See Aetna Shipping Book.

Pub. on 1947 Shipping Mn Map

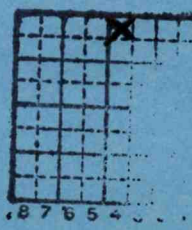
Delta Collieries C. C.

Delta Mn.

1935-43 #5
1943- #6
#7

S-4

COUNTY No. 1811



33H4

9 S

4 E

IS&S Index No. 702

(Sheets) COAL PRODUCTION (Sheet)

No.	Period Mo.	Day	Year	Mo.	Day	Year	Tons	
						1935		#8
4	1	1	1936	12	31	1936	471	689
4	1	1	1937	12	31	1937	398	351
S-4	1	1	1938	12	31	1938	338	484
						1939	454	407
						1940	531	847
S-4	1	1	1941	12	31	1941	532	979
S-4	1	1	1942	12	31	1942	500	278
						1943	583	178
						19		

831.525

This mine was shifted to #6 and little relocation ~~abo~~ in 1943.

SUMMARIES

No.	to	No.		
		1935	359	836

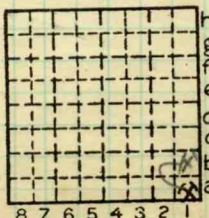
Railroad, Wagon, Idle, Abandoned Strip

S-4 IDENTIFICATION

County No. 868 Coal No. 5

Quad. Harrisburg Part 3

County



Sec. 2

T. 10 N. S.

R. 4 E. W.

Index No. 0902 ~~1002~~ - a-1

COAL MINE—PRODUCTION

(Sheets) **COAL PRODUCTION** (Sheet)

Period						Tons	
Mo.	Day	Year	Mo.	Day	Year		
1	1	1935	12	31	1935	359	836
1	1	1936	12	31	1936	471	689
1	1	1937	12	31	1937	398	351
1	1	1938	12	31	1938	338	484
1	1	1939	12	31	1939	454	407
1	1	1940	12	31	1940	531	847
						2 554	614
1	1	1941	12	31	1941	532	979

Delta Coal Mini g Co

SUMMARIES

No.			to No.			Tons	
1	1	1935	1	31	1940	2 554	614

Railroad, Wagon, Strip, Idle, Abandoned

Sec. 2

IDENTIFICATION

County No. ~~181~~ 868

Coal No. 5

Coal Report No. S-4

Quad. Harrisburg

County Williamson

T. 10 S.

R. 4 E.

Index No.

h g f e d c b a

8 7 6 5 4 3 2 1

COAL MINE—PRODUCTION

ILLINOIS GEOLOGICAL SURVEY, URBANA

(2732—2M—7-41)

Mine originally operated by: (1)

Date 1935 Delta C. M. Co.

Original name or number:

Illinois Coal Report p.

LATER OPERATORS

Date	Operator	Name or No.
2 1943	Operation shifted to 33-9S-4E to mine #6	
3	Coal. Kept C. Rpr. #5-4. Has	
4	County #1811. See notes	
5	at that location.	
6		
7		
8		
9		
10		
11		
12		
13		
14		

*Also owners #See ownership sheet

Railroad, Wagon, Strip, Idle, Abandoned

IDENTIFICATION

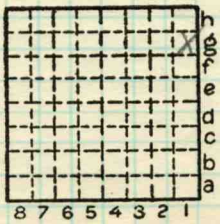
County No. 868

Coal Report No. 5-4

Quad.

County Williamson

Coal No. ☐5



Sec. 2

T. 10 N. S.

R. 4 E. W.

Index. No. 0902 A1

COAL MINE OPERATOR

(92753—1M—6-54) 2

MOORE'S MODERN METHODS

LOCATION AND ELEVATION

Location: side R. R.
side R. R.
side Highway No.
on top. map Location sheet X

Elevation: Method, 1. Est. ( ) ft.
2. Inst. (kind) ft.
By Data sheet

DEPTH

Authority To coal ft.
Authority Rail to rail ft.
Top of coal above rail. (Est. Rule) ft.
To coal ft.

ALTITUDE OF TOP OF COAL

By estimated data
By instrumental data ft.

Thickness

Max. in. Min. in. Aver. 50 in.

GEOLOGICAL DATA

Mine notes, date None

Coop No. Pyr. inv. Coal Ash inv.

CHEMICAL DATA

Analyses Face	U. I.	B. M.	Others
Car	U. I.	B. M.	Others
Org. Sulf	U. I.	B. M.	Others
Ash fusion	U. I.	B. M.	Others
Ash anal.	U. I.	B. M.	Others
	U. I.	B. M.	Others

Classification

Misc. tests: Coking. Cleaning Boiler

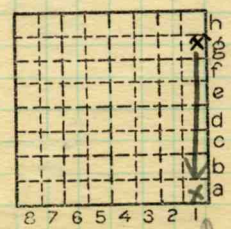
Published descriptions: 500'N 300'W } SE Col NGNE

Railroad, Wagon, Idle, Abandoned Strip

820' from N, 300' from E
IDENTIFICATION

County No. 88 Coal No. 5
Part 3

Quad. Harrisburg
County Williamson



Sec. 2
T. 10 N. S.
R. 4 E. W.
Index No. 0902 G A1

COAL MINE LOCATION AND DATA

(34215—1M—3-30) 7

Mine originally operated by: (1) Delta Coal Mining Co.

Date 1935

Original name or number:
Illinois Coal Report 1935 p. 250

LATER OPERATORS

	Date	Operator	Name or No.
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

(No 5 coal strip abd 1943)

* Also owners #See ownership sheet

Railroad, Wagon, Idle, Abandoned Strip 1943

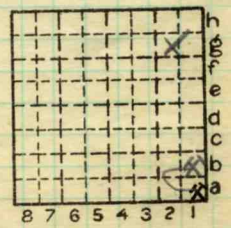
IDENTIFICATION

S4

County No. Coal No. ☐ 5

Quad. Harrisburg Part

County Williamson



Sec. 2

T. 10 N. S.

R. 4 E. W.

Index No.

0902 ~~1002~~ a-1

COAL MINE OPERATOR

(3106-21531) 3

Mine Sampled 18 Jul 62 by
G. Eadie & H. Gluskoter
Accompanied by T. Hightower,
Ass't Prop. Manager, Ayrshire
Collieries Corp.
Pit locations of Samples by
Rube Barter, Pit Boss.
Spl #1 Exposed 23 days before sample
was taken.
Spl #2 exposed 20 days before Sampling
Spl #3 " same day of Sampling

Sample Locations

#1 650'S, 200'W, NE Cor Sec 25
T9S, R4E

#2 950'S, 950'W, NE Cor Sec 24
T9S, R4E

#3 2950'S, 1150'W, NE Cor Sec 24
T9S, R4E

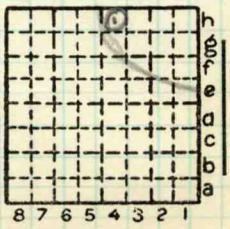
Supt. Maurice Williams P.O. Marion
Foreman - R.C. Barter
4000 T/day
Strip 5' Coal

Carmac C.C. (Delta)
#6 coal

By Date

Quad. Part

County Williamson #1811



Sec. 33
T. 9 N. S.
R. 4 E. W.
Index No. 5-4

:see abd Mine Notes: Sec 33 9S 4E for early opers.

Delta Coal & Mining Co.

Delta Collieries Co. (8/46)

Delta Collieries Co. Delta Mine (1948)

Carmac Coal Co. Delta Mine (1957)

Thunderbird Collieries Corp. Delta Mine

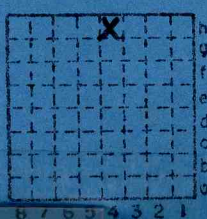
Ayrshire Collieries Corp. Delta Mine

AMAX Coal Co. Delta Mine (12/71)

AMAX DELTA

AMAX COAL CO.
DELTA MINE (Strip)

Mine Index No. ~~0833~~ 702
County No. 1811
Coal Report No. S-4



Sec. 33
T. 9 S.
R. 4 E.
Index No.

WILLIAMSON COUNTY

AMAX DELTA M

FORM 180 W

Mine originally operated by: (1)

Date 1935 Delta C. M. Co.

Original name or number:

Illinois Coal Report p.

LATER OPERATORS

	Date	Operator	Name or No.
2	1943	Operation shifted to	
3		33-95-4E to mine #6	
4		Coal. Kept C.Rpr. #5-4. Has	
5		County #1811. See notes	
6		at that location.	
7			
8			
9			
10			
11			
12			
13			
14	From abandoned mines note book		

*Also owners #See ownership sheet

Railroad, Wagon, Strip, Idle, Abandoned

IDENTIFICATION

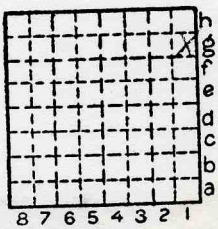
County No. 868

Coal Report No. 5-4

Quad.

County Williamson

Coal No. ☐5



Sec. 2

T. 10 N. S.

R. 4 E. W.

Index. No. 0902 A1

COAL MINE OPERATOR

From abd books

MOORE'S MODERN METHODS

LOCATION AND ELEVATION

Location: side R. R.
side R. R.
side Highway No.

on top. map Location sheet X

Elevation: Method, 1. Est. ( ) ft.
2. Inst. (kind) ft.

By Data sheet

DEPTH

Authority To coal ft.
Authority Rail to rail ft.
Top of coal above rail. (Est. Rule) ft.
To coal ft.

ALTITUDE OF TOP OF COAL

By estimated data
By instrumental data ft.

Thickness

Max. in. Min. in. Aver. 50 in.

GEOLOGICAL DATA

Mine notes, date None

Coop No. Pyr. inv. Coal Ash inv.

CHEMICAL DATA

Analyses Face	U. I.	B. M.	Others
Car	U. I.	B. M.	Others
Org. Sulf	U. I.	B. M.	Others
Ash fusion	U. I.	B. M.	Others
Ash anal.	U. I.	B. M.	Others
	U. I.	B. M.	Others

Classification

Misc. tests: Coking. 500'N 300'W Cleaning SE Coal NONE Boiler

Published descriptions:

Railroad, Wagon, Idle, Abandoned Strip

820' from N, 300' from E

IDENTIFICATION

County No. 8C8

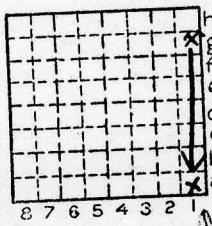
S-4

Quad. Harrisburg

County Williamson

Coal No. 5

Part 3



Sec. 2

T. 10 N. S.

R. 4 E. W.

Index No. 0902 A1

COAL MINE LOCATION AND DATA

(34215—1M—3-30) 7

From abd mine books

(Sheets) COAL PRODUCTION (Sheet)

Period Mo.	Day	Year	Mo.	Day	Year	Tons	
1	1	1935	12	31	1935	359	836
1	1	1936	12	31	1936	471	639
1	1	1937	12	31	1937	398	351
1	1	1938	12	31	1938	338	484
1	1	1939	12	31	1939	454	407
1	1	1940	12	31	1940	531	847
						2 554	614
1	1	1941	12	31	1941	532	979

Delta Coal Mining Co

SUMMARIES

No.			No.					
1	1	1935 to 1	31	1940		2	554	614

Railroad, Wagon, Strip, Idle, Abandoned

IDENTIFICATION

County No. ~~81~~ 868

Coal No. □5

Coal Report No. S-4

Quad. Harrisburg

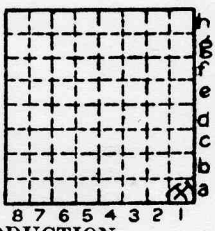
County Williamson

Sec. 2

T. 10 N. S.

R. 4 E. W.

Index No.



COAL MINE—PRODUCTION

ILLINOIS GEOLOGICAL SURVEY, URBANA

(2732—2M—7-41)

from old books.

MOORE'S MODERN METHODS

(Sheets) COAL PRODUCTION (Sheet)

No.	Period Mo.	Day	Year	Mo.	Day	Year	Tons	
						1935		
4	1	1	1936	12	31	1936	471	689
4	1	1	1937	12	31	1937	398	351
S-4	1	1	1938	12	31	1938	338	484
						1939	454	407
						1940	531	847
S-4	1	1	1941	12	31	1941	532	979
S-4	1	1	1942	12	31	1942	500	278
						1943	583	178
						19		

48

831.525

This mine was shifted to #6 and little relocated ~~after~~ in 1943.

SUMMARIES

No.	to	No.		
		1935	359	836

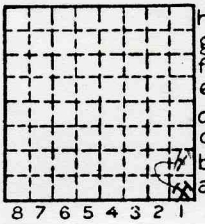
Railroad, Wagon, Idle, Abandoned Strip

S-4 IDENTIFICATION

County No. 868 Coal No. 5

Quad. Harrisburg Part 3

County



Sec. 2

T. 10 S.

R. 4 E.

Index No. 0902 ~~1008~~ - a-1

COAL MINE—PRODUCTION

(34217—1M—3-30) 7

MOORE'S MODERN METHODS

Mine originally operated by: (1)

Date 1943 — Delta Coal & Mining Co

Original name or number:

Illinois Coal Report 1944 p.

LATER OPERATORS

	Date	Operator	Name or No.
2		This mine was started 1944 in No 6 coal tipple moved from old location of S1	
3			
4	Aug. 1946	Delta Collieries Co. (Ayreshire Collieries Co)	
5			
6	1948	Delta Collieries Corp.	Delta
7	1957	CARMAC COAL CO.	DELTA
8		Thunderbird Coll. Corp.	Delta
9			
10			
11			
12			
13			
14			

2600" N 550" E cen. 33 (1946 61c)

100'S 750'W of NE corner NW NE (1948)

*Also owners #See ownership sheet

Railroad, Wagon, Strip, Idle, Abandoned

1945

IDENTIFICATION

County No. ~~156~~ 1811

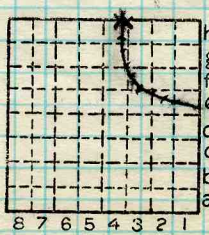
Coal Report No. S4 (1948)

Quad. Marion

County Williamson

Coal No. □6

4'8"



Sec. 23 33

T. 9 N. S.

R. 4 E. W.

Index No. 33 ~~43~~ 4

08 ~~19~~ H8

COAL MINE OPERATOR

(68020—1500—11-38) 2

MOORE'S MODERN METHODS

(Sheets) COAL PRODUCTION (Sheet)

Period Mo.	Day	Year	Mo.	Day	Year	Tons	
1	1	1944	12	31	1944	599	808
		1945				576	720
Changed operations from coal No 5 To No 6 during 1945 - and moved tipple to present site							
Abandoned in '47 # 1946 Coal #5						379	758
		1946 #6 Strip				201	048
		1947				574	604
		1948				526	927
		1949				395	703
		50				424	216
		'51				501	152
		'52				698	715
		53				641	745
		1954				674	140
		1955				886	585
		1956				787	907
		1957				784	781
		1958				835	847
		1959				875	085
		1960				760	876
		1961				909	704

SUMMARIES

No.	to	No.			
1944	thru	1961	12	035	321

Railroad, Wagon, Idle, Abandoned Strip

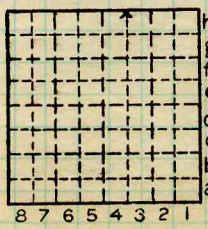
IDENTIFICATION

County No. 181 Coal No. 6

S4

Quad. Marion Part

County Williamson



Sec. 23 33

T. 9 S.

R. 4 E.

Index No. 4

0823 H3

COAL MINE—PRODUCTION

MOORE'S MODERN METHODS

(Sheets) COAL PRODUCTION (Sheet)

AMAX COAL CO.

DELTA MINE

Period Mo.	Day	Year	Mo.	Day	Year	Tons		
		1962				771	172	
		1963				974	219	
		1964				996	762	
		1965				1 142	988	
		1966				787	442	
		1967				996	808	
		1968				863	482	
		1969				709	407	
		1970				1 082	627	
		1971				1 011	980	
		1972				1 046	137	
		1973				921	015	
		1974				907	008	
		1975				780	834	
		1976				731	056	
		1977				453	795	
		1978				395	877	
		1979				999	196	
		1980				2 137	292	
		1981				1 769	869	
		1982				1 915	385	
		1983				2 538	660	
		1984				2 567	599	
		1985				2 392	141	

SUMMARIES

No.	to	No.			
1962 thru 1985			28	892	746
1944 thru 1985			40	928	067

Railroad, Wagon, Strip, Idle, Abandoned

IDENTIFICATION

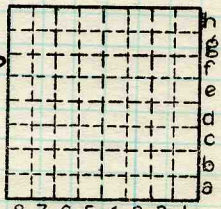
County No. 181

Coal Report No. S-4

Quad. MARION

County WILLIAMSON

Coal No. 6



Sec. 33

T. ~~N.~~ 9 S.

R. 4 E. ~~W.~~

Index No. 083343

COAL MINE—PRODUCTION

(2732—2M—7-41) ILLINOIS GEOLOGICAL SURVEY, URBANA

AMAX "Delta"

production continued

Year	Tonnage	
1986	1,577,217	
1987	2,266,200	
1988	1,360,590	S
1989	1,764,614	
1990	2,214,177	
1991	2,410,711	
1992	1,648,599	
1993		
1994	1,387,598	
1995	1,251,154	
1996		

See also Saline Co. "Hosco" of AMAX

'Stripping resumed in East pit in 1988
Now Stripping No6 coal and No. 7 coal'
Coal June 1990

ILLINOIS GEOLOGICAL SURVEY, URBANA

Carmac Coal Co. THUNDERBIRD - AYRSHIRE
Delta Mine (strip)
Sample from near south end of pit
650' S & 200' W of NE cor. Sec. 25, T. 9 S,
R. 4 E, 3 PM.

4' 8" of Coal No. 6, Sample #1

Coal has been exposed since June 24, 1962.
Rusty discoloration along cleavage - Coal is broken probably from shooting sandstone overburden.

Boney coal near top - a few inches lost; seam contains pyrite nodules.

Irregular top of coal with shale interbedded.

DETAILED DESCRIPTION OF COAL

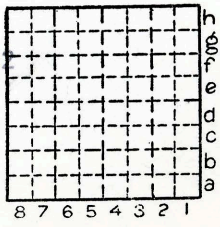
From top down

Thickness Inches		Feet	Inches
14	Clarain - calcite and pyrite in cleavage.	1	2
1/4	Fusain, soft	1	2¼
11 1/4	Clarain - bright banded	2	1½
1/4	Shale	2	1 3/4
9 3/4	Clarain - normally bright banded, calcite and pyrite in cleats, pyrite nodules	2	11 1/2
1	Shale - with pyrite nodules (Blue Band)	3	0 1/2
9 1/2	Clarain, normally bright banded	3	10

G. Eadie and
By H. Gluskoter Date 7/18/62

Quad. Part

County Williamson



Sec. 25
T. 9 N. S.
R. 4 E. W.

FORM 180-W

ILLINOIS GEOLOGICAL SURVEY, URBANA

Delta Mine (strip) continued
Sample #1

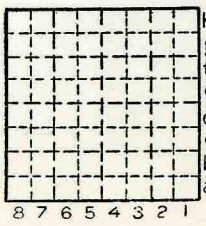
Inches		Feet	Inches
3/4	Boney Coal - pyrite nodules pyrite in beds 1/16" thick	3	10 3/4
9 1/4	Clarain, normally bright banded (No calcite)	4	8
	Underclay		

G. Eadie and
H. Gluskoter

By _____ Date 7-18-62

Quad. _____ Part _____

County Williamson



Sec. 25

T. 9 N. S.

R. 4 E. W.

(17381—5-48)
MOORE'S MODERN METHODS
FORM 180 W
ILLINOIS GEOLOGICAL SURVEY, URBANA

Carmac Coal Co. THUNDERBIRD - AYRSHIRE
Delta Mine (strip) Sample #2
Sample from 300' South of North end of pit.

950'S and 950' W of NE Cor. Sec. 24, T. 9 S., R. 1 E.

Sample has been exposed since June 26, 1962.
*Water level has been 12-18" above base of the coal.
Some fine silt and clay was deposited along cleavage.

4'6½" of No. 6 Coal

Collected by G. Eadie and H. Gluskoter

Black shale top has a few bands of coal interbedded at base. Uppermost coal band is 1½" in thickness.

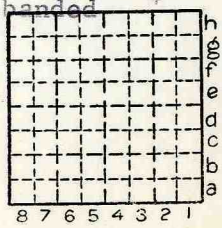
DETAILED DESCRIPTION OF COAL

Inches		From top to bottom Feet	Inches
11	Clarain, calcite in cleats up to 1/32", bright conchoidal fr fracture, vitrinite and pyrite banded in vertical cleats	0	11
1/4	Fusain - mineralized		11 1/4
10 1/4	Clarain, normally bright banded, calcite cleats	1	9 1/2
3/8	Fusain - mineral interbedded with 1/8" pyrite band	1	9 7/8
1 1/8	Fusain - soft	1	11
22	Clarain, normally bright banded, calcite cleats, pyrite in vertical cleavage, pyrite nodules; up to 1/8" pyrite band, some soft fusain streaks.	3	9
3	Bone coal, shale pyrite, some vitrinite - all in same zone	4	0
6 1/2	Clarain, normally bright banded Underclay	4	6 1/2

By GE and HG Date 7/18/62

Quad. Part

County Williamson



Sec. 24
T. 9 N. S.
R. 1 E. W.

(77438—5M—5-58)

ILLINOIS GEOLOGICAL SURVEY, URBANA

Carmac Coal Co. AYRSHIRE - THUNDERBIRD

Delta Mine (strip) Sample #3

Sample from behind shovel
Coal exposed same day as sampled.
Coal was part of roadbed and is highly fractured
2950'S and 1150' W of NE Cor. Sec. 24, T. 9 S., R. 4 E.

58" of No. 6 Coal

Collected by G. Eadie
H. Gluskoter

DETAILED DESCRIPTION OF COAL

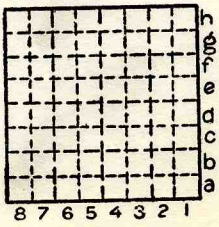
Thickness Inches		From top to bottom Feet	Inches
3 1/4	Clarain, normally bright banded calcite and pyrite in cleats	0	3 1/4
1 3/4	Shale - pyrite and vitrinite bands	0	5
22 1/2	Clarain, normally bright banded calcite and pyrite in cleats	2	2 1/2
1/8	Shale	2	2 5/8
10 3/8	Clarain, normally bright banded, calcite and pyrite in cleats. Pyrite & fusain band up to 1/8" thick.	3	1
1	Shale - pyrite nodules	3	2
9	Clarain - fine to medium bright banded	3	11
2 1/4	Shale - blue band	4	1 1/4
6 3/4	Clarain - normally bright banded fusain bands to 1/4"	4	8
1/8	Shale	4	8 1/8
1 7/8	Clarain	4	10

Location 800' N of Runway

By EG & HG Date 7/18/62

Quad. Part.

County Williamson



Sec. 24
T. 9 N. S.
R. 4 E. W.

(77438—5M—5-58) 2

ILLINOIS GEOLOGICAL SURVEY, URBANA

Carmac Coal Co., Delta Mine

Sampled July 18, 1962 : Eadie & Gluskoter

Accompanied by T. Hightower, Asst. Prep. Manager, Ayrshire Collieries Corp.

Pit locations of samples by Rube Barter, Pit Boss.

Sample # 1; exposed 23 days before sampling

Sample # 2; exposed 20 days before sampling

Sample # 3; exposed same day of sampling

#1: 650'S, 200'W, NE corner sec. 25, 9S-4E

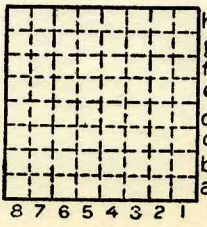
2: 950'S, 950'W, NE corner sec. 24, 9S - 4E

3: 2950'S, 1150'W, NE corner sec. 24, 9S - 4E

By Eadie&Gluskoter Date 7-18-62

Quad. Part

County Williamson



Sec. 33

T. 9 N. S.

R. 4 E. W.

Ayrshire C. M. C. Hormer Thunderbird Coll. Corp.
Williamson County - S.33-9S-4E
Delta Mine - Location in Mine
#6 Coal
Heinz H. Damberger & Hermann W. Pfefferkorn
September 30, 1969

1) No coal balls in #6 Coal.

2) No clear indications of earthquake (no slips, clastic dikes etc.)

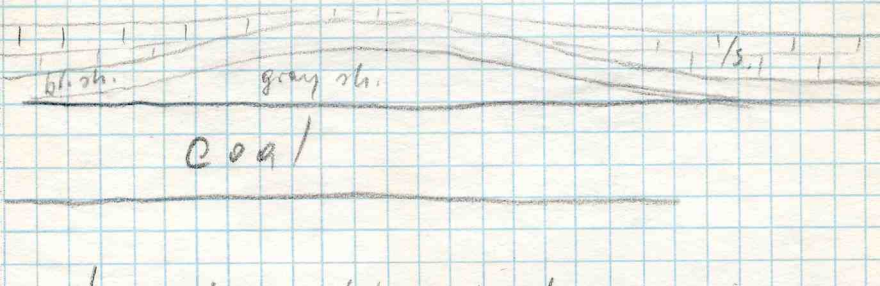
3) No plant compression fossils.

4) But nice observations on facies on top of #6 Coal possible.

a) Coal seam thickness does not change systematically (and hardly at all) along at least 1/2 mile long face (coal and high wall)
b) Lenses of gray shale up to 1.2 ~~in.~~ m thick in center, thinning out gradually over 20-30 ~~in.~~ m to each side to nothing. 3 such lenses were observed. Gray shale lenses are convex upward; plant debris found on bedding plains of well bedded shale, but undeterminable.
c) Black shale rests in almost uniform thickness on gray shale lenses and where gray shale is missing, directly on coal. Black shale is as usual very hard, fissile, well laminated, lower part some what flaser bedded and pyritized shell fragments of bracks and pelycopods (lams), mostly small, in some like "shell breccia". 2'--3' thick
d) Limestone, gray, 1.5 ~~in.~~ m thick where on black shale with gray shale, thinning to 0-.5 ~~in.~~ m above center of gray shale lenses, so that top of limestone is ± parallel to top of coal seam.

e) Gray sandy shale and channel sandstone follow above Section, in high wall (bottom to top): approx. 6' coal, 0-4' gray shale, 2-3' black shale, 0-5' limestone appr. 15-20' gray, sandy shale, +3' channel sandstone, above that, mainly pleistocene.

No samples taken

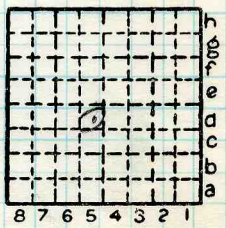


Illinois State Geological Survey

Delta Mine, Sample No. 1

Fred Schroeder, superintendent

thick		
0.35'	0.00'-0.35'	Coal, canneloid appearance, conchoidal fracture; very finely laminated.
1.85'	0.35'-2.20'	Coal, normally bright banded with several fusain lenses up to 0.02' thick.
0.08'	2.20'-2.28'	Fusain parting, soft with interpolated thin vitrain lenses.
0.96'	2.28'-3.24'	Coal normally bright banded; much pyrite cleat filling and nodules in upper half.
0.02'	3.24'-3.26'	Shale, highly carbonaceous with pyrite streaks and nodules. Thickness from 0.05'.
0.44'	3.26'-3.70'	Coal normally bright banded.
0.06'	3.70'-3.76'	Shale, highly carbonaceous. Thin coaly streaks, many irregular pyrite streaks and nodules. Excluded from FC sample.
0.86'	3.76'-4.62'	Coal normally bright banded; several fusain lneses up to 0.03' thick.
0.19'	4.62'-4.81'	Shale, carbonaceous, hard with many pyrite concretions up to 0.15' thick. "Blue band" (?). Excluded from FC sample.
0.97'	4.81'-5.78'	Coal normally bright banded. Base of coal. Sharp contact with soft underclay.
0.04'		Underclay, soft claystone; small plant remains, coalified.



By NHB & HHD Date 7/14/70

Quadrangle

County Williamson Sec. 14 T 9S R 4E

200'W. & 400'S. of center of Section 14.
Seam elev. 367' (from mine map).

Total seam thickness:
5.76 feet = 69 inches = 1.76 meters.

General remarks:
Coal well cleated; cleat filling mainly calcite;
some pyrite especially upper half of coal.

Main cleat directions (vertical cleats): (Fines N, S)
I. 130°, 128°, 132°, 138°, 132°, 140, 142,
138, 137, 142, 135

II. 57, 40, 55, 55, 52, 53, 45, 50, 47, 50,
30, 44, 60, 45, 36, 40

Samples collected:
Face channel sample - 1 barrel
Column sample - 2 barrels

Williamson Co.
Delta Co.

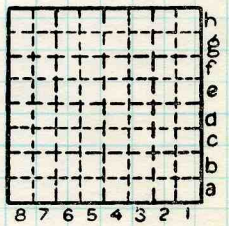
Dr. Sec. 14 - 9S - 4E

Delta Mine, Sample No. 2

thick		
0.30'	0.00'-0.30'	Compact coal, a few thin vitrain laminae.
0.10'	0.30'-0.40'	Shale, gray, soft, with several vitrain laminae. Excl. from FC sample
2.80'	0.40'-3.20'	Coal normally bright banded; several thin fusain partings.
0.11'	3.20'-3.31'	Shale, carbonaceous, fairly hard, with pyrite lenses. Excluded from FC sample.
0.94'	3.31'-4.25'	Coal normally bright banded; several thin fusain partings.
0.09'	4.25'-4.34'	Shale, carbonaceous, with many pyrite lenses, hard. Excluded from FC sample.
1.01'	4.34'-5.35'	Coal normally bright banded; fairly hard.
0.02'		Underclay, soft, sharp contact w/ M coal

Sample collected:
Face channel sample - 1 barrel
Column sample - 2 barrels

Seam thickness:
5.35 feet = 64 inches = 1.63 meters.



By NHB & HHD Date 7/14/70

Quadrangle

County Williamson Sec. 14 T 9S R 4E

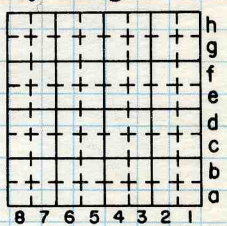
500'W., & 400'S. of center of Section 14
Seam elev. 367' (from mine map).

ILLINOIS GEOLOGICAL SURVEY, URBANA

AMAX - Delta Mine
Highwall Description

thick

≈20'	Drift
1.1'	0-1.1' - Shale - Medium light gray (weathers red-brown); poorly laminated. Sharp contact with.
0.7'	1.1-1.8' - Allenby Coal - Rotten; normally bright banded when fresh.
1.5'	1.8-3.3' - Shale (Seatrock) - Very carbonaceous (stigmarian); medium gray. Sticky clay in part; moderately laminated.
5.5'	3.3-8.8' - Bankston Fork Limestone - Weathers rusty. Fresh surface medium gray. Contains micritic nodules in claystone matrix.
9.0'	8.8-17.8' - Shale - Medium gray, well laminated. Contains fine cross-laminations.
2.7'	17.8-20.5' - Sandstone - Medium light gray when fresh; fine grained, compact. Anvil Rock
34.0'	20.5-54.5' - Shale - Medium gray, well laminated. Contains sideritic bands and lenses ≈0.1' thick and abundant light gray siltstone interlaminations especially in upper part.
0.3'	54.5-54.8' - Conant Limestone - Medium dark gray; argillaceous. Contains abundant tubular forams.
0.3'	54.8-55.1' - Jamestown Coal - Normally bright banded.



By H.H.D. & W.J.N. Date 5/30/74

Quadrangle

County Williamson Sec. T 9S R 4E

thick		
0.5'	55.1-55.6'	- Shale - Dark gray, well laminated; hard (calcareous?), pyritic.
5.3'	55.6-60.9'	- Brereton Limestone - Medium gray to medium dark gray; fine grained; hard, dense. Contains several thin calcite veins. Sharp contact with.
2.5'	60.9-63.4'	- Anna Shale - Black, "slaty." Contains pyritized shell fragments (Dunbarella common). Herrin Coal - Top of coal exposed only.

AMAX - Delta Mine, 5/30/74

Amax Coal Company Delta Mine
(Strip) Roger Nance, John Nelson,
Jim Palmer 7/20/76 (afternoon)

Notes by John Nelson

We visit the main active pit (miners are on vacation) in SE¼, Section 17, T. 9 S., R. 4 E., Williamson County.

(1) Base of incline. On top of Herrin (No. 6) Coal with good highwall exposure to north side of the pit which runs approximately NE-SW.

Generalized Section (All Units Vary in Thickness)

35-40' Drift (Illinoisian) ; clay, yellowish brown, silty with small deeply weathered pebbles.

Bench

15' Shale (Lawson) - Medium-dark gray, firm, poorly bedded, finely silty, faintly laminated, numerous fine-grained, sideritic lenses and bands up to 0.1' thick. Most layers are lenticular. Sharp contact:

0.6' Limestone (Conant) - Dark gray, fine grained with small light gray crystals and fossil fragments, massive, very argillaceous, weak.

0.4' Coal (Jamestown) - Normally bright banded, fairly well cleated, thin shaly interlaminations near top.

0.6' Shale - Very dark gray, poorly bedded, calcareous, highly carbonaceous, fairly weak, contains shell fragments near bottom, appear to be pelecypods. Sharp contact.

6.0'± Limestone (Brereton) - Dark gray, fine grained, very hard, massive, finely silty, fine fossil fragments, small calcite veinlets and recrystallized patches. Varies considerably in thickness. Sharp contact:

3.5'± Shale (Anna) - Black, hard, fissile, "slaty," finely silty to smooth, contains oval pyritized concretions and pyritized tree stems. Varies in thickness.

Units can vary in thickness by about 50% either way, but no pinch-outs noted, and changes are gradual. More of the Lawson Shale is exposed to the NE as the overburden thickens. At NE end of highwall the upper part of the Lawson Shale is sandy, grading to fine grained, argillaceous sandstone (Anvil Rock). No Energy Shale noted.

Small limestone "boss" noted at Anna Shale-Brereton Limestone contact. (Photo.) Shale below is deformed and shattered, but much of the highwall is shattered due to blasting. The limestone in the "boss" is slightly different—medium gray, mottled brown, sublithographic, very dense, few calcite-filled fractures, fairly massive, few shell fragments and crinoid debris noted.

The Anna Shale in SW part of pit has prominent 025° and 100° vertical or nearly vertical fracture sets. Along the 2000 feet of well-exposed highwall, no faults (other than slips with no displacement), claydikes, or significant stratigraphic changes noted.

SW end of pit, adjacent to dragline, only about 6 feet of Lawson Shale are present below drift; 30-40 feet of Lawson Shale/Anvil Rock Sandstone at NE end of pit.

Inverted

PHOTO 1

Small limestone "boss", a downward protrusion of the Brereton Limestone into the Anna Shale. This is one of few stratigraphic and structural irregularities observed in this mine.

Slight mottling and apparent burrowing noted in places at the top of the Anna Shale just below the contact with the limestone. Transitional "clod" layer, but base of limestone is sharp everywhere in pit

The dragline in this pit is a 60-yard Bucyrus-Erie walking dragline. Under construction is a "walker" with a 177-yard bucket.

Near the dragline (1000 feet west of base of incline) the drift shows two layers. Upper 30 feet or so is light orange-brown and very sandy, with layer of cobbles and boulders including a 6 foot limestone(?) boulder at the base. Below this is some 20 feet of darker brown, more clayey drift, with highly weathered, mottled, varigated pebbles.

Minor water seepage in upper, sandy layer. Top 5 feet appears extremely sandy, friable.

The dragline must sit on the rock bench because the drift bench won't support it. So the dragline has to sit on the solid and remove both the drift above and the rock below.

mn_act_williamson_01.tif

PHOTO 2

An abandoned pit of the Delta Mine just south of Highway 13 and east of the presently active workings. Upper two-thirds of highwall in foreground appears to be light-colored, thin-bedded Anvil Rock Sandstone Member. Good examples of sandstone channels are said to be present in this pit, but none are visible from this location. For more than a mile the highwall is too steep to climb without ropes.

AMAX Coal Company -- Delta Mine
Williamson County
September 14, 1977 -- J. Nelson, J. Popp; notes by Popp

We visited the abandoned pit and highwall of the Delta Mine along Highway 13 east of Crab Orchard and along Bankston Fork Creek (22,23,24, 9S, 4E, Williamson County). The highwall does not have coal exposed at the water level, and the immediate interval above the water is shale (greater than 5' thick) with limestone above. The section is well weathered and well exposed.

After walking along the pit we drove to the Delta Mine office. The mine has been toubled lately by the threat of a restraining order stopping work. The order is because of deep mining in the No. 5 Coal in the Parton Mine below the Delta Mine.

Williamson County
Amax Coal Co. - Delta Mine
October 11, 1978

Notes by Popp on a visit with R. Jacobson, J. Utgaard, SIU, and Ron Lyles, Amax Community Relations Representative (deals with State and Federal Relations), and Mike Rodgers, Director of Public Relations for AMAX Mine Property is 6000 acres; 850 affected.

1450 Pit

We had a look at the highwall at the north end of the pit. Gray shale is present immediately above the coal, and below it is a "dark" shale and canneloid coal—actually the coal looks awfully dirty to be canneloid.

I took several pictures and a sketch on the next page shows about what I saw.

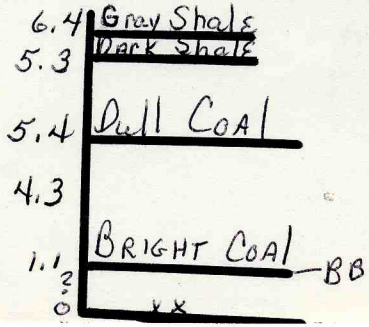
A rather distinct break can be seen between the dark shale and the canneloid coal. The dark shale is highly carbonaceous with plant debris some of which is pyritized. There are shell fragments, mostly lingula.

The dark gray shale appears to be continuous over the gray shale, although neither ends of the gray shale are visible. It also appears that where we stopped, the gray shale is thickest of the pit exposure.

The dull coal layer is apparently variable in thickness, and apparently thins as the gray shale thins.

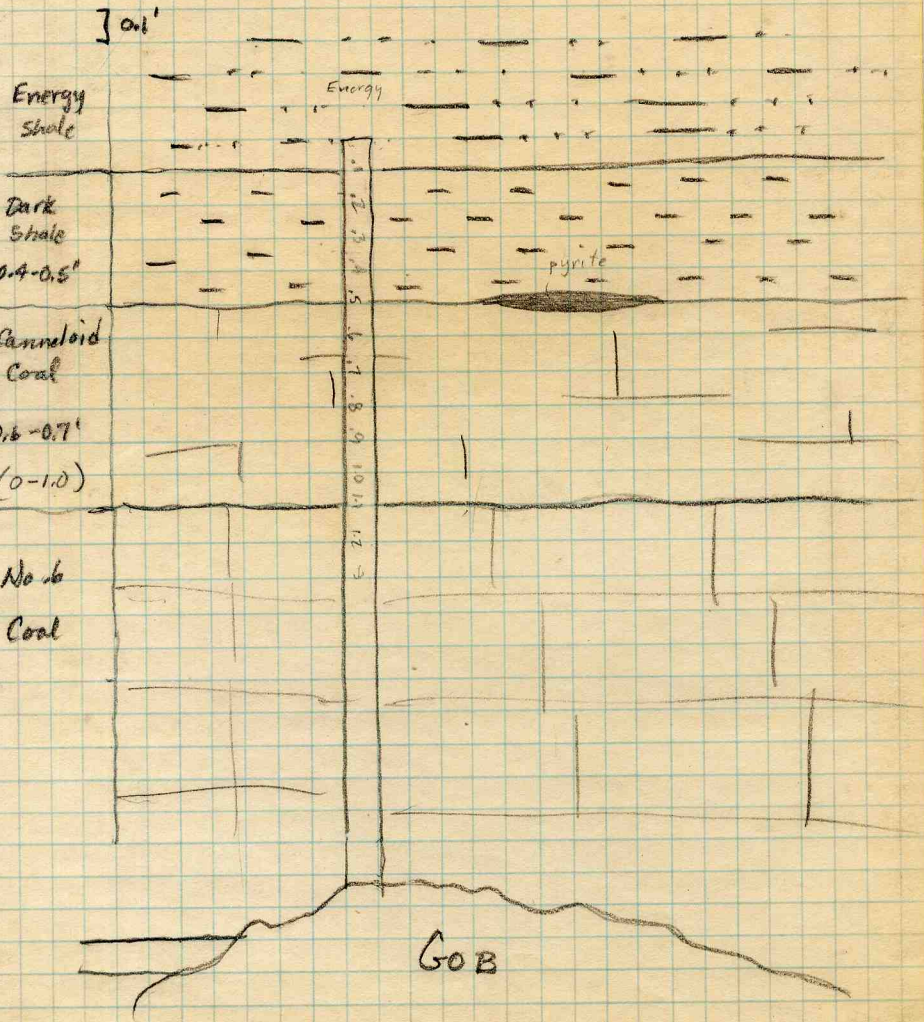
This pit is up to 110-115 feet deep which is about 30' over their limit. Therefore they make two cuts.

Coal thickness is apparently fairly consistent from about 5.5' to just over 6'.



DELTA MINE

CANNELOID COAL BELOW ENERGY SHALE



Location on reverse side

Williamson County
AMAX COAL COMPANY - DELTA MINE

1450 PIT
OCTOBER 11, 1978

JTPopp

FORM 180 W

AMAX COAL COMPANY DELTA MINE-HARCO PIT

October 29, 1979

Notes by John Nelson on visit with John Popp and Bob Griffin.

Pit is in Saline County but notes are filed in Williamson County (location of original mine).

This is the new expansion that is hoped to raise the output of the Delta Mine from about 500,000 tons yearly to about 2,500,000 tons. A new tipple, washing plant and office have been built near the Harco Pit. The old pit near Crab Orchard is still in operation but coal from that pit is being washed at the new tipple.

The Herrin (No. 6) Coal is being mined in the Harco Pit. The mine is located just south of the master fault in the Cottage Grove Fault System. Thus far they have not mined all the way to the fault because the coal pitches steeply close to the fault. A small fault, offsetting the coal, has been encountered in the pit, and the main purpose of our visit is to study this feature.

Sketch map (drawn from memory) shows approximate relationship of faults to mining area. On the first cut the fault was found striking east-west and had almost no displacement. Westward the fault curves to a WNW heading and increases in throw. As presently exposed the fault has about 12 feet of throw down to the north.

Eastern end of fault is 505' north, 465' west of SE corner $NE\frac{1}{4}$ $NW\frac{1}{4}$ Section 4, T. 9S- R. 5E.

Present intersection of fault with highwall is 610' north, 785' west of SE corner, $NE\frac{1}{4}$ $NW\frac{1}{4}$ Section 4.

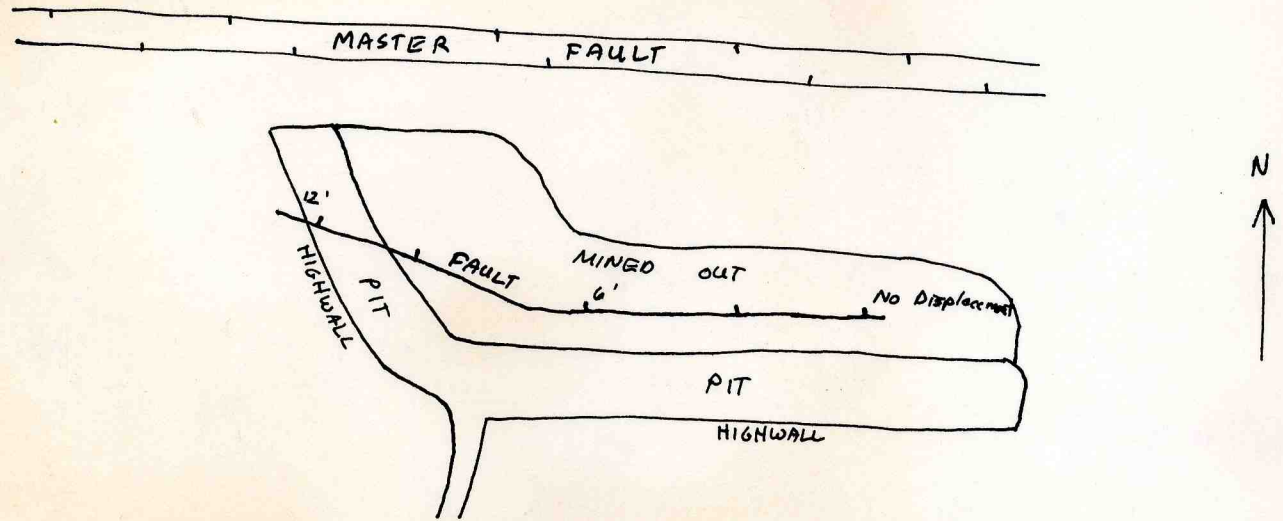
Known length of fault thus is about 350 feet.

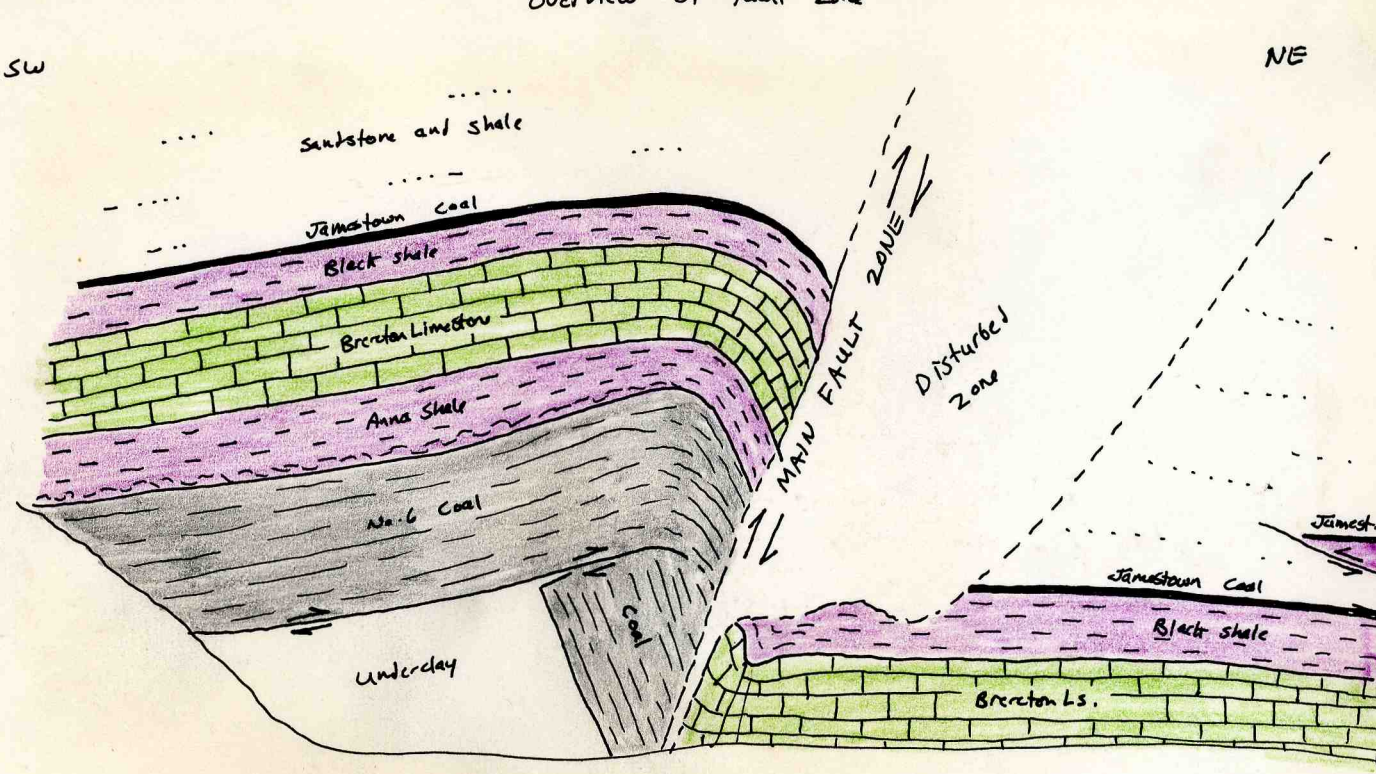
Estimated Section on Highwall.

Top-disturbed by mining.

4' Limestone or sandstone, gray, blocky, massive, deeply weathered.

SKETCH MAP OF HARCO PIT





4-5' Clay or soft shale, gray, weathers buff.

0.5' Danville (No. 7) Coal; increases to 18-24" to south according to Tom Durham, engineer with AMAX.

30' Sandstone, light gray, very fine-grained, thinly laminated with dark gray shale, micaceous, carbonaceous, fine plant debris. Contains zones of silstone or gray silty shale. Becomes finer near base, grading to sideritic silty shale.

0.5' Limestone (Conant), medium-dark gray, coarse grained, very argillaceous, fossiliferous.

0.6' Coal (Jamestown), N.B.B., interbedded with black shale.

0.5' Shale, dark gray, calcareous; almost a limestone; poorly bedded, fossiliferous, carbonaceous.

1.5' Shale, black, smooth, well-bedded, finely micaceous, occasional plant fossils.

4.0' Limestone (Brereton), medium gray, fine-grained, hard, massive.

2.5' Shale (Anna), black, hard, smooth, fissile.

5.5' Coal (Herrin No. 6) Thickness from Tom Durham. Only exposure of seam is close to fault, where coal is much disturbed by tecetonic activity.

6' Claystone, exposed at fault, not examined in detail.

Exposure of Fault

The fault is very well exposed on the highwall. It is a complex structure. It is perhaps best described as an asymetrical anticline broken by a high-angle reverse fault and by numerous smaller low-angle to horizontal thrust faults. See sketch for overview.

The anticline makes a large "hump" in the floor of the pit. From the trend of this I judge the azimuth of the structure to be about 115. The main reverse fault has a wide zone; no clearly-defined plane. It dips roughly 60 degrees to the southwest, and the Brereton Limestone is upthrown about 12 feet on the southwest side of the fault.

It is very difficult to describe the structures in the shale and sandstone above the Jamestown Coal. A wide zone is clearly disturbed, but cannot tell how much is due to faulting and how much is the result of slump along the highwall.

Bedding-plane slippage has occured on the coal/underclay contact southwest of the fault. The upper block has moved relatively upward and to the northeast. This bedding-fault cannot be seen to cross the main high-angle reverse fault. Thus I can visualize the following sequence of events:

A. Strata folded into an anticline.
B. Upper limb of anticline broken off and thrust over lower limb of anticline, the slippage occuring on coal/underclay contact.
C. High-angle reverse fault forms.

The following orientations were measured on bedding surfaces in the over-riden block of coal:

106/60 NE 108/58 NE
108/56 NE 113/68 NE (close to main fault)

The coal is crushed and locally is slickensided on bedding planes.

The axis of folding of both upper and lower limbs appears to be essentially horizontal and parallel with the fault.

The coal in the upper limb is closely fractured and there are at leat 4-5 layers of crushed coal along which slippage apparently has occured. Close to the main fault the coal is crushed and the bedding is obliterated. Additional bedding-plane slippage has occured in the Anna Shale just above the coal; this part of the Anna Shale is crushed. On the crest of the fold the full thickness of the shale is crushed, and the unit appears to be slightly thinned.

The Brereton Limestone is intensely fractured over the crest of the fold; the fractures are filled with white calcite. The black shale above the Brereton has behaved similarly to the Anna Shale.

On the downthrown limb the limestone again is intensely fractured although it is not folded and lies nearly horizontal. The strata above the Brereton are jumbled to the extent I can't make any sense out of the structure.

North of the main fault the strata dip irregularly and gently toward the north end of the pit, which is said to be only a couple hundred feet from the major Cottage Grove fault. According to Mr. Durham farther east the coal pitched up to 20% and was difficult to mine. The coal is very "rolly" and is said to vary in thickness and has pulverized zones.

Thrust fault north of main fault. A large low-angle thrust fault has caused repetition of the Jamestown Coal about 40 feet north of the main high-angle fault. The fault itself does not have a clean-cut plane but rather a zone several inches thick of crushed rock. Assuming a strike of 155 degrees, the fault dips 15 NE, and has a throw of 5.2 feet and a heave of about 18 feet; the northeast side is upthrown. There is some drag folding in the footwall close to the fault zone. This thrust has the opposite sense of movement and so cannot link with the bedding-plane fault on the other side of the main fault.

Additional indications of low-angle or bedding-plane slippages are seen southwest of the main fault in strata above the Brereton Limestone. In most places the shales are so chewed up that I cannot tell the relative sense of movement.

Conclusions on fault. All indications are that the dominant action was horizontal compression along an azimuth of about 025 (farther east, the compressive azimuth was north-south). No indications were found of significant strike-slip or oblique-slip movements. Thus I would consider this fault to be secondary and not part of the master fault, even though it strikes nearly parallel with the master fault.

Coal balls Tom Durham reported that large masses of coal balls were encountered in two places in thepit;

the map in the office shows one mass 50 feet west of the SE corner NE¼ NW¼ Section 4; the other mass about 100' north, 100' west of the SE corner NE¼ NW¼. From Tom's description it appears that the entire thickness of the seam was replaced and the area had to be bypasse ed by the loading shovel.

AMAX Coal Company, Delta Mine
Williamson and Saline Counties
October 29, 1979

Notes by Popp on a visit with C. J. Nelson and Bob Griffin. Visit with Tom Durham, Engineering Manager.

Pit is approaching edge of Old Peabody Mine No. 43.

Harco Pit is 11 miles from the 1450 Pit at Delta. The total production will be 2.5 M TPy with about 800,000 from Delta and up to 2.0 M from Harco. The pit location is approximately NE, NW, 4-9S-5E, Saline County. The pit is working in the area of the old Peabody Mine No. 43 which worked in the No. 5 Coal.

Fault is exposed in highwall with reverse fault displacement, as shown in photos. Tom reports that just south of this fault they also encountered coal balls in a pod large enough that they had to jump over it. The coal has a rolling topography in this pit, possibly because of its proximity to the mastor fault and/or this subsidiary fault. Tom says that the coal is also soft, possibly resulting in the irregular topography either due to faulting or due to inexperience of the stripping operator.

In measuring the section, several fault related features could be noted: 1. a zone of shattered or pulverized coal is present not unlike what Nelson and I saw at Orient No. 4 Mine; and 2. the base of the Anna Shale is very soft and crumply whereas normally it is hard and fissile. Both of these features are probably indicative of the faulting. In particular, they may indicate horizontal or thrusting action.

The fault exposed is a reverse fault with an estimated 12-15' of displacement. Drag along the fault place is very well exposed, and the coal on the hanging wall dips south about 11° (19%).

Nelson pointed out the fact that a thrust fault overrides the reverse fault. See his notes and sketch. Then to the north 50-60' is another thrust fault which displaces the Jamestown and Conant. Their section is repeated due to thrusting.

Coal ball sample, location of coal ball pods:

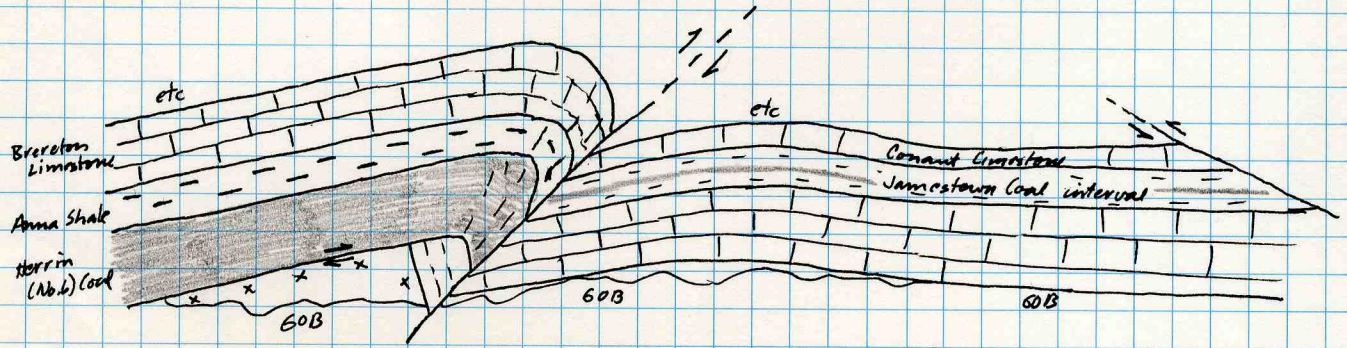
SE/c NE NW, 4-9S-5E
50' of SE/c

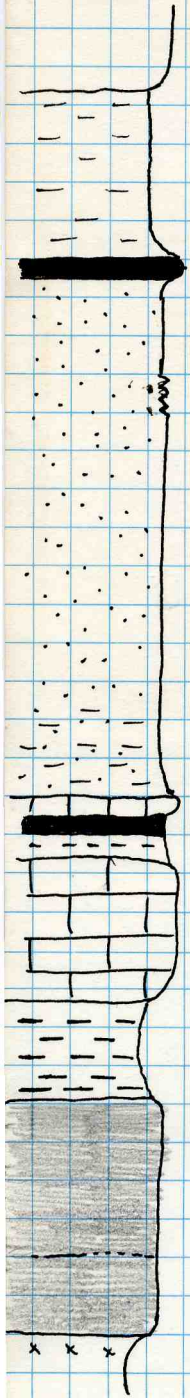
Two pods have been plotted on the mine map. The pods are still accessible, although they haven't made the coal accessible. Don't have a good idea when the coal will be mined.

AMAX COAL CO. - DELTA MINE ; HARCO PIT

October 29, 1979

West Facing View





Weathered limestone or sandstone

Clay or soft shale, gray, weathers buff

Danville (No.7) Coal, 0.5'

Sandstone, 30', light gray, very fine-grained, thinly laminated with dark gray shale, micaceous, carbonaceous, fine plant debris. Contains zones of siltstone or gray silty shale. Becomes fines near base, grading to sideritic silty shale

AMAX COAL CO. - DELTA MINE
HARCO PIT - OCTOBER 29, 1979

Conant Limestone, 0.5'

Jamestown Coal Interval, 1.1' (0.6' coal, 0.5 shale)

Brereton Limestone, 3.6', gray to dark gray, hard massive, calcite-filled veinlets. Sharp contact.

Anna Shale, 2.6', lower 0.4' is crushed and soft, upper 2.2' is hard and fissile.

Herrin (No.6) Coal, 6.1', bright banded, pyrite on cleat, soft and broken, blueband 2.1' from base.

Underclay, 4.6'+, gray to light gray, nodular

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View of major fault in Harco Pit. South (left) side is upthrown and strata dip away from fault, except right along the fault plane where they are sharply dragged in direction of movement. Coal on north side of fault is below floor of pit. Geometrically this is a high-angle reverse fault.

All photos by John T. Popp.

A different view of the fault. Note drag on hanging wall (left). John Nelson is examining the Brereton Limestone on the downthrown side of the fault.

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MOORE'S MODERN METHODS
FORM 180 W

John Nelson taking notes in front of small thrust fault which lies north of major fault. The fault surface runs approximately from Nelson's left elbow past the rock hammer toward the upper-left corner of the photo. Jamestown Coal (J) and associated strata are repeated on highwall due to fault.

Close-up view of last photo- hammer has not been moved- showing deformation (small drag fold) in shale along thrust fault.

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Bob Griffin (of ISGS; with shovel) and Tom Durham (of AMAX) preparing to take a sample of gob in the west pit of the Delta Mine, near Crab Orchard.

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MOORE'S MODERN METHODS
FORM 180 W

Two views of new prep plant at the Harco Pit.

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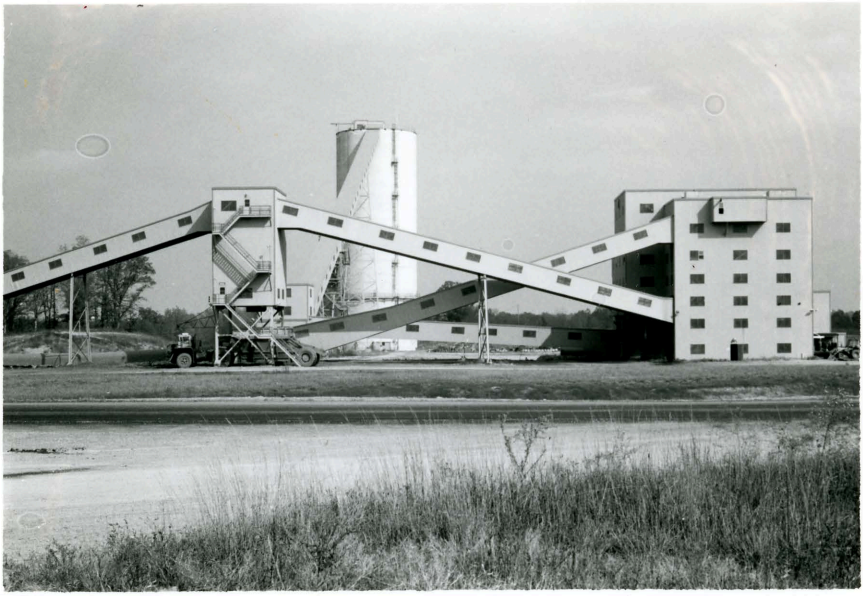

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DELTA

DELTA MINE

AMAX Coal's Delta Mine is located ten miles west of Harrisburg, Illinois, in both Williamson and Saline Counties. The mine began operation in 1934, producing coal from the #6 Herrin seam. Once owned by Ayrshire Collieries, Delta Mine became a part of AMAX in 1969. In that year, AMAX Inc. acquired Ayrshire Collieries, later changing the company's name to AMAX Coal.

Under a major expansion program, Delta is scheduled to grow from the 999,196 tons it produced in 1979 to 2.5 million tons annually during the decade of the 1980s. As part of this expansion, construction was completed on a new Bucyrus-Erie 3270-W dragline in 1979. The dragline, the second largest model made in the world, is identical to the one at AMAX Coal's Ayrshire Mine near Chandler, Indiana. It is currently operating on the east edge of Delta near the small town of Harco. Another pit, located nine miles to the west, is being worked by a model 1450-W Bucyrus-Erie dragline.

These huge machines are used to remove the overburden lying over the coal, depositing it on one side of the pit. Then coal is mined by shovels and trucked to the mine's preparation plant where it is crushed and cleaned to remove rock and other impurities. Delta's modern preparation facilities were built in 1978 and are able to handle more than 7,000 tons of raw coal per shift. The cleaned coal is stored in one 15,000-ton-capacity silo, ready for loading into unit trains on a spur that connects with Illinois Central & Gulf Railroad lines. The coal is shipped to utility customers in Illinois, Wisconsin, Iowa, Michigan and Missouri, where it is used for electrical generation.

Reclamation progresses along with mining at Delta, as it does at all AMAX Coal mines. In 1980, 358 acres were affected by mining; another 348 acres were seeded in the reclamation process that restores mined lands to productive use. In addition, 33,500 trees were planted on Delta's reclaimed areas in 1980.

MAJOR EQUIPMENT

Coal Shovels: A Marion 151-M is used to remove coal in the pit worked by the B-E 1450 dragline and a Marion 182-M is used in the B-E 3270 pit. These shovels have 11-and 16-cubic-yard bucket capacities.

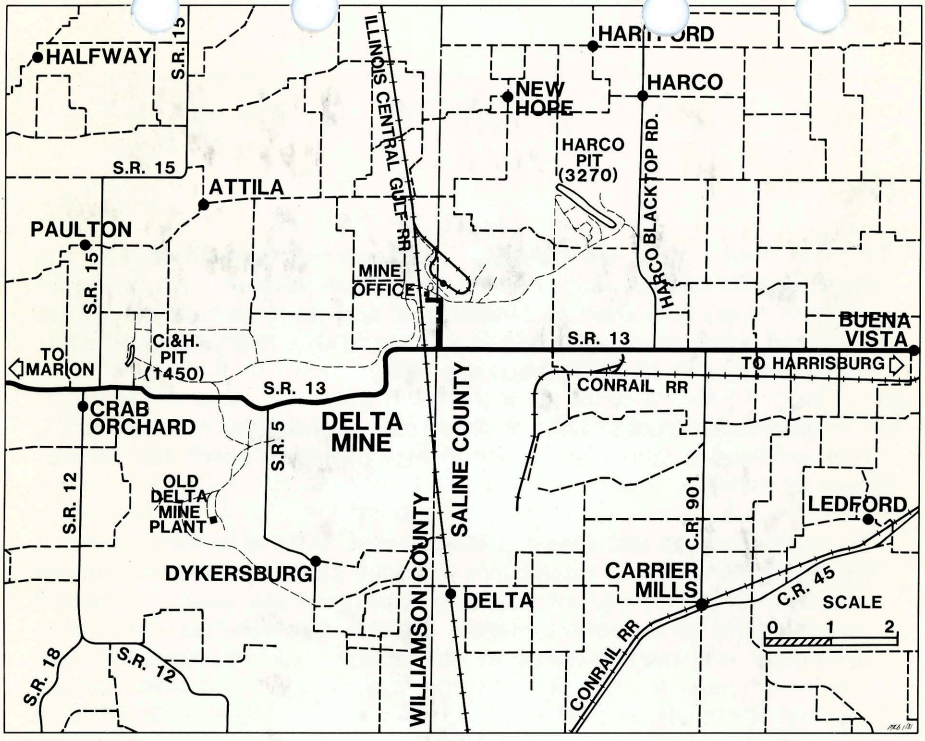
Drills: Four drills are utilized at Delta to bore holes in the overburden. Loaded with a mixture of ammonium nitrate and fuel oil, the holes are shot to loosen dirt and rock so that it can be removed more easily by the draglines. Three Bucyrus-Erie 61-R drills and one D-40-K Driltech are used.

Coal Haulage Trucks: Delta's fleet of coal haulers, numbering 15, include Euclids and Darts, the majority of which carry 120 tons of coal at a time.

Topsoil Removal and Cleanup Machinery: At Delta Mine, as well as at all AMAX Coal operations, a large fleet of earth movers is utilized for a variety of purposes. Scrapers are used for topsoil removal and replacement, dozers and graders for road maintenance and contouring earth in preparation for reclamation, and front-end loaders for cleaning the top of the coal seam before mining. Caterpillar D-4, D-8 and D-9 dozers, Fiat Allis HD41-B dozers, and Caterpillar 637-D and Wabco 333 scrapers are among the earth movers used.

DRAGLINE SPECIFICATIONS

	B-E 1450-W	B-E 3270-W
Boom length	250 feet	330 feet
Working radius	246 feet	311 feet
Weight (in millions lbs)	6	17.5
Horsepower	10,375 AC	18,000 AC
Bucket capacity (in cu yds)	60	176
Tub diameter	55 feet	85 feet
Walking speed	0.16 mph	0.10 mph
Length of step	8.5 feet	5-6 feet



(JANUARY 1 - DECEMBER 31, 1980)

TONS OF COAL PRODUCED:	2,137,292
AVG. COAL SEAM THICKNESS:	5.5 feet
OVERBURDEN MOVED:	39,124,000 cu yds
AVG. OVERBURDEN DEPTH:	81 feet
AVG. STRIPPING RATIO:	18.6 to 1
KILOWATT-HOURS USED:	66.9 million
ACRES AFFECTED:	358
ACRES SEEDED:	348
TREES PLANTED:	33,500
NUMBER OF EMPLOYEES:	306
ESTIMATED STATE/LOCAL TAXES:	$3,450,900

AMAX Coal Company - Delta Mine

Sept. 29, 1981 Notes by John Nelson

Visit during big field conference of ISGS people and AMAX geologists and engineers. Among those present were:

I.S.G.S.

Dwain Berggren
Paul Du Montelle
Leon Follmer
Dave Gross
Paul Heinrick
Bev Herzog
John Kempton
Ivan Kricpak
Brian Trask

AMAX

Eric Adidas
Jim Goss
George Hargraves
George Mott
Jeff Shanks
John Williams
Pat Wiram

We visited Pleistocene exposures, reclamation projects, natural outcrops, and other things in addition to visiting the pit, so time was limited for study.

HARCO PIT

Area visited approx. SE¼ SE¼ NE¼ Section 5, T. 9S. R. 5E. 600' NE of water tank at abandoned Peabody No. 43 Mine.

Harco Pit - Highwall trends E-W and faces north. Pit is approx. 100 feet deep. Estimated section:

15-20' surface, not exposed. Thicker to west

10-15' shale, gray, soft. Sandstone or limestone bed near base.

1'< coal (Allenby) - bright banded.

2-3' claystone, greenish.

5' Limestone (Bankston Fork) buff, shaly.

35-50' siltstone, greenish gray, argillaceous, poorly bedded, micaceous. Grades into laminated med-dk gray silty shale.

8' Ls (Brereton) dark gray, fractured.

2-3' Shale (Anna) black + fissile

Coal - poorly exposed. No clean face here.

Highwall is steep and rather dangerous to approach closely for detailed study. No coal is exposed in this part of the pit.

Toward the west the siltstone in the highwall coarsens to fine-grained sandstone, light gray, argillaceous and poorly bedded. Contact to Lawson Shale is sharp. The sandstone would be Anvil Rock Sandstone.

Shear fractures ("slips") in coal trending S 60° E, dip ~50° SW, no visible offset. Three such fractures noted. No other evidence of faulting observed.

AMAX plans to open a third pit between here and Crab Orchard. A 110-yard Marion dragline is being erected. The company hopes to boost annual production to 3 million tons when all three pits are in operation. The new dragline will have capability to mine to 150 feet.

The Harco pit is just south of the Cottage Grove fault (master fault) which here has

the north side down thrum about 200 feet. A steep flexure in the coal was encountered a year or so ago. The coal pitched too steeply for the equipment to handle. The strata as exposed here today bear little evidence of faulting and show only a very slight dip toward the west or NW.

The dragline at Harco Pit has a 60-yard bucket and the coal loader a 12-yd. bucket. Haulage trucks are of 70 and 100-ton capacity. The coal is not shot but sometimes must be ripped by a dozer. Rubber-tired machines clear the immediate overburden from the coal.

The shales close to the coal (Anna and Energy shales) contain much pyrite, so AMAX tries

to place these shales low in the spoils, so they won't be close to the surface and be oxidized to produce acidic drainage. AMAX takes numerous cores of the bedrock and shelby-tube samples of surficial materials, to characterize the overburden materials with respect to toxic materials, trace metals, acidity and such.

Surficial materials as described by Leon Follmer.

6' spoils from old underground mine.

2½' Peoria Loess, yellowish-gray.

1' Farmdale soil, "A" horizon - brownish-gray, silt. well-marked horizon.

2' Silt, iron-stained. Roxanna loess. Clayey. Sangamon soil at base. Gradational contacts.

3-8' Till, yellowish to orange-gray; sandy silt with sandstone pebbles, carbonaceous debris, iron-stained, probably secondary iron "B" horizon of Sangamon soil - locally only 3' thick

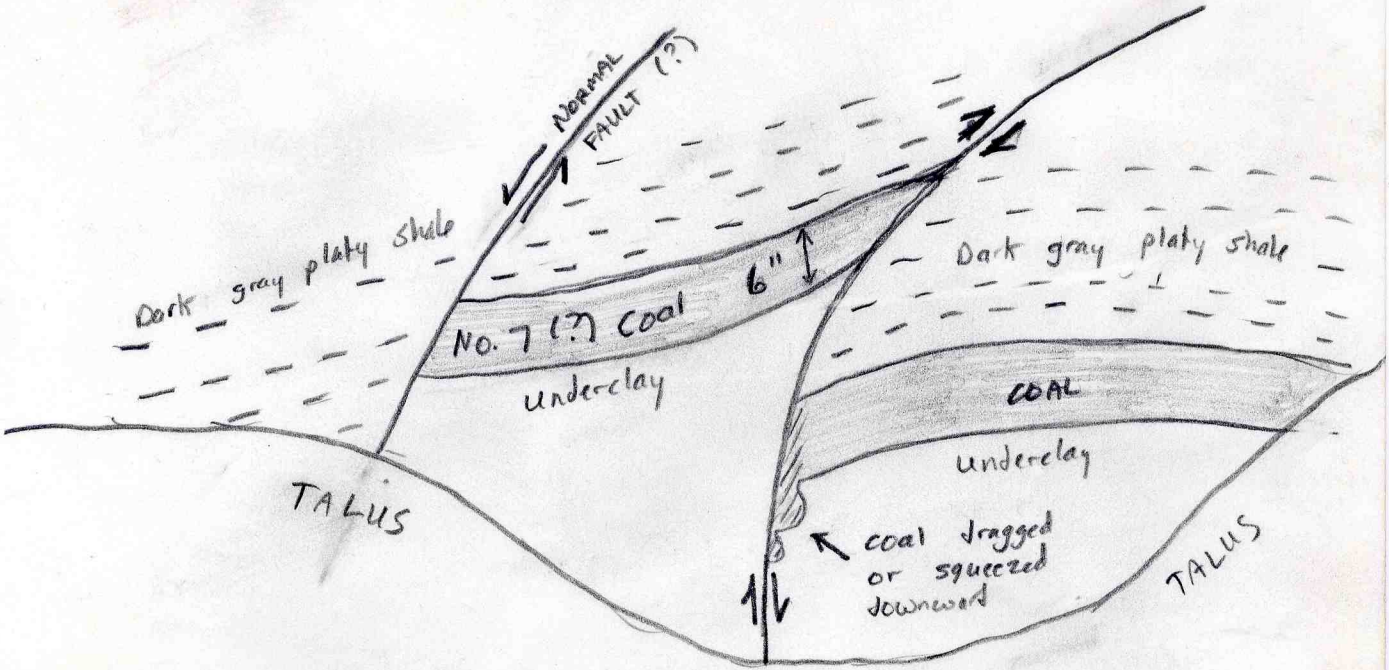
Bedrock

NE

Approx. SE¼ SE¼
Section 5.

Small fault on haul road.
Strike N 45° W.

SW



NOTE THAT DRAG IS WRONG FOR A REVERSE FAULT. PROBABLY EITHER 2 STAGES OF MOVEMENT (FIRST NORMAL, THEN REVERSE) AND/OR HORIZONTAL SLIPPAGE.

Small faults exposed on haulage road south of pit near top of hill in roadcut. The better exposed fault strikes N 45° W (direct measurement on fault surface.) A thin coal bed said to be the No. 7 coal is upthrown about 1 foot to the northeast, making this geometrically a reverse fault. The fault plane steepens downward almost to vertical, and the drag is "wrong way" for a reverse fault. Note especially (see sketch) crushed coal below main seam on footwall. Fault probably is oblique-slip.

Other fault appears to be a normal fault, but is poorly exposed.

Trend is typical for subsidiary faults.

Crab Orchard pit

Approx. W½ NE¼ SE¼ sect 18, T. 9S - R. 4E
Williamson County,

Near dragline are exposures of the surficial deposits - Pleistocene lake deposits, overlain by yellowish-gray till perhaps 20 feet thick. The till is a sandy clay or silt with weathered pebbles; contains carbonaceous veins and grayish reduction zones - as usual.

Lake beds consist of sticky bluish-gray ^ and greenish clay interbedded with gray to yellowish-brown sand, and local lenses of gravel. Stratification is coarse and irregular. Some poorly sorted sand & gravel (outwash) with large-scale slumping, and contorted layering perhaps produced by the weight and pressure of ice. Some of the clay is thinly laminated. Total thickness of

surficial deposits are 30 to 40 feet. This is hard to judge, because materials have been disturbed by mining.

Leon Follmer interprets this as an area where the edge of a glacier shoved till over lacustrine deposits, while outwash was being deposited- thus very complex stratigraphy.

These materials- especially the clays- are unstable in the highwall and on spoils. In places the unconsolidated material reaches 80 ft thick, according to drilling. It occupies a series of valleys. The dragline operator must build a bench of rock for his machine - thus he has to handle material twice. The clay and sand would not support the weight of the dragline.

Map prepared by Eric Aditas shows Pennsylvanian sandstone (Anvil Rock) directly overlying and/or truncating the Herrin Coal in places.

According to Paul Heinrich this is not related to Late Saline to the east — Wisconsinan slack-water lakes created when the Ohio and Wabash drainages were interrupted by huge volumes of glacial outwash, etc. These here presumably were lakes of the Illinoisan glacial stage, and lay right at the front of the glacier at its maximum advance. Paul has seen deposits like these near the foot of the Shawneetown Hills where the Illinoisan glacier was halted at its maximum advance.

We did not look at the bedrock in detail, only drove through the pit. No sandstone was in evidence - appears to be about 20 - 30 ft of rock, mainly med to med-dk gray mudstone (Lawson) probably Anna shale and Brereton Ls. below.

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FORM 180 W

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Telephoto shot, looking across AMAX's reclaimed land to tipple of the Brushy Creek Mine. Surface mine is south, underground mine is north of Cottage Grove fault.

John C. Moore Corporation, Rochester, N.Y. 14604
MOORE'S MODERN METHODS
FORM 180 W

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Dragline at the Crab Orchard pit, AMAX Delta Mine.

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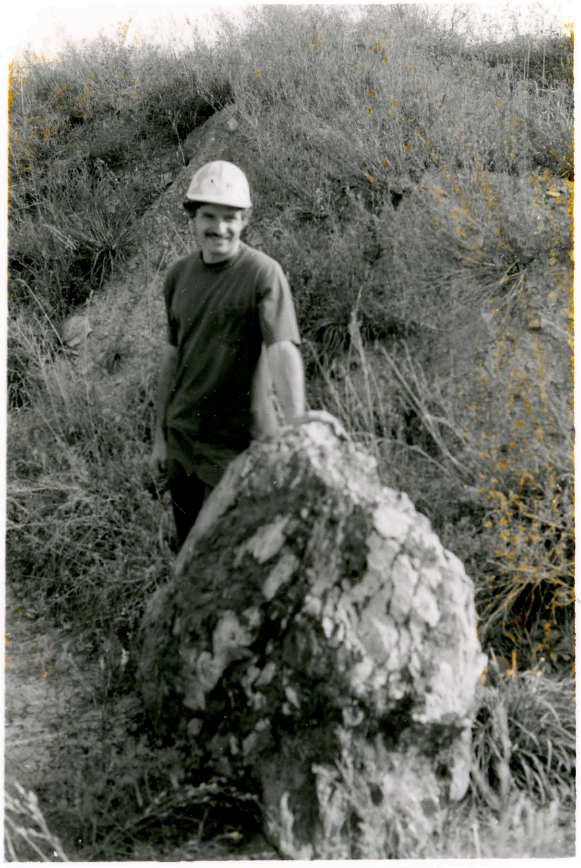
Dragline at the Harco pit, AMAX Delta Mine.

Photo of the small fault exposed along the haulage road into the Harco pit. Thin coal seam, possibly Danville (No. 7), displaced by a minor reverse fault. C.J. Nelson in photo taken by Brian Trask.



Large block of coal, full of coal balls, found alongside haulage road in reclaimed area east of Crab Orchard pit. According to AMAX personell, such coal balls occasionally cause problems in mining. C.J. Nelson posing for scale. Photo by Brian Trask.

Closer view of the mass of rock from previous view, showing intergrown coal balls (light colored) surrounded by compressed and contorted bands and stringers of coal.

John C. Moore Corporation, Rochester, N.Y. 14604
MOORE'S MODERN METHODS
FORM 180 W

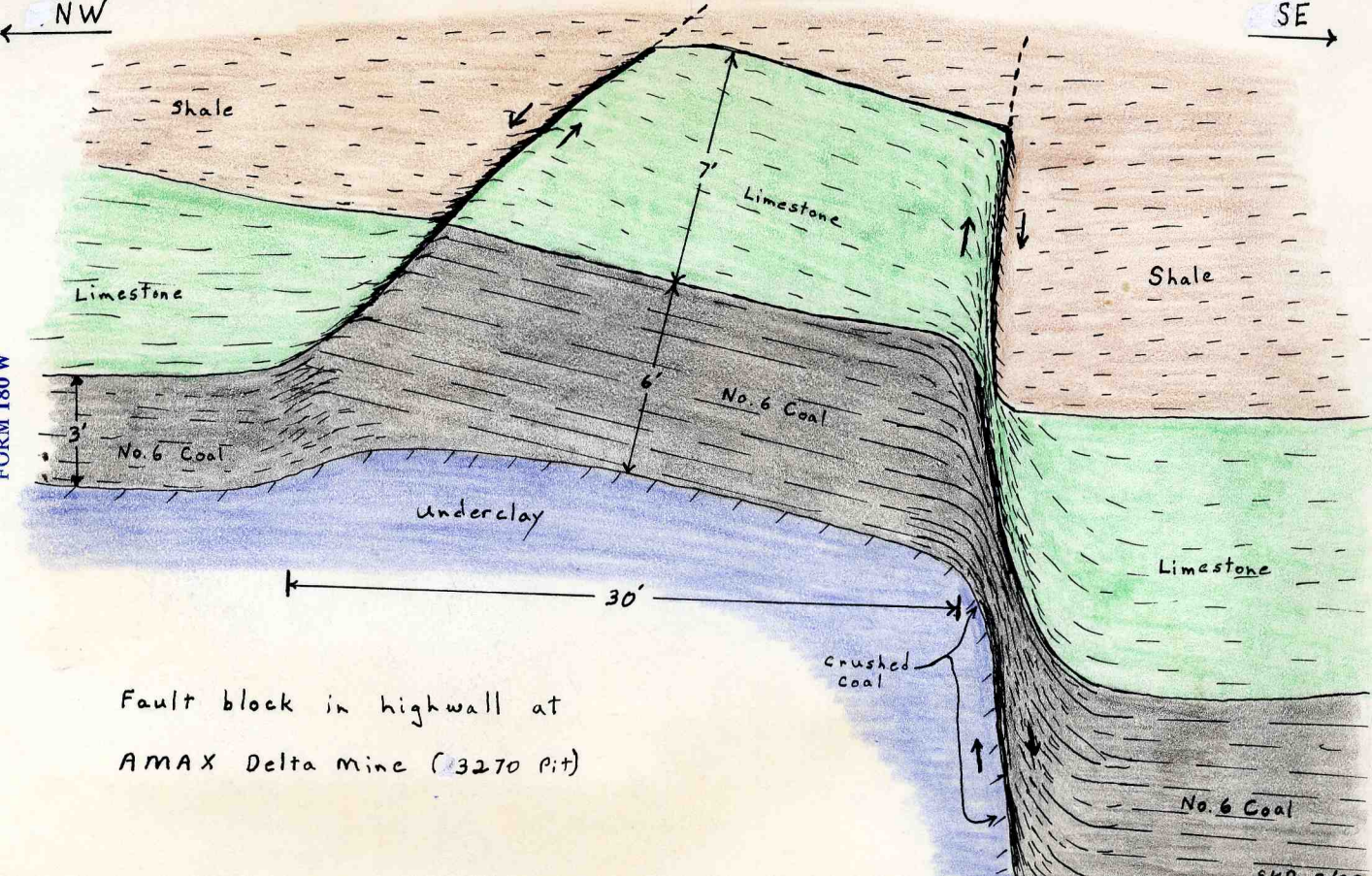
AMAX COAL CO. Saline County
DELTA MINE 3/15/83
Harco Pit (3270 pit)

Notes by Steve Danner on a visit with John Nelson to AMAX's Delta Mine. We were invited by Delta's engineers to see some faults in the highwall of their Harco Pit, the only active Delta pit located in Saline County. George Hargraves, one of Delta's resident engineers was our guide on this visit.

The present highwall is L-shaped because of a box-cut at the southeast end of the pit. The long axis of the pit trends about N15°W, with the box-cut angling to the northeast. Most of the coal has been loaded out so we have a good view of the coal in the highwall.

About 150 yards from the southeast end of the pit we encounter a rather abrupt offset of the Herrin (No. 6) Coal and the superjacent Brereton Limestone. See sketch on next page. A large block of coal and limestone, about 30 feet in length, has been faulted, tilted, and pushed upward. On one end of the horst the vertical offset is about 8 to 9 feet. It appears that this horst is only a small part of a much larger fault block, that continues for another 100 feet or so to the northwest. The fault that bounds the southeast end of the horst also bounds that end of the larger fault block. The coal northwest of the horst is anomalously thin; at 3 feet, it is only half the thickness of the normal coal. The limestone however, maintains its normal thickness. The bounding faults appear to intercept the highwall at somewhat less than 45°. They die out a short distance up in the shale.

One interesting feature of the fault block is the contrasting responses of the rock units to the faulting. Both the limestone and the coal show prominent drag folds on the SE side of the



Fault block in highwall at AMAX Delta mine (3270 Pit)

FORM 180 W

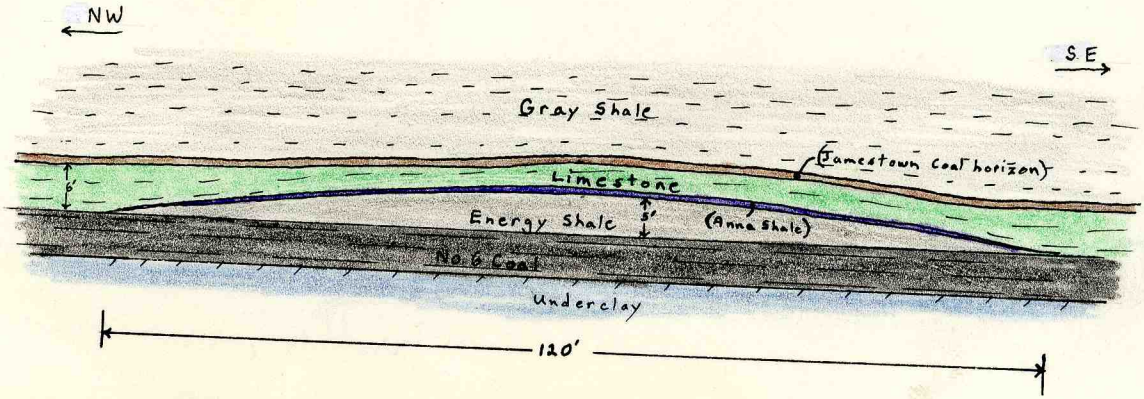
block. In contrast, very little drag folding is evident on the NW side of the block. Strange!

Energy Shale lens. A couple hundred feet SE of the aforementioned fault block is a wide lens of Energy Shale. The lens is about 120 feet wide and 5 feet thick. It is overlain by a thin bed of Anna Shale. This appears to be the only place in the highwall where these two units are present. Everywhere else the limestone lies directly on the coal. See sketch on next page.

There are a couple of subtle features here that may be worth noting. First, the Anna Shale thins outward from the center of the lens and does not extend beyond the edges of the lens. The Brereton Limestone, however, thins towards the center of the lens, where it is only about ½ its usual thickness. Typically the Anna and Brereton tend to thin down over these lenses.

Fault in highwall of box-cut. Several offsets of strata can be seen in the highwalls on both sides of this box-cut. A sketch of one of these faults is included in these notes. The fault is a high-angle, normal fault with about 6 feet of throw. It appears to die out 5 to 10 feet up in the gray shale. There are no signs of drag folding. The gouge zone is about 6 inches wide and contains mostly clay (weathered shale). The fault trends about N75°W. The faults on the other side of the box-cut are similar in the amount of offset, but they exhibit a good degree of drag folding. See John Nelson's notes for more details.

Lens of Energy Shale in Highwall at AMAX Delta Mine (3270 Pit)



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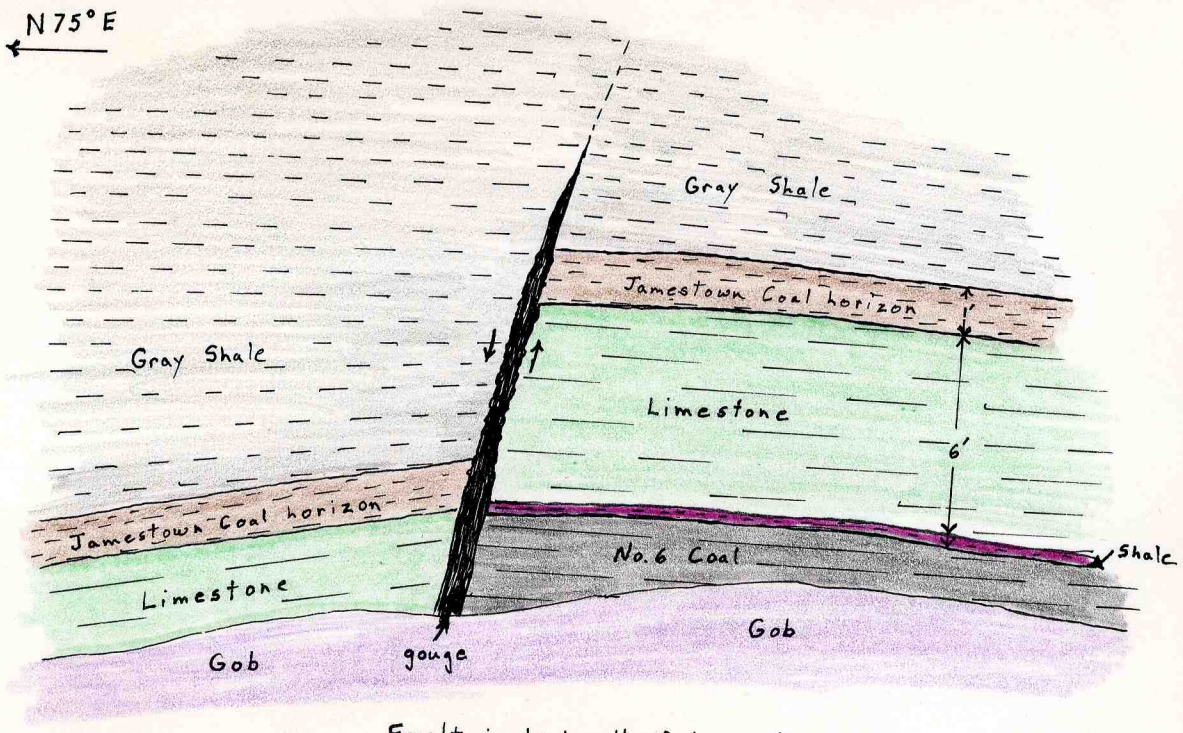


Fault in highwall of box-cut at

AMAX Delta Mine (3270 Pit)

SKD 3/83

AMAX COAL CO. - DELTA MINE. Notes by John Nelson with Steve Danner. George Hargraves from AMAX. March 15, 1983.

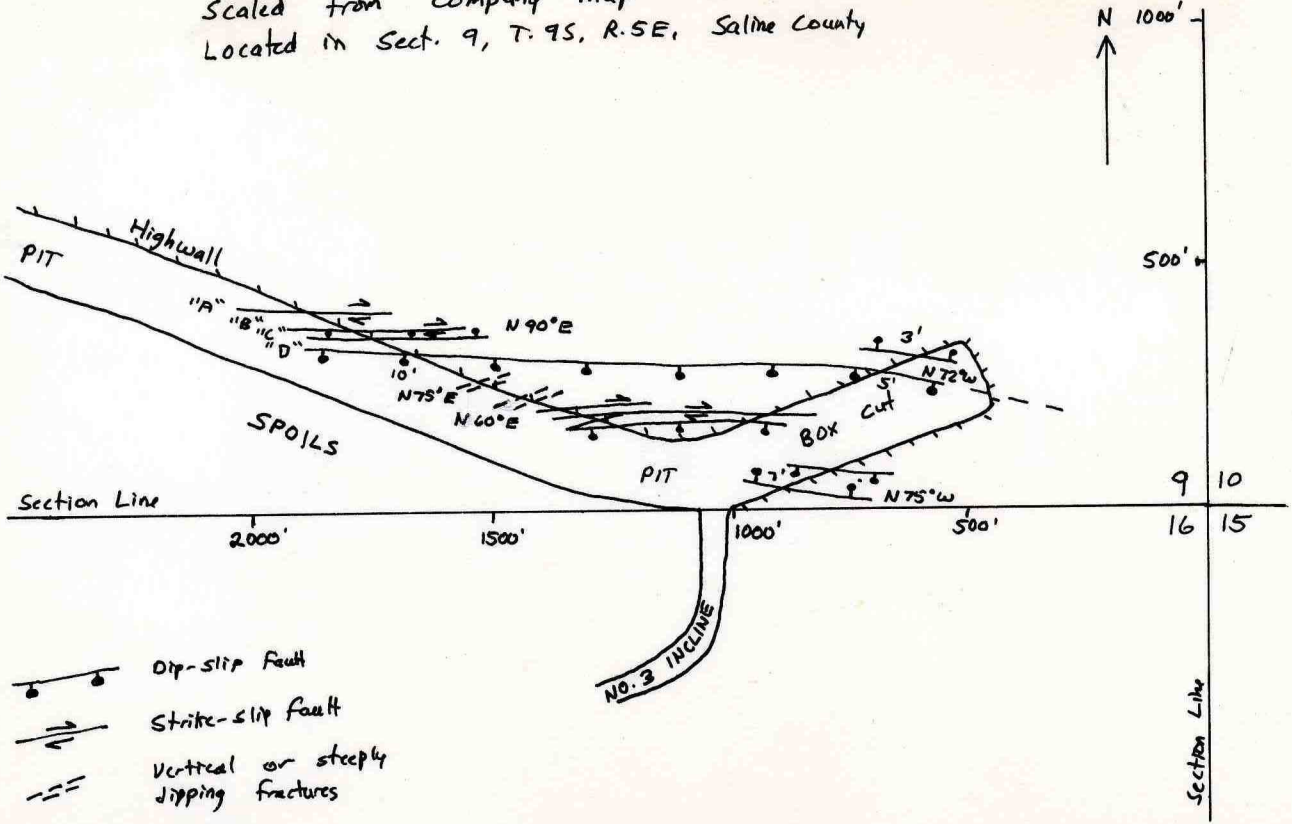
Fault zone exposed in the new "3370" pit. Location of fault exposure: see attached map.

The pit is now roughly 1 mile long, and the highwall trends N 60° W, facing southwest. The main fault zone trends roughly east-west so we see a very oblique view in the highwall. It is a compound fault zone roughly 75 feet wide with a combination of strike-slip and vertical displacement. Overall the coal is downthrown about 10 feet south of the fault.

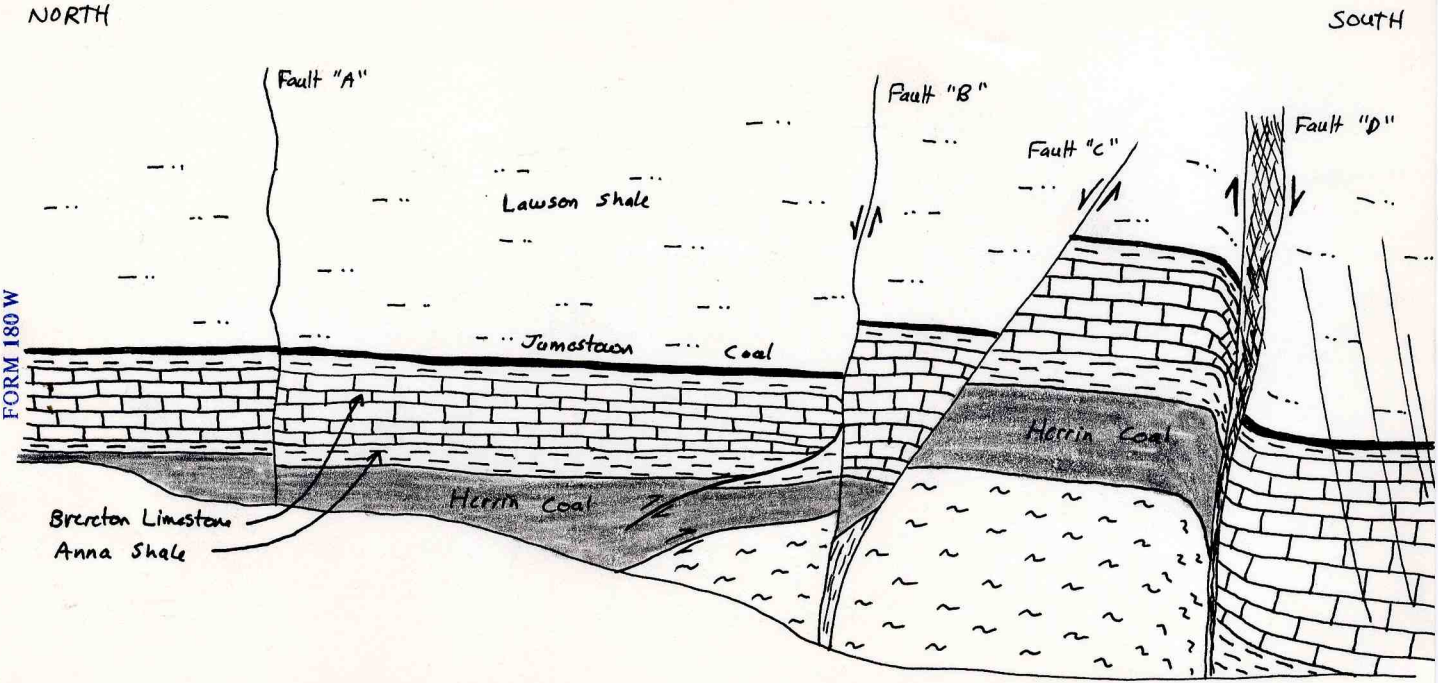
The northernmost fault (Fault A in sketch) is nearly vertical, and the coal is thrown about one foot down to the south. This is primarily a strike-slip fault, as indicated by horizontal mullion and slickensides. Furthermore, the Anna Shale is only 4 inches thick north of the fault, but about a foot thick south of it. The coal and the Lawson Shale are thoroughly fractured south of the fault, and less fractured north of it. North of the fault are large planar vertical fractures in the Lawson Shale (the gray shale or siltstone above the Jamestown Coal).

The next fault (Fault B) also appears to be a strike-slip fracture with nearly vertical, sinuous plane and horizontal mullion. The coal seam pinches out as it approaches Fault B, and it is crushed. There appears to have been horizontal or thrusting movement in this area. There is too much loose debris to get many details.

Map of 3370 Pit and faults
Scaled from company map
Located in Sect. 9, T. 9S, R. 5E, Saline County



Cross-section of fault zone, looking east.



FORM 180 W

Fault C is a normal fault, dipping about 60° north, and it has about 4 feet of throw down to the north. Fault D, the largest break, is nearly vertical, and drops the coal about 10 feet to the south. Slickensides are nearly vertical along Fault D, but the fault has quite a wide breccia zone, and I cannot rule out the possibility of horizontal movements.

South of Fault D are numerous very prominent east-trending fractures that extend nearly the full height of the wall. They dip about 75° southward and curve slightly in dip direction. They show no slickensides or visible offset.

Further south, the orientation changes to N 70° E. Some of the fractures in the Brereton Limestone are lined with coarse calcite crystals - they must have been open. The fractures farther south are oriented N 55-60° E (see sketch map).

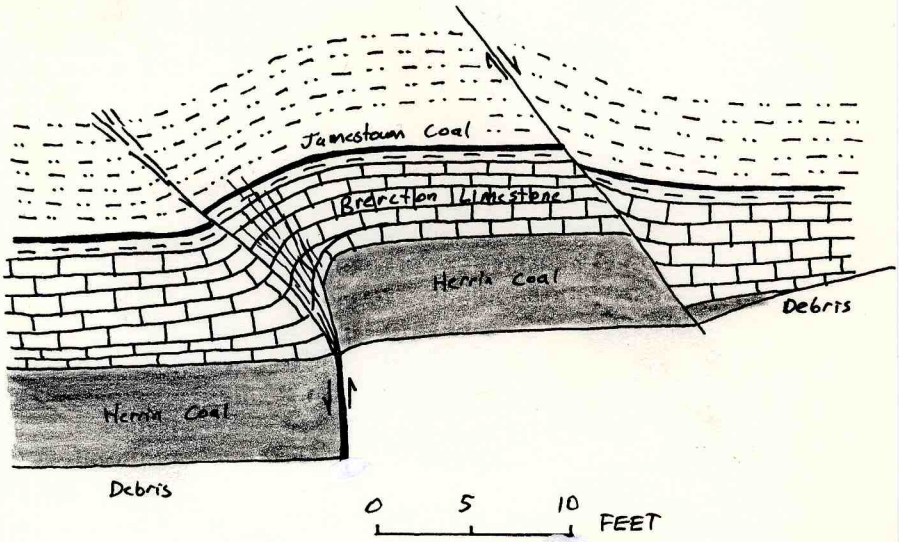
Just west of the base of No. 3 Incline are several faults and zones of highly fractured to crushed coal. The faults trend N 80° E to N 80° W and show both horizontal and vertical slickensides, mainly horizontal mullion indicate dominantly strike-slip movement. The coal dips toward the southeast. This area can be described as a faulted anticline.

East of No. 3 Incline the pit turns to a heading of N 55° E and is coming back across the main fault zone. The exposures are not very good due to loose material and debris, but several large displacements are evident.

Note how both of the faults in this view abruptly die out upwards. On the reverse fault the displacement is dissipated through shattering of the strata, especially the Brereton Limestone, and also through folding of the beds. The throw of the normal fault dies out through folding, creating a monoclinal flexure. The simplest interpretation of this structure seems to be that the narrow slice of rock between the two faults was pushed upward from below.

Sketch of faults in 60x cut
Looking west

S N



The largest fault strikes N 72° W and along it the Herrin Coal is cleanly upthrown about its full thickness (5 feet) to the north. The break in the Herrin Coal is clean and vertical, with some drag and much crushed coal near the fault. As shown in the sketch the Brereton Limestone is shattered along this fault, and the Jamestown Coal is barely offset - a small north-dipping thrust fault of a foot or so, on the south limb of a fractured monocline. This then, appears to be a classic upthrust fault that dies out upward. I believe the strata were pushed up from below, causing a clean break in the lower strata, with the fault dissapating upward.

Interpretation

The faults observed today represent part of the master fault of the Cottage Grove Fault System. In this part of Saline County the master fault is split into two subparallel, east-trending segements, roughly a mile apart. The fault in the Delta Mine is the southern segement. (See map from Circular 522).

Theoretically, the displacement along these faults should be almost pure strike-slip. In fact, there is eveidence for considerable strike-slip movement within the fault zone; however, the magnitude and direction of lateral offset cannot be determined. Primary evidence of strike-slip includes prominent horizontal slickensides and mullion on fault surfaces, near-vertical faults with inconsistent directions of vertical offset, and severe crushing and fracturing of rocks along fractures having inconsequential vertical offset. On fault "A" the abrupt change in thickness of the Anna Shale on opposite sides of the fault also signifies horizontal motion on the fault.

However, a number of the faults show vertical slickensides, and otherwise appear to be the result of dominantly dip-slip movement.

Special interest in these exposures relates to the fact that I have seen the same fault zone underground, in the Springfield (No. 5) Coal in Sahara Coal Company's Mine No. 20, on January 16, 1979. The place where I saw the faults underground was only a few hundred feet east of the box cut at the east end of the 3370 Pit. The Springfield Coal is 100 to 120 feet below the Herrin Coal. In the underground mine, the coal lies level north of the fault zone, but pitches abruptly southward htrough the zone, creating a fractured, monoclinal flexure. The largest fault observed in Sahara No. 20 had 6 feet or a little more of vertical displacement. Most of the faults underground seemed to show vertical, rather than horizontal slip. It is not possible to say that any of the faults observed underground also were seen in the surface mine. There appears to be a rather significant change in the structural pattern between the levels of the two coal seams.

To try to relate these observations to the "big picture", I would say that absence of proof for strike-slip movement on segments of the Cottage Grove Fault System does not negate my idea of overall right-lateral movement being responsible for the system. After all, the driving forces probably were active deep in the earth's crust, and transmitted upward through the sedimentary column, which responded inconsistently to those forces. Indications here, and at many other places along the master fault, are that strike-slip movements at depth formed narrow slices of slivers of rock, which were pushed upward or allowed to subside downward between the walls of the fault zone. Furthermore, I suspect that a large portion of the wrenching stresses were absorbed by creating of the northwest-trending subsidiary faults; the master fault may show only slight horizontal offset in many portions of the fault system.

Monday, November 14, 1983
Visit to AMAX Coal Co., Delta Mine, Williamson Co.
Notes by D. K. Lumm, I.S.G.S.
Field partners: S. K. Danner, W. J. Nelson, I.S.G.S
Guide: George Hargraves, Mining Engineer

Purpose of visit is to examine a thrust fault in the 8750 pit reported by H. H. Damberger on a visit to the mine last week. No other details were given to us.

Thrust fault in 8750 pit. Highwall faces south; pit trends N 80 W. Strip mining by the 8750 dragline is advancing to the west to lengthen the pit and will later proceed to the north. Location of thrust fault is in Sec. ?, T.9S., R.4E., Williamson County.

Strata which have been affected by faulting occur above the Danville (No. 7) Coal which is being mined in this pit. The Herrin (No. 6) Coal is also being mined on a lower bench.

From the bench to the top the strata are:

ered) coal (Danville No. 7), not studied

7.0' shale; olive gray, smooth, very thinly laminated, noncalcareous, nonfossiliferous; with discontinuous limestone beds 0.4-0.5' thick.

1.3' shale; black, smooth, soft, not fissile but platy, noncalcareous, with some plant hash.

.0-2.5' limestone (Piasa); light tan to light brown, weathers gray to yellow brown, dense, fossiliferous (brachiopods and other fragments), folk classification: packed biomicrite. Dunham classification: wackestone.

6-8' sandy shale: not examined at close hand.

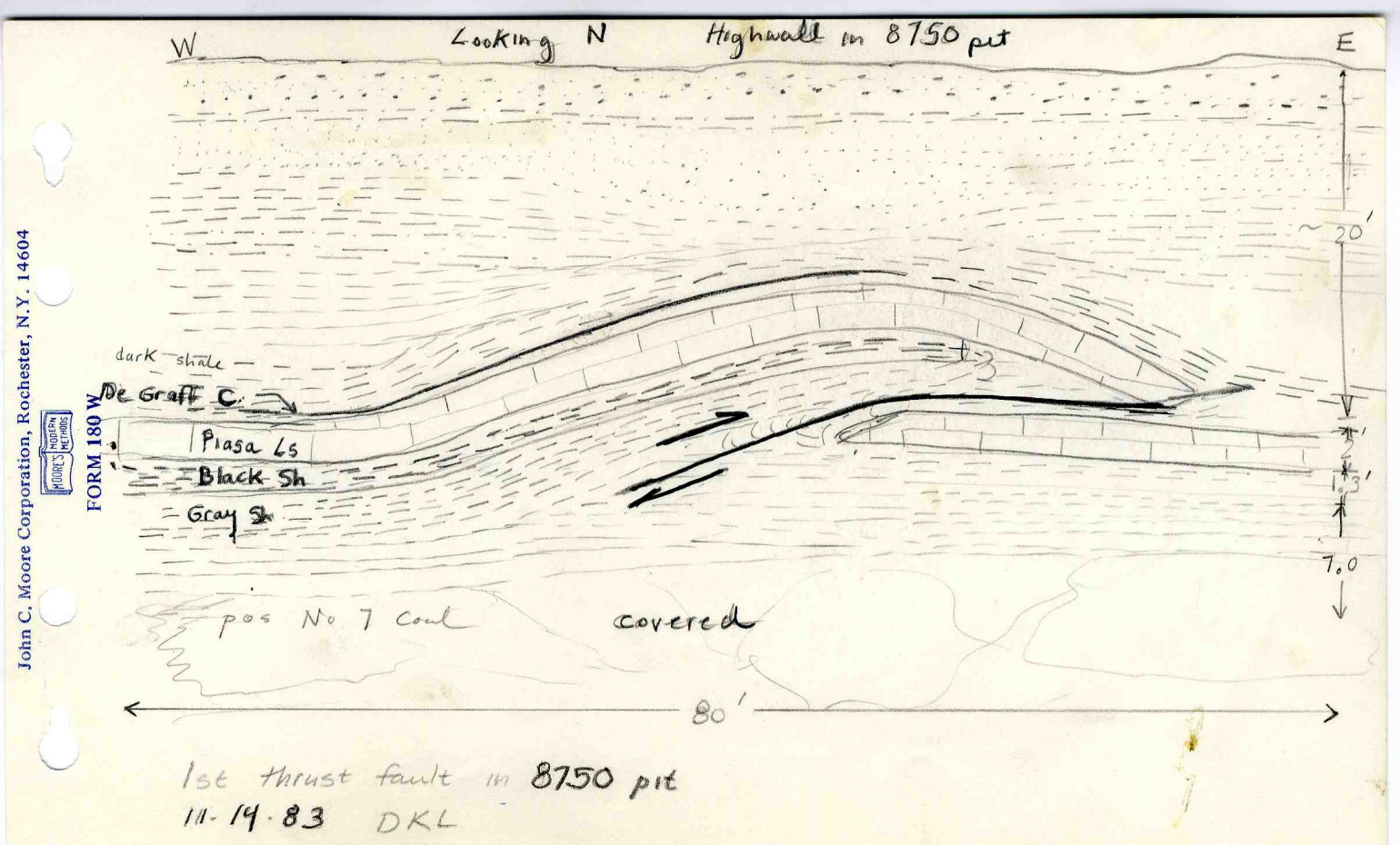
12-15' sandstone: not examined at close hand.

Vertical offset is measured at 5.3 feet. Depending upon one's perspective the fault trends N 10 E to N 50 E. Also the fault plane dips from 10 or 15 W to 47 W.

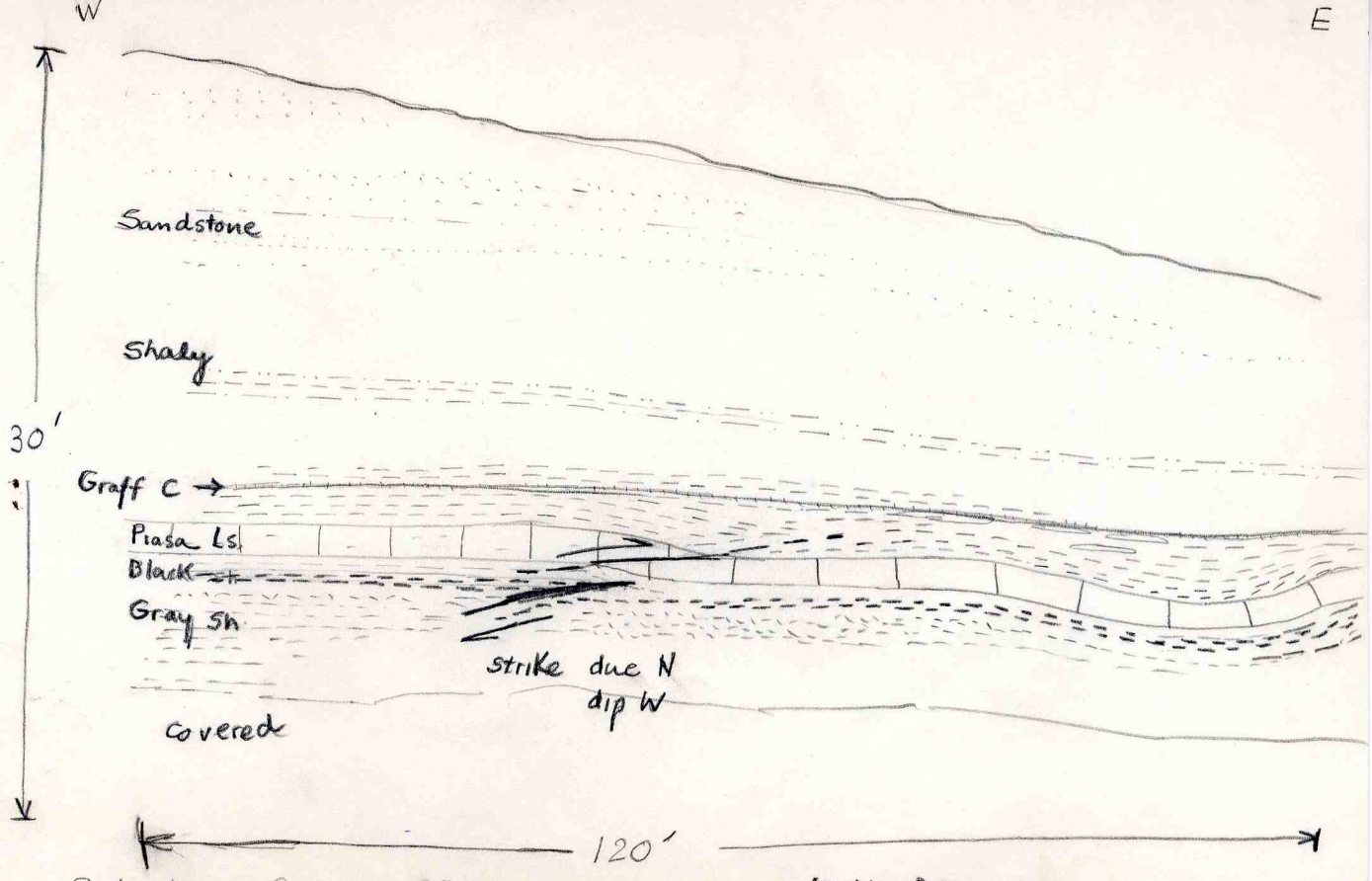
Offset on the Danville (No. 7) Coal is only about 3.0 feet. The fault does not penetrate the entire highwall exposure. See sketch on following page.

Another thrust fault is exposed on the east end of the 8750 pit. See sketch.

See additional notes and sketches by Nelson and Danner. End Visit.



1st thrust fault in 8750 pit
11-19-83 DKL



2nd thrust fault in 8750 pit

4-14-83 DKL

AMAX Coal Company - Delta Mine - Williamson County, Illinois. November 14, 1983. Notes by John Nelson on visit with D. K. Lumm and Steve Danner, accompanied by George Hargraves of AMAX.

Purpose of visit was to examine thrust fault reported by Heinz Damberger on a visit about five days previous.

The fault is exposed on a highwall above the Danville (no. 7) Coal. AMAX has recently begun strip-mining this seam, in conjunction with the deeper Herrin (No. 6) Coal, in the pit west of the big right-angle bend of Highway 13 in eastern Williamson County. The coal is said to range from 18 to 24 inches thick where mined, but no clean exposures were available at the time of the visit. The highwall on which the fault is visible runs east and west, and faces southward. We did not obtain the exact location, but the fault is less than ½ mile west of the northern bend in the highway, which would place it in the SE¼ or SW¼, SW¼ NE¼ Section 14, T. 9S, R. 4E.

The fault definitely is a reverse fault (see sketches), with the west side upthrown, but I was unable to determine the direction of strike. The vertical offset in the Danville Coal apparently is slight, and movement of heavy equipment has erased the trace of the fault on the pit floor in the underclay. No faults are visible in the pit dug down to the Herrin Coal, about 150 feet south of the No. 7 highwall, and parallel with it. My best estimate is that the fault strikes southwest, or possibly due south.

The displacement is greatest at the Piasa Limestone, which is offset more than 5 feet. The fault abruptly flattens upward and is nearly horizontal where it cuts the DeGraff Coal, about 1 foot above the top of the Piasa.

Beyond this the fault appears to merge with the bedding of the shale, and it cannot be traced into the sandstone that is the uppermost bedrock unit on the highwall. The overlying Pleistocene materials have been scalped, and are too badly disturbed to show any trace of the fault - if it exists, which it probably does not.

Most peculiar is the fact that the fault dies out downward as well as upward, showing less than 2 feet of offset on the Danville Coal. The coal was covered by talus and we had to dig back to find the fault. The apparent dip of the lower part of the fault surface is about 50 degrees. If it extends farther down it has little or no vertical offset and was not recognized on the highwall above the No. 6 Coal to the south. It is entirely possible that the dislocation is confined to strata between the Danville and DeGraff Coals.

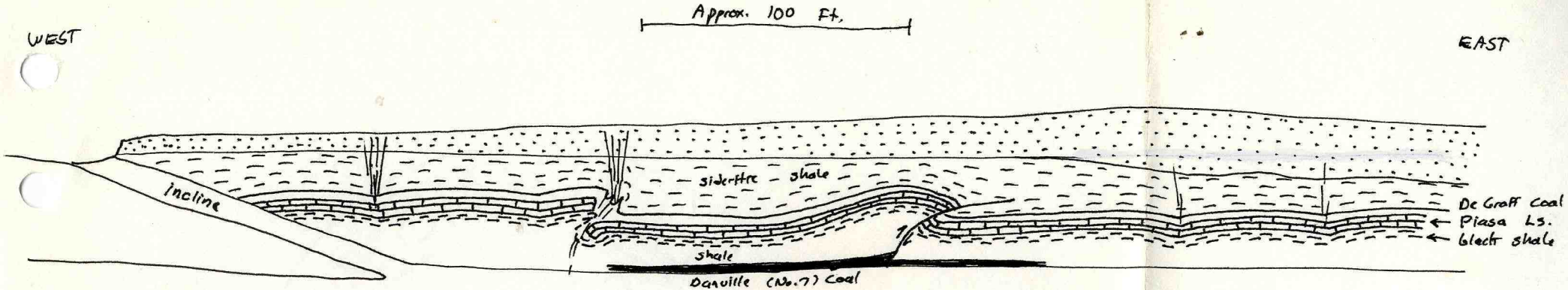
The geometry of the fault indicates that it formed either by horizontal compression or by upthrusting. The latter seems unlikely as in the case of an upthrust, one would expect the displacement to increase downward rather than decrease. However, we cannot rule out the possiblity of oblique or strike-slip motion that would create the illusion of inconsistent offset at different levels on the fault. I am more inclined to believe that this structure is the product of horizontal compression similar to the numerous north-trending thrust faults that have been observed in underground mines of this district, and apparently related to the modern compressional stress field of the southern part of the Illinois Basin. We need a more definitive exposure to resolve this question.

Other ambiguous structural features are visible along this same stretch of highwall. About 100 feet west of the thrust fault is what appears to be a west-dipping high-angle reverse fault on which, again, offset is greatest at the Piasa Limestone and diminished both upwards and downwards. Close examination of this feature, however, suggests that it may have been produced by blasting (there is a shot hole adjacent to the "fault"). Also seen are several small sharp synclinal dips in the strata, both east and west of the thrust fault. Vertical fractures are found along the axis of these dips. If they are tectonic they suggest a compressional force; but again we cannot rule out blasting in their origin.

Near the eastern end of the pit (SE¼ SW¼ NW¼, Section 13) are two low-angle thrust faults that definitely are natural and not caused by the use of explosives. One has a heave component of about 10 feet and dips westward at a very gentle angle. The measured attitude of part of the fault surface is N-S/ 18 W; in most places the dip is less than 18 degrees. The main visible offset is in the black shale beneath the Piasa Limestone, and in the limestone itself. Horizontal slippage in the overlying and underlying shales is evidenced by zones of sheared contorted and crushed shale along the fault zone.

A smaller reverse fault nearby dips about 38 degrees to the west and visbly affects only the black shale below the Piasa Limestone, causing an apparent doubling of the shale's thickness.

I have little doubt that these faults are true compressional structures, and probably they are the product of the modern stress field. Unfortunately, they cannot be traced into Pleisocene deposits, so we have no opportunity to determine whether the movements actually are post-Pleistocene.


Approx. 100 Ft.
WEST
EAST
incline
siderite - shale
De Graff coal
Piasa Ls.
Glecht shale
shale
Danville (No. 7) Coal

Thrust fault on highwall of Delta Mine. Dark shale below Piasa Limestone shows the thrusting most clearly; the west (left) block having been pushed up and over the eastern block.

Closer view of the same.

Smaller thrust fault near eastern end of pit shows the same relative sense of movement. The dark shale is immediately below the Piasa Limestone.

AMAX Coal Co. 11-14-83
Delta Mine Williamson Co.

Notes by Steve Danner. Accompanied by John Nelson and Don Lumm (ISGS) and George Hargraves (AMAX). Purpose of visit is to see a thrust fault above the No. 7 Coal in the 8750 Pit.

AMAX has begun mining the Danville(No.7)Coal along with the Herrin (No.6) Coal in their 8750 Pit. The No. 7 Coal is reportedly 1.5 to 2.0 feet thick in this pit, but at present there are no good expesures.

The thrust fault we came to see is clearly exposed in the south-facing highwall. There is a sketch of the fault on page 3 of these notes. The maximum vertical offset on the fault is only a little over 5 feet. Only the Piasa Limestone and the beds immediately above and below appear to be disturbed. The fault peters out in the shale above the DeGraff Coal and in the shale between the black shale and the No.7 Coal.

There is a smaller thrust fault near the east end of the 8750 Pit. The vertical offset on it is only about 2 feet.

An interesting feature of both faults is that the shales appear to have folded under the lateral compression while the limestone shattered Hence, the limestone must have been moderately lithified at the time of faulting. East of the larger fault, the limestone and shale beds undulate gently for several hundred feet.

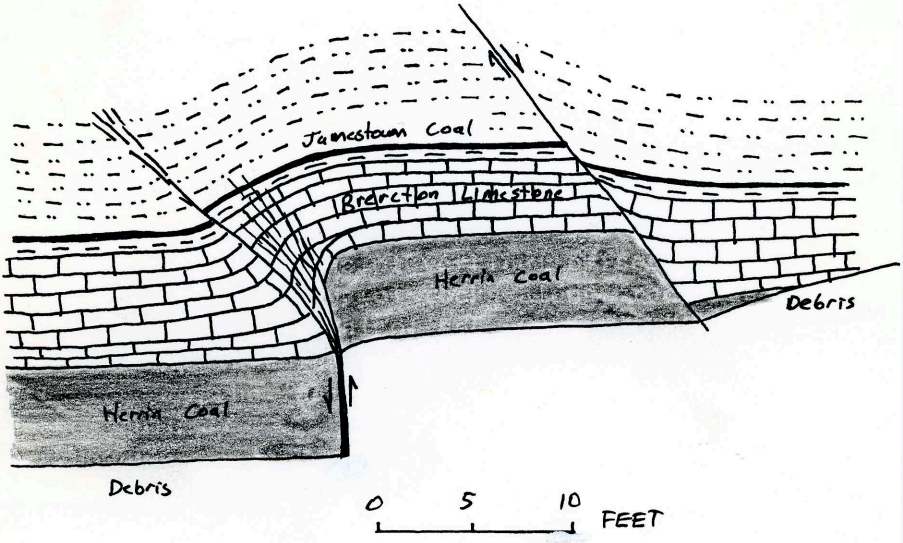
The following is a description of the highwall in the vicinity of the faults. The thicknesses of the upper strata are estimated.

Note how both of the faults in this view abruptly die out upwards. On the reverse fault the displacement is dissipated through shattering of the strata, especially the Brereton Limestone, and also through folding of the beds. The throw of the normal fault dies out through folding, creating a monoclinal flexure. The simplest interpretation of this structure seems to be that the narrow slice of rock between the two faults was pushed upward from below.

Sketch of faults in 60x cut
Looking west

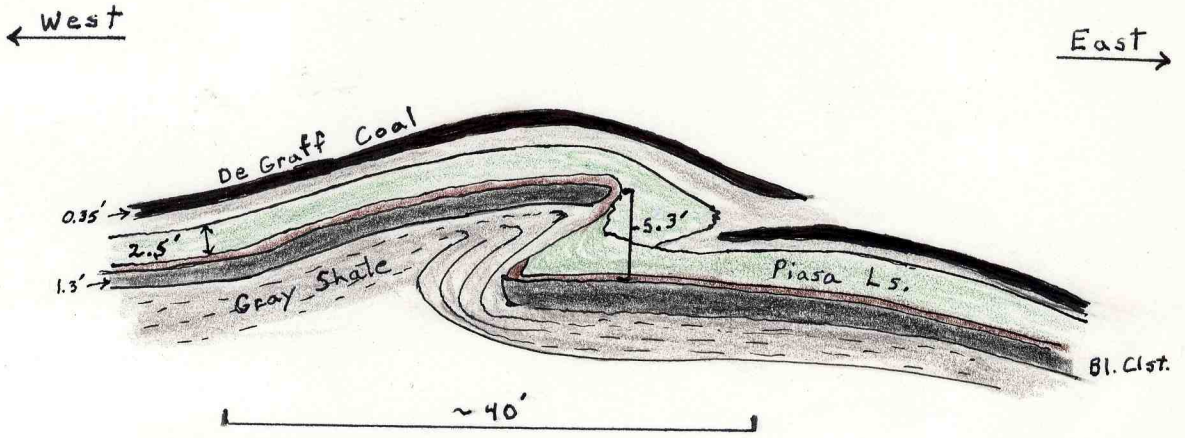
S

N

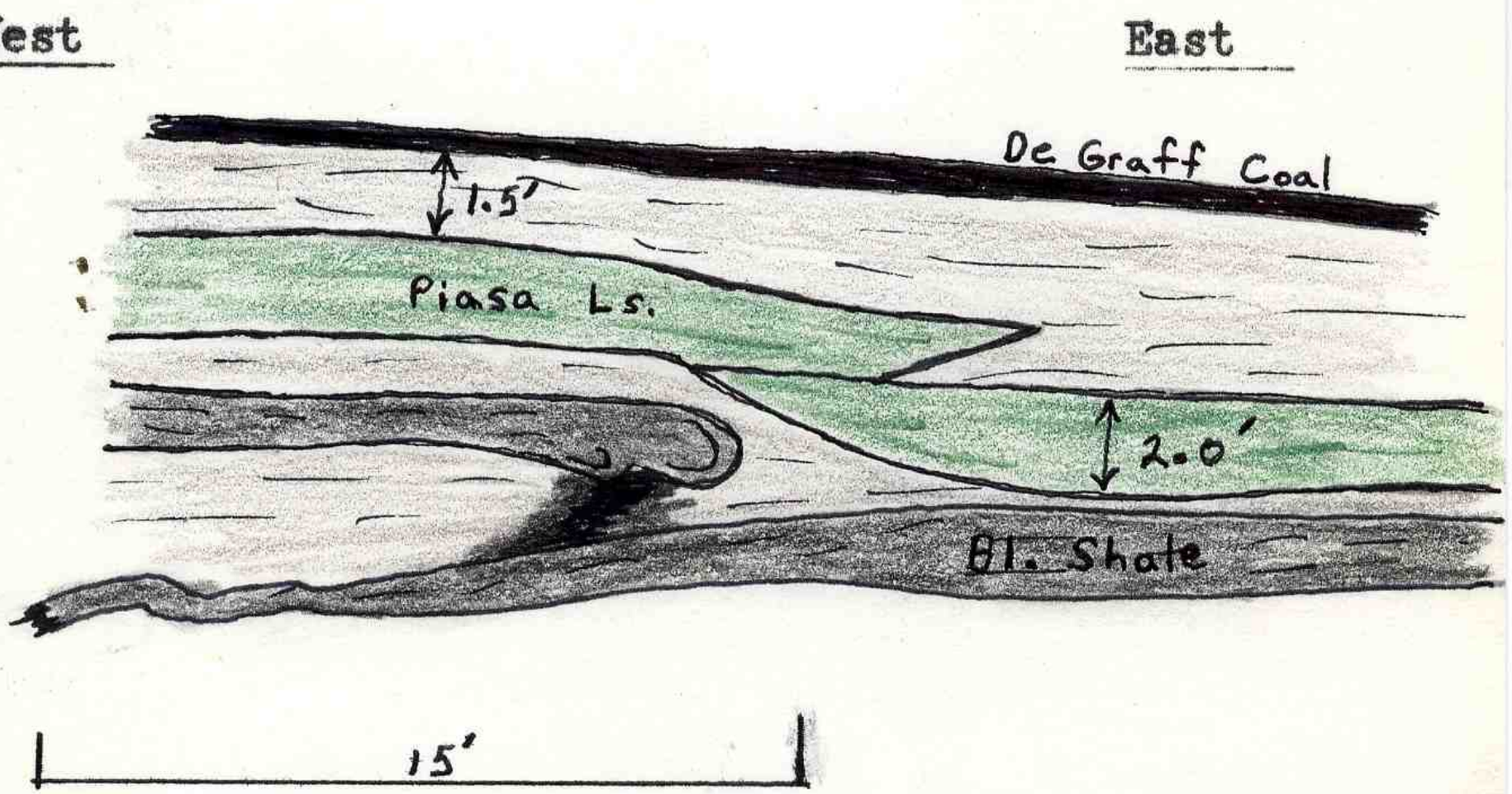


Top of section.

2 to 3' - Unconsolidated materials (alluvium).
2' - Sandstone: light brown to golden and orangish-brown; well-laminated, very micaceous.
12 - 15'- Shale: medium to dark gray; mid-hardness; well-bedded.
0.4' - Coal:(De Graff) N.B.B., blocky.
1.5' -,Claystone: medium gray, slightly shaly; friable; contains thin limestone nodules.
2.5' - Limestone:(Piasa) mottled greenish-brown: hard; well-cemented fossil hash; single bed.
0.5' - Claystone: mottled black, gray, and green soft and friable.
1.3' -,Shale: dark gray to black; well-bedded; fissile; chippy parting.
7' - Shale: olive-gray; moderatley soft; well-bedded; fissile; contains thin limestone nodules.
1.5-2.0'- Coal:(No.7) covered.



Thrust fault in the 8750 Pit at AMAX's Delta Mine



Small thrust fault near east end of 8750 Pit at AMAX's Delta Mine.

Delta Mine
April 8, 1986
Notes by Richard B. Winston. Visited mine with Chen-Lin Chou.

Purpose: Collect 1 channel and 1 column sample for coal-cleaning studies.

C.-L. Chou has a map showing the locations of the channel and column samples.

Description of coal at site of the channel sample of Herrin #6 Coal:

Top Lithotype	Thickness in Feet
SBBC	.25
Shale	.05
SBBC	.22
Fusain	.03
SBBC	.14
Fusain	.03
BBC	.15
SBBC	.75
Shale with pyrite nodules	.08
BBC	.30
SBBC	.27
Bone Coal	.04
SBBC	.30
Bone Coal	.04
SBBC	.23
Bone Coal	.02
SBBC	.18
SBBC and bone coal finely inter-laminated	.14
BBC	.13
Shale - sample taken by C.-L. Chou	.10
BBC	.13
Fusain	.04

Delta Mine (Continued)

Top Lithotype	Thickness in feet
SBBC	.18
Shale, partly pyritized - sample taken by C.-L. Chou	.15
SBBC	.35
Shale, partly pyritized - sample taken by C.-L. Chou	.10
SBBC	.09
Shale	.07
SBBC	.19
Bone Coal	.11
SBBC	.52
Underclay	
	5.38'

Measured thickness of coal = 5.4'
Discrepency = 5.4' - 5.38' = 0.02'

BBC = Bright banded coal
SBBC = Subbright banded coal

Highwall Description

Because the highwall was unstable, no close examination was possible. Consequently, both the lithotype identifications and their thicknesses are estimates.

Top Lithotype	Thickness in feet
Sandstone, grayish green, shaley	5
Coal	1
Underclay	3
Sandstone, massive	5

Delta Mine

Top Lithotype	Thickness in feet
Siltstone	7
Shale, light gray	25
Shale, dark gray grading down to light gray, sharp upper contact	15
Coal, Herrin #6	5

I thought the shale above the coal was Energy Shale; C.-L. Chou thought it was Anna Shale. Chou collected a large block of this shale from just above the coal which Phil DeMaris has identified as Anna Shale. A sample I collected from 5' above the coal was light gray in color and showed less fissility than is typical of the Anna Shale I have seen. The miners report that coal nearby had less than 2% sulfur and that at the site where we collected the sample it was 2.37.

Column Sample of Herrin #6 Coal

Total measured thickness - 5'2" = 5.17

Blocks were numbered from the top down.

Top Block Number	Thickness in feet
1	0.30
2	0.27
3	0.34
4	0.32
5	0.29
6	0.40
7	0.24

Delta Mine

Top Block Number	Thickness in feet
8	0.17
9	0.34
10	0.10
11	0.19
12	0.28
13	0.20
14	0.09
15	0.13
16	0.07
17	0.31
18	0.32
19	0.58
20	0.27
Total	5.21

Discrepency = 5.21' - 5.17' = 0.04'

At the site where the column sample was collected, the shale above the coal was dark brown in color and appeared to be Anna Shale.

We were never asked to register or sign a release at this mine, nor were we given "hazard training".

Mine originally operated by: (1)

Date

Original name or number:

p.

OPERATORS

perator Name or No.

2-10-1987 17 0

Mine head predicts 20-year operation

By Larry Davis
Of The Southern Illinoisan (-j)

AMAX Coal Co.'s Delta Mine near Harrisburg has enough deposits to keep it operating for "roughly 20 years," the mine's general manager said Tuesday.

Dan Hunter briefed members of the Marion Chamber of Commerce on the mine's operations at the chamber's monthly luncheon meeting at the Holiday Inn. He said he calls the 12,000-acre mine site in Williamson and Saline counties his "sandbox, because we play in it every day."

Hunter went into detail about the day-to-day operations at Delta, including a description of the massive equipment used to remove coal from a surface mine in Williamson County and a drift mine that AMAX opened last fall in Saline County.

The current pit at the surface mine is two miles long, and the dragline used to scrape layers of dirt and rock from above a coal seam has a capacity of 176 cubic yards.

"It's a lot of fun," Hunter said, "and we try to make it fun. But we couldn't do it without our skilled labor force."

The mine has about 220 employees, including some 45 office and supervisory personnel, he said.

A competitive coal market means that AMAX stresses cost effectiveness and encourages "ideas from everyone in the work force," Hunter said.

"The price of coal has dropped considerably," he said, noting the drop on the spot market to a current price of $18 or $19 a ton from a mark "in the mid-30s" a few years ago.

The firm has been able to increase productivity by listening to the workers who operate its machinery, he noted.

The surface mine is expected to produce between 1.5 million and 1.7 million tons of coal this yea: Adding an expected half million tons from the drift mine gives the operation an annual capacity for about 2.2 million tons of coal.

Hunter said the mine can process about 7,000 tons of coal on each shift. Most of it is sold to utility customers in Illinois, with other customers in Indiana, Michigan and Wisconsin AMAX sells about 1.2 million tons of coal each year to Central Illinois Public Service Co., Hunter said.

He said the coal market has improved somewhat recently, "and we've taken advantage of that." The firm has begun operating a secondary machine on the third shift.

Hunter fielded a wide range of questions from chamber members, including queries about coal exports, acid rain legislation and the company's recent decision to close its reclaimed land to hunters and fishermen.

Although a brochure he distributed notes that Delta ships coal to Japan, Hunter said exporting is currently "very very iffy," because of competition from such nations as Colombia and Australia.

On acid rain legislation, he said, "I think it's going to happen sooner or later. To what degree, I don't know."

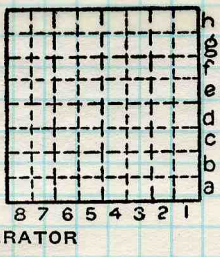
He foresees purchases of coal from outside Illinois, installation of scrubbers, or the use of a mix of products as the options available to utilities.

Delta
Williamson Cty

#5

ndoned

Coal No.



Sec.

T. N. S.

R. E. W.

Index. No.

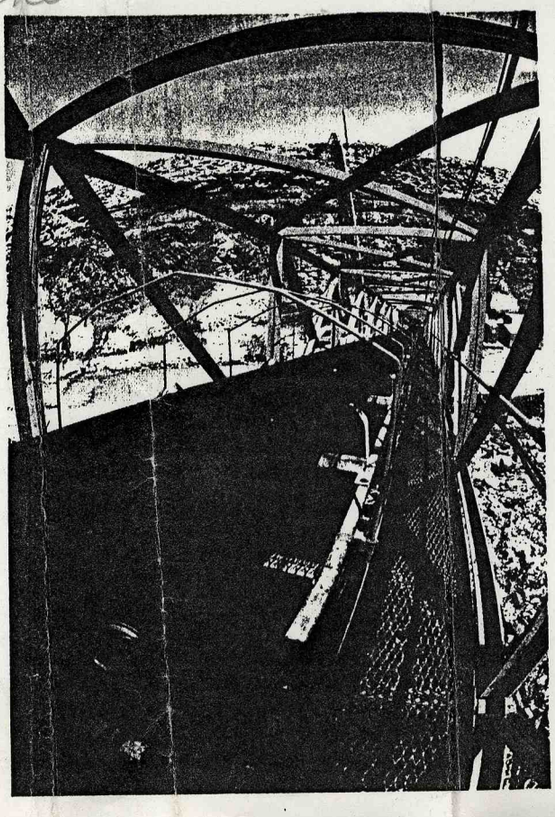
COAL MINE OPERATOR

(92753—1M—6-54) 2

See Saline Cty 95 SE Sec 9 Harco mine

Amax Takes Its Delta Surface Mine Underground

(9/87) move to Saline Co.



Amax Coal Co. has brought new life to a former section of its Delta surface mine near Harrisburg, Ill., by punching entries into the highwall to form a 500,000-tpy underground mine.

Delta's mined-out Harco section has been transformed into the company's first highwall mine. If the mine succeeds, as Amax expects it will, the company might create other underground mines when surface operations reach their economic limits. At Harco, surface mining stopped when the overburden to coal ratio reached 24.27:1.

Amax executives are convinced they have found a way to make highwall mines cost-effective alternatives to surface operations. They say they have minimized construction costs by punching into a highwall at the level of the coal seam.

L. Max Cooper, director of underground operations development at Amax Coal Co., Indianapolis, Ind., estimates that the capital cost of developing Harco with surplus and rebuilt equipment was half that of developing a similar mine with new machines. He emphasized that his estimate does not even include the fact that Amax did not have to build a preparation plant or loadout dock for Harco, but could share these units with the section of Delta still operating..

"The story here is about a greater utilization of existing assets, allowing us to be more competitive in the marketplace," Cooper said.

Amax uses Harco coal to supplement coal mined at the nearby Delta surface operation to fulfill Illinois utility contracts. "It's all the same specification coal," said Amax spokesman Jeffrey Weber. "We don't have a Harco pile and a Delta pile."

Harco is only the second underground coal mine Amax has opened since it entered the coal business in 1969 with its acquisition of Ayrshire Collieries. It opened the Wabash mine, near Keensburg, Ill., in 1973.

Amax expects Harco to produce at capacity for 10 years. The coal as mined is rated at 11,500 Btu with a sulfur content of 2.5%, ash content of 9.5% and moisture content of 9.8%. The mine is now at full production with two active mining sections and 90 employees.

By opening drift entries in the highwall, "we have brought renewed life to a coal seam that we otherwise would have abandoned," said Weber. "We're at coal level so we don't have the cost of sinking shafts [or slopes to the 100-ft-deep coal seam]. If we had had to start this mine from scratch and sink a shaft, it wouldn't be here."

Amax is convinced it got a good deal in buying used and rebuilt equipment. Only two machines, Harco's Eimco (formerly NMS Marietta) continuous miners, are new. Two rebuilt Stamler feeders, two rebuilt Lee-Norse double-boom TD2-34 roof bolters and six rebuilt Joy shuttle cars were received after Amax traded used equipment for the rebuilt machines in transactions with companies such as MAT Industries, of West Frankfort, Ill., and Marathon, of West Virginia.

Three Unitracs, all the conveyor belting material, the main mine fan and all of the underground electrical distribution system came from Castle Gate Coal Co., a subsidiary of Amax, Inc., in Utah.

A radial stacker was bought for a moderate price for Harco's 13,000-ton storage pile, along with some underground supply cars, from J & R Coal Co., a nearby underground operator that had recently gone out of business.

"I would encourage other companies to consider using used equipment," said Cooper. "If they choose that direction, they need to know what they're buying, and that they're dealing with reputable firms such as Marathon and MAT Industries." Harco's main mine surface substation, office trailers and

Jeffrey Trewhitt, McGraw-Hill World News, Chicago

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7
8
9
10
11
12
13
14

*Also owners #See ownership sheet

Railroad, Wagon, Strip, Idle, Abandoned

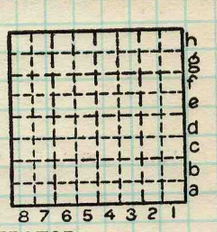
IDENTIFICATION

County No._____ Coal No.

Coal Report No._____ ☐

Quad.

County



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COAL MINE OPERATOR

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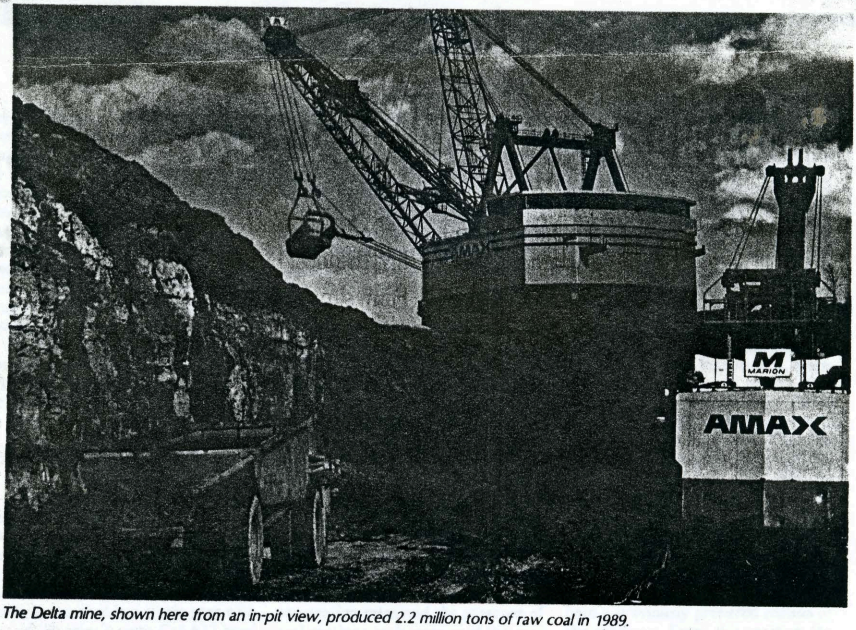


The Delta mine, shown here from an in-pit view, produced 2.2 million tons of raw coal in 1989.

DELTA MINES FROM STRENGTH TO STRENGTH

Twin-bench casting, operator training and spoil-side stripping have greatly increased equipment utilization and coal production

It must be the goal of most mining companies to take a highly successful mine and make it more so. This is exactly what has happened at Amax Coal Industries' Delta operation when management embarked on a three-stage improvement program.

Three years ago, the mine started to use the twin-bench casting system, whereby blasting is used as an aid to stripping a large portion of the overburden. Towards the end of 1989, Delta sent all of its stripping operators on a dragline-simulator training course, and by the mid-1990s the mine expects to be converted to a spoil-side stripping operation.

To date, twin-bench casting and the dragline course have resulted in a 12% increase in equipment utilization and a 3% to 5% increase in coal recovery. Once Delta converts to spoil-side stripping these values are expected to be further improved.

Located 10 miles west of Harrisburg in southern Illinois, the Delta mine began operation in 1934, producing coal from the Herrin (No. 6) seam. Ayrshire Collieries operated the mine from 1946 until 1969, when the mine was acquired by Amax. Today Delta is producing from the lower Herrin (No. 6) seam, which is located an average of 110 ft below the surface, and the upper Harrisburg (No. 7) seam, which lies an average of 30 ft below the surface.

In 1989, Delta stripped more than 30 million cu yd of overburden, processed 2.2 million tons of raw coal and shipped 1.8 million tons of clean coal. The pit, which is oriented in an east-west direction, is 150 ft wide, 11,000 ft long and an average of 110 ft deep. The stripping ratio is 18:1.

Until the mid-1980s the mine operated four large- and medium-sized draglines, but by 1988, the number of draglines had been reduced to two units—a Bucyrus-Erie 3270-W and a

Author information
Peter Darling, technical editor

Marion 8750. After the successful implementation of twin-bench blasting, mine management realized that it would be more cost-effective to boost the productivity of its largest dragline by 12% using additional support equipment, rather than continuing to operate and maintain a second stripping machine. As a result, the Marion 110-cu-yd capacity machine is now on a care-and-maintenance schedule.

The present pit, located in the eastern half of the property, was worked for a short period during the early 1980s; stripping was resumed in 1988.

STANDARD STRIPPING PREVAILS

Despite the new twin-bench casting and soon-to-start SSS, the first two stages of uncovering the coal are standard to virtually every dragline operation in the Illinois Basin. Topsoil, which is between 9 and 12 in. thick, is removed in a single pass with one of the mine's eight Cat 637 bowl scrapers. Removal of the topsoil and its immediate replacement in a site to be reclaimed is ideally conducted in the drier months in an effort to reduce compaction.

The 3.5- to 5-ft thick layer of rooting media, located immediately below the topsoil, is loaded by a tracked Hitachi EX-3500 23-cu-yd capacity hydraulic excavator into end-dump haulers, which dump onto the leveled spoil piles. This phase of the stripping and reclamation operation is also ideally undertaken during dry spells because rooting media is essentially a clay that can create traction problems for wheeled vehicles.

TWIN-BENCH CASTING

Delta was the world's first mine to use the twin-bench blasting method, even though the geology is not ideal for any type of cast blasting (let alone twin-bench casting). Once adopted, the modified method soon proved to increase dragline productivity and to lengthen the life of both drag and hoist ropes. Dan Hunter, the general mine manager, said that economic projections indicated that by using twin-bench casting in two-thirds of the pit, overall productivity had been boosted by 30%. Twin-bench casting has also led to a 20% reduction in bucket maintenance, in addition to permitting the placement of spoil bridges at convenient locations across the pit-void. This reduces scraper travel between the benches and the spoil side.

In its most basic form, twin-bench casting is the blasting of the lower bench into the pit, followed by the blasting of the upper bench. The volume of material actually cast from the upper bench is less than that from the lower bench, but is supplemented by dozers that push the upper bench into the cavity created by the lower bench casting.

Once the pit has been established, the mining sequence follows a logical pattern. After the top soil and rooting material have been removed, the 35 ft of overburden to the No. 7 seam and the 75 ft of parting between the No. 7 and No. 6 seam are drilled with one of the mine's three B-E 61R tracked electric-drills. Due to fluctuations in the depth of the coal, drill operators closely monitor both the penetration rates and the presence of coal cuttings to determine if the coal has been breached. This practice is necessary since blasting beyond the rock horizon results in coal damage and excessive pit dilution.

The 12 1/4-in. holes that are laid on a 28-ft square grid are charged with Anfo or Atlas Powderan/Anfo water resistant slurry and primed with Trojan (EDC) primers. At the moment, Delta is working towards drilling a 13 3/4-in. hole on a 28 x 35-ft spacing. Although this is expected to lead to a 25% increase in the amount of explosives used per hole, the overall powder factor will continue to be 1.3 lb/cu yd, while the drilling effort should be reduced by between 15% to 20%.

The parting is blasted first, with between 20% and 30% of the material being shot into the pit-void. The No. 7 overburden is then shot, sometimes within minutes of the first blast, with between 5% and 10% of the material being cast into the hole left by the preceding shot. Two Cat D11 dozers then push the remainder of the blasted overburden into the pit-void so that the dragline roadway, located 30 ft below the original ground level is, in effect, recreated to allow conventional stripping.

At the end of the stripping sequence the dragline moves 110 ft onto a previously prepared section of the roadway. From this position the dragline starts to dig the combined No. 7 and No. 6 overburden without having to side-bench the No. 7 overburden, as was the case before twin-bench blasting was used.

Essentially twin-bench casting has enabled explosives and dozers to do much of the work of the dragline.

The mine presently employs one dragline—a Bucyrus-Erie 3270-W—plus additional support equipment to enhance total productivity.

Moreover, according to Hunter, the productivity of the dragline itself has been increased from 5,000 to 6,000 cu yd per hour, and the average time required to uncover the No. 7 coal has been reduced from six to two hours.

"Once the decision was made to go ahead with this new and untried mining method, twin-bench blasting very much developed by itself," said Hunter. "Most of the early effort to get the new method off the ground was dedicated to reorganizing a comprehensive scheduling for the support equipment and deciding how far to push the material with the dozers so that we did not end up putting poor spoil at the bottom of the first spoil pile (the buck wall). In the past, this has led to stability problems and the slipping of spoil onto the coal. Not only is this dangerous and leads to the rehandling of spoil or to the loss of coal, but it is easily avoidable by placing the soft clay in designated areas behind the buck wall.

"The only real problem," Hunter continued, "was that the upper bench or walkway had to be made from suitable material because the dragline tended to become bogged down in soft clays—the same ones that occur immediately above the No. 7 coal. It is for this reason that the dragline reaches behind itself on the roadway and takes out a single lift of clay and places it in the gully behind the most recently placed buck wall."

In this way, any failure of the clay will not result in the problem of spoil sliding back into the pit and possibly

Dragline operator course

"Stripping," said Neil Rice, the dragline training supervisor at Southern Illinois University (SIU), "is not just a question of moving dirt from the highwall to the spoil area—it's an art." It was with the intention of perfecting this art that the dragline training program of the Coal Extraction and Utilization Research Center at SIU in Carbondale, Ill., was developed.

Each course, which lasts either one or two weeks, is tailored to the particular operation of the students being taught. With the aid of video tapes, sound slides and reading assignments, the student is introduced to the theoretical background, operational principles and capabilities and limitations of the machines being used. These aspects are then studied with the aid of a mine model, a computer applications model, a concept trainer and a dragline simulator.

The mine model is a three-dimensional, 1:300-scale model of a dragline in its active mining area. The material used in the mine model is a mixture of sand, mineral oil and Oil-Dry. This blend has been designed to swell by 25% when loosened, to settle at an angle of repose of 34% and to form a highwall capable of bearing the weight of the dragline model.

The model is set up to represent the client's actual pit configuration. During the mine model exercise the students use the scale model dragline, which has an adjustable digging radius and dumping height, to mine through a complete stripping cycle. The purpose of the mine model is to emphasize dragline positioning, spoil placement considerations, dragline and mine planning, digging progressions and operational adjustments to account for changing conditions. The mine model is known at the center as the "sand-pit."

Through the use of computer simulators the students become familiar with range diagrams, which show the effects of varying pit dimensions and the digging radius required for changing overburden depths. Dig face analysis familiarizes the trainee with the optimization of the dragline's position throughout the set or move. This part of the course has not been designed to turn dragline operators into computer experts, but to simply enable them to grasp the consequences of altering certain operating or pit parameters.

The computer provides a two-dimensional model that fulfills two important functions: it allows the operators to grasp the ramifications of varying certain parameters such as boom angle, highwall angle and poor pad positioning; and it allows the operators to see how their work fits into the whole plan of events rather than just viewing themselves as the focal point of the mine.

The concept trainer is a 1:50 scale model of a dragline, complete with motorized drag and hoist functions. The trainer is used to familiarize the students with the workings of a dragline and to develop the hand-eye coordination necessary to work the

A 1:300-scale mine model of a dragline in its active area is used as part of the dragline training program at SIU in Carbondale, Ill.

covering some of the No. 6 seam. The gap from where the clay has been taken is filled with material from the key cut. Dozers then level this refilled area so the bench again provides a flat walkway for the dragline.

The area to the north of the pit has been effected by ancient erosion channels that have caused a total washout of the No. 7 seam. In these areas the mining method reverts to a more conventional single-cast blasting system.

SINGLE STAGE STRIPPING

The mine's main stripping tool is a Bucyrus-Erie 3270-W dragline with a 176-cu-yd bucket that is capable of handling 250 tons per load. The 8,750-ton dragline has a boom length of 330 ft, a working radius of 311 ft and a tub diameter of 85 ft. The B-E 3270-W is supplied with 25,000 v and is capable of generating 18,000 hp. As expected, the dragline works 24 hours-a-day throughout the year, except for Christmas Day.

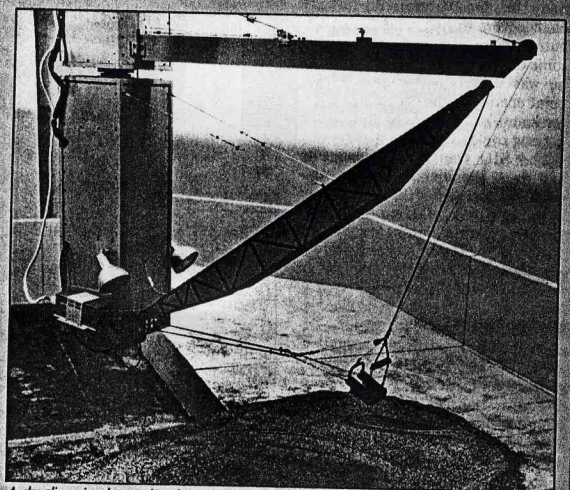
It is interesting to note that the sheer size and weight of the dragline has led to a set of maintenance procedures more akin to a scene out of *Gulliver's Travels* than to a modern coal mine in Illinois. The repair and maintenance of the dragline bucket is a case in point, necessitating the services of a mobile bucket repair shop with dimensions of 30 x 30 x 80 ft. Every six months the dragline bucket is cable-tied to a steel sheet that acts as a sled. Using loaded scrapers (pulling capacity of 40 tons) in tan-

hoist and drag controls. In addition to coordination, the concept trainer is used to impart dragline terminology and to illustrate the basic theory of bucket motion and control.

The dragline simulator was developed by McDonnell Douglas Corp. in 1980 when the company was developing a monitoring system for draglines. By measuring the outputs of the swing, drag and hoist motors against the actual performance of the dragline and the bucket, it was possible to convert the functions of the dragline into a series of resistances. By matching resistance patterns it is, therefore, possible to determine what the machine is doing. By feeding this information into a program via an AT&T computer and interfacing this with the controls of a dragline, McDonnell Douglas was able to produce a dragline simulator.

The simulator consists of a one-fiftieth scale dragline, boom and bucket assembly in a mine setting similar to that of the operator's own property. By changing the input to the computer program one is able to simulate a number of different parameters including size of motors, dragline model and type of material being moved.

The dragline model is controlled from a B-E console, but should the client's mine use a Marion dragline, then the program can be easily changed so that the hoist responds accordingly. In addition to the control link-up, there is a video camera mounted at the base of the dragline boom which projects a full scale image onto a plexiglass screen in front of the operator's console. A microphone and loudspeaker link-up adds to the reality of the simulator.



A dragline simulator, developed by McDonell Douglas Corp., can simulate the type of material to be moved and motor sizes, among others.

The simulator has been designed so that there is a built-in delay, this mimics a dragline where the swing and hoist motors must wait for any inertia to be dissipated before a change in direction is possible. A computer-driven teletype keeps a tally of how many successful operations were conducted, how much material was moved and how much time each operation required.

To date, the clients can be divided into two categories: mining companies that are changing from shovel/truck to dragline stripping operations and operators who wish to improve the performance and utilization of their draglines.

Whatever the specific reasons for attending the dragline course, the underlying factor must be that the dragline is an expensive piece of equipment which must be used to its best advantage. As Richard Erickson, the dragline training coordinator, noted, "The dragline is the pacing item at the mine, and with operating costs ranging from $5,000 to $10,000 an hour, it's easy to see how a productivity boost from 70% to 71% could easily manifest itself as a $0.5 million to $1 million reduction in the year's operating bill. In today's competitive coal industry, this could be the difference between a profit or a loss." □

dem, assisted by D11 tractors on the inclines, the bucket is dragged from the pit to the workshop. Water trucks are used to slick up the surface of the haul roads. The mobile workshop is then positioned around the bucket, one of two owned by the mine. Each bucket has a cutting lip of 21 ft, is 30 ft deep and 15 ft high.

It was as a result of the simulator course at Southern Illinois University (SIU) that the actual stripping operation became divided into five steps. Crew changes now take 3 minutes—the time for the dragline crew to stop the machine and swap places. Gone are the traditional 20-minute changeovers during which time the outgoing operator had to explain in some detail to his relief exactly what he was doing. With the new five-point operation, the oncoming operator knows exactly where he is in the digging cycle.

The SIU course is divided into four parts: the mine model, the computerized range-finder, the concept model and the dragline simulator. Despite certain initial reluctance from the operators, all of Delta's dragline shifts were intermingled and sent on a week's refresher course, which has since proven to be invaluable to the stripping operation. Despite initial skeptism on the part of some operators, one of whom remarked that after 36 years of dragline operation, he "was too old to start playing around in a sandbox," the course was enthustically received by all concerned. The school also provided an excellent opportunity for experienced operators to swap ideas with management on how the stripping could or should be run in the future.

The principal results of the simulator course are to be found in the placement of stable spoil, the consistency of spoil pile make-up and the pattern of operation. This has instilled a sense of camaraderie, rather than rivalry, among the three dragline crews. (See accompanying story on dragline simulation.)

DELTA'S DRAGLINE OPERATIONS

Delta uses five standard stripping positions:

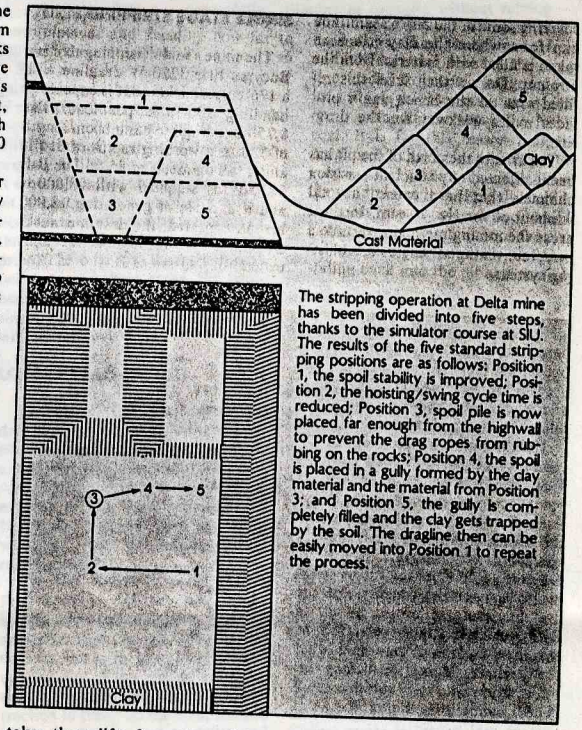
•*Position 1.* In this position, the center of the dragline stands 50 ft from the highwall. The dragline takes three lifts from the end wall and places this spoil in the pit. Soft roadway material from behind the machine is also removed from this position. Placement of this unstable spoil material behind a stable spoil pile improves overall stability.

•*Position 2.* The dragline moves 121 ft (17 steps), at 45 sec a step, away from the highwall and begins the excavation of the key cut. This material is used to build the spoil pile base (or buck wall). The material removed from Position 1 has reduced the hoisting/swing cycle time from this position by allowing the bucket to clear the key cut easily.

•*Position 3.* As the key-cut becomes deeper, the drag ropes will start to drag against the rocks, so the dragline must move between 27.5 and 38.5 ft towards the end wall and 22 ft (4 steps) towards the highwall. This will allow the key-cut to be completed and the No. 6 coal seam to be exposed. The spoil is dumped into the gully formed between the buck wall and the spoil from Position 2. (Before the simulator course, there was a tendency for the operators to stay in this position too long, resulting in the spoil pile not being placed far enough away from the highwall.)

•*Position 4.* The dragline moves five steps towards the highwall before removing at least half of the remaining slice. This spoil is dumped into the gully formed by the clay material and the material from Position 3.

•*Position 5.* The dragline moves six steps towards the highwall, stripping the remaining material from the slice and placing it behind the dome of the last spoil pile. In this way the gully is completely filled and the clay trapped by solid spoil. The dragline then moves to its next Position 1.



The stripping operation at Delta mine has been divided into five steps, thanks to the simulator course at SIU. The results of the five standard stripping positions are as follows: Position 1, the spoil stability is improved; Position 2, the hoisting/swing cycle time is reduced; Position 3, spoil pile is now placed far enough from the highwall to prevent the drag ropes from rubbing on the rocks; Position 4, the spoil is placed in a gully formed by the clay material and the material from Position 3; and Position 5, the gully is completely filled and the clay gets trapped by the soil. The dragline then can be easily moved into Position 1 to repeat the process.

SPOIL SIDE STRIPPING

Management is planning to convert to spoil-side stripping in the summer. The advantages of SSS include less rehandle of spoil, less movement of the dragline (only two steps instead of five) and improved spoil stability. In addition to this, the effective range of the boom can be increased by 20 ft, making it easier to keep the spoil off the coal. Hunter suggested that although there was a possibility of increasing the width of the pit, he was reluctant to do it because, as the pit moves to the north and the overburden depth increases, it would be necessary to continually adjust the pit width.

An additional advantage of converting to SSS will be the ease with which cross-pit bridges can be built without the quantity of rehandling that this process now necessitates.

The current delay in going to SSS is due to a layer of limestone above the No. 6 coal seam. This limestone, which is between 6 and 8 ft thick, is harder than either the shale in the parting or the coal itself. It therefore requires more energy to fracture. Tests, however, have shown that it is very difficult to fragment the limestone without damaging the coal.

To circumvent this problem, Amax has been attempting to break up the limestone with 300 and 350 ms delays in order to reduce coal damage. The shale and limestone form a natural shear plane, however, and when the charges were initiated, the resulting shock wave caused the shale to slip over the limestone and slice through the detonating cord. It was found that 350 ms delays in each charge gave more consistent results.

Despite the temporary setback caused by the blasting problems, Amax has forecasted that the changeover to SSS be successfully completed by mid-1990. Work is continuing on the project.

The only disadvantage of the pit going to SSS is that a certain amount of rehandling of cast material will be required. This rehandling, however, will only involve material that has previously been moved by the dozer. It should be noted though, that as the pit progresses in a northerly direction, the area effected by washouts of the No. 7 seam will increase from the present 25% to 75% during the next two years. In these areas, the twin-bench cast will be replaced with a single-bench cast, and rehandling will be reduced.

LOADING AND LAYOUT

To improve the efficiency of the dragline and to facilitate the task of blending, both seams are stripped and loaded simultaneously; the No. 6 coal is loaded from the endwall just exposed by the dragline, while the No. 7 coal is loaded from the walkway upon which the dragline is currently operating.

The No. 7 coal is loaded into a fleet of 120-ton bottom-dump trucks by two front-end loaders, a Cat 992 and a Cat 988. The coal is friable and does not normally need to be broken up; however, if the loaders are experiencing trouble maintaining enough traction to scoop up the coal, the end loader bucket is used to spike and shatter the coal or a D9L dozer is dispatched to rip it.

The No. 6 coal is loaded by a Marion 182 15-cu-yd shovel. Coal extraction and haulage is done five days-a-week plus one evening shift per week. The aim is to keep the plant running at capacity without relying on surface storage since this involves rehandling of coal and an increase in fines.

There are five main water sumps (capacity of 500,000 gal) along the pit, with any number of smaller temporary sumps (capacity of 100,000 gal) that are dug when conditions dictate. Both temporary and permament sumps are dug in the fire clay below the No. 6 seam, between the edge of the coal and the spoil. In the course of spoil placement, these sumps will be covered up and new ones dug by the dragline.

PROCESSING THE COAL

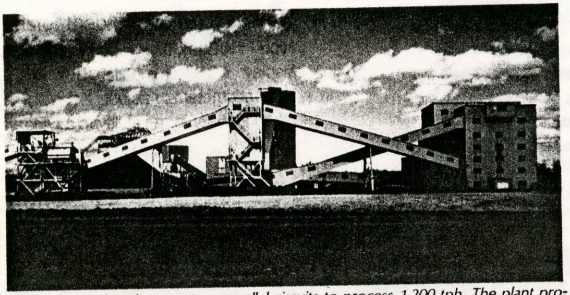
The mine uses 11 Dart bottom-dump (average capacity of 120 tons) to haul the coal the 2.5 to 5 miles (depending if one is at the western or eastern end of the pit) to the plant. The 1,200-tph processing plant, built by McNally-Pittsburg in 1978, features two parallel circuits.

Raw coal passes through a rotary breaker that reduces the material to 6 in. before being divided into two parallel streams, onto the jigs and through a set of screens. Screen oversize (plus 2 in.) passes to a jaw crusher; the mid-range reports directly to the product belt; and the underflow passes through cyclones, a froth flotation circuit, and a vacuum filter unit to produce a fine coal cake. Coarse waste is loaded into trucks, while clean coal reports to the product belt and a 15,000-ton silo or via a 300-ft-long travelling tripper to a 40,000-ton stockpile. There is also a 20,000-ton raw coal capacity stockpile at the processing plant.

Of the 1.8 million tons of clean coal produced in 1989, 90% of it was shipped by rail and 10% was moved by road. Although most of the coal is used for the generation of electricity within a 200-mile radius, some of the coal is shipped as far as Florida.

Fines from the processing plant are pumped directly to a slurry pond while the coarse waste is dumped into permitted areas on either the pit bottom or in gullies purposely left within the spoil dumps.

At Delta, coal blending has become an integral part of the operation to meet consumer requirements.



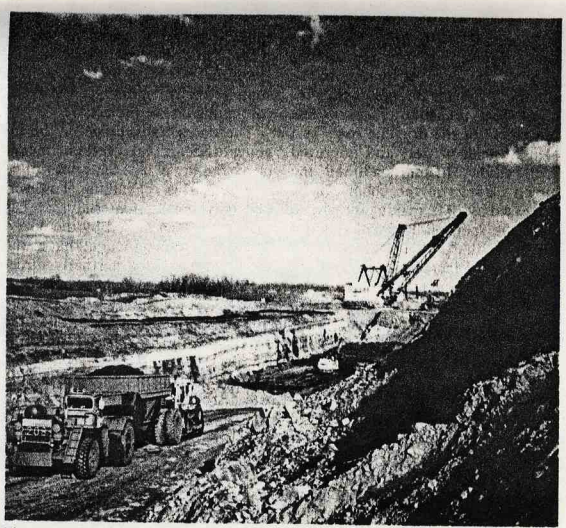
Delta's prep plant features two parallel circuits to process 1,200 tph. The plant produced 1.8 million tons of clean coal in 1989.

One of the advantages of twin bench casting is that both seams are exposed simultaneously, so coal blending can be effected through direct loading, with a percentage blend adjustment being made on a daily basis. At the moment, the mixture ratio is one part of No. 7 coal to three parts of No. 6 coal. The blended coal has been rated at 11,500 Btu per lb, 2.8% sulfur and plus 11% ash.

DIGGING INTO THE FUTURE

There are no significant changes in the chemical composition or physical characteristics of either coal seam as one travels to the north, although the depth of overburden does increase. It is this depth of overburden rather than any other factors that has determined that Delta possesses another 15 to 20 years of potential reserves.

Delta has successfully masterminded three innovative measures in as many years. On the basis of this hat trick, one wonders what rabbit Amax will pull out of thin air next year. □



The mine has a fleet of Dart bottom-dump trucks for hauling coal from the pit to the preparation plant. Truck capacity is about 120 tons.

CYPRUS ISSUES WARN FOR DELTA; HIGH-SULFUR MINE COULD CLOSE THIS YEAR

Cyprus Amax Coal Co. last week announced the possible layoff of 169 people at Cyprus Amax's Delta surface mine in southern Illinois which probably will be closed for good in November.

Cyprus Amax issued a 60-day WARN notice to 138 hourly and 31 salaried employees at Delta, located near Marion. The move was not unexpected. Company officials in Englewood, Colo., cited exhaustion of economic dragline reserves and the impact of the 1990 Clean Air Act Amendments on high-sulfur Illinois Basin coal.

The company said hourly employees affiliated with the United Mine Workers of America will receive severance benefits as specified by the 1993 contract between the union and Bituminous Coal Operators Association. Salaried personnel will receive benefits outlined in company severance policies.

The WARN notice for Delta focused industry attention on Cyprus Amax' contract with Central Illinois Public Service Co. The long-term agreement has delivered significant amounts of coal from Delta to the Newton I power station, which is equipped with a scrubber. However, CIPS has tested coal at Newton I from Cyprus Twentymile Coal's Foidel Creek mine in Colorado. One industry analyst said closing Delta would allow Cyprus Amax to shift the contract to its Colorado mines while allowing CIPS to save money by shutting down the Newton I scrubber.

For example, Delta shipped 423,100 tons to Newton from January through May 1995, according to federal reports. In April, Delta's shipments fell from over 90,000 t/m to 30,900, while Foidel Creek's rose to 136,400. Both mines ship coal of over 11,000 Btu/lb., but Foidel Creek's sulfur content was 0.71bs. SO2/mmBtu in April, compared with Delta's 4.9 lbs. SO2/mmBtu. The delivered price of Delta Coal on contract was $43.93/t shipped from Williamson County IL compared with Foidel Creek's spot price of $31.12/t delivered form Routt County CO.

A CIPS official said of Cyprus Amax' announcement, "Their WARN notice has nothing to do with what's going on between us and them — at all. That's basically it — we aren't switching fuels there at this point. They've issued a WARN notice, and they notified us that they did that, and that's basically all we know," he said. The contract between CIPS and Cyprus Amax runs until 2002.

September 25, 1995 • COAL WEEK

By_____

Quadrangle_____

County_____

Delta mine lays off miners and idles dragline

Cyprus Amax Coal's Delta mine laid off 30 miners and four salaried employees. The company said the layoffs were due to the depletion of economic dragline reserves and the general condition of the coal industry in the Illinois Basin.

The also mine idled its Bucyrus Erie 3270 dragline, which had been the largest operating walking dragline in the country. The stripping ratio exceeded 20:1 when the company shut it down. The Delta mine will continue operations in Williamson and Saline counties, Ill., with a work force of 107 hourly employees and 27 salaried.

Workers are being trained to operate an Addcar highwall miner, which will produce 1.3 million clean tons per year. Delta will continue to ship to the Central Illinois Public Service Co.'s Newton No. 1 unit through 1996.

From "COAL" Jan. '96

FORM 180 W

SAMPLE HISTORY

Plant sampled: **Delta** Date: **11-10-92**

Company: **Amax Coal Co.** Sample ID: **Delta**
20 NW First St., Evansville, IN 47708 **C32771**

Company representative: **Mike Shackeford, Gen Mgr Prep.& Quality,**
20 NW First St, Evansville, IN 47706 812-421-3989
Nate Coffey, Prep. Plant Mgr, 618-982-2101-ex 219

Mine (source of sample): **Delta** Collected by: **RRR & RDH ***

Seam identification: **Herrin** Time of closure: **4:15pm, 11/9/92**

Mining period represented (dates): **11-9-92**

Panel(s) & location(s) in mine:
Mine locations (descriptive):

About 3 - 3.5 mi ENE of Prep plant

¼ or footage section twp rge
2 + 3 9S - 5E Saline Cnty

Type of Preparation Plant:

McNally wash boxes, tricones and cyclines for 28 x 60 m sizes, froth flotation for -60 mesh fraction. 435

Sampling point: # increments:
435

Belt (describe position in plant)

Two stage mechanical sampler off main product belt. Primary cutter of the 48 in. belt, 1 cut/min, secondary cut yields 100 lbs/day; hand riffled. Our sample is a composite of the incriments taken over the day's shift (7.25 h).

Train Truck

Company's sampling device (yes / no) YES
Type: **J. B. Long mechanical sampler.**

Other (describe)

Amax has an on-line analyzer that yields ash contents averaging 1 % higher, and sulfur 0.1 % lower than ASTM results.

Procedures (describe other aspects):

* **The sample was taken and bagged by Nate Coffey. The Danville seam is mined and blended as mined when present. At no time do they process only the Danville. So there is no opportunity to obtain a sample of this seam.**

	Thickness	Top	Bottom

From: Coal Week
V. 21, No. 18, 5/1/95

CIPS REEXAMINES CYPRUS AMAX PACT; REASSIGNMENT, BUYOUT POSSIBLE AT NEWTON 1

Central Illinois Public Service Co. is considering a number of options to get out of a high-priced contract with Cyprus Amax Coal's Delta surface mine in southern Illinois, ranging from a switch to Cyprus Amax's Twentymile mine in Colorado to a buyout of the remaining four years of the contract.

A CIPS coal buyer told *Coal Week* the Delta contract has been "renegotiated umpteen times" with the coal company and is a "1970s-type agreement" that requires the Springfield-based utility to pay a $/t price "in the mid to upper thirties" for high-sulfur coal burned at the Newton No. 1 power plant.

Coal Week recently reported CIPS is testing low-sulfur coal from Cyprus Amax's Foidel Creek mine in Colorado at Newton 1 with a possible eye to shutting down the aging scrubber on the generating unit (4-10 *Coal Week*). No decision is final, however, and CIPS also is considering upgrading the 16-year-old scrubber or replacing it with a new, more modern scrubber.

According to the coal buyer, CIPS is weighing three main options with regard to the Delta contract: switching the contract to Twentymile; an outright buyout; or switching to another high-sulfur coal supplier in Illinois. No one option currently has an edge on the others, he said.

OVER

The coal buyer confirmed Cyprus Amax desperately wants to retain the contract, if not at Delta, then at Twentymile. "They want to keep it somehow," he observed. "They'd still like to be a 100 million ton (annual) producer."

COMPANY
FARM
DATE DRILLED
AUTHORITY
ELEVATION
LOCATION

Cyprus Amax representatives could not be reached for comment. The company said in its latest quarterly report, however, that coal shipments from its Midwest mines were reduced during the first quarter partly because of higher unit costs at Delta due to unscheduled dragline repairs and unfavorable stripping ratios.

8/29/96

Talked to D. Michael Rounds, Director of Communications of Cyprus Amax Minerals Co. in Englewood, Co (ph. 303/643-5186) re status of Delta Mine. He said that as of 8/19/96 the mine has been officially idled and placed in reclamation. He knows of nothing of any interest in the purchase of the mine (I had mentioned rumors I had heard e.g. that a company was interested in using highwall miner to mine coal. He said Amax would certainly listen to any proposals, but he is unaware of any offers as of this time and they are proceeding with reclamation work.

HEINZ DAHMBERGER

CYPRUS AMAX MINERALS COMPANY
Post Office Box 3299
Englewood, Colorado 80155

NEWS
For immediate release
on 6/21/96

CYPRUS AMAX MINERALS REACHES AGREEMENT ON COAL SUPPLY CONTRACT

Denver (June 21, 1996) -- Cyprus Amax Minerals Company (NYSE: CYM) today announced it had reached an agreement in principal under which Central Illinois Public Service Company (CIPS) will discontinue coal purchases from the Delta mine in Illinois and pay Cyprus Amax Minerals $70 million. This will result in a gain in the fourth quarter of 1996. While Cyprus Amax will cease shipping coal from Delta effective June 30, 1996, Cyprus Amax retains the right to supply coal to CIPS under certain circumstances.

Milton H. Ward, Chairman, President, and Chief Executive Officer of Cyprus Amax Minerals Company, said, "Our agreement with CIPS demonstrates the positive relationship our organizations enjoy to mutual benefit. CIPS will avoid the expensive retrofitting of the Newton plant scrubber. At the same time, Cyprus Amax and its shareholders will receive fair and reasonable value for the displaced shipments from Delta."

The Delta mine of Amax Coal Company, a Cyprus Amax Minerals company, is located near Harrisburg, Illinois, and has been providing 1.3 million to 1.5 million tons of coal annually for CIPS' Newton Unit No. 1 power plant near Effingham, Illinois, under a contract originally scheduled to run until the year 2002. Delta's coal contains medium to high-sulfur levels, and emissions from the power plant were treated in a scrubber to remove pollutants in order to comply with provisions of the Clean Air Act. CIPS plans to begin burning low-sulfur coal at the unit to avoid the expense of substantial renovation to the flue gas desulfurization equipment, the emissions scrubber, in use at the station since 1979.

Future plans for Delta are still being formulated, but it is likely that production will be phased out during the next few months in the event the mine is unable to compete in the highly-competitive spot coal markets.

Cyprus Amax Minerals Company, headquartered in Englewood, Colorado, is a leading U.S. copper and coal producer, the world's largest producer of molybdenum and lithium, and holds significant positions in gold. The Company is exploring for base and precious metals worldwide.

Media Contact:
D. Michael Rounds
Director of Communications
(303) 643-5186

Investor Relations Contact:
Francis J. Kane, Vice President
Investor Relations and Treasurer
(303) 643-5362

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CYPRUS DELTA TO REMAIN OPEN; HIGHWALL MINER TO REPLACE DRAGLINE

Cyprus Amax Coal Co. won't close its Delta surface mine in November after all, but will change its method of mining in a move that probably will reduce the work force by about half.

Several weeks ago, the Colorado-based company issued a 60-day WARN notice to 138 hourly and 31 salaried employees at Delta, located near Marion in southern Illinois (9-25 *Coal Week*). At the time, most observers thought the mine would close because its economic dragline reserves have been exhausted. Delta's dragline will, in fact, be shut down next month.

However, the company plans to bring in a highwall miner developed by an Addington Resources affiliate and continue mining high-sulfur coal at the rate of about 1.3 million tons in 1996, said Joe Angleton, Illinois president of the United Mine Workers of America. Cyprus Amax officials could not be reached for comment.

Dennis Kirchner, fuels director for Central Illinois Public Service, also told *Coal Week* the utility fully intends to purchase 1.3 million tons from Delta next year for its Newton Unit 1 station.

Angleton said CIPS and Cyprus Amax also are "working on a price structure (for Delta) for after 1996." He said the union is hopeful some of the 60 or so miners to be laid off in November eventually will be recalled if the price can be lowered and CIPS continues buying coal from the mine under a contract not scheduled to expire until 2002.

Coal Week 10-23-95 3

Coal Week, 11/27/95: Cyprus Amax announced last week that it laid off 34 employees at its Delta Mine. Causes given were "depletion of

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reserves suitable for dragline mining" and the general conditions of the coal industry in the Illinois Coal Basin, where higher-sulfur reserves are suffering under requirements of the federal Clean Air Act Amendments (of 1990).

From Coal Week, 9/2/96:

Cyprus Amax Coal Co. formally closed its Delta mine in Illinois Aug. 19. Cyprus Amax spokesperson Mike Rounds said last week that the closing affected 98 workers at the big surface operation. An additional 34 miners remain at Delta, conducting reclamation, he said.

The mine's fate was sealed by a contract renegotiation between Cyprus and **Central Illinois Public Service Co.** that allowed CIPS to shut down the scrubber at its Newton I power plant, shifting to compliance coal. Cyprus is shipping coal from stockpile at its Shoshone mine in southern Wyoming through the rest of 1996. CIPS has options to buy Colorado coal from Cyprus starting in 1997, but it has solicited bids on a wide range of compliance coals for comparison.

Symbol Description Inches

Shutdown of Amax's Delta Mine deals Illinois coal another setback

In another setback for the Illinois coal industry, Amax Coal sent layoff notices to all 169 workers at its Delta Mine near Marion, IL. The dismissals are due to take effect in 60 days, but the company stopped short of saying it would close the surface mine. "We will not know the answer until late November," said Mike Mitchell, an Amax Coal spokesman.

Meanwhile, Cyprus Amax Coal said that 81 of 91 employees at its Empire coal mine in northwest Colorado will be laid off and the mine closed indefinitely.

In Illinois, Mitchell said the 60-day layoff notices were issued in compliance with a federal law covering shutdowns of factories and other sites. However, the mine's major customer, CIPSCO of Springfield, IL., said it has not received any notice of alterations in its supply contract with the Delta Mine. "There is no change in the status of the contract," said Jim Goff, the utility's director of investor relations.

The Delta Mine produces about 1 Mt/a (1.3 million stpy) of coal and sells it to two CIPSCO power stations in Jasper and Jackson counties. The contract, which has been in effect since mid-1977, is due to expire at the end of 2002. "Our understanding is that the (layoff) notice relates to a change in mining operations," Goff said.

Amax Coal blamed low coal prices, federal environmental laws and the deregulation of electric utilities as reasons for the Delta Mine decision. "There is no secret that the general condition of the coal industry — and especially southern Illinois — is not good," Mitchell said. The federal Clean Air Act has created "an insurmountable problem. It is like a tornado. You do not know where it is going or how long it is going to go."

Utilities are looking for low-sulfur coal to meet federal air pollution guidelines. Much of Illinois' coal has a high-sulfur content. In addition, many electric utilities have tried to renegotiate long-term contracts with suppliers to take advantage of falling coal prices.

The Delta Mine still has 20 years' worth of reserves. The layoffs there represent the second blow to a Cyprus Amax mine in Illinois in less than four weeks. In August, Cyprus Amax said it would take a $310-million pretax write-off for the quarter ending Sept. 30 because of its Wabash Mine near Keensburg. The write-off followed the revision of a contract with a big customer, PSI Energy, an Indiana utility. The contract had been in arbitration for several years. Cyprus Amax agreed to cut the price of coal, while PSI agreed to extend the contract eight years to 2010.

Cyprus Amax also said it would cut costs and increase reserves. Earlier in the year, the Wabash Mine dismissed 51 hourly and salaried workers. It has 638 employees and produces about 3.6 Mt/a (4 million stpy) of coal.

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CIPS buys out Cyprus Amax contract

Central Illinois Public Service (CIPS) decided to forgo an expensive renovation of an aging scrubber at the 555-megawatt Newton power station Unit No. 1, and opted to switch to low-sulfur coal—a move that may mean closing Cyprus Amax Coal Co.'s Delta surface mine near Marion, Ill.

CIPS estimates it will save more than $100 million over 10 years by buying out the remaining 5.5 years of Delta's long-term contract.

"We analyzed many options, including continuing to burn Illinois coal and renovating the scrubber," said Clifford Greenwalt, CIPS president and CEO. "The decision to switch to out-of-state, low-sulfur coal, which will not require use of the scrubber, will result in substantial savings for our customers."

Greenwalt said the anticipated $100 million savings would be the net result of the planned payment later this year of a $70 million buyout fee to Cyprus Amax, significantly lowering delivered coal costs, eliminating scrubber renovation costs, and avoiding the related operation and maintenance expenses.

CIPS intends to buy low-sulfur, out-of-state coal through the remainder of this year for Newton Unit No. 1. The utility's final agreement with Cyprus Amax provides options for future purchases of low-sulfur coal from the Colorado-based coal producer in 1997, 1998, and 1999.

Milton Ward, Cyprus Amax president and CEO, said in a statement that his company and its shareholders will receive "fair and reasonable value for the displaced shipments from Delta."

While Delta's future is uncertain, Cyprus Amax said it's likely that production will be phased out during the next few months if the mine is unable to compete in the spot coal markets.

"We're disappointed that we're losing the coal," said Joseph Spivey, president of the Illinois Coal Association. "We hate to lose any Illinois production, but that's the decision they (Cyprus Amax) made with CIPS." Even after the Newton fuel switch, CIPS said it still will be a large purchaser of Illinois coal. The utility still will buy almost 2.7 million tons of Illinois coal per year for its other generating stations.

From:
"COAL"
Aug. 1996

John C. Moore Co...