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August 8, 2003

U.S. Nuclear Regulatory Commission
ATT: Deborah DeMarco
Office of Nuclear Materials Safety and Safeguards
Two Whiter Flint North
Mail Stop 8 A23
Washington, D.C. 20555

Subject: Submittal of Presentation Titled "A Comparative Analysis of Fault Zone Architectures in Welded Tuff at Yucca Mountain, NV, with Implications for Paleohydrology"

Dear Mrs. De Marco:

The purpose of this letter is to transmit the aforementioned presentation Dr. Mary Beth Gray will give at the California Institute for Geophysics and Planetary Physics (IGPP) Workshop on Fluid from and Transport through Faulted Ignimbrites and Other Porous Media. The presentation discusses the classification and origin of four types of faults found at Yucca Mountain. Three of the fault types are formed by progressive cataclasis. The fourth type is characterized by puzzle-piece breccia cores consisting of > 65% calcite indicating that these faults had a strong dilitational components and formed under fluid saturated conditions. Theses faults indicate that at some time in the geologic history of Yucca Mountain, fluid fluxes were sufficient to develop secondary minerals at elevated temperatures.

This work was initiated to refine models of faulting used in repository assessment codes to evaluate uncertainties of the risk associated with potential direct disruption of the empaled waste by fault movement.

If you have any questions please contact Dr. John Stamatakos at (210) 522-5247 or me at (210) 522-5252.

Sincerely,

[signature] for B Sagar

Budhi Sagar
Technical Director

BS/slo
Enclosure

cc (w/o Encl.):

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D. DeMarco	S. Wastler	P. Justus	J. Stamatakos

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

Mary Beth Gray, Bucknell University

John A. Stamatakos, CNWRA

David A. Ferrill, CNWRA

Mark A. Evans, U. Pittsburgh

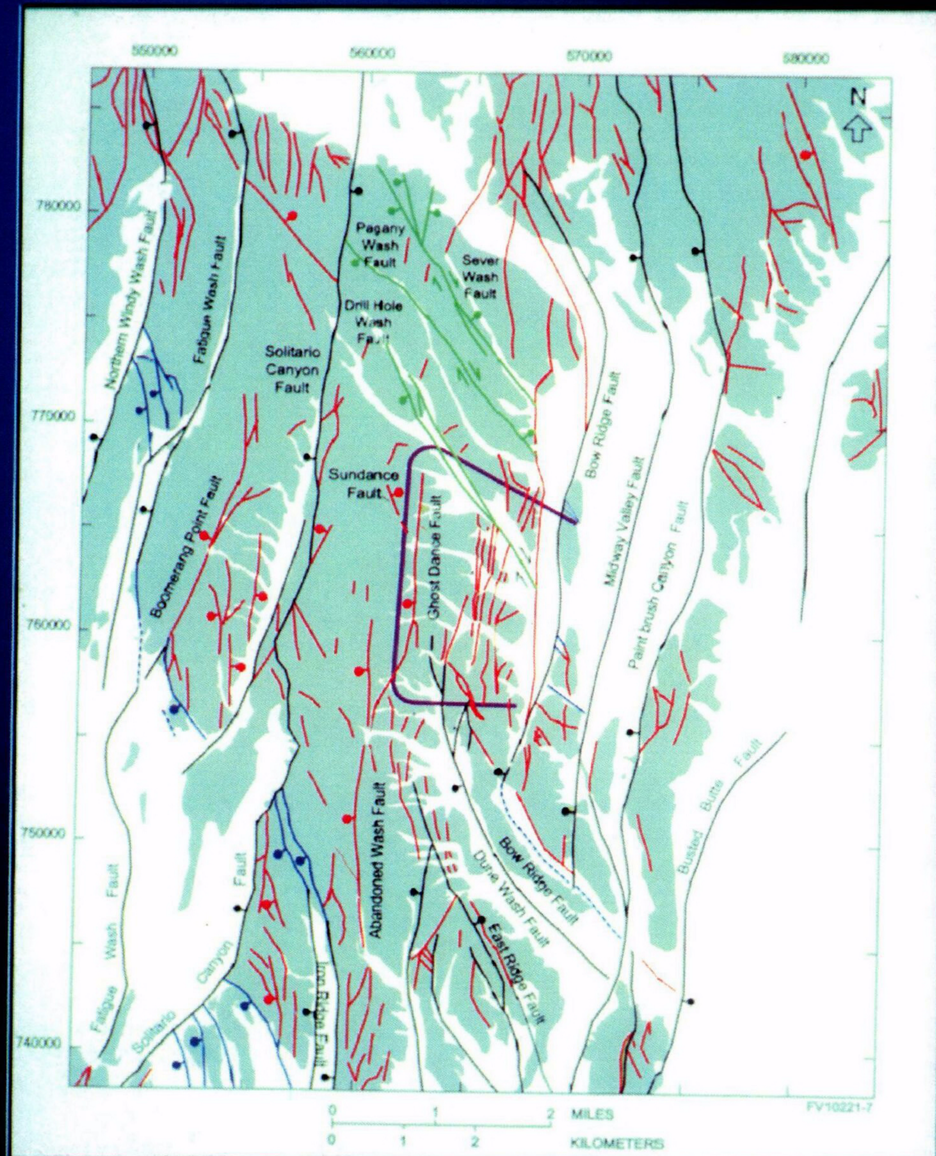
* Work supported by the U.S. Nuclear Regulatory Commission (contract NRC 02-02-012). This abstract is an independent product of the CNWRA and does not necessarily reflect the views or regulatory positions of the NRC.

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).

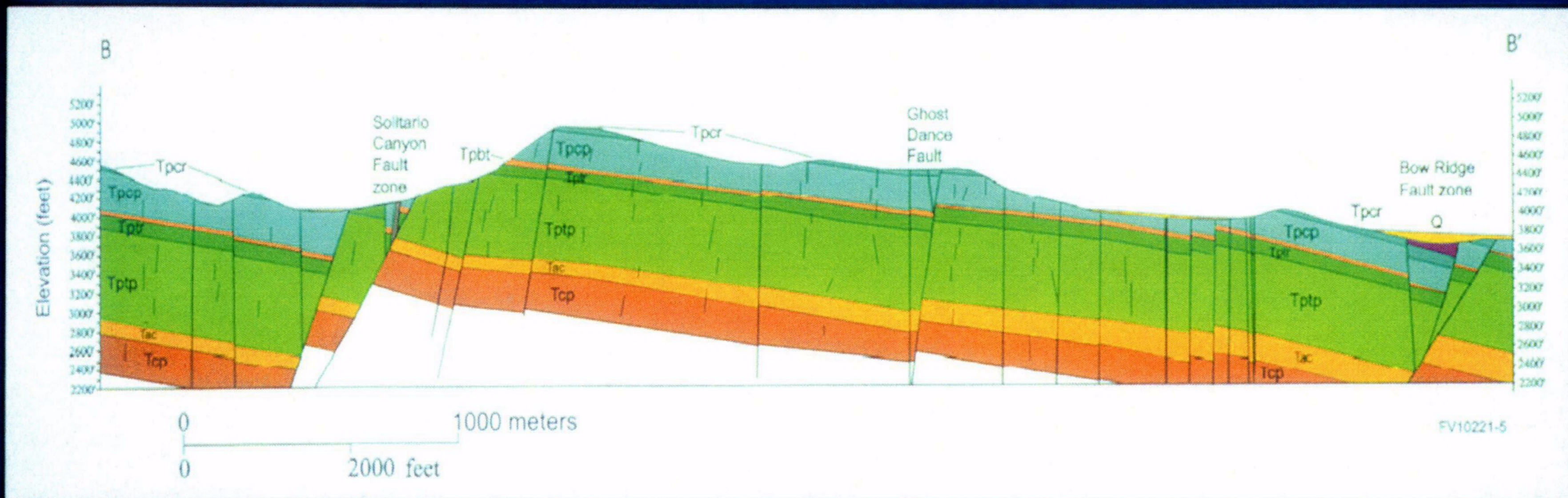
Site Location

Faults in the Yucca Mountain Area



after Day et al., 1998

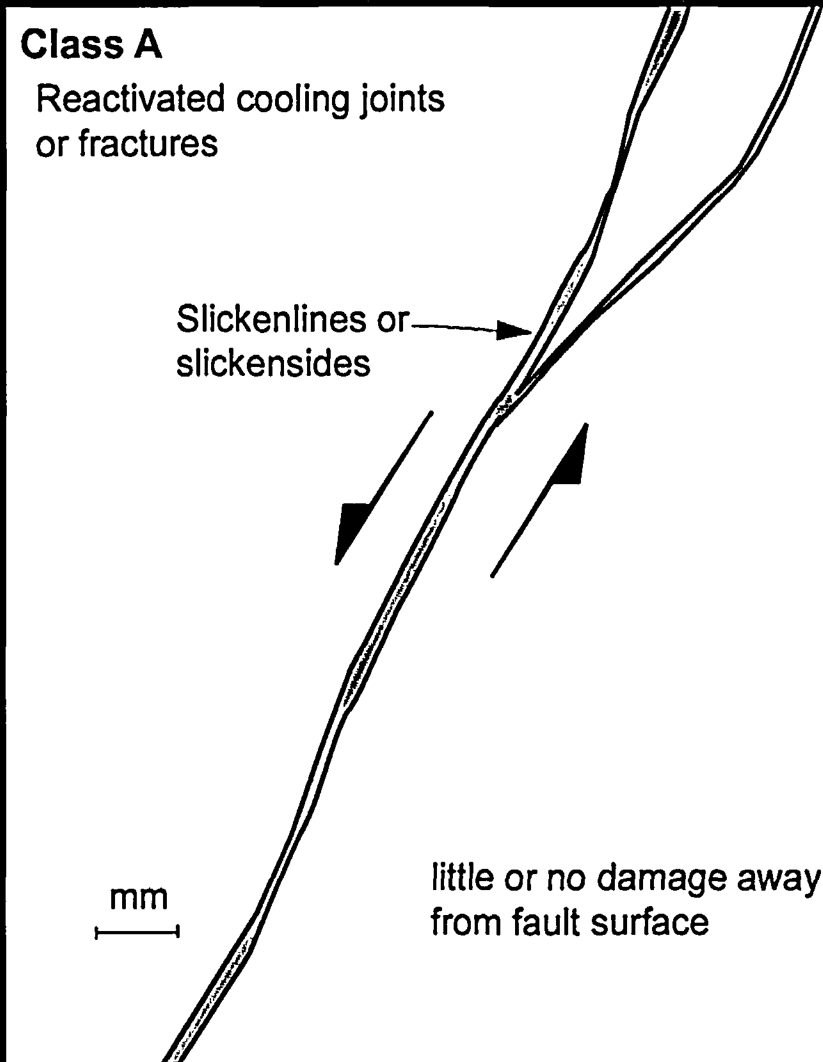
Simplified Geologic Cross Section of Yucca Mountain, West to East

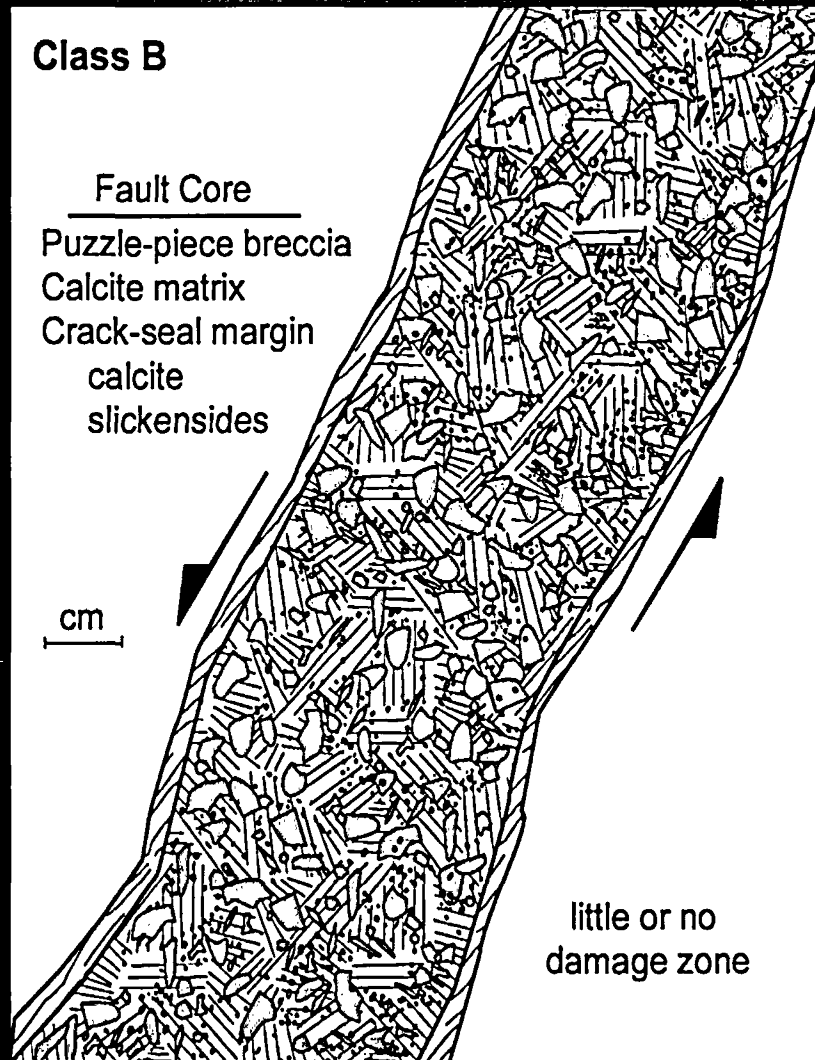


after Day et al., 1997

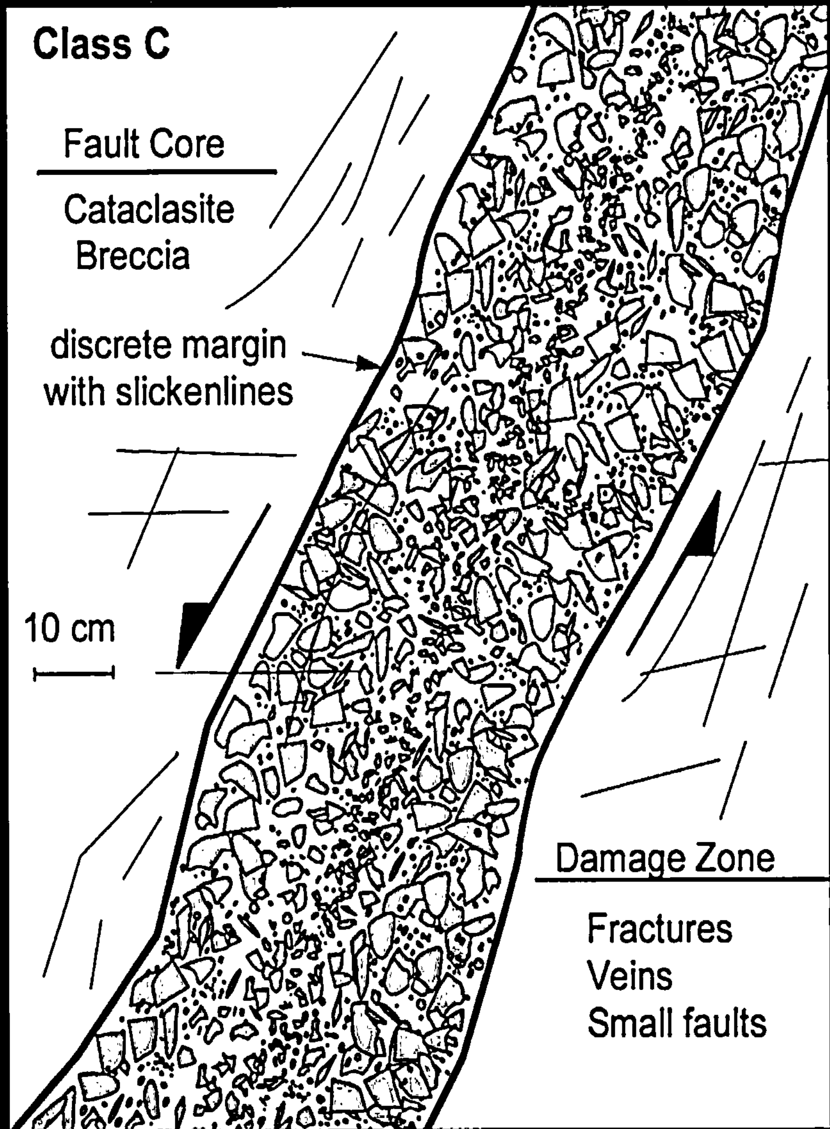
C01

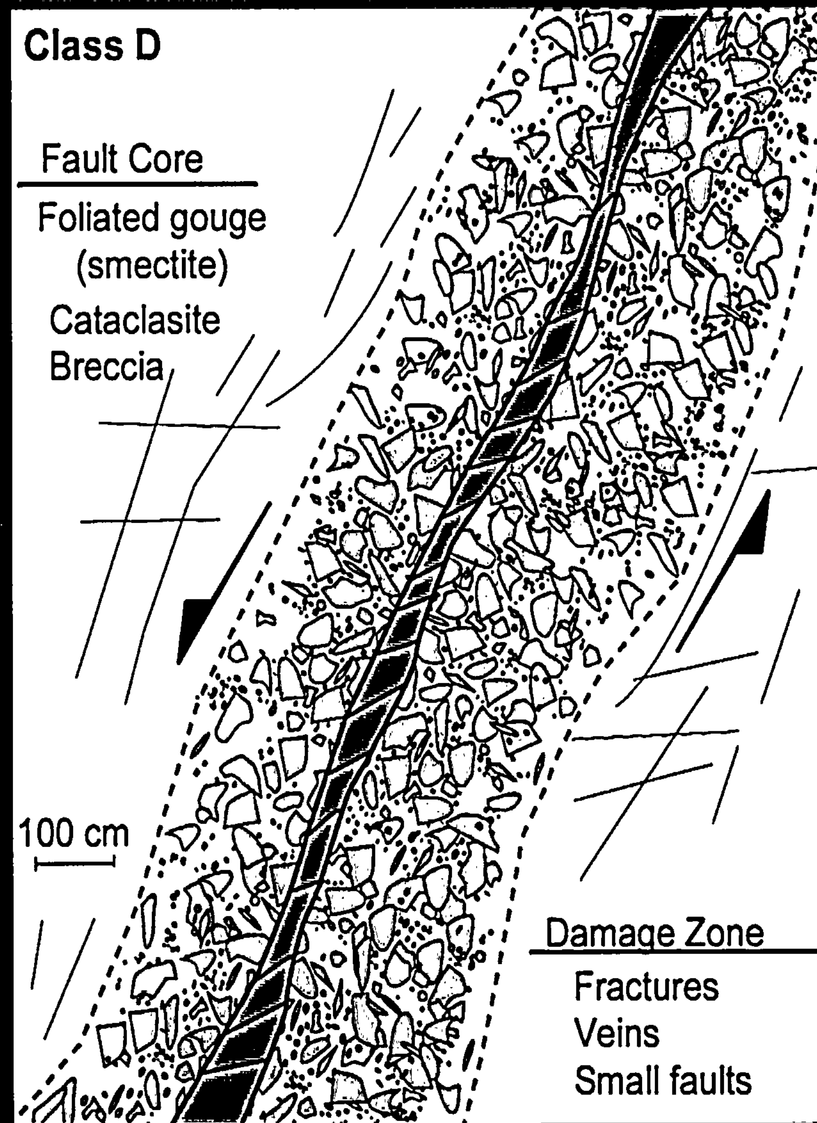
Fault Zone Classes



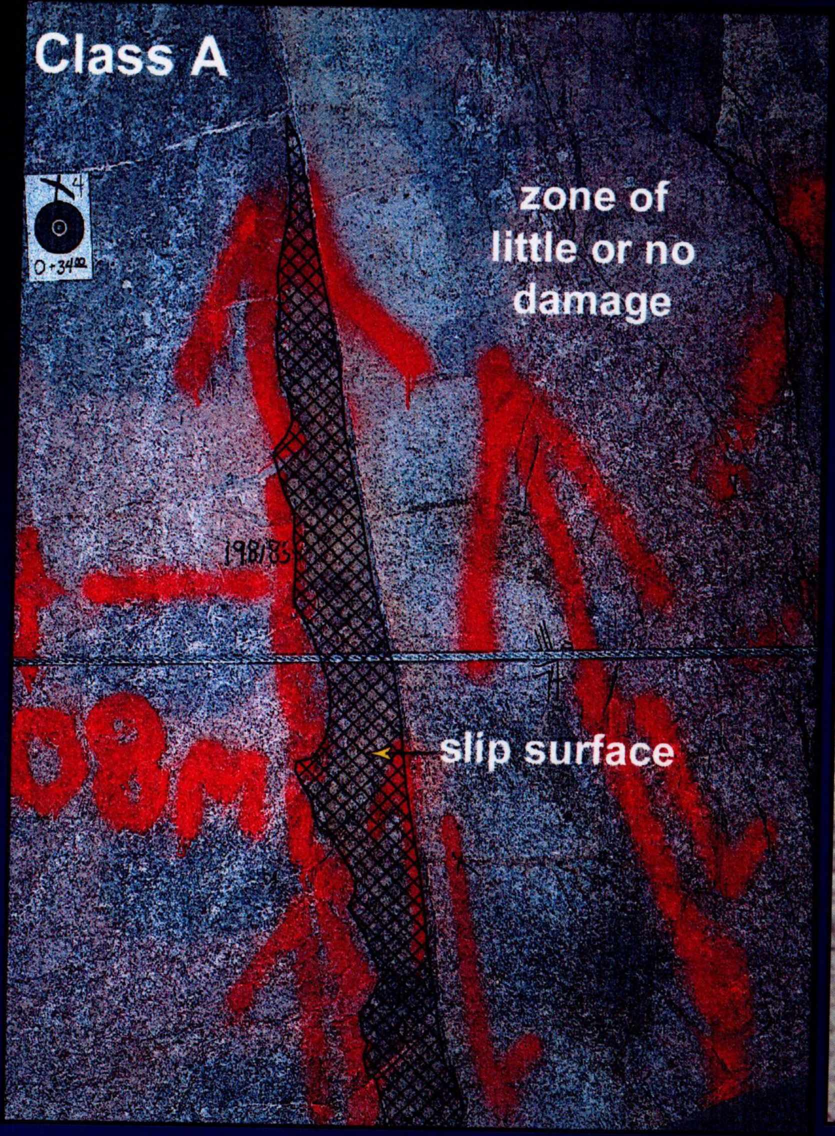


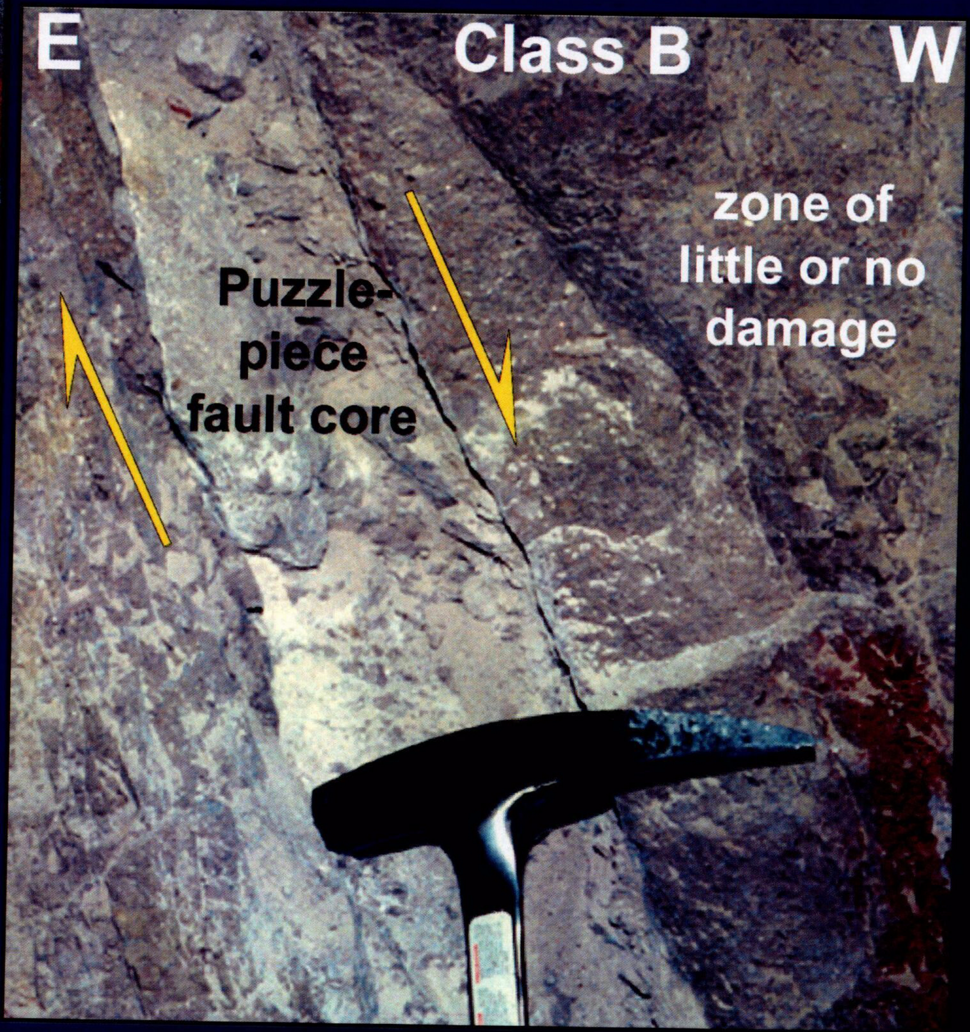
Fault Zone Classes





Photographs of Fault Zone Classes





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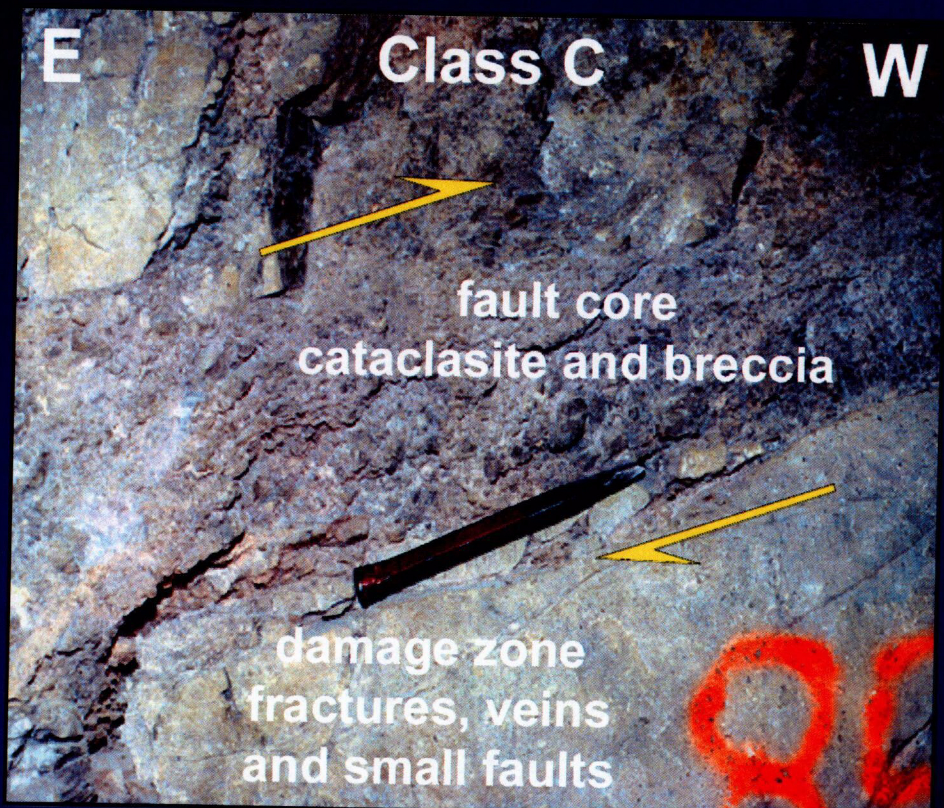
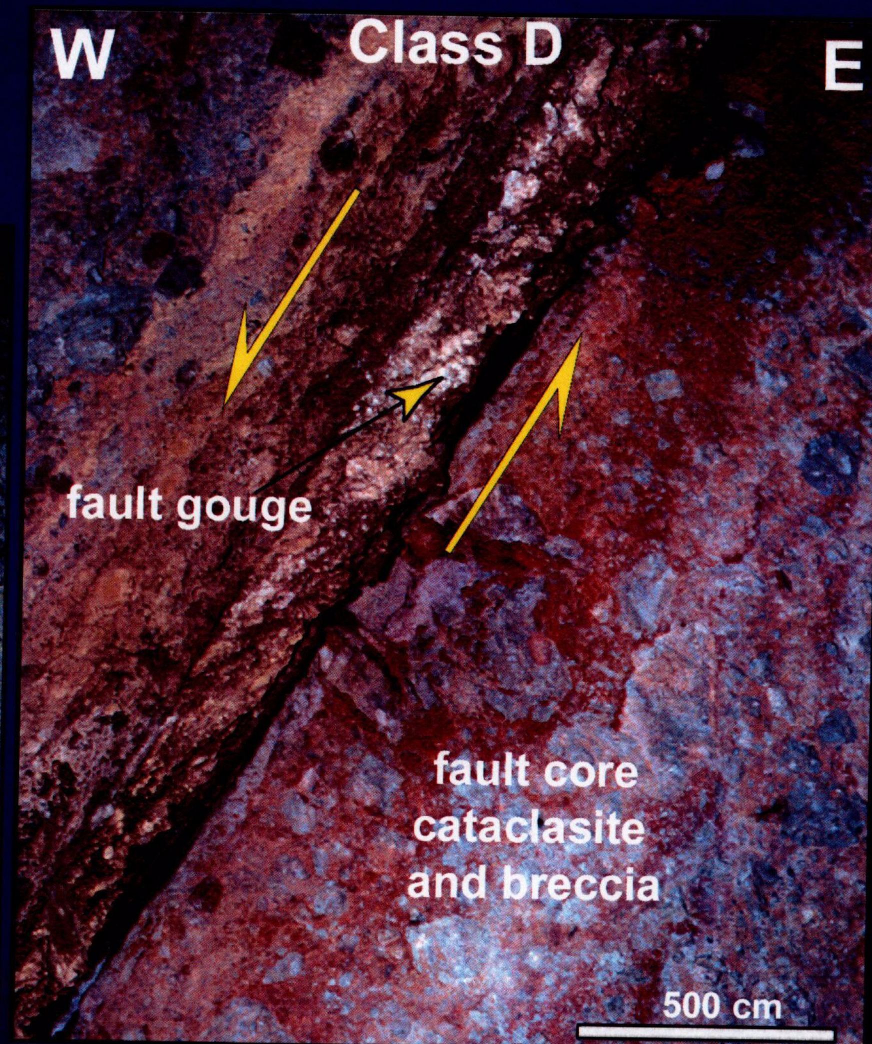
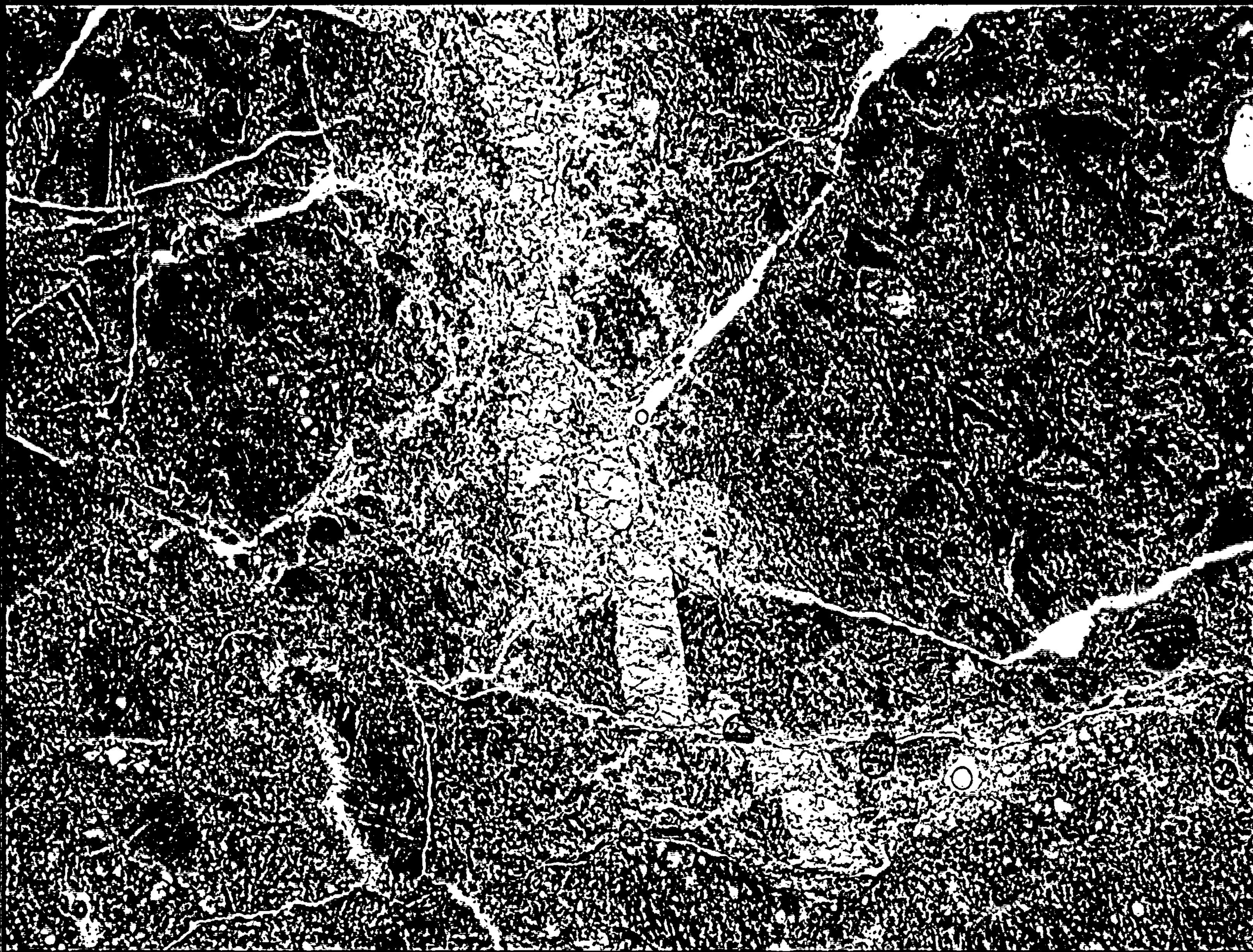


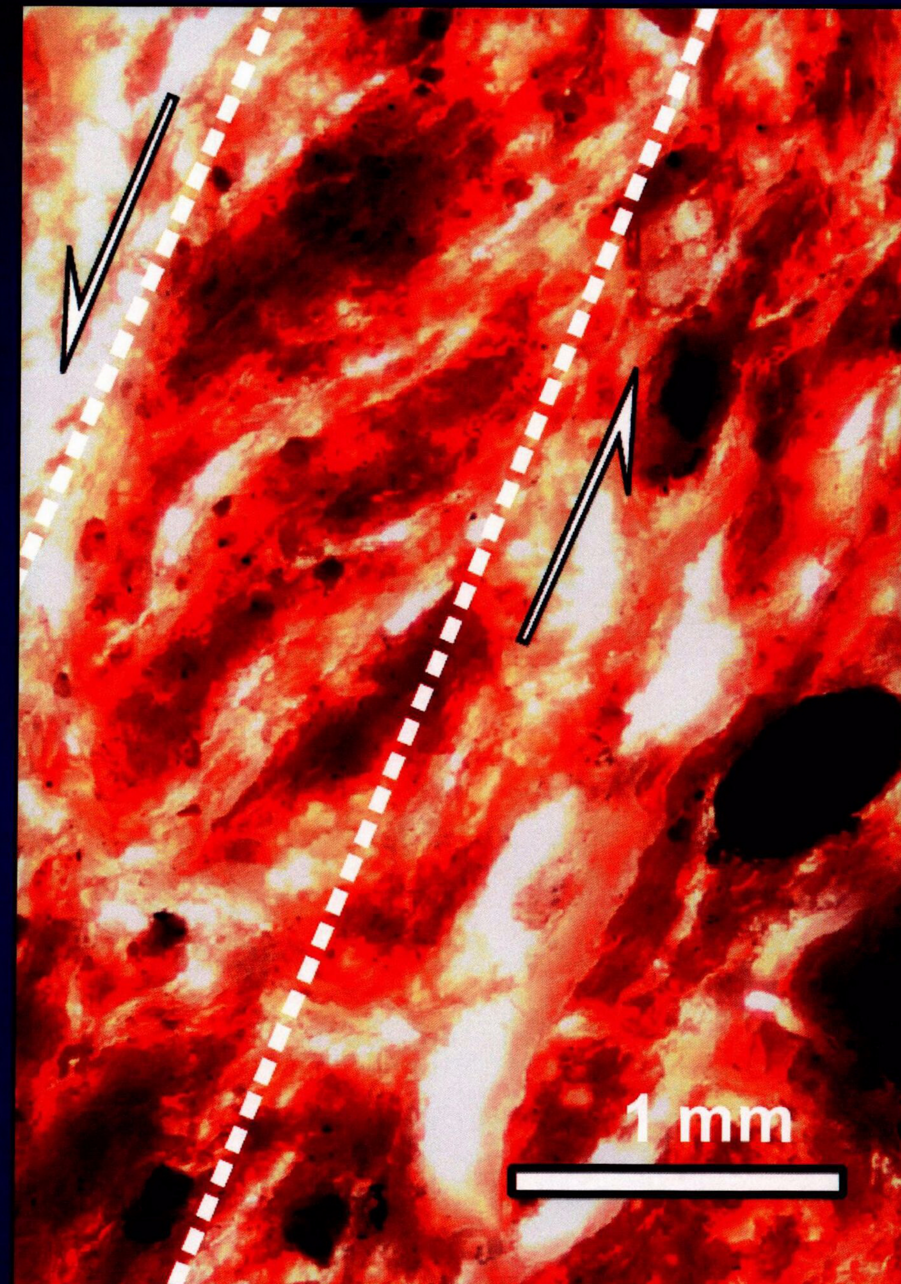


C03

Cataclasite in Sundance Fault Zone

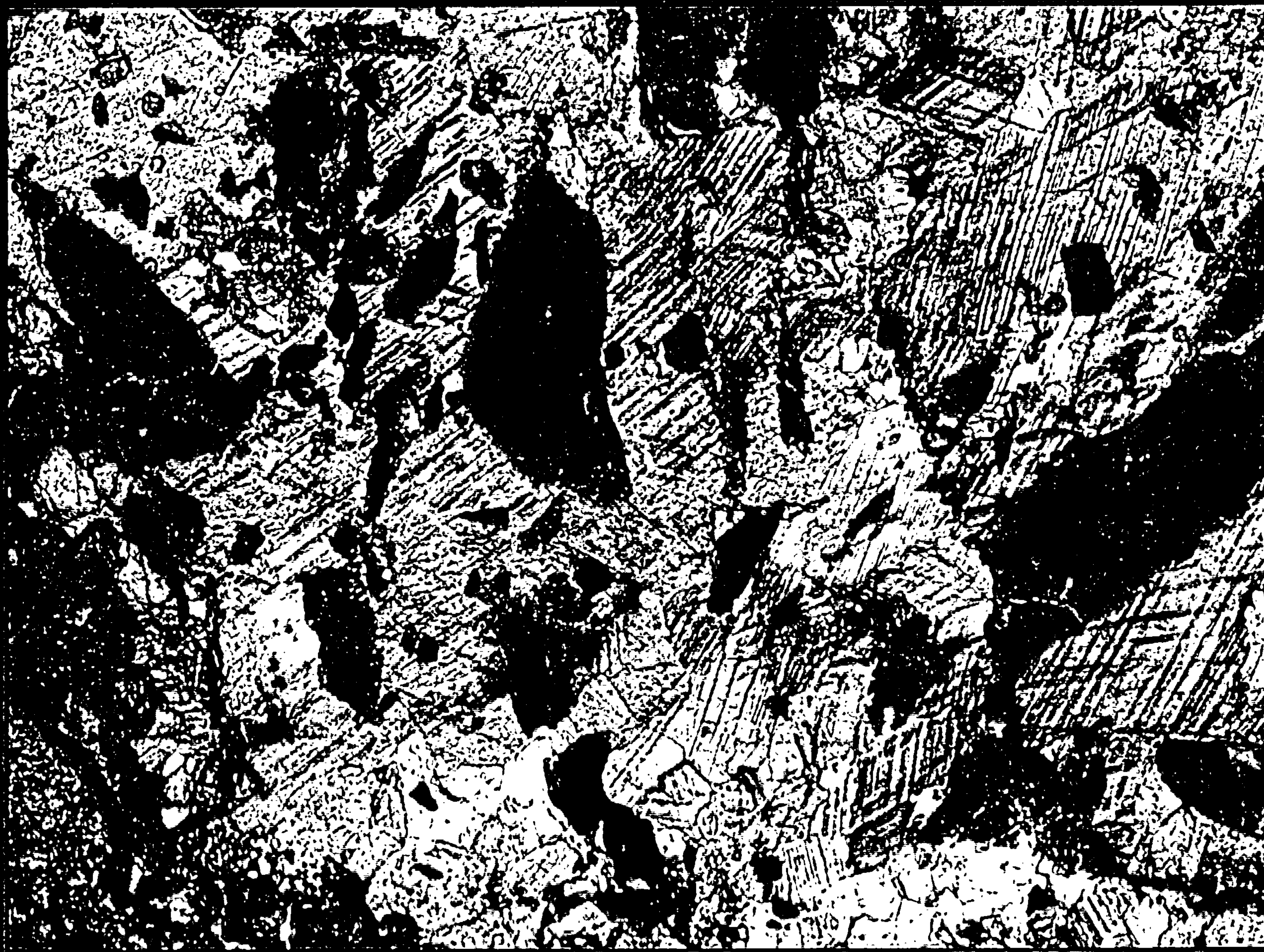


Foliated Gouge in Solitario Canyon Fault Core



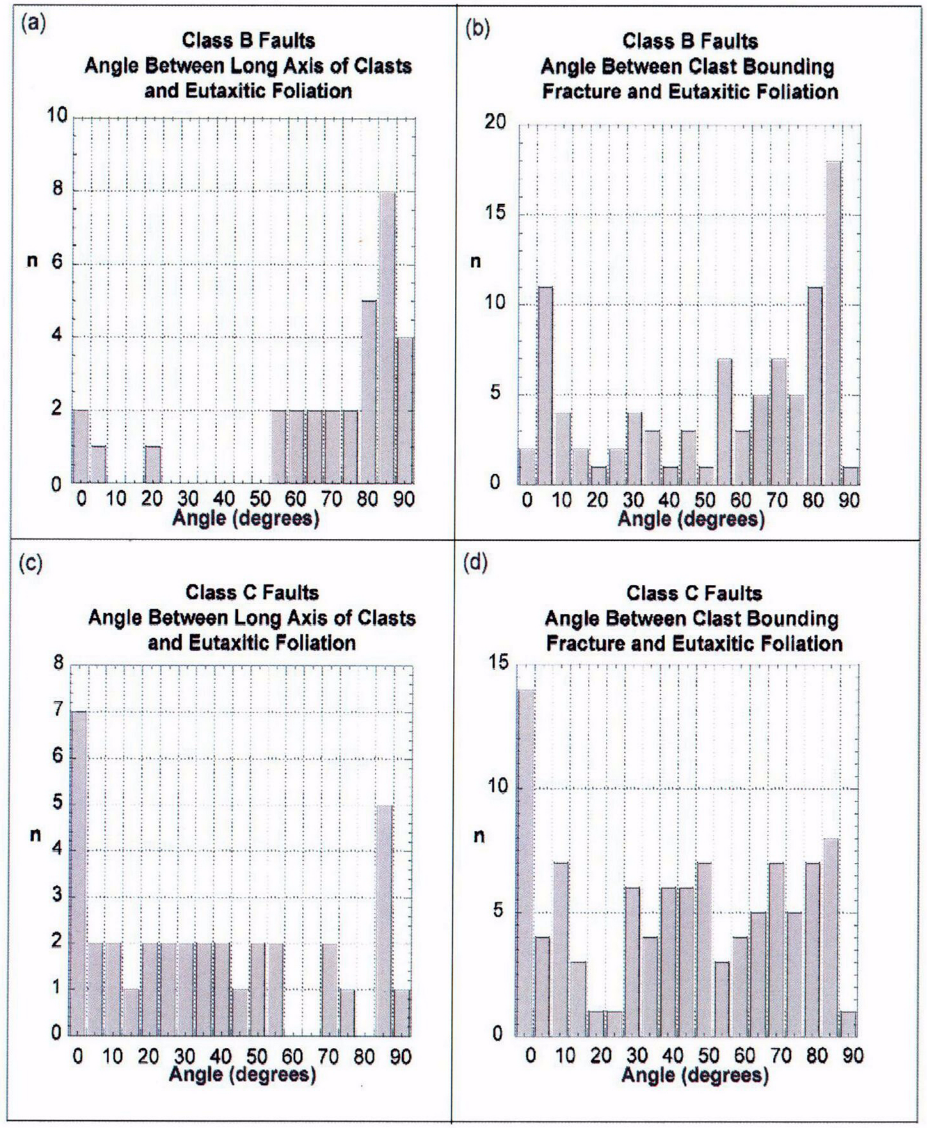
C04

Calcite Matrix from Class B Fault Zone



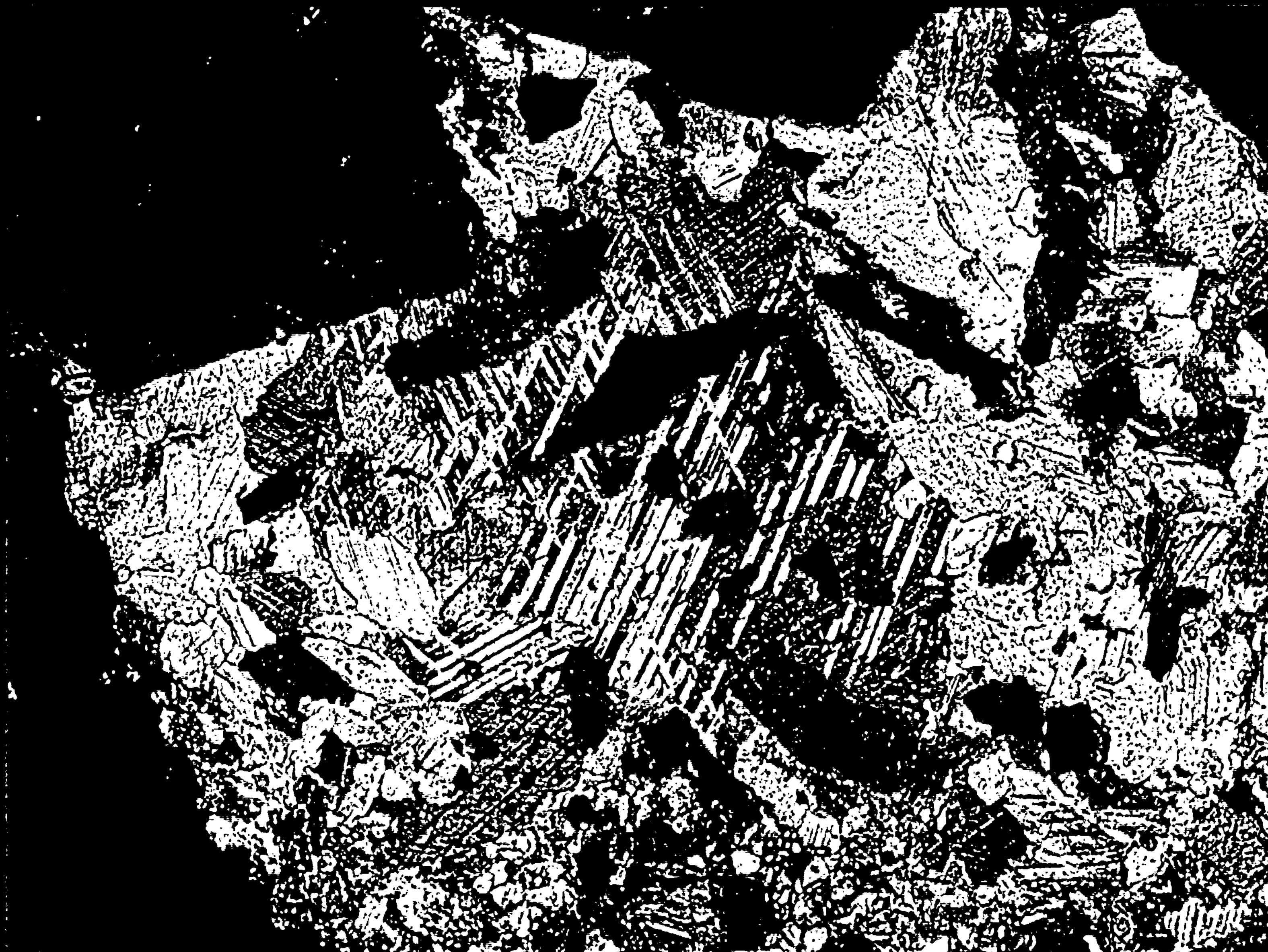
Calcite Deformation Twins

Clast Geometries

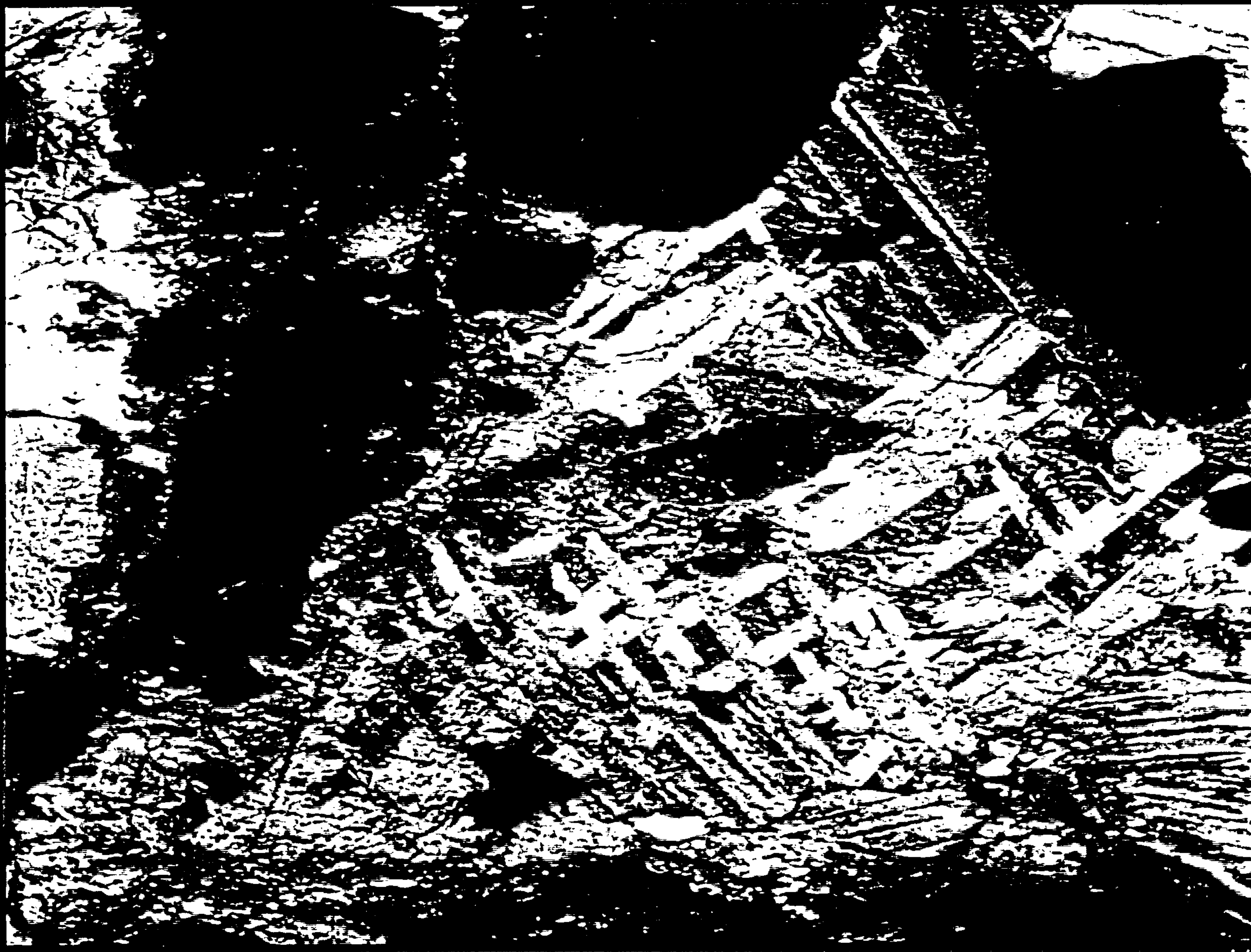


Deformed Calcite Crystal

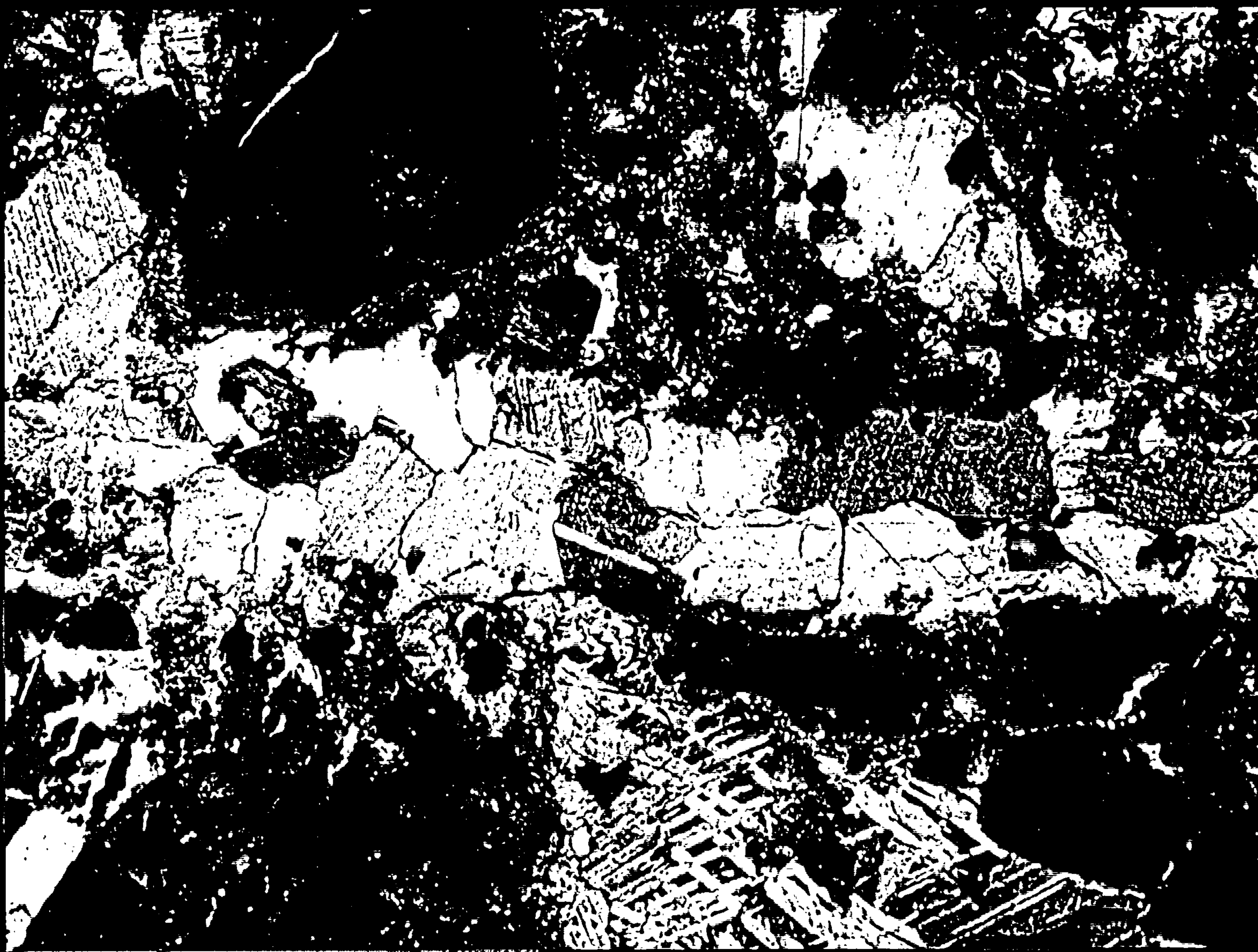
Thick Twins in Calcite Matrix Crystal



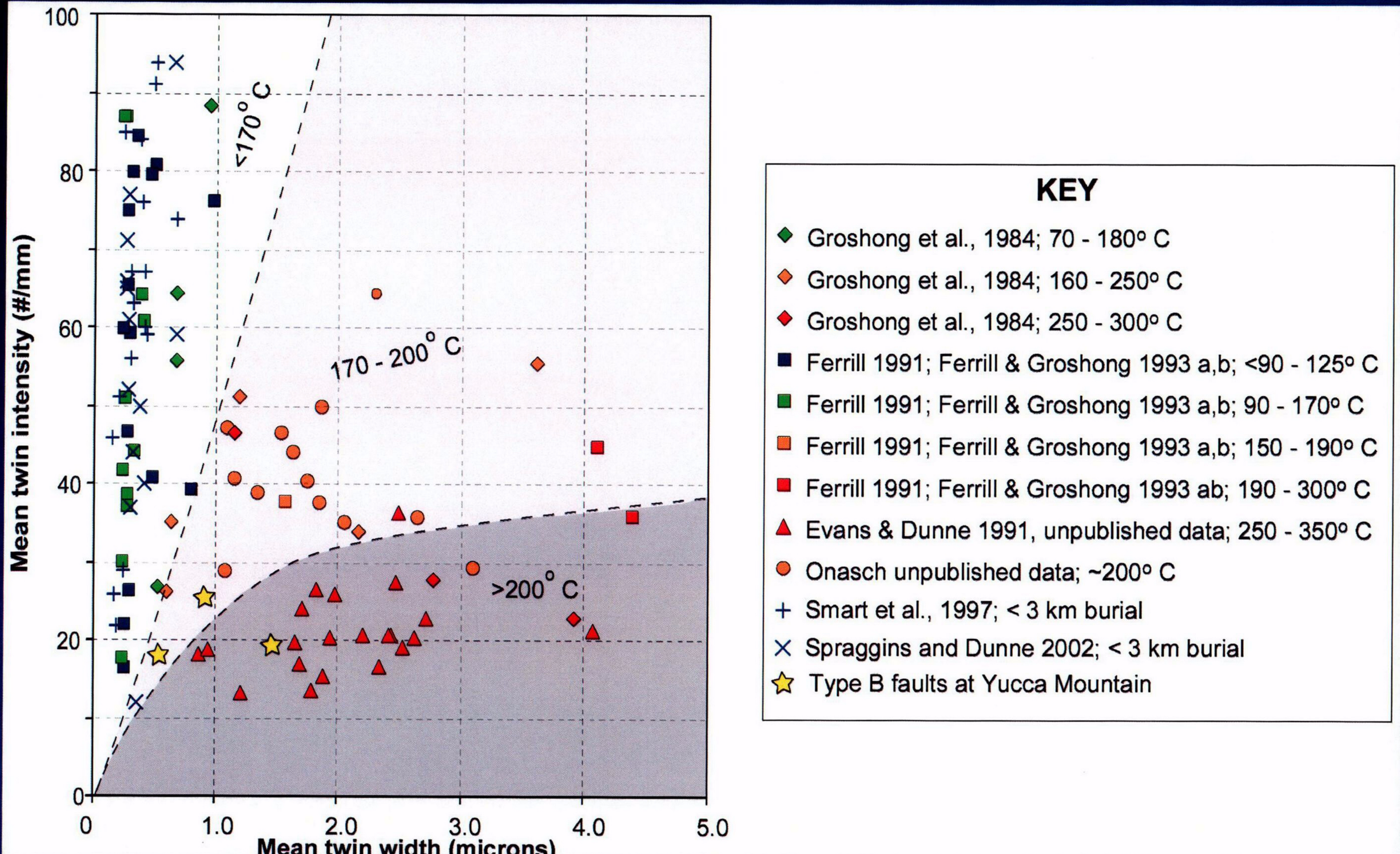
Thick Twins in Calcite Matrix Crystal



Post-Kinematic Vein

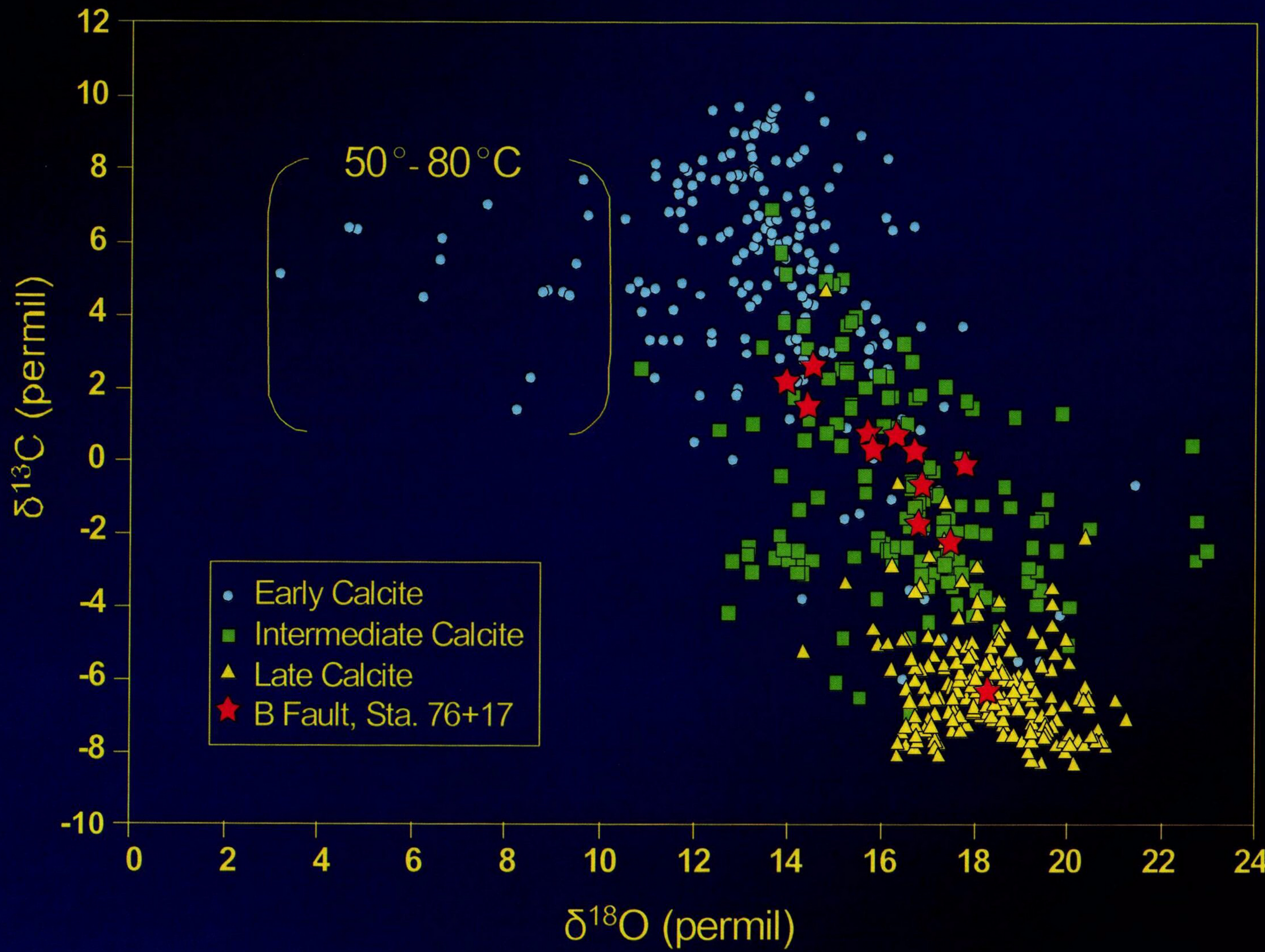


Temperature Conditions of Deformation



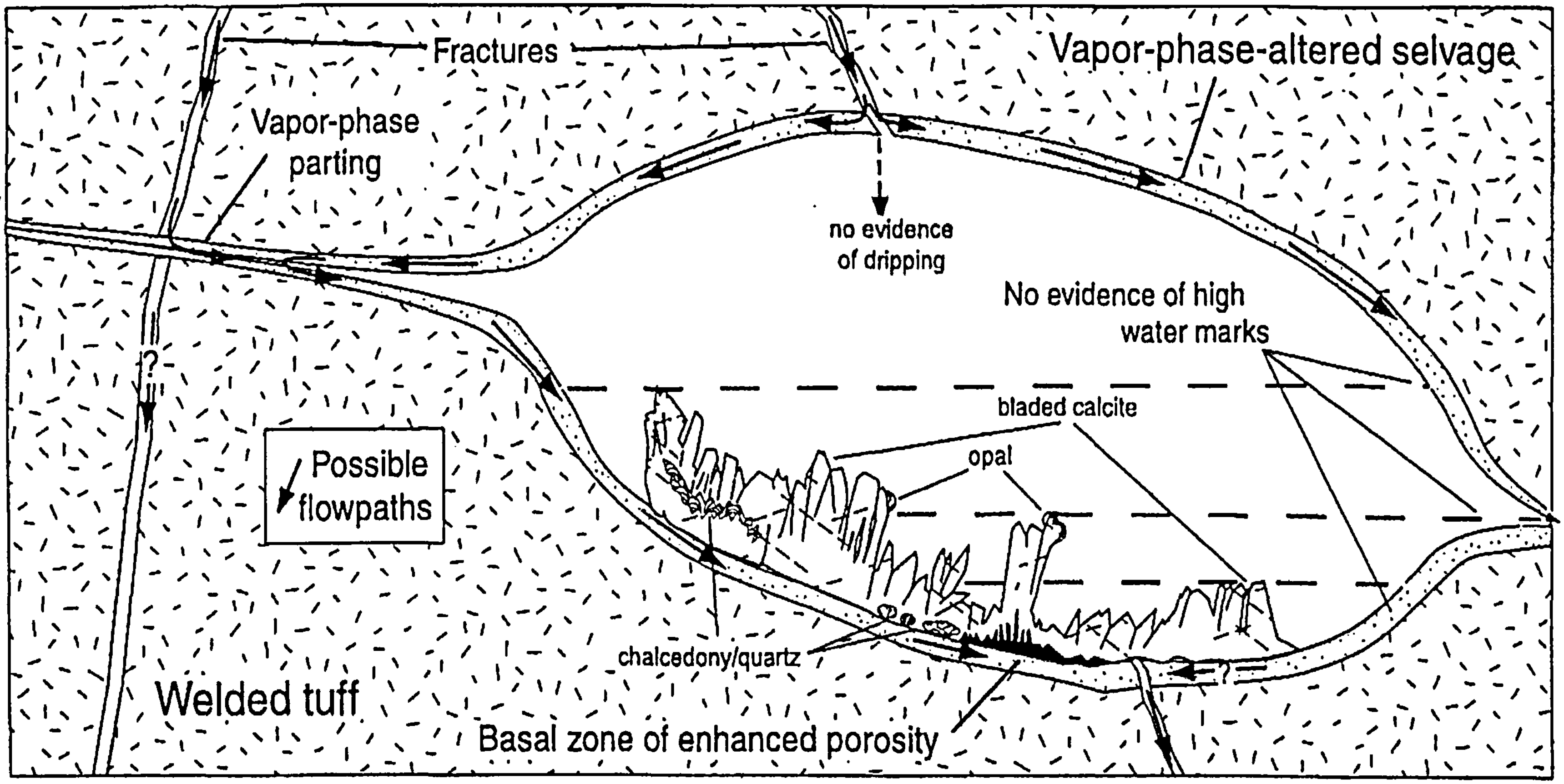
C05

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



COG

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 °C.
- The age of Class B fault zones remains unknown.