Black Beauty Coal Co.
Vermilion Grove Mine

#6 coal

17N-12W - Section 12 or 13 NE or

T17N- R11W -18 NW

Mine index 1026

Black Beauty Coal Company - Vermilion Grove Mine. Underground mine is Herrin (No. 6) Coal, tipples located about one mile north of Vermilion Grove in southern Vermilion County. Notes by John Nelson, January 18, 2002.

I visited the mine at the request of Penny Padgett, company geologist, who is concerned about "cutter" roof failures. The mine is new. From the slope bottom two sets of entries, eight entries per set, have been developed about 800 feet north and 1000 feet west. Penny reports that cutters develop in north-south entries and typically are oriented slightly west of north.

1.) Entry 4 (fourth from West) of Main North at intersection 640 feet, north of slope bottom. Cutter or possibly a "kink zone" runs north along entry, somewhat sinuous but trending NNW at its northern end. Shale is crushed along center line and slightly bowed downward, as in true kink zone.

Coal seam approximately six feet thick. Roof is dark gray shale, lighter upward, fine planar lamination in lower part. Coal laminae near base. About three feet exposed (maximum).

2.) Roof cut down for overcast, Entry 3 at 840 feet, Main North. Again roof shale grades from dark gray, fine planar lamination at base to medium gray three to four feet above top of coal. Siderite bands and nodules are common. A few plant remains in lower part of shale.

Joints are localized, most trend NW-SE.

3.) Entry 1 (westernmost) of Main North about 900 to 1050 feet inby slope bottom. Roof fall extends north along the west rib from the north edge of the overcast to the working face. This is a true kink zone. Shale is buckled down, pulverized, and ends of broken layers overlap indicating east-west compression. Roof shale character as before.

4.) Entry No. 2 at face.

A kink zone is forming along the west rib from the face back about 50 feet. Shale is crushed, broken ends overlapping and the roof is working.

5.) Entry 4 of Main North at face, about 1040 feet inby slope bottom. A kink zone follows the center line of the N-S entry. Thus far I've seen no kinks, cutters, or roof falls in any E-W heading.

The continuous miner operator thinks that taking two to three feet of roof shale down after mining the coal reduces the "kink" problem. He takes shale to the base of the "dimpled" siderite layer. Of course, where to dispose of the shale is another problem.

6.) Face of Entry 6 in Main North. A discontinuous kink zone meanders down the entry. The miner's observation that kinks extend only up to the "dimpled" layer, two to three feet above the top of the coal, seems to be correct. Perhaps only the thinly laminated shale is subject to kinking.

Entry 7 has a similar situation. I haven't seen any more joints in the roof.

7.) In Entry 8 there is a small kink along the west rib. South of the last intersection, a sinuous kink zone runs down the center of the entry.

8.) Entry 8 about 850 to 900 feet inby slope. A small kink zone crosses the entry diagonally NW-SE. Along it, the shale has well developed joints trending N50-55E, spaced four to six inches apart.

Southward in this entry, numerous slips in the roof have led to roof falls. The slips have no particular orientation. More large slips in Entry 7 run mostly N-S.

9.) Main West, crosscut 500' west of slope bottom on Entries 4 and 5. A major roof fall extends north through two intersections and intervening crosscut plus part of crosscut north of Entry 5. At north end of the fall are <u>two</u> kink zones, a bad one along the west rib and a smaller one near the east rib. The fall is 10 to 12 feet high and hasn't been cleaned. We can't tell how high the kink zone extends into the roof. At north end of fall, four feet of dark gray laminated shale is sharply overlain by medium gray, silty shale that is weakly fissile and contains a few sandstone laminae along with siderite bands and nodules.

10.) Main West, crosscut 500 feet west of slope bottom at Entries 1 and 2 (the two southernmost entries). The intersection at Entry 1 has fallen and is completely blocked by fallen rock. The fall extends north, near the east rib of the crosscut into Entry 2. The shale has fallen up to five to six feet above the top of the coal and a kink zone is to blame. This kink extends to the top of the roof fall. Two feet of medium gray, silty shale sharply overlies three to four feet of dark gray laminated shale.

This fall also extends along Entry No. 1 into the next intersection east. A kink zone running east-west is developed along the south rib of this east-west entry. It is definitely a compressional feature. Shale along south side of the fracture zone is sharply bent downward, being forced southward by horizontal shale slabs north of the break.

This doesn't fit the expected pattern but surely is significant!

The E-W kink doesn't reach the top of the big roof fall, six feet above the coal. Again medium gray shale sharply overlies four feet of dark gray laminated shale.

General Observations and Conclusions

My main purpose was to try to understand cause of "cutter" roof failure; I spent little time looking at other features in the mine.

The Herrin Coal that is being mined is about six feet thick. The coal seam is horizontal to gently undulating, and no pronounced changes in thickness were noted. No faults or rolls were observed. The only water seepage encountered was in the slope. No problems with the floor were observed or mentioned. The roof is Energy Shale, the lower two to four feet being dark gray, carbonaceous, and containing fine planar, parallel lamination. Above this is medium gray silty shale that is less fissile and may contain sandstone laminae. Siderite bands and nodules are common; the miners call this rock "dimpled" because of the nodules.

Roof failure is highly preferential in north-south headings. This is true both in the Main North, where the falls are in entries, and in the Main West, where most of the falls are in crosscuts. From my limited observation I cannot say whether falls are more common adjacent to unmined coal or in interior entries. The only falls attributed to pre-existing geologic features were in Entries 7 and 8 of the Main North, where a zone of slickensided "slips" was encountered in the roof. These appeared to have random orientation in Entry 8 but a preferred N-S trend, along the length of the heading, in Entry 8. The slips affect the roof only and not the coal. They might be due to differential compaction around sandstone bodies higher in the roof sequence.

Most falls are caused by development of kink zones, nearly all of which form in north-south headings. These kink zones probably are caused by horizontal is situ stress oriented in a roughly east-west direction. East-west compression is shown by forcible convergence of the broken rock layers that sag down along the axis of the kink zone. The dark gray, laminated shale is highly prone to forming kinks and the miners tell us that taking down this shale immediately after mining the coal tends to reduce the tendency of the roof to break. However, in large roof falls in the Main West we observed some kink zones that extend to the tops of the falls in gray, silty shale at least six feet above the coal. Also, in the Main West one large roof fall has taken place along an east-west kink zone. It may be significant that the east-west kink is at the corner of the pillar on the southernmost heading, adjacent to the unmined coal.

Penny Padgett and mine management discussed possible re-orientation of the mine plan to reduce the formation of kink zones. The optimum plan is to drive the mine headings at 45 degrees to the principal stress axis. We agreed that before such a step is taken, obtaining instrumental measurements of the orientation of the stress field is essential.

Vermilion Grove Mine, Vermilion County
T. R. Moore, 20 April, 2004

Vermilion Grove mine tour
Contact: Penny Padgett, Black Beauty Coal Company (wholly owned subsidiary of Peabody Energy) Evansville, IN 47702, (812) 424-9000, email ppadgett@bbcoal.com
Accompanied by Russ Jacobson, John Nelson, Chris Korose, and Scott Elrick

First stop near the north end of 1st Main South (copy of mine map acquired by John Nelson and should be in accompanying files): Roof fall occurred between a set of roughly parallel roof joints where they are cut by a second set, allowing a long, rectangular block to stope out. The headings are oriented N65W and N25E and the primary joints bounding the roof fall are trending N78W and N20E. The fall edges are ragged however, not clean planes, so this was not just a simple fracture-bounded block fall.

The mine, like most of those underground mines I have visited so far in Illinois, is dry. I am amazed by how dry most of these mines, and apparently the seams themselves are. "The only time we get any water is when the overlying sandstone gets into the roof" or when there are open joints or faults that penetrate up into such an overlying (or underlying) sandstone.

The roof in this portion (and much) of the mine is laminated to thin bedded, interlaminations of light grey clayey fine siltstone, slightly silty gray shale, slightly to moderately carbonaceous dark grey to black shale and carbonaceous partings in varve-like rhythmically repeated sets. These are bundled into repeating sets on what at first glance appear to have two or more harmonics. As such they are highly suggestive of a slack water deposit being influence by tidal flux. These may represent the subaqueous portion of a broad tidal flat or tidally influenced brackish "lake", or may be adjacent to a strongly tidally influenced distal channel system. During high tide periods (likely not daily periods but rather monthly spring and neap), there is overbanking of the silty mud sediments into a broad, slack water body. During the low tide periods, that flow of muddy water is confined to the channel and the clayey, carbonaceous debris accumulates there. This would produce the varve-like lamination.

In some places small scale soft-sediment compaction and deformation features are evident, but those typically only deform a section a few inches in thickness, a few of the varve like sets. There are a few places where the penecontemporaneous deformation will include whole beds. Still, these are not strong deformation events and seem mostly to be from differential loading and compaction. These include small pillows and small-scale convolutions, but not more vigorous features such as sedimentary boudinage.

There are also gentle, mildly erosional or non-depositional "cut" and fill structures. These are not scours that were then filled with new deposits, but rather broad rolls of sub-parallel laminae and thin beds. As such they resemble deposition in hummocks and swales, in some ways swaley bedding or hummocky cross stratification, but they are not. These muddy sediments would not have been being deposited in an energetic setting and the resemblance to SWB and HCS is only superficial. They may, indeed, represent drapes of these muddy beds over small hummocks and into swales, but this is likely caused by periodic deposition from a mud-rich water column onto a bottom with some low-amplitude topography.

The top bench of the coal seam fades gradually over about 1 ft of stratigraphic thickness from clean coal to bone and into dark, carbonaceous shale and interbedded siltstone like the overlying roof (described above).

[*Not having ready access to the mine map and not wanting to bog down our progress during this quick tour, I did not note specific locations within the mine where I made the following observations.*]

Cleat orientation measurements:

N75E	N79W	N80E
N80E	N72W	N82E
N72W	N82E	N84W
N78E	N90E	

Strong joint trend:

N03E
N05E
N-S

Weaker non-systematic joint trend:

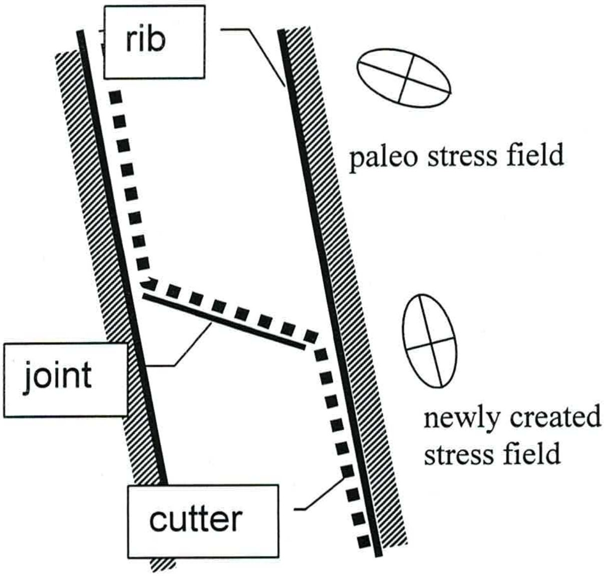
N20W
N22W

Following the trend of the above-described roof fall into another section of the mine, one can see other similar falls, bound by twin sets of parallel roof joints. These vary in orientation from N78W to N75E. At one of the later stops, looking down the heading to the southeast, one could see these begin to curve off to a bearing of N70W.

There is sometimes another, more weakly developed set of orthogonal joints present in the roof with orientation of N40W and N50E. These are secondary, formed after the stronger set above.

In the "varve" roof, there are distinct rhythmic sets with at least two or three separate harmonic cycles in their repetitiveness. Within these beds there are scattered siderite blebs, nodules, and cements. They seem to be somewhat more preferential in the silty laminae.

The roof parts very evenly in most of the mine where the laminated "varve" roof is present. This leaves a good, smooth roof that looks almost man-made, resembling a giant flagstone surface. But in many areas, where the middle of the room has this nice smooth roof, there will be a cutter along one or both ribs. In some cases these fractured zones have dropped up to a foot of roof material. These zones will sometimes go around the corner into the crosscuts, following their rib as well. They do not appear to be related to natural fractures, but rather are induced by the removal of the coal, concentrating the stress at the point where the weight of the unsupported span of the roof is focused at the free-space point just inside of the rib. I suspect the roof is acting like an unsupported beam and is trying to fall, either hinged at one end in some cases where there is a cutter only along one rib, or trying to drop as a block where there are cutter zones along both ribs. In at least one case, Scott and I observed a place where there was a cutter running down one rib up to the point where there was an oblique natural fracture. The bad roof followed the trend of that natural fracture diagonally across the cut, and then went on as a cutter along the opposite rib. This pattern resembles that sometimes seen in naturally faulted areas where there is a weak, pre-existing structural trend that is oblique to younger extension. The extensional faults will try to follow the old trend to a point and then step off in an en echelon offset in the orientation of the maximum stress direction, then begin again along the old weak trend.



Orientations of a largely mineralized cleat set:

N28W	N35W	N28W
N33W	N28W	N30W
N24W	N33W	

Complimentary set with only spotty mineralization:

N42W	N60W	N60W
N50W	N60W	
N55W	N62W	

First SW panel of Second West Main

Line of bad roof along a fracture zone, oriented about N40E.

Cleat orientations:

N80E	N80W
N78E	N85W
N85E	N90E

The above are all face cleats, partially mineralized to sealed with calcite. The degree of cleat development, here, is considerably poorer than I have observed in the mines in SE Illinois.

Complimentary butt cleat orientations about N18W.

Stopped and examined a new, big roof fall that came down recently.

1st Southwest Panel: Clastic dike. (See also notes by others in ISGS party in description of this feature.) General trend of this linear feature is N40E over a distance of 1000 to 1500 ft. The associated fracture zone is highly irregular locally, though, and occasionally changes sense from dipping SE in some places to dipping NW in others, but in both cases would have antithetic fractures or small-offset faults of the other sense. The dip of the fracture exploited by the plastic clay also varies in magnitude. The clay intrusion is irregularly edged and seems to have been forcibly injected into the coal bands. Except for at one spot, it does not intrude into the overlying roof shale, but is confined to the more readily compressible coal.

Riola Mine, Vermilion County
T. R. Moore, 20 April, 2004

Vermilion Grove mine tour
Contact: Penny Padgett, Black Beauty Coal Company (wholly owned subsidiary of Peabody Energy) Evansville, IN 47702, (812) 424-9000, email ppadgett@bbcoal.com
Accompanied by Russ Jacobson, John Nelson, Chris Korose, and Scott Elrick

[*Not having ready access to a mine map, I did not note specific locations within the mine where I made the following observations.*]

First stop on the tour was in an area in which an overlying sandstone has rolled down and cut into first the roof and then into the full seam (or very nearly so). Where the sandstone is present in the roof, the roof bolts are rusty and there are occasional puddles on the claystone floor. This is in marked contrast with the rest of the mine which is essentially dry.

The sandstone exhibits large-scale planar tangential crossbedding in its lower beds. The basal surface is mildly erosional on a close scale, but does cut into the roof and the coal on a larger scale. Its distribution in this portion of the mine is as pods or a "string of pearls", suggesting to me that the thalweg of the channel in which it is being deposited was undulating vertically, such that it cut deeply into this pre-existing strata only at points. I don't know how these map out, but they may indicate the deeper cuts by the channel in the curves of a meandering channel, whereas the places where it is well above the level of the seam may relate to the reaches between the scour pools. The sand-filled channel was said to be about 200 ft wide. The scoured channel seems to have been initially filled, first, with a dark gray claystone and then, later, with the crossbedded sandstone. There is no basal channel lag nor inclusions of hard clasts, clay galls, or coal rip-ups, but rather seems to have been being filled by active deposition by terrigenous sand. The internal bedding may be laterally accreted beds, rather than slip-face crossbeds. It is difficult to tell with the limited exposure in the roof. Some show convolute bedding and other soft-sediment deformation.

The pre-mine drilling was done on *c.* ½ mile centers, much too broad a spacing to be able to define a sandstone body such as this. [I need to get a copy of my "probability paper" to Penny on this subject.]

Stopped and examined a roof fall that came down in just the past 24 hours. The area between this and another recent roof fall nearby was wet. When the first fall came down, the water started to come in along the rib in the room adjacent to the fall. Then, a week later, the fall continued in that direction. In the area between the two falls, there were a couple of long roof joints that had released and fell to the floor. All of the old bolts in the area were rusty, too, suggesting that they were allowing water entry. I guess that the roof bolts are either penetrating or stopping just short of an overlying, water-saturated sandstone body. It is possible that the falls have their origin at the level of the basal contact of that sandstone, if such is the case.

Of what I observed in the mine, the overall cleating is poor and many of the face cleats are mineralized with calcite. In a couple areas, I noticed short, mineralized fractures that had not developed in multi-band cleats, but do resemble short tension gashes. These too are calcite sealed.

The tour was unexpectedly cut short when the man trip broke down. The connecting link between the power steering hydraulic cylinder and the control rod broke. Because the other available man trip car was needed for the upcoming shift change, we decided to return to the surface rather than potentially cause a disruption to people's schedules.

Black Beauty Coal Company - Vermilion Grove Mine - Vermilion County

Notes by John Nelson on visit with Tom Moore, Russ Jacobson, Scott Elrick, and Chris Korose of ISGS with Penny Padgett and Eric Quam of Black Beauty, April 20, 2004.

I composed the following notes in the office the day after the mine visit using rough notes made underground as a guide.

We spent about three hours underground, visiting two areas of the mine. The first area was at the north end of the First Main South; the second was the 1st Southwest Panel off the 2nd NW Main. We rode a mantrip between the two areas but walked out much of the 1st SW Panel. Mining is complete in the latter area and the panel is due to be sealed within a month from now.

General geology. The Herrin Coal is fairly uniform in thickness in the area we toured, 5 ½ to 6 feet, and the seam is level to very gently rolling. The "blue band" is less than an inch thick and about 1.8 to 2.0 feet above the floor. Other clastic partings seem to be discontinuous. The immediate floor is olive-gray slickensided claystone. We did not see more than the uppermost few inches of floor exposed. We saw no signs of floor heave and were told it is not a problem here.

At the top of the Herrin Coal is a layer of "bone" or dull, shaly coal to black, carbonaceous shale containing many very thin laminae of vitrain. This interval varies from less than 0.1 to about 0.8 ft thick. In one place the bone is split away from the main coal by a lens of shale, but generally the bone acts as a transition zone from coal to roof shale.

The immediate roof in both areas we walked is dark gray shale that contains very fine, planar, parallel and rhythmic siltstone laminae. Penny calls the shale "varved", which is a good descriptive term; but these are tidal rhythmites and show well marked neap and spring cycles. Siderite occurs as laminae and small nodules. In places, small-scale (typically measured in inches) slump features are present. The only fossils we found are tiny arthropods that Russ identified as *Leaia sp.* As seen in roof falls, the shale gradually becomes lighter colored upward, the silt content increases, and the rhythmic laminations disappear. No significant water seepage was observed anywhere in the mine.

In one place a layer of dull coal is in the roof about 1.7 feet above the top of the main seam. The dull coal reached a maximum of 0.5 ft thick and tapered to a feather edge without (as far as we can tell) joining the main seam. The dull coal covered an area of roughly 70 to 100 feet in diameter although we could not see it in its entirety. They was no rooted zone beneath. Evidently this was a large mat or accumulation of transported peat.

Roof stability. In both areas we examined the immediate roof of rhythmically laminated shale is a "draw shale" that falls during mining. The layer that draws can vary from a few inches to more than a foot thick. Once the roof is bolted, further spalling seldom occurs. In many places the main roof is solid and smooth as a billiard table.

A more serious problem is cutter roof. Cutters form along one or both ribs and do not deviate from the pillar's edge. In the Main South, they seem to occur equally in north-south as in east-west headings and do not favor one rib over the other. They begin as spalling of immediate roof and progress to narrow linear falls that can run 5 or 6 feet above the coal. In cross section they can be rectangular or a narrow inverted "V".

In several places it is evident that roof is failing in cantilever fashion. That is, as a cutter forms along one rib the entire span of roof is hinging downward about a pivot point above the opposite pillar. This is shown by sharply tilted slabs of shale along the break line (See sketch). In places I saw a V-shaped arrangement of shale slabs similar to a kink zone; however the tilted shale slabs on the inside of the entry are merely loose pieces that are sagging. Where cutters form along both ribs, presumably the span of roof is inching downward as a single mass. Eventually a massive roof fall may result.

Fortunately, cutters seem to be confined to small areas. We saw only a few examples in the 1st SW Panel. In the Main South they were strongly developed through an area of three or four crosscuts as we saw them. I notice on the mine map that the severe cutters in the Main South are in line with a zone immediately to the west where the coal in now-sealed panels was left unmined, or the miners left larger pillars than normal. Eric and Penny did not have a definite answer as to what kind of problem was encountered there. The mining pattern suggests that the severe cutters followed a linear east-west zone at least 1,500 feet long and a few hundred feet wide. If my interpretation is correct, the miners are likely to encounter cutters as they approach the inby end of the 1st Northeast Panel off the 2nd NW Main.

Cause. I have no clear idea as to what causes cutters. They are not common in Illinois mines. Unlike kink zones, cutters do not seem to run in a preferred direction. This suggests that cutters are not a product of horizontal stress. However, the possible linear alignment of cutters through the Main South suggests some form of tectonic influence. More detailed mapping and study is needed to sort out the causes. This is particularly true should the miners run into cutters at the face of the 1st NE Panel, proving the linear hypothesis.

Possible Cure. First a disclaimer: I have no rock mechanics or mining engineering background.

Suggestion: If this has not been tried already, angled roof bolts anchored above the pillars might stop cutters from propagating. Trusses composed of angled bolts above opposite pillars, connected by steel rods tightened by a turnbuckle, might prevent the break from forming along the rib line by transferring stresses onto the coal pillars (See sketch).

Clay Dike. We viewed a clay dike in the 1st Southwest Panel. It was said to be the only such feature encountered in this mine. In my experience, clay dikes are rare in mines having a thick gray shale roof. This particular dike has several features that make it unusual, if not unique, among such structures I have seen.

The single clay dike at Vermilion Grove follows a linear trend approximately N 45 E across the panel for a known distance of about 1,500 feet. It gradually dies out at its northeast end. The southwestern continuation lies in unmined coal. For a clay dike to be this straight and long is remarkable. Near all of the hundreds I have mapped in other mines follow curved or sinuous courses and have no preferred orientation.

Black Beauty Coal Company - Vermilion Grove Mine. September 13, 2005. John Nelson with Scott Elrick and Bill DiMichele (Smithsonian Institution), and Phil Ames and Todd Grouns of Black Beauty.

4th Southwest Panel

This is currently the westernmost workings, west of the 3rd Southwest Panel that I visited about two months ago. Coal is 6 to 7 feet thick and overlain by medium gray siltstone that contains lenses and laminae of light gray sandstone, coal stringers, and abundant plant debris. Contact to coal is strongly rolling and riders of coal splay into roof. Many of the larger rolls run NW-SE.

Plants here are mostly pteridosperm foliage and broken stems, all transported. Lycopod leaves and broken *Pecopteris* fronds are common. We also saw a number of stigmarian roots - lycopods were uprooted.

Some lenses of siltstone are enclosed by the topmost layers of coal. Others are higher in the roof. Micro-faulted and slumped lamination are present.

No water seepage here. The 4th SW isn't mined up to the wet area encountered in the 3rd SW.

We saw one re-bolted roof fall about 9 feet above the coal. Rock is siltstone with sandstone laminae and carbonaceous partings. Bedding undulates gently, layers gradually thicken and thin. A little water is dripping.

Main West - 4th SW Junction

West of belt junction, water is pouring out of a set of fractures in the roof. The fractures strike N85°E, dip 80-85°N, and are spaced several feet apart. They are tight fractures or lined with a film of clay. Some enter the top of the coal but I can't tell if they go through the coal. Zone of wet fractures is about 10 feet wide and crosses the set of entries.

Todd's map shows this is part of a swarm of water-bearing joints that cross this area - roughly 300 by 600 feet exposed thus far.

The rolling siltstone roof, with abundant coal stringers and ripped-up plant debris, is the same as in the panel.

We saw a second set of joints like the first at northwestern corner of the workings. Some go all the way through the coal. There is no displacement.

Plants in this area include *Lepidodendron*, *Lepidophlois*, *Cordaites*, *Sigillaria*, and *Pecopteris*.

1st Southwest Panel

At first crosscut back from face of panel on travel entry is a normal fault striking N10°E/35-50°E. Throw is three to four feet, displacing roof, coal, and floor (not dying out downward). Striations are vertical. A little normal drag in hanging wall.

In the next crosscut north, we could not locate the fault, although the coal rises to westward where the fault should be. Heavy rock dust hides the detail here.

This is evidently a non-tectonic fault (but not a clay dike-fault).

This area again has rolly siltstone roof. At the faces water is dripping and in one place coal is cut down to three feet thick. Bedding surfaces in the roof are thickly coated with fossils including lycopod stems and foliage, *Cordaites*, *Calamites*, *Pecopteris*, and *Sphenophyllum*. The fern foliage is profuse and less fragmented than in the other places we have visited today.

We stopped briefly at the junction of the 1st SW Panel and Main West. Roof is similar to all we've been seeing, but a little finer grained (silty mudstone rather than siltstone) and more sideritic. Plant fossils are abundant as before.

Northwest Mains

We made a quick stop at footage 4270 (about 1300 feet east of the right-angle turn in main entries). Roof is medium gray silty shale, indistinctly bedded, sideritic. Plant fossils are less abundant than at points west, and more fragmentary - no large stems or logs. Contact to coal is even to slightly rolly. This looks a lot like typical roof at Riola Mine.

With two more stops eastward (back toward the slope), we see a complete and gradual transition from rolly, sandy siltstone on the west to dark and finely laminated clay-shale on the east. Cutters become more and more pronounced as we progress into finer shale.

A zone of fractures and small faults accompanies the dike. Near its southwest end, a normal fault having the NW side downthrown about one foot displaces roof, coal, and floor. Followed northeast along strike, the structure changes to a small graben or in places, a fault with overall throw down to the southeast. Fault surfaces bear vertical slickensides and mullion, indicating pure dip-slip. All displacements are normal. Fracture zone in the roof is composed of intersecting "slips" or small faults that extend at least 6 feet above the coal (as seen in roof falls).

The dike itself is filled with soft light-colored clay. It may follow a fault plane through the coal, or take a zig-zag course. Many intricate small sills and clay veinlets crisscross near the main dike, but maximum width is less than one foot. The coal shows "false drag" and convergent bedding, all typical for clay dikes I have seen elsewhere. Also as is typical, the underclay bulges upward along the dike.

The clay dike never enters the roof, although the faults and slips continue upward. See sketches. In one place the top of the clay dike was sharply truncated at the contact between the bone coal and the rhythmically laminated shale. The shale itself is both folded and faulted. Drag along faults is in the direction of displacement, but roof shale bedding conforms to that at the top of the coal.

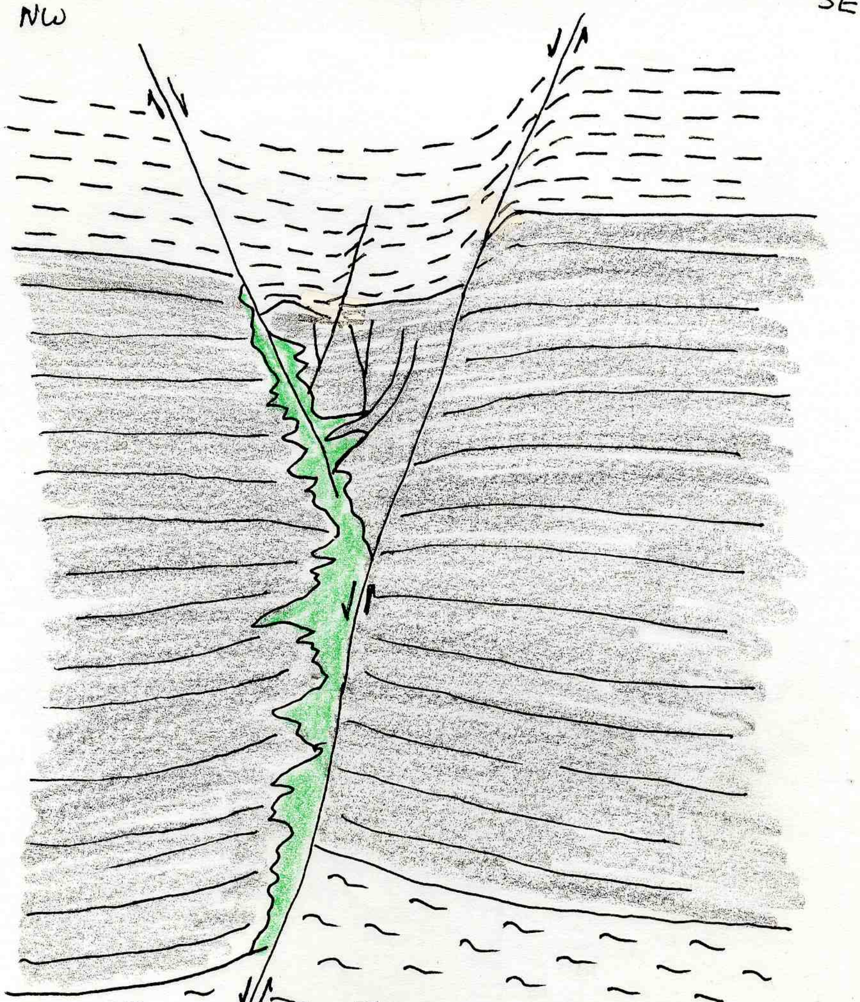
Origin. The fact that roof shale truncates the clay dike indicates that the dike formed before deposition of the shale. Later movement or differential compaction caused small faults and folds to extend upward through the roof shale.

Like all clastic dikes, this one is a product of horizontal extension (stretching) that ruptured the peat, allowing sediment to flow into the ragged break. The peat was in a tough but pliable, leathery state when the rupture formed.

Penny believes the clay came from below the coal, but the case is not clear. Her theory requires clay below the coal to be liquefied and forcibly injected upward. An alternate theory is that soft, soupy mud overlying the peat simply flowed into the break when it formed. Remnants of this mud were washed away before roof shale was laid down (or simply incorporated into the shale).

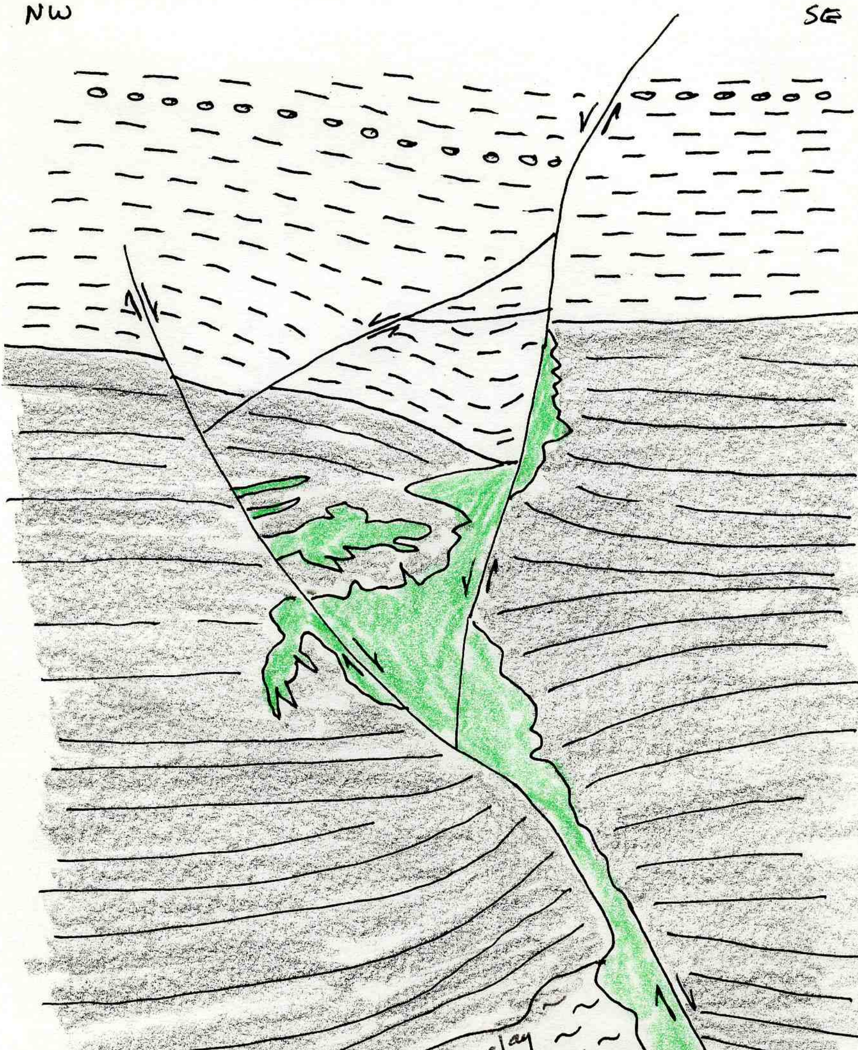
The linear extent of the dike and the lack of nearby depositional anomalies (such as a channel or roll in the coal) suggests that the peat was torn apart by horizontal tectonic stress oriented northwest-southeast.

Mining implications. Vermilion Grove miners will probably see this dike again if they develop another panel west of the 1st SW. The projected trend can be drawn on a map with a ruler. Where the dike crosses a mine opening at a right angle, it causes little trouble. Mining parallel to the dike leads to serious roof falls. If mining along the dike is unavoidable, extra support should be placed to prevent failure along the zone of intersecting faults above the coal. The location of the slips and clay dike will be obvious as the coal is mined.



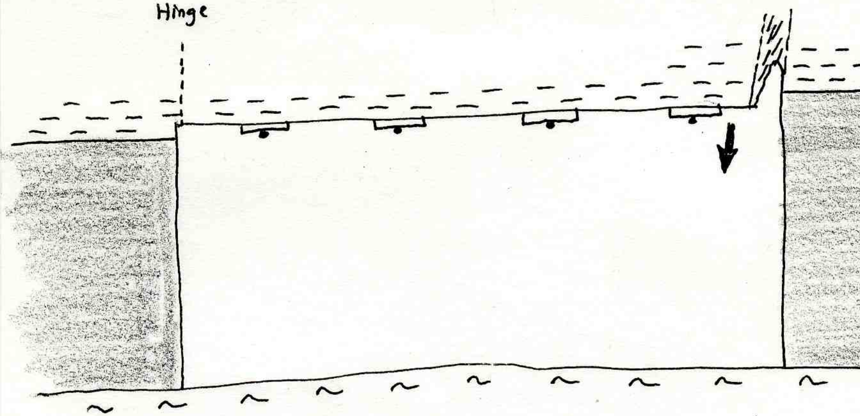
Clay Dike - Vermillion Grove Mine

W. J. N. 4/20/04

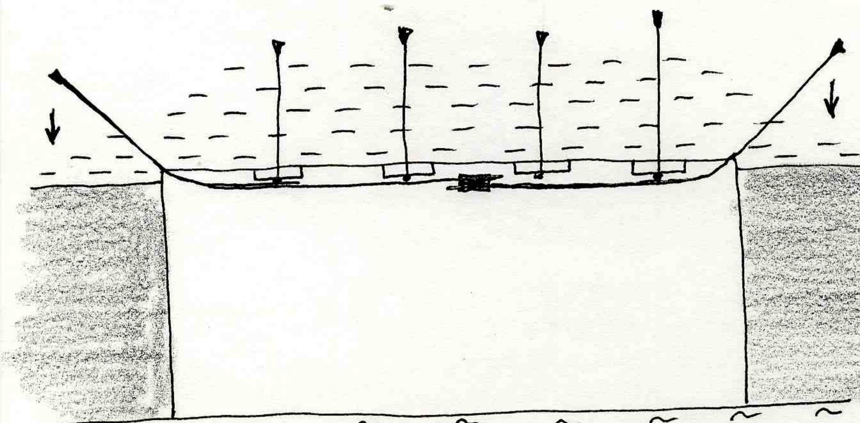


Clay Dike — Vermilion Grove Mine

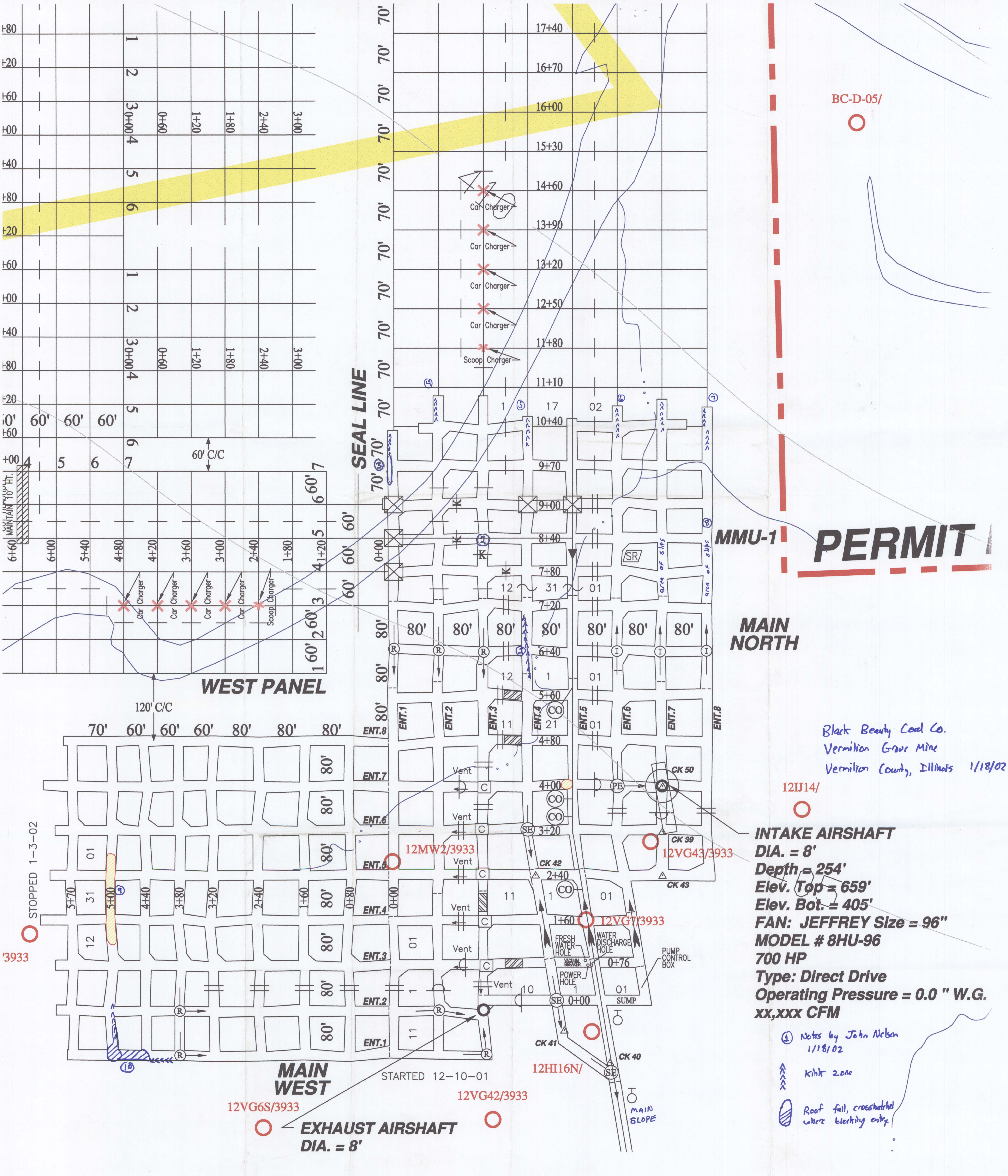
W. J. N. 4/20/04



Cutter developing along one site of entry
Roof behaves as a cantilever.



Angled truss bolts might transfer
load above coal pillars and prevent
cutters from forming?



SEAL LINE
WEST PANEL
60' C/C
120' C/C
MAIN NORTH
MMU-1
PERMIT
BC-D-05/
Car Charger
Scoop Charger
area of slips
MAIN WEST
STARTED 12-10-01
STOPPED 1-3-02
ENT.1
ENT.2
ENT.3
ENT.4
ENT.5
ENT.6
ENT.7
ENT.8
Vent
FRESH WATER HOLE
WATER DISCHARGE HOLE
VACUUM BREAKER
POWER HOLE
SUMP
PUMP CONTROL BOX
MAIN SLOPE
CK 39
CK 40
CK 41
CK 42
CK 43
CK 50
12IJ14/
12MW2/3933
12VG43/3933
12VG7/3933
12HI16N/
12VG42/3933
12VG6S/3933
3933
INTAKE AIRSHAFT
DIA. = 8'
Depth = 254'
Elev. Top = 659'
Elev. Bot. = 405'
FAN: JEFFREY Size = 96"
MODEL # 8HU-96
700 HP
Type: Direct Drive
Operating Pressure = 0.0 " W.G.
xx,xxx CFM
EXHAUST AIRSHAFT
DIA. = 8'
Black Beauty Coal Co.
Vermilion Grove Mine
Vermilion County, Illinois 1/18/02
Notes by John Nelson 1/18/02
Kink zone
Roof fall, crosshatched where blocking entry.

Black Beauty Coal Co. - Vermilion Grove Mine

Notes by John Nelson, April 25, 2006, with Scott Elrick of the ISGS, Bill DiMichele of the Smithsonian Institution, and Phil Ames of Black Beauty.

Purpose of the visit is to catalogue and collect fossil plants in the roof shale as part of a basin-wide paleobotanical study undertaken by Bill DiMichele.

The Riola Mine is being shut down, and Vermilion Grove will mine its reserves. We go to the face area of the workings furthest northwest. **Location:** cannot determine exactly, newest workings not on our map. Approximately 2000' SL, 1500' WL, Sec. 3, T18 N, R12 W.

The coal seam here is fairly level, but the roof-coal contact irregular. Swarms of rolls and slips run approximately north-south. The roof and roll filling consists of gray, rhythmically laminated siltstone with lenses and laminae of light gray sandstone. The largest rolls cut 2 to 3 feet into the coal. Fossil plants are common, and locally profuse, especially in rolls. *Sigillaria, Cordaites,* and *Lepidophlois* dominate; a few calamites, cones, and ferns are present. The latter consist of broken fronds, mostly *Pecopteris* and *Alethopteris.* We found *Lepidophlois* branches with fronds attached, indicating that limbs were broken off living trees.

Bill identified *Spenophyllum longifolium*, a plant that supposedly is confined to Stephanian or Upper Pennsylvanian rocks. The Herrin Coal, of course, is Desmoinesian or Middle Pennsylvanian.

Three tree stumps were found at Crosscut 2730' between entries 1 and 2. The largest is 2 ½ ft. in diameter and vertical; two smaller ones are tilted. They appear to be rooted in the coal "rider" at the top of a roll. Nearby, another tilted stump has well preserved roots at the base, just above the main coal seam. Stumps are not common, but stigmarian roots are common in the roof.

At the corner where the main travelway turns from northeast to northwest, the roof is less rolly than at the face. Fern foliage is plentiful, including *Pecopteris, Alethopteris, Sphenopteris,* and *Sphenophyllum.* Lycopod leaves and *Sigillaria* stems also are common here. **Location:** on map. 600' SL, 1000' EL, Sec. 3, T18 N, R12 W.