2948

Ronald Caswell - President
Steve ...... (locally "in charge")
Charlie Austin, Supt.
Ray Pitman, Foreman
Spencer Young, Geologist
Jay Torrey, Electrician
Fred Keady - owns coal
Dave Sutter, Engineer

CO.

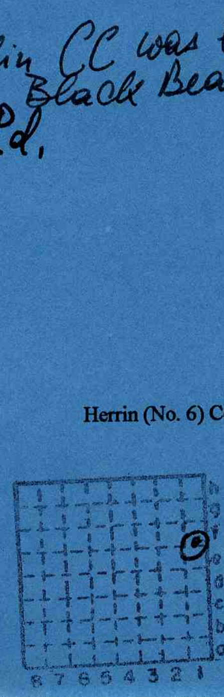
1829 E. Southern Manor Dr.
Terre Haute, IN 47802
ph. 812/894-3480

12/99: Catlin CC was bought by Black Beauty CC.

address:
8282 Catlin-Indianola Rd.
Catlin, IL 61817
ph. 217/662-8896

Herrin (No. 6) Coal

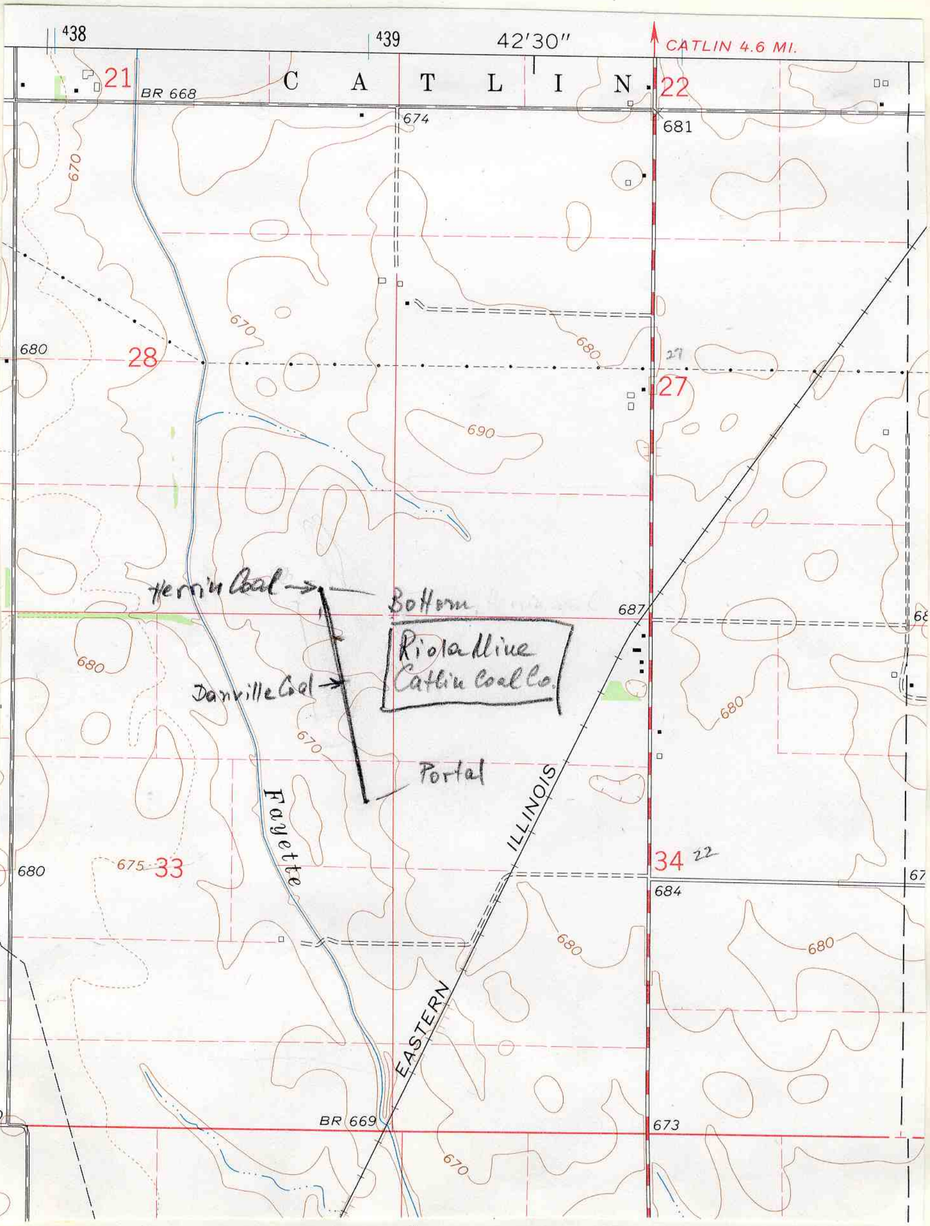
Slope Mine
RIOLA MINE
Mine Index No. 1018
Vermilion County



Sec. 33
T. 18 N.
R. 12 W.
Index No.

MOORE'S MODERN METHODS

FORM 180 W



Location map for the Riola Mine
Georgetown 7.5 min. Quad

The News-Gazette

SECTION
B
Monday
September 2, 1996

FEATURES

Jay Toney, chief e
neer/maintenance supervi
Catlin Coal Co.

"I wouldn't do this if I d
n't like it. Every day is d
ferent. I'm not too wor-
ried. Safety is up to the
people who work the
mine and run it, and we
safe here. Sometimes
things get a little hectic
with too many things
going on at once, but
that's the challenge."To
has been a coal miner f
11 years, the last year
spent at the Catlin mine
which opened last
September. His only oth
job was in a factory. He
didn't like that because
was "too monotonous."
work day runs from 7 a
to 5 p.m., and his work-
shop is 250 feet down.

Visit to Riola Mine of Catlin Coal Co.
February 8, 1996
by Heinz Damberger and Colin Treworgy,

Ray Pitman, miner; forman Steve...

accompanied by Spencer Young and Charlie Austin, Mine Superintendent.
Also met in office Ronald Laswell, President and Jay Toney, Electrician.
phone. # of mine office: 217/662-8896

Mine location (of portal): Vermilion Co., 260 ft W of E line, 1880 ft S of N line of Sec. 33, 18N-12W. (based on 1"=400' mine map in permit application and information on length and direction of slope indicated below).

Purpose of visit: Sample Danville (No. 7) Coal; first visit to mine, take notes on geology.

General information on mine

This is a new mine currently under construction. At the yard area of the mine they removed top soil (48 in. according to permit) and stored it to the E of the mine site. They depression thus created is being filled with the rock excavated from the slope.

They are currently digging the slope, at a 9 degree angle against the horizontal (grade of 6:1), in a northerly direction, at 13.5 degrees W of N. Along projection of the slope onto the surface they drilled 13 holes, about 100 ft apart, which they use primarily to pour concrete into the void behind the lining, constructed of steel arches and multiplates between the arches; one hole is used for power lines. The concrete is mixed on site. Total length of slope, from portal to Herrin Coal, will be 1640 ft; depth from surface to coal is 251 ft (surface elevation 682 ft, Herrin Coal elevation 431 ft (cross section 5 of permit mistakenly says 631 ft); the projection of the slope at the surface is about 1620 ft. Depth to the top of the Danville Coal is 186 ft, at about 1260 ft down the slope from portal.

The construction of the slope shaft is very substantial and hides rocks penetrated completely, except where they create openings to the E, as sumps, to collect any water that runs down the slope. So far they have constructed 3 sumps, one about every 400 ft. These sump areas provide a window to about 8-10 feet of rock.

Construction of the slope proceeds in increments of 100 ft. They use a continuous miner to create the opening of about 18-20 ft width and 10-12 ft height. Final width is 16 ft; max. height within the arch is 9.5 ft (based on permit application) Almost the entire cross section of the slope is kept free of obstruction by suspending the belt from the ceiling, providing about 6 ft of unobstructed space below the belt. Ventilation to the face is provided through a large diameter pipe that is cemented in behind the lining on the left side.

Geologic observations

Drift: During construction, they experienced unexpectedly high (compared to what they had expected from studying ISGS publications for the area, and from the drill hole information they had!) influx of groundwater near the base of the drift, apparently from a shallow bedrock valley filled with sand. This slowed them down in construction for a while.

Bedrock above the Danville Coal, as seen in the 3 sump areas:

Farmington Shale: thick sequence (drill hole data indicate ca. 100 ft) of medium gray shale to silty shale, mostly massive, with bedding barely discernible; gives impression of fairly strong rock that should normally not cause much of an instability problem.

Danville (No. 7) Coal and adjacent rocks (as exposed at bottom at time of visit):

Top
Farmington Sh.
~8 ft   Shale, gray, massive, a little darker in bottom 0.5 ft; fairly strong rock

Danville Coal 0- 0.28

	0.28	Coal, normally bright banded
		- 0.42
	0.14	Heavily pyritized shale, lenses out within sample column, partially in sample
		- 1.81
	1.39	Coal, normally bright banded
		- 1.83
	0.02	Shale, dark gray, carbonaceous, lenticular
		- 2.06
	0.23	Coal, bright banded
		- 2.10
	0.04	Shale, carbonaceous, with plenty of fusain
		- 2.21
	0.11	Coal, boney, hard
		- 2.23
	0.02	Shale, gray, slightly carbonaceous
		- 2.42
	0.19	Coal, boney, hard
		- 2.77
	0.35	Coal, normally bright banded
		- 2.88
	0.11	Coal, boney, hard
		- 2.90
	0.08	Shale, dark gray, carbonaceous
		- 3.19
	0.29	Coal, boney, hard
		- 3.33
	0.14	Coal, normally bright banded
		- 3.50
	0.17	Coal, boney, dull, hard

Note: We took a channel sample of the 3.5 ft thick coal seam and submitted it for chemical analysis to ISGS coal lab, USGS coal lab (for trace element analysis), and Catlin CC for washability analysis

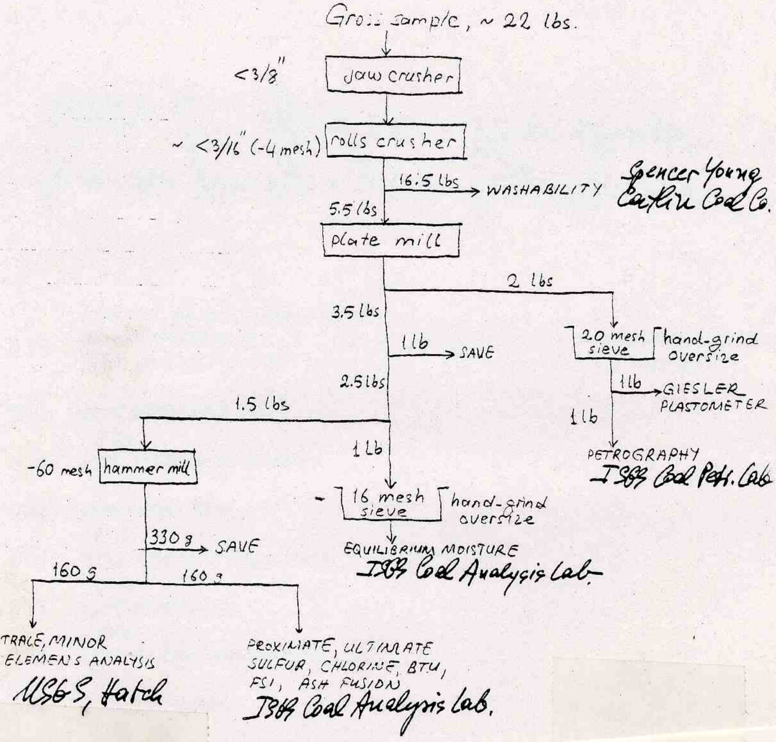
Note: Spencer Young's ph # 812/894-3480
Catlin C.C. office near Terre Haute.

HD 3/1/96

processed by I. Demir

3/1/96

CHANNEL SAMPLE, Riola Mine of Catlin Coal Co.



Sample location, depth and elevation: 520 ft W of E line, 720 ft S of N line of Sec. 33, 18N-12W; depth to coa 186 ft, elevation of coal is 496 ft (according to cross section for slope in mine permit application, which shows surface elevation of 682 ft), or about 490 ft (based on 7.5 topo quad, which indicates surface elevation of abou 676 ft).

Long -87.7151 Lat 39.9820
Spl. # C 34943, Regn. # 22298

Drill cores

Spencer Young showed us some partial drill cores, in particular a core of the Herrin Coal which he had cut into half; half of the core was submitted for chemical and washability analysis. The other half he had "polished" with sandpaper and then coated with Thompson's Waterseal, to bring out details of the coal's structure. He wa disappointed with the results. I offered him our coal petrographic lab facilities to do a better job in polishing th core which he wants to preserve as a "conversation piece" for the mine's office; he plans to eventually mount it in a special box so it can be displayed.

He also showed us a couple of cores of the roof strata which showed gray shale with siltstone/fine sandstone flaser-like interlaminations. Very little breakage was in evidence in one core, while another core was broken u some. It was difficult to see any details because the cores were wrapped in plastic. They will keep the cores at the mine's office (during next visit we should request access to these cores for a detailed description!). Spencer reported that when the cores were drilled they came out of the core barrel as a solid, nearly unbroken core, giving the impression that the immediate roof is a competent, strong rock.

I asked Spencer for other cores. He said that most of them were submitted to Eric Sproul for rock mechanical analysis. Eric did the detailed core descriptions; the cores were broken up during testing. I asked for their logs; noted some hesitation to part with them, at least at this time.

Mine planning etc.

They expect to reach the Herrin Coal in about 6 weeks. Plans are to develop parts of the Main North entries, to about 900 ft from the bottom, then to turn E and develop East Mains, with 3 production panels each to N and S. Plans currently are not yet fixed on how, in what sequence the panels will be mined; but probably they will mine the southern panels first. The panels are about 900 ft wide and 2300 ft deep each. This will be a one unit mine and they expect to mine to the 1st SE panel in yr. 1, mine most of the 1st SE panel in yr. 2, about 2/3 of 2nd SE panel in yr. 3, up to about ½ of 3rd SE panel in yr. 4, rest of 3rd SE panel in yr. 5, and so on. This is a one-unit mine; they will use one continuous miner unit; at full production they anticipate an output of 300,000 tons per year.

They don't seem to have any firm contracts for the coal yet. But Mr. Laswell mentioned that his company has been in the coal trucking and mining business for many years (his son is 3rd generation), thus indicating that he has good connections to potential users, for instance a large paper plant in Terre Haute. The mine permit states that their main customer will be a grain company in Danville.

Entrance to slope, Riola Mine

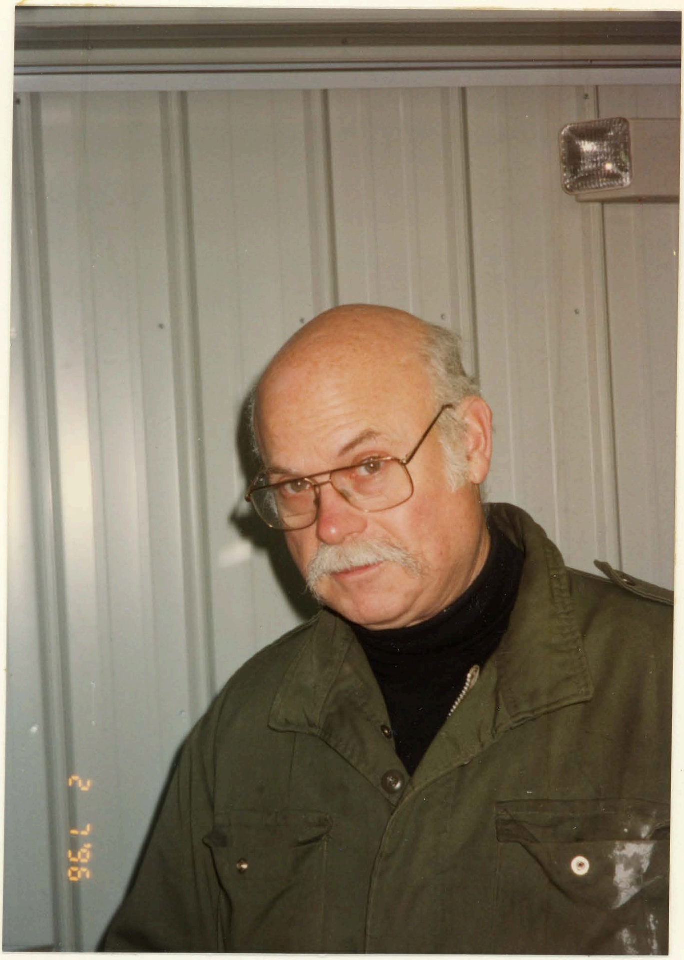
Slope (above). Main office (below), Riola Mine

mn_act_Vermilion_01.tif

A scene during construction of the Riola Slope. An area was excavated by continous miner, bolted, trusses erected, and then concrete poured around the trusses. Mine Foreman Ray Pitman leans against the roof bolter. Geologist Spencer Young is in the midde and Colin Treworgy on the right. The light colored rock in the wall on the right is Farmington shale. The dark area below it is the Danville Coal. A channel sample was taken at this spot.

Colin Treworgy kneeling by the Danville Coal.
A channel sample was taken to the right of the shovel handle.

Ronald Laswell, President of Catlin Coal Co.



Spencer Young, geologist, Catlin Coal Co.

Visit to Riola Mine of Catlin Coal Co.
February 26, 1996
by Heinz Damberger and Colin Treworgy,
accompanied by Spencer Young of Catlin Coal Co.

Purpose: See rock sequence below Danville Coal exposed since our last visit on 2/8/96; will only be exposed for a short period, before they set the arches and pour concrete.

The following rock sequence was observed, from base of Danville Coal downward. Thicknesses are somewhat uncertain because we did not have a means to project the horizontal forward (e.g. a Brunton) as we progressed along the slope.

Top From	To	Thickness	Description
0	2.0	2.0	Claystone, gray, with rootlets, soft, with many slickensided, irregularly shaped surfaces, mostly a low angle, typical for underclays. Grades into
2.0	8.6	6.6	Claystone, gray, hard; with limestone nodules, especially in lower portion, irregular in shape, up to 1-2 in. thick, and a few in. in diameter. Grades quickly into
8.6	19.1	10.5	Sandstone, very fine grained, gray, massive, hard
19.1	22.1	3.0	Sandstone, thinly laminated, dark and light gray, hard, interbedded with fairly massive layers
22.1	23.6	1.5	Sandstone, fine grained, and siltstone, gray, massive, hard
23.6	25.9	2.3	Sandstone, fine grained, gray, hard, wavy thinly laminated, similar to above, still rather hard; dark wisps with fine mica on irregular bedding surfaces (small sample taken). Rapid transition into
25.9	28.4	2.5	Sandstone, very fine grained, gray, fairly massive, hard.

Bottom

Notes:

1) The sandstone is very hard and well cemented. It did not easily break off the wall of the slope when struck forcefully with a hammer. Also, blocks of sandstone pieces picked up at the face did not break easily. This is true for the laminated sandstone as well as the massive. The sandstone does not seem to break or separate readily along laminations as it did at the mines near Murdock to the west.

2) "Kinks" extending over a distance of 10-20 ft were noticable in a couple of places in the bolted roof, along the right (east) side of the slope opening. The kink zones ran nearly parallel to the slope, may be at a slight angle west of the slope direction, but they extended never more than about 1-1.5 ft from the east side of the slope opening. The roof rocks had failed downward in a typical kink fashion, with an irregular fracture down more or less the middle of the kink zone, affecting about 1-2 in. in thickness at the time of observation; the affected zone generally was <1 ft wide. This suggests the pressence of a horizontal stress field, directed nearly E-W like in other parts of the coal basin. This may pose a problem in N-S entries and cross cuts during mine development; we pointed this out to company personnel.

3) The current bottom is about 1500 ft from the portal; they estimate that they are about 18 ft above the Herrin Coal.

Visit to Riola Mine of Catlin Coal Co.
March 14, 1996, 2:30 - 5 p.m.,
by Heinz Damberger, accompanied at mine by Spencer Young

<u>Purpose of visit</u>: (1) inspect rock sequence above Herrin Coal and Herrin Coal itself. They had recently reached the Herrin Coal and were getting ready to pour concrete for the section down to the Herrin Coal, starting either 3/15 or early next week; so this was the last chance to inspect the roof sequence. It was a perfect, sunny spring day for such a visit. (2) deliver ca. 15 pd. coal sample of Danville Coal to Spencer to run a washability test (Mr. Laswall put a damper on Spencer's plans, when he indicated (kiddingly?) that Spencer may have to pay for the test out of his own pocket; it was obvious that Mr. L. does not see any need for spending money to analyze the sample since they do not expect to mine this coal, ever, or at least not during his time).

<u>Observations by company personnel</u>: They were disappointed to have encountered significant "sulfur" when they reached the bottom. They observed that it seems concentrated in the upper part of the coal seam. Spencer Young showed me several pieces of coal containing heavily mineralized (apparently mostly pyrite), irregularly shaped lenses of shale (?)/coal/peat ("sulfur"); these are up to 0.2 ft thick and >1 ft in diameter (I took one sample back to office, for cutting and inspection under binocular/microscope); my first impression was that they might be pyritic coal balls. Some of the smaller mineral lenses (<0.2 ft in diameter, < 0.05 thick) have a dark brown color; they look like sideritic coal balls. Spencer said this came entirely unexpectedly for them because they had not seen anything like it in their drill holes. He showed me his isopach map for coal, based on dh info. Most thicknesses are in the 5 ft to 6 ft range; but some dh had < 5 ft thicknesses, down to 4.6 (or less?) ft. Thin coal sites tend to be isolated occurrences; no clear trend of thinning in a particular direction discernible; in some instances thin coal occurs within a short distance of coal with regular 5-6 ft thickness indicating rapid thinning (Spencer's contour map generally shows relatively small ~~bullets~~ bulls eyes around these thin coal locations). Most cores had relatively low S contents (<2 %), but in a few cases they incountered relatively high S contents (Spencer did not tell how high). US Steel generally performed detailed washability analyses, but Carter did only one float/sink test at about 1.5 s.g. for their cores, to more or less simulate the "cleaning" they expect to get from the breaker & hopper they will install (they do not plan to have a cleaning plant). Thus, they do not have a good understanding of the washability characteristics of their coal; this may become a problem in marketing their coal, especially if clay dikes and associated features are a fairly common occurrence.

<u>My own observations</u>:

<u>Roof rock</u>: About 25-30 ft of roof sequence were exposed during visit; it was difficult to recognize different layers due to the dirt that covers the sides, and the rather smooth surface created by the continuous miner. The sequence appears rather uniform in character, made up mostly of silty shale and siltstone, with occasional fine sandstone beds, about 1 ft or more thick (first one above coal at about 6 - 7 ft). Interlaminations of shale and silt/fine sandst. are most common facies, besides occasional fairly massive fine sandstone beds. Bedding tends to be wavy to flaserlike. Siltstone layers tend to vary in thickness, mostly <0.03 ft thick, and lenticular); ripple bedding not uncommon. Sandstone beds tend to be rather massive in appearance; ripple bedding and some small-scale cross bedding noted in places (and may be more common than could be seen under bad lighting conditions).

Bedding in roof, within about 6-10 ft of coal seam, had dip of up to 17 degr. to ~~N~~ S to ~~NNE~~ SSE; higher up in sequence bedding appears close to horizontal.

<u>Coal seam and immediate roof</u>: During my visit only the upper 4.5 ft of the coal seam were visible, in the sump off slope to NE, close to bottom; they penetrated entire coal in the sump, but the sump was partially filled with water during my visit which kept me from inspecting the entire seam, as well as the face of the the sump.

The contact between the coal and roof shale seems transitional, at least in places, and the top layer of the coal tends to have a boney appearance. The bottom ca. 1 ft of the roof rock is a medium to dark gray shale, much softer than the shale, silty shale, siltstone and fine sandstone further up in the roof sequence. This immediate roof shale does not appear to be as competent as the rocks higher up and could pose a problem during mining; the bottom ~0.1 ft is carbonaceous and rather soft.

The <u>prominent feature</u> in the sump exposure is that the top of the coal drops by about 2 feet from the W to the E side of the sump, apparently due to a <u>clay dike fault</u>. Across the face (not accessible due to standing water in sump) the contact of the coal with the roof drops irregularly by ~2 ft within a couple of feet (see sketch below). I suspect that this is related to a clay dike fault: visible along the W face of the sump exposure is a small clay dike at the top of the coal that extends about 1 ft into the coal, at a low and downward flatening (to near horizontal) angle; the thickness of the fill varies (highly) from a ~~smutch~~ smudge to about 0.1 ft; associated with the clay dike are claystone intrusions into the adjacent coal that extend from the dike, more or less parallel to the bedding of the coal, for distances of up to about 1 ft (may be more as very thin intrusions, but bad lighting conditions prevented confirmation) (see sketch below). A small, barely discernible, normal displacement (to N) of the top of the seam is associated with the clay dike. It appears that further N, towards the face, the top of the coal is affected by additional clay dike(s) and associated clay intrusions. The clay intrusions tend to be mineralized with pyrite (spark when hit with hammer); I suspect this was the source of the "sulfur" samples which Spencer had collected at the surface from the coal they mined here.

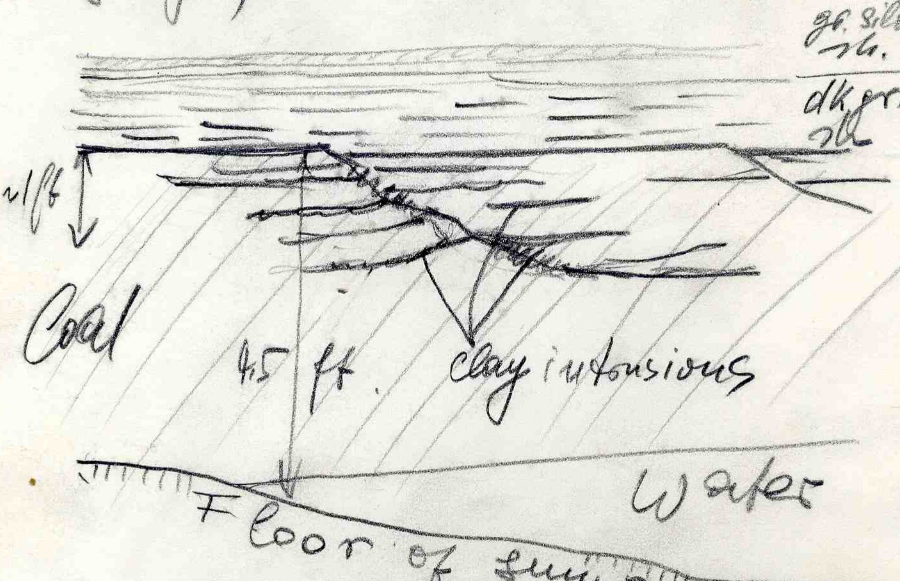
The clay dike fault seems to trend in a NE direction; but this will have to be confirmed after further exposures are created.

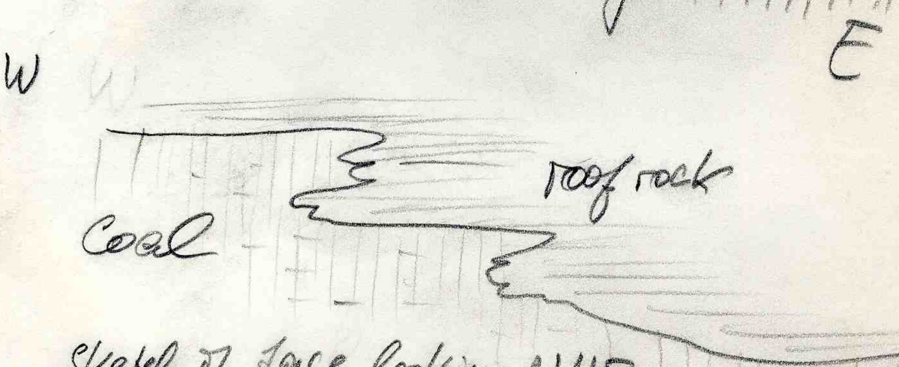
I talked to Mr. Laswell, Charlie Austin and Spencer Young about my observations and tried to give them some sense of what to expect from a clay dike (fault). I told them that clay dikes have not been common in mines in the Herrin Coal I was able to visit during the past 20 years in the area (i.e. V-Day and Lee mines). I promised to provide them some more background information on clay dikes.

Rioka Mine 3/14/96

SSW NNE

Sketch of left (W) wall of sump opening at about 45° to slope, close to bottom of slope





Sketch of face, looking NNE

Visit to Catlin Coal Company's Riola Mine
May 16, 1996
Heinz Damberger and Colin Treworgy
Notes by C. Treworgy

We visited the Riola Mine to examine the geology of the area around the bottom of the slope. The mine is in the process of developing the bottom area to connect two air shafts to a set of north-south main entries. Six entries have been developed, four to the east of the slope entry and one to the west. Mining has progressed about 350 feet north from the bottom of the slope. We traversed the margins of the mined area making brief observations of the seam and roof in an attempt to assess the overall geologic framework influencing mine conditions. No time was taken on this trip for detailed measurements or descriptions of individual geologic features.

NOTE on the mine development at bottom: The slope bottoms out on top of the Herrin Coal and grades to the base of the coal over 50 feet or so to the first westward cross-cut. This can be confusing because the coal appears to be thin like in nearby entries to the east where the full seam has been reduced by shearing off (at this point it is not known if the full seam thickness is present at the base of the slope).

The following observations by C. Treworgy are keyed by number to the sketch map of the mine.

1. The first entry to the east of the slope extends northeastward for two cross-cuts. In the first cross-cut to the east of the slope the coal has been displaced by two or more low-angle shear surfaces.

As little as 6 inches of coal is present in one area. The coal also appears to have slid along the underclay. The shear surfaces join and rise to the top of the seam to the northeast. The actual strike of the shear was not determined.

2. At the northeast end of this cross-cut, the entry turns north and the coal is about 5 feet thick. The roof along the northward entry has a disturbed appearance. Numerous small slips extend upward into the roof and material has fallen from the roof along the next 60 to 80 feet of entry.

3. A large slip and a roll were observed in the northwest corner of this intersection.

4. The immediate roof contains abundant, well-preserved plant material - tree trunk impressions and leaves, some on stems. This appears to be the original (unsheared) roof of the coal. The roof is relatively even except for the small slabs of shale-bearing plant material that are slaking off.

5. A shear surface has removed the top of the coal. The coal is about 3 feet thick.

6. The shear surface is visible at the top of the coal in the intersection. The coal is about 5+ feet thick.

7. Several photos were taken of a large "classic" roll in the south rib.

8. The coal and roof appear to be normal. The coal is more than 5 feet thick and there are large (horizontal) tree trunks in the immediate roof.

9. The top of the coal has been sheared away leaving about 2 feet of coal.

10. The top of the coal has been sheared away leaving about 4 feet of coal. The coal/shear interface is commonly smooth and horizontal, but at this location the roof material intrudes into the coal (see sketch).

11. Photos and hand specimens were taken of thin layers of fine sand just above the shear surface. These appear to be liquefaction features.

12. The coal is 3 to 4 feet high. An elongate pod of fine sand appears to be embedded in the coal at the west face of the entry. The pod is about 3 feet long and at most half a foot thick. Although as exposed, there is no apparent connection to the roof, it may extend upward to the roof behind the present face. North of here the roof is disrupted by small slips.

13. The roof and coal appear undisturbed. The immediate roof contains abundant, large, well-preserved fossils of tree trunks, stems, and leaves.

14. The coal and roof appear normal

15. A large slip is visible in the roof.

16. Normal coal and roof. Abundant plant fossils.

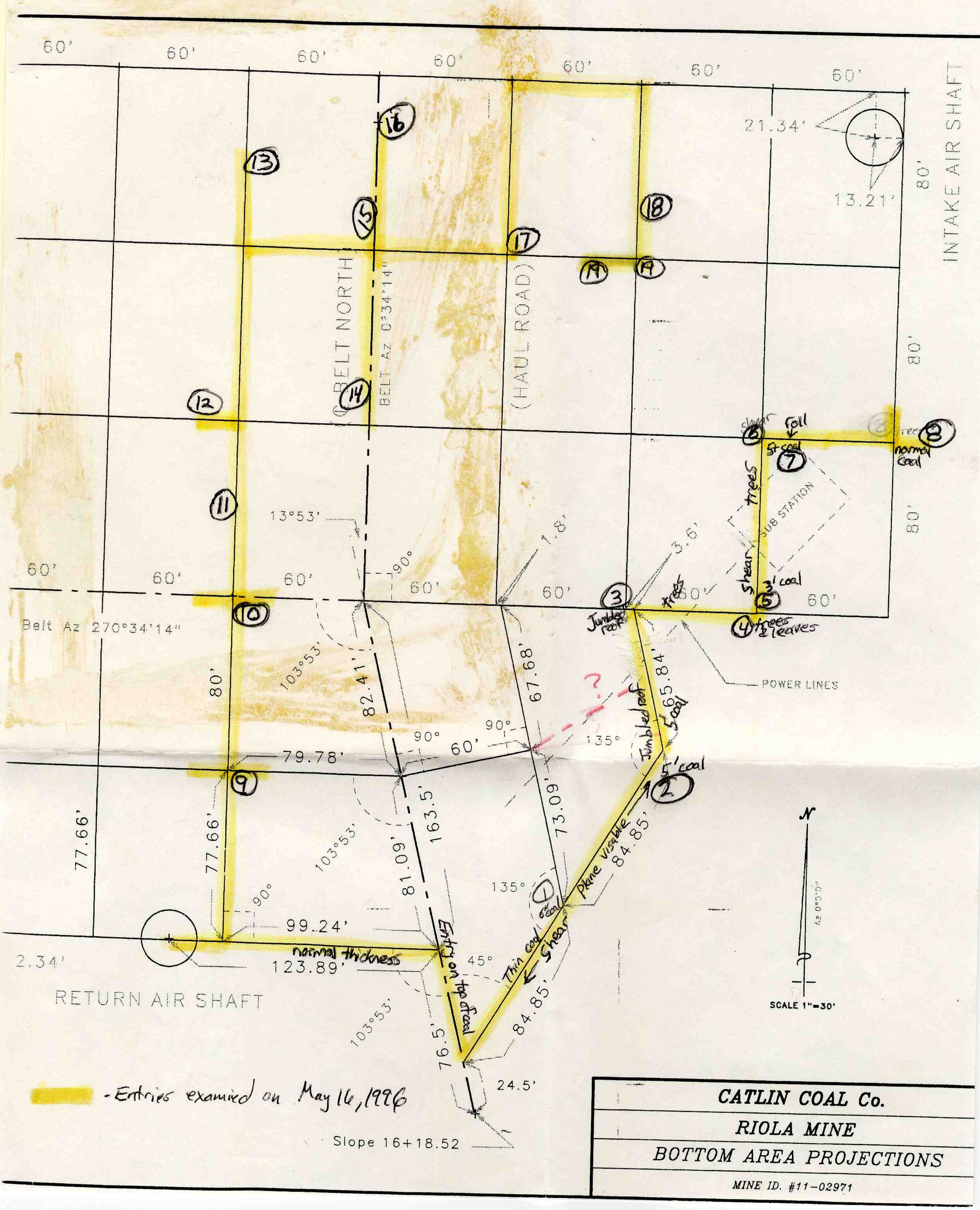
17 & 18. Normal coal and roof.

19. Small slips in roof.

John C. Moore Corporation, Rochester, N.Y. 14604

MOORE'S MODERN METHODS

FORM 180 W



Observations and notes by HHD, 5/16/1996.

Observations
A prominent, somewhat undulating, nearly horizontal shear surface can be seen, generally within a foot or two of the top of the coal seam, in the diagonal NE entry from the bottom and in the cross cuts to the north of it. Even though this shear surface is not always as distinct as in this area, it appears to be present over the entire mine as far as it has been developed (see map), except possibly in its NW-most part (locations 13, 14, 15 (?), 16, 17).

This prominent shear seems to be expressed either as a single, very sharp surface (only a knife's edge "thick" and therefore sometimes difficult to identify if it follows a bedding surface), or as a set of closely spaced shear surfaces which form a zone of highly disturbed (mylonized) rock of just an inch or two thick, or as two or more shear surfaces that are separated by inches to a couple of feet of rock. The rock between and above the main shear surface(s) tends to be affected, sometimes more, sometimes less, by subsidiary shear surfaces ("slips"); in places the rock between shear surfaces looks relatively undisturbed, in other places it is severely affected by the internal shearing. The rock and coal below the basal shear surface generally appears relatively undisturbed.

In general, the major shear surface or surfaces stay above the coal seam; but occasionally they cut through part or all of the coal seam, at very low angles, and are the apparent cause of thickness reduction of the seam to less than 1 ft in an area along the SE wall of the diagonal NE entry from the bottom of the slope, near the first cross cut (Location 1 on sketch map). However, the presence of a shear surface within the coal does not necessarily mean reduction, or significant reduction, in thickness, as noted in other places where shearing and minor faulting was noted within, and even at the base of the coal, without significant impact on the coal thickness. Colin noted somewhat reduced thicknesses, due to shearing, at locations 5, 9, 10, 11 and 12. Another apparent effect of shearing within the coal is the occasional presence of irregularly shaped rock bodies within the coal, which look out-of-place because the coal is otherwise relatively free of significant rock partings, and also because of their irregular shape and abrupt ending (location 11).

The shear surfaces have a listric appearance in cross section and tend to flatten out downward and disappear in bedding planes where they are difficult to recognize, until they cut across bedding planes. Subsidiary shear surfaces above the main shear tend to merge into the basal shear, or terminate against it, clearly indicating their subsidiary nature.

Where the basal shear surface is located a foot or more above the top of the coal, the rock underneath may exhibit little disturbance. In the absence of roof falls one could get the impression that one is out of the disturbed zone. The NW-most portion of the mine might represent such an area where the shear zone has migrated higher up into the roof strata. The roof there looks normal and undisturbed. Another (more optimistic) possibility is that the basal shear surface has permanently risen higher up into the roof sequence in that direction, or is not present (e.g. if lateral displacement was small it could peter out).

The major problem with roof control in the mine is related to the widespread intensive shearing of the rock mass **above** the basal shear. While the basal shear is near horizontal, commonly following bedding planes, generally within a foot or two of the top of the coal, the associated shear surfaces above the main shear (called "slips" by the miners) dip at various angles and exhibit many different trends even for a single slip surface, thus breaking up the roof's rock mass into rock bodies of variable size that are surrounded by polished shear surfaces and difficult to stabilize by roof bolting. The rock bodies between the slip surfaces are difficult to support, especially in places where two slip surfaces trend more or less parallel and dip in opposite directions, forming an upside-down V. One such feature, Charlie Austin thinks, is traceable from near the bottom of the slope in a NNW direction along several entries and cross cuts; but detailed mapping would be required to confirm such consistent trends in the highly disturbed rock mass above the main shear surface. The impression one gets is that the attitudes of slip surfaces in this rock mass are quite variable from place to place, and rather unpredictable.

There are only a few places in the mine where the roof is exposed beyond a few feet up, for instance near the bottom of the slope. Observations there indicate that the development of slip surfaces is most intense within the bottom 5-10 ft of above the basal shear; but shear surfaces can be seen extending much higher up into the roof.

Apparently closely associated with the shearing are occasional "rolls" in the roof that extend down into the coal. One "classic" roll was observed in location 7:

this is a football-shaped body of shale within the top 3-4 ft of the coal seam, about 8 ft across and about 3-4 ft thick in its center, associated by thin "riders" of coal that extend from the coal seam on each side several ft across the roll (uncertain if coal extended all the way across). It was difficult to see the internal rock texture and structure of this roll, but I would expect to find soft sediment deformation features, and indications of flow and intrusion, rather tha indication of sedimentation in a channel within the peat, which is a common interpretation of such features (see photos).

In several places we noticed that sand had been mobilized (including locations 12 and 12): thin irregular veins of fine sand were observed in several places within disturbed roof rock and also within the coal. In one place (location 12) an irregularly shaped body of sandstone up to about ½ ft thick was found about 3 ft below the top of the coal; on one side it ended abruptly, apparently because it was sheared off there. At the same site several small very irregularly shaped sandstone inclusions were observed within the coal seam, apparently brought into the seam along shear zones when the disturbance happened.

Roof Control

5 ft mechanical roof bolts are used immediately after the coal is mined. As soo as feasible thereafter they reinforce the roof by inserting 8 or 12 ft resin bolts, four across the entries and rooms, at spacings of 4 ft. This is done to stabilize the bottom area, that must stay stable during the full life of the mine. They do not expect to use this kind of expensive roof control for the entire mine.

Due to the locally severe disturbance of the roof strata by shearing, minor roof failures - some extending several feet up - are common through much of the currently developed mine. However, their roof control plan seems to be working in that no major failures have occurred in spite of the difficult to control roof.

Another measure they take, especially in "rough" roof, is to connect roof bolts across the entries by iron "bacon strips"; their purpose is primarily to keep individual, smaller rock masses from dislodging.

Possible interpretation of observed features

(1) Our first interpretation was that we were looking at the underside of a major landslide that happened when the Herrin Coal had been buried under at least

tens, possibly over 100 ft of sediment. The basal major shear surface would be the surface along which the rock mass moved during the landslide. Naturally many adjustments were required within the sliding rock(sediment) mass causing the creation of numerous internal slip surfaces within the landslide mass. The sliding could have happened in a single episode, or it could have happened repeatedly. As the sediment mass moved along a major basal shear surface primarily above the seam (which was still in the peat stage) the basal shear may have split up into two or more surfaces locally, forming subsidiary shears, some of which apparently penetrated the peat deposit, depending on local conditions. Since peat is a rather tough material that yielded to the pressure by compression, but resisted shearing, most of the deformation was confined to the sediments above the seam. One might therefore expect the size, shape, and extent of the failure to reflect the ancient topography, thickness and character of sediments in the area. Since the gray shale rock body ("Energy Shale") thins westward this would be the logical direction of movement for a landslide, failure happening more or less parallel to the direction of isopachous lines for the gray shale rock unit. Locally, this would suggest a movement to the W to SW (o.k. ??). A directional analysis of the slickensides on the basal shear surfaces (grooves created by sliding) should reveal the principal direction of the landslide if this was a landslide.

A landslide could have been triggered by irregular loading during relatively rapid sedimentation that created instability in the pile of sediments we now refer to as Energy Shale. This might have been exacerbated by the thick deposit of peat underneath that was highly compactible (>5:1). Or the landslide could have been triggered by an earthquake.

(2) Another possible interpretation, favored by HHD, is that the various disturbance features are all related to the area being affected by a major earthquake some distance away at a time when the peat, the Energy Shale and probably additional units of the roof sequence had been deposited (observations in other regions of the Illinois basin would suggest that at least the Anvil Rock Ss, possibly the Bankston Fork Ls had already been deposited). As the surface (Raileigh?) wave(?) moved through the area the partially consolidated sediment sequence was uplifted and then dropped within seconds. The strong contrast in physical properties between the thick peat deposit (at least 2x as thick as the coal is now) and the various overlying strata probably caused a decoupling between the peat seam and the overlying strata near the top of the seam and

differential movements between the two; the effects of these movements are now expressed in one or several shear surfaces traceable through most of the mine. As the uplifted sediment package settled back down, the thick peat deposit compacted differentially, depending on local variations in its and the roof strata's thickness and properties; this required considerable adjustments in the strata above the peat deposit and led to irregular shearing within the roof strata, especially in the vicinity of the peat deposit. Local failure patterns depended very much on how the sediments were stacked up locally and aerially, what their thickness was, how they were laid down, what their lateral variability was, and what the local topography looked like. Undoubtedly, since the sediments were only partially consolidated, slumping was triggered, with the development of locally prominent shear surfaces. Associated with the disturbance were sediment failure patterns typically associated with "seismites": local liquefaction of some sediments (especially sand) and intrusion into other strata, micrafracturing, foundering (sinking) of higher up sediments in other sediments, forming irregular downward protrusion structures, e.g. football-shaped rolls.

Add comments on: "typical" roll, position relative to shear; intrusion of ss; apparent movement at base of coal (very sharp contact), e.g. near intake air shaft; liquefaction features: intrusions of "rock" into coal, ss veins; involvement of coal with sheared roof, e.g. around roll, stringers possible interpretations of observed features (landslide; differential movement above "giving" thick peat

Coal

Underclay

B. Photo northeast of photo A. Probably between stations 1 and 2 on map.

← see photo A

A. Photo taken looking northwest, probably near station 1 on map. The top and bottom of the coal ~~have been sheared~~ are bounded by shear planes. The roof sediments, coal, and floor have been distorted and contain flow features and microfaulting and thrusting.

See Photo B →

Disturbed roof

Coal

Disturbed roof

Coal

Disturbed roof sediments above coal. Photo probably taken somewhere between map stations 2 and 3. The shear surface is not readily visible at this location.

listurbed roof near map location #2 ? Riola Mine 5/16/1996
he shear surface is near the top of the coal.

sediments "intruded" into coal. The location of this is uncertain.
probably between stations 1 and 5. Riola Mi

rbed sediment above shear zone at top of coal. Riola Mine
Faulting and thrusting in sediments. 5/16/96

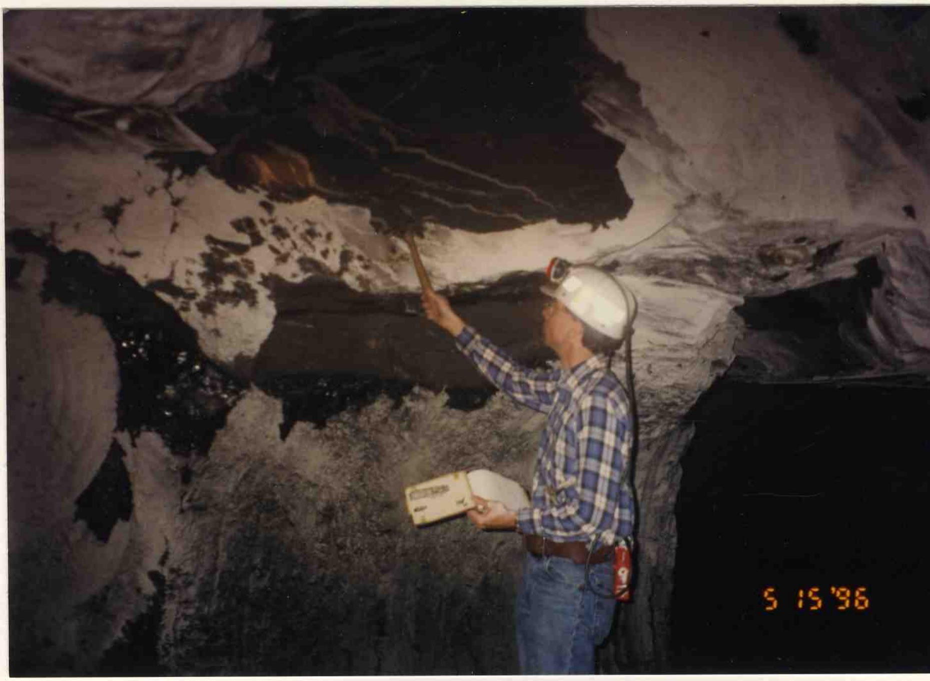
Rida Mine

photo was probably taken near station 6.
seam is nearly full height. Disturbed roof, including possible liquifaction f
exposed above the coal. Colin Treworgy holds the notebook.

ght half of "classic" roll, location #7, 5/16/1999 Riola Mine
photo 1 of 3

[illegible] location #7 Riola Mine 5/16/1999

location # 7 5/16/1999 Riola M



Colin Treworgy holds hammer by thin layers of fine sand just above shear surface. These appear to be sand liquefaction features. Location #11 on map.

5/16/1999, Riola Mine

Another view of the shear surface and sand liquefaction
location #11, 5/16/1999 Riola Mine

MOORE'S MODERN METHODS
FORM 180 W

Close-up of layers of fine sandstone.
Location 11, 5/16/1996 Riola Mine

John C. Moore Corporation, Rochester, N.Y. 14604

MOORE'S MODERN METHODS

FORM 180 W

Ron Laswell, President of Catlin Coal Co.

Eric Truesdale, one of the owners of Catlin Coal Co.

Conveyor belt from slope, Riola Mine

Coal stockpiles, Riola Mine

Coal stockpile, Riola Mine

Coal stockpile, Riola Mine

Coal stockpile, Riola Mine

January 24, 1997
Visit to the Catlin Coal Company's Riola Mine, Vermilion County
by Colin Treworgy and Heinz Damberger
(Notes by Colin Treworgy)

We were asked to visit the mine by Eric Truesdale, one of the mine owners, to observe the roof conditions encountered in the mine. This is intended as a brief reconnaissance visit to observe the general mine conditions and determine what additional mapping might be useful. We were accompanied on our visit by Charlie Austin, the mine superintendent.

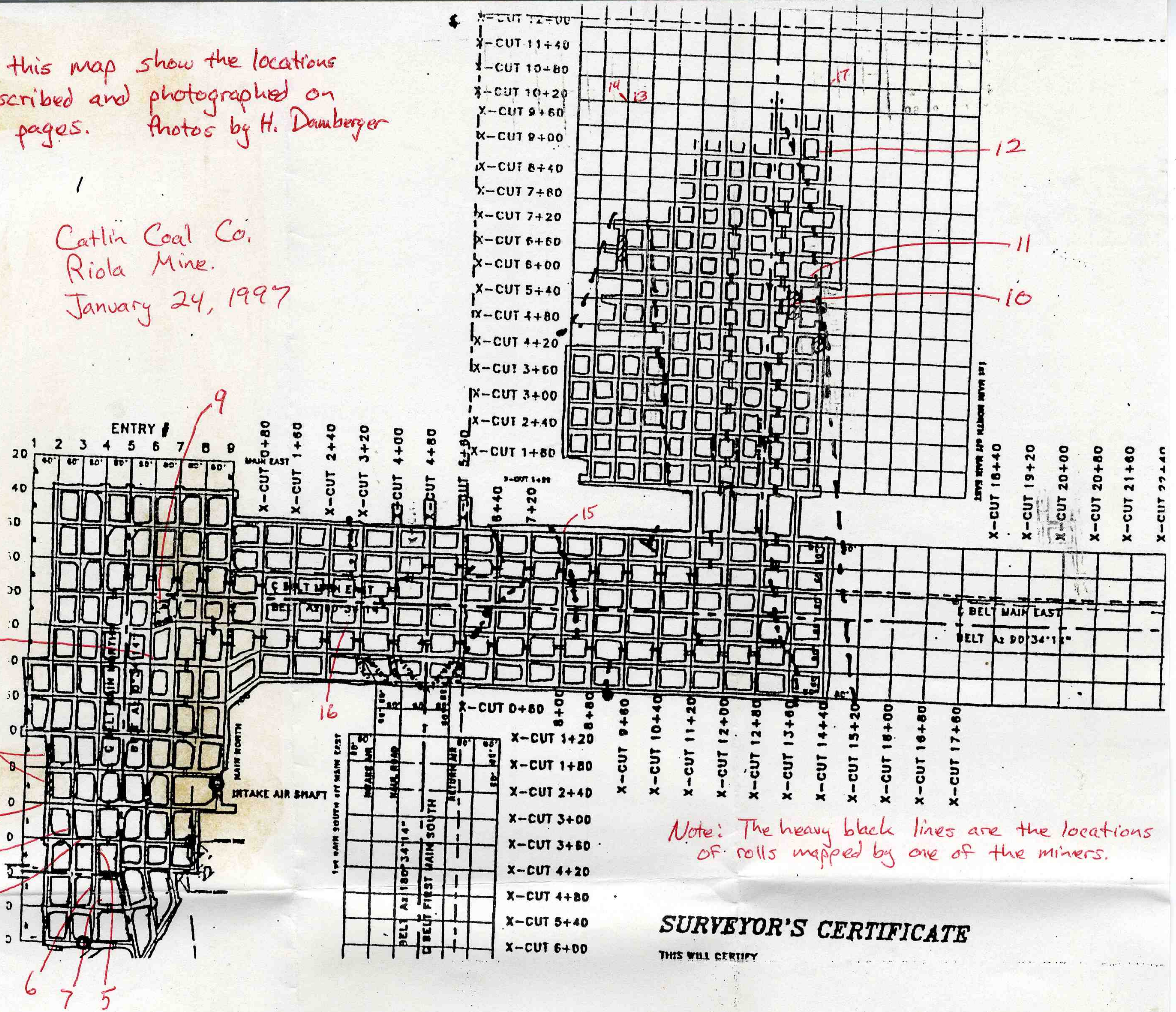
The mine has added a small preparation plant since our visit last spring. The plant is equipped with 2 jigs . Mine production currently ranges from 2,000 to 4,000 tons per day. Charlie showed us some analyses of the previous week's shipped product:

	(Dry Basis)		
Moisture (%)	Ash(%)	Sulfur(%)	Btu/lb
18.80	9.01	1.48	13,252
17.55	15.49	1.82	11,977
18.3	11.61	1.62	12,742

We first toured the Main North area around the base of the slope. We had examined much of this area on our visit last spring, but took this opportunity to revisit some areas that have fallen. This is the area that has been affected by movement of the coal and roof material along a low angle shear surface.

The numbers on this map show the locations of sites described and photographed on the following pages. Photos by H. Damberger

Catlin Coal Co.
Riola Mine.
January 24, 1997



Note: The heavy black lines are the locations of rolls mapped by one of the miners.

SURVEYOR'S CERTIFICATE

THIS WILL CERTIFY

Notes by C. Treworgy Photos by H. Damberger

Location 1. The coal rises in elevation about 5 feet. At the top of the rise, the roof is disturbed and consists of grey shale with thin siltstone laminations. There are many indications of soft sediment flow. Thicker bands of silt or fine sand have inclusions of shale and flow structures. In places, the coal appears pulled up into the overlying sediment. Heinz took three photos of the northwest corner of the intersection. Charlie reports that the coal rises and falls in elevation in other parts of the mine and that the floor is usually weak in the low areas.

Another view of the northwest corner of intersection, map location #1.
Note hammer on wall above Charlie Austin.

Charlie Austin, mine supt.
Northwest corner of intersection. Map location #1.
Note hammer on wall above Charlie.

Close up of disturbed sediment. Northwest corner of intersection, Location #1. This is a close up of the hammer seen in the previous two pictures.

East wall of entry, just south of intersection at map location 1.
Close-up showing disturbed bedding and sandstone veins in roof above coal.

2. A large fall blocks the entry.

3. This location is at the top of a small rise that is a southeast extension of the area described as location 1. The contact between the coal and roof rock is irregular, wavy.

4. This location is also along the ridge described in 1 & 3. A roll is observed in the pillar on northwest corner of the intersection. The interior of the roll has the appearance of a seismite. A sample of the rock was collected.

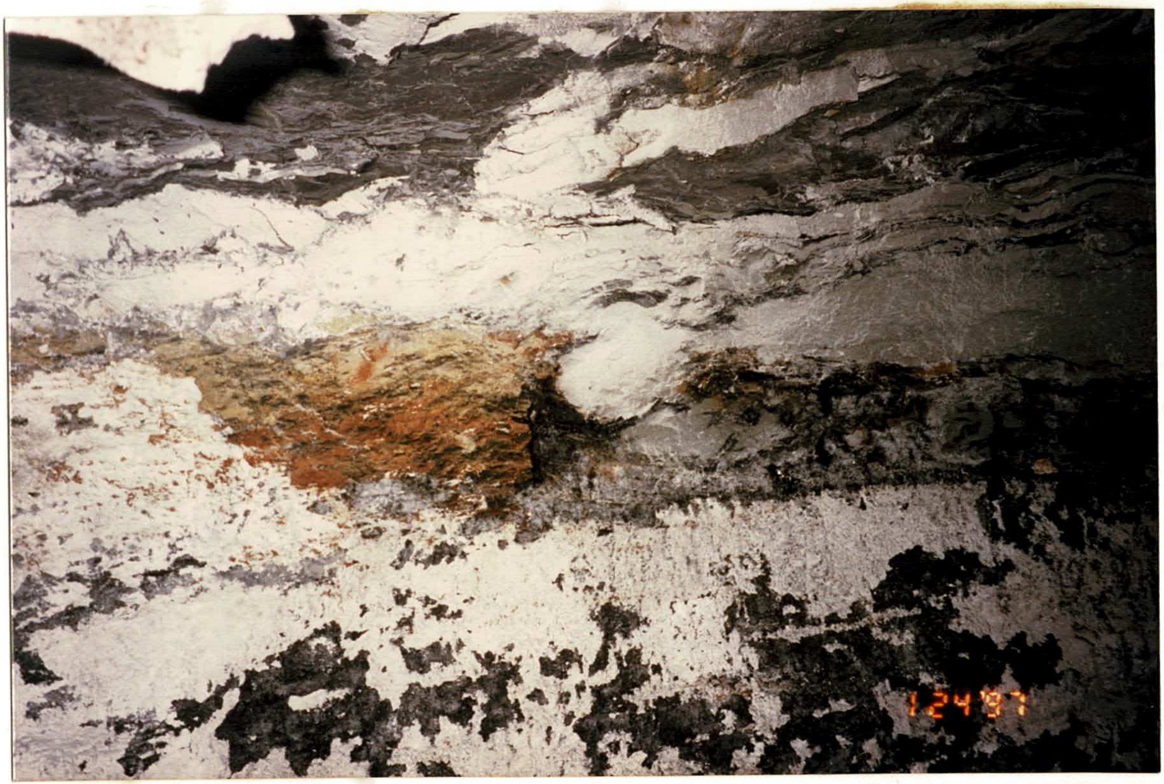
5. A photo of a sand-filled fracture in the roof. Charlie Austin is holding the hammer.

6. A photo of a coal stringer extending up into the roof material. Charlie Austin holds the hammer.

7. Photo of a coal rider above a lense of disturbed shale. The coal is only about 3 feet thick near this point. Charlie reports that the sulfur content of the coal is usually higher in disturbed areas such as this.

8. A coal rider 4 to 6 inches thick rises from the top of the coal on the west side of the entry to about 3 feet above the coal on the east side of the entry.

9. Photos taken of a small roll containing sand.



Roof

Coal

This photo was taken at location 3 or 4. Note disturbed roof sediments, micro faulting, sandstone veins, and irregular contact between coal and roof.

Roof

Top of Coal

Location #5. Note sand-filled, near vertical fractures in roof sediments.

Roof sediment

Top of Coal

A coal stringer extending up into roof sediments. Location #6

Location #7. A coal rider above a lense of disturbed shale.
The next photo is of this same scene, but better focused.

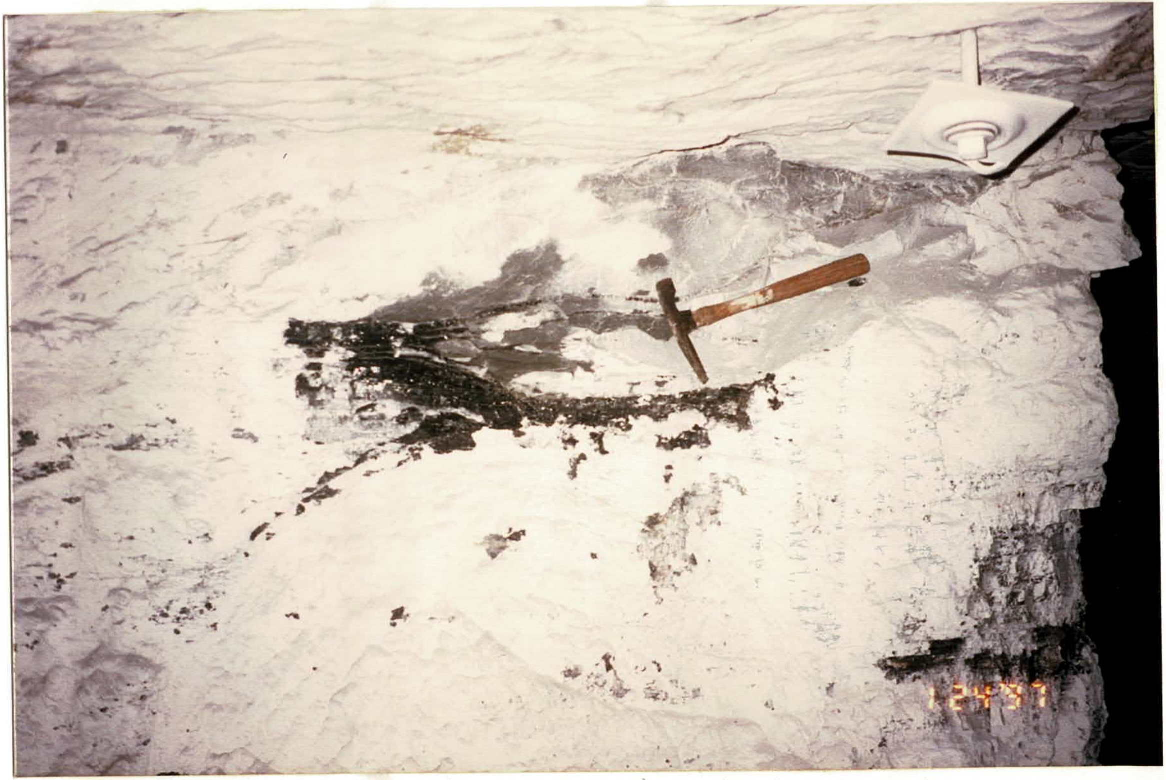
Roof rock

Top of coal

Location 7. A coal rider above a lense of disturbed shale.

Location #9. A small roll containing sandstone.

Riola Mine



Location #9 Another view of the small roll containing sandstone.

Riola Mine

Small slip at top of coal seam. Note displacement of coal. Riola Mine
Location 9 or 10 (or somewhere in-between).

We traveled to the first Main North off the Main East. The shear surface has not been observed in areas away from the immediate bottom of the slope. The features in and conditions of the roof along the Main East and in the first Main North off the Main East are typical of what has been seen in other mines operating under an Energy Shale roof. The roof consists of a medium gray shale, in some places containing abundant plant fragments, large, horizontal-lying tree trunks, and occasional stumps. In other places the roof contains abundant thin laminations of siltstone. We did not take time on this visit to map the distribution or the frequency of these units. The main roof disturbance encountered are rolls. These are typically less then 10 feet in width but extend for many hundreds of feet in a direction that is usually slightly west of north. One of the mine employees, Ray Pitman has begun mapping these rolls and if possible, the face boss adjusts the location of rooms to avoid having a roll cross and intersection. It appears that all of the large falls are either related to rolls or are in areas with the abundant, thin siltstone laminations.

10. Site of a large roof fall. The mine has left the rock on the floor and graded the entry up over it. The roof rock at this location consists of shale with abundant thin laminae of siltstone and a few thin stringers of coal. The bedding of the lower-most sediments is nearly horizontal parallel to the coal, but each succeeding layer is slightly more inclined. At a distance of several feet above the coal the bedding appears to dip about 20 degrees to the north. The rock separates easily along the bedding planes. No major slips or disturbances were observed. Two photos were taken of Colin pointing at the sediments with a pencil.

Location #10, Closeup of roof rock   Riola Mine

11. Photo of Colin in front of a large roll.

12. Photo showing displacement of the coal in the roof. Numerous horizontal tree impressions are in the immediate roof along the entry east of this spot.

13. Photos taken of a roll in the south rib.

14. Photos taken of rolls in the north rib.

15. Shale with thin laminations of silt and some thicker bands of sandstone. There are several slips in the sediments. The coal thins to about 4 feet or less. Water is dripping from the sandstone layers in the roof. The entry to the east has been timbered.

16. The coal thins to about 3 feet for a short distance between cross-cuts. On the south wall he thinning occurs as slip-bounded steps (see sketch). The north wall appears to be smoother.

17. Numerous horizontal tree impressions and two vertical stumps observed in the immediate roof.

A large roll. Location #11, Riola Mine

Displacement of coal. Location 12, Riola Mine

Displacement of coal into roof rock.
Location 12 Riola Mine

Displacement of coal at top of seam.
Location #12, Riola Mine

Notes by. H. Damberger

Visit to Riola Mine of Catlin Coal Co.
Jan. 24, 1997
by Heinz Damberger and Colin Treworgy,
accompanied in mine by Charlie Austin, Mine Superintendent, and later Ray Pitman, foreman

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Purpose of visit: Inspect new mine workings developed since last visit to further investigate the type of roof problems they encounter, to try to understand the origin and, hopefully develop model that permits prediction into unmined areas; also determine if additional drilling might help them avoid areas that may be too costly to mine.

Cleaning plant, production, customers: Since our last visit they built a cleaning plant and installed two jigs in it, all by themselves. The plant performs well; capacity exceeds their max. anticipated production (~500,000 t/yr). They send entire raw production through the plant, including the fines, and significant amounts of rock (which causes occasional clogging problems in the operation of the jigs). We saw one page with three recent chem. analyses of delivered coal: S content varied between 1.2 (?) and 1.8 %, ash 9-12 %, moisture content 16-19 %, with corresponding heating values of around 10,500 to 10,800 Btu/lb (?). They have several customers: Lauhoff Grain Co. of Danville, Illinois Power's Vermilion plant, a paper company in Terre Haute. They mentioned that IP "complained" about the low sulfur content of the coal; IP says it makes their precipitator work less efficiently.

Underground mine: They continue to experience considerable water influx into slope but have decided against trying to stop the inflow because they are concerned that water may find new ways to enter the mine; it may also build up considerable pressure on the slope structures, potentially to the point of failure. This is clean water and they can simply dispose of it without treatment; main cost is pumping. The nearby village of Georgetown is interested in water they pump because the village regularly experiences water shortages during dry summers.

Since our last visit they have extended the Main North entry system to about 800 ft north of the bottom of the slope. They also completed the intake air shaft located in the easternmost entry of Main North, 3 ½ cross cuts north of bottom.

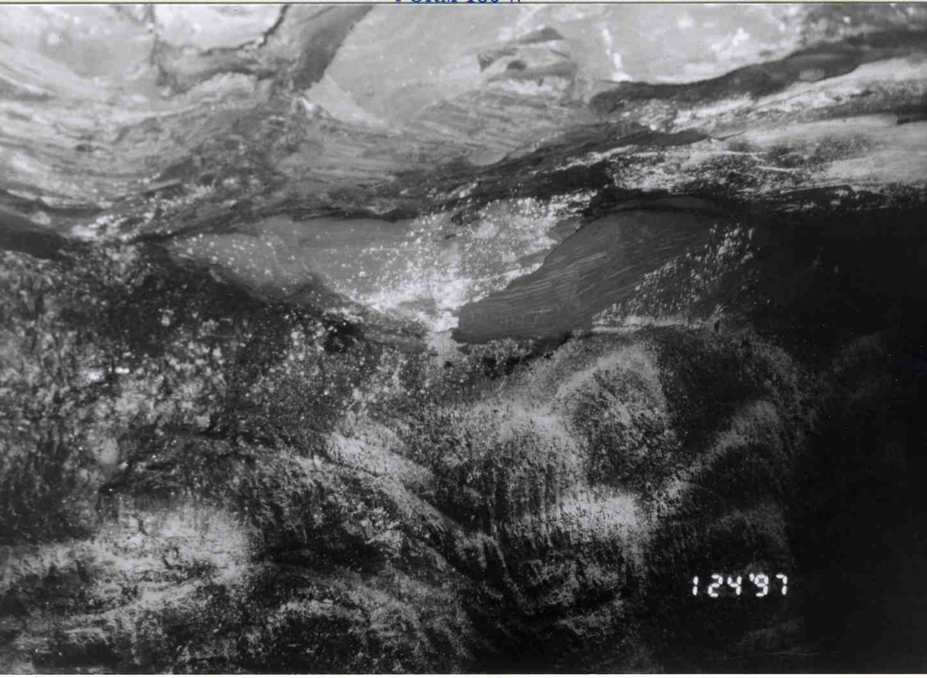
They then developed their Main East entries, to 1440 ft ("14+40 cross cut") They use a 7 entry system (2 intake, 3 neutral, 2 return entries) rather than the originally planned 9 entry system (3, 3 and 3), to reduce maintenance costs due to the difficult roof conditions they experienced.

Geologic observations

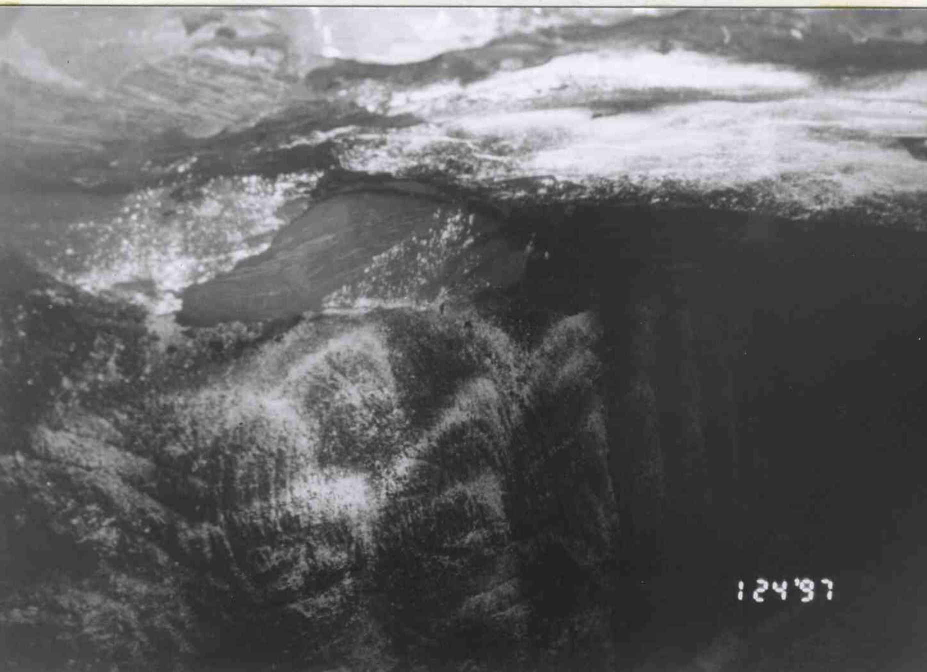
Observations, perceptions, concerns of company personnel and response to roof problems: The principals of the company are very concerned about the difficult roof conditions they are experiencing. Mr. Eric Truesdale had called Colin earlier in January and asked for a mine visit by us to give them our opinion about their roof and to suggest what they might do to avoid bad areas, or to improve roof control. They also hired Fred Newman, a consulting coal geologist, apparently only for a single visit to the mine, which occurred just a couple of days before our visit. Fred told them that he didn't think that to drill exploration holes ahead of planned mining would provide much useful information for specific mine planning, i.e. layout of mine, avoidance of bad areas, etc., mostly because the features that cause roof problems are too small in size for delineation by drilling.

In the meantime, Ray ....? (foreman?) has mapped several roof disturbance features (they didn't have a name for them yet) in the 2nd Main North Panel and put on their 1'=400' scale mine map (see copy below). These features - they turned out to be very similar to the "rolls" we had observed and mapped in several mines with similar "gray shale roof" in the Quality Circle of southern Illinois, during our roof studies in the 1970s - have a definite trend to them: a few degrees W of N, more or less; and they can be traced for hundreds of feet. Charlie said that most of their roof problems in the 2nd Main North panel seem to be related to these features. They are coping with these as best they can. For instance, if feasible they modify the mining pattern so rolls will not run along entries, and particularly intersections; rather, they try to arrange pillars such that rolls are mostly over pillars, and in cross cuts; they also increase the size of pillars locally, or do not mine some rooms, especially near areas of major roof failures, to stop the roof failure from spreading.

We looked at numerous rolls and I took photos of some typical ones (see below). The largest rolls affect a width larger than that of a pillar and they can be traced over considerable distances. Ray has mapped 5 or 6 of the more prominent ones so far (see map below). During our tour we could confirm that what he had mapped were rolls and that what he had connected probably are continuous features, with a considerable amount of variance in appearance from place to place. However, the typical football shaped appearance can usually be recognized in some form: thickening towards the center, protrusion down into the coal by 1-2 ft, coal layers that connect sideways to the top layer of the coal seam extending upwards over them for some distance, usually from both sides, and usually not over the entire "football". Some rolls thicken quite rapidly to their full thickness, others are flattened out. Internally, the sediment structure (bedding) commonly is difficult to discern, at least in parts, and frequently deformational flow structures can be observed, especially near their tips on both sides. In several cases, normal faults with small displacements (a few inches max) were observed usually close to their lateral limits.

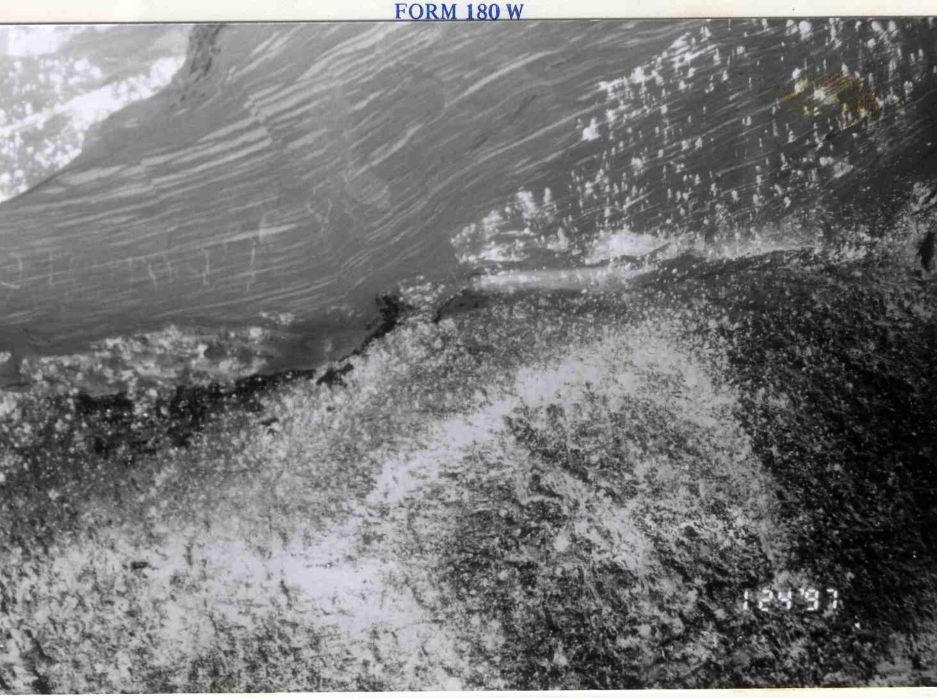


Roll, south rib, location 13 Riola Mine



MOORE'S MODERN METHODS

FORM 180 W



Closeup of roll, south rib, Location 13, Ridola Mine

GSL STORAGE INFORMATION

Date Brought to GSL 6/14/96

Driller/Operator/Company Catlin Coal Co, Riola Mine

Farm Name/Property Owner ? Well # ~~C1 C2 C3 C7~~ CC 01, CC 02, CC 03, CC 08, CC

County Vermilion State IL API #(?)

Sections 27 & 28 Township 18N Range 12W

Spot Location (N.S.E.W.Line) see below

Bottom Hole Formation(s) Top of Herrin (No.6) Coal

Type of Drill Hole: (Oil, Water, Strat.test, Split spoon, etc.) Coal test

Submitted By Heinz Damberger

Date Drilled/Collected

Footage Intervals: From ~20 above Herrin Coal To

Projected Use of this ...... (Core) Cuttings, Outcrop, Other:
log, search for soft sediment deform. features

a) Permanent Storage b) Temporary Storage c) (Study & Discard)

Estimated Date to be Worked ~~Before~~ end of 1996

Formations (if available) Carbondale Fm.

CC 01 2130 ft EL, 2650 ft SL of Sec. 28
CC 02 500 ft EL, 50 ft SL of Sec. 28
CC 03 2200 ft WL, 2330 ft SL of Sec. 27
CC 08 1260 ft WL, 30 ft SL of Sec. 27
CC 09 1180 ft EL, 2700 ft NL of Sec. 26

These cores put into CS temp. storage in Annex on 6/14/96 (received from Eric Sprouls, South. Indiana U.)

whr.1/22/96 Rev.4/24/96

FORM 180 W

Phone call on 3/21/97 to Riola Mine:
They will increase production to 500-600 K/y ton level, put in ~~second production~~ "supersection" panel, after securing 25Kt/mth contract with Illinois Power, for their Vermilion plant (had asked for this info for 1997 "Coal Industry in Illinois" map)

H. Damberger

6/23/97 - Saw in recent issue of "Coal Week" that IP is asking for bids for 25Kt/mth of high S coal. Ray Pitman said they were aware of that; IP actually wanted ~ 60Kt/mth but Riola Mine couldn't supply that much. Also IP is concerned about low S content of Riola coal which reduces efficiency of their electrostatic precipitators; would prefer higher S coal; Pitman said IP will blend Riola coal with other high S coal. I suggested to Pitman that they expand their mine to W where S content increases. He said it may not be enough, though, but they have talked about it.

6/19/97 - Charlie Austin called to ask about use of / availability of satellite photos to look

for signs of subsidence along W border of Bunsenville Mine. They are concerned that they may have mined beyond limits of mine shown on final map (N-S road, RR). Charlie suspects sinkhole along RR at . . . to be indication of subsidence.
I suggested they check into aerial photos instead. Offered help. Checked with Libr.
→ UI Map & Geogr. Libr (3-0827): they have full coverage of Vermilion Co. for 1940, '54, '60, '66, '73, '83, '88, '93. DeMaris said he could help Spencer Jones interpret photos.
Called back at mine and told Ray Pitner that, pass on to Charlie Austin. Ray thinks they will want to check this out. Will call me back.
6/23 – Phil DeMaris took a coal spl. at mine for ICCI project on coal vs. fly ash properties, Vermilion power plant. Phil said that they have continuous ash analyzer installed. Send coal to cleaning plant only when ash specs are too high, otherwise coal is sold unwashed; Lanhoff gets unwashed coal. Only coal f. IP is washed when needed.

Catlin Coal Company, drill hole #2
Approximate location (based on permit application):
25 ft from the south line, 500ft from the east line, section 28, Township 18N Range 12W, Vermilion County

5.8' Herrin Coal @ 250.5'

This hole was drilled near the bottom of the shaft. The following photographs show the interval from 230' to 238' deep (approximately 12 feet above the coal).

Core from Catlin Coal Co. hole #2, Riola Mine

Close-up of micro slumping in core from Catlin Coal Co. hole #2

Black Beauty Coal Co. - Riola Mine - Vermilion County, Illinois
Notes by John Nelson on visit with Russ Jacobson of the ISGS and Penny Padgett of Black Beauty, January 31, 2002.

The purpose of the visit was to have a general look at the geology and mining conditions. No coal samples were taken. This is an underground mine in the Herrin Coal. See sketch map for general arrangement of workings. The mine presently has only one working section, which has two continuous miners and battery-powered shuttle cars loading coal onto conveyor belts. The working face is currently in the 2nd Panel West off the 2nd South. Until last fall there were two working faces, the second being at the end of the Main West. That crew has been transferred to the Vermilion Grove Mine. Ordinarily they produce coal here on two shifts and perform maintenance on the third. The mine recently set a daily tonnage record of (if I heard correctly) about 9,600 tons. Annual production is a little over 1 million tons of coal.

At slope bottom is an area of rolls and sandstone or siltstone roof. The coal seam dips into irregular troughs, and the upper part of the coal is partially truncated and/or intertongues with the roof rock. In places the coal is reduced to less than 3 feet thick. The roof is gray siltstone to very fine-grained sandstone having abundant fine argillaceous laminae. Slips are common and roof conditions poor. A combination of erosional channels and load or slump structures appear to be involved.

We stopped to view a large roof fall on the Main West travelway about 650 feet west of the slope bottom. Penny told us the fall extends southward across two intersections. The fall is 15 to 20 feet high here, as best I can tell, and the roof rock appears to be thinly bedded gray siltstone or mudstone having abundant carbonaceous debris (black) on the bedding surfaces, all the way to the top of the fall. Fossil plants are abundant in the immediate roof. Carbonaceous partings, of course, can lead to easy separation of the roof rock along the bedding planes. I see no kink zone, although a cutter has developed along the west rib of the crosscut north of the roof fall.

Riding the mantrip through the Main West, I observed numerous cutters in the crosscuts (north-south headings). These are linear roof falls that extend along the outside corners of the crosscuts, right along one or both rib lines. These falls commonly extend upward 2 or 3 feet and the tops of the falls, viewed while whizzing by, appear to be unbroken flat surfaces, not kinked or bowed downward. Cutters seem to be especially common along the west ribs but also are developed along the east ribs. Some cutters are present along the east-west entry we are traveling, but they are not as bad as those in the crosscuts. Turning south into the 2nd Panel South, I saw strong cutters along the travelway and less severe cutters in the east-west crosscuts. Going southward into newer workings, the cutters disappear.

At the face of the 2nd West Panel, the coal seam is 5 ½ to 6 feet thick and undulates gently. The roof is medium gray, slightly silty shale that contains numerous siderite nodules. Plant fossils occur in great profusion in the roof shale and include many whole logs of lycopods as much as 3 feet wide and more than 20 feet long. Calamite stems and foliage also are abundant, lycopod (?) cones are common, and fern foliage is uncommon. Several upright fossil tree stumps were seen, in many cases the "plug" of shale within has fallen out. Only the basal 2 to 3 feet of the roof shale is visible, and it is all highly fossiliferous.

We stopped to look at an area of "faulty top" along the 2nd South on our way back north. The faulty area is shown on the mine map to be trending northeast and crossing into adjacent abandoned works. This proves to be a series of rolls, similar to those seen at the slope bottom, accompanied by siltstone or sandstone roof. Some of the rolls are erosional, others appear to be load structures. Many large roof falls have occurred in the entries east of the travelway. Although the largest falls are on north-south headings, no kink zones were seen. The main causes of falls are probably the combination of numerous slips and irregular scour surfaces combined with laminated roof rock that splits readily along the bedding planes.

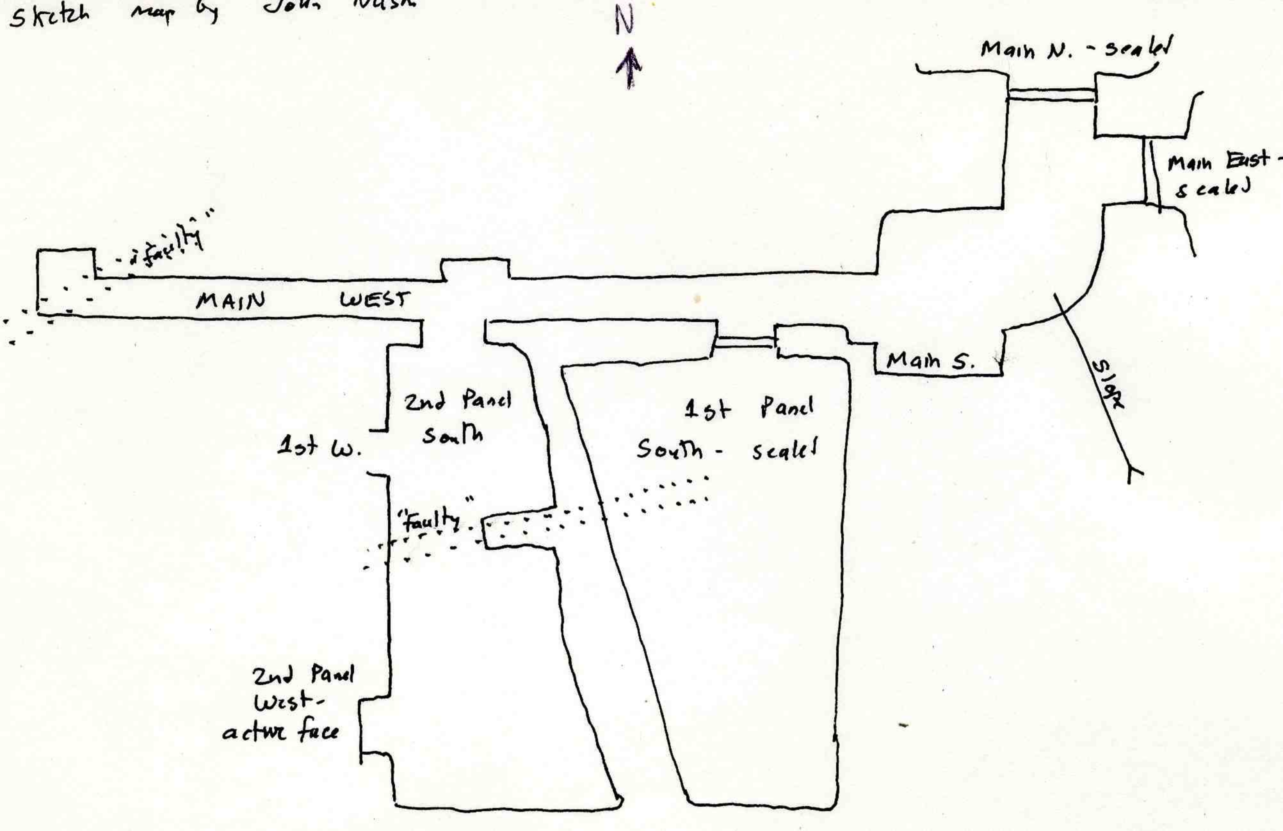
An unusual fracture or fault was seen in a roof fall on the travelway. The fracture trends ENE and dips 50-60 degrees southeast. It is nearly planar but has very small displacement in the roof, and dies out above the top of the coal. Brown material, resembling siderite, fills the fracture at the top of the roof fall; at first I thought the structure was a clastic dike. I saw another set of linear fractures trending ENE and dipping both SE and NW in entries east of the travelway. Lacking a detailed map and being short of time, I did not determine whether these fractures line up with the first one. They could be tectonic faults, but lack of displacement in the coal favors non-tectonic slips.

Near the end of the Main West Entries we visited briefly a third area of faulty top, also shown as trending northeast on the mine map. Again this is a series of rolls, in which the coal seam is bowed into troughs and is partially eroded and replaced by siltstone or sandstone of the roof. As at the slope bottom and in the 2nd South, large slips are numerous and many roof falls have taken place. Here as elsewhere, the "blue band" is inconspicuous. Where Penny showed it to us, it is a band of dull coal or bone no more than an inch thick and less than 2 feet above the floor.

Summary. Among mines I have seen having gray shale roof, this one has better than average roof conditions. The biggest problems we saw are associated with the three sets of rolls, which are readily mappable and should be predictable in advance of the working face. I saw no kink zones or other direct indication of in situ stress, although roof falls appear to be more common along north-south entries than east-west ones. Cutters, which form along the ribs and extend several feet upward, develop only in the older works and were not evident in newly mined areas. They seem to be more prevalent in north-south headings, but mapping would be needed to verify their distribution. Conditions at Riola contrasts with those at the nearby Vermilion Grove Mine, where severe kink zones develop immediately after mining and lead to roof falls at the working face. According to Penny, the roof shale at Riola has ten times the compressive strength of that at Vermilion Grove - a factor that readily accounts for the more serious stress-related roof failure at the latter.

Black Beauty Coal Co. - Riola Mine

Sketch map by John Nelson



Black Beauty Coal Company - Riola Mine - Vermilion County
Notes by John Nelson on visit with Russ Jacobson, Tom Moore, Chris Korose, and Scott Elrick of the ISGS and Penny Padgett of Black Beauty, April 20, 2004.

This was a brief tour. We spent less than 2 hours underground. We planned to visit the working face at the 2nd Main South off the Main West, but our mantrip broke down and we opted to catch another ride back to the bottom. We briefly inspected geology in three areas of the Main South near the junctions with the Submains Southeast and Main Northwest, and also a large roof fall that was being re-supported in the Main West not far from the slope bottom.

These notes were composed in the office the day after the visit, using hasty notes made underground as a guide.

General geology. We didn't spend enough time underground to get much of a picture of typical conditions. In four areas where we looked, however, the roof lithology was similar. It is siltstone to silty mudstone, or weakly fissile shale, medium gray with an olive cast, containing occasional lighter gray sandy laminae and man diffuse nodules and bands of siderite. Carbonized plant fossils are abundant in the immediate roof. They consist of foliage, stems and branches; including many whole lycopod trunks lying flat and in places, upright or tilted fossil stumps as large as two feet in diameter. Many bedding planes are liberally coated with coalified plant debris, leading to much rashing and separation of the immediate roof layers.

Channel. Along the easternmost entries of the Main South, north of the Submains Southeast a channel was encountered, cutting out the coal. In one place, the mine entry sloped down abruptly where miners followed the coal to its pinch-out. Unstable roof prevented close examination, but two episodes of channel filling were evident. The lower one consisted of greenish gray silty mudstone that exhibits much deformed bedding and many slickensides. The upper channel fill is fine-grained sandstone, some of which is massive and some of which is laminated. The area is wet, with a moderate amount of water dripping from the roof.

In several places roof falls exposed sandstone overlying the coal near the channel margins. Bedding of the sandstone dipped at 20 or 30 degrees. This appeared to be lateral accretion bedding.

The trend of the channel outside this small area is not known. In fact, its trend within the area mined is not clear. It was not encountered in the Submain Southeast. We were told that no drill holes found it. Penny mentioned that the abandoned Bunsenville Mine, east of Riola, may have encountered similar channels, which she likened to a "string of beads". This gives the impression that the channel is normally above the coal and only locally cuts into or through it.

My observation of accretionary bedding implies a meandering stream course. Accretionary bedding is characteristic of point bars in a meandering stream (either fluvial or tidal). A meandering stream cuts most deeply on the outsides of the bends. Further mapping is needed to provide a clearer picture of the channel geometry. This is likely to be a difficult feature to project ahead of mining.

Roof falls. We had a brief look at two massive, entry-blocking roof falls on the entry east of the haulage road in the Main South near the Main West junction. We were told one of these falls took place earlier the same day. We could not see clearly into the falls and there were no obvious structural features (slips, kink zones, etc.) leading toward them. Company officials told us the area was dry before the roof fell, now water is seeping. This suggests that the falls breached water-bearing sandstone more than five feet above the coal.

Black Beauty Coal Company - Riola Mine - Vermilion County
Notes by John Nelson with Bill DiMichele (Smithsonian Institution), and Doug Latoz from Black Beauty, September 12, 2005.

Southeast Submains

At entrance to submains, outby the air doors, plant fossils are abundant in the immediate roof. Many ferns, including *Pecopteris* and *Neuropteris*, plus cordaites and lycopod leaves - many small stems but no large trunks.

Cutters form in both N-S and E-W headings, but no kink zones. A large fall is adjacent to the air door in the crosscut running N-S. The fall probably began as a cutter.

Bill makes three counts of fossils within single crosscuts, between two intersections (area about 40 x 18 feet).

On northeastern (return) entries about 500-600 feet into the southeast submains, two large roof falls have occurred on a southeast-trending entry. Cannot see geologic causes for the falls, and no signs of in situ horizontal stress. Cutters seem to be equally common in entries and crosscuts.

This area has abundant lycopod fossils, including large trunks. Also *Sigillaria* and *Calamites*. As usual, fossils are concentrated in the basal one foot of roof shale.

Main West

We chose another area with little rock dust for statistical counts of fossil plants. The first area has many *Sigillaria* logs and several upright stumps two to three feet in diameter, along with profuse stems and foliage. Doug found a slab of shale on which a sinuous back-filled horizontal burrow, about ½ inch wide and one foot long, leads away from a siderite nodule. This is the first trace fossil I've seen in this mine.

Cutters are here also, and are common in both crosscut and entries.