Mineralogy and Geochemistry of the Alluvium in the Fortymile Wash Region South of Yucca Mountain, Nevada

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Background

- A portion of the likely groundwater flow path from the proposed repository at Yucca Mountain consists of the saturated alluvial sediments of Fortymile Wash
- Performance assessment models indicate that the alluvium may serve as an important barrier to radionuclide transport
- Characterization of the alluvium is not yet complete

Background

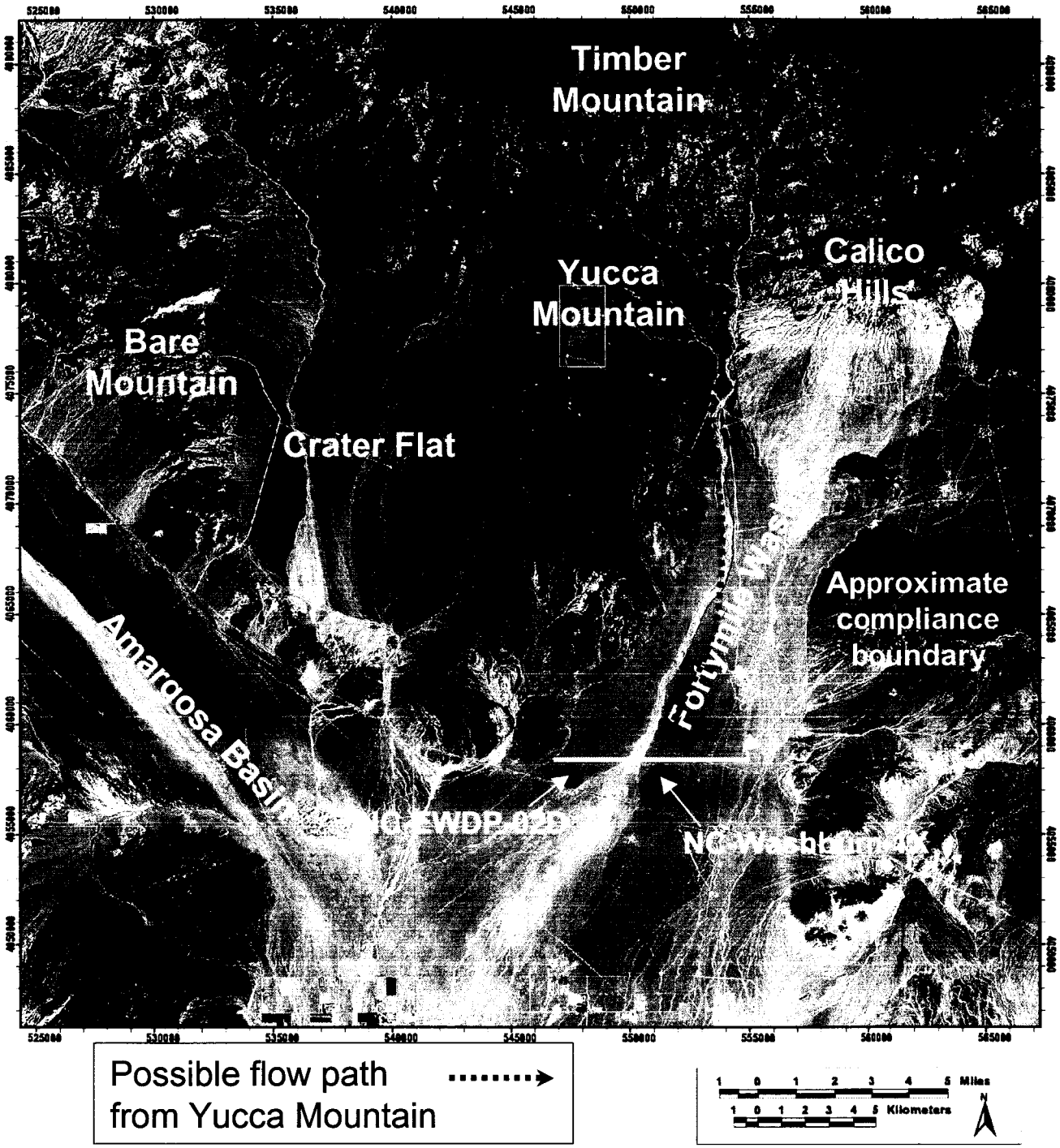
- The Early Warning Drilling Program (EWDP) was established by Nye County in FY1999
- DOE, its contractors, and other interested parties have participated in Nye County's EWDP activities
- EWDP activities have made significant positive contributions to the characterization and understanding of the saturated alluvium

Purpose

- Conduct mineralogic and chemical analyses on samples collected from selected EWDP wells within Fortymile Wash
- Use the analytical results to inform and evaluate parameters used to represent alluvium retardation in performance assessment models
- Test and confirm observations made from studies of Fortymile Wash stratigraphy and EWDP cuttings and water samples

Methods

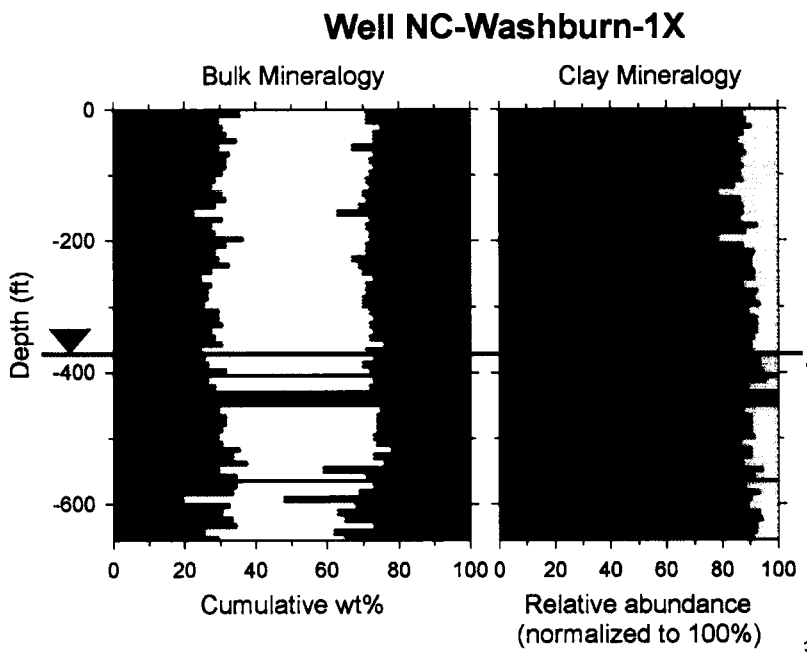
- Well cuttings from two EWDP Wells, NC-EWDP-02D and NC-Washburn-1X were obtained from the DOE Sample Management Facility
- Cuttings were sieved to facilitate petrographic analyses
  - Large grains or aggregates retained on No. 10 sieve (2.0 mm) used for thin section and SEM analyses
  - Grains retained passing through No. 35 sieve (0.5 mm) used for bulk XRD, XRF, and ICP-MS
  - Bulk and clay fractions processed for XRD

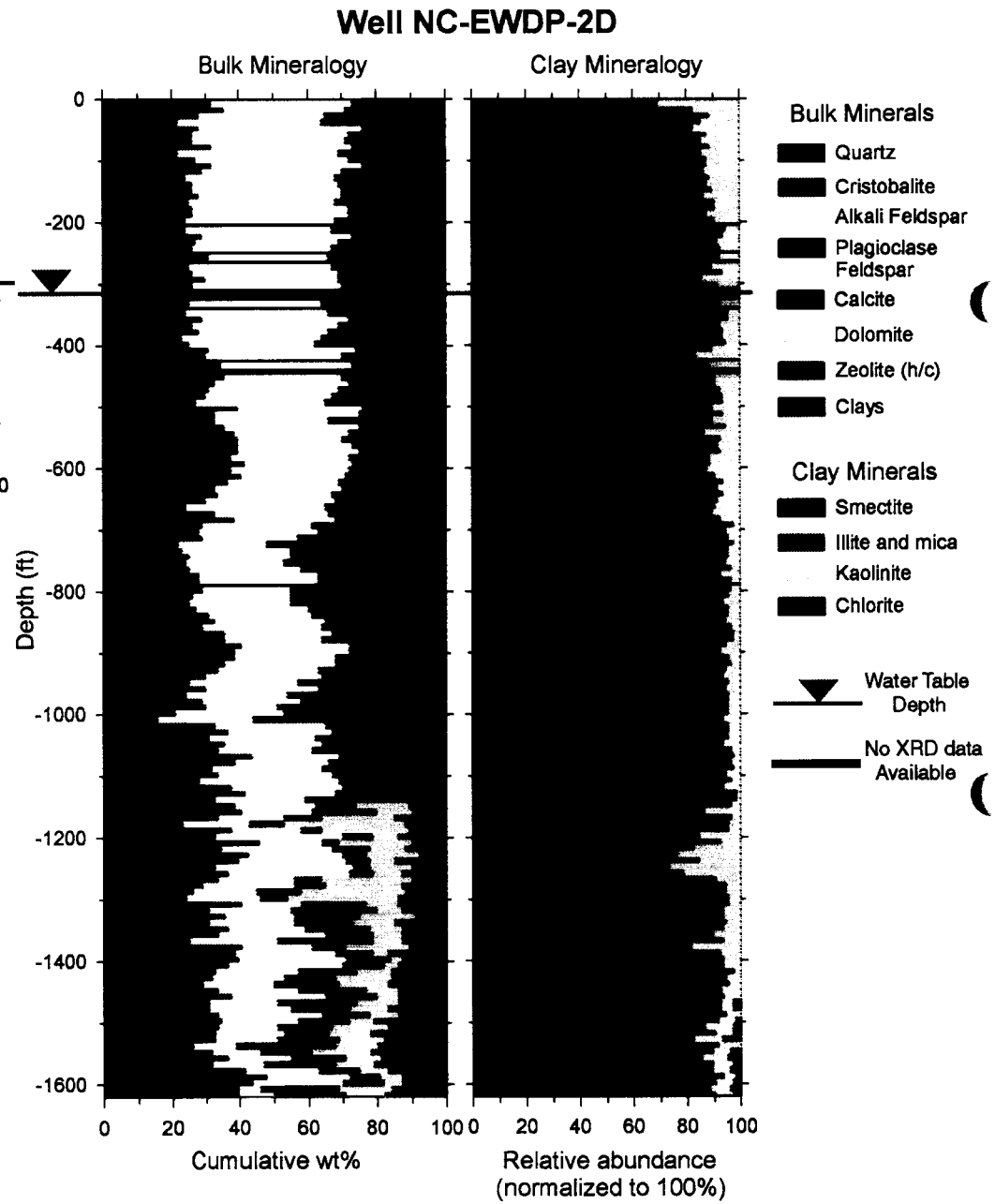


Location of Boreholes Relative to Possible Saturated Zone Flow Paths

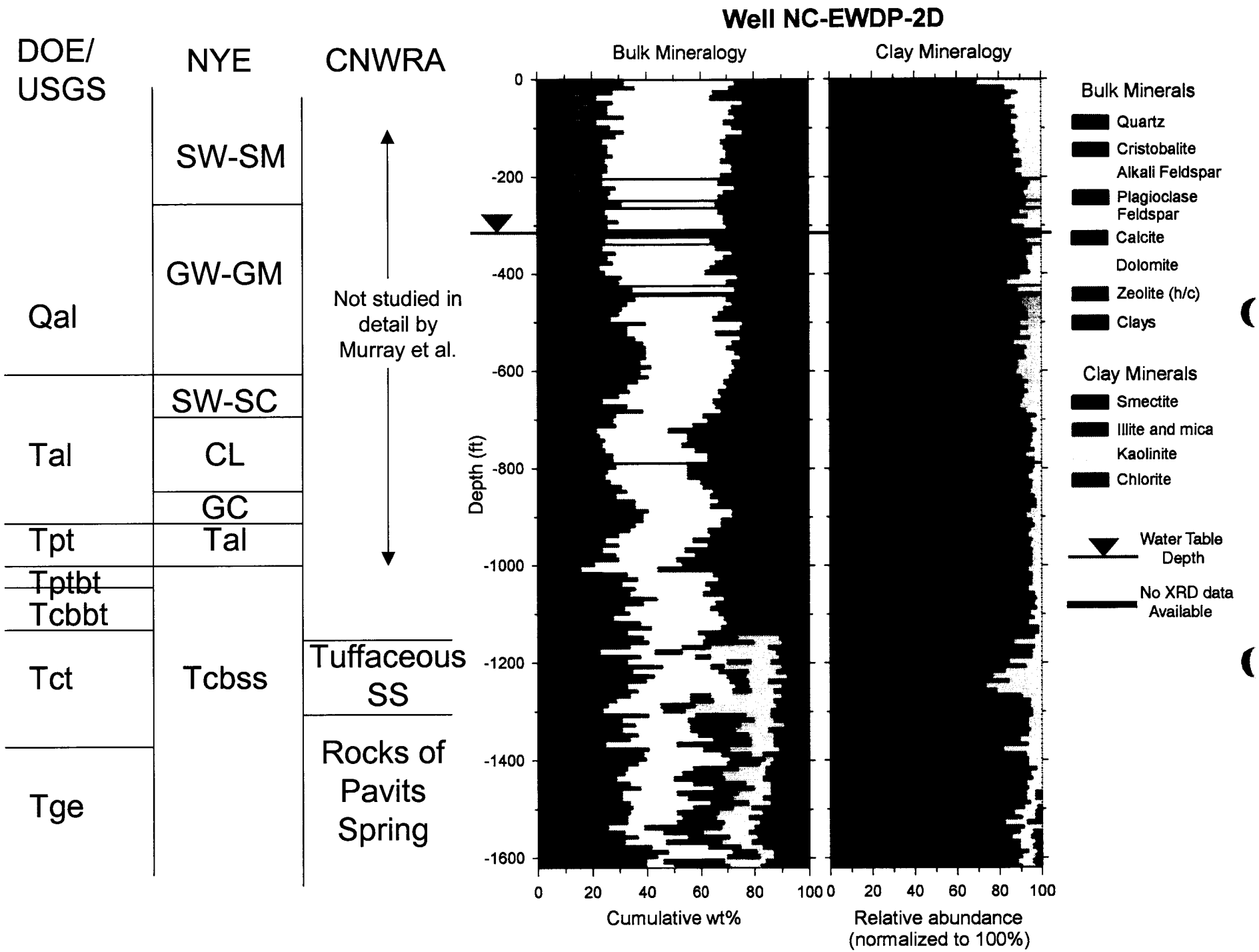
- Expected direction of flow is predominantly toward the south
- Flow expected in fractured volcanic rock and alluvium
- Some uncertainty in the length of the alluvium portion of the flow path

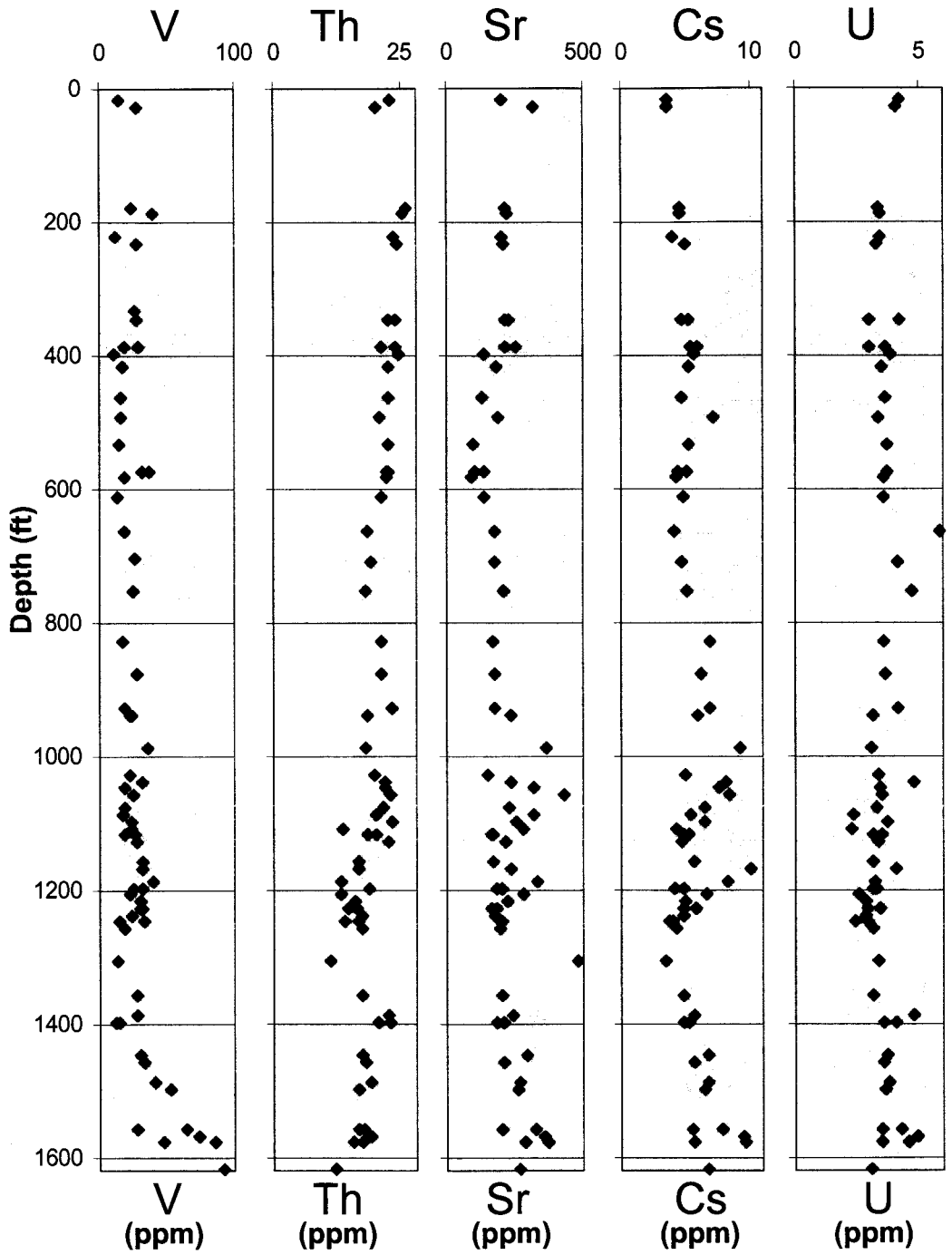
XRD Results

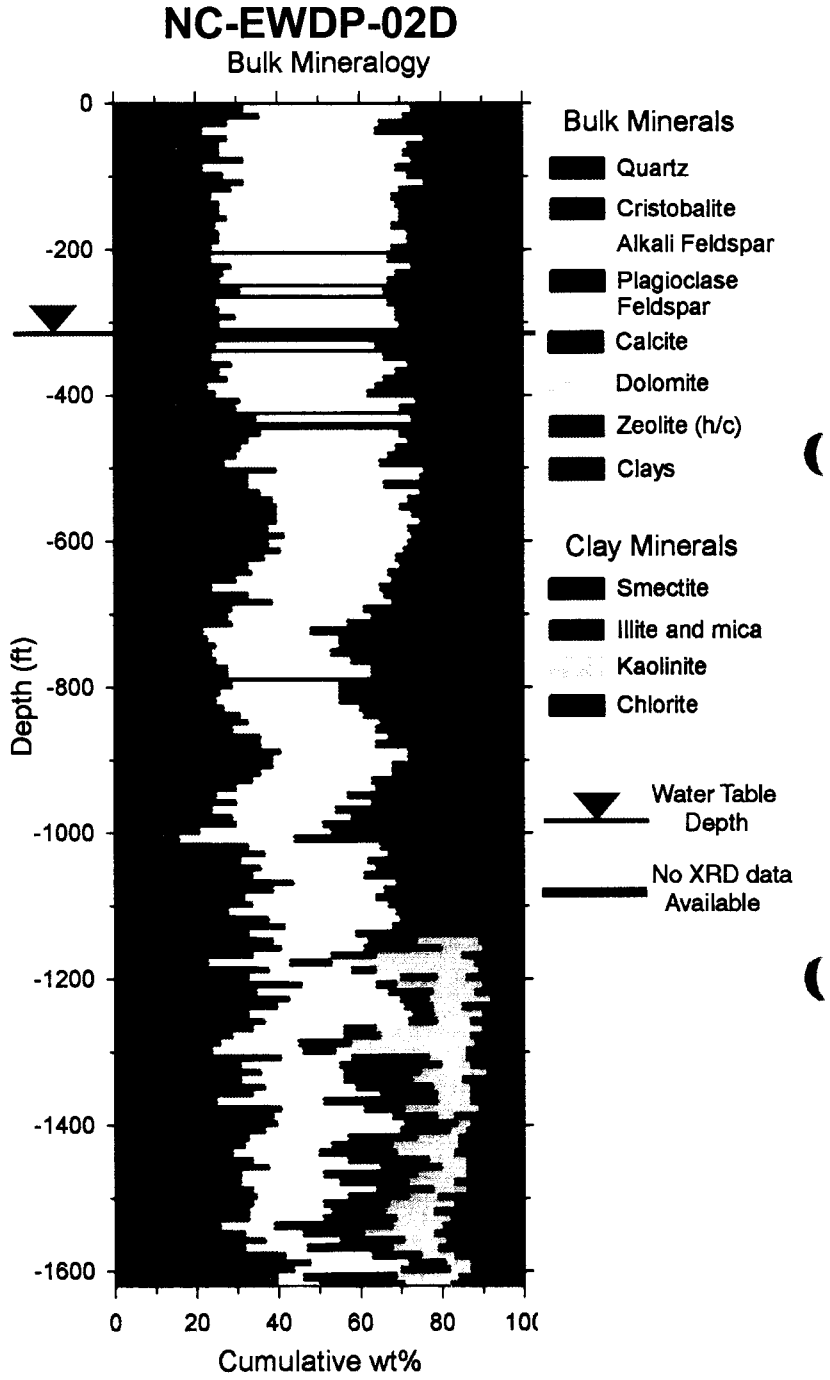




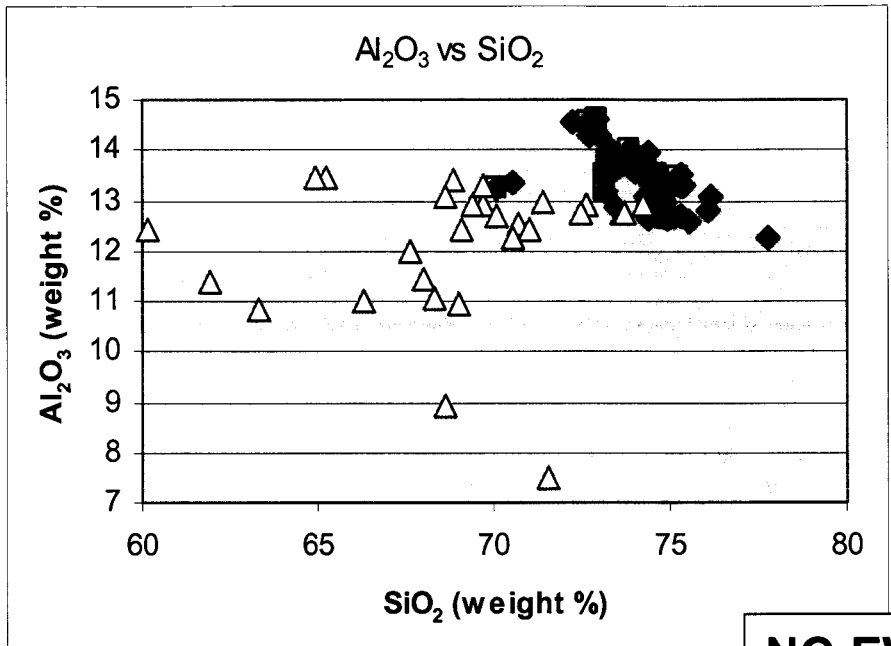
- Comparison of mineralogy for wells NC-Washburn-1X and NC-EWDP-02D

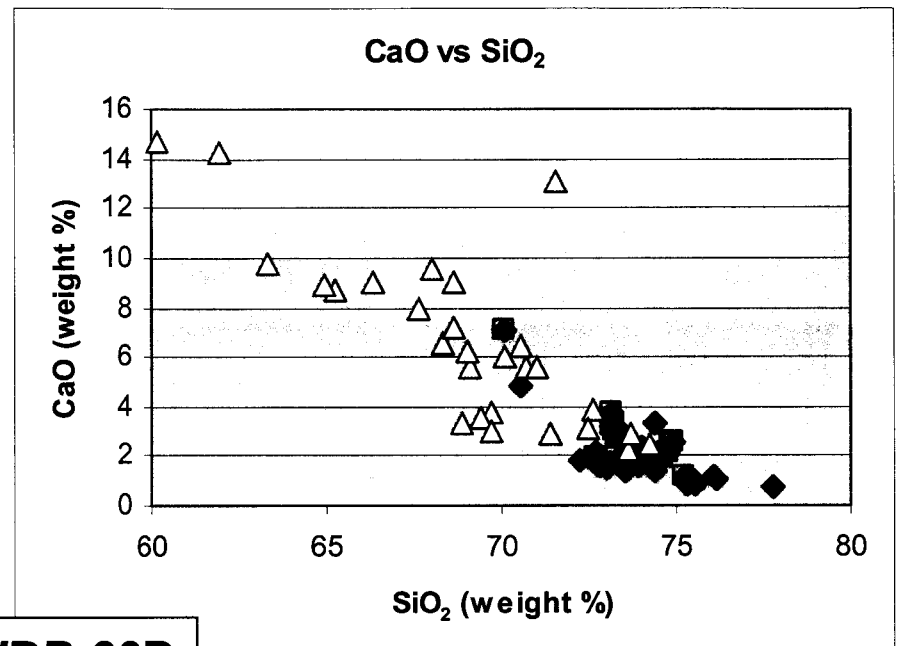

Well NC-EWDP-2D
DOE/ USGS
NYE
CNWRA
Bulk Mineralogy
Clay Mineralogy
Qal
Tal
Tpt
Tptbt
Tcbbt
Tct
Tge
SW-SM
GW-GM
SW-SC
CL
GC
Tal
Tcbss
Not studied in detail by Murray et al.
Tuffaceous SS
Rocks of Pavits Spring
Depth (ft)
0
-200
-400
-600
-800
-1000
-1200
-1400
-1600
0 20 40 60 80 100
Cumulative wt%
Relative abundance (normalized to 100%)
Bulk Minerals
Quartz
Cristobalite
Alkali Feldspar
Plagioclase Feldspar
Calcite
Dolomite
Zeolite (h/c)
Clays
Clay Minerals
Smectite
Illite and mica
Kaolinite
Chlorite
Water Table Depth
No XRD data Available


V
Th
Sr
Cs
U
0
100
25
500
10
5
Depth (ft)
0
200
400
600
800
1000
1200
1400
1600
V (ppm)
Th (ppm)
Sr (ppm)
Cs (ppm)
U (ppm)

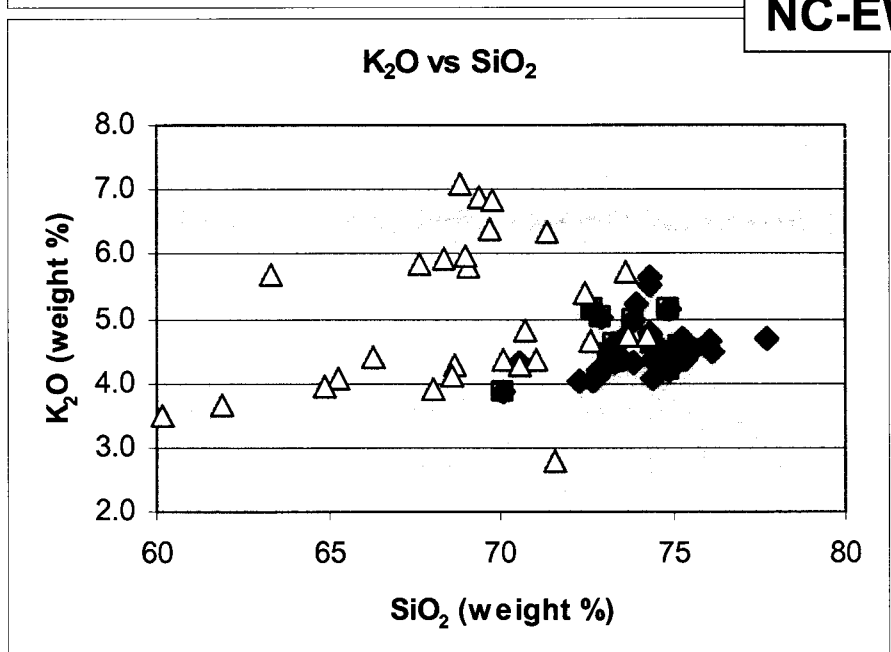

NC-EWDP-02D
Bulk Mineralogy
Depth (ft)
0
-200
-400
-600
-800
-1000
-1200
-1400
-1600
0
20
40
60
80
100
Cumulative wt%
Bulk Minerals
Quartz
Cristobalite
Alkali Feldspar
Plagioclase Feldspar
Calcite
Dolomite
Zeolite (h/c)
Clays
Clay Minerals
Smectite
Illite and mica
Kaolinite
Chlorite
Water Table Depth
No XRD data Available

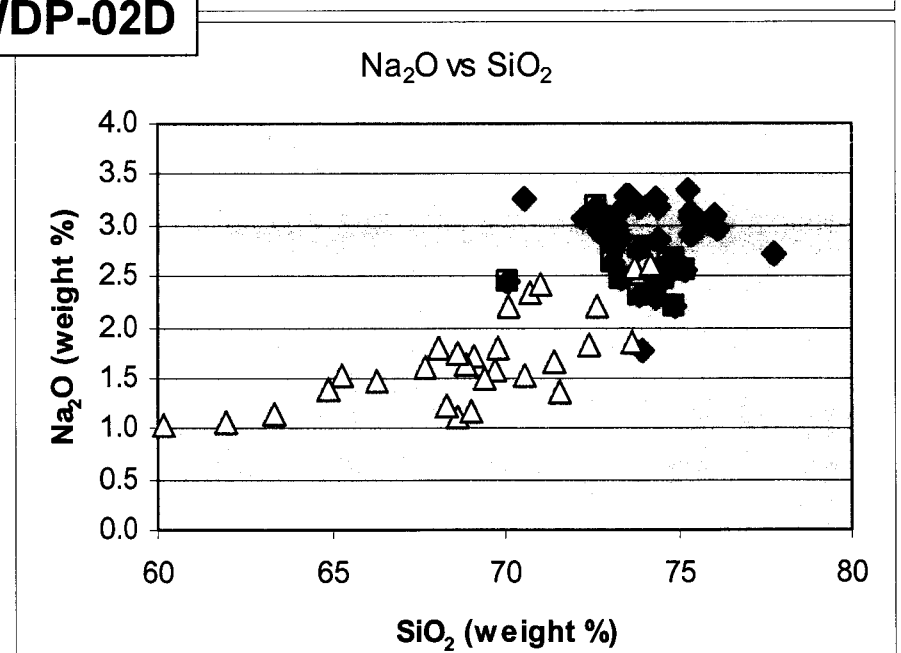
◆ Shallow (above 1150 feet) □ Zeolite rich (700-1150 feet) △ Deep (below 1150 feet)



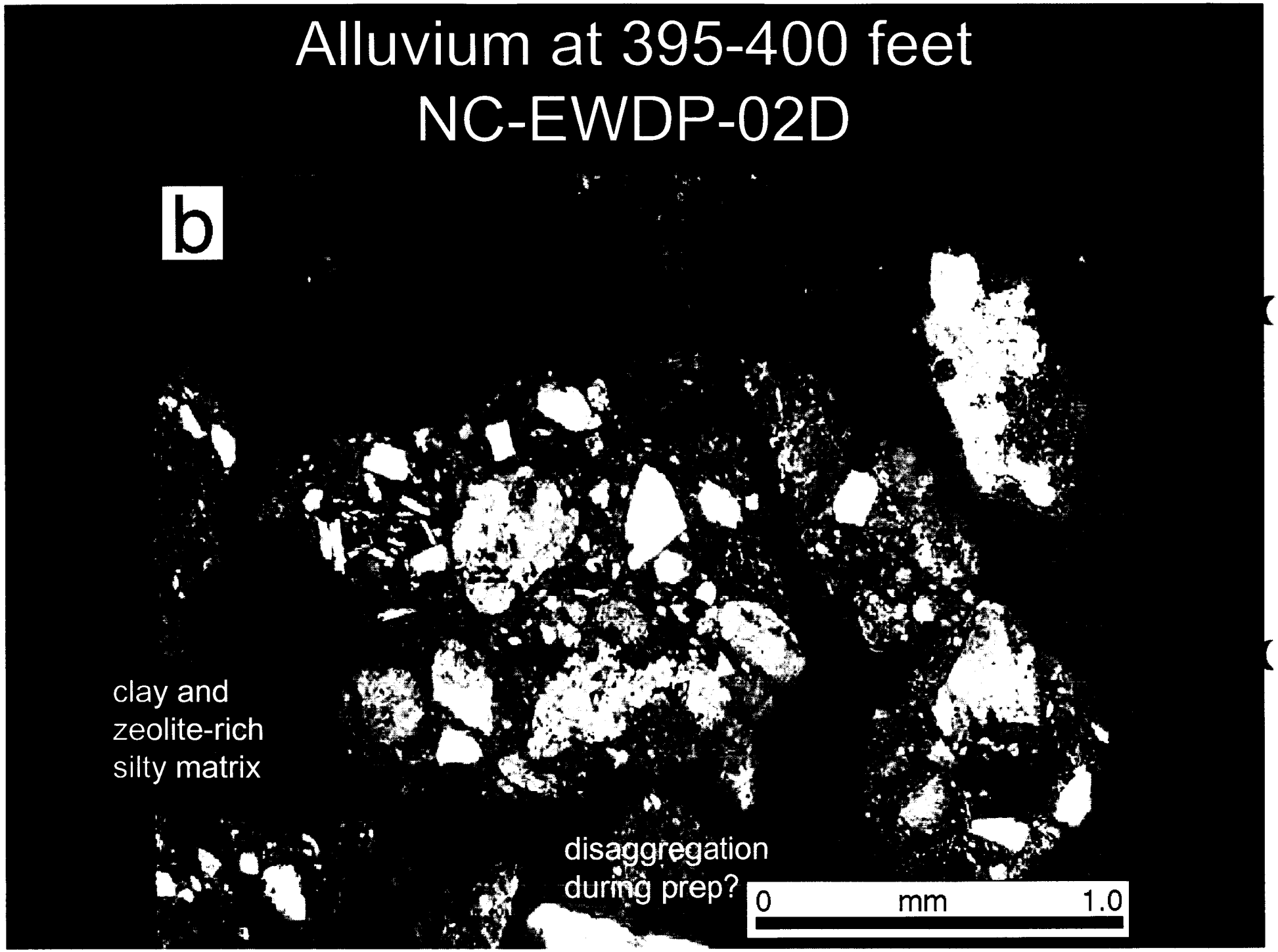


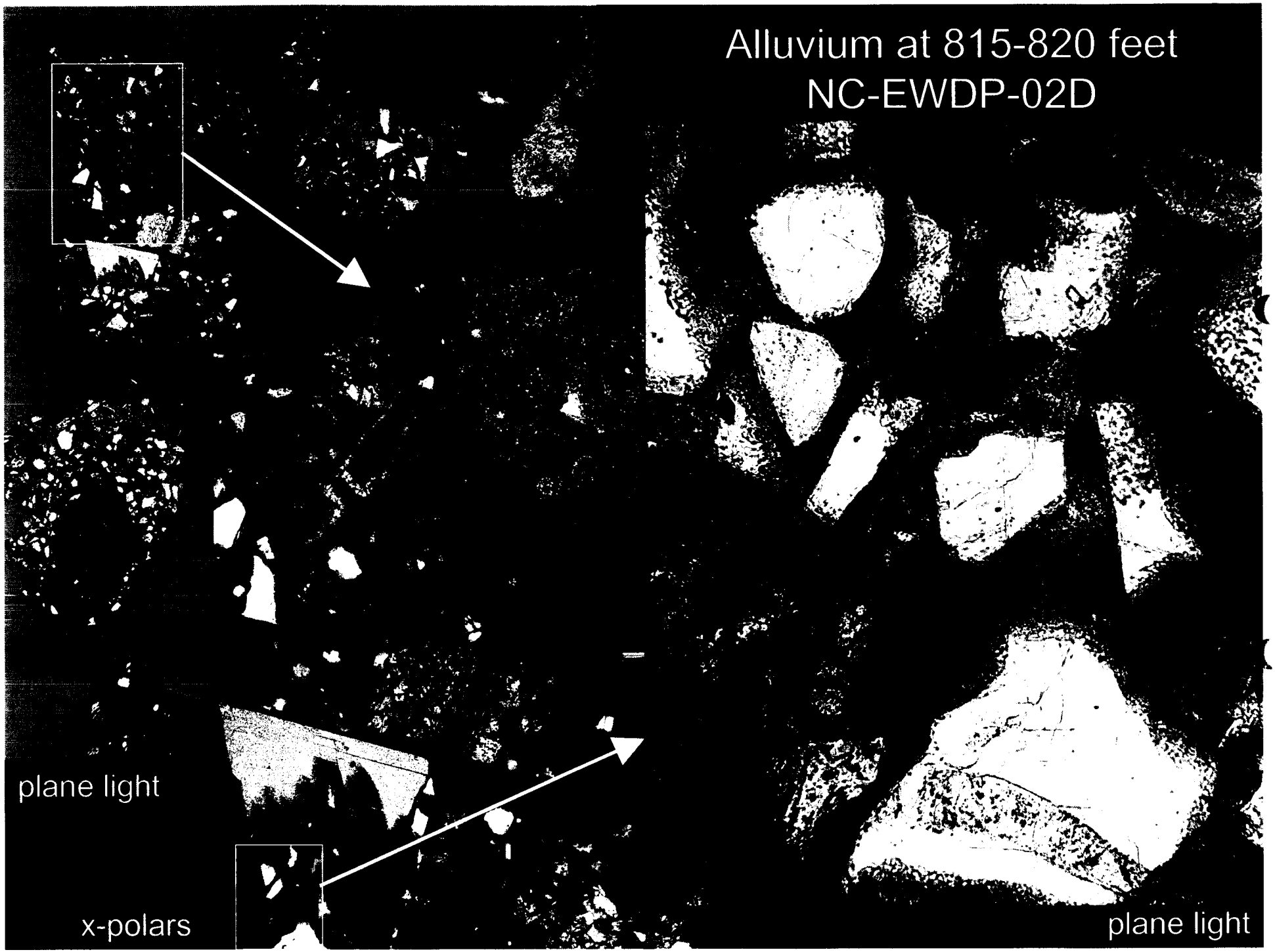
NC-EWDP-02D

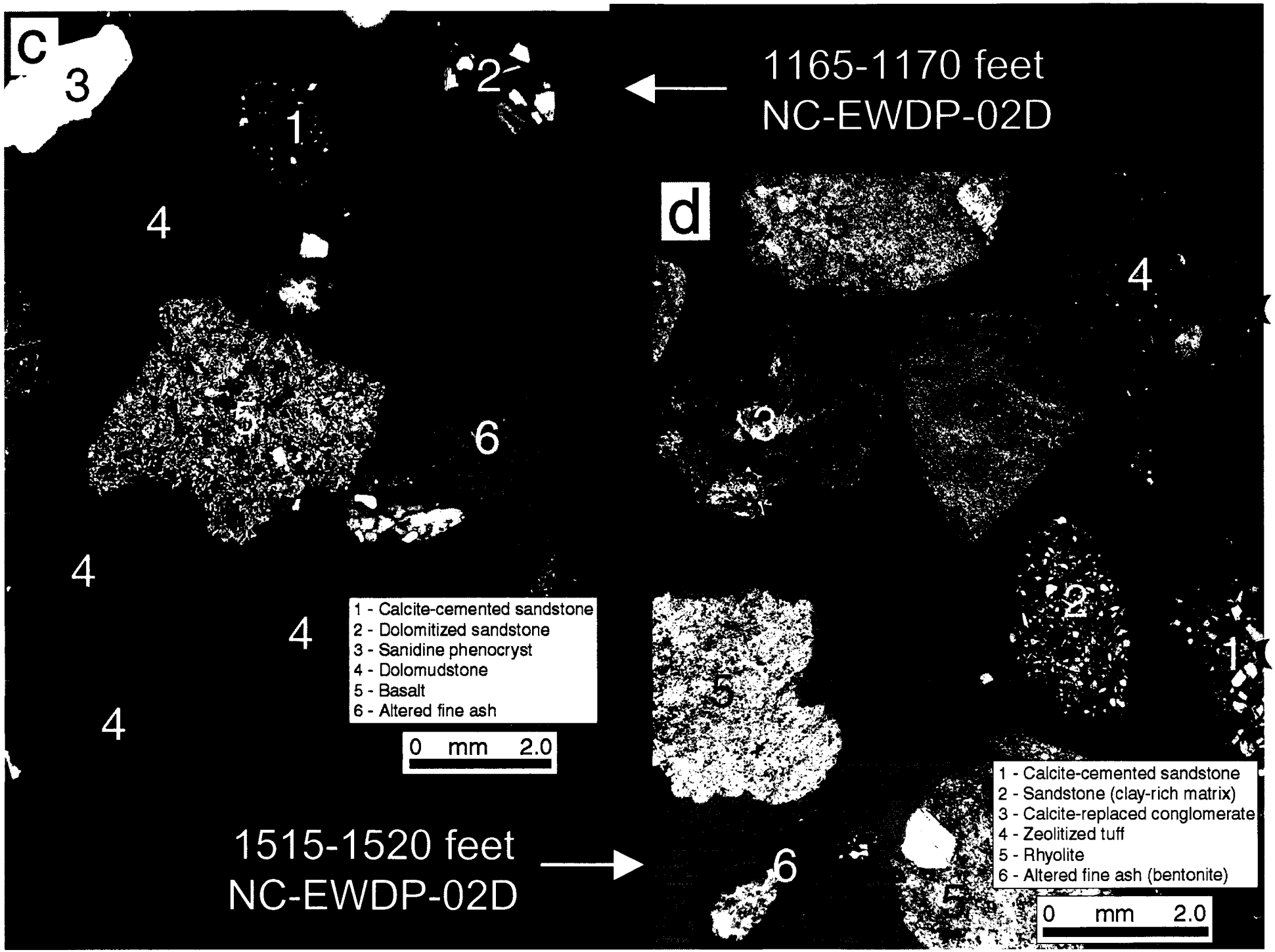


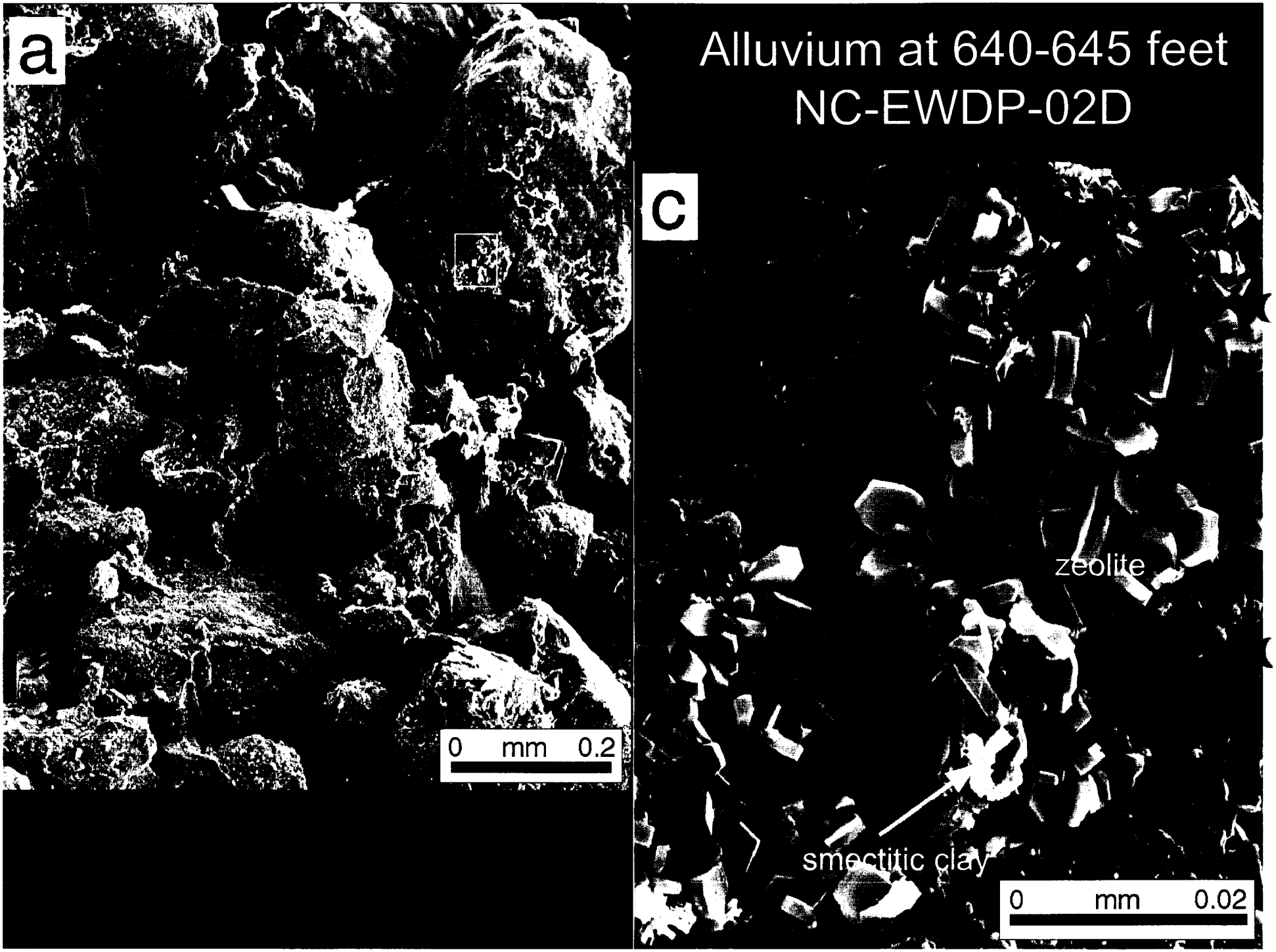


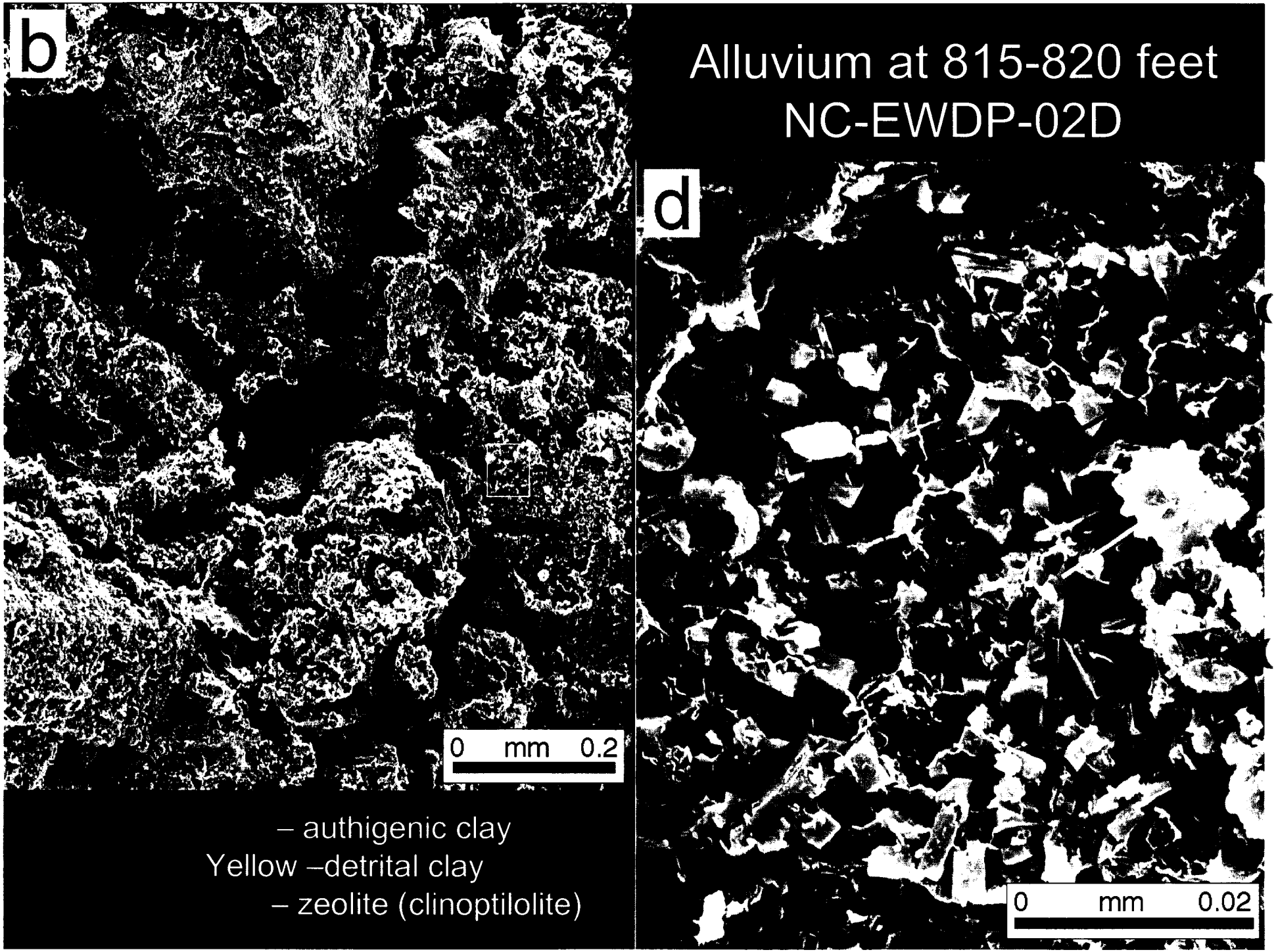
Alluvium at 395-400 feet
NC-EWDP-02D



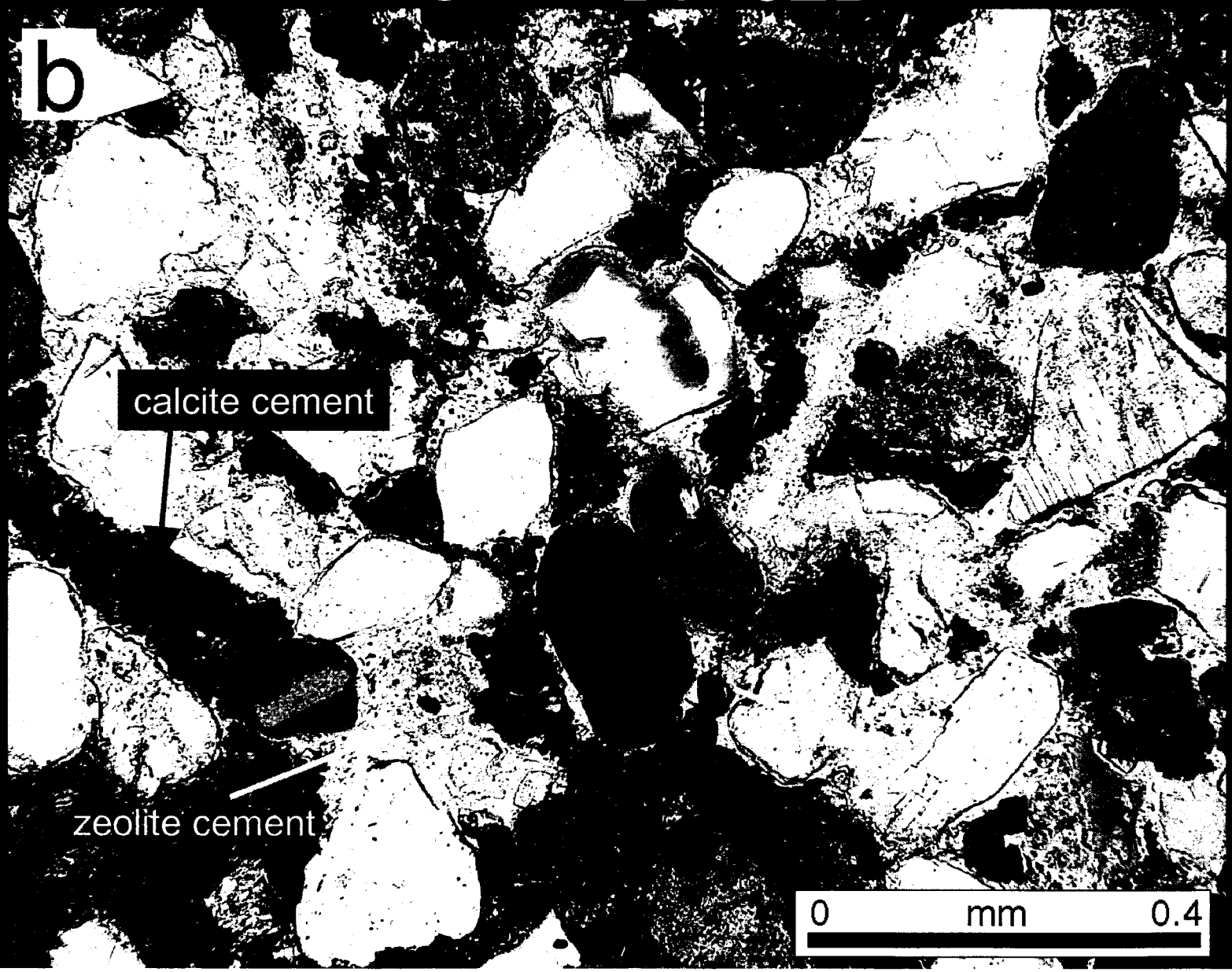

Alluvium at 815-820 feet
NC-EWDP-02D
plane light
x-polars
plane light


c
3
1
2
4
5
6
4
4
4
1 - Calcite-cemented sandstone
2 - Dolomitized sandstone
3 - Sanidine phenocryst
4 - Dolomudstone
5 - Basalt
6 - Altered fine ash
0 mm 2.0
1165-1170 feet
NC-EWDP-02D
1515-1520 feet
NC-EWDP-02D
d
4
3
2
1
5
6
5
1 - Calcite-cemented sandstone
2 - Sandstone (clay-rich matrix)
3 - Calcite-replaced conglomerate
4 - Zeolitized tuff
5 - Rhyolite
6 - Altered fine ash (bentonite)
0 mm 2.0

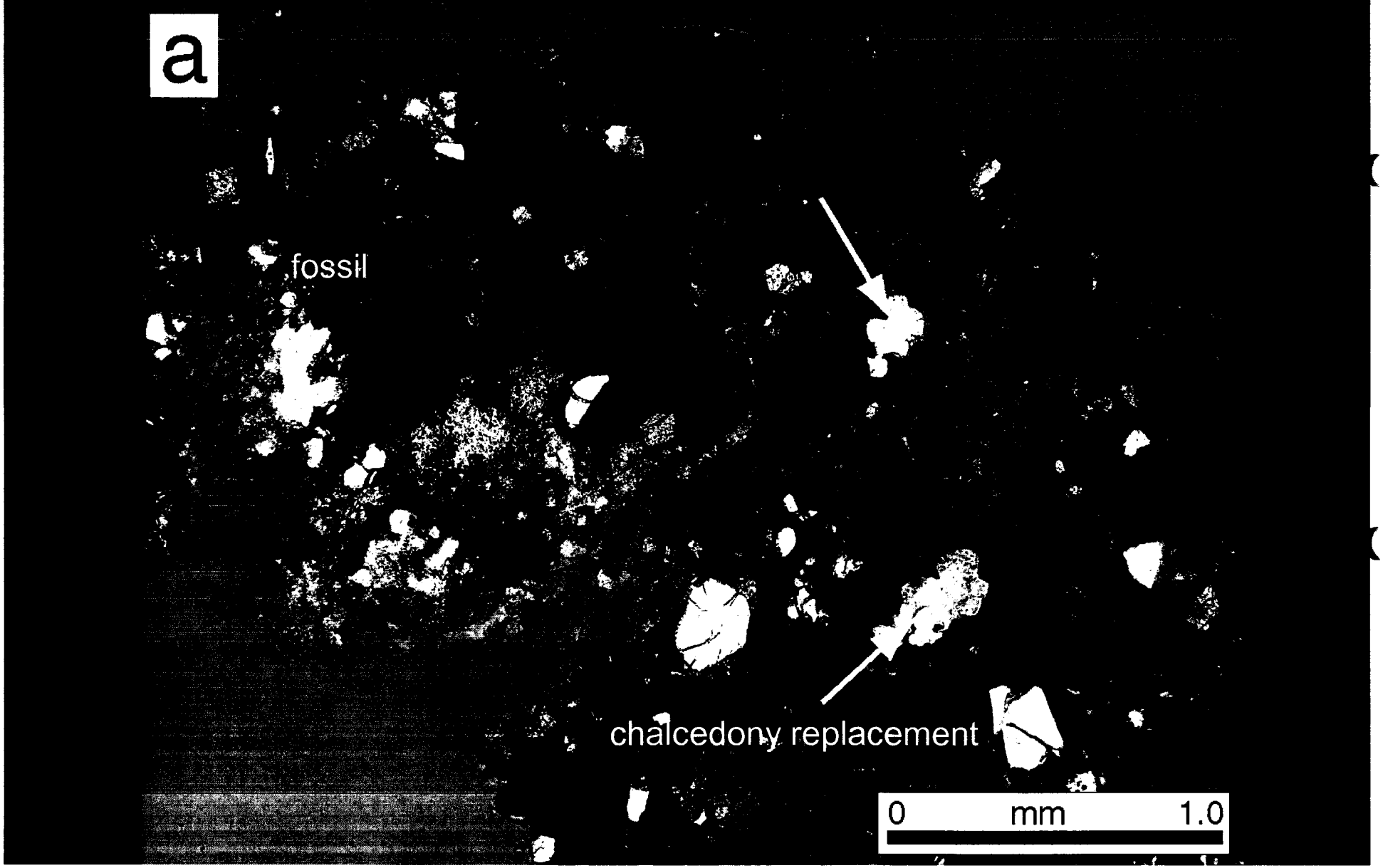

a
0 mm 0.2
Alluvium at 640-645 feet
NC-EWDP-02D
c
zeolite
smectitic clay
0 mm 0.02


b
0 mm 0.2
– authigenic clay
Yellow –detrital clay
– zeolite (clinoptilolite)
Alluvium at 815-820 feet
NC-EWDP-02D
d
0 mm 0.02

Sand grain at 975-980 feet
NC-EWDP-02D



Limestone pebble at 1515-1520 feet
NC-EWDP-02D



Summary

- Washburn-1X and NC-EWDP-02D have similar trends in mineralogy through the depth of Washburn-1X
- Mineralogy does not change significantly at the water table
- Calcite and dolomite increase with depth in NC-EWDP-02D (associated with older sediments)
- Zeolite and smectite minerals occur as grain coatings and interstitial material and may play an important role in assessing retardation of radionuclides in alluvium