Rhyodacite Dikes of the Queens Tunnel Complex, NYC Water Tunnel #3

Charles Merguerian

HOFSTRA UNIVERSITY

Stage 2, City Tunnel 3

Robbins 235-282 HP TBM

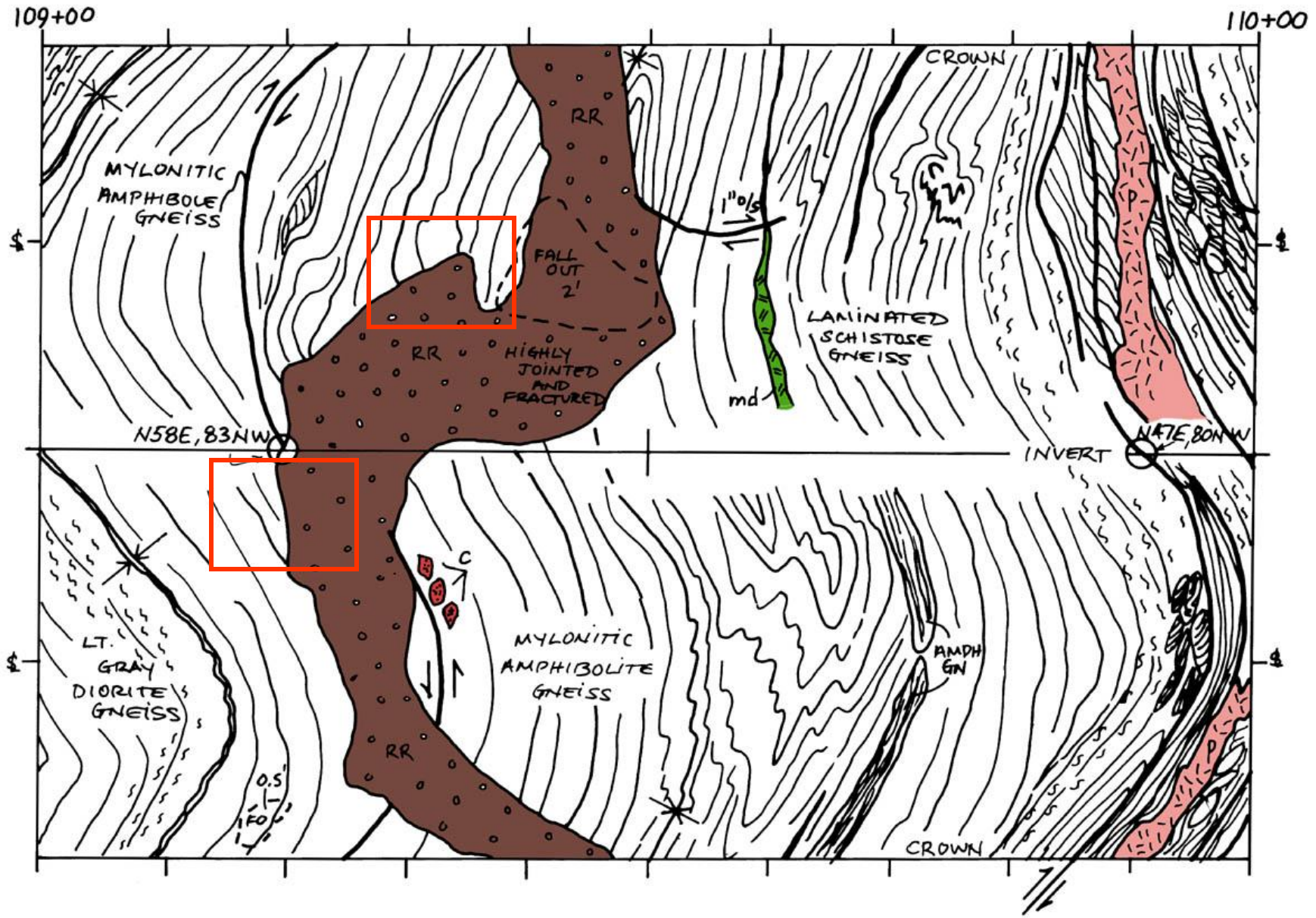
Tunneling Difficulties


Collapsing Crown

Five Laterally Extensive Dikes

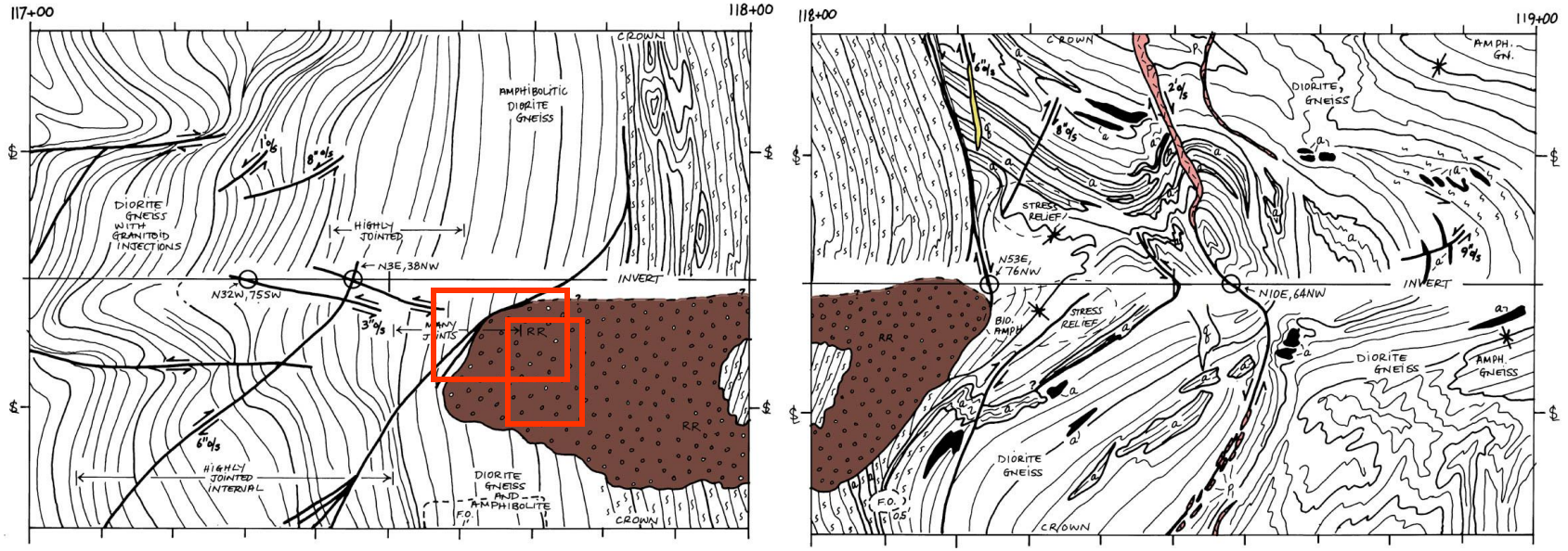
Dike	Stations	Orientation	Exposed Length	Thick-ness	Brief Comments
1	109+20 - 109+52	N65°W, 57°NE	32'	12'	cuts N58°E, 83°NW normal fault
2	117+58 - 118+24	? - RW Only	66'	>8'	cuts N52°E, 76°NW normal fault and shear zone
3	128+70 - 129+21	? - LW Only	51‘	7'	cuts D_3 shear zone
	129+53 - 130+41	N48°W, 78°SW	88'	11'	cuts N20°E, 10°NW thrusts and older F_3 fold
4	131+70 - 132+42	? - LW Only	72‘	6'	cuts N30°W, 23°SW thrust fault
	132+40 - 132+56	? - RW Only	16‘	3'	thin selvage cuts thrust fault and shear zone
	132+58 - 133+62	N61°W, 81°NE	104'	5'-10'	cuts N44°E, 83°SE reverse shear zone; fractured
5	149+93 - 151+36	N52°W, 90°	143‘	16'	cut by N20°E, 70°NW normal fault; clay-rich gouge
	151+45 - 152+40	N40°W, 83°SW	95‘	14'	cut by N18°E, 70°NW normal fault; clay-rich gouge

Dike 1

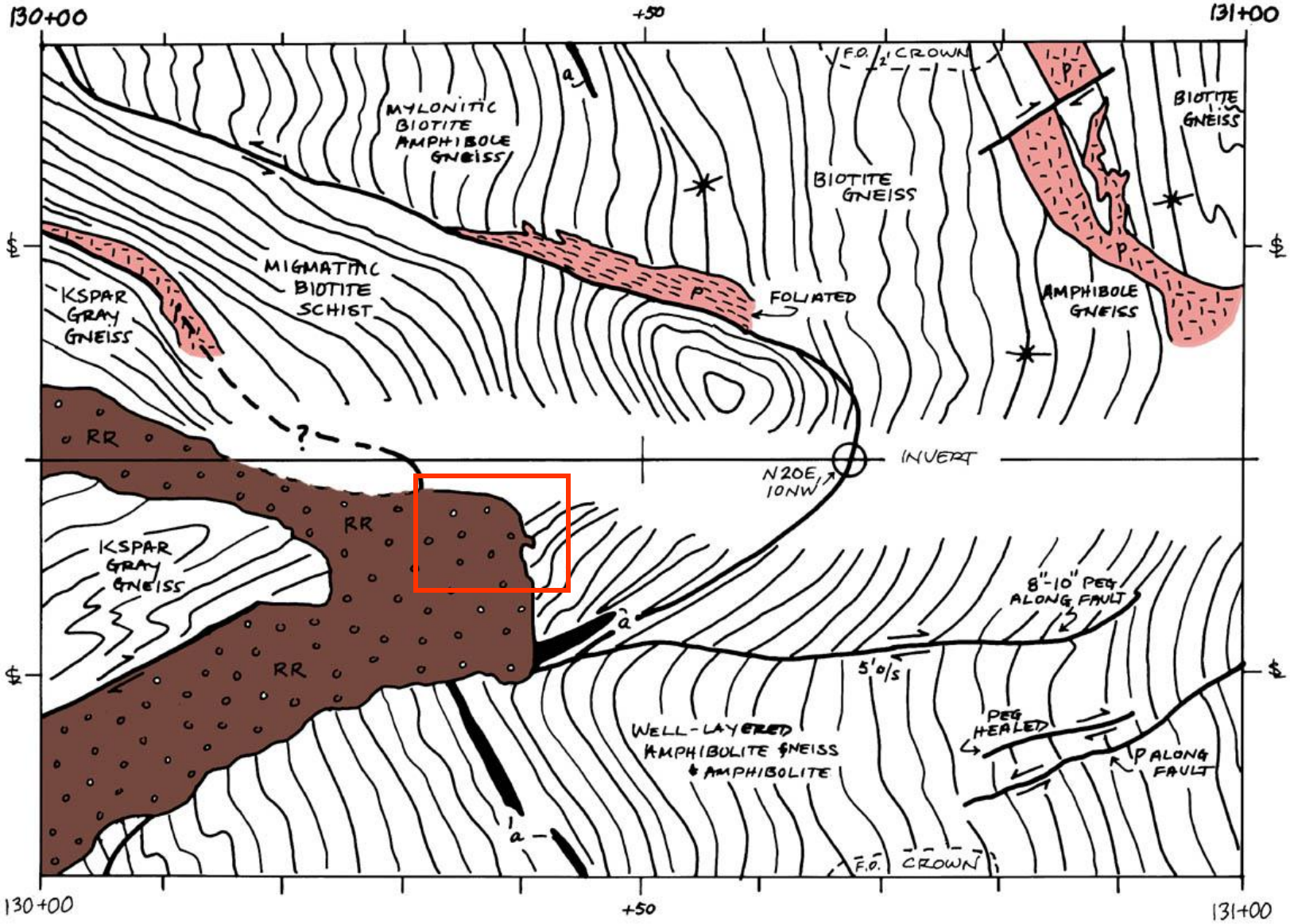

109+00
110+00
CROWN
MYLONITIC AMPHIBOLE GNEISS
RR
FALL OUT 2'
HIGHLY JOINTED AND FRACTURED
1"o/s
LAMINATED SCHISTOSE GNEISS
md
P
N58E, 83NW
INVERT
N47E, 80NW
LT. GRAY DIORITE GNEISS
MYLONITIC AMPHIBOLITE GNEISS
AMDH GN
0.5'
FO
CROWN


Station 109+20, Right Wall
Cooling joints extend 10' into country rock

Dike 2

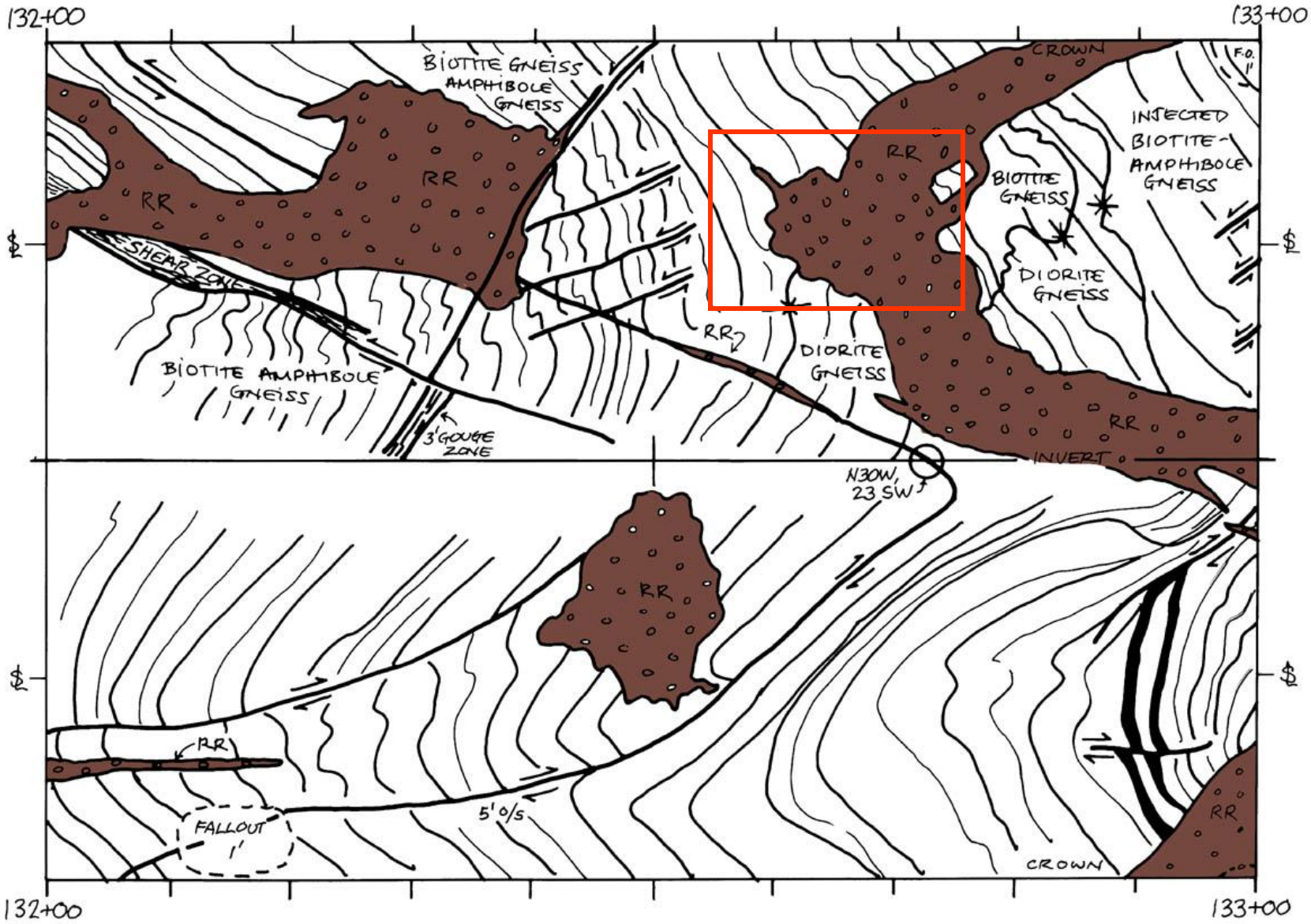

117+00
118+00
CROWN
AMPHIBOLITIC DIORITE GNEISS
DIORITE GNEISS WITH GRANITOID INJECTIONS
HIGHLY JOINTED
N3E, 38NW
N32W, 75SW
MANY JOINTS
RR
INVERT
HIGHLY JOINTED INTERVAL
DIORITE GNEISS AND AMPHIBOLITE
F.O.
CROWN
118+00
119+00
CROWN
AMPH. GN.
DIORITE GNEISS
STRESS RELIEF
N53E, 76NW
N10E, 64NW
INVERT
BIO. AMPH.
RR
DIORITE GNEISS
AMPH. GNEISS
DIORITE GNEISS
F.O.
CROWN

Dike 3


130+00
+50
131+00
F.O. 2' CROWN
MYLONITIC BIOTITE AMPHIBOLE GNEISS
BIOTITE GNEISS
BIOTITE GNEISS
MIGMATITIC BIOTITE SCHIST
KSPAR GRAY GNEISS
FOLIATED
AMPHIBOLE GNEISS
RR
INVERT
N20E, 10NW
KSPAR GRAY GNEISS
8"-10" PEG ALONG FAULT
5'o/s
WELL-LAYERED AMPHIBOLITE GNEISS & AMPHIBOLITE
PEG HEALED
P ALONG FAULT
F.O. CROWN
130+00
+50
131+00

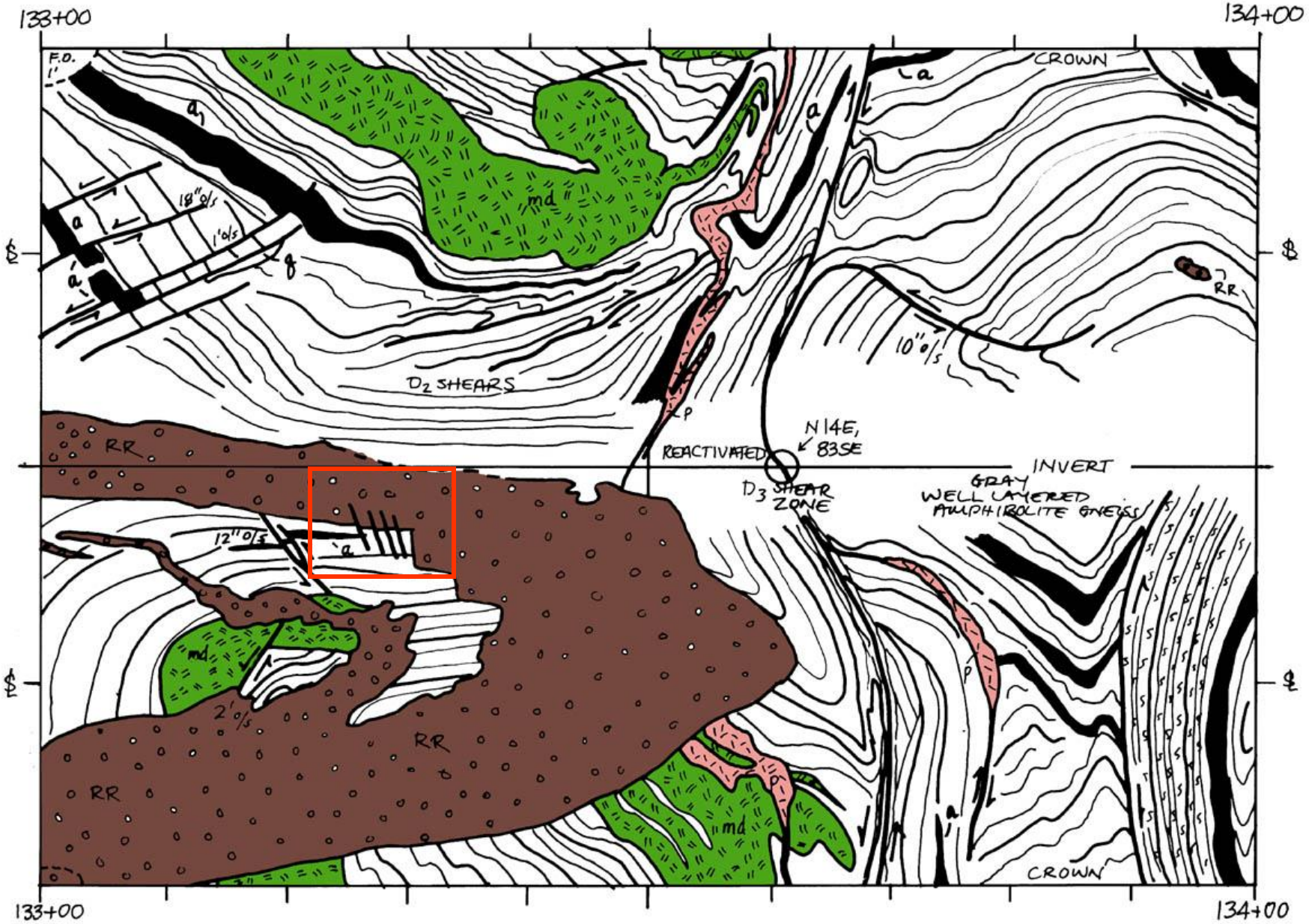

Station 130+40, Right Wall
Multidirectional cooling joints in rhyodacite

Dike 4

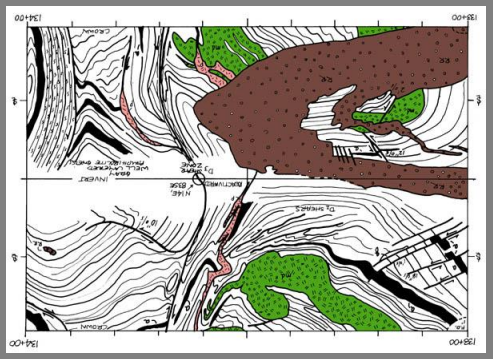

132+00
133+00
BIOTITE GNEISS
AMPHIBOLE GNEISS
RR
SHEAR ZONE
BIOTITE AMPHIBOLE GNEISS
3' GOUGE ZONE
CROWN
F.O. 1'
INJECTED BIOTITE-AMPHIBOLE GNEISS
BIOTITE GNEISS
DIORITE GNEISS
INVERT
N30W, 23 SW
5'0/s
FALLOUT 1'
CROWN


132+60
132+65
132+70

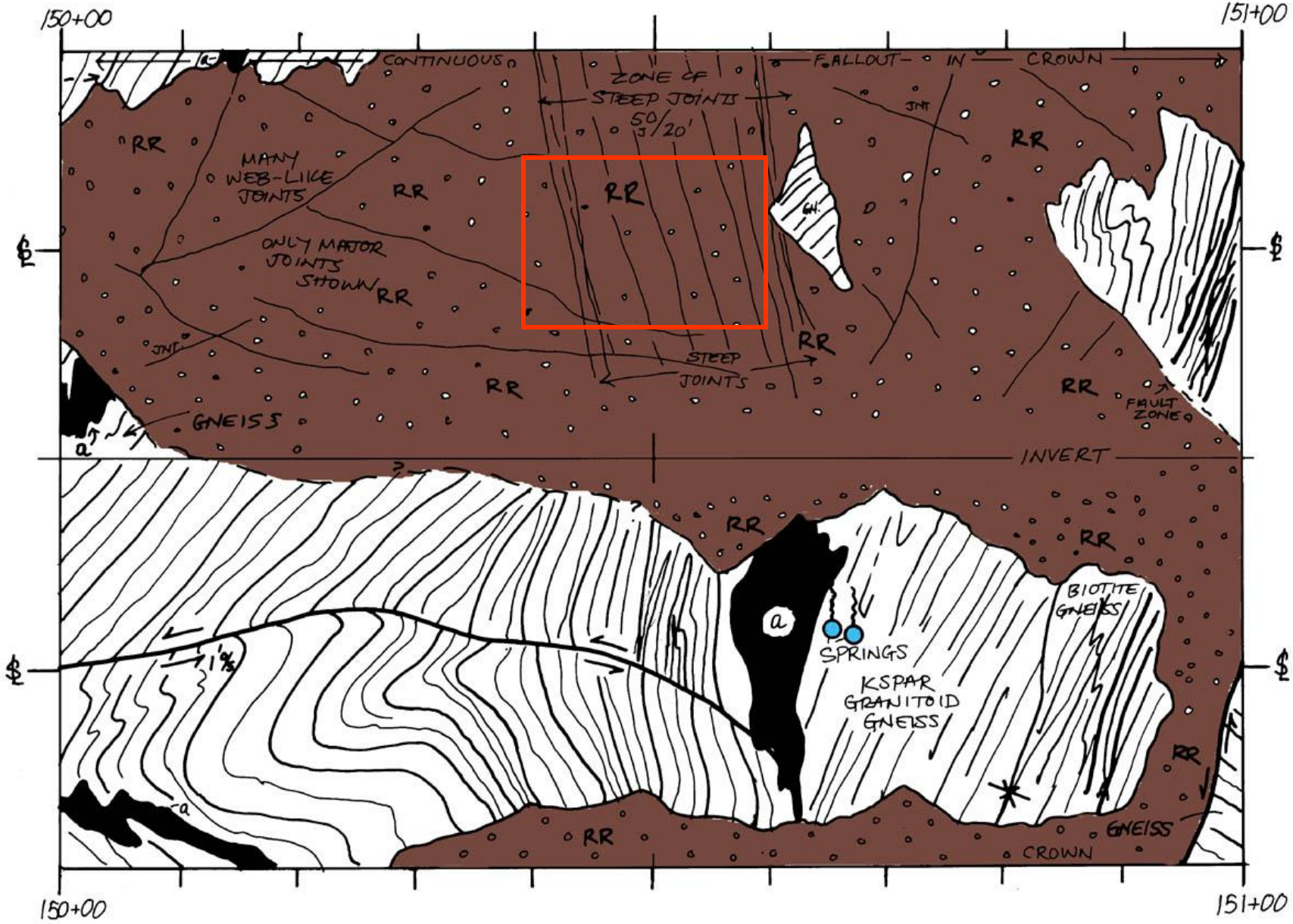
Dike 4


133+00
134+00
F.O.
1'
a
md
18"o/s
1'o/s
g
D2 SHEARS
CROWN
RR
10"o/s
P
N14E,
83SE
REACTIVATED
D3 SHEAR ZONE
INVERT
GRAY
WELL LAYERED
AMPHIBOLITE GNEISS
12"o/s
2'o/s
RR
CROWN
133+00
134+00

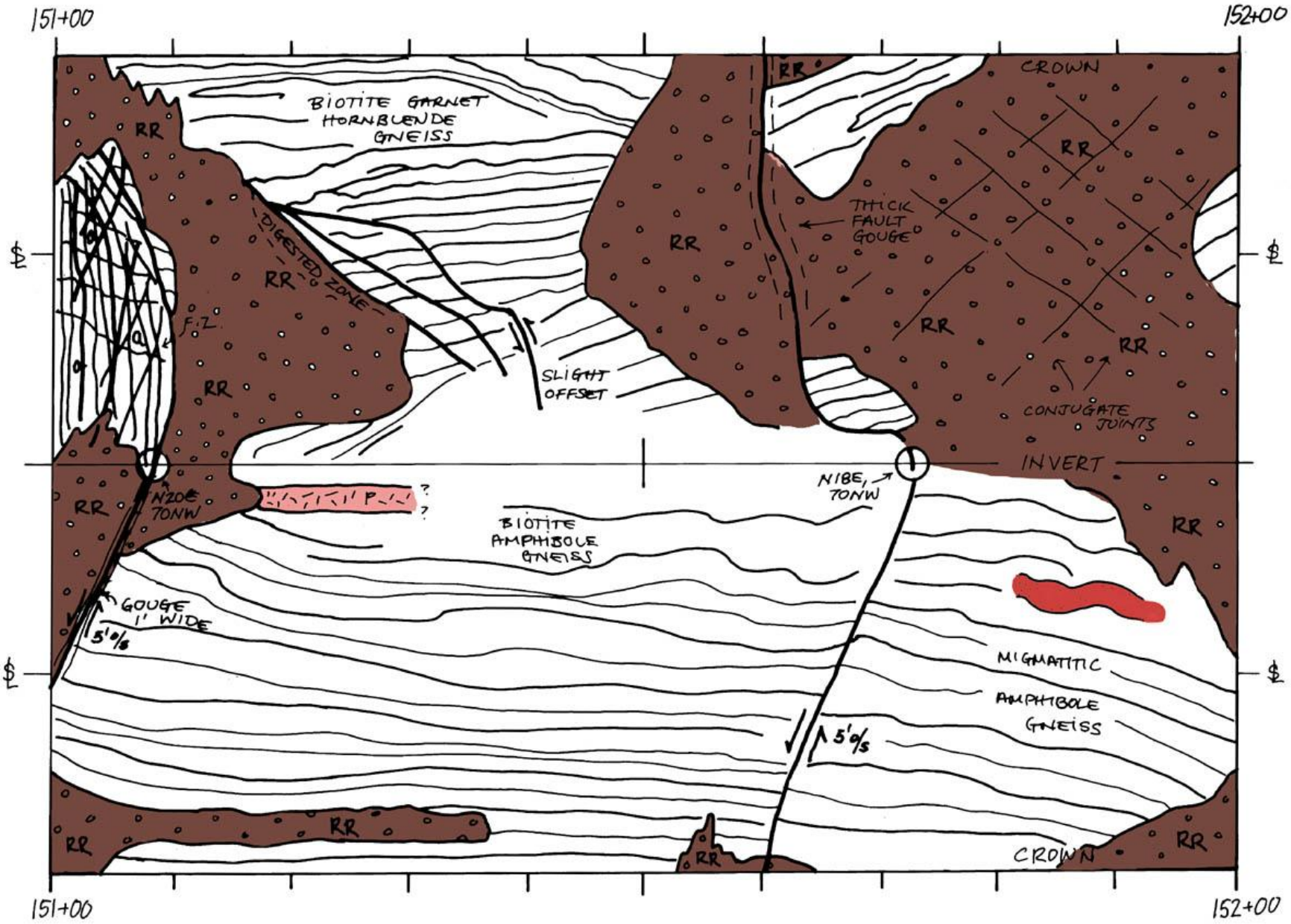
Dike 4



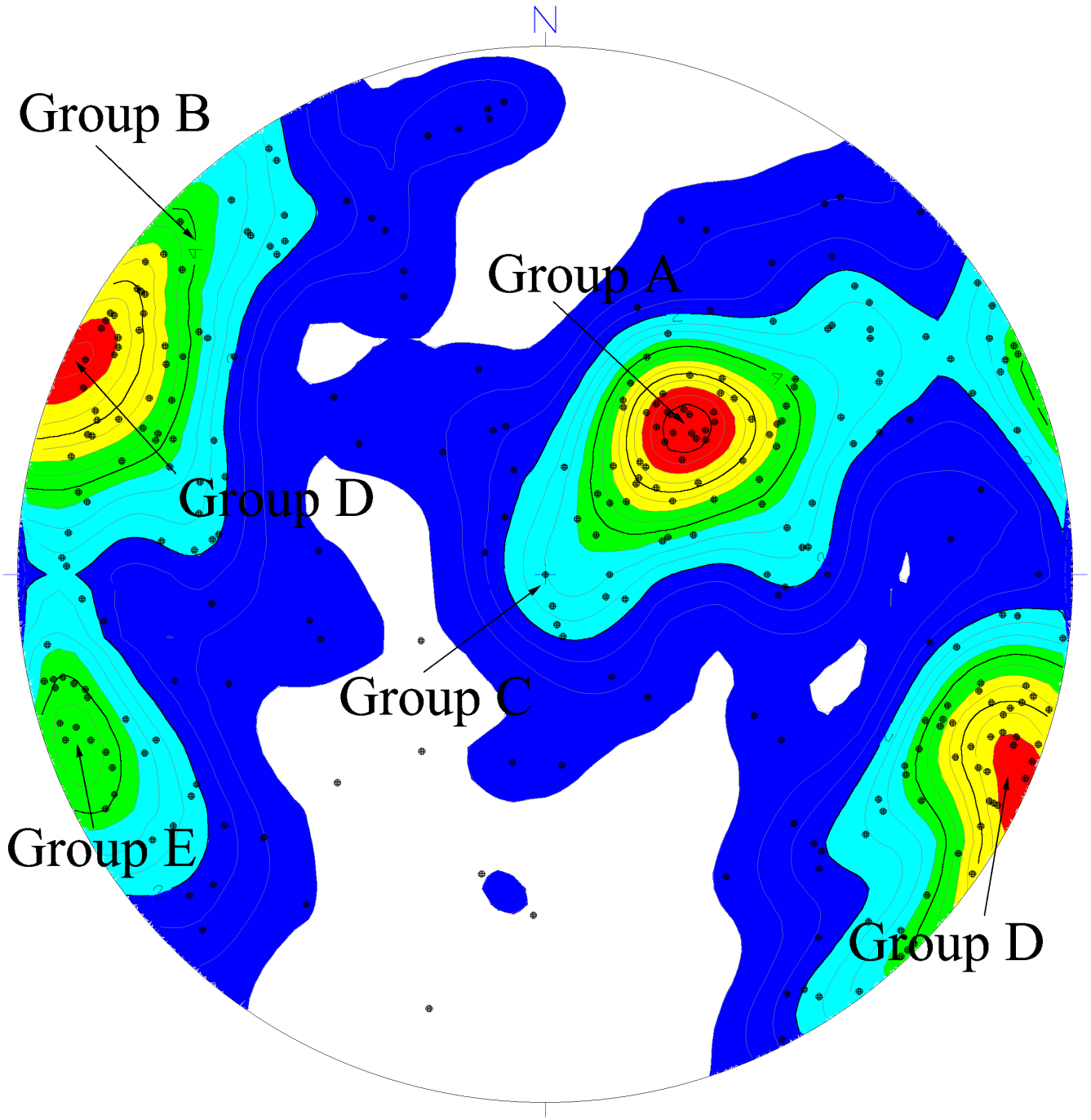
Dike 5


150+00
151+00
CONTINUOUS
ZONE OF STEEP JOINTS 50/20'
FALLOUT IN CROWN
MANY WEB-LIKE JOINTS
ONLY MAJOR JOINTS SHOWN
RR
JNT
STEEP JOINTS
GNEISS
FAULT ZONE
INVERT
SPRINGS
KSPAR GRANITOID GNEISS
BIOTITE GNEISS
CROWN
1%

Dike 5

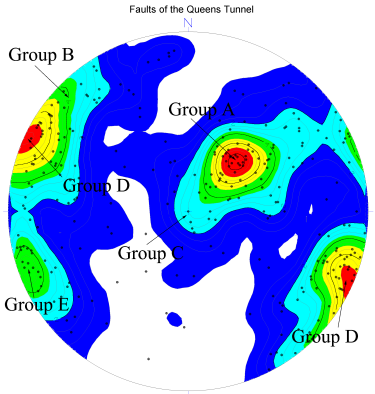

151+00
152+00
BIOTITE GARNET HORNBLENDE GNEISS
RR
DIGESTED ZONE
F.Z.
SLIGHT OFFSET
THICK FAULT GOUGE
CROWN
CONJUGATE JOINTS
INVERT
N20E 70NW
N18E, 70NW
BIOTITE AMPHIBOLE GNEISS
GOUGE 1' WIDE
5'o/s
MIGMATITIC AMPHIBOLE GNEISS
151+00
152+00

Faults of the Queens Tunnel



BRITTLE FAULTS

- **Hundreds of faults mapped in five major groups**
- **From oldest to youngest:**



Group A = NW strike and gentle SW dip

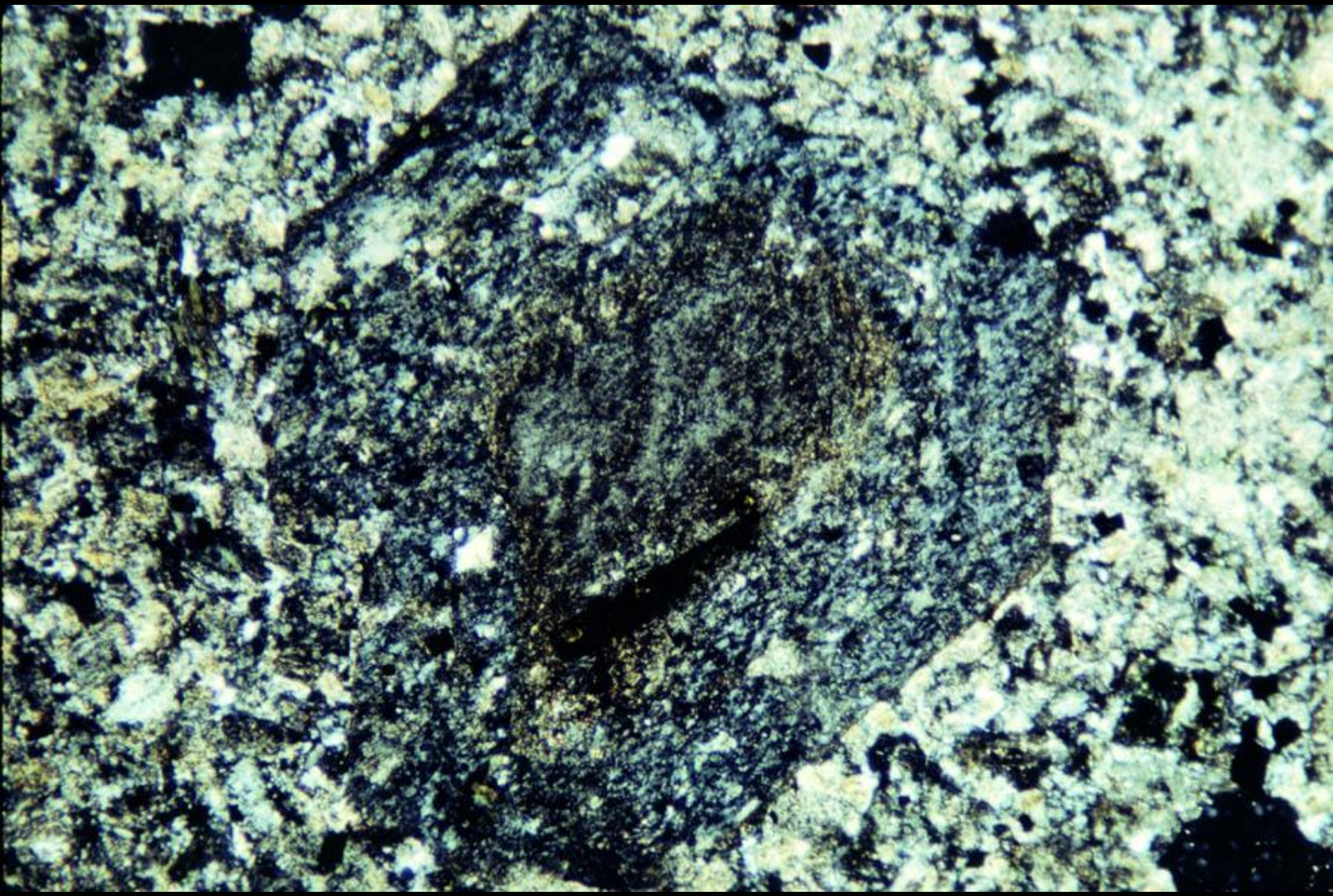
Group B = ENE strike and steep dips

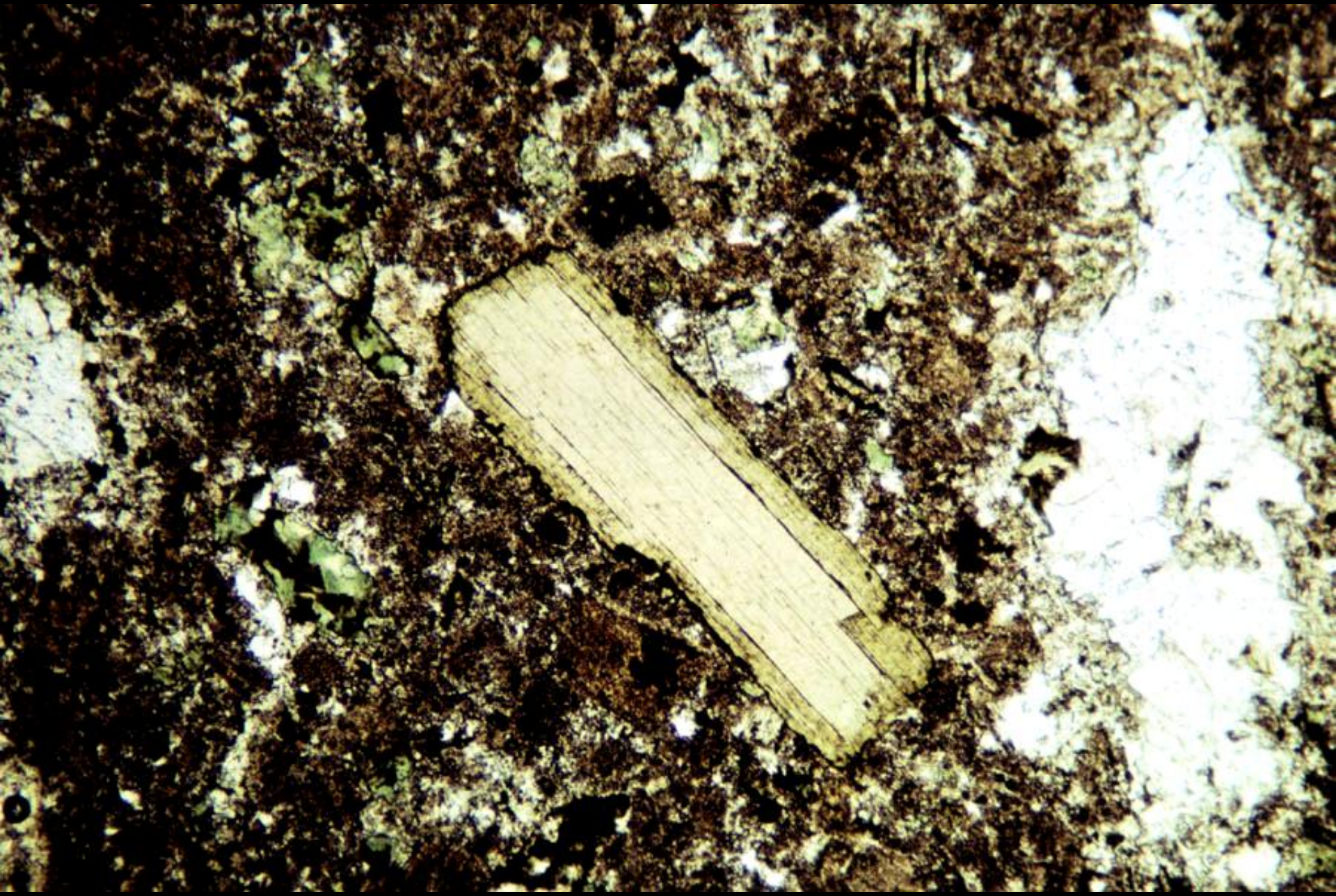
Group C = Subhorizontal fractures, faults, and shears

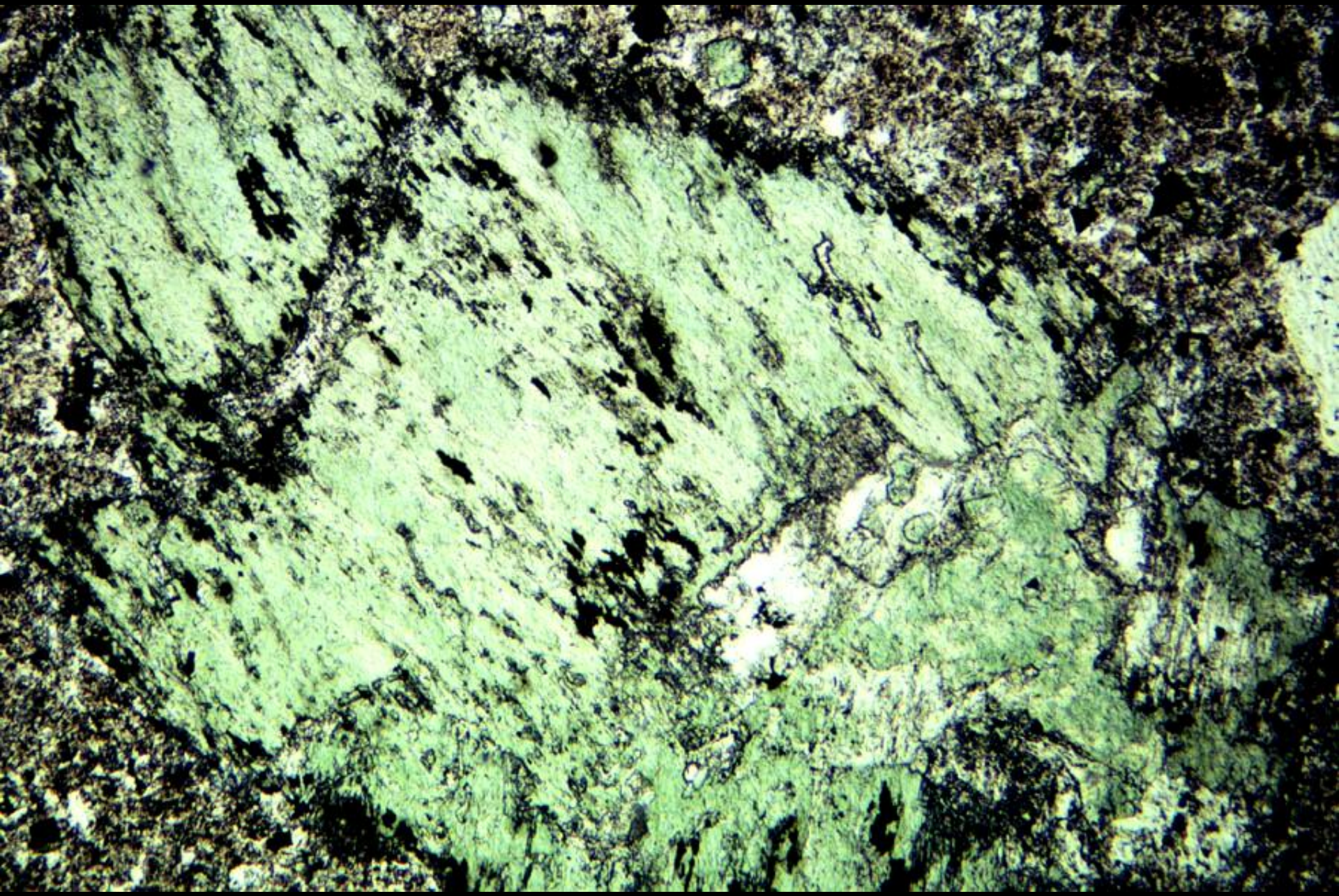
Group D = NNE-trending fault system (hitherto unknown)

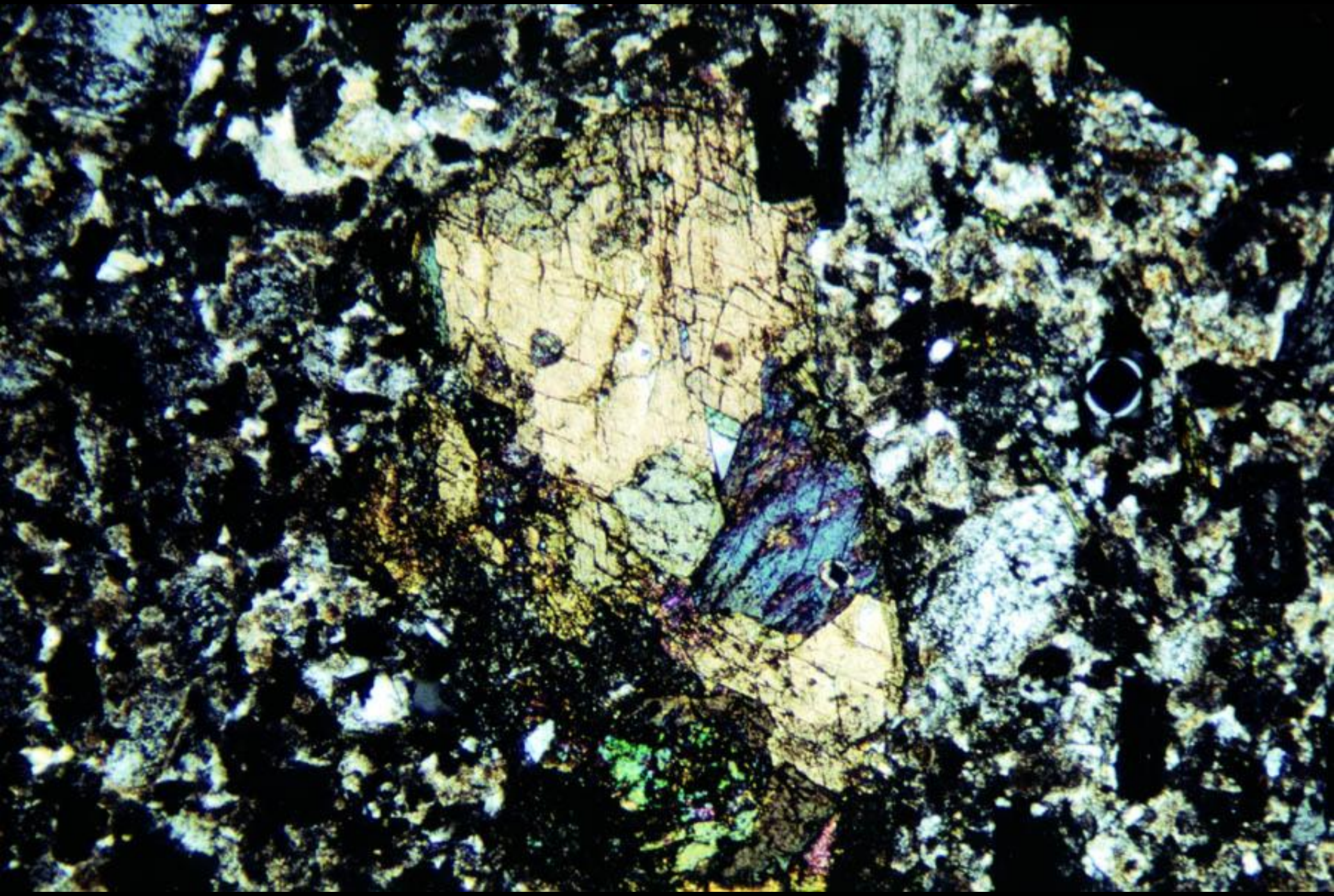
Group E = NNW-trending “Manhattanville” fault system

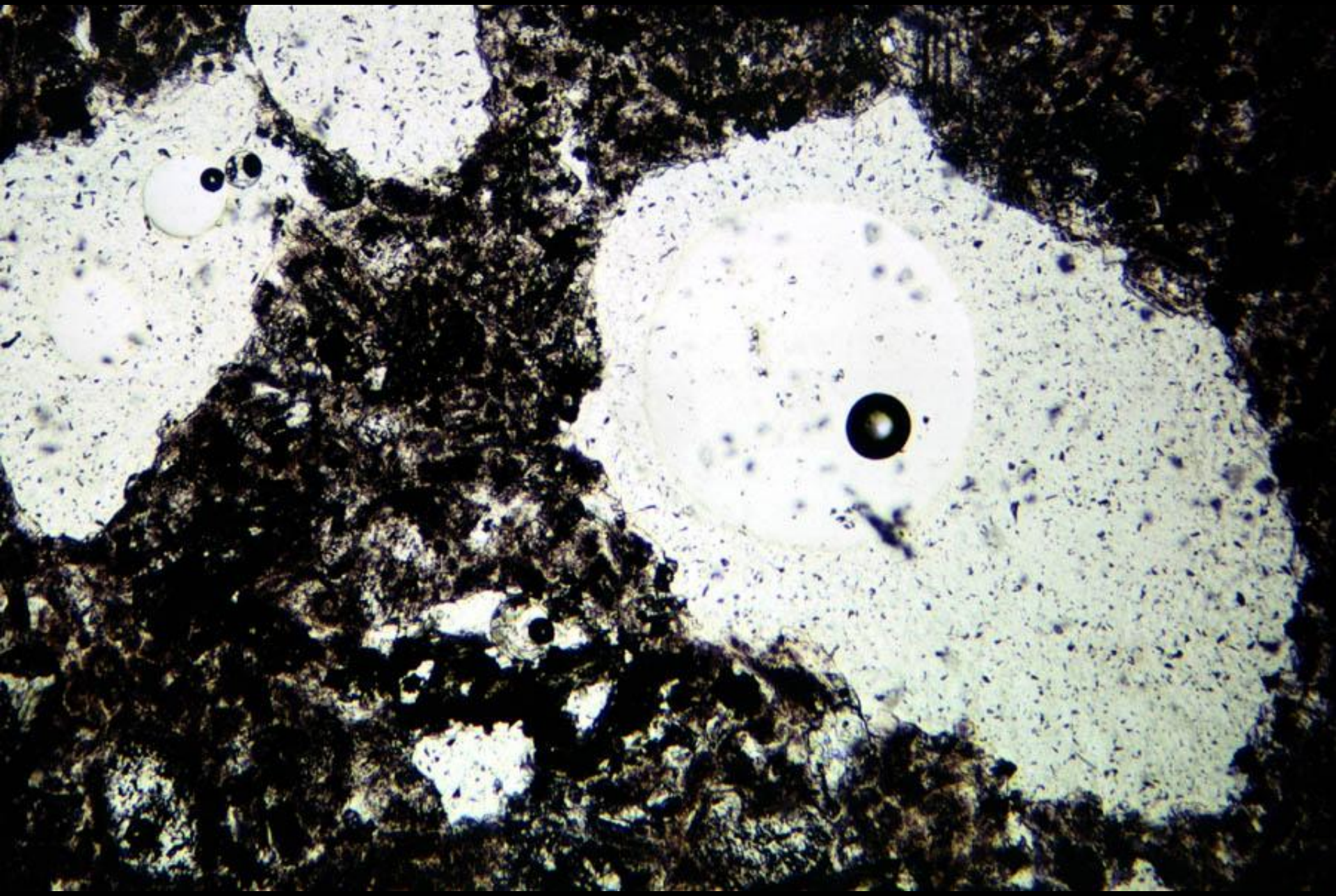
Major Elements	QTR-1	Q01-B	Q02-B	QT Average	Nockolds Rhyodacite
SiO2	64.89	66.16	63.06	64.70	66.27
TiO2	0.58	0.51	0.62	0.57	0.66
Al2O3	14.54	14.83	14.78	14.72	15.39
FeO*	3.73	3.31	4.35	3.80	4.15
MnO	0.07	0.08	0.08	0.08	0.07
MgO	1.62	1.77	2.22	1.87	1.57
CaO	3.97	4.40	5.54	4.64	3.68
Na2O	4.80	5.07	4.48	4.78	4.13
K2O	4.52	3.26	4.35	4.04	3.01
P2O5	0.40	0.41	0.54	0.45	0.17
Total	99.12	99.80	100.01	99.64	99.10
LOI	0.87	3.81	2.86	2.51	0.68
**Total Iron as Fe0*					












R12
R13
R13

Lava Flows in Woodside