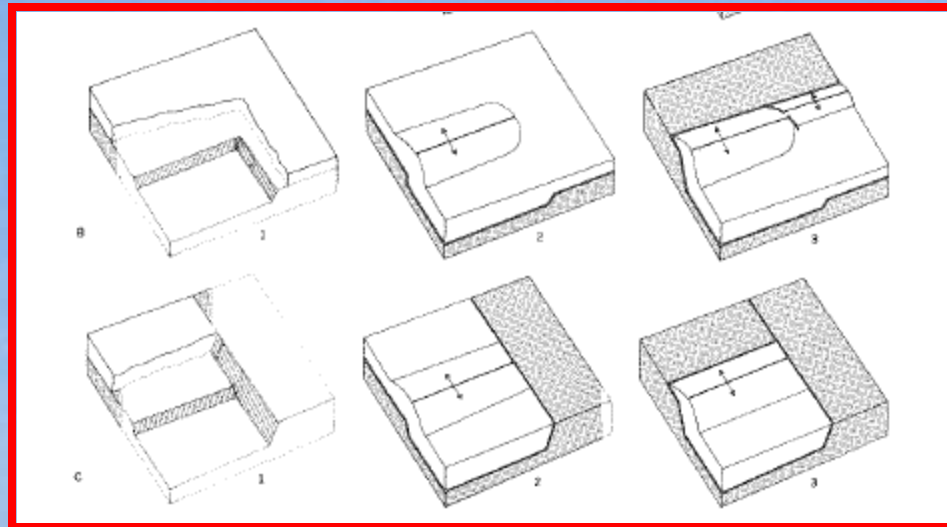


LISTRIC FAULTING AND KARST DEVELOPMENT ALONG THE YELLOW SULPHUR TRANSVERSE FAULT ZONE NEAR BLACKSBURG, VA

W.S. Henika



Block diagram illustrating fault bend fold development by varying the relationship of ramps, transverse faults and thrust faults. Modified from Leonard D. Harris, 1970

LISTRIC FAULTING AND KARST DEVELOPMENT ALONG THE YELLOW SULPHUR TRANSVERSE FAULT ZONE NEAR BLACKSBURG, VA

W.S Henika

Virginia Tech Department of Geosciences

OVERVIEW

1. *Location and Geomorphic Setting*
2. *Alleghanian Structure and Stratigraphy*
3. *Post- Alleghanian Deformation and Karst topography*
4. *Implications for Interstate Corridor Engineering*

PULASKI

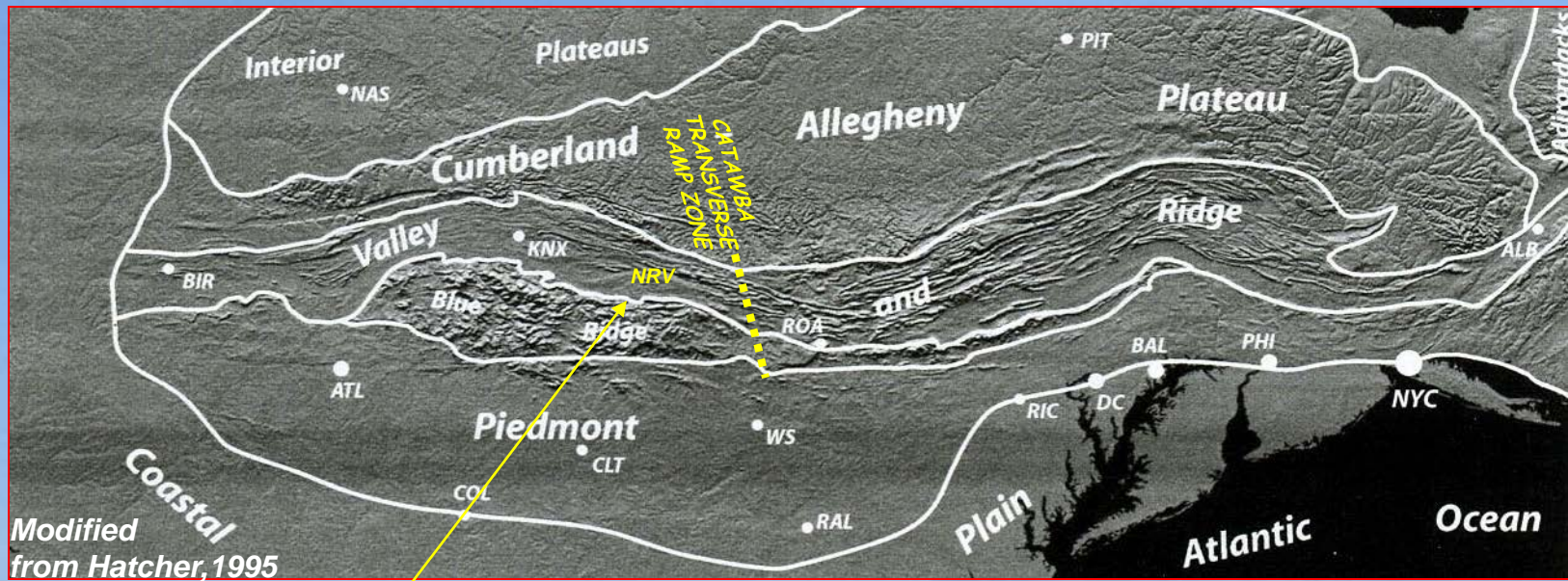
RAMP

YELLOW SULPHUR
TRANSVERSE
FAULT ZONE

CATAWBA RAMP

*View of Valley and Ridge
Topography From Poor Mountain
at the Crest of the Blue Ridge*

Blacksburg is located at the northeastern end of a high plateau that contains the New River Valley (NRV).



The New has headwaters on the Blue Ridge plateau. The river crosses into the Valley and Ridge near Fries where it follows the bow-shaped tip line of the Blue Ridge thrust front northeast to the Radford area.

THE CATAWBA TRANSVERSE RAMP ZONE IS A GEOMORPHIC FEATURE OF THE FIRST ORDER

**BRUSH MTN.
COAL FIELD**

NEW RIVER

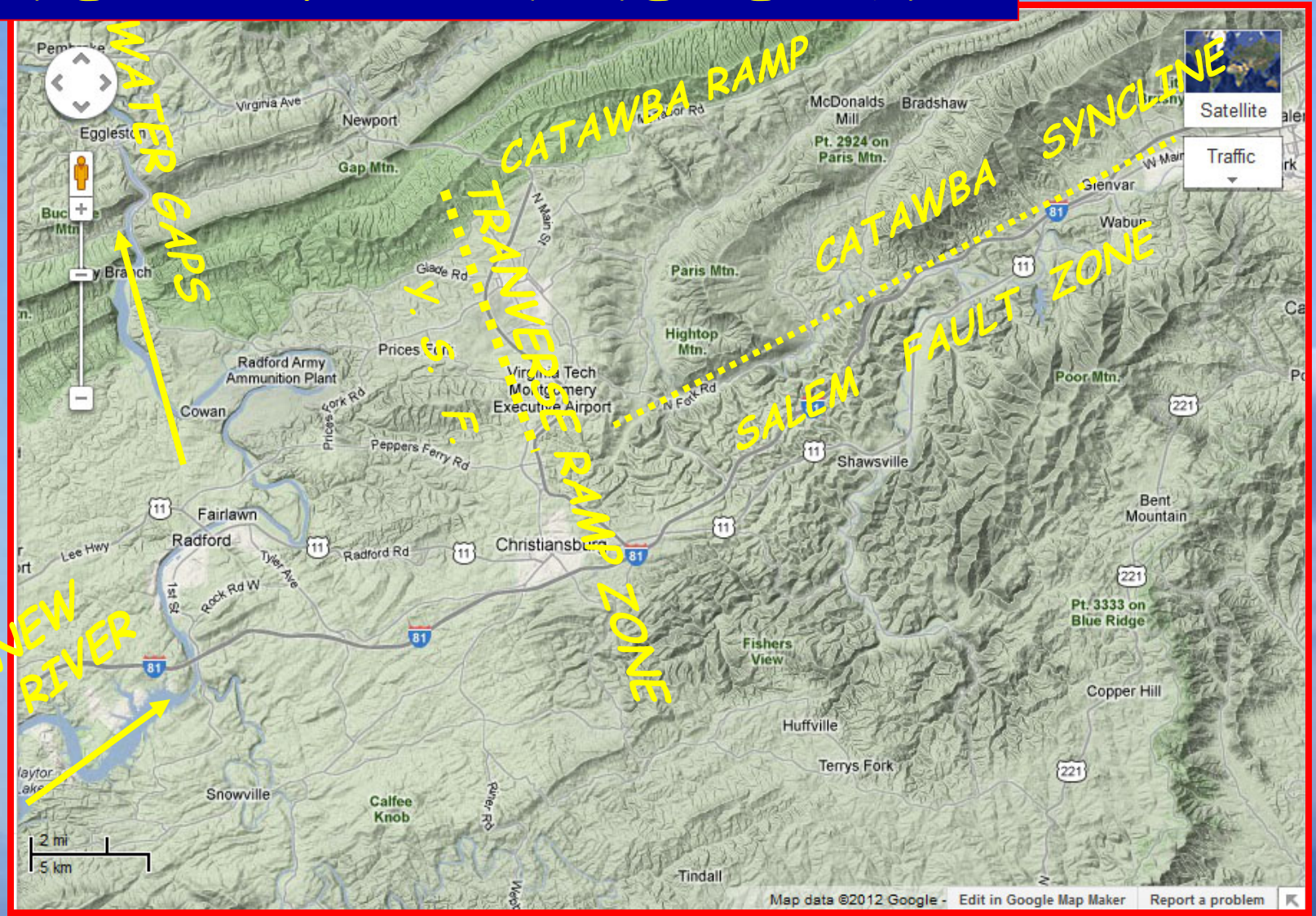
**PRICE MTN.
COAL FIELD**

ROANOKE RIVER



At Radford the New turns northwestward following fracture zones in bed rock along the SW shoulder of the Catawba transverse ramp. Beginning at an elevation of about a thousand feet above the Roanoke basin northwest of Radford the New River has cut through the Alleghany Ridges to enter the Alleghany Plateau at Narrows -finding the most direct route through the Appalachian thrust-fold belt.

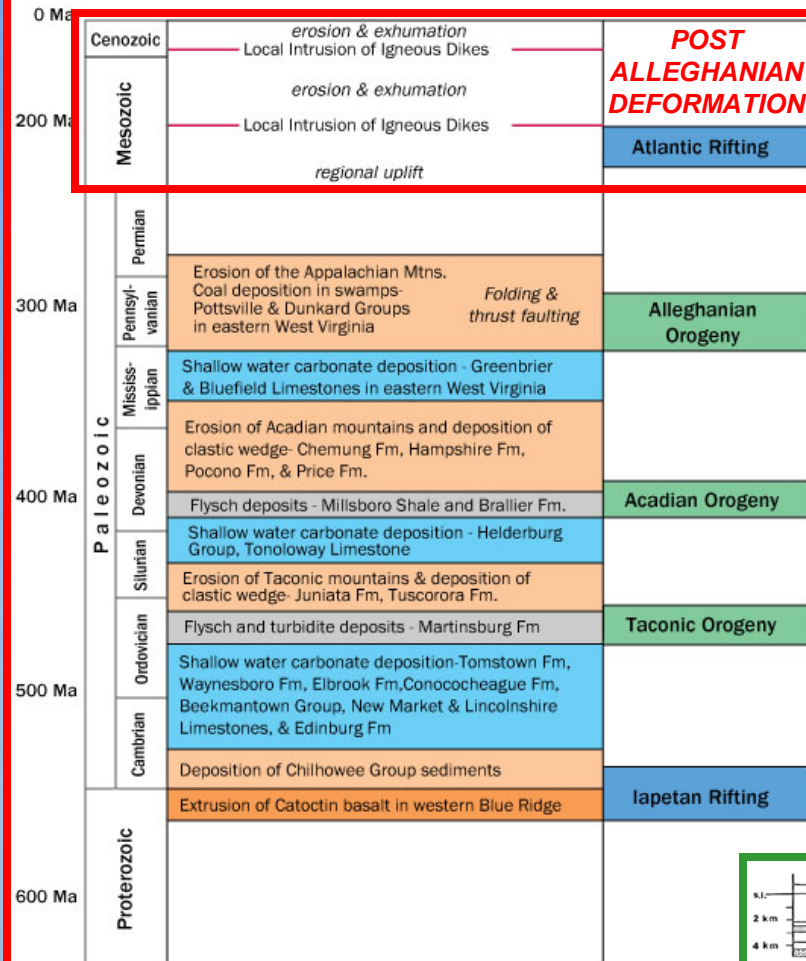
RECENT TOPOGRAPHIC EXPRESSION OF THE CATAWBA TRANSVERSE RAMP



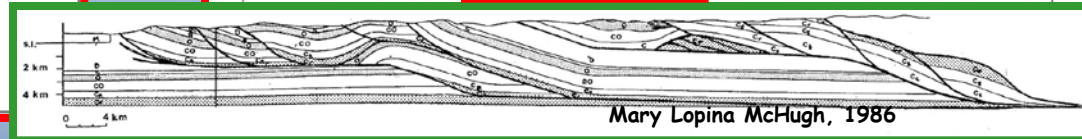
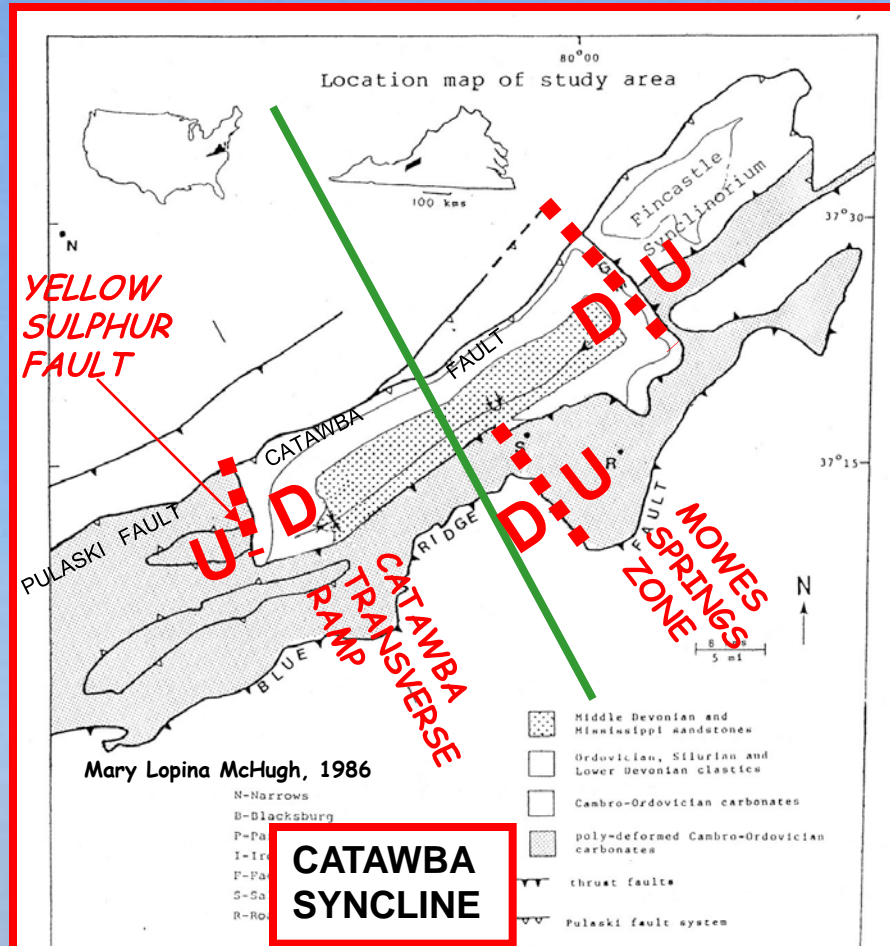
NEW RIVER TURNS NW AT TRANSVERSE RAMP ZONE

Geologic Events in the northern & central Virginia Valley & Ridge province

K. Davis & C.M. Bailey, College of William & Mary

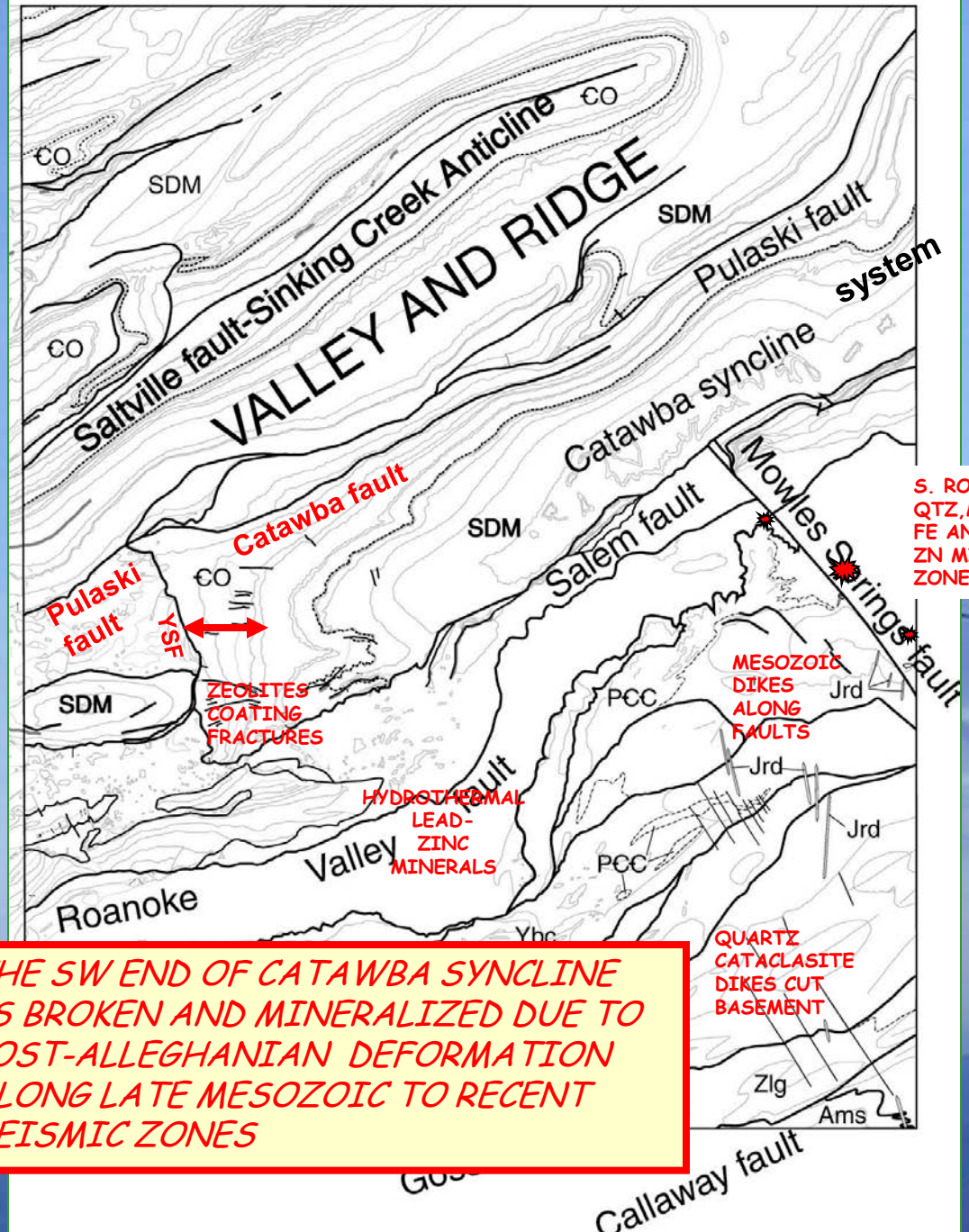
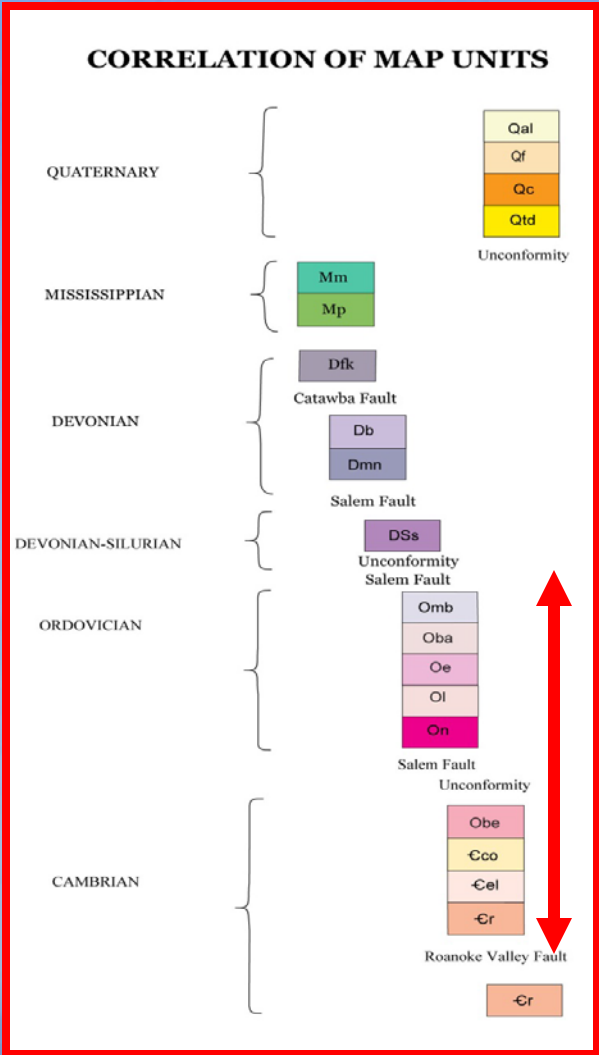


POST-ALLEGHIANIAN DEFORMATION !



THE YELLOW SULPHUR FAULT AT THE HEAD OF THE CATAWBA TRANSVERSE RAMP ZONE TRUNCATES THE SW END OF THE CATAWBA SYNCLINE AND THE PRICES MTN ANTICLINE TO THE SW!

PALEOZOIC UNITS ON THE RAMP HANGING WALL ARE LIMESTONE AND DOLOMITE



THE SW END OF CATAWBA SYNCLINE IS BROKEN AND MINERALIZED DUE TO POST-ALLEGHANIAN DEFORMATION ALONG LATE MESOZOIC TO RECENT SEISMIC ZONES

**S. ROANOKE
QTZ, MN,
FE AND
ZN MINERAL
ZONES**

**MESOZOIC
DIKES
ALONG
FAULTS**

**QUARTZ
CATACLASITE
DIKES CUT
BASEMENT**

THE SEISMICLY ACTIVE MOWLES SPRINGS TRANSVERSE RAMP ZONE IS LOCATED ABOUT 17 MILES NORTHEAST OF THE YELLOW SULPHUR TRANSVERSE FAULT ZONE. BOTH TRANSVERSE FRACTURE ZONES NEARLY IDENTICAL GEOMORPHIC SIGNATURES ALONG THE SALEM FAULT AND VERY SIMILAR ORIENTATIONS WITH RESPECT TO THE CURRENTLY OPERABLE STRESS FIELD

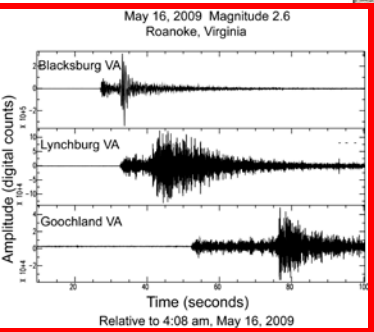
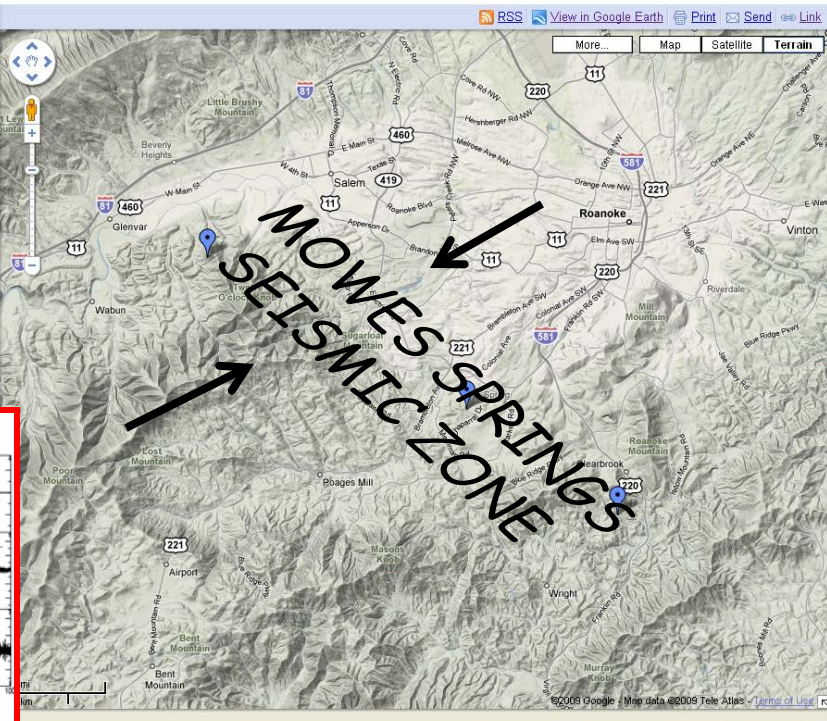
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 9 views - Public
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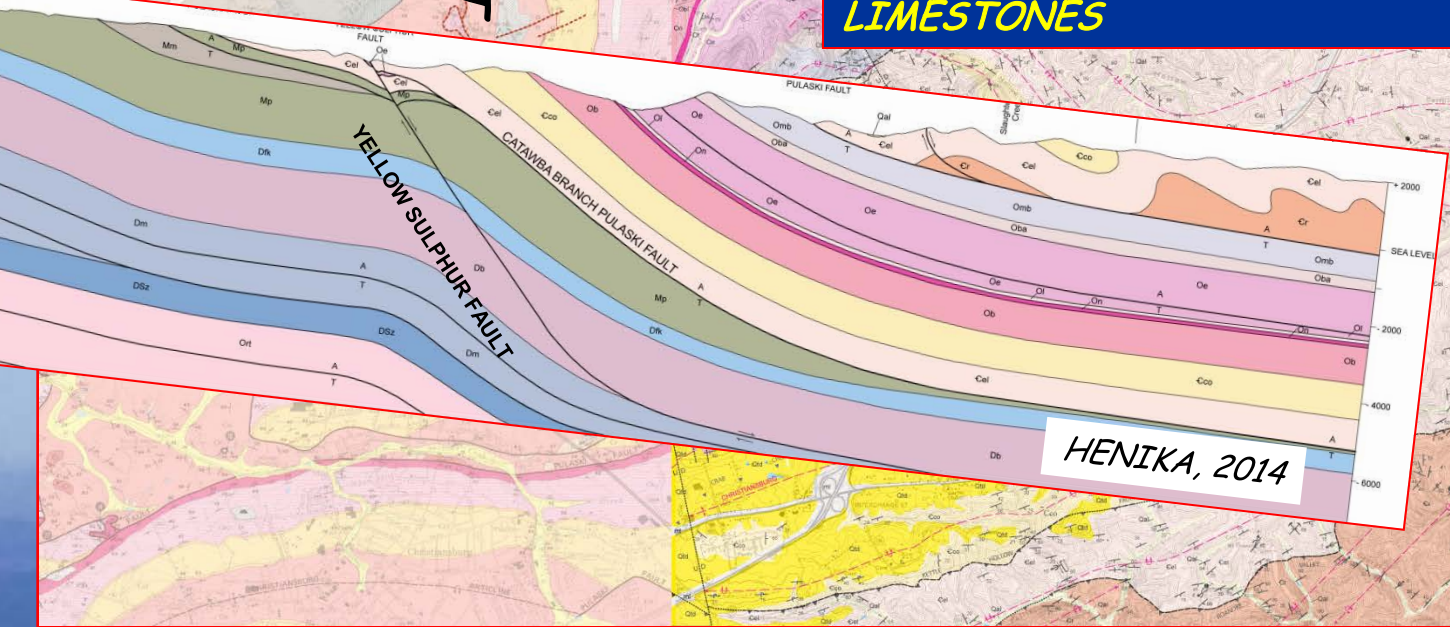
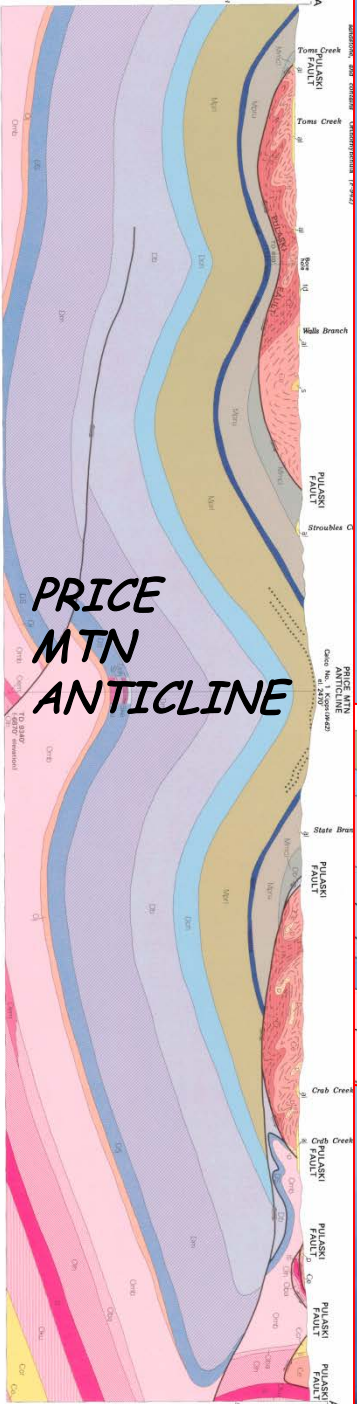
- [Cave Spring quake](#)
+37° 13' 1.92", -80° 0' 9.72"
- [12 o'clock Knob quake](#)
+37° 15' 43.20", -80° 5' 56.40"
- [Back Creek quake](#)
+37° 11' 9.60", -79° 56' 48.12"

[Report a problem](#)



**PRICE
MTN
ANTICLINE**

BARTHOLOMEW, 1979



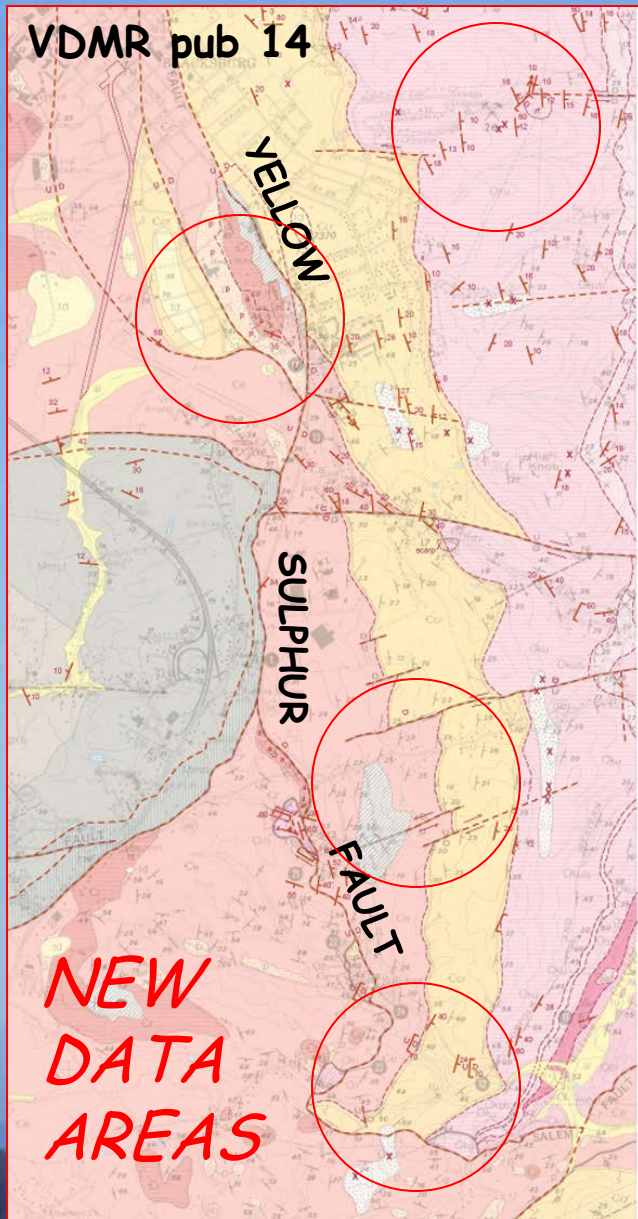
HENIKA, 2014

**NEW DIGITAL GEOLOGIC MAP
OF BLACKSBURG QUADRANGLE**

**NEW DIGITAL GEOLOGIC MAP
OF IRONTO QUADRANGLE**

**NEW GEOLOGIC PROFILES
SHOW A SERIES OF STEEP
E-W FAULT BLOCKS THAT LINK
THE YELLOW SULPHUR FAULT
WITH THE EDINBURG SHALE.
THESE LOOSE BLOCKS MAY BE
HAVE BEEN DETACHED ON
DEFORMED DEVONIAN SHALE TO
FORM A TECTONIC SLIDE DOWN
THE EAST-DIPPING 'PROW'
OF THE FLAT-BOTTOMED CATAWBA
SYNCLINE. ANOTHER POTENTIAL
DETACHMENT ZONE MAY BE
KARST FRACTURE ZONES IN THE
MIDDLE ORDOVICIAN
LIMESTONES**

RECENT EXUMATION OF NORMAL FAULTS, ROLLOVER FOLDS, AND EPIKARST FISSURES ALONG THE CATAWBA TRANSVERSE RAMP AT YELLOW SULPHUR



Bartholomew compiled the Blacksburg quad geology from Ritter's 1963 MS research but favored an East dipping Yellow Sulphur fault (above).

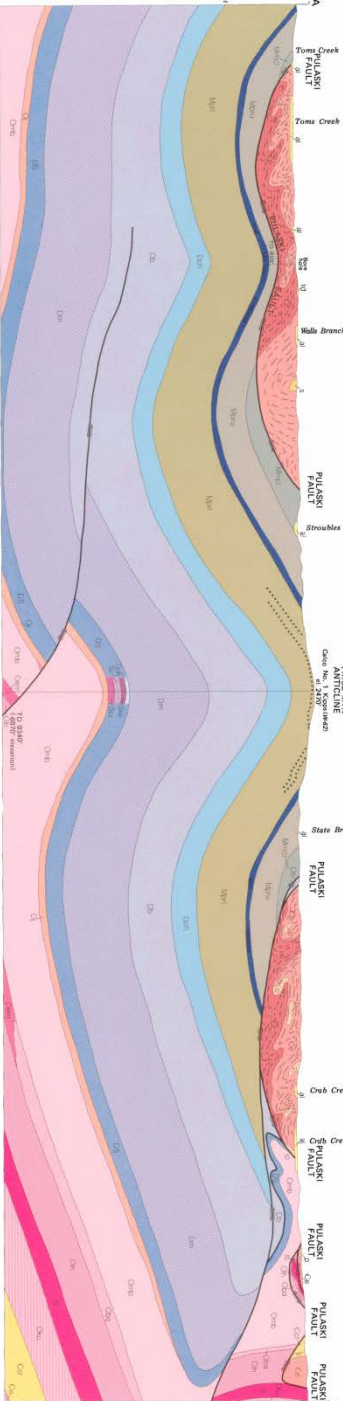
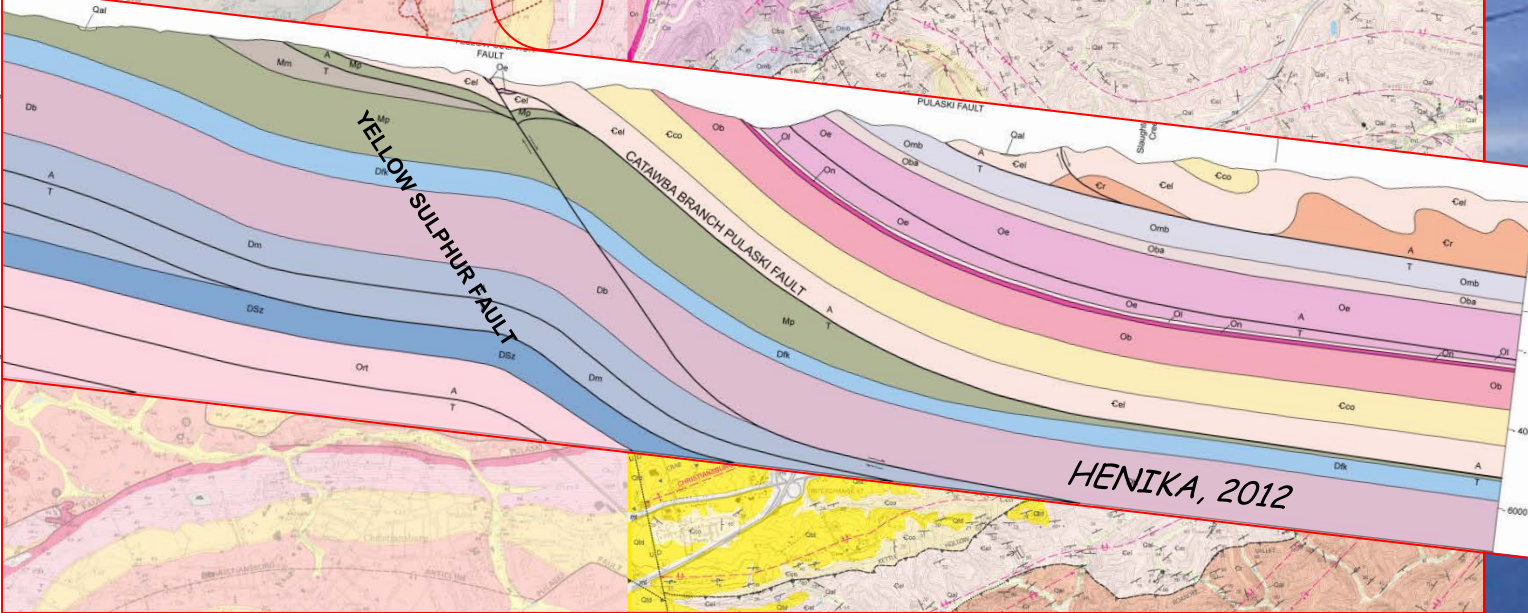
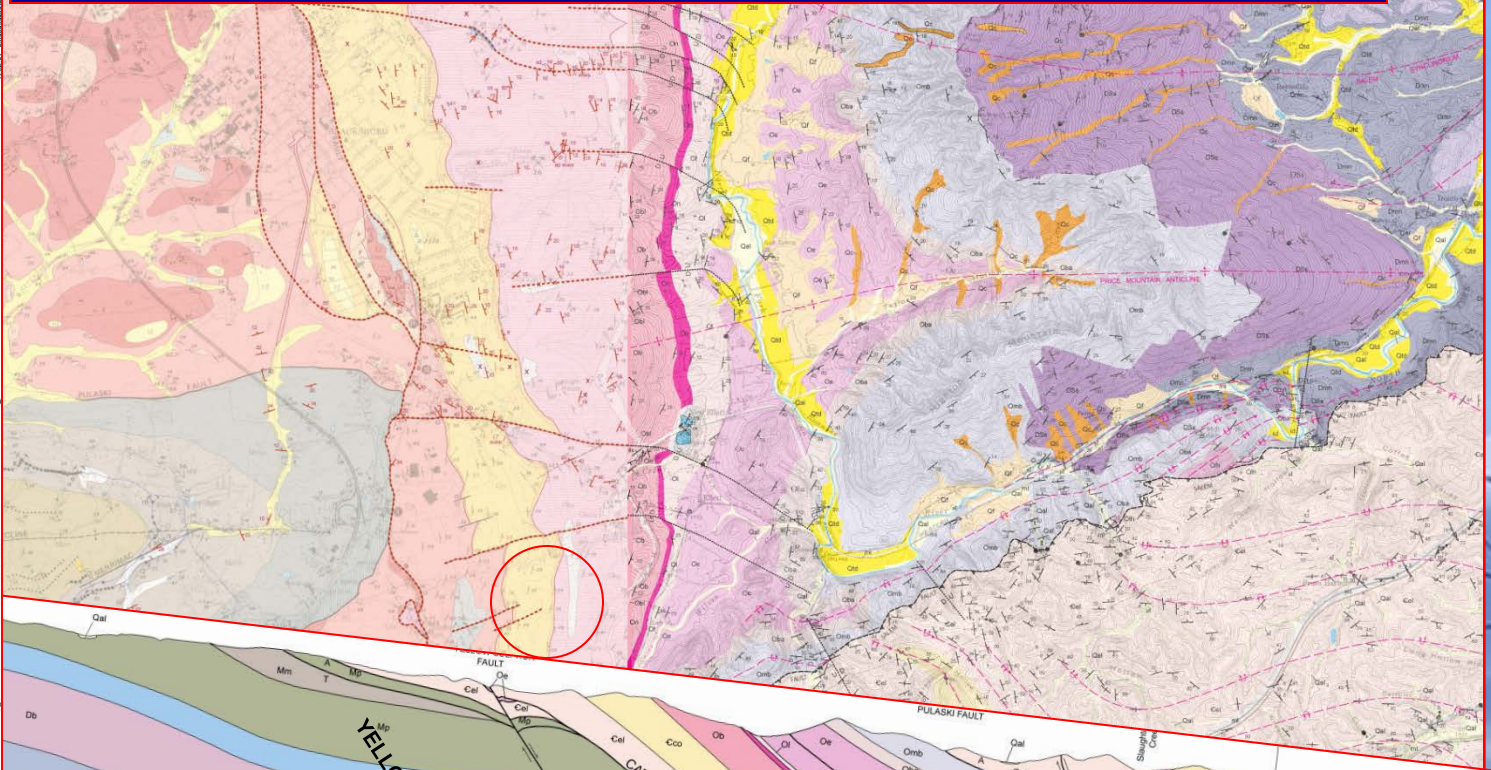


The west dip noted near Yellow Sulphur Station is an antithetic imbrication of less than 100 m. stratigraphic throw within the Elbrook Formation. East dipping detachments are more common on The Catawba Ramp.



CUTS ARE STEEP AND TRAINS ARE FAST! DON'T GO THERE.

THE VIRGINIA TECH SMART ROAD WAS A MAIN STOP ON OUR 50TH HIGHWAY GEOLOGY SYMPOSIUM FIELD TRIP



BARTHOLOMEW, 1979

HENIKA, 2012

ROBIN REED'S RU MS GAVE US A 'FIRST LOOK'

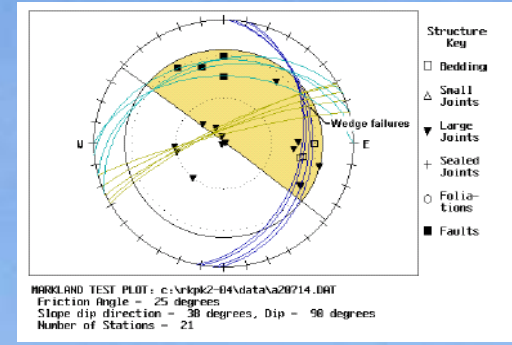
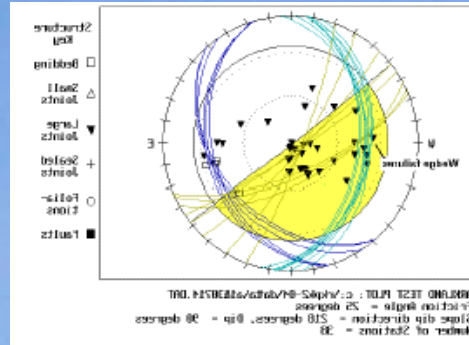


Smart Road Deep Cut Looking North /Northeast. "Possible Fault Zone With Highly Fractured Rock ... Major Instability".

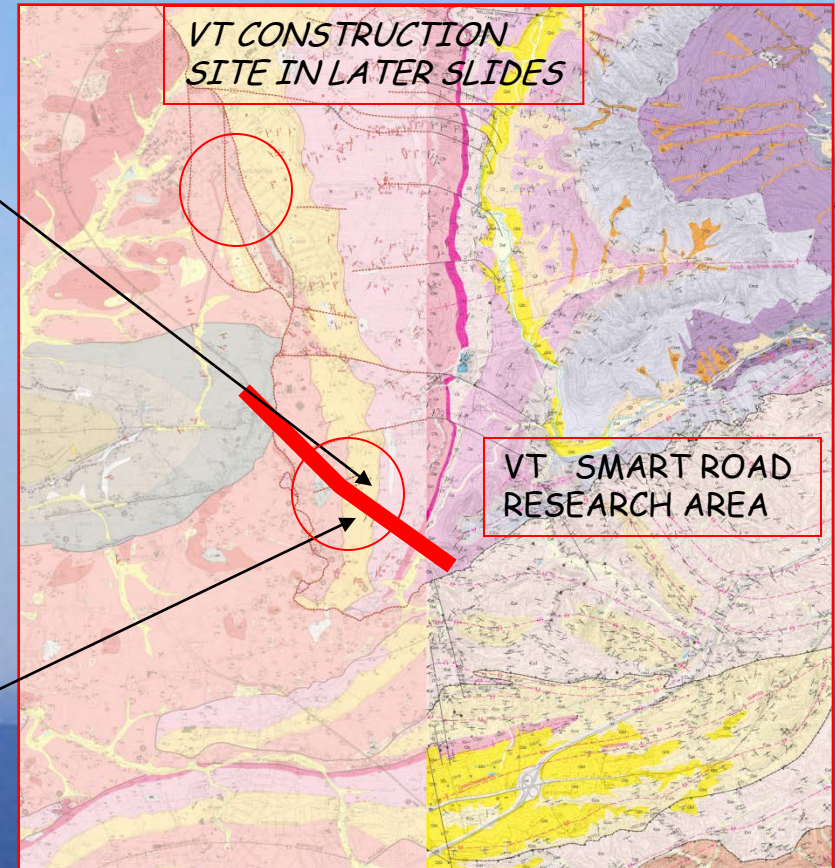


ZEOLITE COATING
BEDDING PLANES

Smart Road Deep Cut Looking Southwest "Highly Unstable"



MARKLAND PLOTS HIGHLIGHT UNSTABLE SLOPES



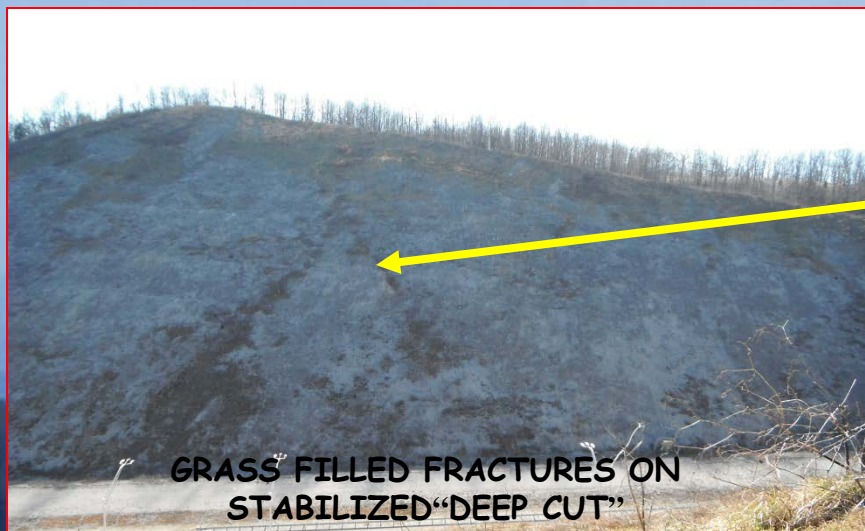
VT CONSTRUCTION SITE IN LATER SLIDES

VT SMART ROAD RESEARCH AREA

THE VIRGINIA TECH SMART ROAD WAS STABILIZED AFTER A CAREFUL GEOTECHNICAL STUDY BY ROBIN REED



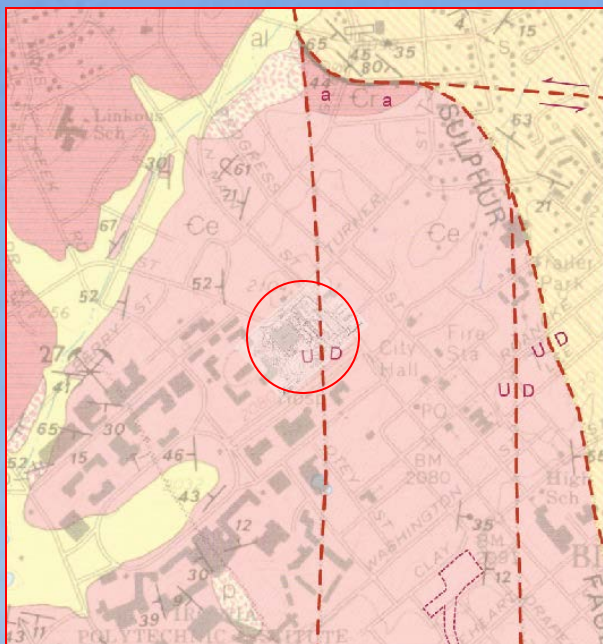
“BEYOND THE SMART ROAD” FRACTURE TRACED TO NE ALONG TRANSVERSE RAMP INTO EPIKARST .



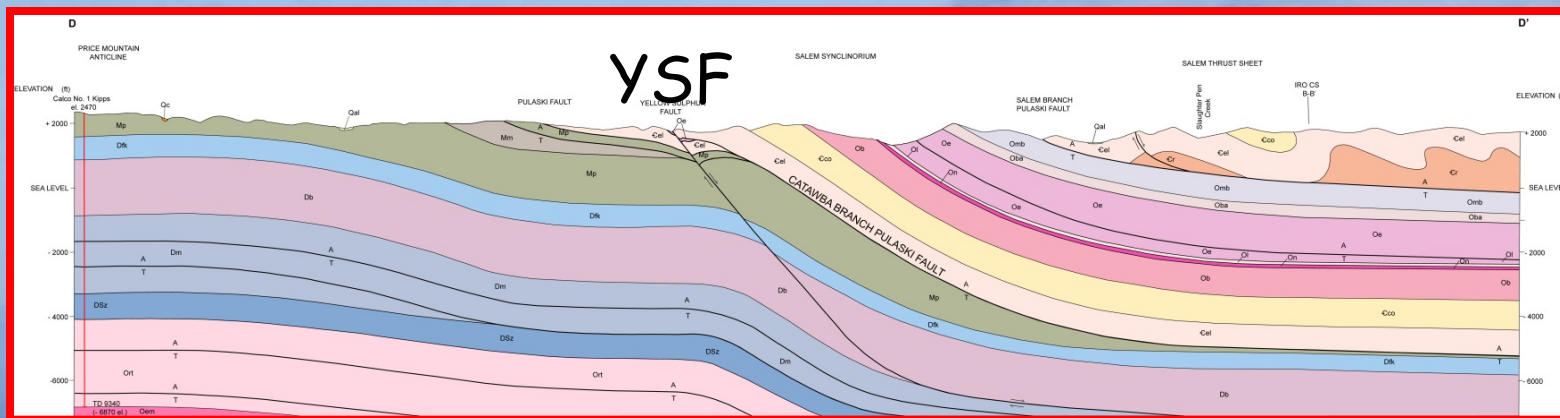
GOOGLE EARTH VIEW OF “DEEP CUT” IN 2012.



CORE DRILLING AT THE VIRGINIA TECH CENTER FOR PERFORMING ARTS PROVIDES NEW INSIGHT INTO STRUCTURE AND STRATIGRAPHY ON THE PULASKI THRUST SHEET.



NEW CENTER FOR THE PERFORMING ARTS ADJACENT TO SCHULTZ HALL

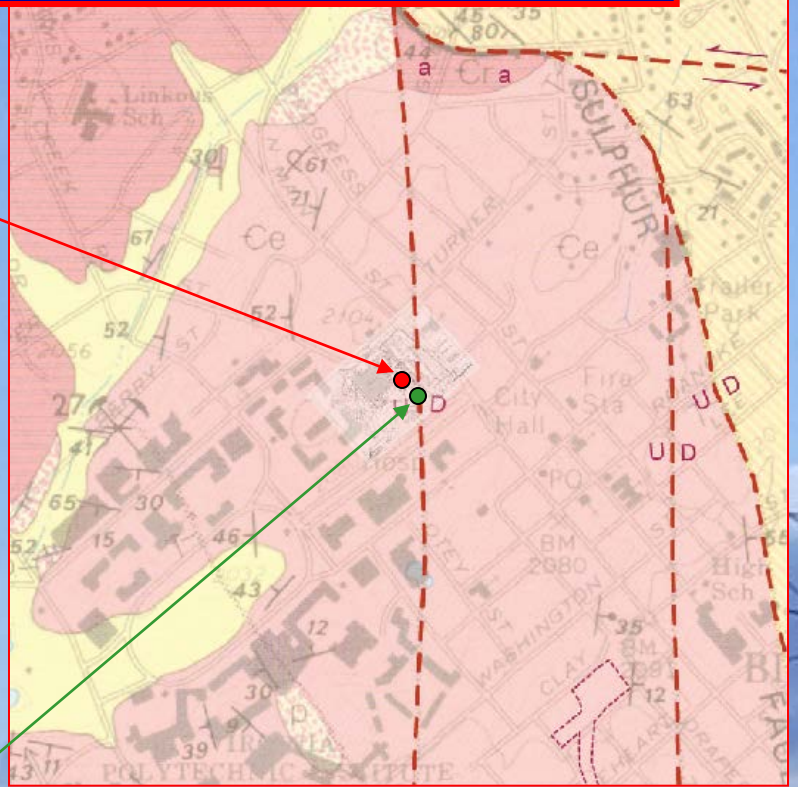


50 km of new detailed geologic profiles along streams, road and railway cuts, gas exploration bore holes and diamond drill core support Ritter's Preferred interpretation that the YSF has an eastward dip.

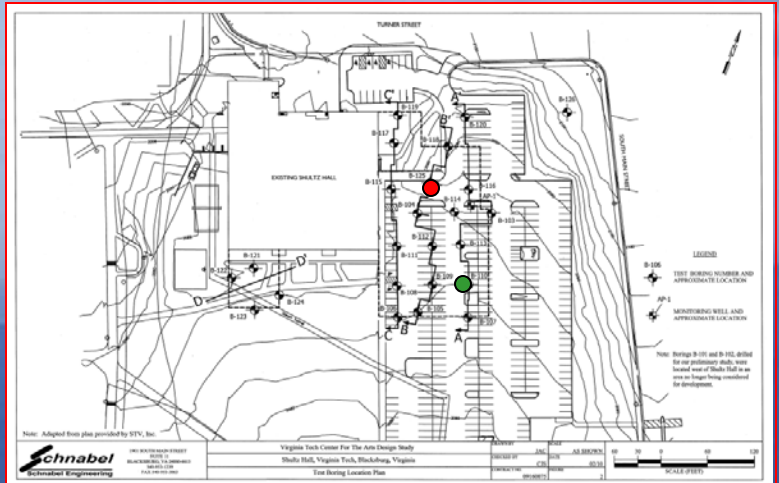
NEW CONSTRUCTION LEADS TO BETTER UNDERSTANDING



Calcite-filled extension fractures (gash veins) in upper Elbrook dolomite footwall of the Yellow Sulphur fault

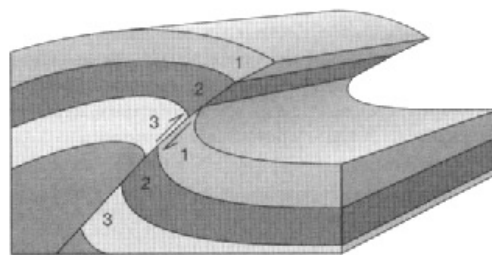
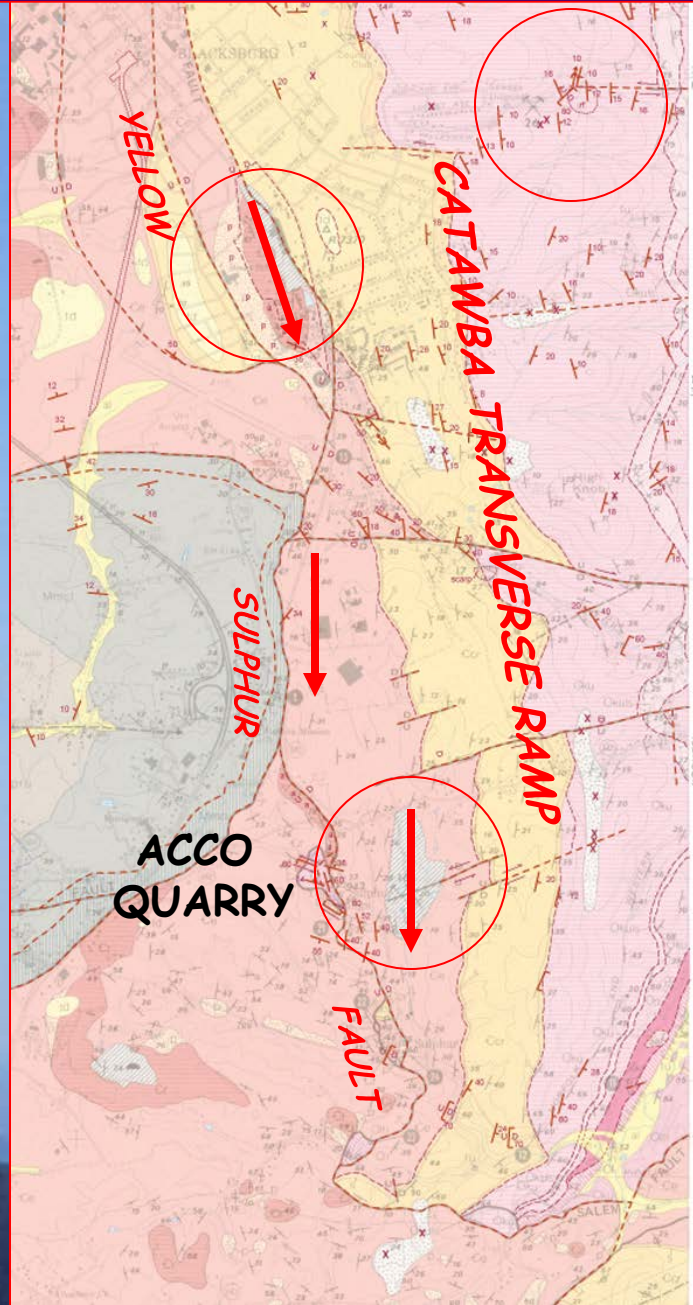


Highly macerated ductile phyllite - breccia from lower Elbrook
Typical of basal detachment in Pulaski system exposed in new I81
Climbing lane cuts!

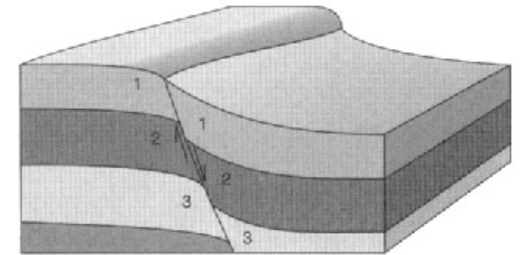


COURTESY OF SCHNABEL ENGINEERING

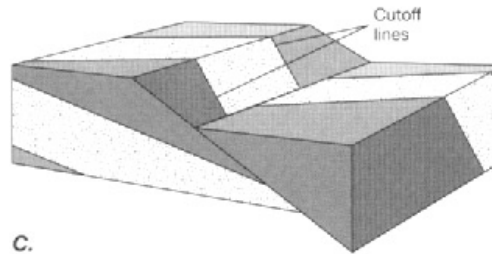
RECENT EXHUMATION OF NORMAL FAULTS, ROLLOVER FOLDS, AND EPIKARST FISSURES ALONG THE CATAWBA TRANSVERSE RAMP ZONE



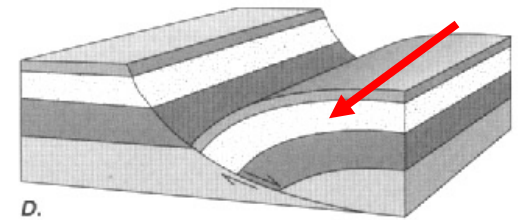
A.



B.



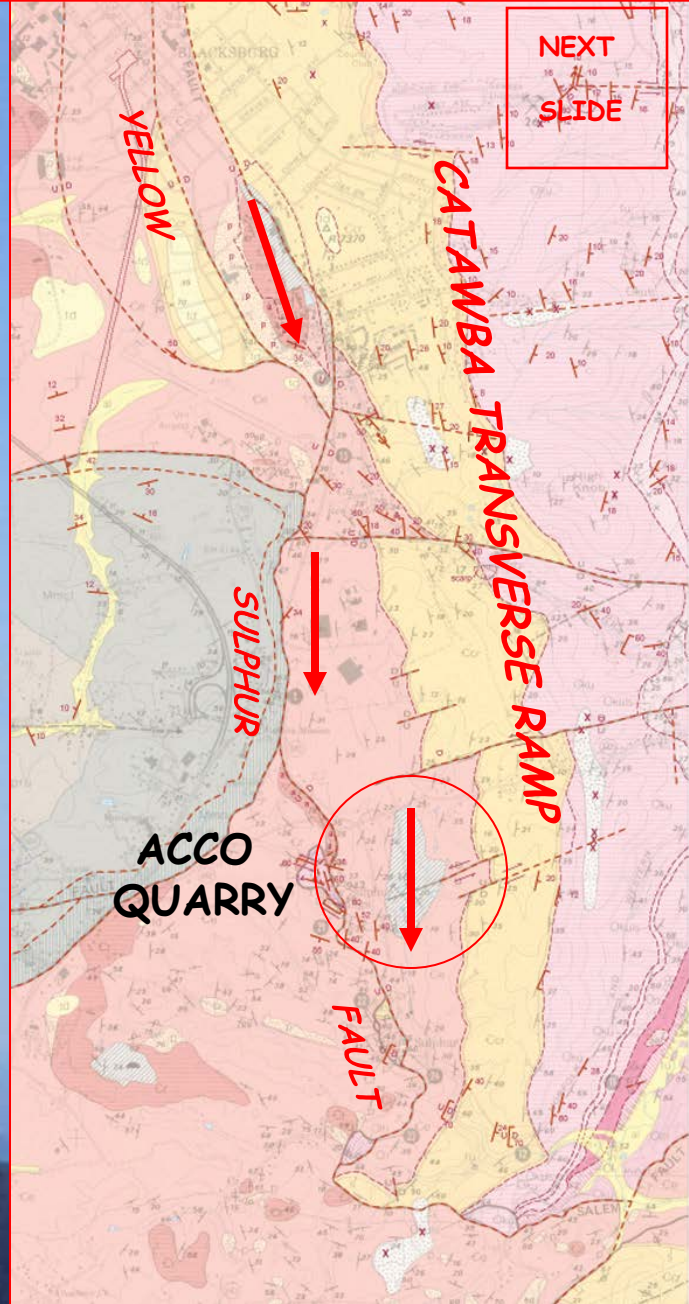
C.



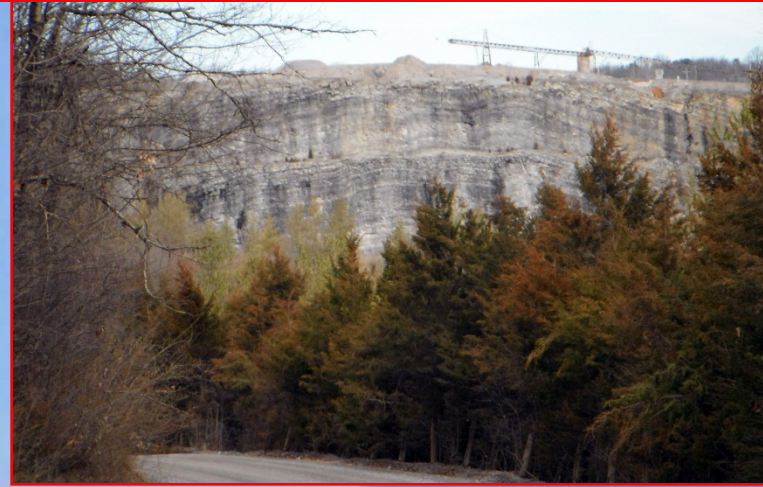
D.

FOLDING ASSOCIATED WITH LISTRIC FAULTING

RECENT EXHUMATION OF NORMAL FAULTS, ROLLOVER FOLDS, AND EPIKARST FISSURES ALONG THE CATAWBA TRANSVERSE RAMP ZONE



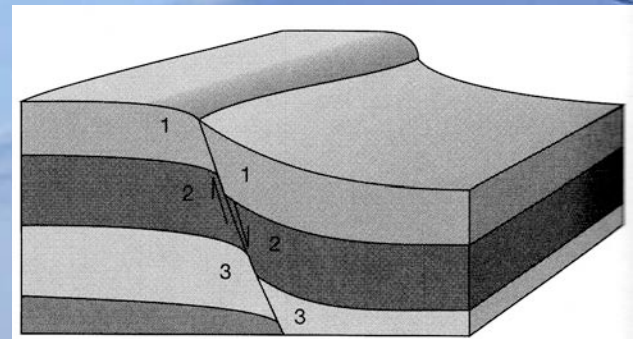
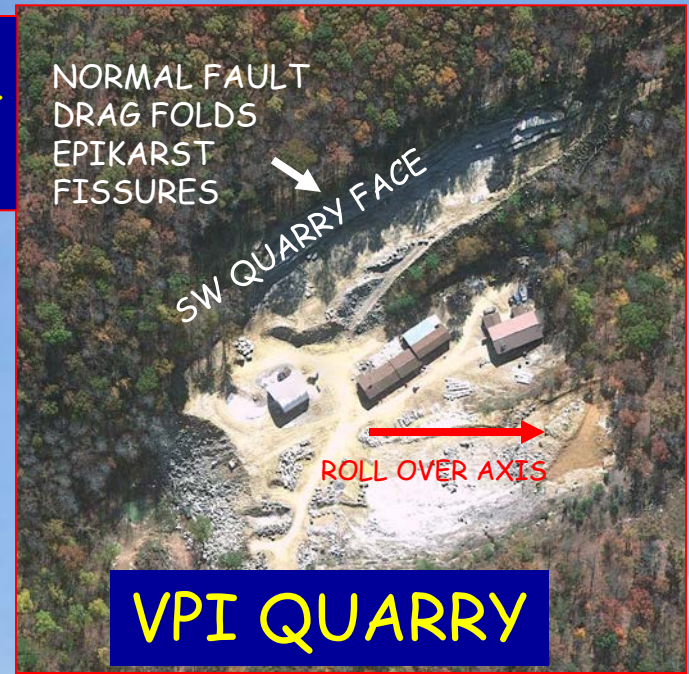
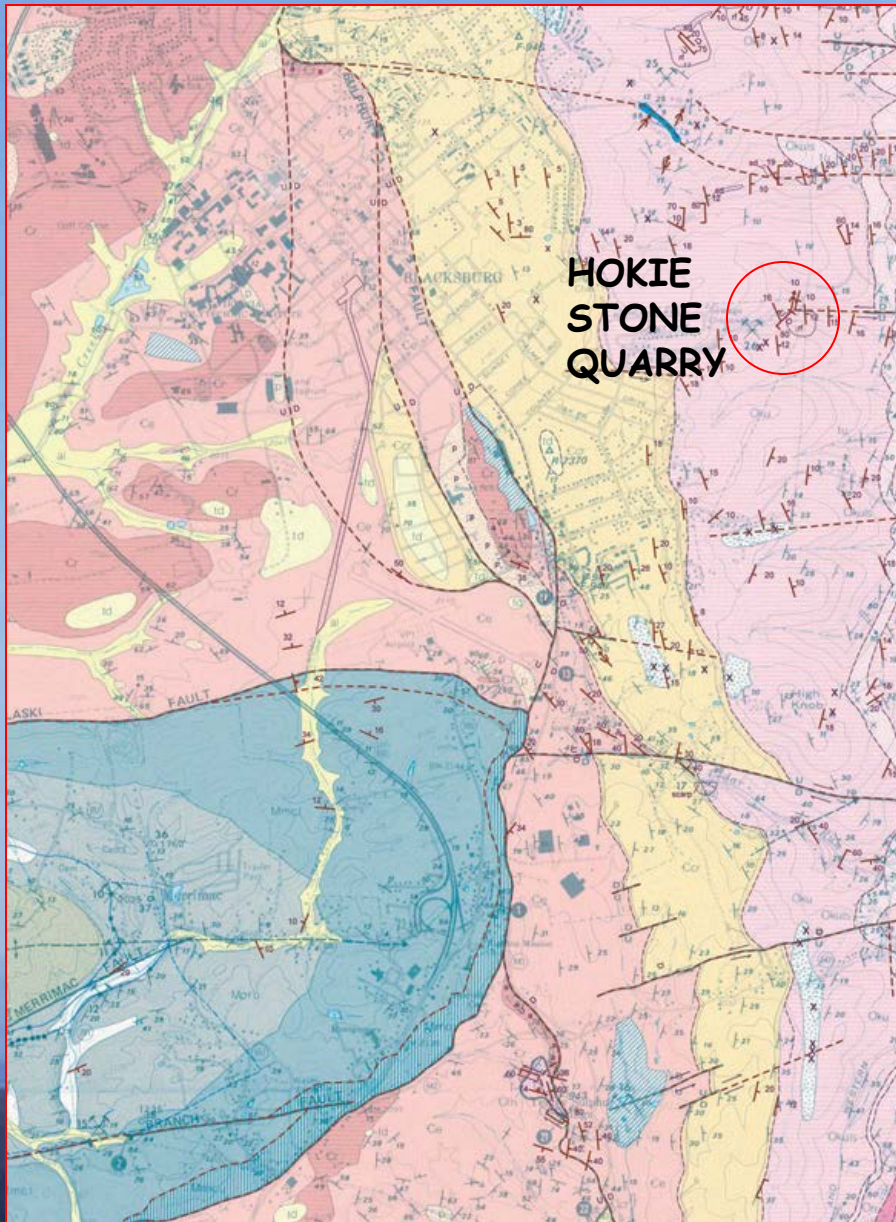
ADAMS CONSTRUCTION (ACCO QUARRY)



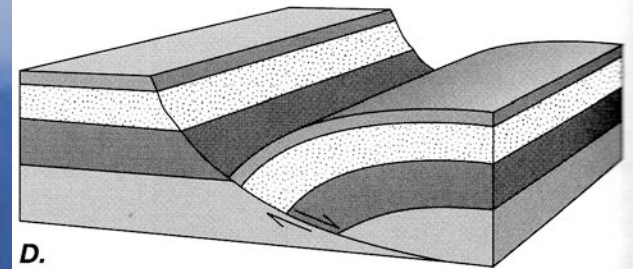
QUARRY FROM YELLOW SULPHUR SPRINGS RD



RECENT EXHUMATION OF NORMAL FAULTS, ROLLOVER FOLDS, AND EPIKARST FISSURES ALONG THE CATAWBA TRANSVERSE RAMP

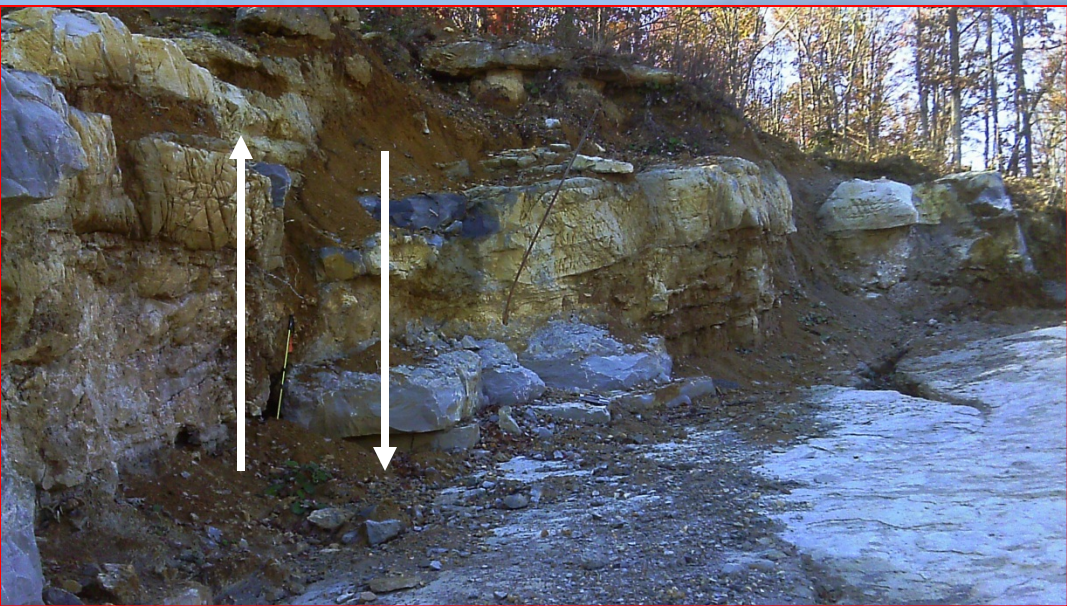


B.



D.

**RECENT EXUMATION OF
NORMAL FAULTS, ROLLOVER
FOLDS, AND EPIKARST
EXTENSION FISSURES ON
THE CATAWBA TRANSVERSE
RAMP ZONE IN BLACKSBURG**



**RECENTLY EXHUMED EPIKARST
STRUCTURE IN VT QUARRY**

“IMPLICATIONS FOR HIGHWAY ENGINEERING ”

- The SW culmination of Catawba Syncline impinges on a major NW– SE lateral ramp.
- The Catawba Transverse Ramp has a complex tectonic history.
- Detailed geologic profiles across this area highlight post-Alleghanian deformation.
- Old structures may be being reactivated by gravity detachment. This may represent a synergy between late normal faulting and deep solution of fractures in the ramp.
- Similar mechanisms may have been important in the long history of stream capture and SW migration of the Eastern Continental divide between the Roanoke Basin to the NE and the New River Basin to the SW.
- Careful geotechnical studies will be required to meet engineering challenges in this complex terrain.

“To keep every cog and wheel is the first precaution of intelligent tinkering”

Aldo Leopold