A Comparative Analysis of Fault Zone Architectures in Welded Tuff at Yucca Mountain, NV, with Implications for Paleohydrology*

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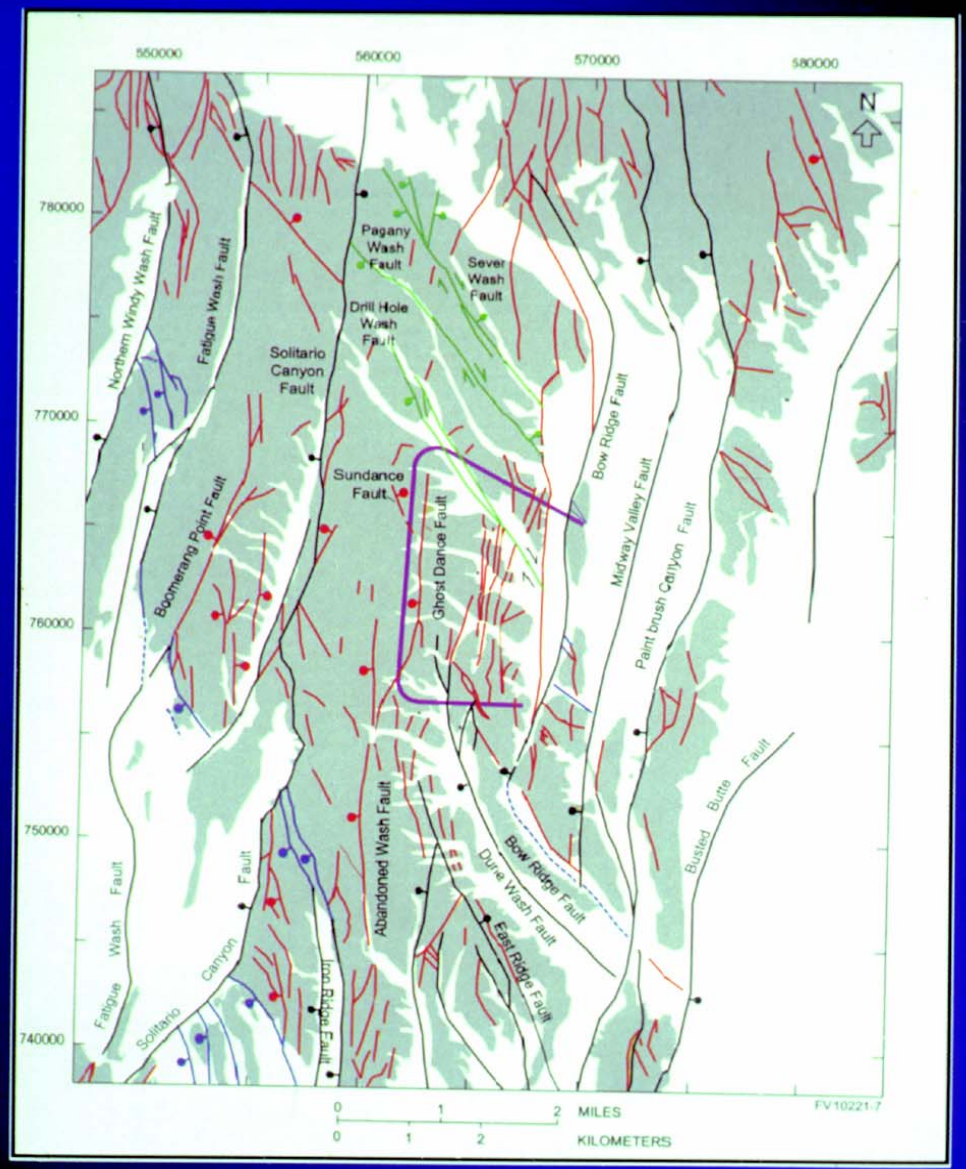
Study Objectives

- Evaluate uncertainties in the direct rupture of waste package by faulting (e.g., SDS IRSR rev. 2).

- Evaluate significance of uncertainties in fault and fracture control of groundwater flow (e.g., Farrell et al., 1999; Ferrill et al., 1999; SDS IRSR rev. 2).

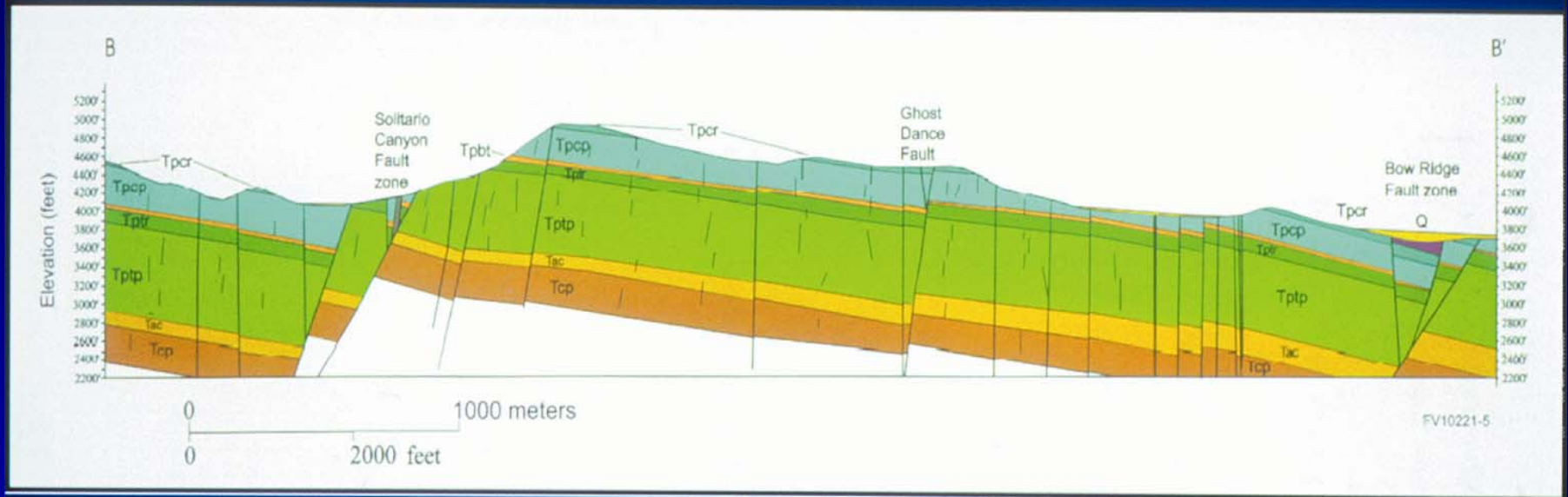
Site Location

Faults in the Yucca Mountain Area



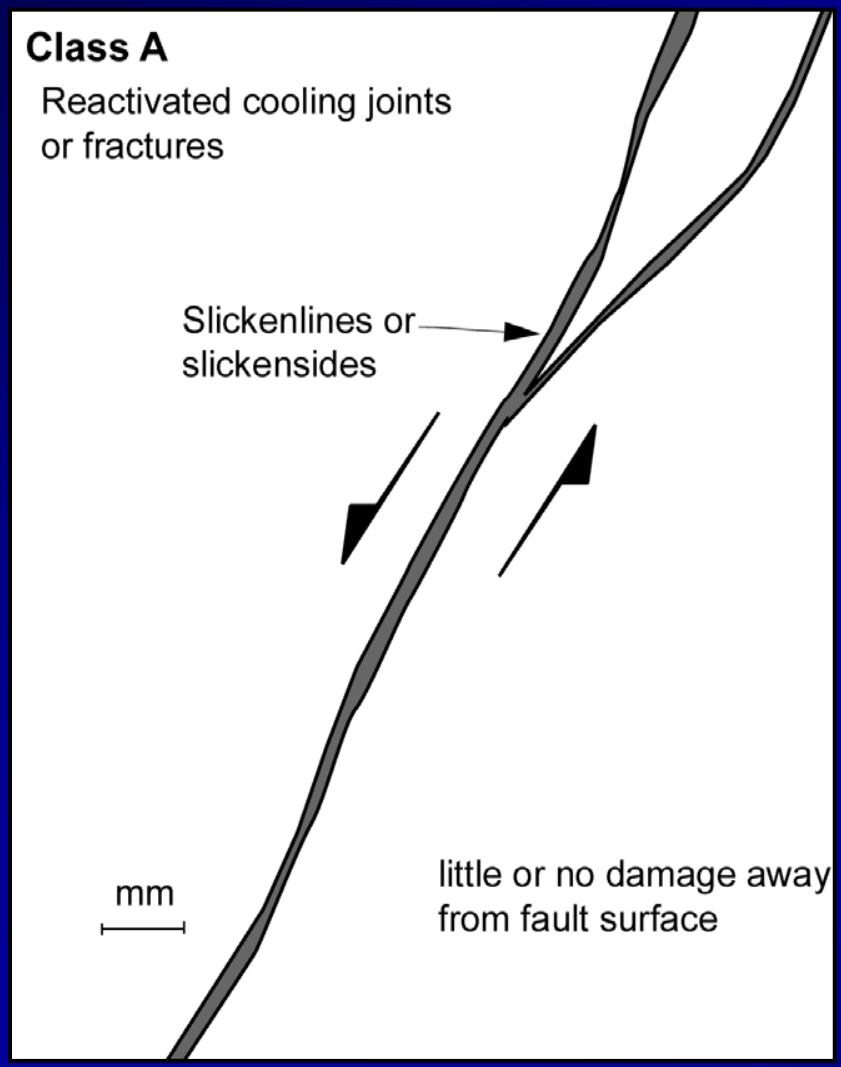
after Day et al., 1998

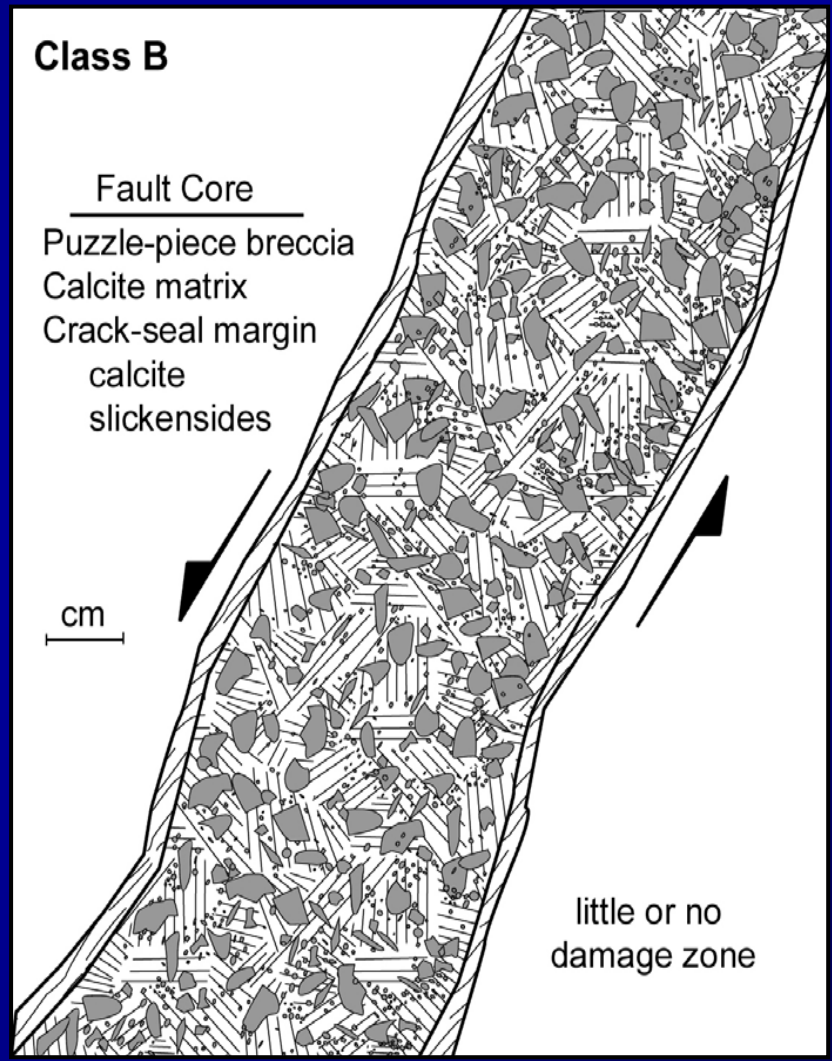
Simplified Geologic Cross Section of Yucca Mountain, West to East



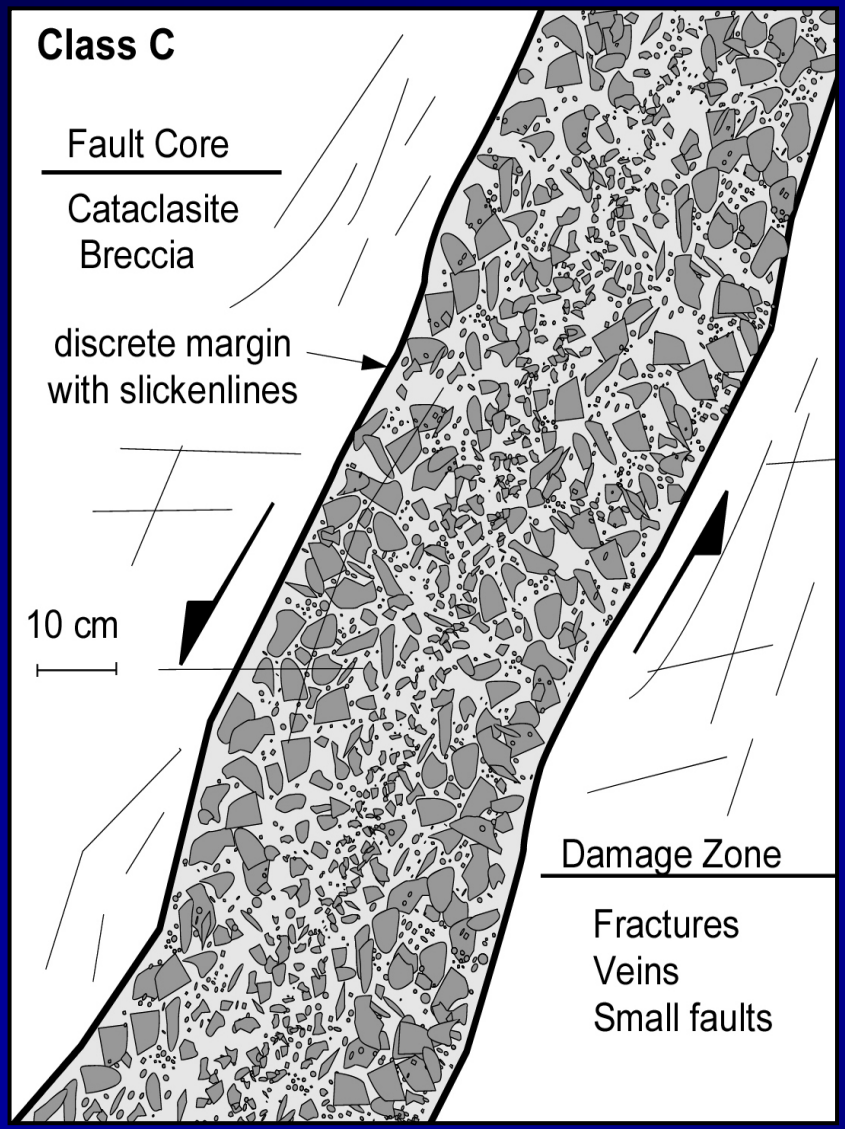
after Day et al., 1997

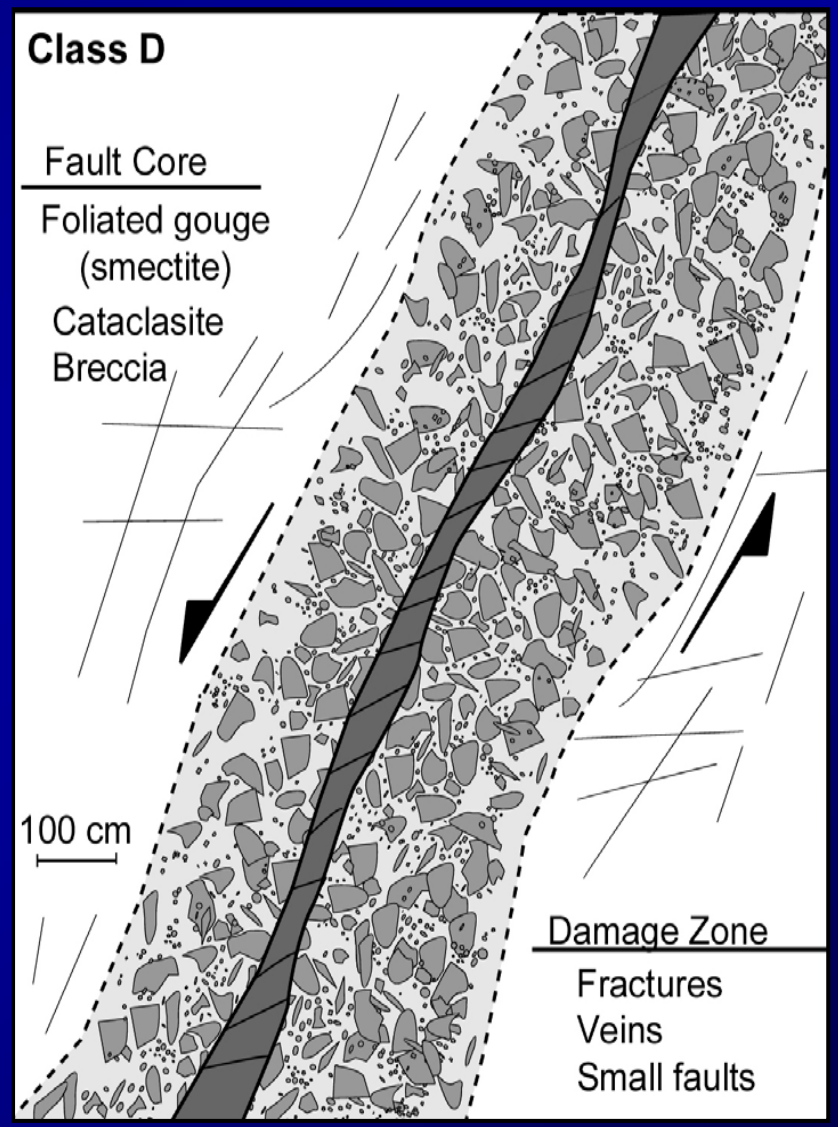
Fault Zone Classes



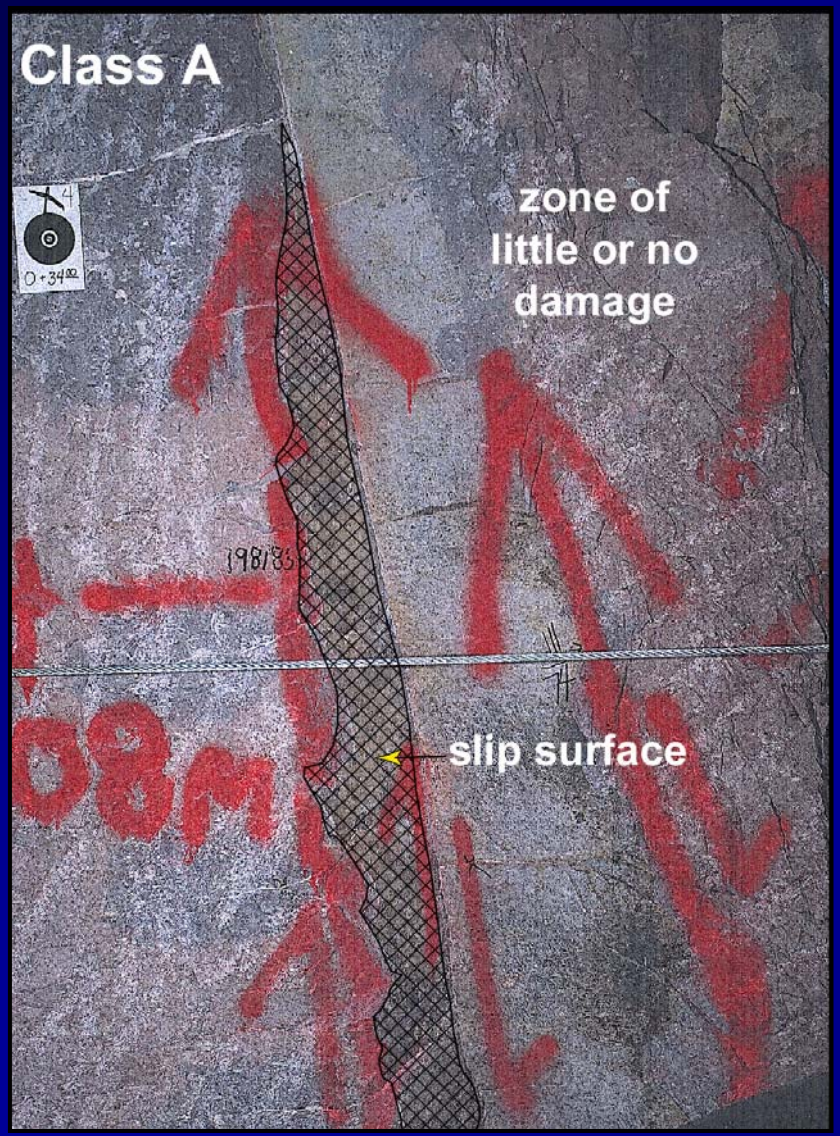


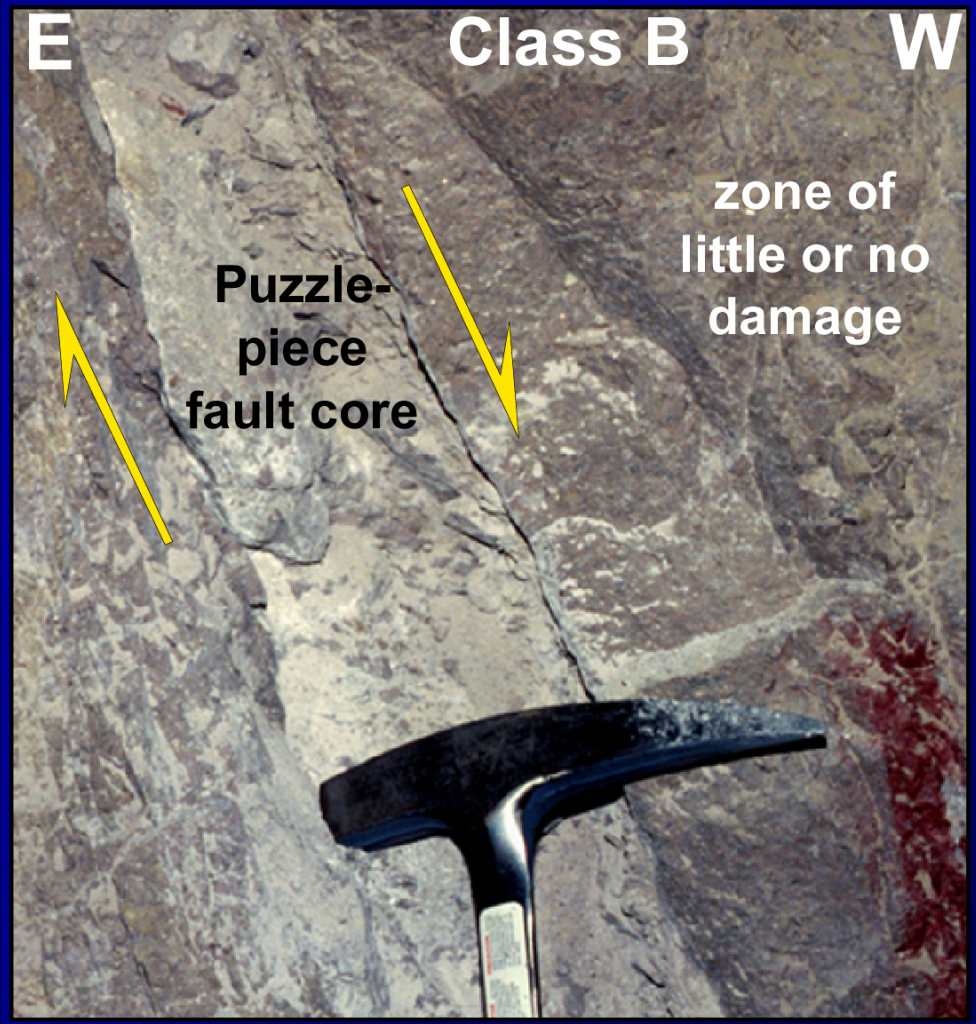
Fault Zone Classes





Photographs of Fault Zone Classes





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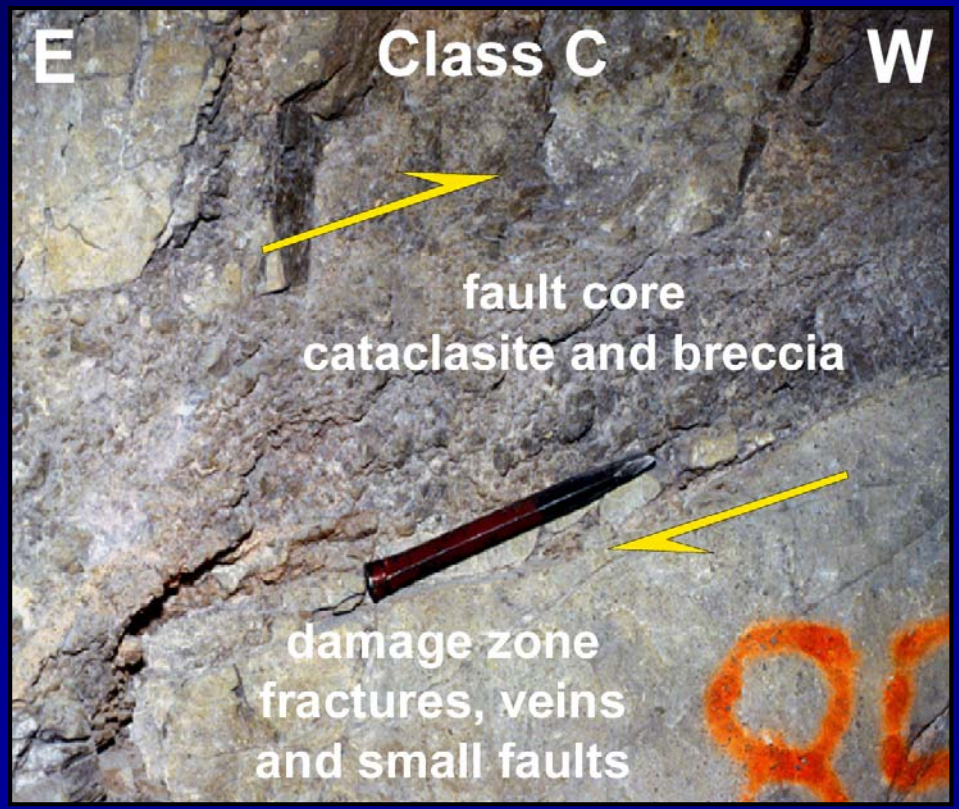
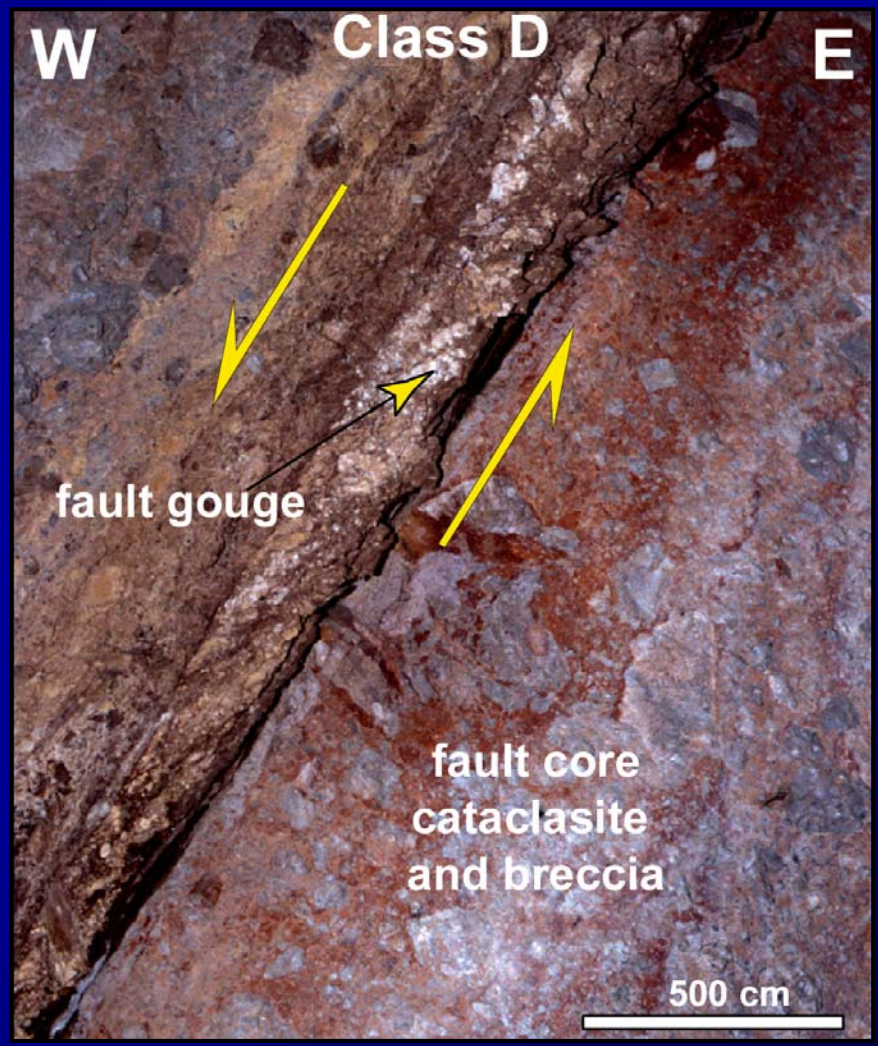
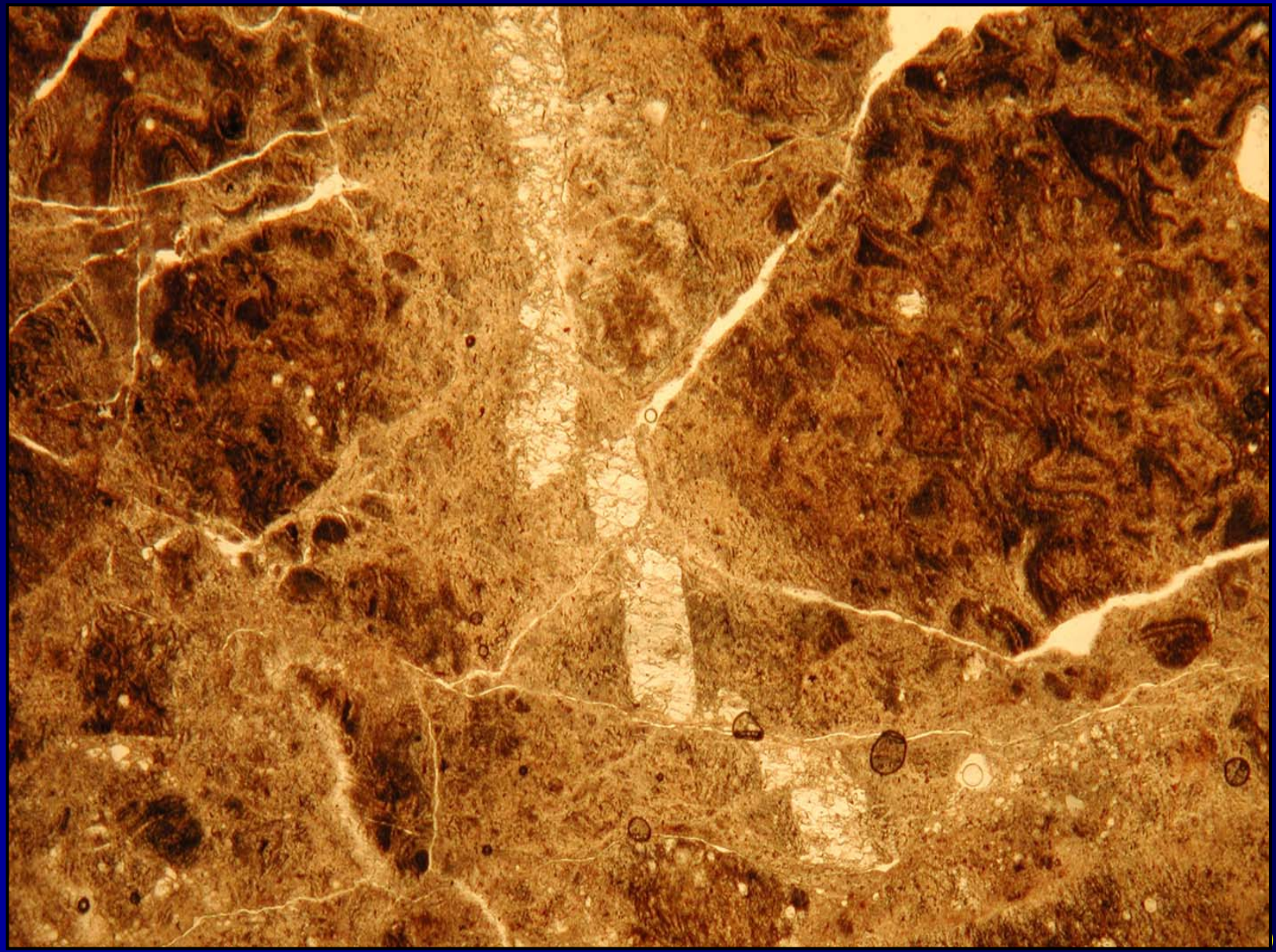
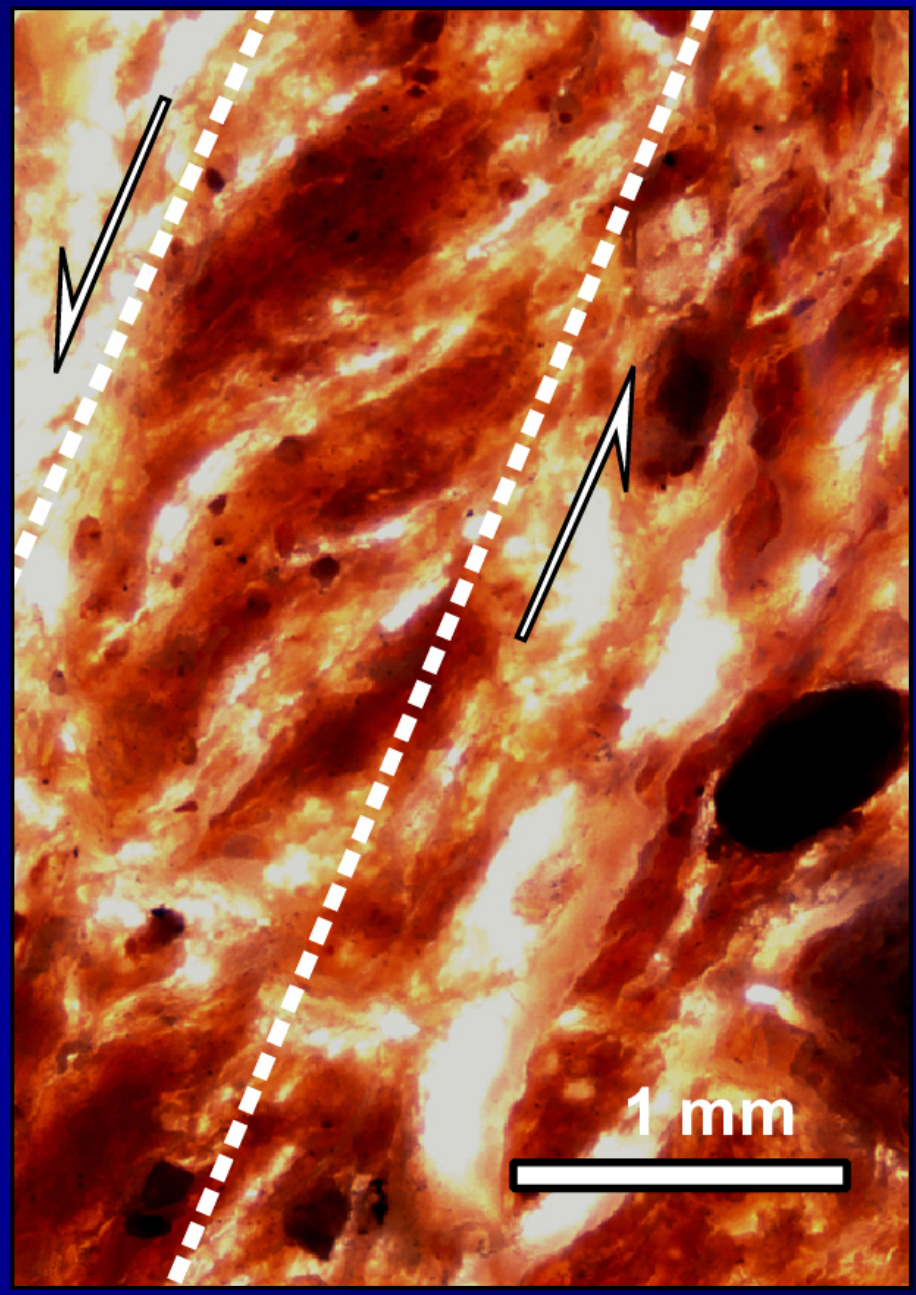




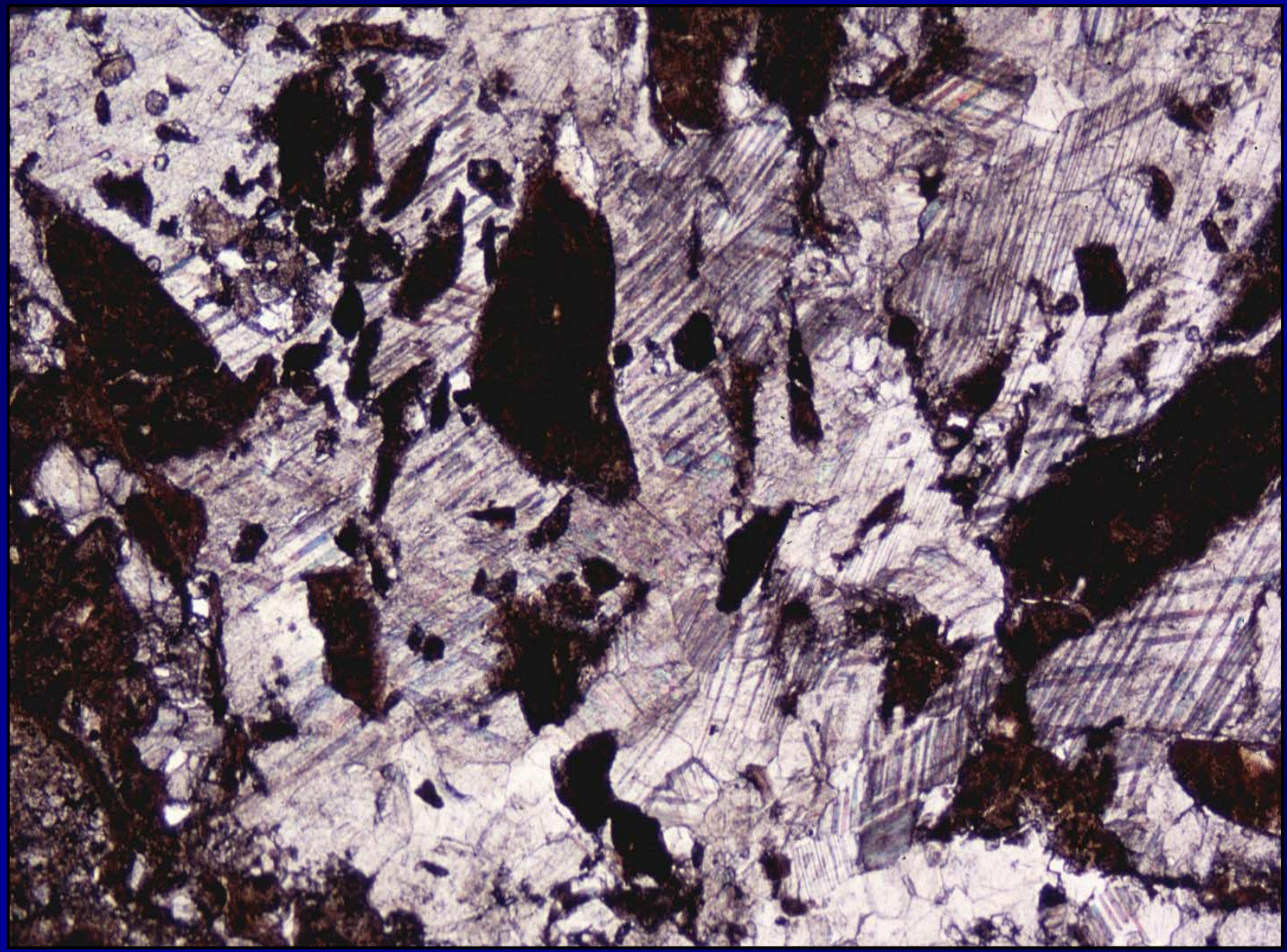
Cataclasite in Sundance Fault Zone



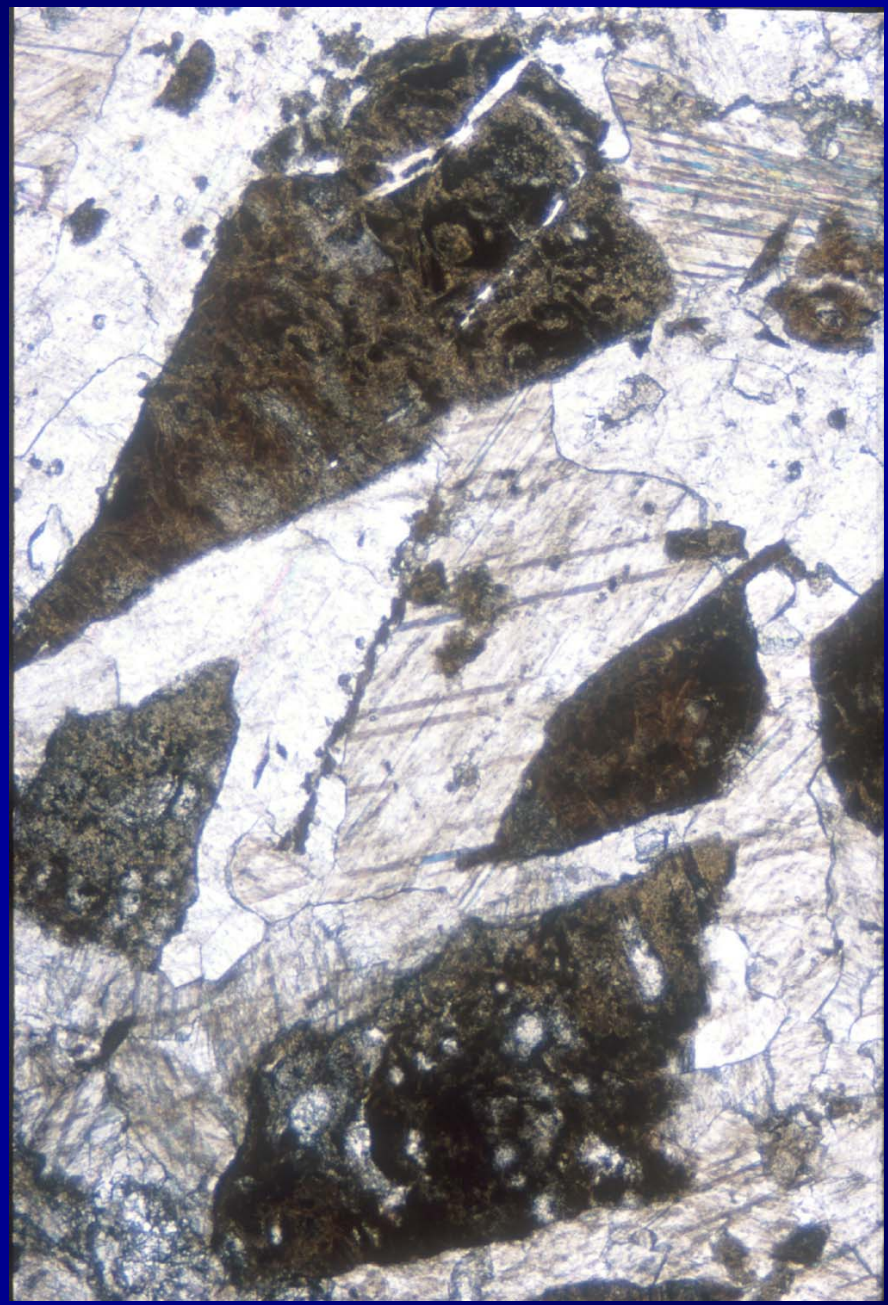
Foliated Gouge in Solitario Canyon Fault Core



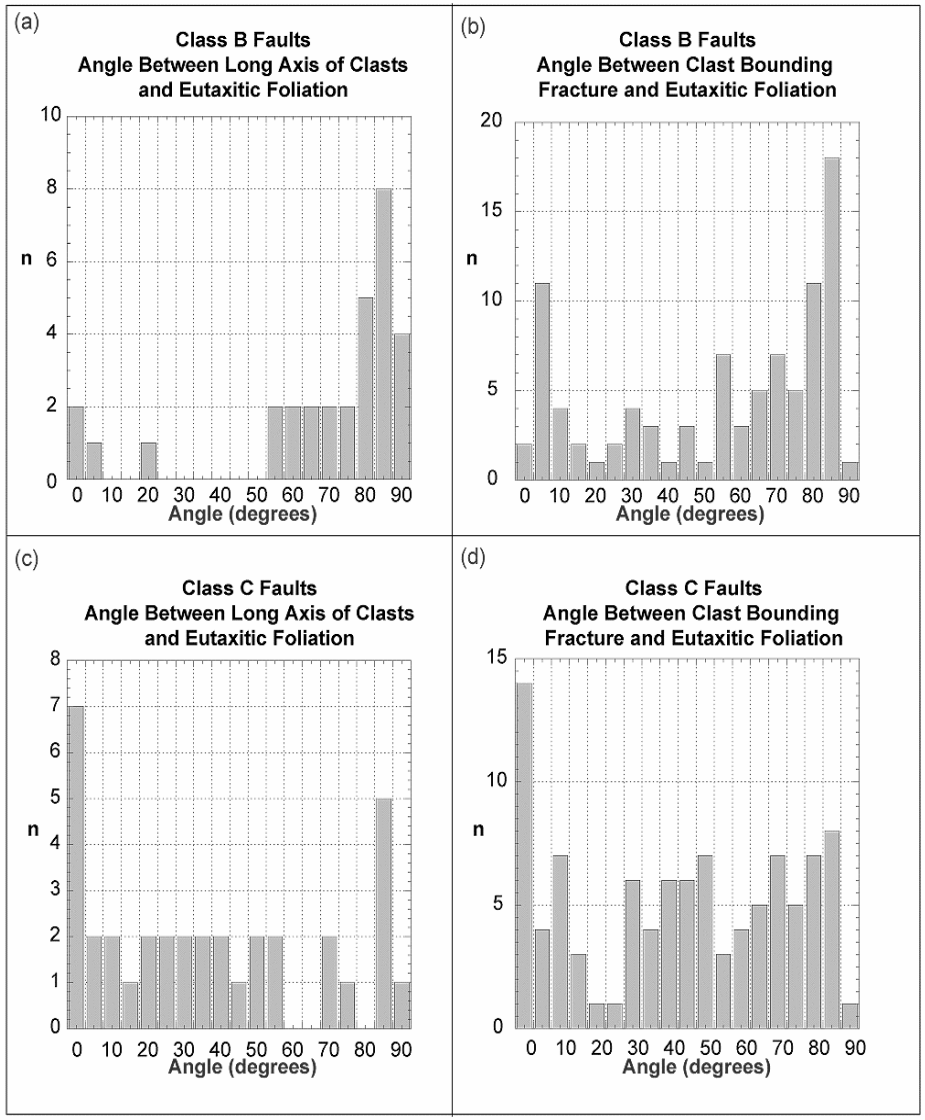
Calcite Matrix from Class B Fault Zone



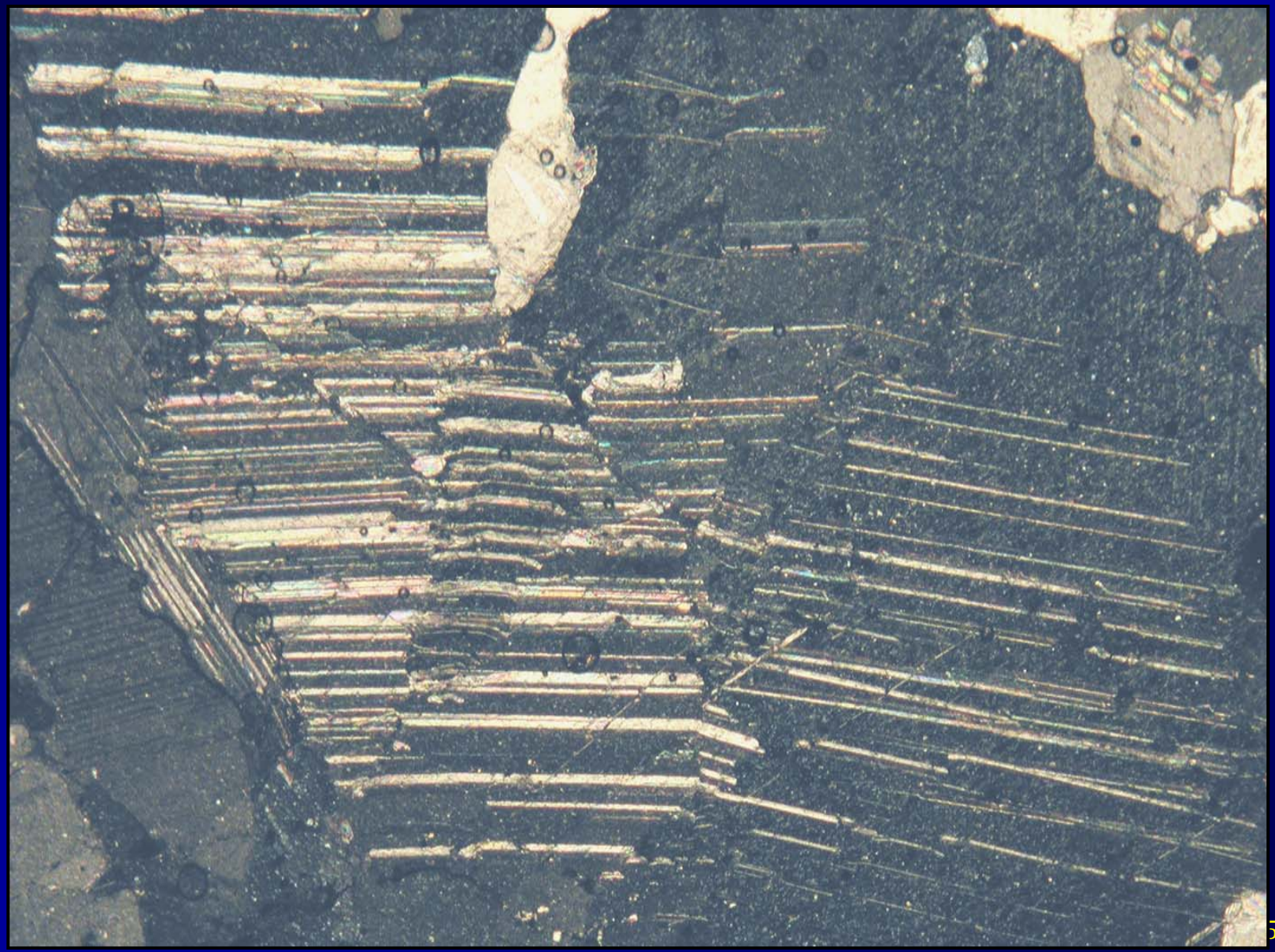
Calcite Deformation Twins



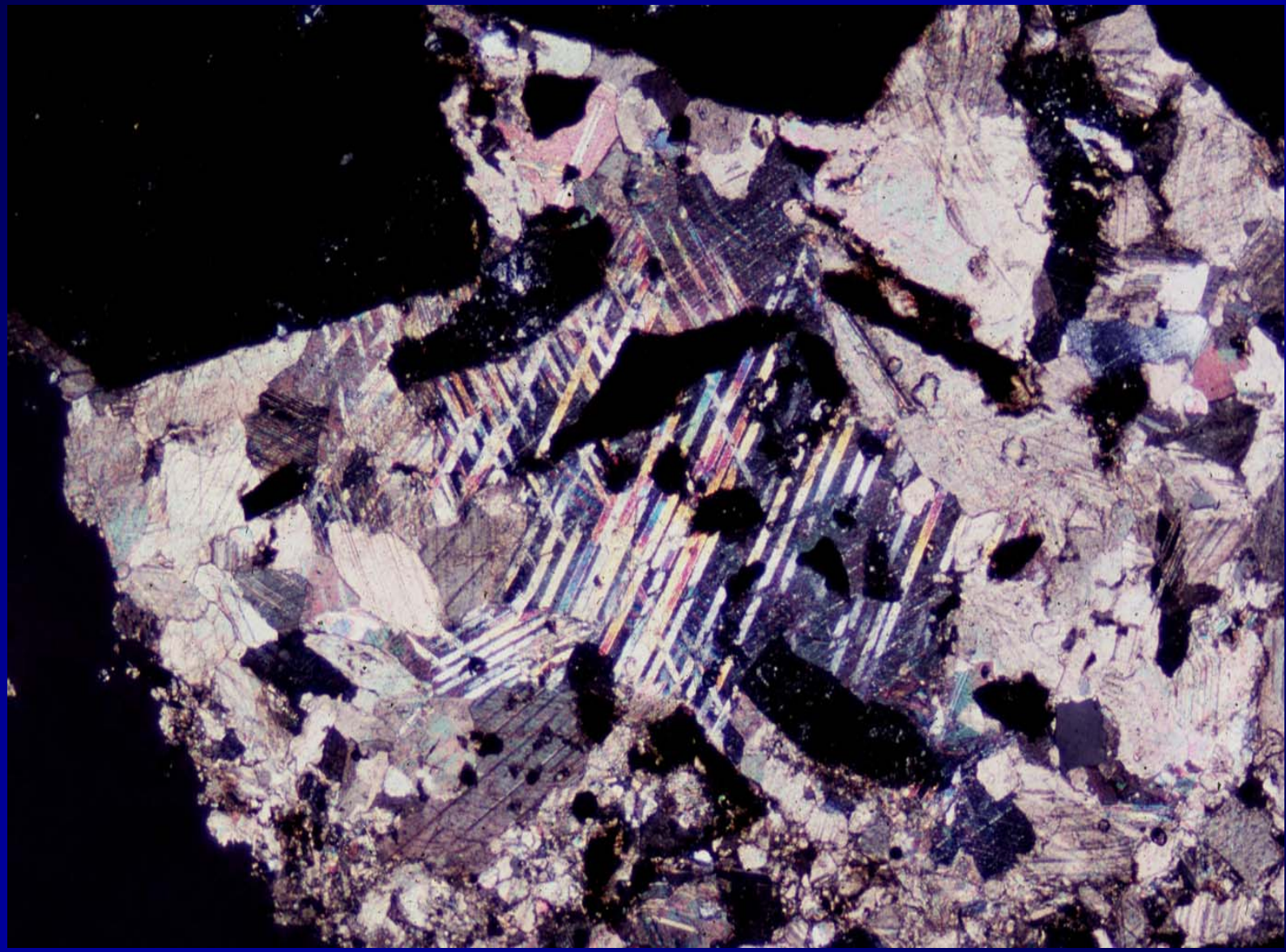
Clast Geometries



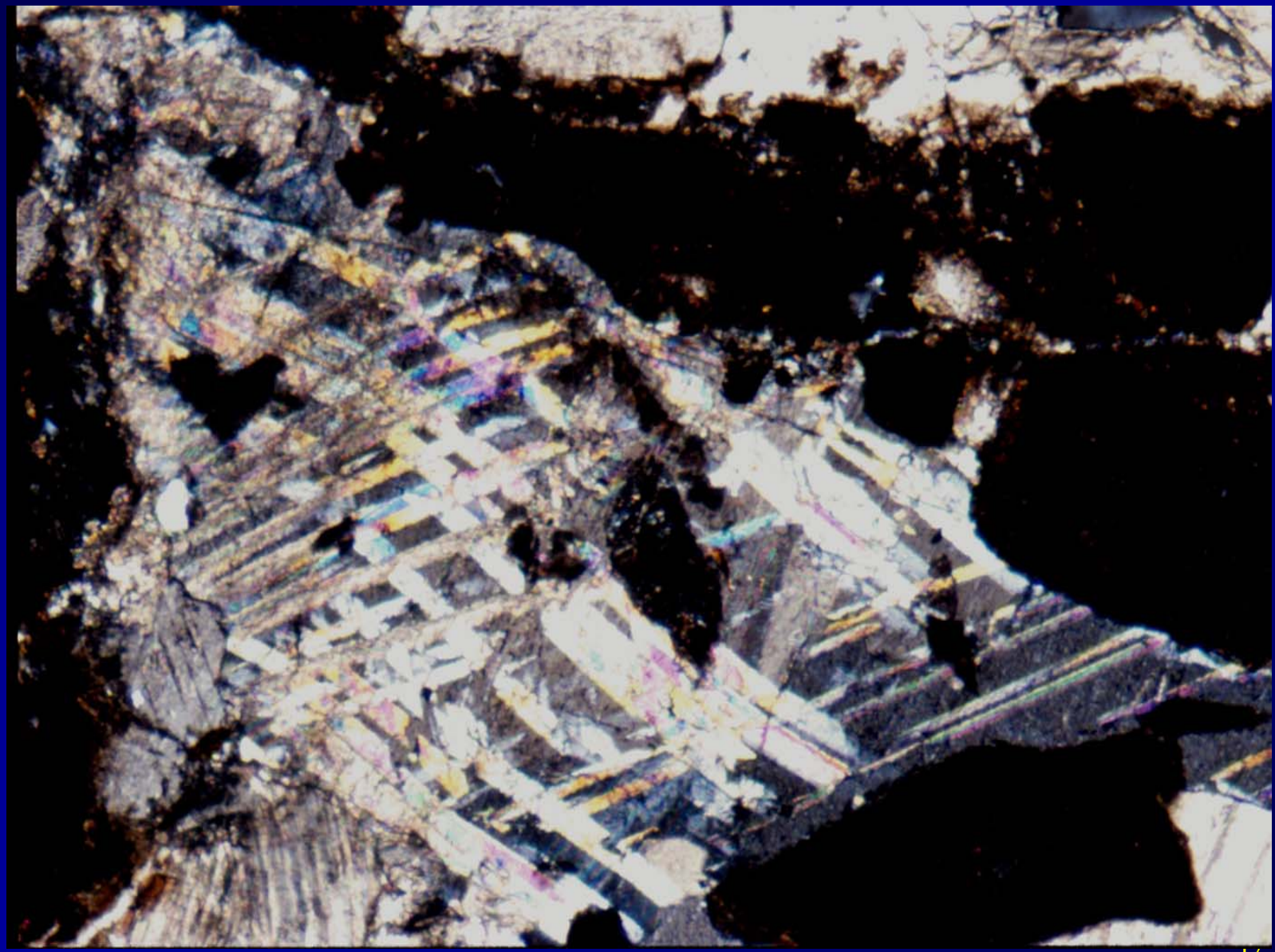
Deformed Calcite Crystal



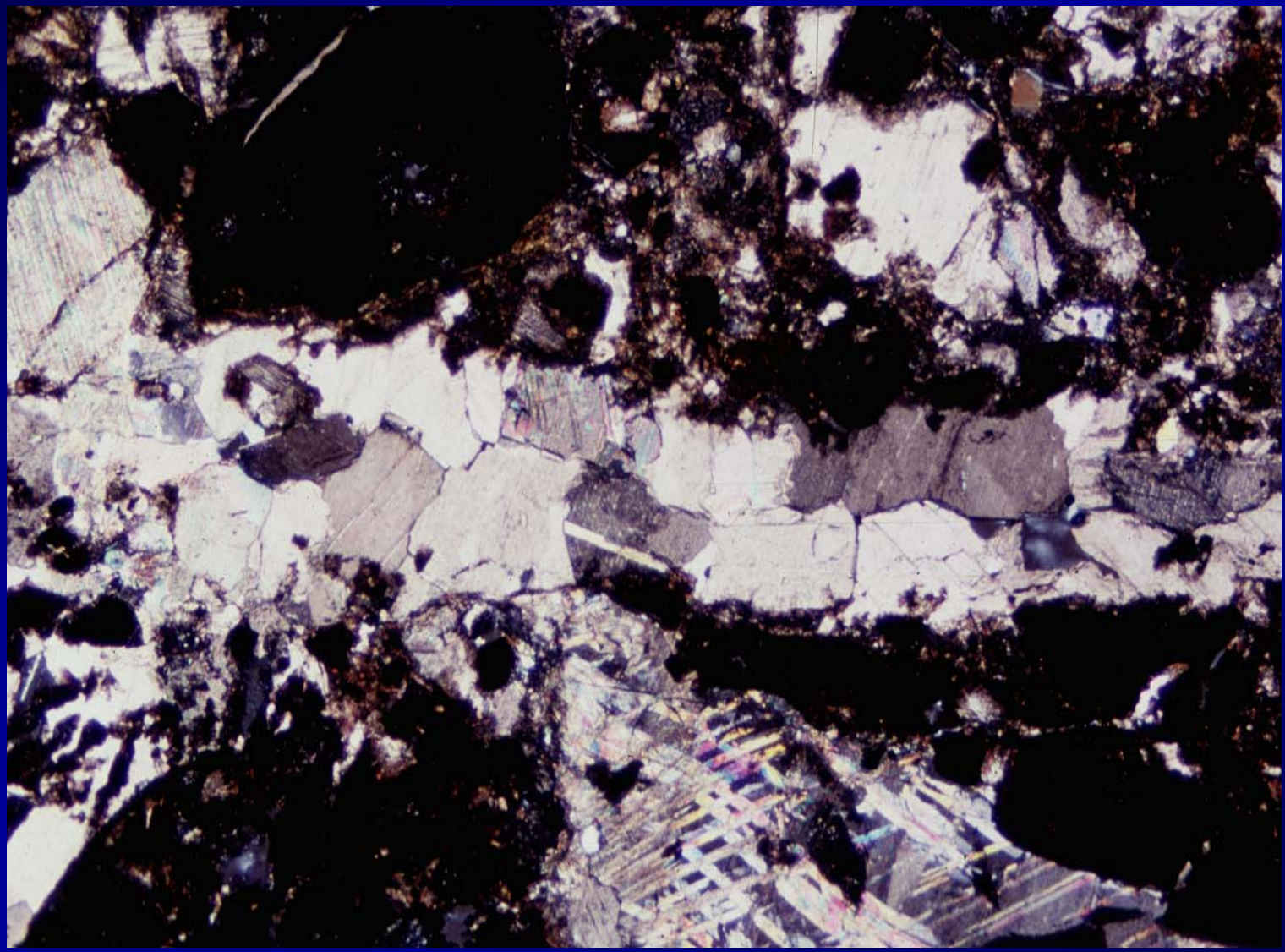
Thick Twins in Calcite Matrix Crystal



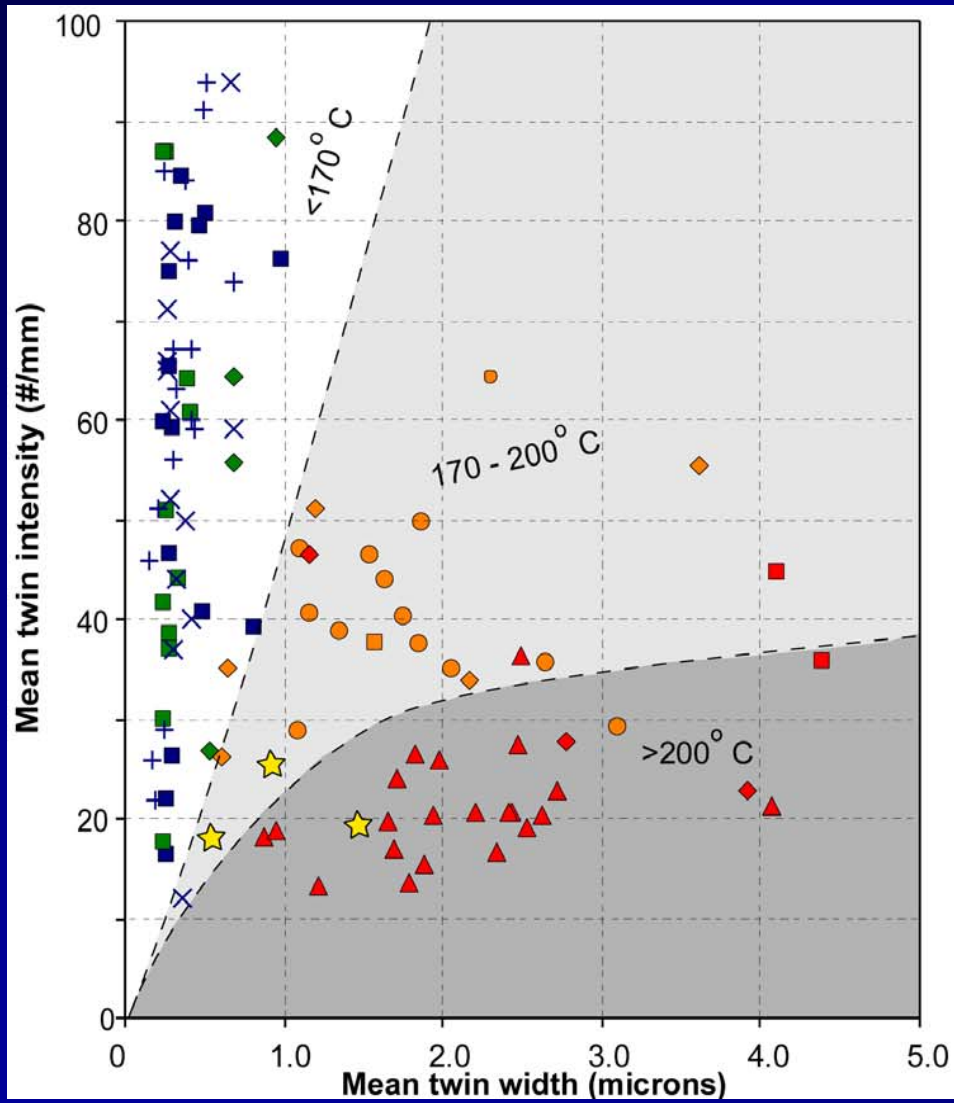
Thick Twins in Calcite Matrix Crystal



Post-Kinematic Vein



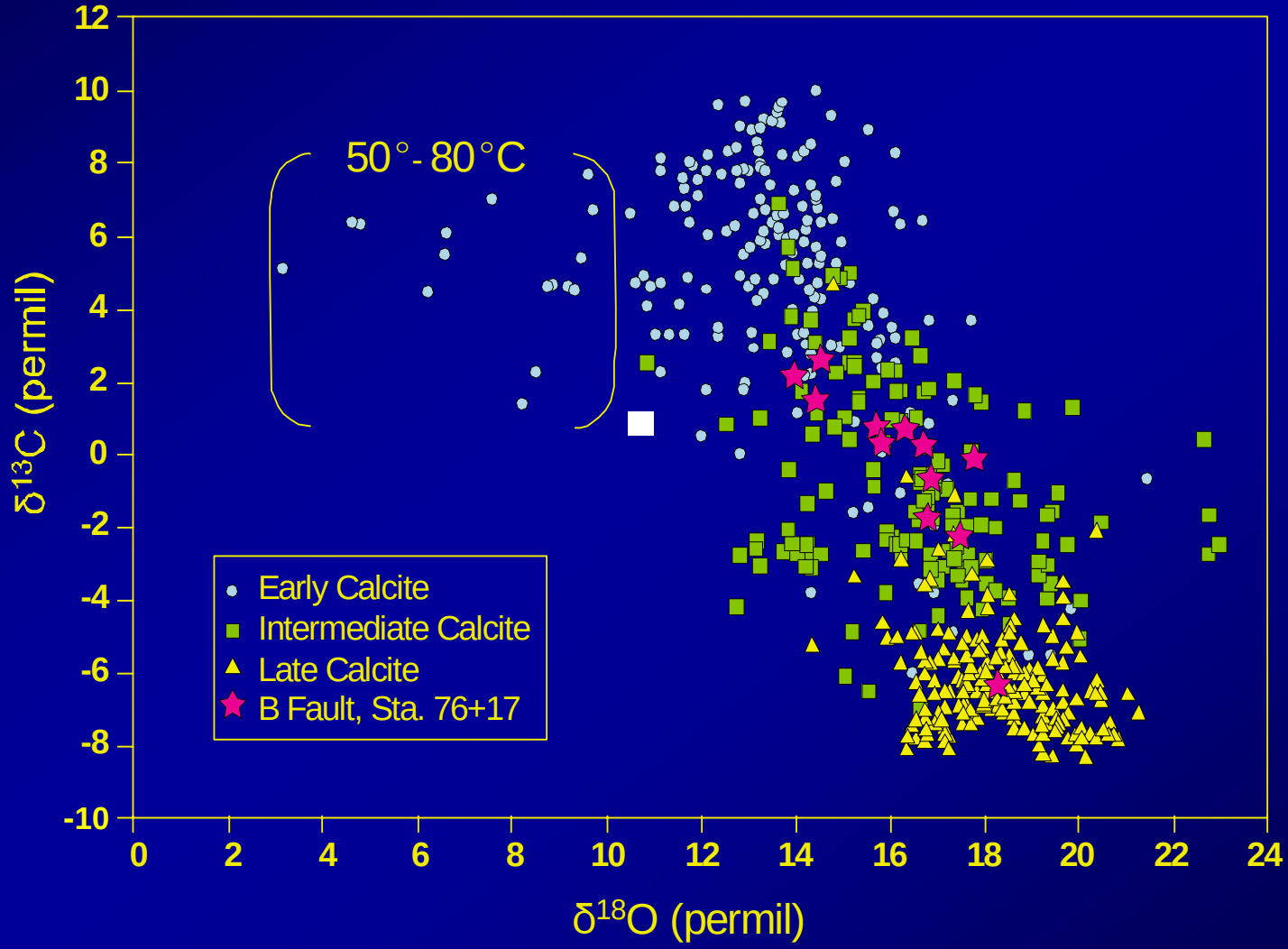
Temperature Conditions of Deformation



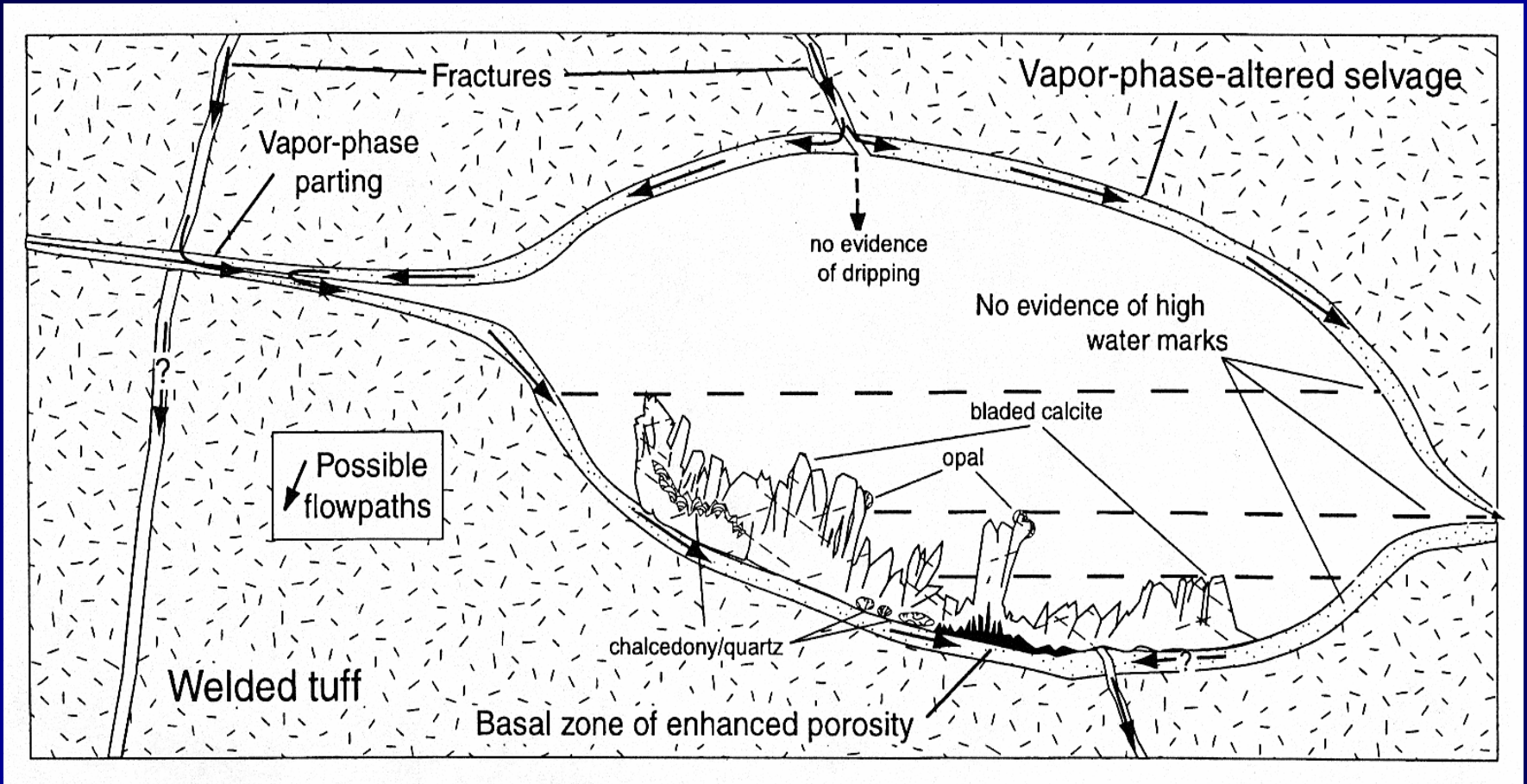
KEY

- Groshong et al., 1984; 70 - 180° C
- Groshong et al., 1984; 160 - 250° C
- Groshong et al., 1984; 250 - 300° C
- Ferrill 1991; Ferrill & Groshong 1993 a,b; <90 - 125° C
- Ferrill 1991; Ferrill & Groshong 1993 a,b; 90 - 170° C
- Ferrill 1991; Ferrill & Groshong 1993 a,b; 150 - 190° C
- Ferrill 1991; Ferrill & Groshong 1993 ab; 190 - 300° C
- Evans & Dunne 1991, unpublished data; 250 - 350° C
- Onasch unpublished data; ~200° C
- Smart et al., 1997; < 3 km burial
- Spraggins and Dunne 2002; < 3 km burial
- Type B faults at Yucca Mountain

Oxygen and Carbon Isotopes (From the USGS, Yucca Mountain Project)



Saturated or Unsaturated Conditions?



(Whelan et al., 2002)

Conclusions

- Classes A, C, and D can be genetically linked (a breccia-cataclasite-gouge progression with increased fault displacement) and are generally not associated with abundant calcite mineralization.

- Class B fault zones are heavily mineralized with calcite and appear to be unrelated to other faults at Yucca Mountain.

Conclusions

- Class B fault zones have distinctive mineralization histories when compared to other faults, lithophysae, or fractures.
- Class B fault zones are dilational and calcite mineralization accompanied and assisted fault displacement in a fluid saturated environment.
- Mechanical twins suggest faulting occurred at > 170 ºC.
- The age of Class B fault zones remains unknown.