Harrisburg Area Geological Society
14th Annual Field Trip
Saturday, April 29, 1995

Geology of the Rohrer Quarry and Binkley and Ober Quarry near East Petersburg, Lancaster County, PA

Leaders:

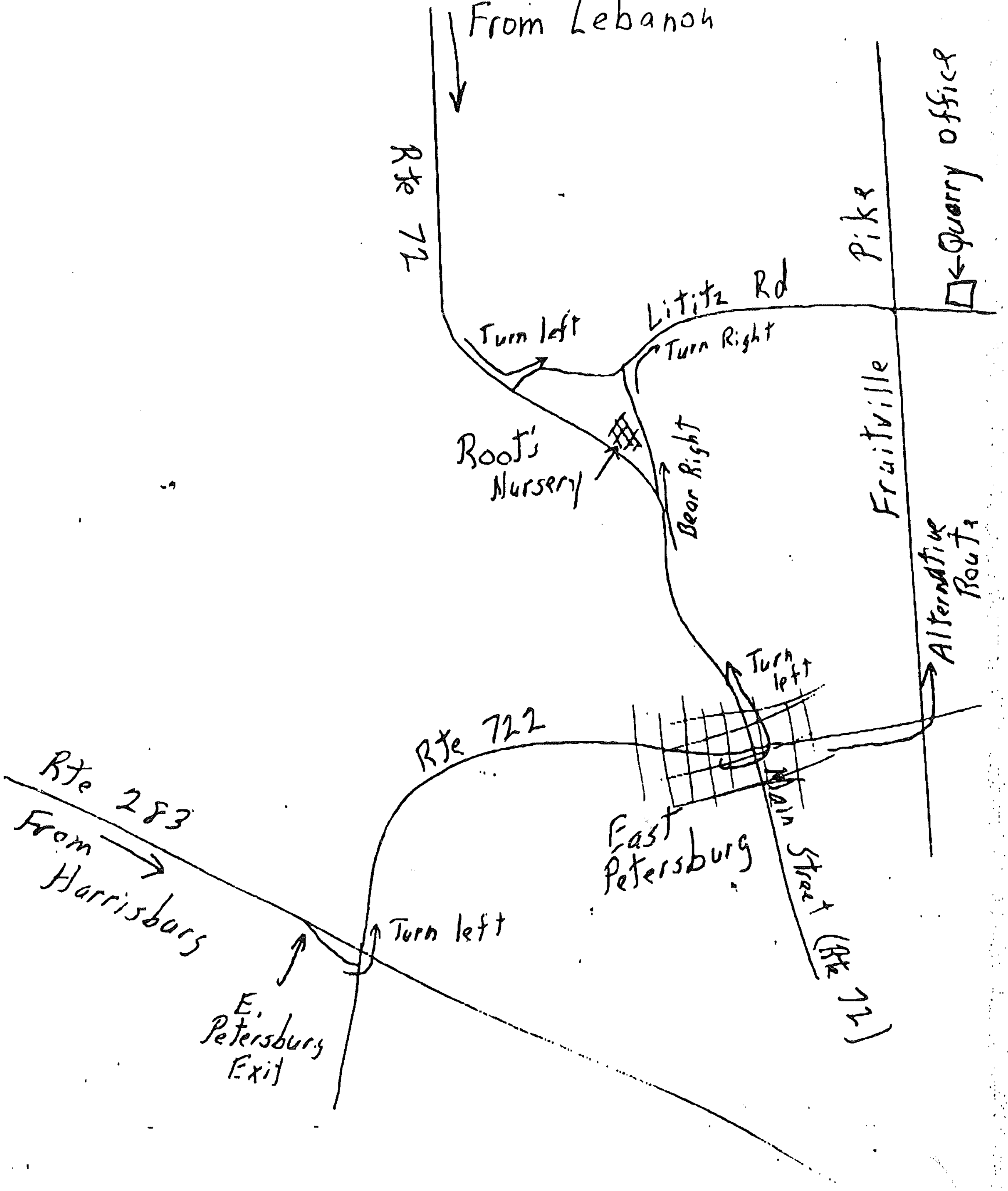
Richard P. Nickelsen
Bucknell University

Donald U. Wise
Franklin & Marshall College

Richard Clouser
Tethys Geotechnical Consultants

NOTE: No formal guidebook was prepared for the field trip. Handouts that describe the geology of each quarry and other pertinent materials are attached.

Directions To Rohrer's Quarry



HAGS FIELD TRIP TO CARBONATE QUARRIES in LANCASTER COUNTY
APRIL 29, 1995

Leaders:

I. Richard Nickelsen and Donald Wise, written description, map, section and stereonets of geology at Rohrer's Quarry and Binkley and Ober's Quarry, Lititz and E. Petersburg.
2. Adam Keiper and Charles Scharnberger, contribution on interpretation of fault fabrics and their significance from a study done by a Millersville University geology class at Rohrer's quarry.
3. Rick Clouser, Tethys Consultants Inc. report on the "Search for a $CaCO_3$ Sweetener at Rohrer's Quarry"

SEQUENTIAL DEFORMATION AT ROHRER'S QUARRY, LITITZ, PA.

STRATIGRAPHY: The dominant lithology is interbedded limestone and dolomite of the Ordovician Epler Fm. At the S and SE end of the quarry there is a dark carbonaceous limestone, possibly a Cambrian unit, or the Ordovician Stonehenge Fm. or Myerstown Fm.

LARGE SCALE STRUCTURE: A large, (wavelength > .5 mile) open, upright, N-verging anticline is exposed across the N and S Rohrer's quarries. Limb dips are 50 - 65° N on the N limb, 20 - 30° SW or S on the S limb. The S limb is terminated on the SE by a complex zone, trending 65°, that seems to be the faulted hinge of a recumbent syncline but may also have enjoyed late, superposed, steeply-dipping faulting. Beds of both the dark, carbonaceous limestone and the Epler Fm of the S and SE parts of the quarry are more penetratively deformed than elsewhere. The Epler Fm. contains boudins in upright dolostone beds separated by inflows of more ductile limestone, while in the dark limestone, boudins, isoclinal hinges and bedding/low dipping cleavage relationships suggest overturned bedding. Rohrer's quarry is near the S side of an area where beds are generally right side up, bordered to the S by an area where beds are generally over- turned as defined by Meiler and Becher, Hydrogeology of carbonate rocks, Lancaster 15' Quadrangle, G.W. report W 26.

SEQUENTIAL DEFORMATION: It is possible that the quarry rocks have been deformed during the Taconian, Alleghanian, and the Triassic-Jurassic, but we are unsure that our evidence of 3 deformations can be correlated with those events. Generally, limestones and dolomites exhibit ductility contrasts; dolomites being stiff and deformed by small thrusts, wedges, pre-folding strike-slip faults, breccia "explosions", and boudinage, while limestones exhibit refracted cleavage, and flowage in the black-laminated white "marble" beds manifested by mylonitic fabrics (?), sinistral parasitic folds with associated cleavage, or injection into spaces between dolomite boudins and fault steps.

The first stage of deformation, D - 1, perhaps Taconian or early Alleghanian in age, occurred during pre-folding, top to the NNW regional shear and layer- parallel compression that resulted in a cleavage striking 60 - 80° and dipping SE. Cleavage bedding intersections strike 60°. The D - 1 cleavage has smear lineations and elongated oolites that demonstrate tectonic transport and stretching toward 325-330° (See 'Fabric elements at Rohrer's Quarry' attached). This cleavage either maintains its early vergence to the NNW(cleavage dips SE) or has been refracted by later flexural slip or flow during south limb folding, or has been overprinted or obscured by flexural slip/flow that has created some parasitic folding and cleavage during sinistral slip on the N limb. Calcite-filled veins seem oriented with the D - 1 deformation, rather that D -2 (see 'Fabric Elements at Rohrer's Quarry).

The second stage of deformation, D - 2 was folding, perhaps Alleghanian, around WNW axes that was preceded by: I. early wedges and thrusts, 2. early, conjugate, strike-slip faults that strike 350 to 40°. The bisector of the acute dihedral angle between conjugate strike-slip faults is approximately perpendicular to the D - 2 fold axes. Especially in the N quarry it can be seen that small thrusts climb section down dip to the N, and that the early D - 2 strike-slip faults have slickenlines that parallel fault/bedding intersections that were rotated to their present attitude as bedding was folded later in D - 2. (refer to Kuiper and Scharnberger handout) D - 2 also either rotated, refracted, enhanced or diminished, by overprinting, the early rock cleavage of D - 1.

The third stage of deformation, D - 3, possibly Triassic-Jurassic, formed brittle strike-slip or normal faults of small separation or slip that caused extension, either perpendicular or oblique to the prior compressional deformation(s). In several places the strike-slip(or oblique slip faults) seem to be transfer faults coupled with (and terminating) normal faults to produce extension both in the N - S direction and in an ENE - WSW direction, parallel to the strike of the Triassic basin. These later Triassic-Jurassic(?) faults in some cases seem to follow earlier structures (faults,bedding) that had attained suitable attitudes during the earlier deformation(s). Several fine examples of D - 2 strike-slip faults that have their horizontal slickenlines overprinted by vertical, normal slip slickenlines of D - 3 age are visible in the S quarry. In other areas these steep faults appear as extensional faults on the crests of D - 2 folds, and thus may have formed earlier than the Mesozoic. Careful inspection of fault surfaces to determine slip directions, slip overprinting, slip sense, and relative stiffness/ ductility of adjacent rocks at the time of faulting is essential to understanding these relationships.

PROBLEMS TO SOLVE:

1. Relative age of "explosion" or "extension" breccias consisting of thick zones of crystalline calcite containing "floating" breccia fragments of limestone, or more probably, dolostone, that have been little rotated and show coherent, matched fragments of country rock separated by calcite veins. Overpressured P_p seems necessary....they could be formed in either D - 2 or D - 3, or could they?

2. Origin of sinistral(when looking west) parasitic folds in white "marble" beds. Do these beds develope out of "exploded" breccias with black laminations equal to breccia fragments? Are they formed during D - 2 flexural slip of earlier mylonitic layering? Other ideas?

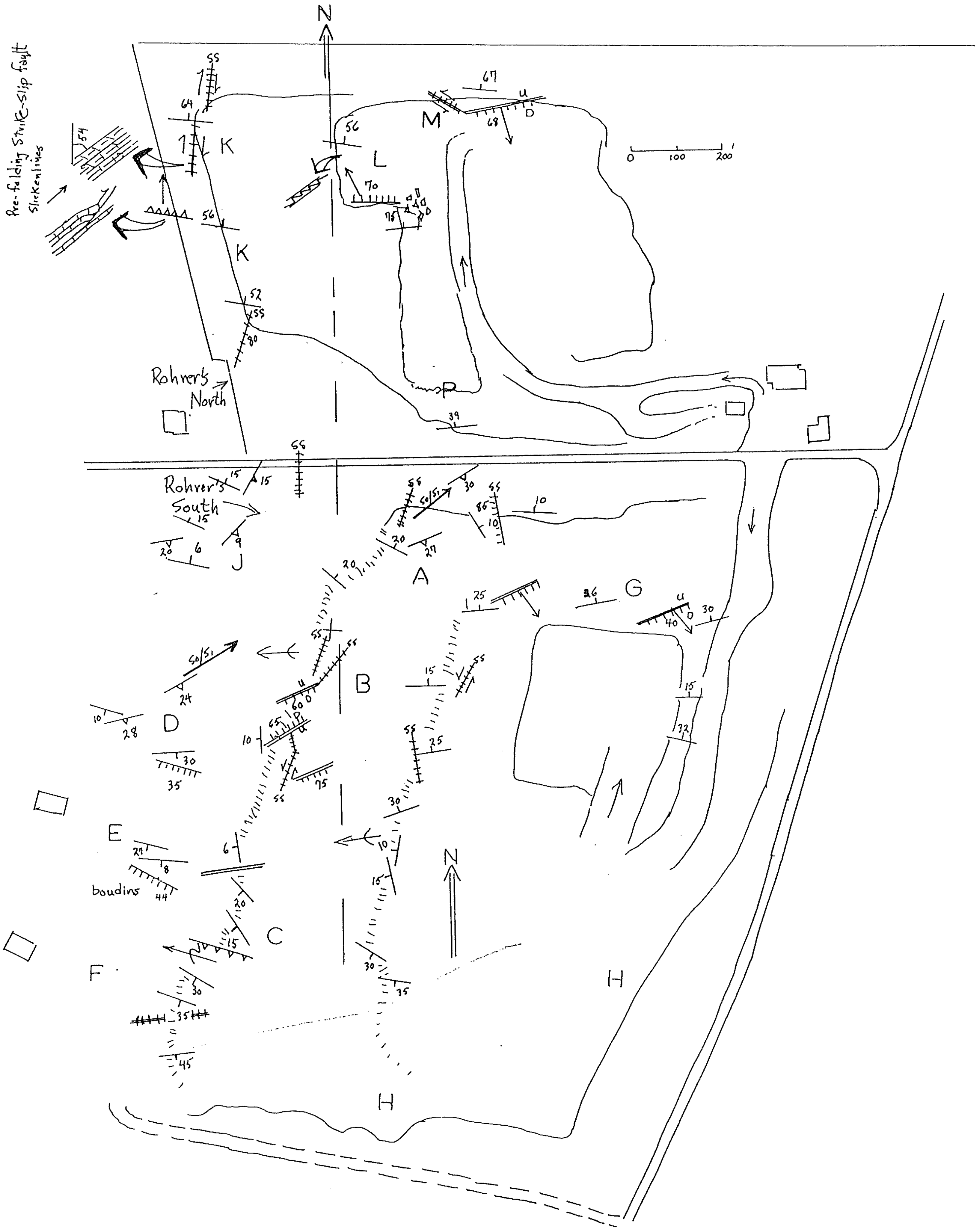
3. Is the dark carbonaceous limestone of the SE quarry border simply a recumbent synclinal hinge with associated overturned bedding, or is there later D - 3 faulting? Is the dark carbonaceous limestone actually equivalent to the Epler Fm., appearing different because of more intense deformation that has caused pressure solution residual concentration of carbon? In the SW part of the quarry, what was the relative age and the process involved to create the more intense deformation of the Epler Fm. that is manifested by the dramatic dolostone boudins, and calcite flowage into boudinaged horizons?

Acknowledgements:

Thanks to Rohrer's Quarry, especially Wilbur Rohrer, owner and Randy Newcomer, Director of Compliance and Public Safety

AND TO

Binkley and Ober's Quarry, especially Lee Ober, owner and Al Kelchen, Quarry Superintendent, for their permission to study the quarries and to conduct this field trip.



N
Pre-folding Strike-slip fault slickenlines
54
55
64
K
K
56
52
55
80
Rohrer's North
56
L
70
78
67
M
u
D
68
0
100
200'
39
56
Rohrer's South
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15
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56
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86
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27
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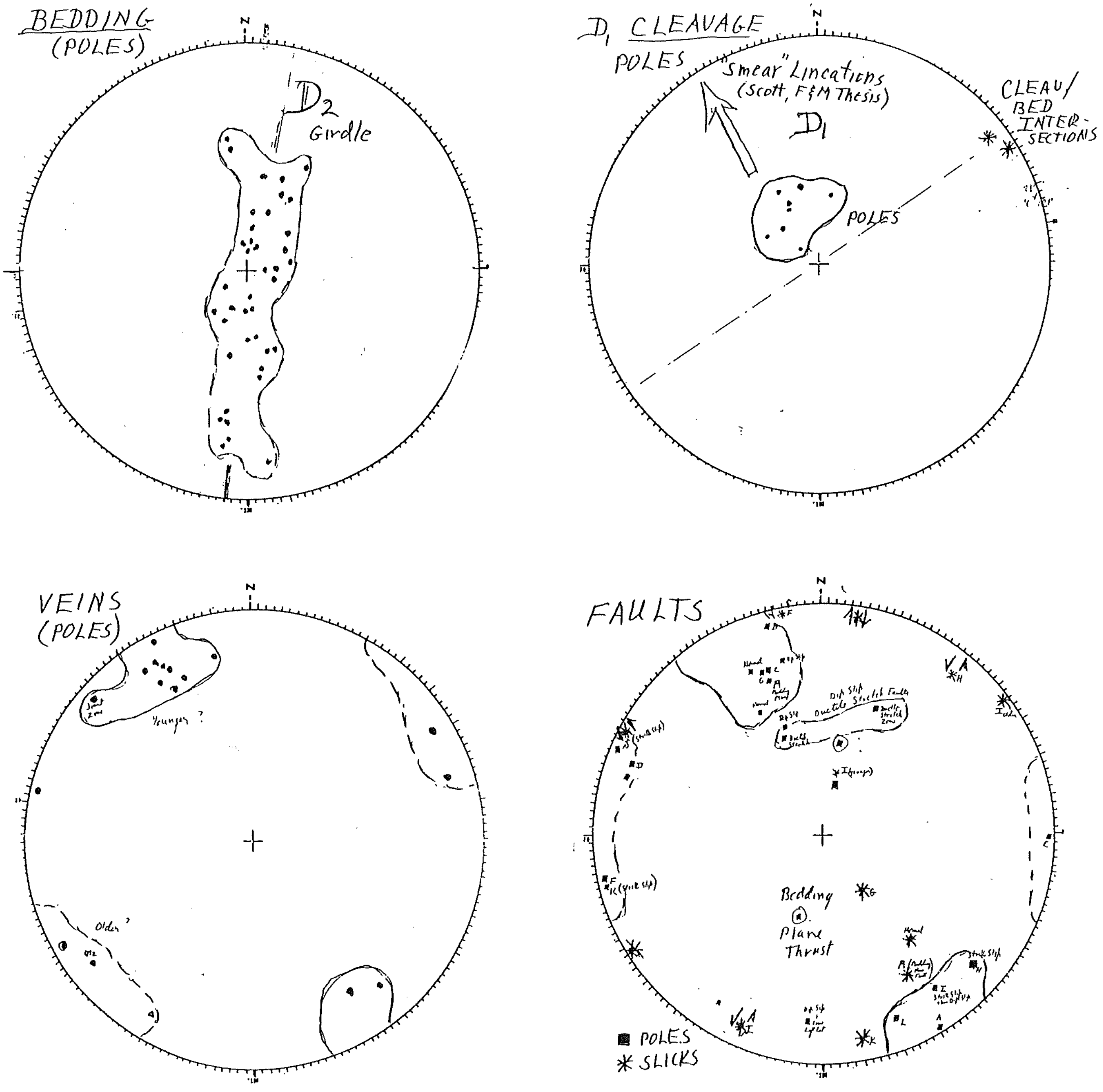
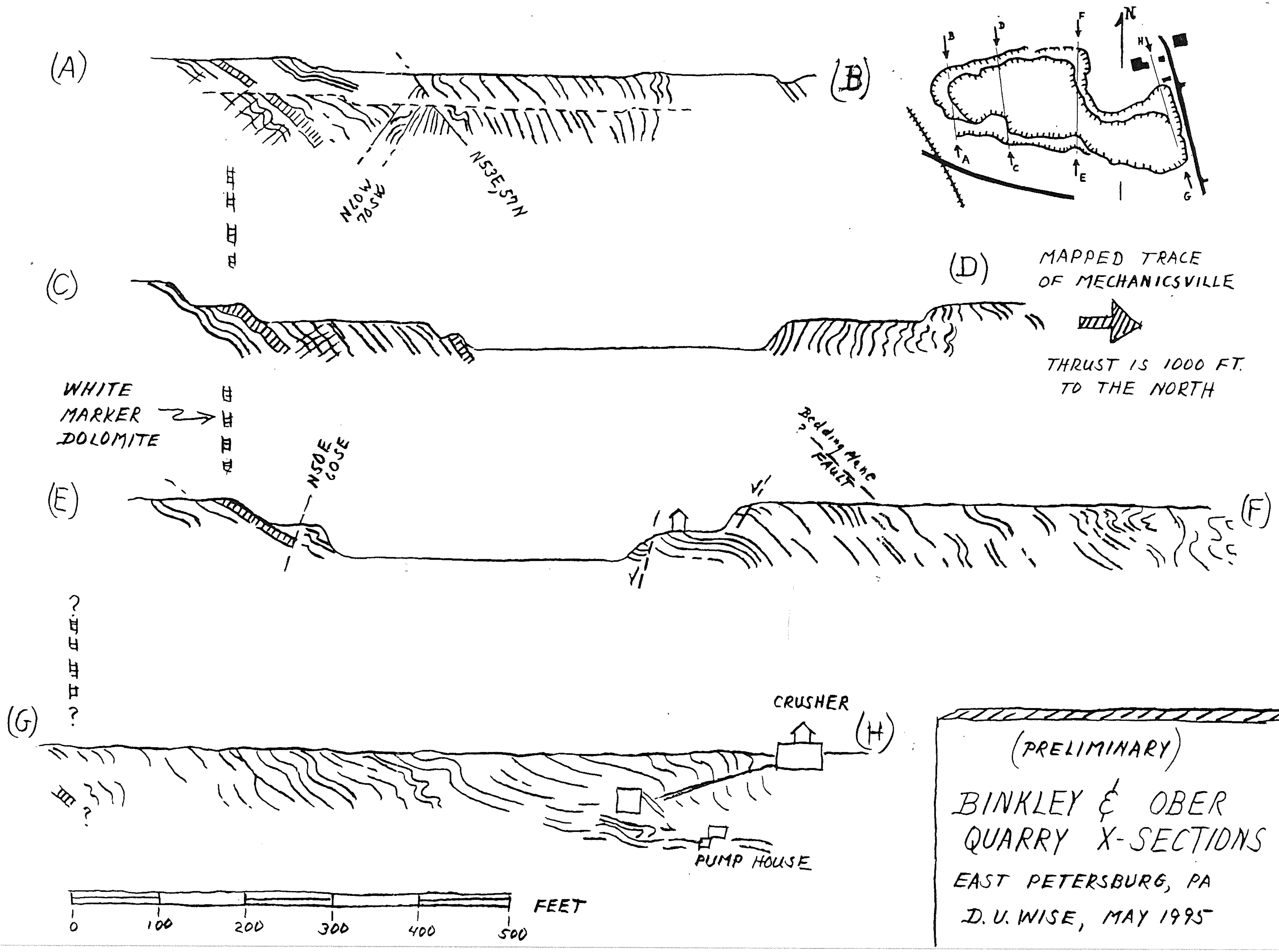


FABRIC ELEMENTS AT ROHRER'S QUARRY

EAST PETERSBURG - LITITZ AREA, LANC. CO., PA

Nickelsen & Wise Data, April 18, 1995

All VIEWS CORRECTED TO LOOK WEST



(PRELIMINARY)

BINKLEY & OBER QUARRY X-SECTIONS

EAST PETERSBURG, PA
D. U. WISE, MAY 1995

LOOKING FOR SWEETENER AT ROHRER'S QUARRY

By Richard L. Clouser
TETHYS CONSULTANTS, INC.

Production of ag-limestone and FBC sorbent at Rohrer's Quarry requires a consistent and reliable source of high calcium limestone sweetener. In the past, Rohrer's Quarry has purchased high calcium limestone sweetener, at a considerable cost, to supplement its reserves of limestone. If deliveries are delayed, production schedules can be disrupted. In order to maintain control over cost and production schedules, Rohrer's Quarry asked TETHYS Consultants, Inc. to conduct exploration of their property to locate any possible source of high calcium sweetener.

After preliminary planning, research, and evaluation of the chemical specification required, an exploration program and budget were developed. In order to minimize the budget, in-house resources at Rohrer's Quarry were utilized where possible. These resources included York Drilling, who provided a down-the-hole hammer drill and has a long term contract to drill shot holes. Most quarries either own a drill rig or have an agreement with a drilling company for such drilling services. Another resource which will be made available is a laboratory for the analysis of samples. Rohrer's Quarry maintains an analytical laboratory suitable for the analysis of drill samples.

When compared to core drilling, a down-the-hole hammer drill is faster and less expensive to use, but several disadvantages must be considered.

1. The cuttings are very small (5/8" to dust).
2. Contacts can be very hard to impossible to recognize during drilling operations, thus limiting stratigraphic analysis.
3. The reliability of narrow, discrete sampling intervals are limited due to contamination of the cuttings with upper level materials. To minimize the effects of contamination from the upper level materials, larger bulk samples can be taken and carefully split to maintain the integrity of the results.
4. Drilling must be conducted without water, resulting in very dusty conditions during drilling operations. Fugitive dust is a potential problem and may restrict locating drilling sites near property lines, buildings, and public roads.
5. No interval sampling is possible below the water table do to extensive mixing of the chips. A bulk sample for the complete hole is still useable, but of limited value.
6. The maximum reliable sample recovery depth is limited by available air pressure and the maximum permissible contamination from upper level material. Increasing drill hole depth increases the amount of upper level contamination from side wall erosion. Wall erosion will be a function of the competence of the overlying rock units.

The data obtained from a hammer drill, as compared to core drilling will be limited, and restrict any geological interpretation. Where cost and the objective of the exploration are narrowly focused, such as locating a high calcium limestone source, the use of a hammer drill is a very useful and cost effective tool.

The quarry is primarily located within the Epler formation. This Formation is chemically variable from place to place do to its interbedded limestone/dolomite nature. Mining such a variable Formation will require advance planning, testing, and diligence on the part of the Quarry operator to meet a particular chemical specification.

The southeastern corner of the south pit contains a block of stone that is completely different in appearance than that of the Epler Formation. This other rock is very dark gray to black in color and thin-bedded. In contrast, the Epler is medium gray, massively bedded and gently folded into a anticlinal structure. Past drilling and chemical analysis have indicated that the black, thin-bedded rock in this area is high in calcium. Based on this information, exploration for sweetener was focused in the south pit.

In August 1994, 14 holes were drilled in the south pit. Of the 14 holes drilled, 7 holes averaged over 80 percent $CaCO_3$, 4 were between 60 - 80 percent, 1 was under 50 percent, and the last 2 had no sample.

Individual sampling intervals ranged from a high of 97.43 percent to a low of 12.27 percent $CaCO_3$. Based upon these results, it was recommended that the southeast corner of the south pit be reserved as a potential sweetener source.

What is the rock in the southeastern corner? A new unit within the Epler Formation? The black, thin-bedded, high calcium content of the rock would indicate that it is not a part of the Epler Formation. Tentatively, the rock is being identified as the Myertown Formation.

In November 1994, drilling continued to the west of the south pit. Chemical analysis has not been completed, but based upon a comparison of the cuttings, the stone in this area is believed to be the Epler Formation.

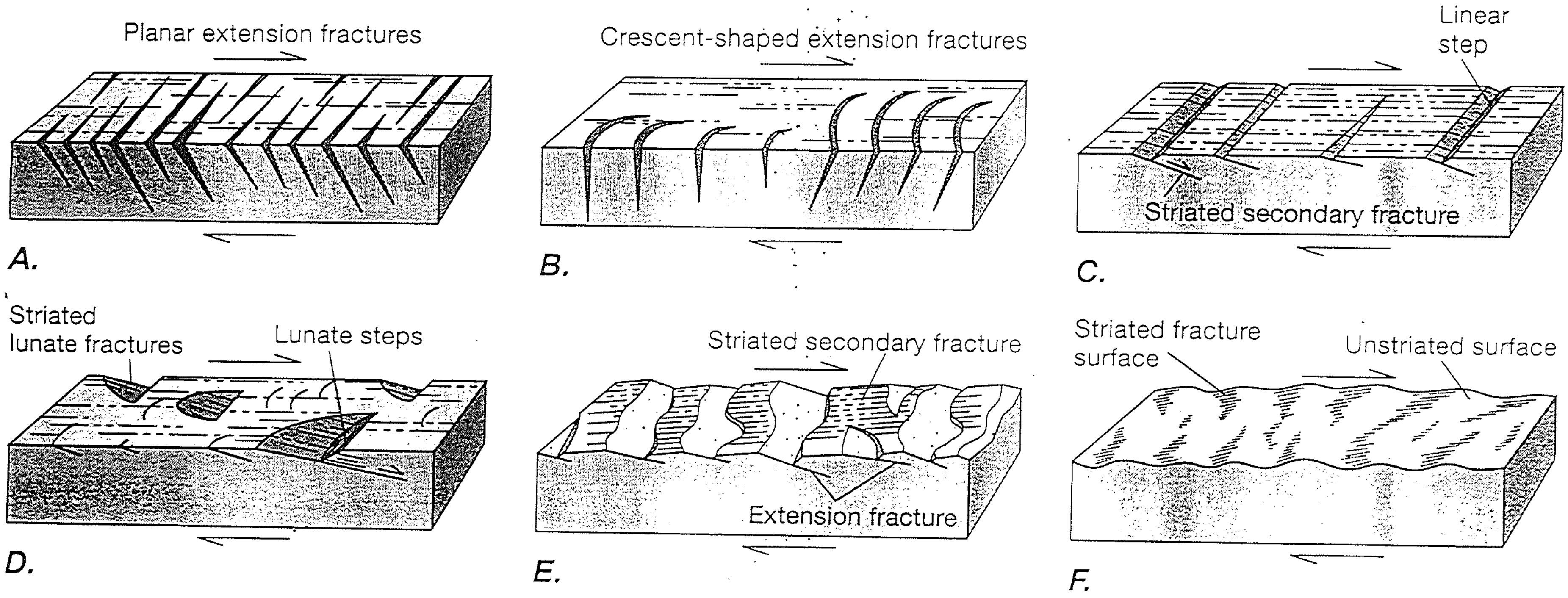


Figure 4.16 Shear sense criteria on brittle faults. Block diagrams show the relationship between secondary fractures and the sense of shear on a brittle fault. The top plane is the shear plane; relative motion is indicated by arrows. Extension fractures are unstriated and may be filled with secondary minerals. Striated fracture surfaces are shear fractures.

ALL CLEAVAGE READINGS FROM MEISLER & BECHER (1971)

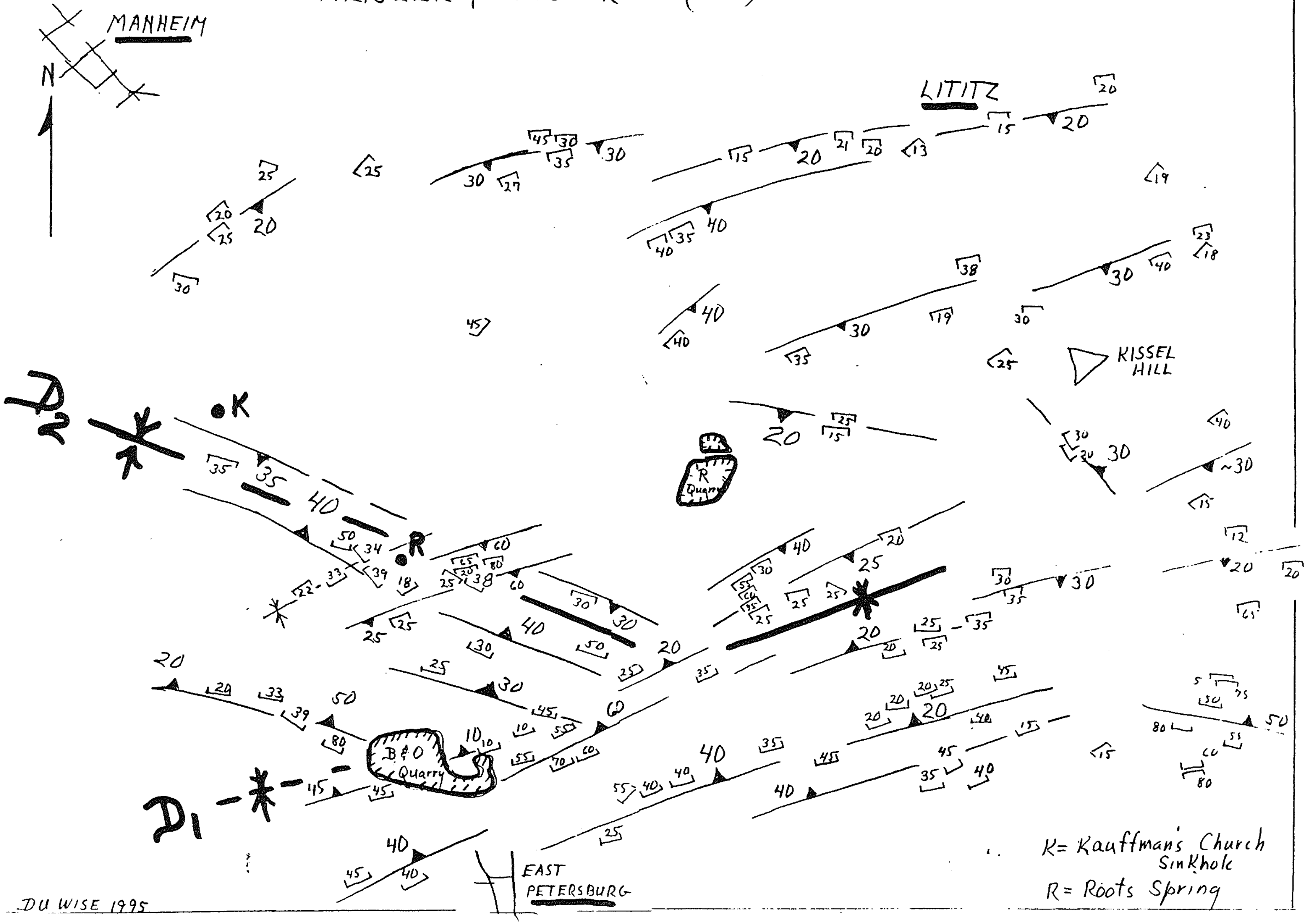


Fig 7

HAGS Spring Field Trip
April 29, 1995

Directions to Nissley Vineyards
About 30 minutes driving time

Mileage Int.	Cum.	
0.0	0.0	Exit Binkley & Ober parking lot and turn right (south) on PA 72.
0.8	0.8	TURN RIGHT onto PA 722 West
1.7	2.5	PA 283

ALTERNATIVE ROUTE: The road log follows the "scenic route" to Mount Joy through Landisville and Salunga. An alternative (probably slightly faster) route is to take PA 283 north three exits--a little over 5 miles--to PA 772 (Mount Joy Rd.). Take PA 772 west (left) to join PA 230 at Mile 10.3 on the road log.

Mileage Int.	Cum.	
0.7	3.2	TURN RIGHT on Harrisburg Pike
1.1	4.3	Enter Landisville
1.3	5.6	Enter Salunga
1.8	7.4	All traffic must turn right
0.1	7.5	TURN LEFT on PA 230
2.8	10.3	PA 772 joins PA 230. If you have been following the alternative route, TURN RIGHT on PA 230.
0.9	11.2	TURN LEFT on Angle Street
0.5	11.7	TURN RIGHT on Donegal Springs Road
2.0	13.7	JOG LEFT and then RIGHT to stay on Donegal Springs Rd. (Follow signs for Cameron Estates)
0.9	14.6	Historic Donegal Church on right
1.1	15.7	Maytown Rd. Continue straight ahead
1.6	17.3	TURN RIGHT on Stacktown Rd. (not marked by roadsign) Donegal Springs Rd. ends here
1.0	18.3	Enter Stacktown
0.1	18.4	Cross Conoy Creek
0.4	18.8	ENTRANCE TO NISSLEY WINERY AND VINEYARDS ON LEFT

HAGS Spring Field Trip
April 29, 1995

SUGGESTIONS FOR LUNCH

The East Petersburg Fire Company is having a chicken barbeque today. Don't know the location, but surely there will be signs.

A large variety of restaurants are to be found within a distance of about 3 miles south of the Binkley & Ober quarry, on Route 72. Return to Route 72 on Lititz Rd. and turn left (south). Mileages are south from Binkley & Ober.

Miles	
0.8	Towne and Country Restaurant (on left)
0.9	Gargano's pizzeria and deli (on left)
1.0	Turkey Hill Minute Market (on left)
1.4	Unimart (on left)
1.7	Burger King (on right)
2.3	Little Caesar's pizza (in shopping center on left)
2.5	Kentucky Fried Chicken and Subway (on left)
3.2	McDonald's and Pizza Hut (on right)
3.3	Wendy's and Long John Silver's (on left) Park City Diner (on right)

OVER FOR ROAD LOG TO NISSLEY VINEYARD

BINKLEY AND OBER QUARRY

Some preliminary observations

Harrisburg Area Geological Society field trip
April 29, 1995

Notes by D.U.Wise, F&M College

With acknowledgement to Lee and Gordon Ober and to Al Kelchen, Quarry Boss, for access and assistance

I Location and General Information

A. Just north of East Petersburg, Lancaster County, PA

B. Oprated by Binkley and Ober since 1912
  1) Production tonnage approximately 500,000 tons/year
  2) In dollar value concrete block production and aggregate are about equal

C. Present quarry size approx 2000 ft E-W by 1000 ft (max) N-S

II Stratigraphy

A. On the north flank of the E-W trending Neffsville anticline that brings up the lower Cambrian Antietam Schist in its core in Blossum Hill, two miles to the south.

B. Nothhward from the core, the Cambrian carbonate stratigraphy appears in younging sequence through East Petersburg to the quarry. The quarry is mapped as entirely within the uppermost Cambrian Buffalo Springs Formation
  1. Buffalo Springs Formation is largely a shallow water dolomite with local units containing appreciable amounts of clastics.
  2. Total thickness (including Snitz Creek Member) is reported by Meisler and Becher (1971) as between 1500 and 3800 feet. Quarry exposes about 700 feet of stratigraphy
  3. There are many sub-units within the quarry which could be separated and mapped for detailed structure. There has been no time as yet to examine these stratigraphic/ sedimentological aspects.

III Broader Structural Setting

A. Meisler and Belcher (Lancaster 15' Quad, 1971) map a major thrust just 1000 feet north of the north wall of the quarry.
  1. Their Mechanicsville Thrust (named for a small road/ railroad intersection about 1 mile west of the quarry) places uppermost Cambrian Buffalo Springs onto lower Ordovician Stonehenge Formation.
  2. Thrust cuts out about 1000 to 2000 feet of the upper Conocheague group (Millbach Formation: a fine grained relatively pure, laminated marble.)
  3. They project the thrust westward to die out in the stratigraphy.
  4. Alternative: I interpret the western end of the Mechanicsville

Thrust to curve around to join the Chickies thrust, becoming the updip projection of that thrust as it passes into its carbonate cover.

- a) With this model the upper plate of the Chickies / Mechanicsville Thrust carries and deforms the bulk of the Lancaster area into a later generation of E-W trending folds.

B. Second generation folds of the region

- a) The Chickies/ Mechanicsville thrust and folding is part of a larger regional second generation folding deforming much of Lancaster County.
- c) This is propbably a northward continuation of the second generation or D2 folds recognized by Freedman, Bentley and Wise (GSA Bull., 1963) which extend from Chickies Rock south across the Martic region.
- d) Age of second deformation is uncertain, whether a mid-Paleozoic Acadian event, or part of regional right lateral transpression of the later Paleozoic or part of the main Aleghenian northward thrusting and transport into the folded Appalachians.

C. First generation regional folding and nappe transport

- a) Pervasive regional flowage and nappe transport is oriented about N30W.
- b) Recognized in most field areas by F&M students as a tectonic "a" lineation, smearing on cleavages, stretching of oolites, boudinage stretching, etc.
- c) See attached figure from Wise, Cloos volume
- d) N60E trend of axes of nappe folds and bedding/ cleavage intersections is an obvious regional grain. Looks like a continuation of the structural grain of York County, now overprinted by the D2 folds and thrusts of the Lancaster County area.
- e) This is a northward continuation of the D1 folds of Freedman, Bentley, and Wise (1963) from the Chickies to Martic region.

D. Overprinting

- a) Regional pattern of overprinting in these two quarries looks very much like that at the nose of Mine Ridge as described by Wise 1970 (Cloos Volume)
- b) Early bedding plane thrusts (seen as small scale wedge-like features in the quarries)
- c) N60E trending D1 flow-fold axes and bedding/ cleavage intersections appear across the region.
- d) SEE ATTACHED FIGURE with all cleavage readings lifted from Meisler and Becher but separated into the two families on the basis of orientation. A regional D1 synform in cleavage projects S60W into the middle of the quarry. A zone of D2 cleavages project toward and seems to terminate against this D1 line. THESE BROADER MAP PATTERNS OF CLEAVAGE TRENDS SUGGEST THAT A MAJOR D1-D2 DOMAIN BOUNDARY SHOULD OCCUR WITHIN THE QUARRY.
- e) Meisler and Becher suggest a regional cross folding forms the

WNW trending Cocalico shale zone (Brunerville arch) separating the Manheim and Hammer Creek Valleys. This would be part of the D2 pattern.

IV Quarry Structure

A. Major cross fault zone trends about N50E, 60 SE across entire quarry.
   1) Includes a number of faults in a zone about 150 feet wide.
      a) Other parallel faults in north central corner and at west end (see cleavage map of quarry)
   2) Downthrown (SE) side of most of the faults shows a zone of dragged and rotated bedding, a meter to several meters wide indicative of NORMAL displacement.
   3) However, most slickenlines indicate STRIKE-SLIP displacement
   4) Lots of local gouge and shattering, some alteration
   5) Tentative interpretation= multiple movement history, an earlier somewhat ductile normal fault displacement with a superimposed more brittle strike-slip phase
   6) This fault zone appears to mark the DOMAIN BOUNDARY suggested by the regional cleavage pattern
      a) parallelism to cleavage and fold grain on south side of the boundary suggests possible tectonic hereditary link
      b) Cleavage synform from the NE projects right into the fault zone
      c) Question of chicken and egg. Was the larger scale cleavage synform responsible for localizing the fault or did early ductile motion along the zone cause the large scale synform ?
   7) Late brittle behavior, trend of the zone, and location along the projection of the Mesozoic Ephrata half graben, all suggest that at least the later phases of motion on the zone were associated with Mesozoic rifting.

B. General bedding orientations
   1) Figure with serial cross sections shows general dip pattern (CARE: note that to keep the sections comparable in the figure, the lower two sections have been reversed in look direction from the most convenient field observation direction.)
   2) South walls of the quarry are cut to a single light gray marker dolomite striking on average about N80W with dips of around 45 degrees to the north
   3) North walls are marked by prominent folds average dips near vertical.
   4) IN MAP VIEW, the two domains are evident from average strike orientation of beds.
      a) On NW side of fault zone beds are about N80-90**W**
      b) On SE side of fault zone beds are about N80-90**E**
   5) EQUAL AREA PLOT (bottom net) of all bedding readings shows the general N dip of beds but the two different fold systems. The overturned beds along the north wall have a D2 strike. The two beds marked as fault drag are on the downthrown side immediately adjacent to members of the major N50E trending fault system.

C. First deformation or D1 structures
   1) Fold hinges of this system trend N60-80E

2) Most easily seen as warps plunging NE on the white dolomite marker unit on the SW wall
    a) Overall trend of dolomite is a D2 effect
3) Cleavages of this system are seen most readily in the dolomites on the south wall
    a) many indications of refraction and reorientation by later deformation
    b) General south dip of D1 cleavage here suggests that even though location is just north of the cross fault, these folds and cleavages are part of the N limb of the N60E regional D1 cleavage synform (see regional map)
4) SEE MAP OF FOLD HINGES AND BEDDING/ CLEAVAGE INTERSECTIONS WITHIN QUARRY.
    a) South and east walls have abundant hinges of this D1 system
5) See equal area net (top one) of all cleavage and fold related structures from east, south and west walls of quarry. (Dominanted by the D1 system)
6) The tectonic "a" or transport smear lineations common throughout the region are very difficult to identify clearly in this particular quarry. (In general, weathering helps make them more visible.)

D. Second deformation or D2 structures

1) Most obvious in the NORTH wall as large fold hinges plunging about S80E at shallow angles
2) AGE RELATION: UNLIKE THE D1 FOLDS ON THE S WALL THESE HAVE CORKSCREW-LIKE MARKINGS ON THEM INDICATIVE OF REFOLDED MINOR D1 FOLDS AND D1 BEDDING/CLEAVAGE INTERSECTIONS.
3) Average or overall strike of south wall also reflects this orientation. See middle equal area plot.
4) Conditions during this second deformation were still ductile enough to produce a well-defined cleavage, at least locally. The distinctions between these two cleavages need to be investigated with the microscope as well as by field observation.
5) Conditions did not seem to produce any of the pervasive tectonic "a" smear lineations so typical of the D1 system

E. Minor Faults and veins

1) There is a rich record here that I have not had time to even begin looking at in a serious way.
    a) Gouge, extension breccias, minor ductile drag, bedding plane wedges, intersections of fault sets are all present.
    b) The west center of the quarry has a complex of bedding plane and D2 fault orientations as well as a very tight large apparent fold with vertical axial surface. These are presently too poorly exposed (and dangerous) for much detailed work but the story of interplay of these structures has real promise.
2) Strike-slip motions seem very common along many trends of faults.
    a) Jurassic Diabases in the Furnace Hills to the north have their joint surfaces almost completely dominated by strike slip motions.
    b) At least some of these faults are probably part of that same response to regional tectonic stress.

3) Calcite veining is much less common in this quarry than in Rohrers Quarry. Reason unknown as yet.

V. HYDROLOGY

A. Quarry pumps on average about 2500 GPM or about 3.5 MGPD
  1) With rule of thumb of about a square mile collecting area for every MGD flow, the quarry should influence a circle about 1 mile in radius
    a) Such an analysis accurate only in an isotropic world. This is not.

B. Pre-Quarry extension, USGS topo map shows a very linear stream precisely over the large cross fault zone.
  1) This stream is still allowed to seep into the quarry from the SW along the cross fault zone
  2) Seeps are reported to occur in the floor of the quarry by the north wall
  3) Flow also occurs from the cross fault zone along the north wall (but be careful..during working hours this may be the wash water from the block plant being recycled)

C. A N50E fault zone in the north-central tip of the quarry also has significant flow along it

D. In the west wall a N60W (D2 ?) and bedding plane fault also have significant water flow along them (see sink hole discussion below).

E. At least for this quarry area, it appears that the N50E fault system is the dominant influence on ground water motion.

F. Two miles to the NW, behind Kauffmans Church (K on the cleavage map) was a large sink hole. Years back I was told by the farmer that he had tried to stabalize gully erosion with straw in the adjacent field but a severe storm had washed all the straw down the sink hole. According to him, the huge spring at Roots farm (R on the cleavage map) about a mile to the ESE was clogged with straw about one week later. The fact that both these locations lie very close to the trough of a D2 cleavage synform (see map) suggests that this second set of fold structures and cleavages can also have significant control of ground water flow. Just north and east of the quarry, the Little Conestoga has large linear sections parallel to the D2 trends sugesting similar control.

VI FINAL COMMENTS

A. A lot more structural work needs to be done in this quarry (My time in it to date totals two full field days)

B. Among the key questions is the nature of the cleavage domain and fault boundary trending across the quarry. It seems surprising that the apparently younger D2 system truncates against the older D1 cleavage. To what extent is this a function of the faulting? Or was the early part of the faulting active with the later D2 events and acted as a terminating structure ?

C. Just where is the Mechanicsville fault located (? 1000 feet to the north ? or is it really within the quarry ?) and how does it relate to any of these structures ? (Neither D1 nor D2 seem to take much heed of such a major regional thrust feature.)
  1) Meisler and Becher's map shows an apparent right lateral displacement

of the thrust trace where the cross fault zone would intersect it. However they show the offset related to a NW trending cross fault rather than any projection of the fault (not exposed at the time of their mapping).

D. The history and style of Mesozoic (and still younger, possibly present-day) deformation is tied up with the younger fault structures in this quarry. This may be one of the better places to try to understand this pattern, a significant undertaking considering the location here near the emerging N-S seismic trend across Lancaster County.

References:

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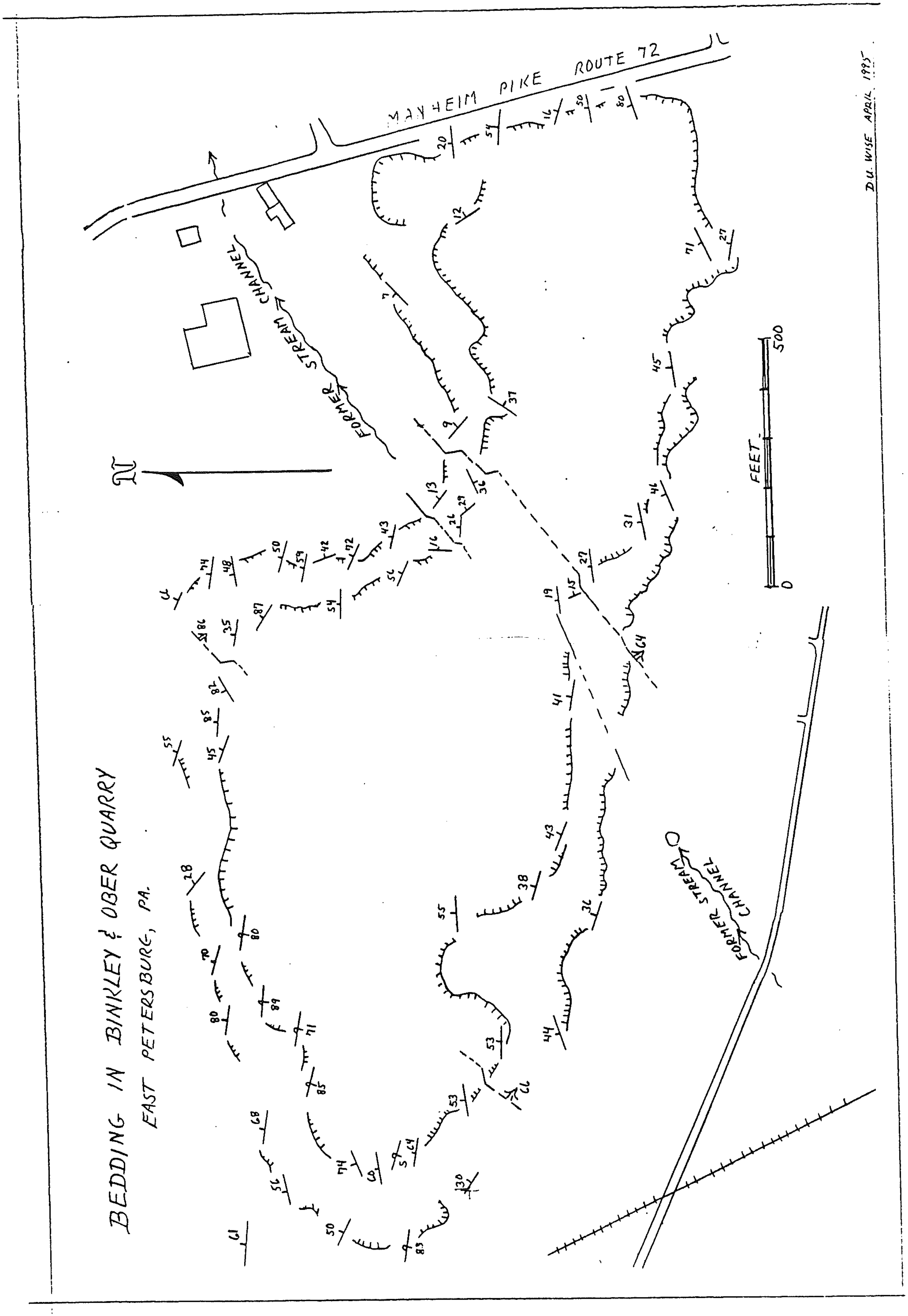
BEDDING IN BINKLEY & OBER QUARRY
EAST PETERSBURG, PA.
MANHEIM PIKE ROUTE 72
FORMER STREAM CHANNEL
FORMER STREAM CHANNEL
N
FEET
0
500
D.U. WISE APRIL 1995
20
54
16
50
80
12
27
71
37
9
45
13
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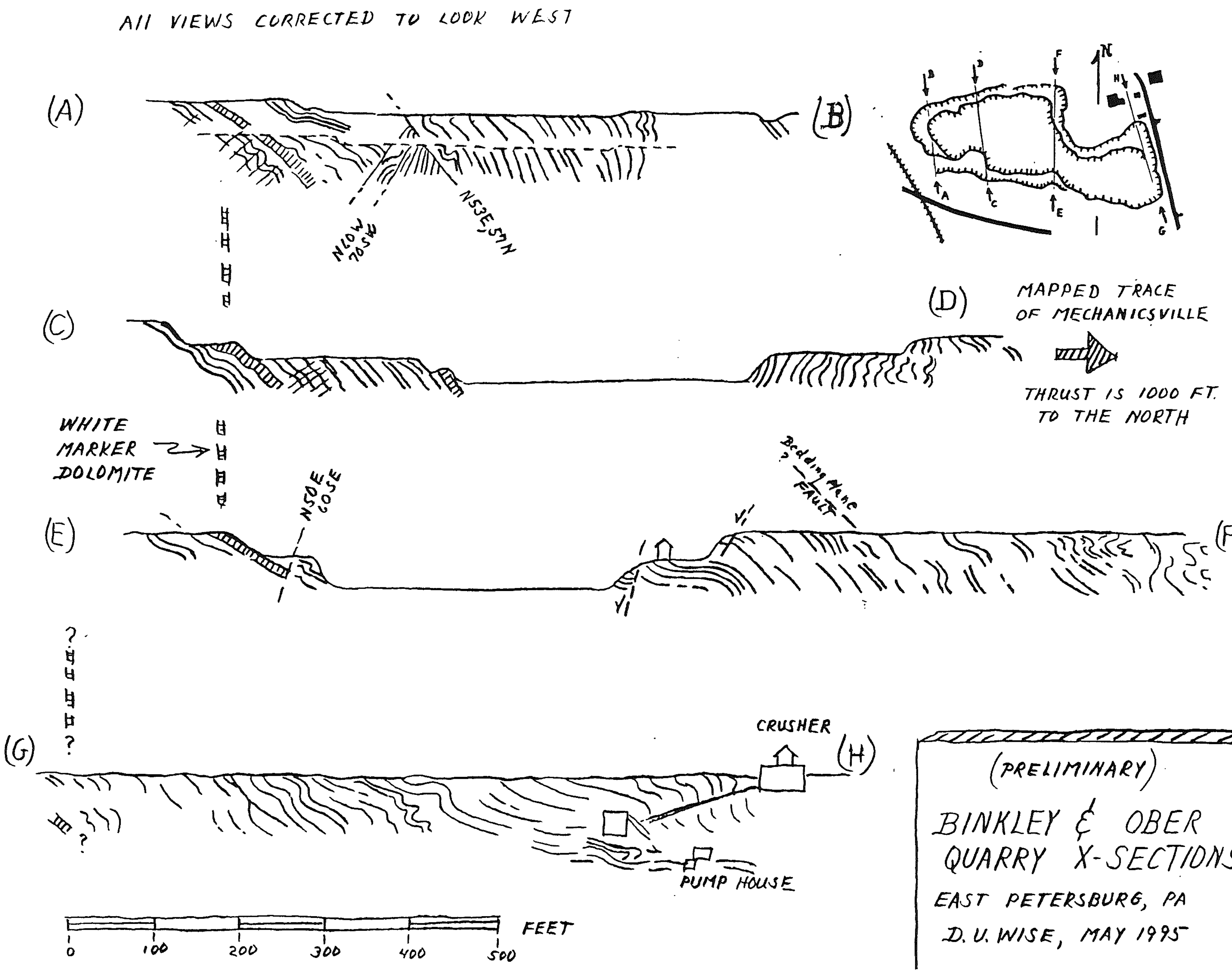
Fig 1



(PRELIMINARY)

BINKLEY & OBER
QUARRY X-SECTIONS

EAST PETERSBURG, PA

D. U. WISE, MAY 1995

Fig 2

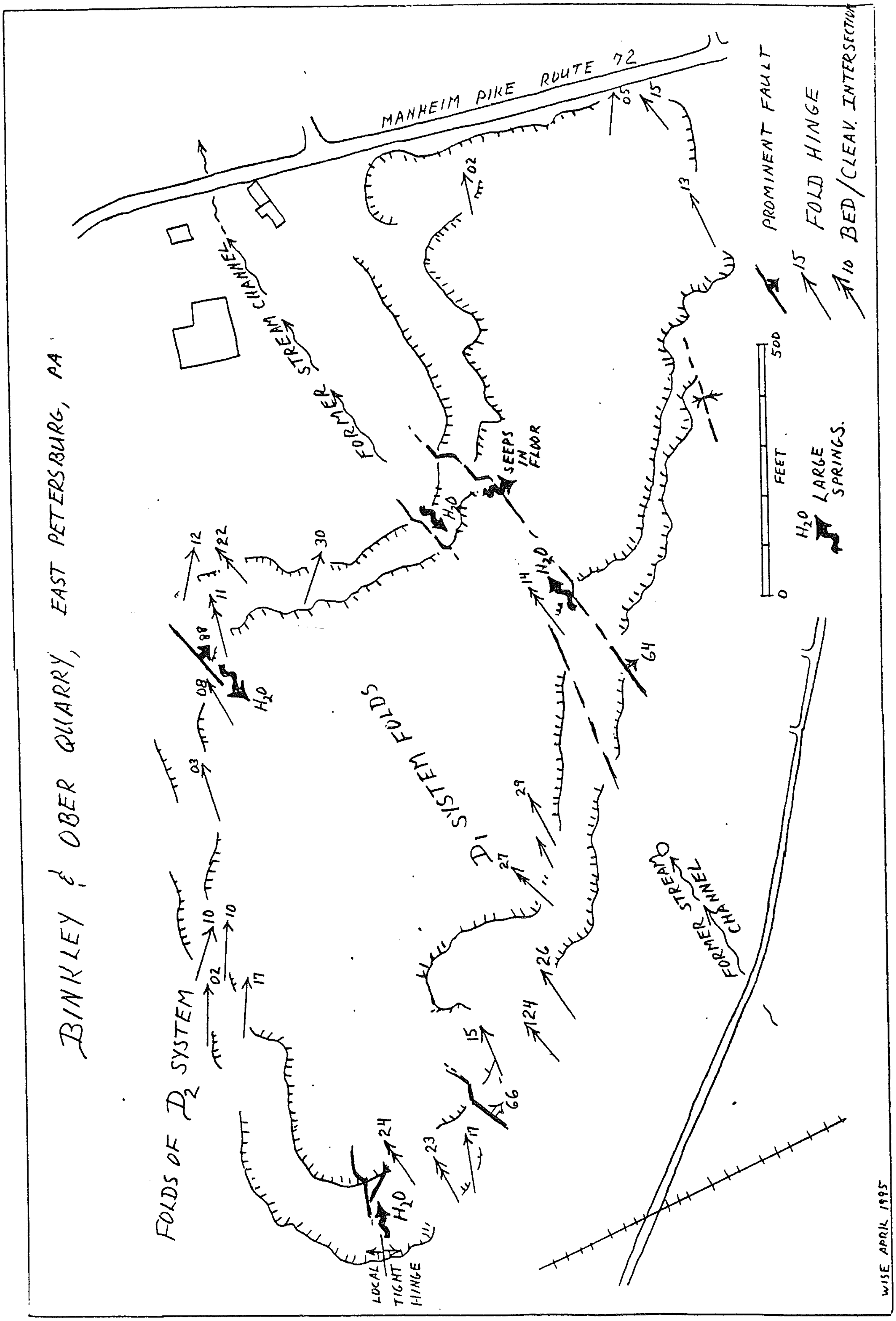
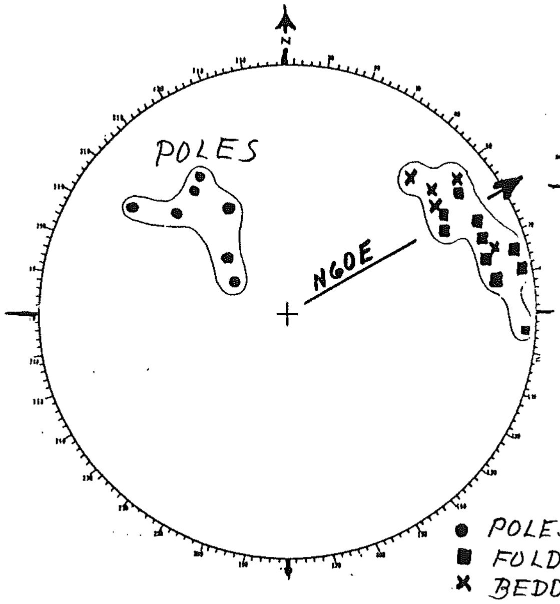

BINKLEY & OBER QUARRY, EAST PETERSBURG, PA
FOLDS OF D_2 SYSTEM
D_1 SYSTEM FOLDS
MANHEIM PIKE ROUTE 72
FORMER STREAM CHANNEL
FORMER STREAM CHANNEL
SEEPS IN FLOOR
H_2O
H_2O
H_2O
H_2O
LOCAL TIGHT HINGE
05
15
02
13
12
22
30
11
88
08
03
10
10
02
17
14
64
29
27
26
24
15
66
11
23
24
PROMINENT FAULT
15 FOLD HINGE
10 BED/CLEAV. INTERSECTION
H_2O LARGE SPRINGS.
0 FEET 500
WISE APRIL 1995

Fig 3

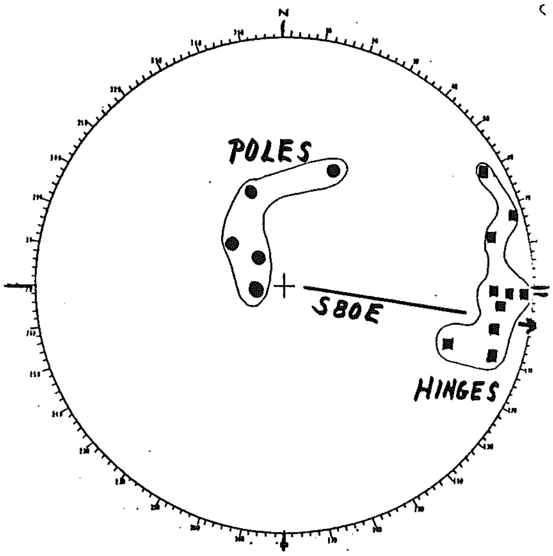
FOLD - RELATED STRUCTURES



D_1 System Axes ≈ N60E

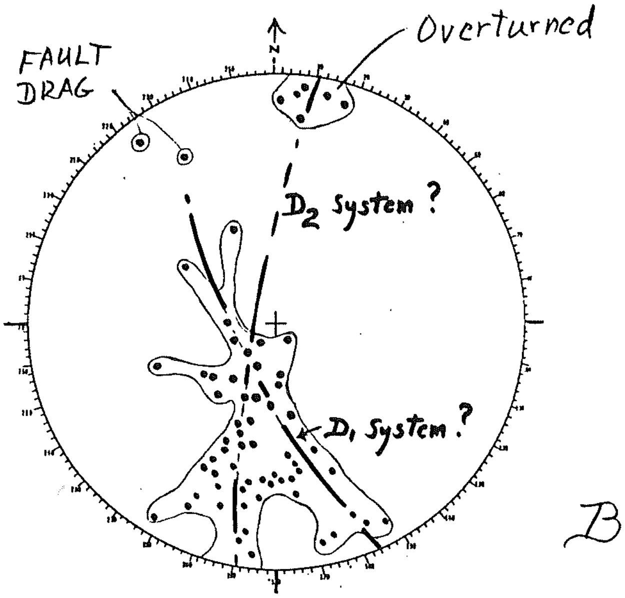
SE, S, & W WALLS OF QUARRY

● POLES TO CLEAVAGE
■ FOLD HINGES
× BEDDING - CLEAVAGE INTERSECTIONS



N & N CENTRAL WALLS OF QUARRY

D_2 System AXES ≈ S 80E

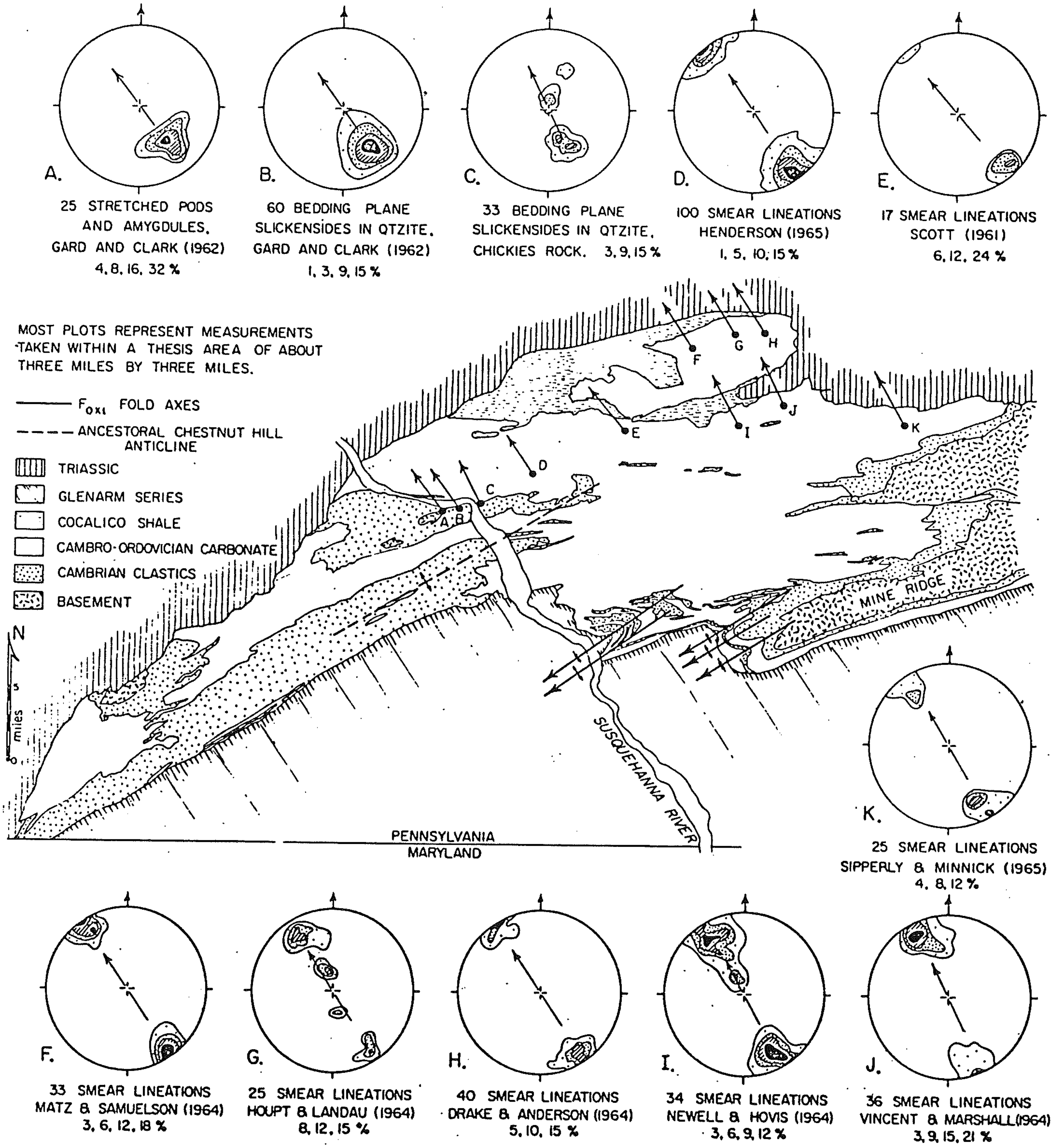


POLES TO BEDS ENTIRE QUARRY

BINKLEY & OBER QUARRY,
East Petersburg, PA

D.U. WISE
APRIL 1995

Fig 4



428 TECTONIC TRANSPORT VECTORS IN RELATION TO F_{ox1} FOLD AXES

Fig 5

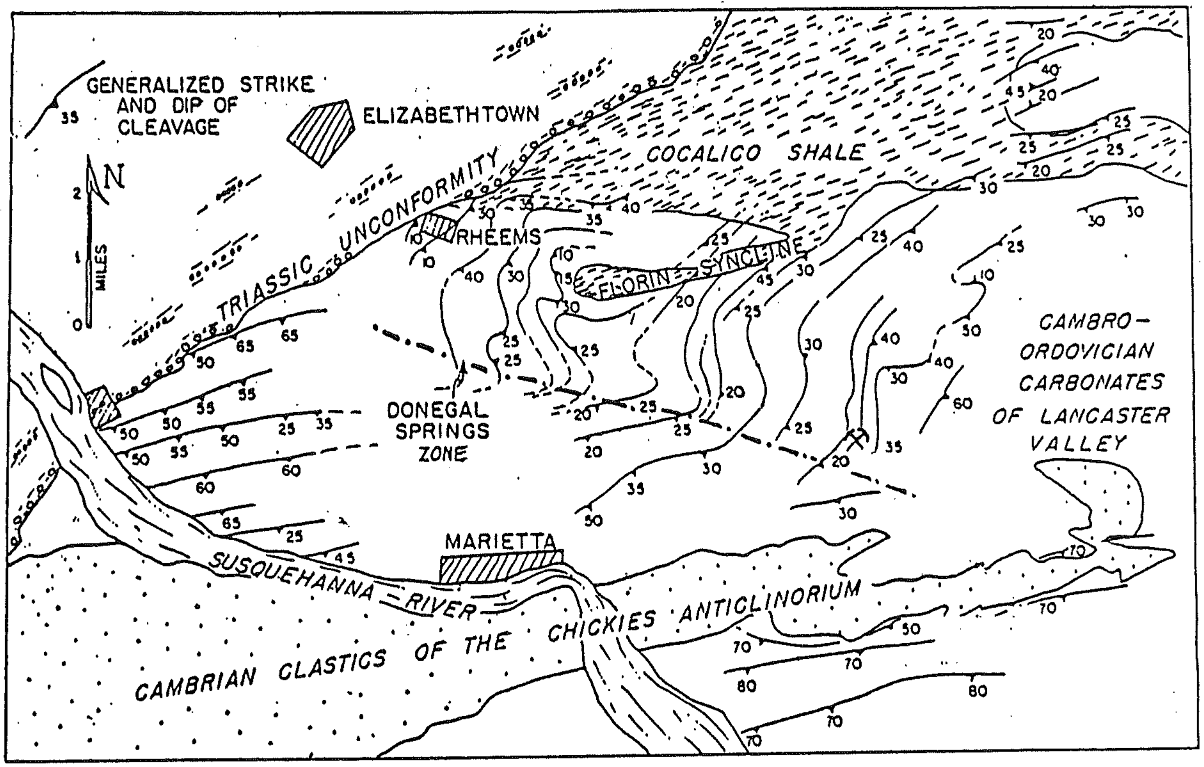
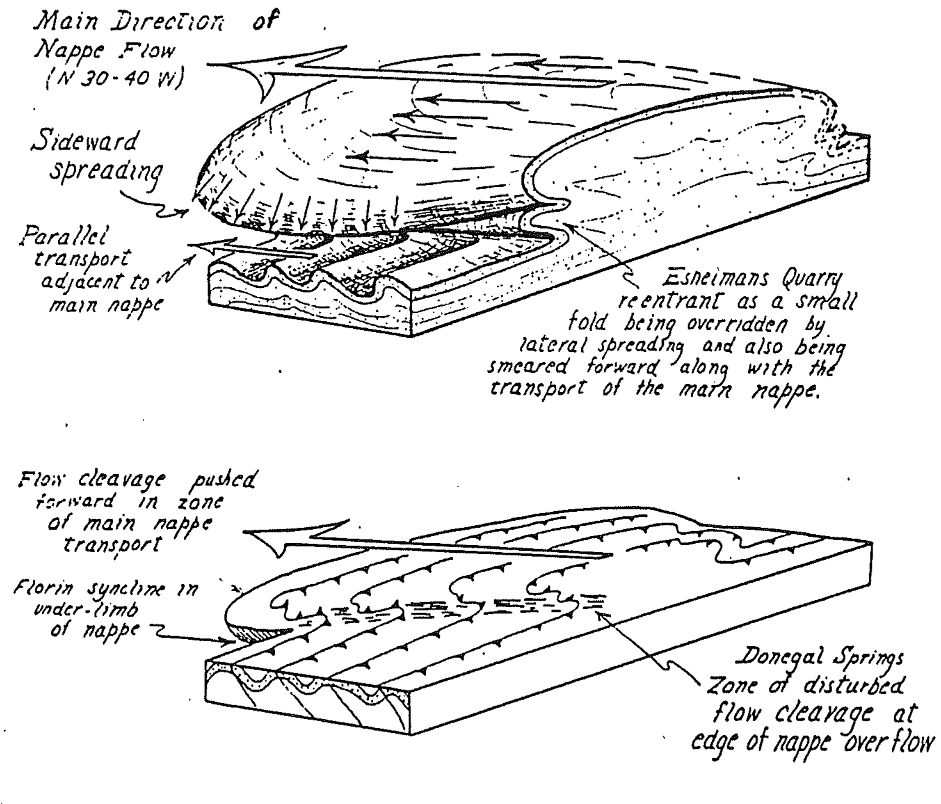


Figure 22 - Disruption of flow cleavage along the Donegal Springs disturbed zone which bounds nappe structures to the northeast against non-nappe folds to the southwest (from Skerlec and Wise, 1968).

WISE 1968 GUIDEBOOK



. - Interpretation of the origin of the Donegal Springs disturbed zone and Eshelman's Quarry re-entrant in terms of nappe transport and distortion of flow cleavage patterns.

Fig 6

WISE 1968 guidebook