

# Stratigraphy, Structure and Rock Mass Properties of the Hartland Formation, Second Avenue Subway, NYC, NY



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24 Mar 2014*



# NYC TBM Projects

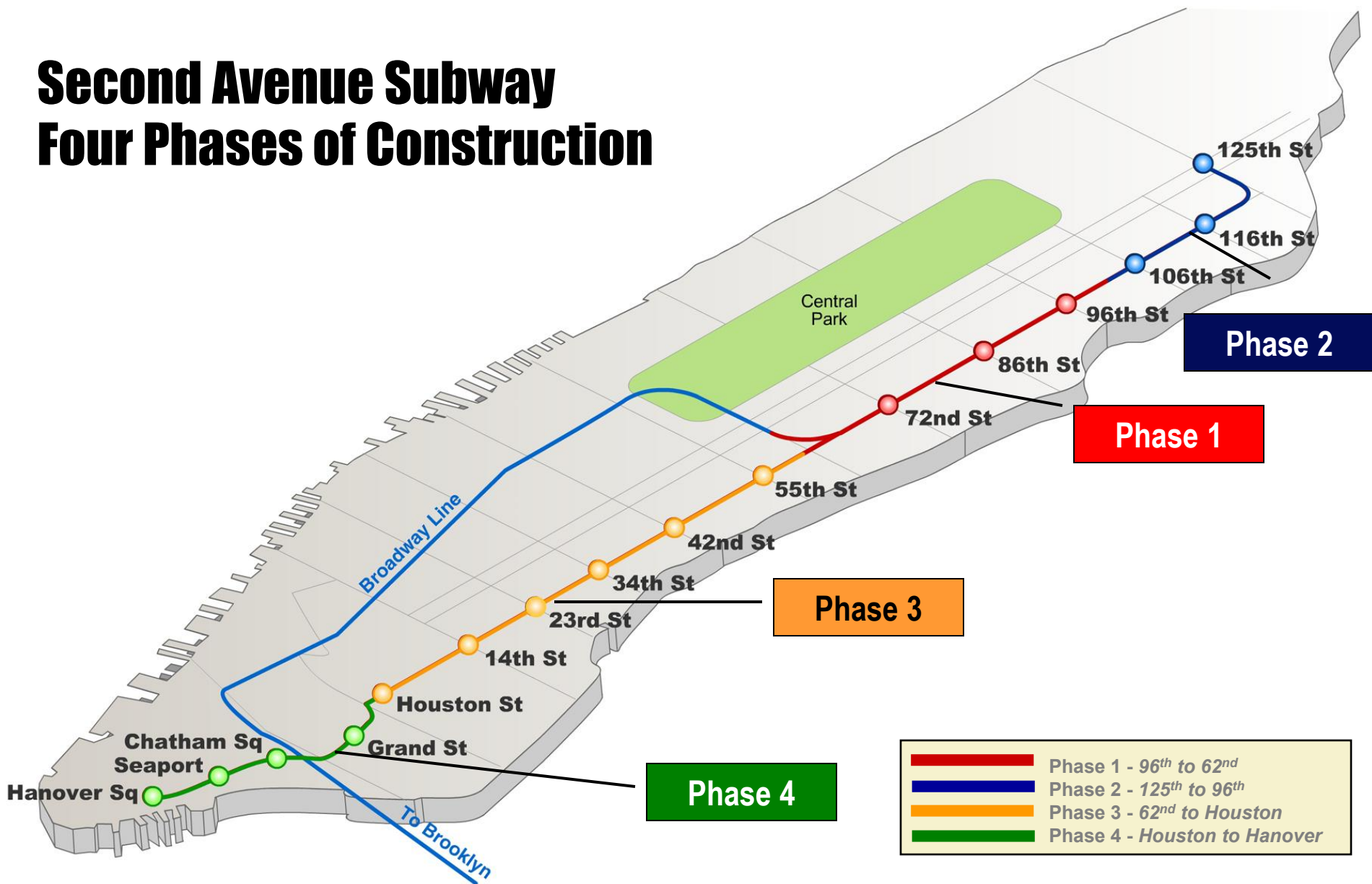
## Second Avenue Subway



1929 – NYC BOT Proposes  
Second Avenue Subway  
1931 – Plans Postponed for  
Depression Era  
\$86M → \$249M → \$500M  
By 1948 – Abandonment  
June 2010 – TBM Starts S Tube  
2013 – Station Complexes

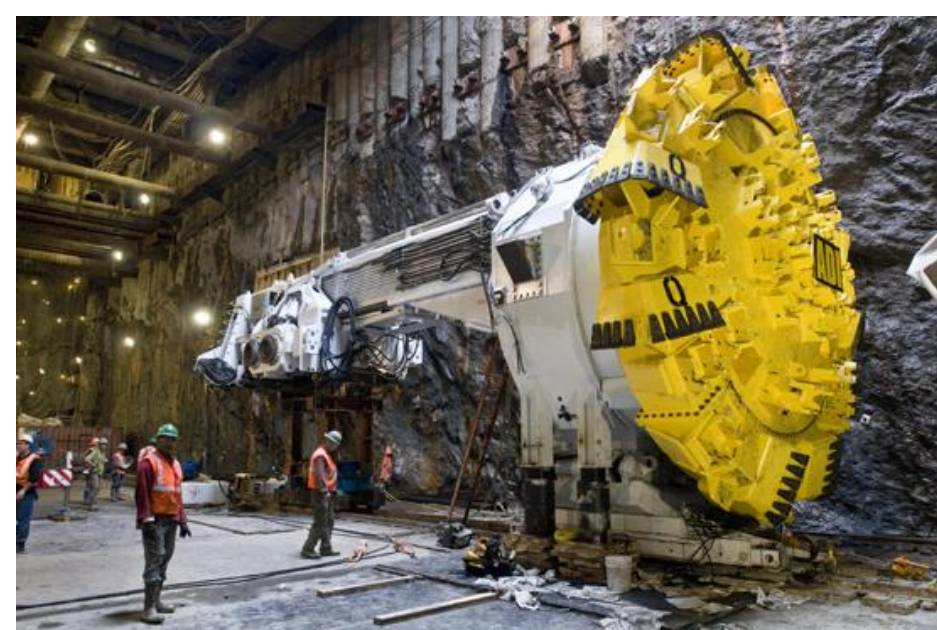
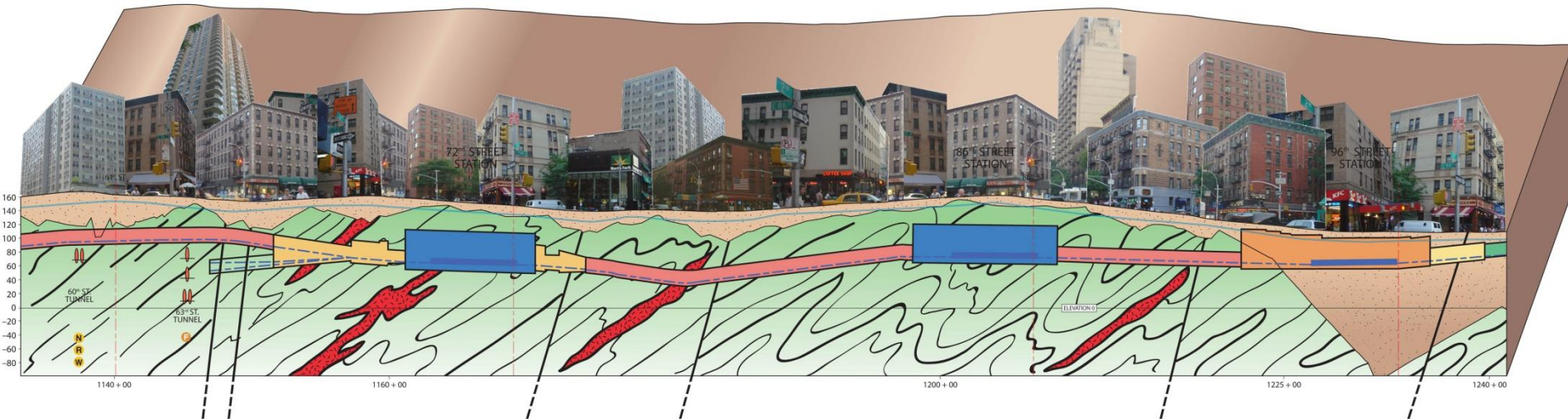
# Second Avenue Subway

## Four Phases of Construction





# Phase 1 - Threading The Needle



April 2010



May 2010



# Second Avenue Subway



96<sup>th</sup> Street Station Complex

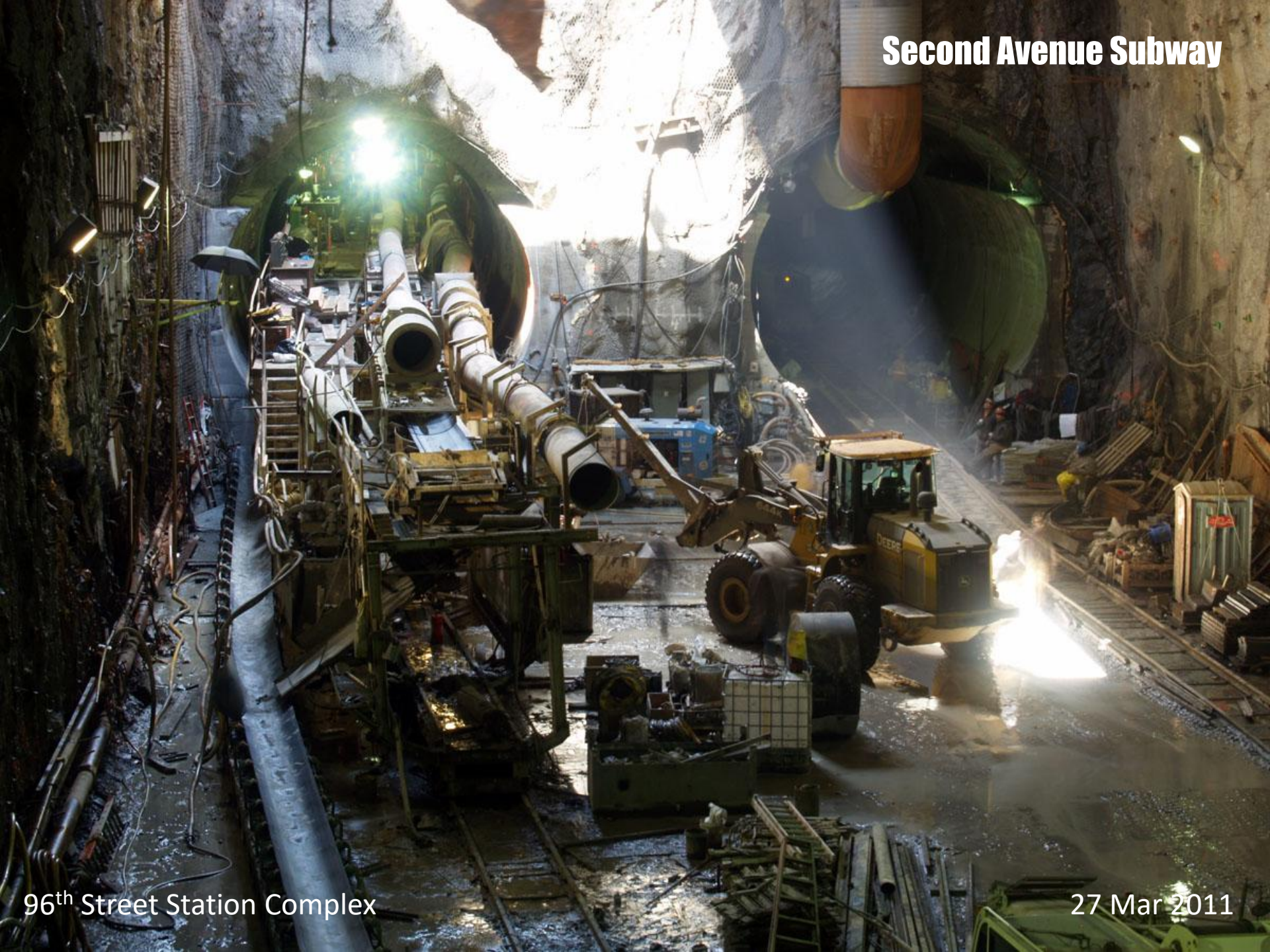
27 Mar 2011



# Second Avenue Subway

96<sup>th</sup> Street Station Complex

27 Mar 2011





# Second Avenue Subway

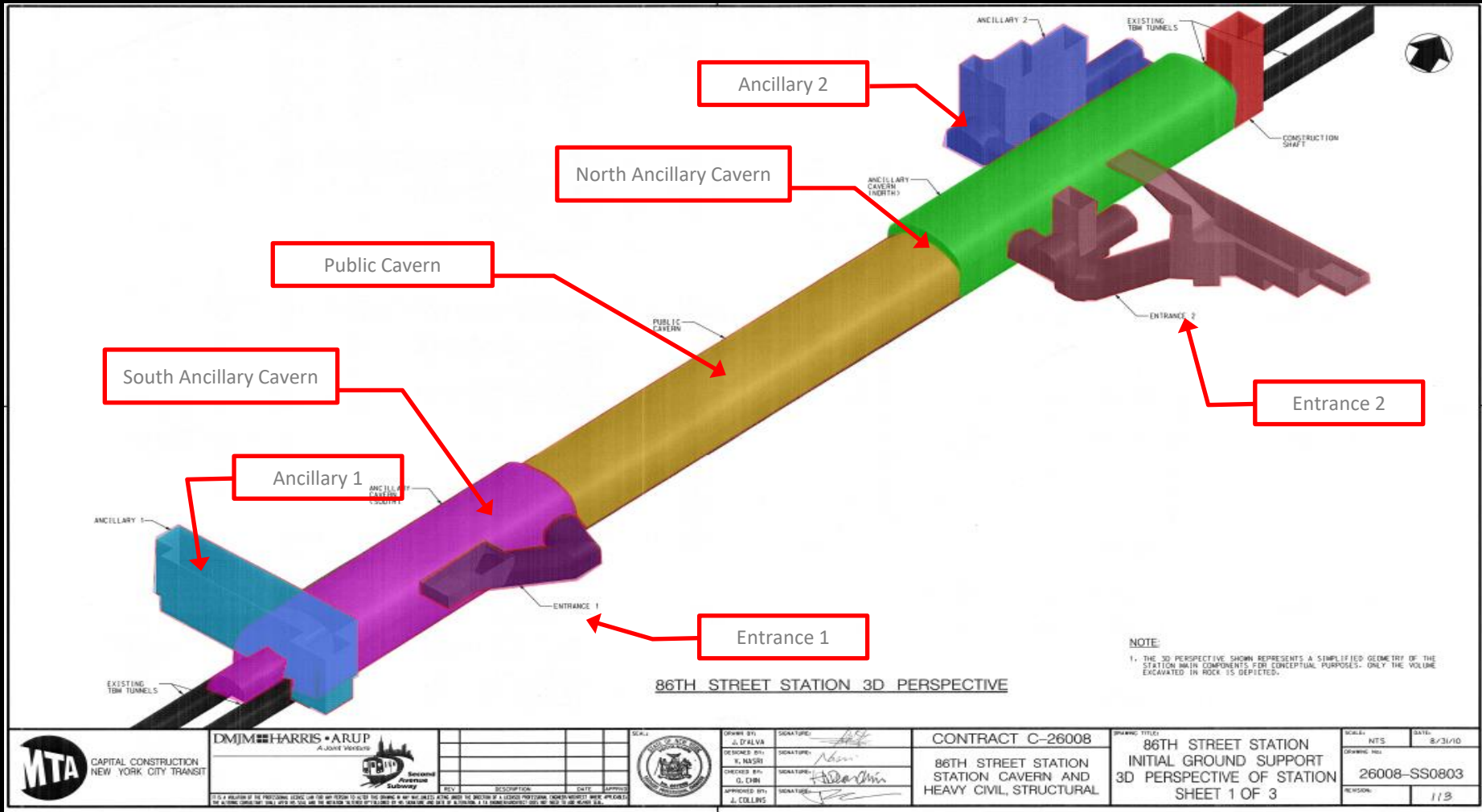


South Tube — Sta. 1172+80

27 Mar 2011



# 86<sup>th</sup> Street Station Cavern Excavation



**Stations 1198+00 to 1209+00 = ~1,100'**



# Second Avenue Subway

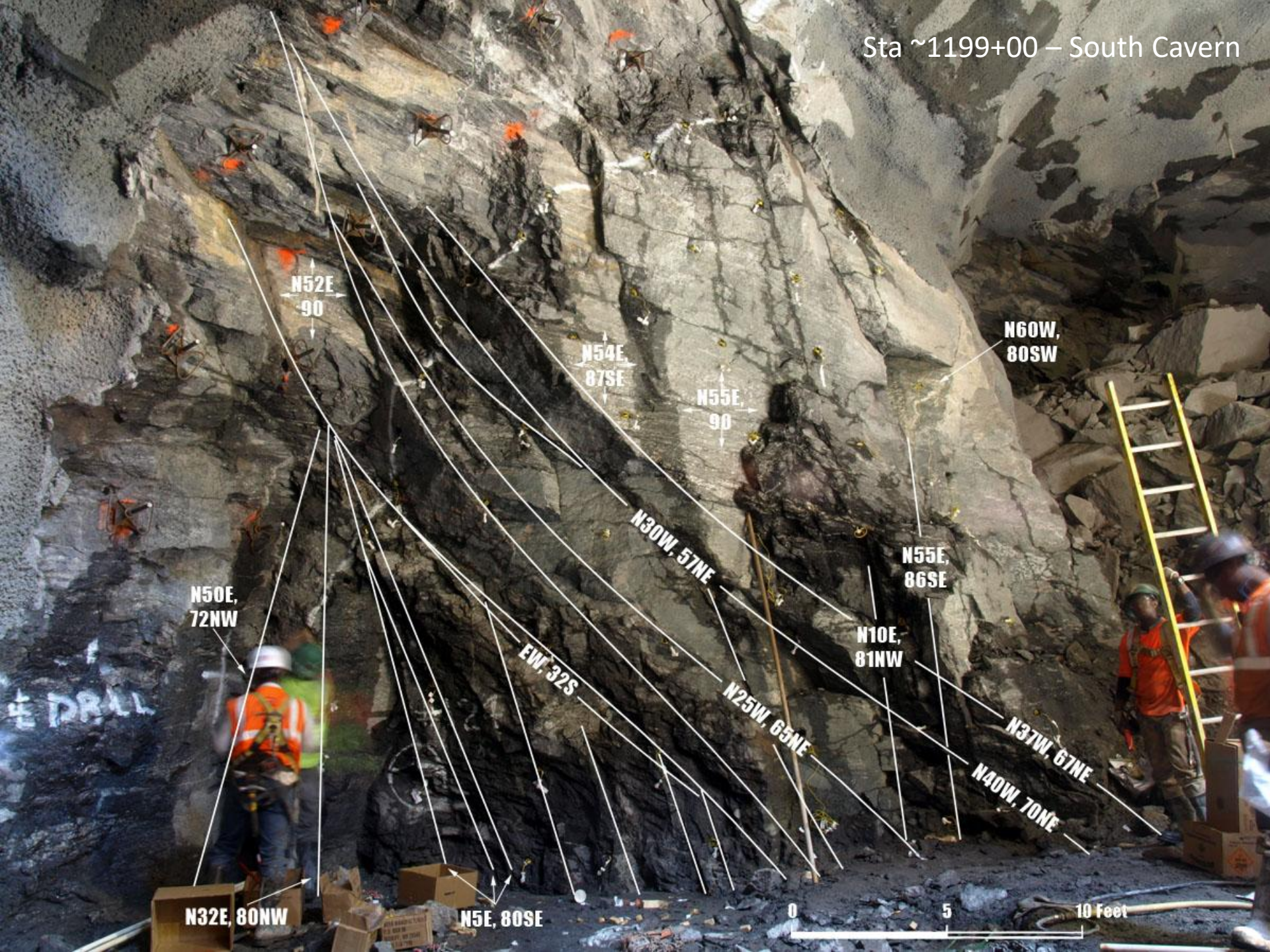


Sta ~1199+00 - South Cavern

0 5 10 Feet



Sta ~1199+00 – South Cavern





Second Avenue Subway

North Cavern





# Second Avenue Subway



01/23/2013

Finished North Ancillary and Public Cavern



# Second Avenue Subway



Unfinished Public Cavern

Sta 1203+95

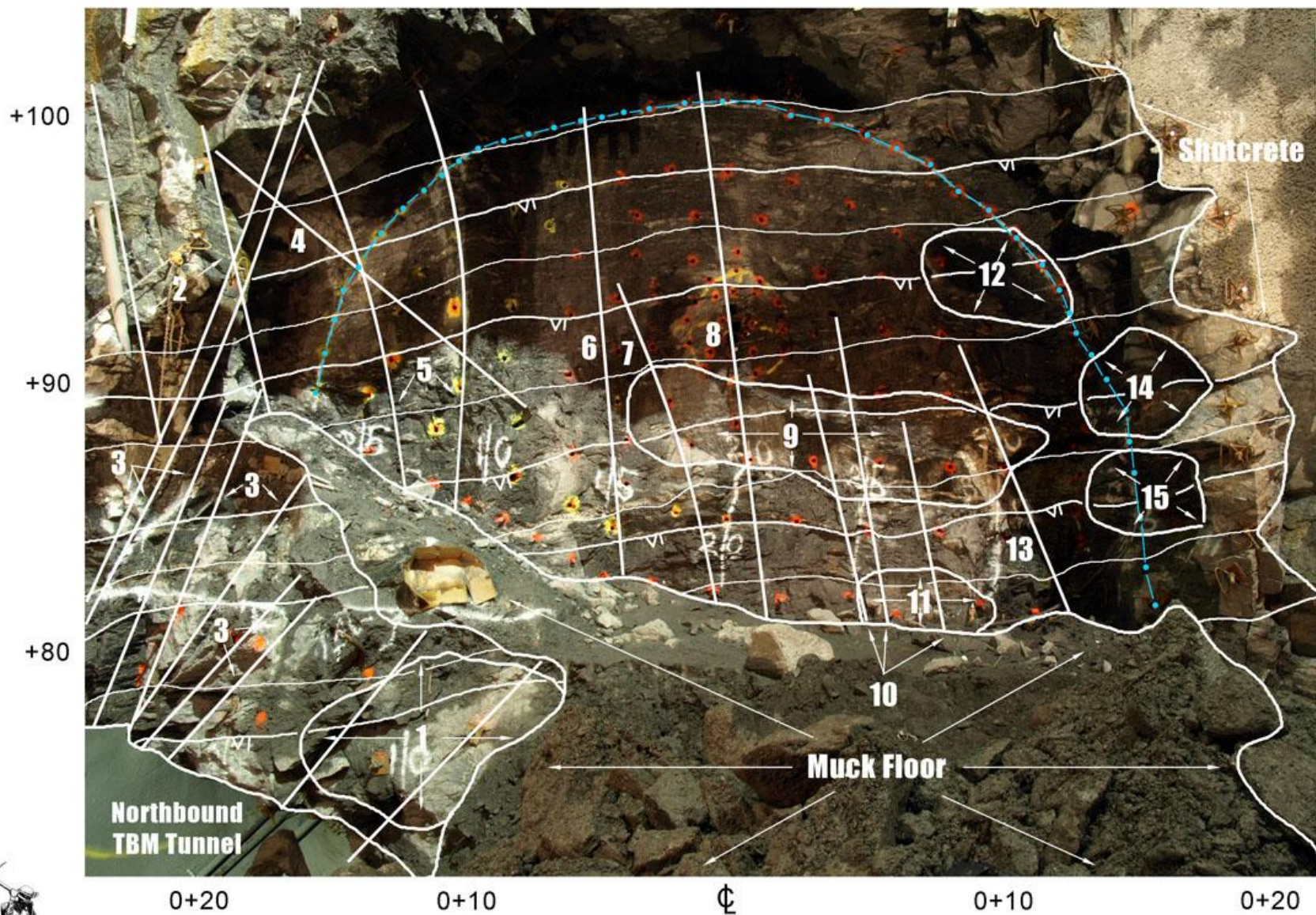


# Second Avenue Subway



Sta 1198+75 – CIR Room





**Duke Geological Lab**  
 Westbury, NY 11590  
 (516) 280-7144  
 www.dukelabs.com

← Stationing in Feet East and West of Second Avenue Centerline →

— = Perimeter Drill Holes of CIR room

Mapped 28 February 2013



# Second Avenue Subway

**CIR Room Floor**  
**Elev. = +81.5'**

Sta 1198+75 – CIR Room



**Second Avenue Subway**

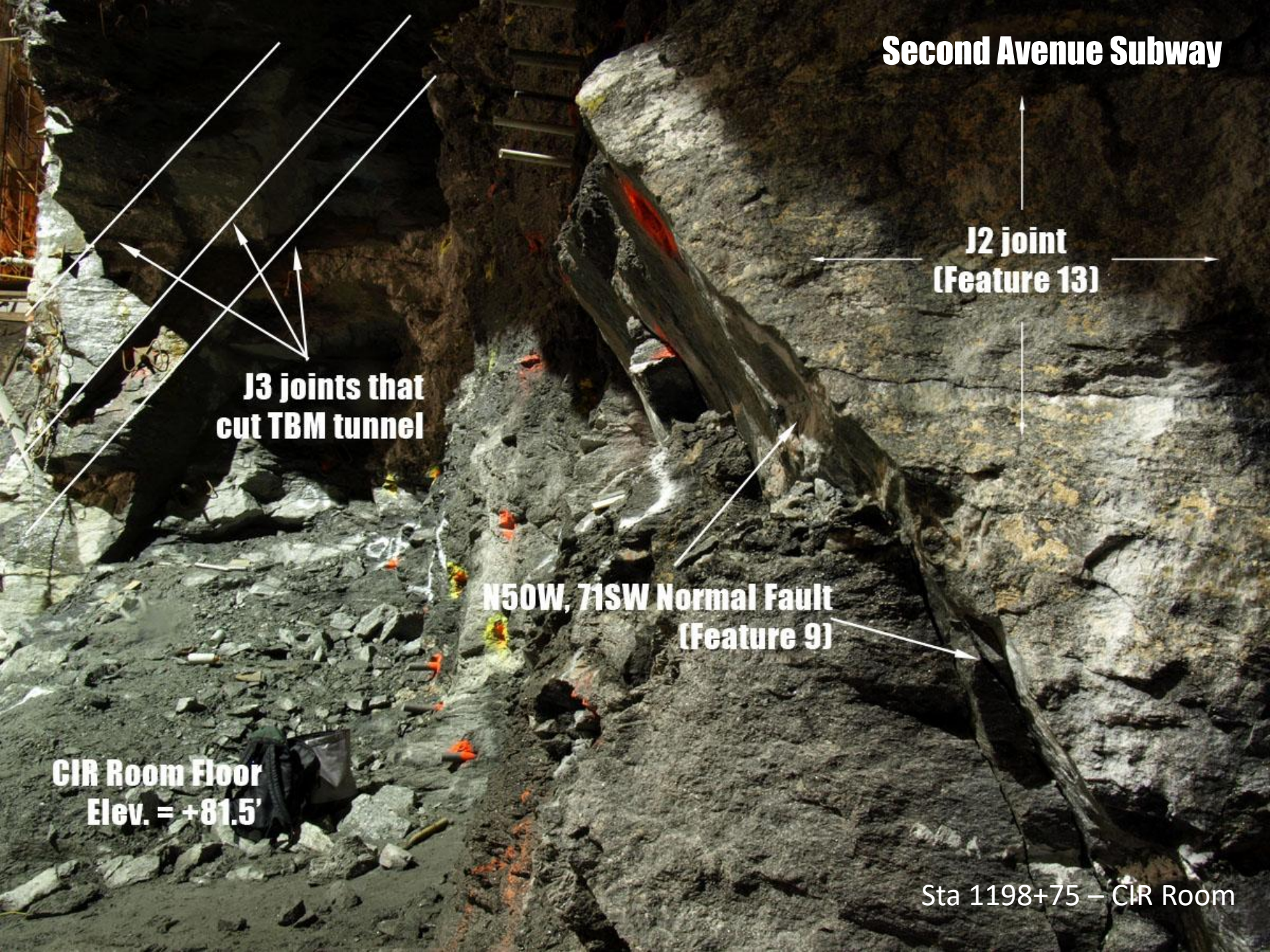
**J2 joint  
[Feature 13]**

**J3 joints that  
cut TBM tunnel**

**N50W, 71SW Normal Fault  
[Feature 9]**

**CIR Room Floor  
Elev. = +81.5'**

**Sta 1198+75 – CIR Room**

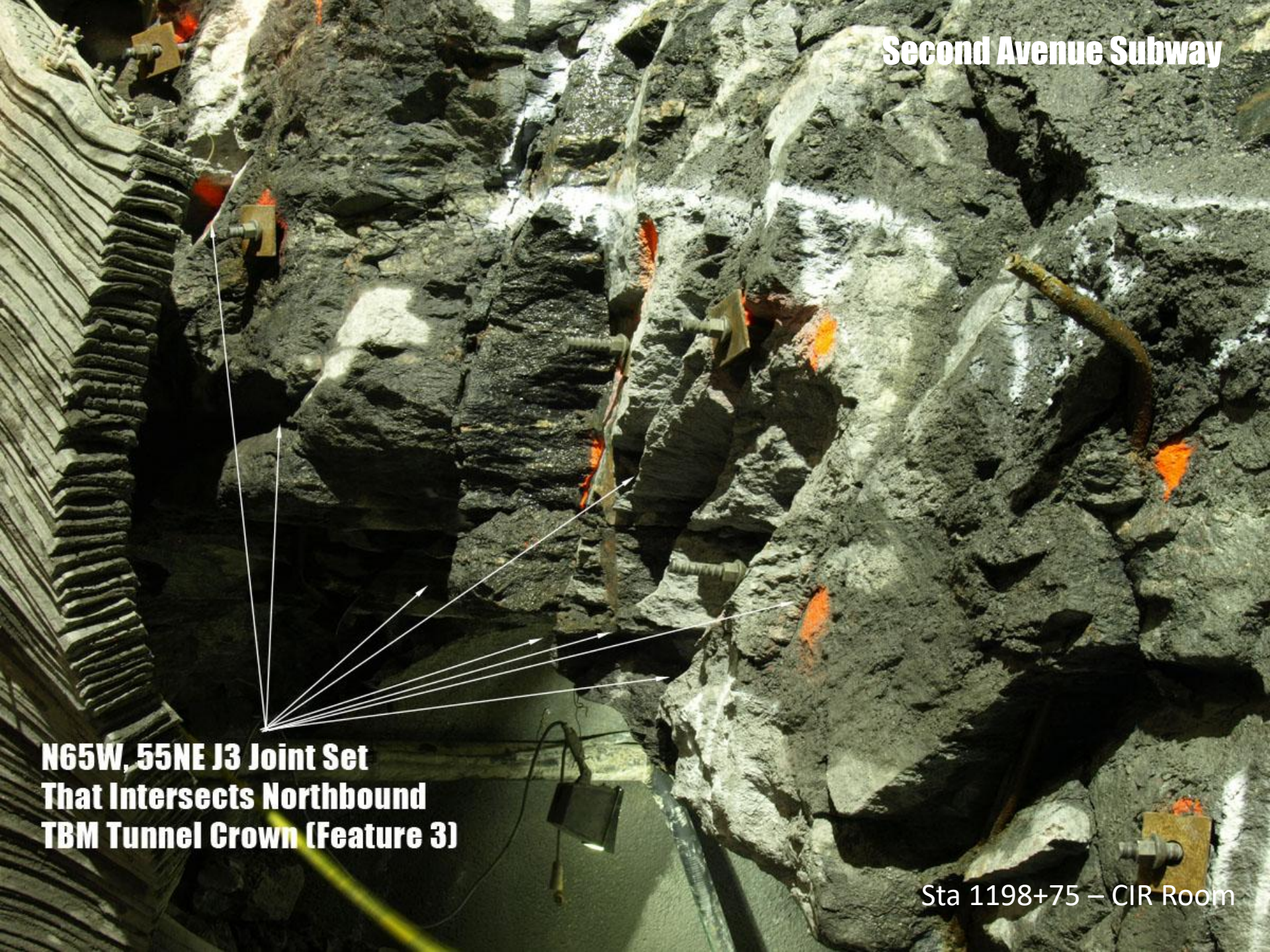




**Second Avenue Subway**

**N65W, 55NE J3 Joint Set  
That Intersects Northbound  
TBM Tunnel Crown (Feature 3)**

**Sta 1198+75 – CIR Room**





# Second Avenue Subway



Sta ~1205+00 – North Cavern



## Second Avenue Subway

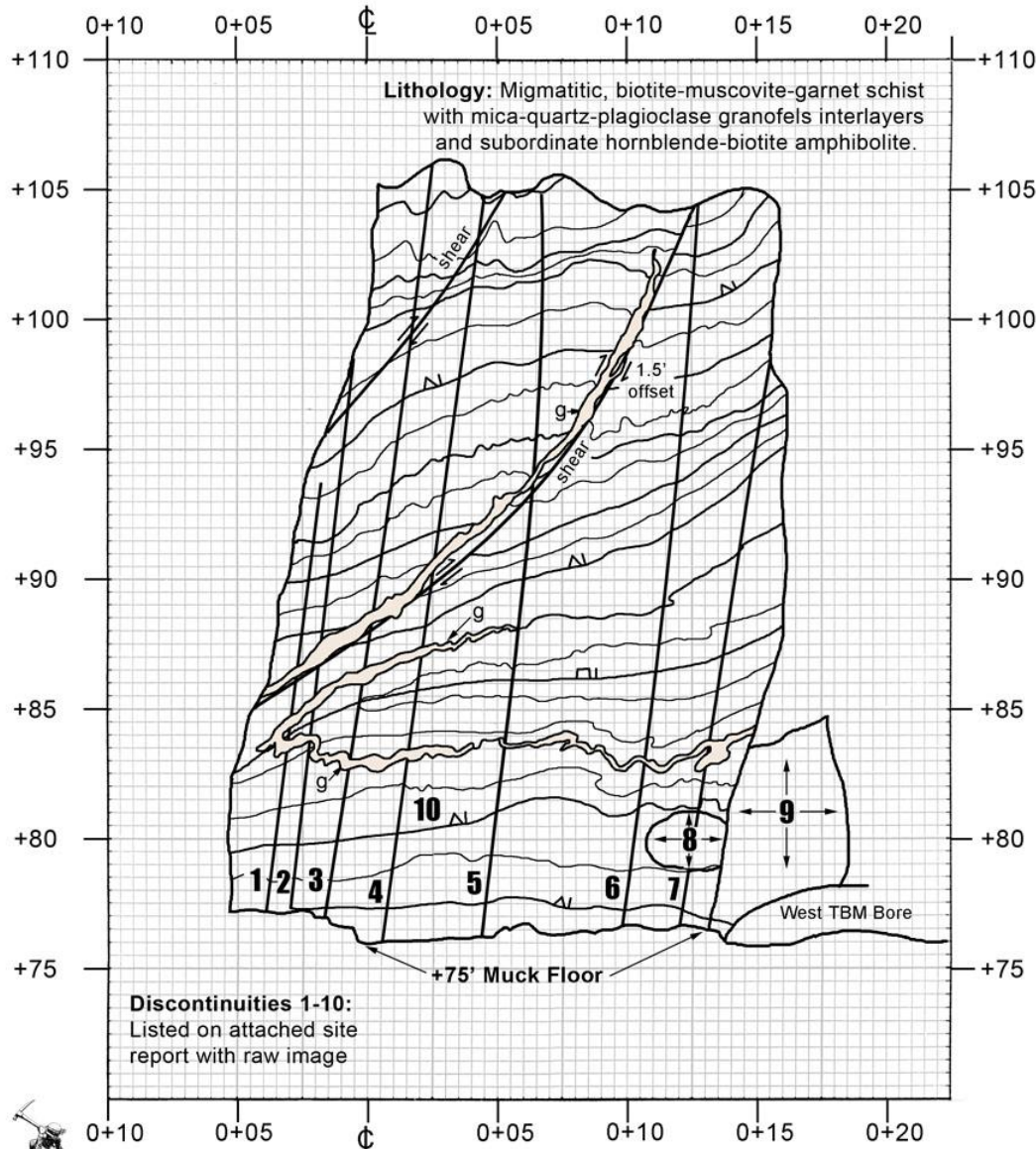


Sta 1204+90  
North Cavern Center Slash



**Second Avenue Subway - North Cavern Center Slash**  
**Working Face at Sta. 1204+90; Elev. +75' to +108'**

# Second Avenue Subway



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Mapped 19 December 2012

**Sta 1204+90**  
**North Cavern Center Slash**



# Second Avenue Subway



Sta ~1205+00 – North Cavern



## Second Avenue Subway

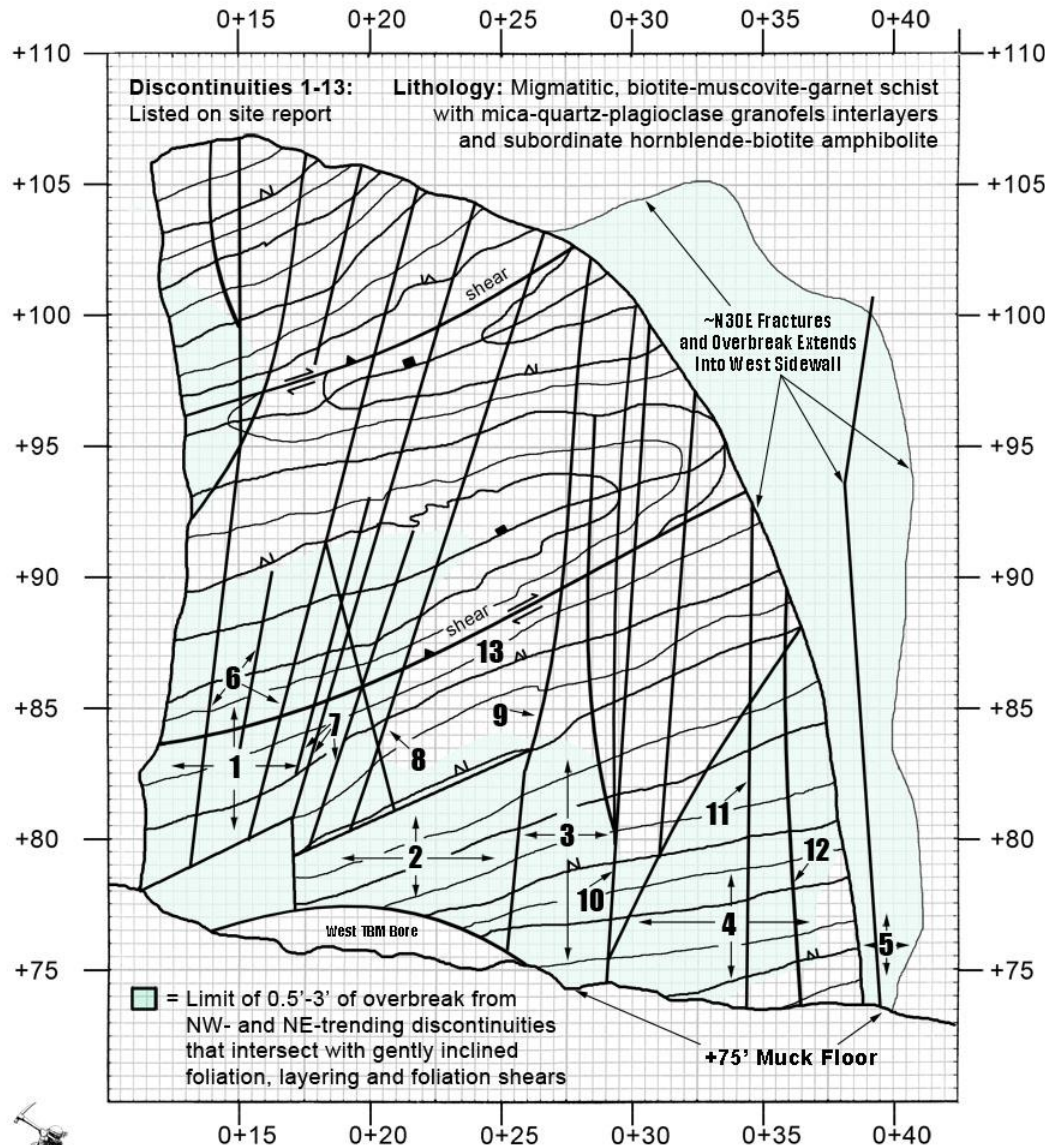


Sta 1205+10 – North Cavern



**Second Avenue Subway - North Cavern West Slash  
Working Face at Sta. 1205+10; Elev. +75' to +105'**

# Second Avenue Subway



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**Stationing in Feet West of Second Avenue Centerline** →

Mapped 19 December 2012

**Sta 1205+10 – North Cavern**



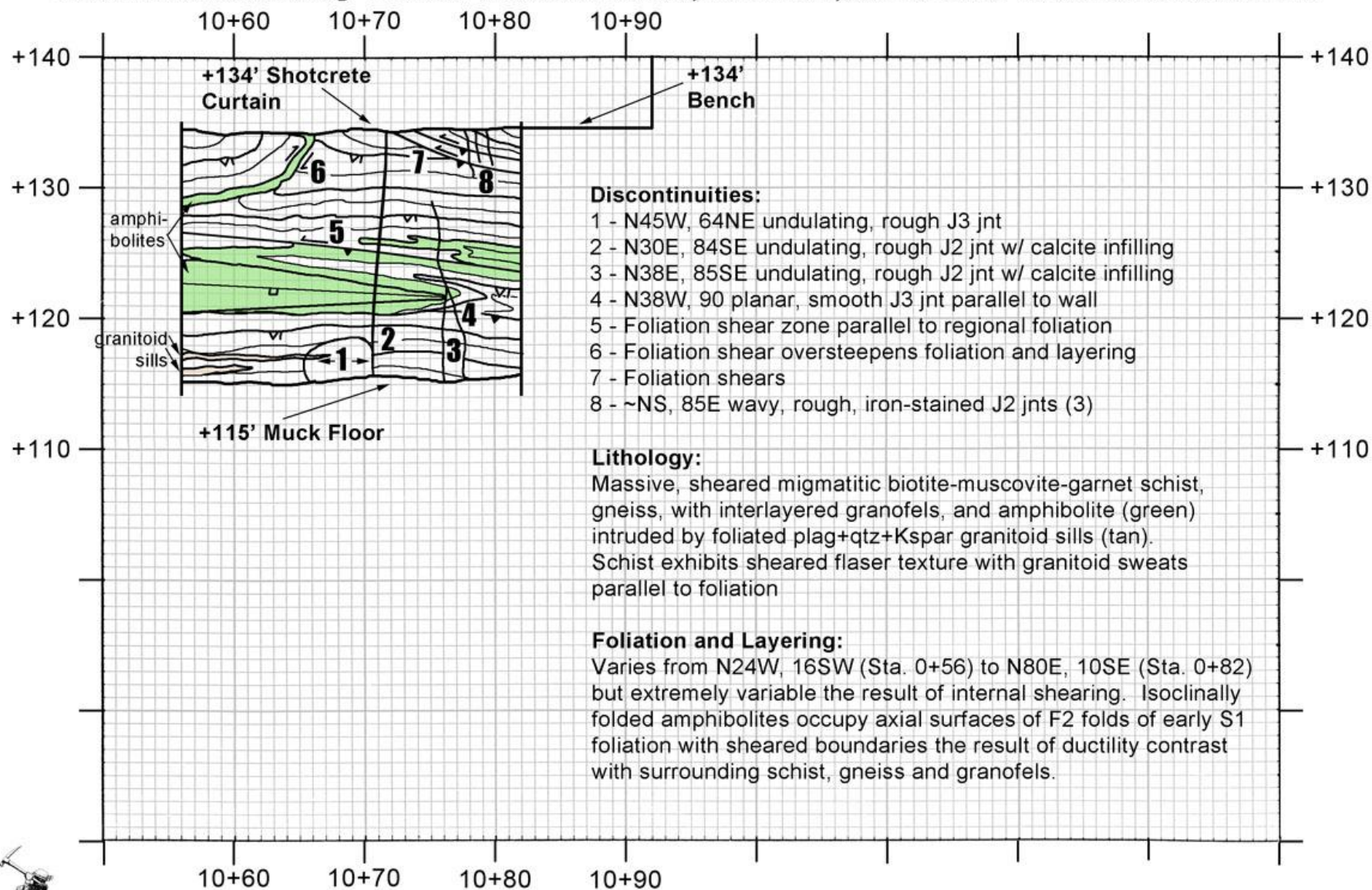
# Second Avenue Subway



Sta 1205+10 – North Cavern



# Second Avenue Subway - Elevator Shaft 86th Street, North Wall, Sta. 10+56 to 10+82 East of Centerline



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Stationing in Feet East of 86th Street Centerline →

Sta 1206+62 – Elevator Shaft

Mapped 21 January 2013



# Second Avenue Subway



Sta 1206+62 – Elevator Shaft



**Second Avenue Subway**



Sta 1206+62 – Elevator Shaft



Second Avenue Subway

Second Avenue Subway  
86<sup>th</sup> Street Station Complex  
Ancillary #2

06 Nov 2012



**Second Avenue Subway  
86th Street Ancillary #2  
Southward View of South Wall  
Elevation +155' to +133'**

**Plate 2**



Sta 1207+07 – Ancillary #2



0+90      0+80      0+70      0+60      0+50      0+40      0+30      0+20      0+10



### Dislocations:

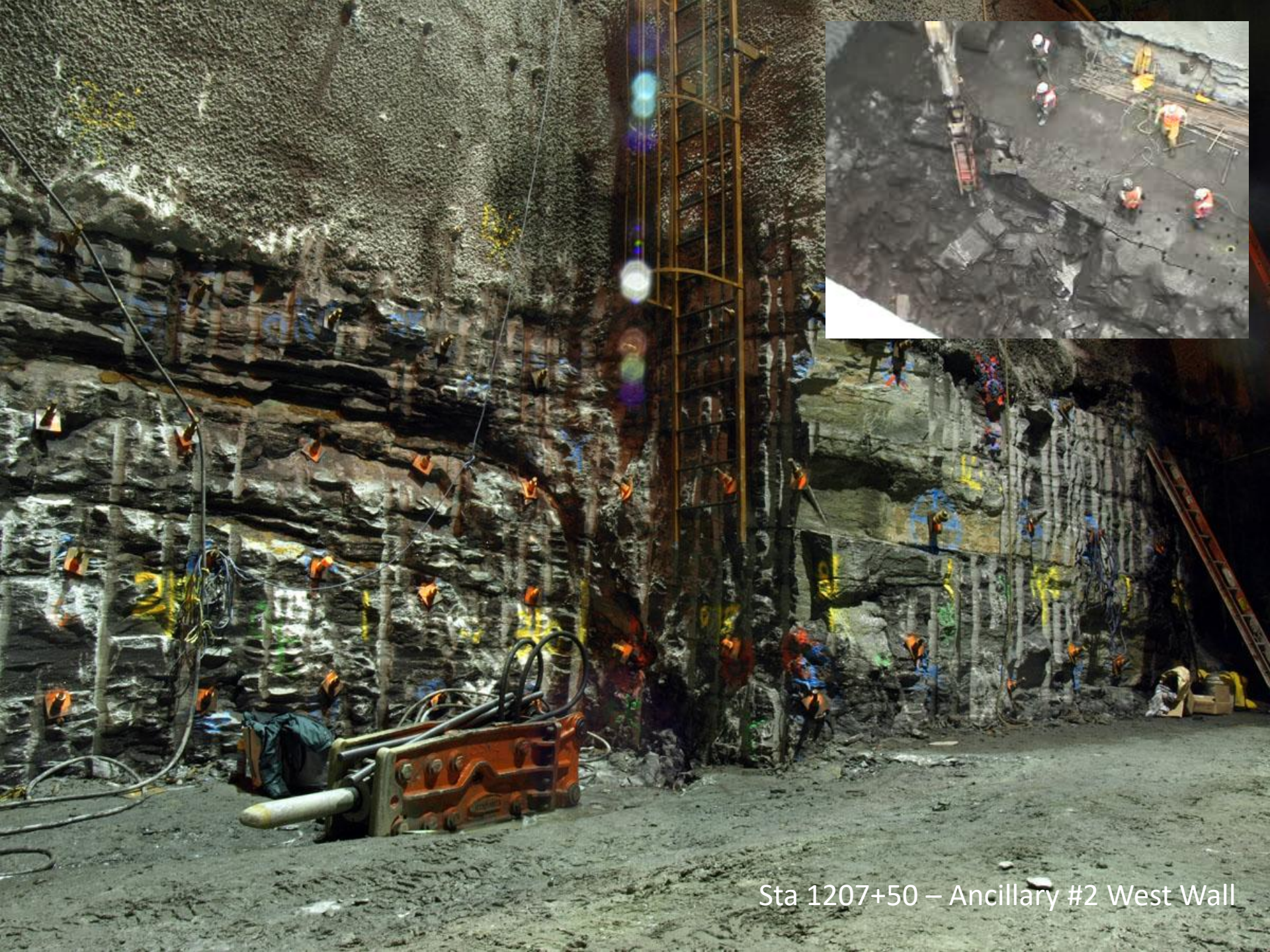
- 1 - N32E, 76SE, planar, rough jnt
- 2 - N35E, 90, planar, rough jnt
- 3 - N34E, 88SE, planar, rough jnt
- 4 - N31E, 85SE, planar, rough jnt
- 5 - N35E, 85NW, planar, rough flt
- 6 - N36E, 90, planar, rough flt
- 7 - N35E, 87SE, planar, rough flt

**← Stationing in Feet North Along East Wall**  
**(Map Drawn Parallel to Sta 0+50 West of Second Avenue Centerline)**

Mapped 21 November 2012







Sta 1207+50 – Ancillary #2 West Wall



# Second Avenue Subway



Sta 1207+50 – Ancillary #2 West Wall









F<sub>3</sub>

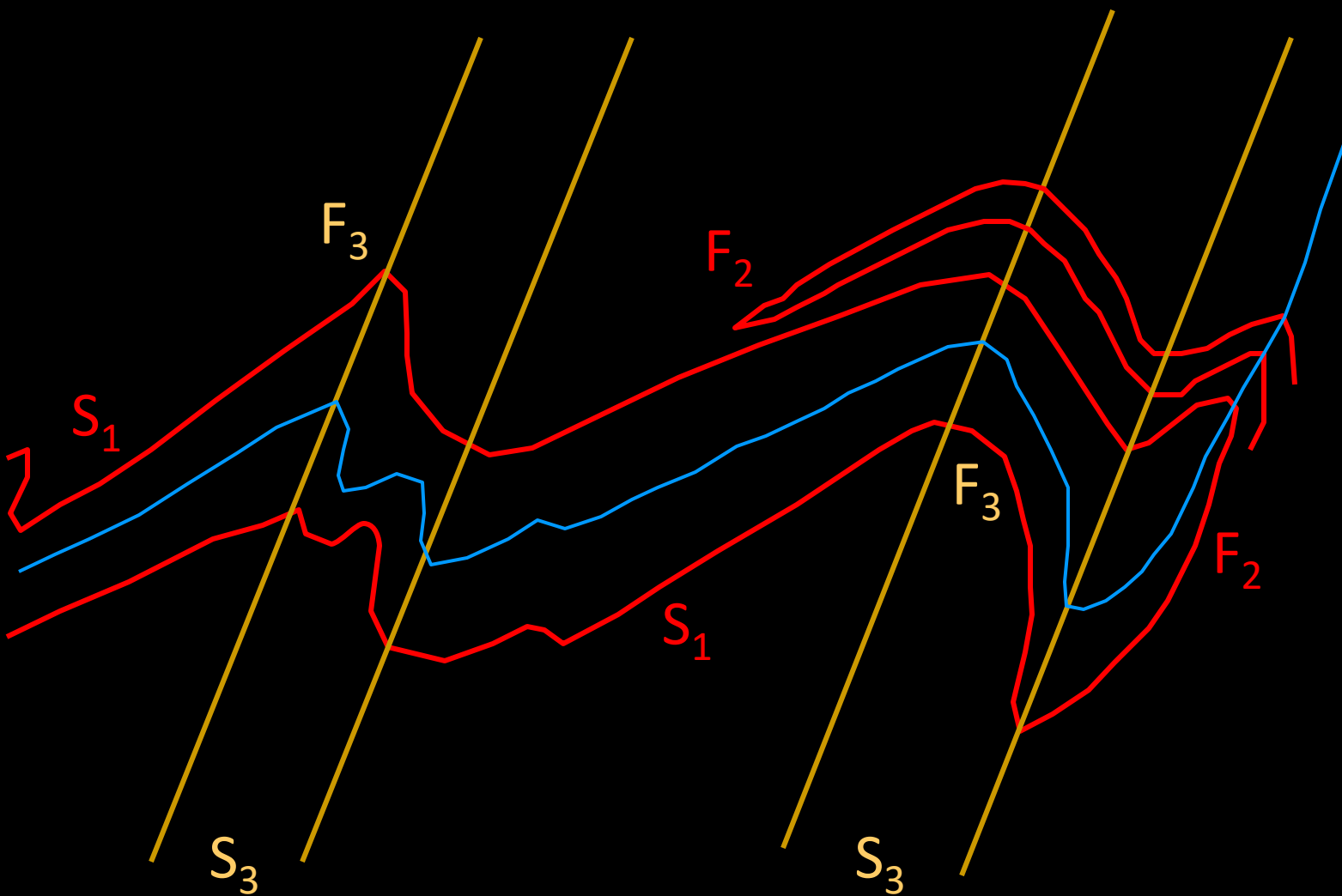
Polydeformed Bedrock – Central Park, NYC





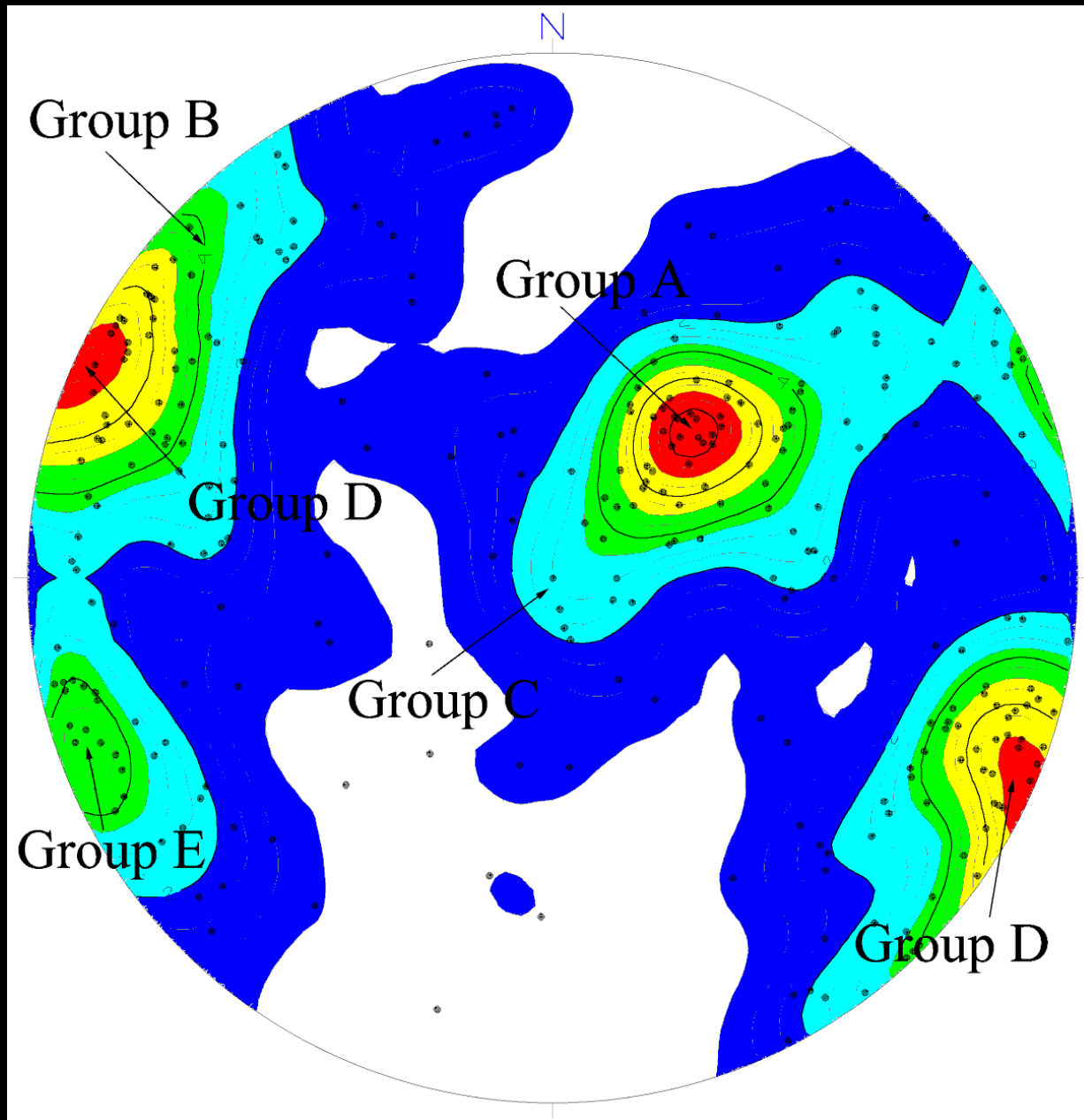
Polydeformed Bedrock – Central Park, NYC



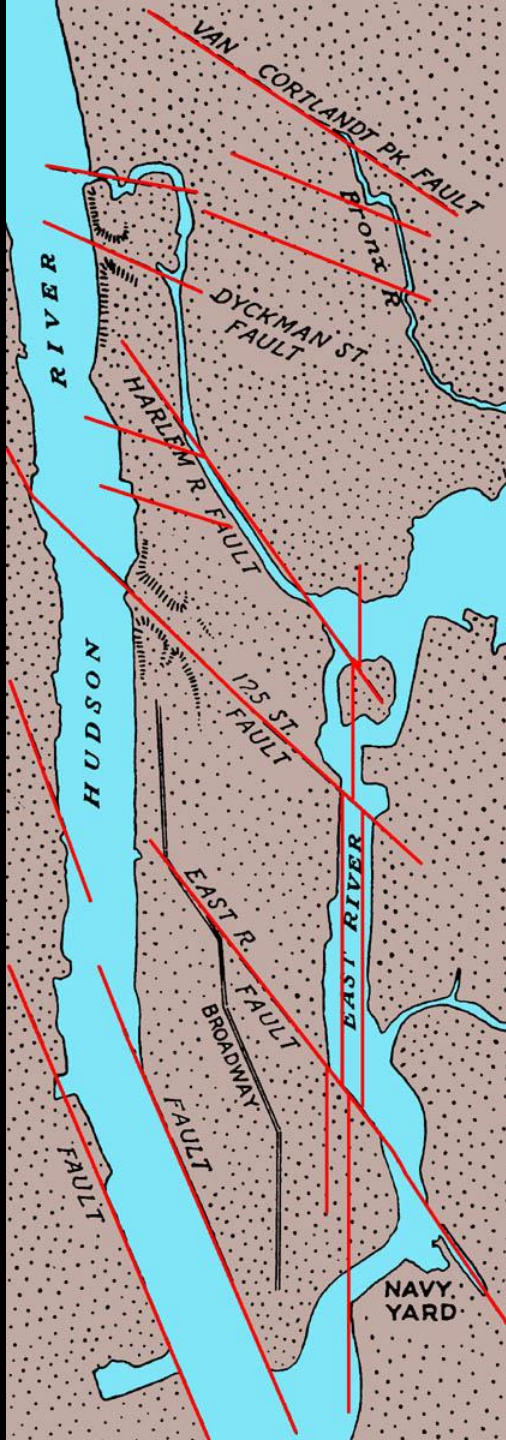




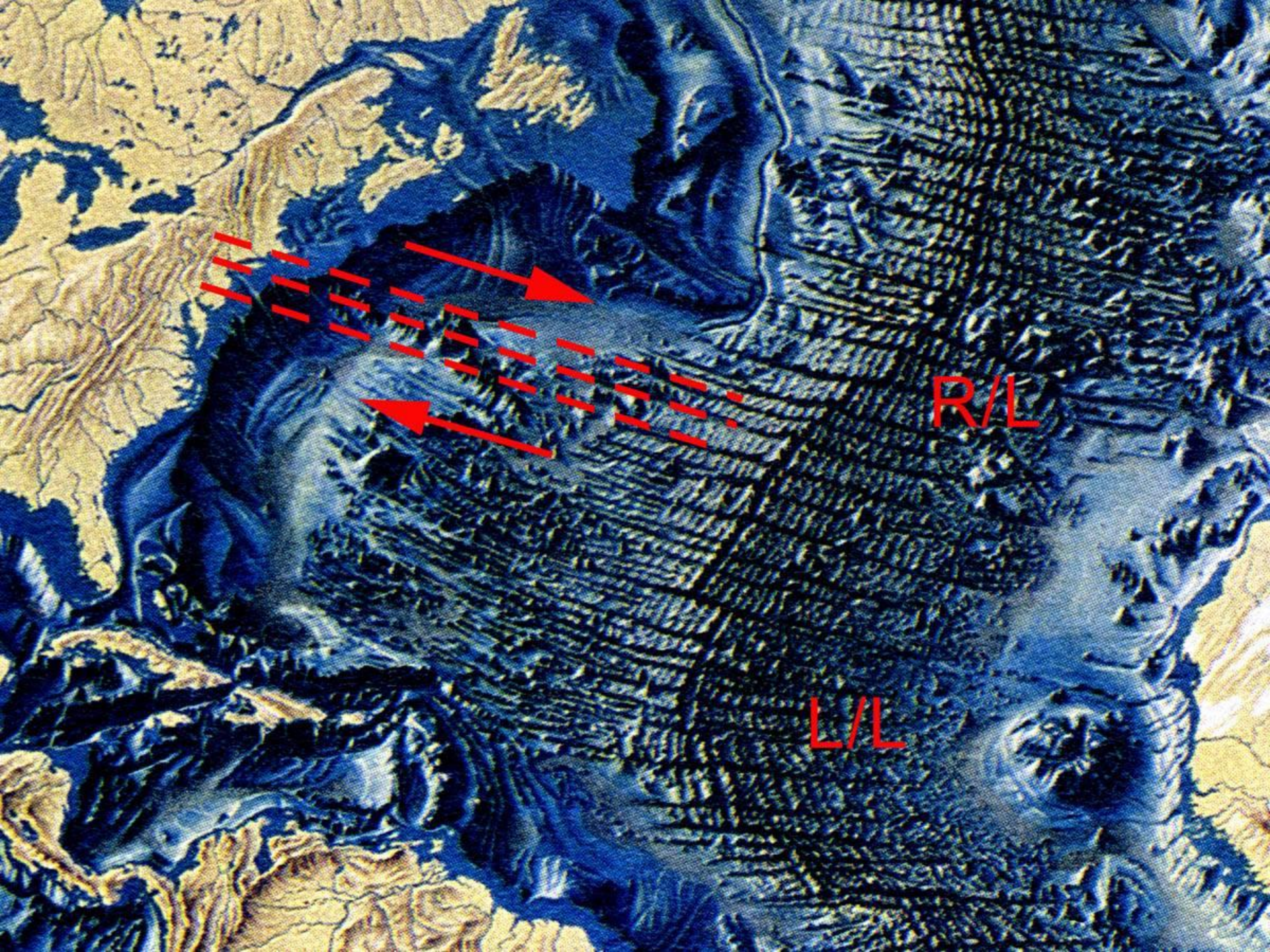
# NYC Faults and Joints











R/L

L/L



OK, That's It! I've Heard Enough!



H. Manne