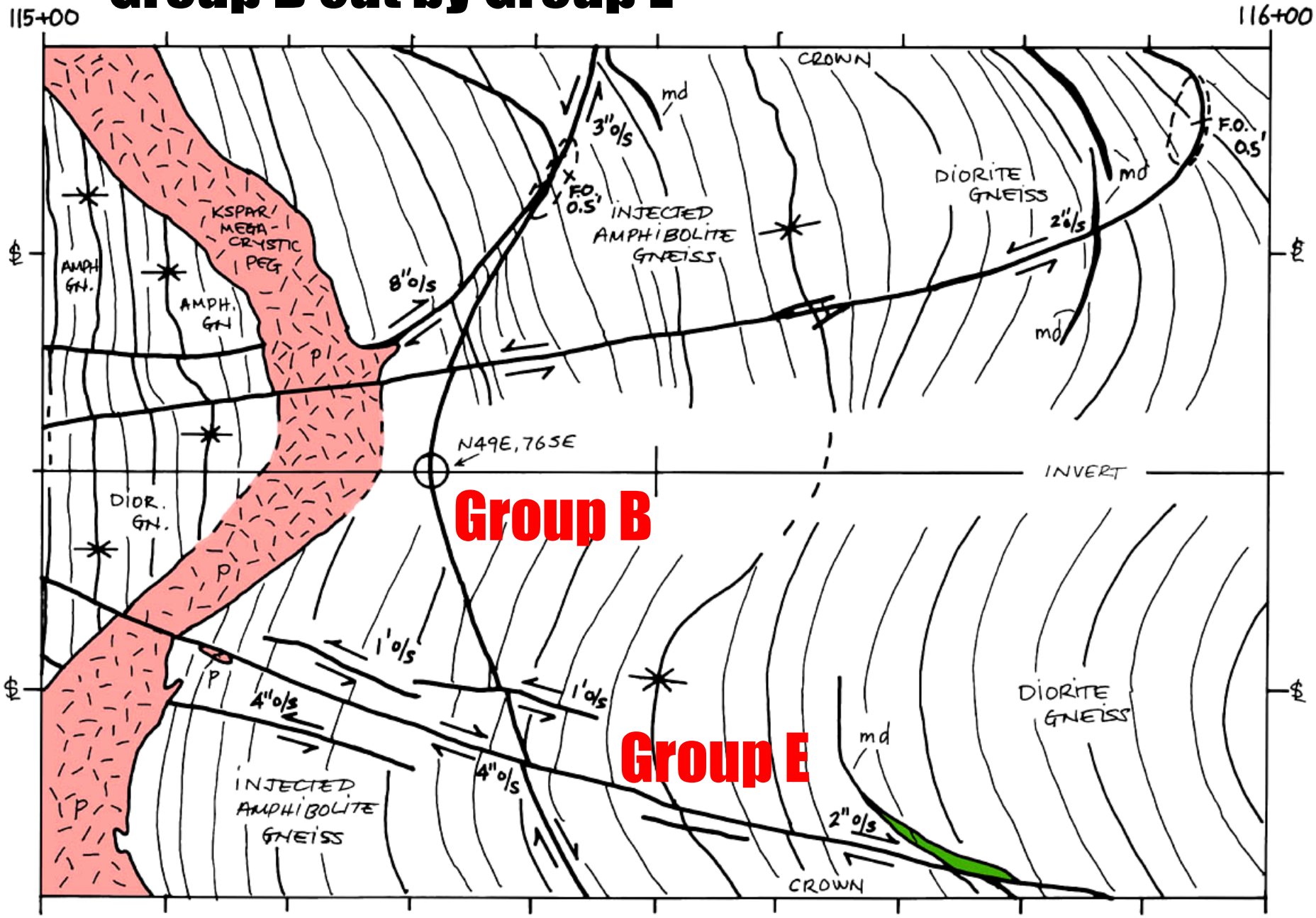


NNW-Trending Fault System of Group E

- NNW strike and steep dips; R/L and L/L strike-slip offset
- Follow S_4 traces of open cross folds (F_4)
- Commonly healed with quartz +/- pyrite
- Youngest fault group – they cut all tunnel structures
- Reactivate many older faults
- Persistent features in NW-leg of tunnel
- Associated with areas of stress relief
- Produce wet zones in areas of fault convergence


NNW-Trending “Manhattanville” Strike-Slip Faults
Splays and Conjugate Joints
Queens Tunnel Sta. 75+85
156+40
156+35
156+30
156+20

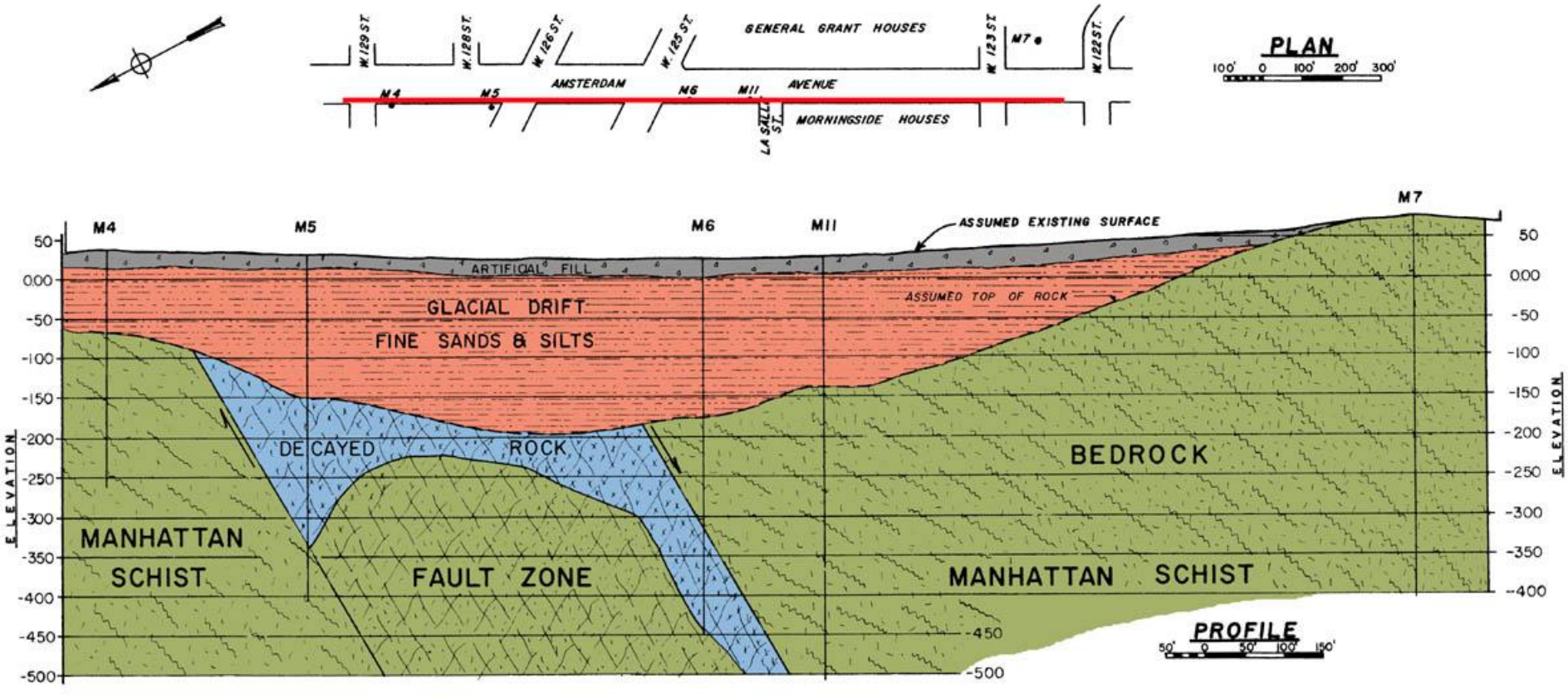
Group B cut by Group E




Crown Failure in Overstressed Rock
Queens Tunnel Sta. 253+40


DESPATCH
MOVING & STORAGE

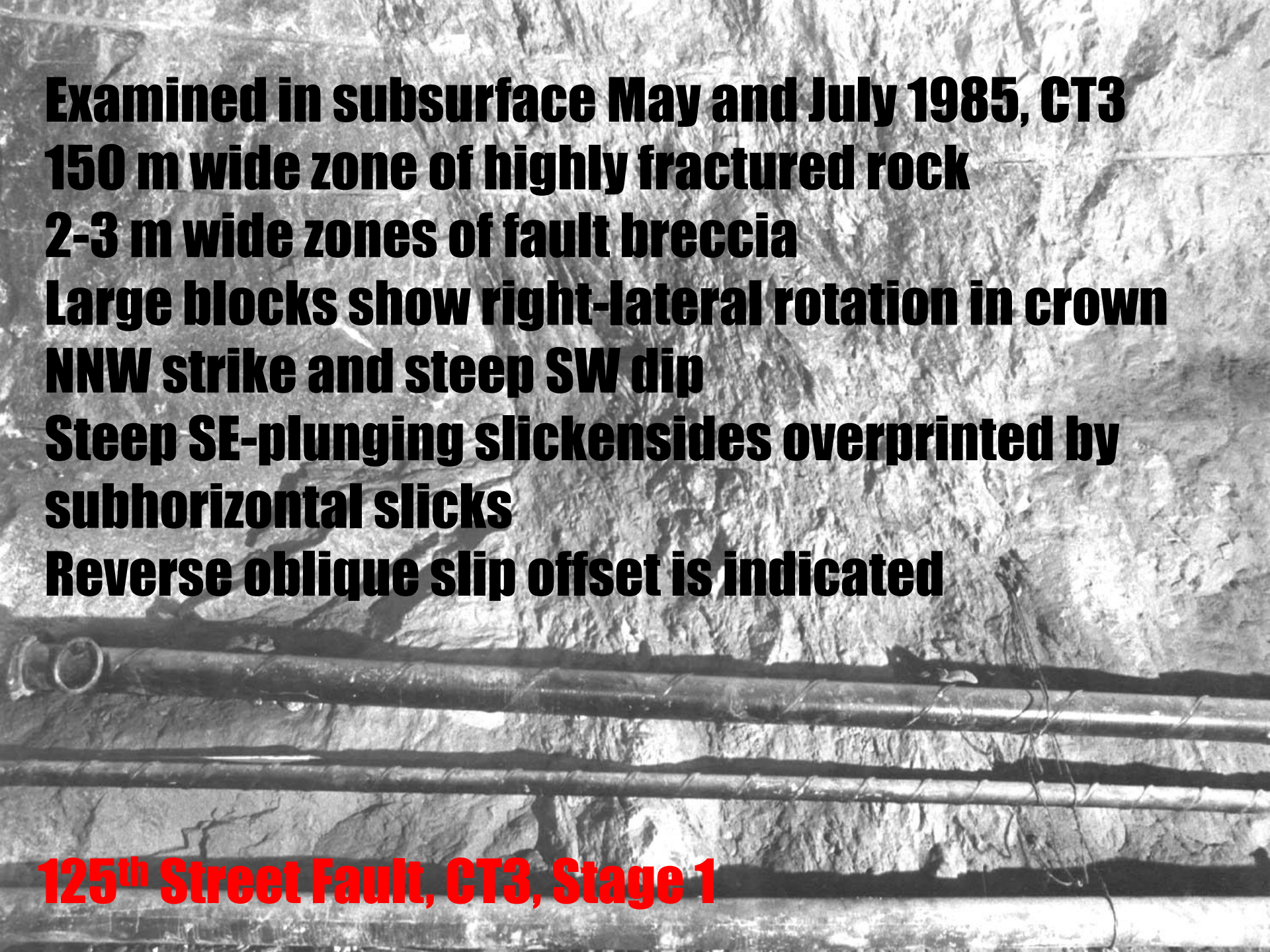
Manhattanville "125th Street" Fault

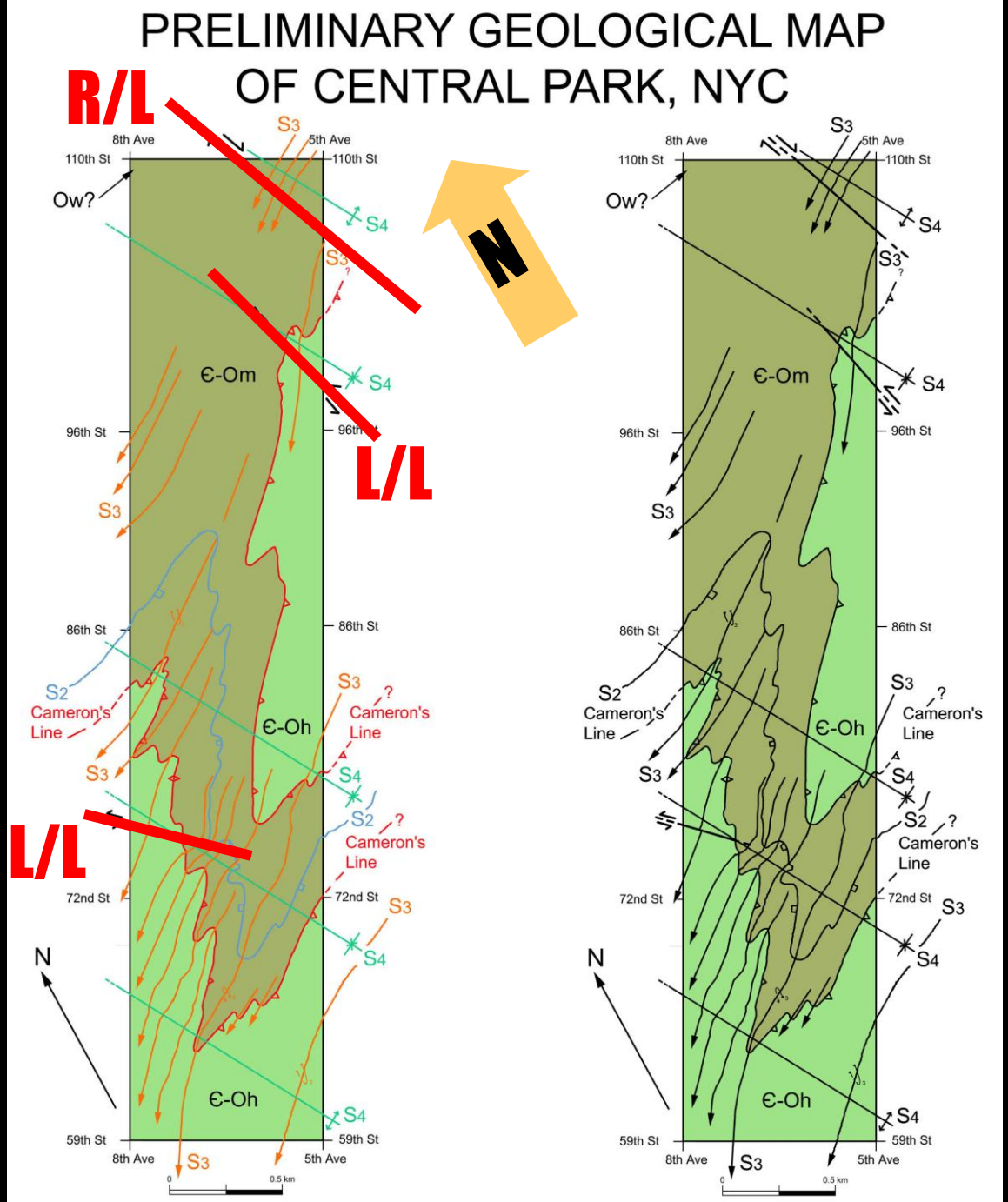


CT3, Stage 1

after Fluhr, 1969


125th Street Fault, CT3, Stage 1


Examined in subsurface May and July 1985, CT3
150 m wide zone of highly fractured rock
2-3 m wide zones of fault breccia
Large blocks show right-lateral rotation in crown
NNW strike and steep SW dip
Steep SE-plunging slickensides overprinted by subhorizontal slicks
Reverse oblique slip offset is indicated
125th Street Fault, CT3, Stage 1



Group E Faults In Central Park

Merguerian and Merguerian, 2004

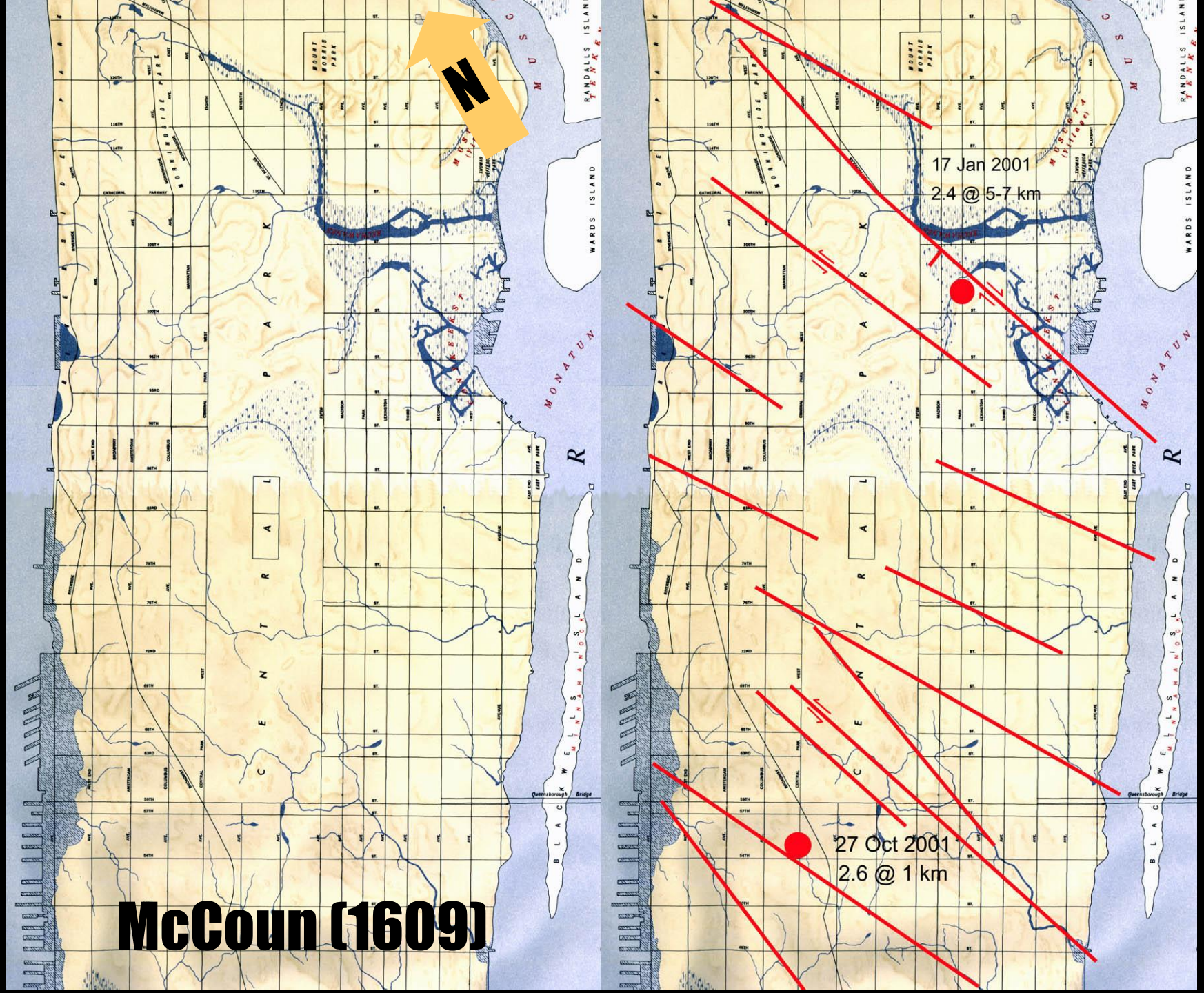
Manhattan Schist

Offsets F_3 Syncline

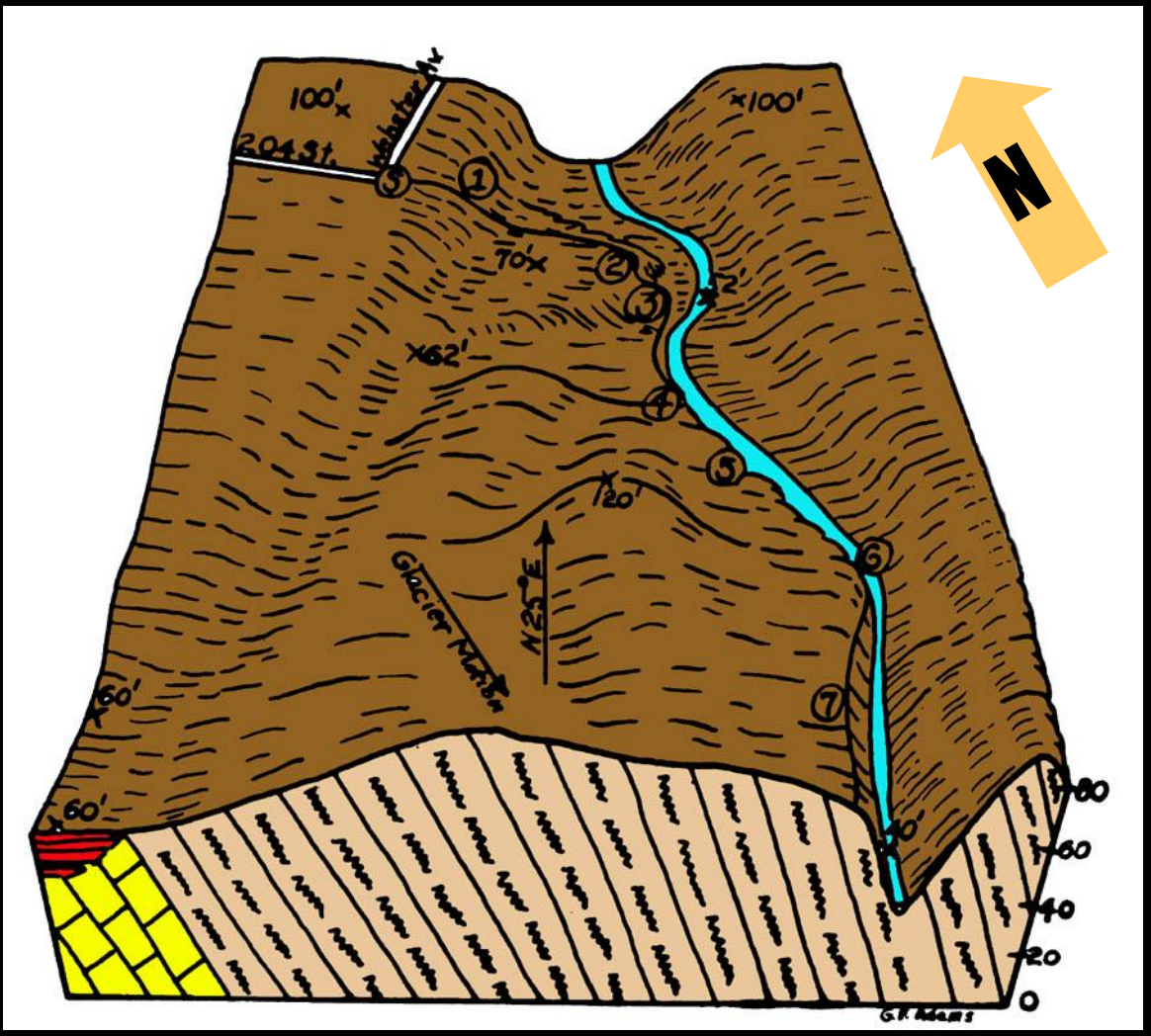
N537

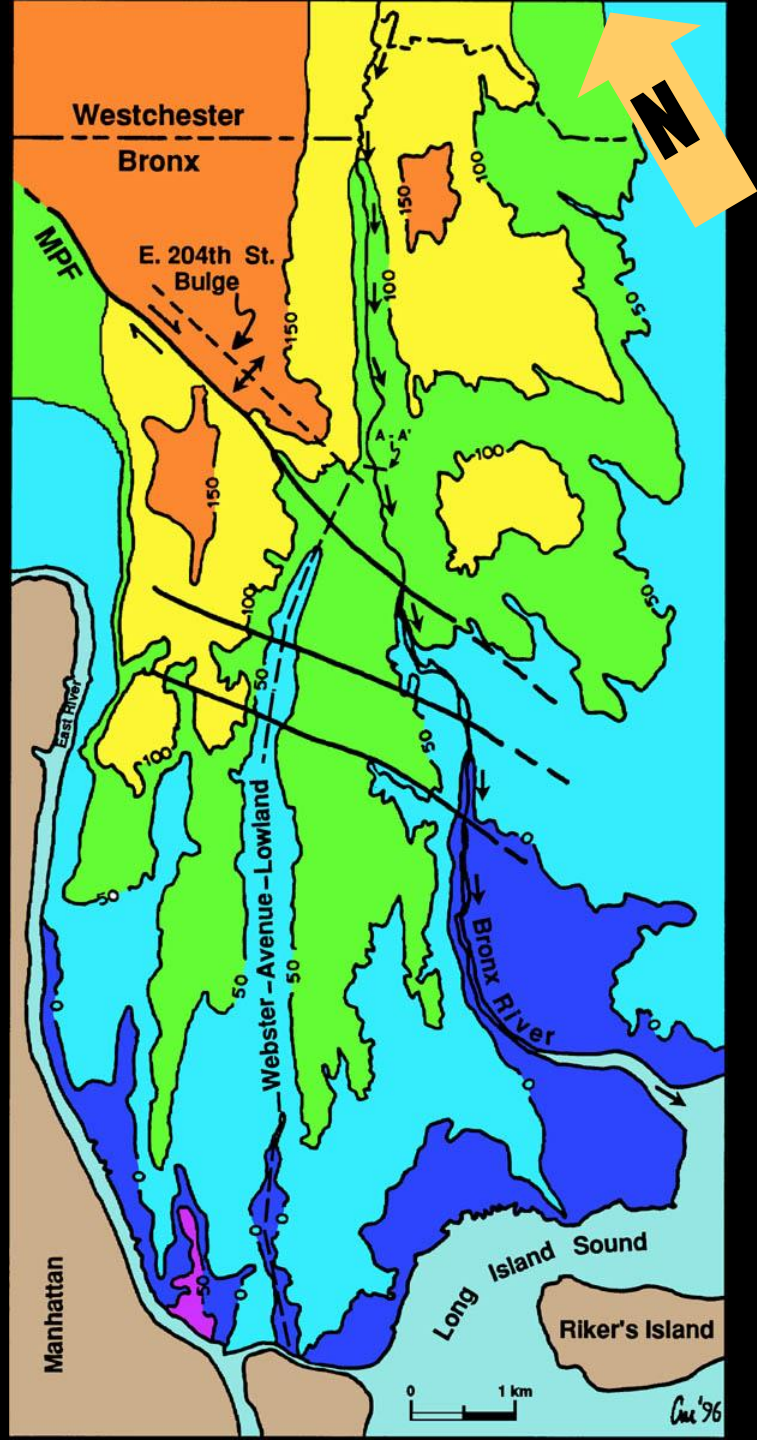
Group E - N12°W, L/L Fault

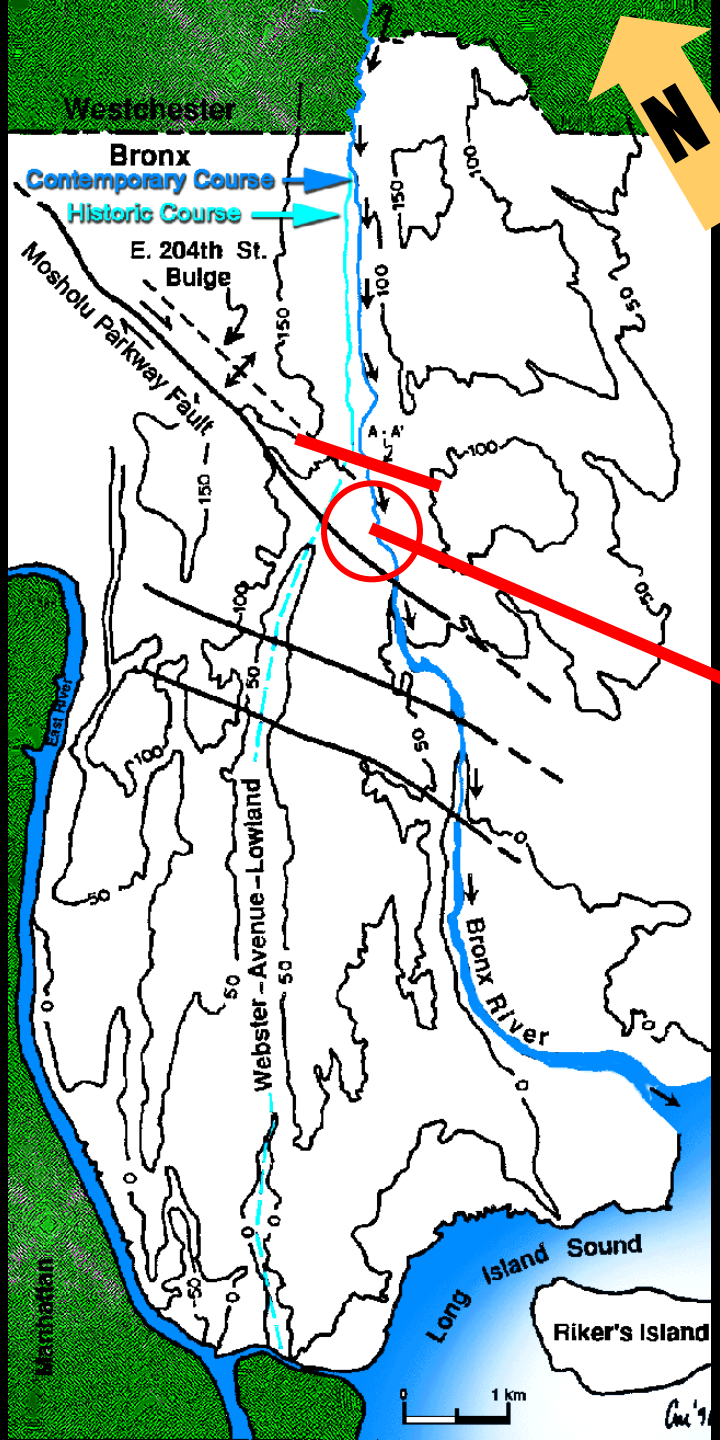
Group E - N45°W, 80°S L/L Fault


N
17 Jan 2001
2.4 @ 5-7 km
27 Oct 2001
2.6 @ 1 km
McCoun (1609)

Bronx River Drainage Anomaly

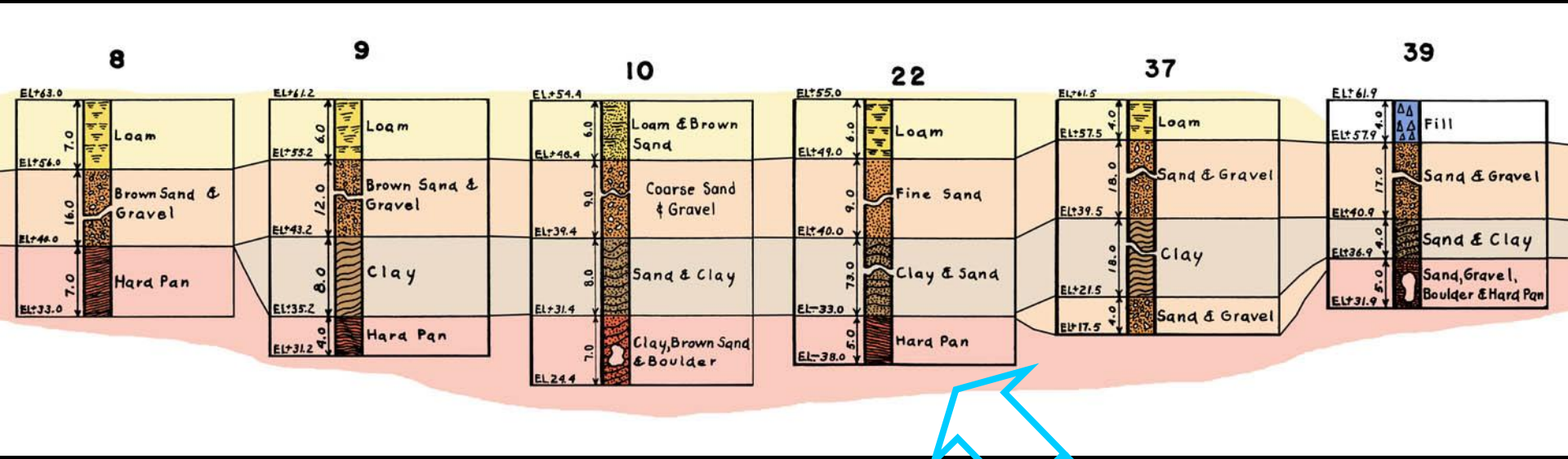






Non-glaciated V-Shaped Bronx River Valley at Snuff Mill, NY Botanical Garden

Burke Avenue Profile – Bronx WPA



Bouldery Till

Stratified Lake Sediment Overlie Glacial Drift

Supports Hypothesis that Damming of Bronx River was Post-Glacial

New York City Earthquake Can it Happen Here?

1737 5.2

1783 4.9

1884 5.2

200? ?


It’s Not My Fault! He put me up to this!