Results of coalbed methane drilling in Panola County, Texas

Edited by Peter D. Warwick, John R. SanFilipo, Alex W. Karlsen, and Charles E. Barker

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only, and does not imply endorsement by the U.S. Geological Survey.

Open-File Report 2005-1046

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Chapter 1

Introduction to drilling operations in Panola County, Texas

By Peter D. Warwick[1]

Chapter 1 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

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Introduction

From June 13 to June 28, 1999, the U.S. Geological Survey (USGS), in cooperation with the Texas A&M University, drilled and continuously cored two coalbed methane test wells in the lower Wilcox Group (Paleocene) of Panola County, Texas. This report presents data obtained from the drilling and analytical program. The locations of the test wells (USGS-PA-1 and USGS-PA-2) are shown on figure 1. The rock core obtained from this drilling project is in storage at the Texas A&M University Department of Geology and Geophysics. The purpose of this report is to release the raw data obtained from these two test wells. Preliminary interpretive reports generated from this data include Warwick and others (1999; 2000a,b; 2002) and SanFilipo and others (2000a,b). This report consists of: detailed rock core descriptions and selected core photographs from both wells (Chapter 2); detailed laboratory descriptions of the coal and associated rock (Chapter 3); plots of the geophysical logs (natural gamma, caliper, gamma-gamma density, and resistivity) from both wells (Chapter 4); coal physical and geochemical data (proximate, ultimate, forms of sulfur, ash fusion temperatures, free swelling index, apparent specific gravity, and trace element data) for both wells (Appendix 1); coal petrographic results including coal maceral composition, and vitrinite reflectance data (Chapter 5); palynological data (Chapter 6); dinocyst data (Chapter 7); coal gas desorption results (following Barker and others, 2002) for samples from USGS-PA-2 (no gas was measured from samples obtained from USGS-PA-1) (Chapter 8); methane and carbon dioxide sorption data from selected samples from USGS-PA2 (Appendicies 2 and 3); Langmuir models for coal sorption of various mixtures of methane and carbon dioxide (Appendix 4); coal gas molecular and isotopic data for a mixture of

coal gas and canister headspace gas (air) (Appendix 5); Railroad Commission of Texas Coal Exploration Registration application and approval letters with detailed location maps (Appendix 6); and digital files for geophysical logs and spread sheets (Appendix 7).

Acknowledgements

Many people contributed to the field and laboratory work associated with this project. First, we would like to thank land and mineral owners John Pilkington, Arthur McFadden, and Buddy Townson, for permission to drill on their properties. We thank Lloyd E. Morris (Director of Drilling Operations), Thomas E. Yancey (Professor of Geology), and Jennifer M. Klein and Brenda McCaleb (Graduate Students), of the Texas A&M University Department of Geology and Geophysics for their assistance in the field and for their contributions to this study. Damaris Torres Pulliza, Dena Schmidt, and Ron Tingook (USGS student interns and contractors) and Robert W. Hook (USGS contractor) worked long hours during the drilling phase of the project. USGS employees Claire E. Aubourg, Steven M. Podwysocki, Roger E. Thomas, Woody C. Wallace, and Jason C. Willett also worked long hours during the drilling phase and helped to make the project successful. The following USGS contracted companies provided analytical services for this project: Century Geophysical Corporation (geophysical logs), Geochemical Testing (coal geochemistry), Isotech Laboratories Inc. (gas geochemistry), R.M.B. Earth Science Consultants Ltd. (coal sorption isotherms), and New Mexico Bureau of Mines and Mineral Resources, Geochronology Research Laboratory (tonstein radiometric ages; no tonstein samples collected in this study had sufficient sanidine crystal size for age determination).

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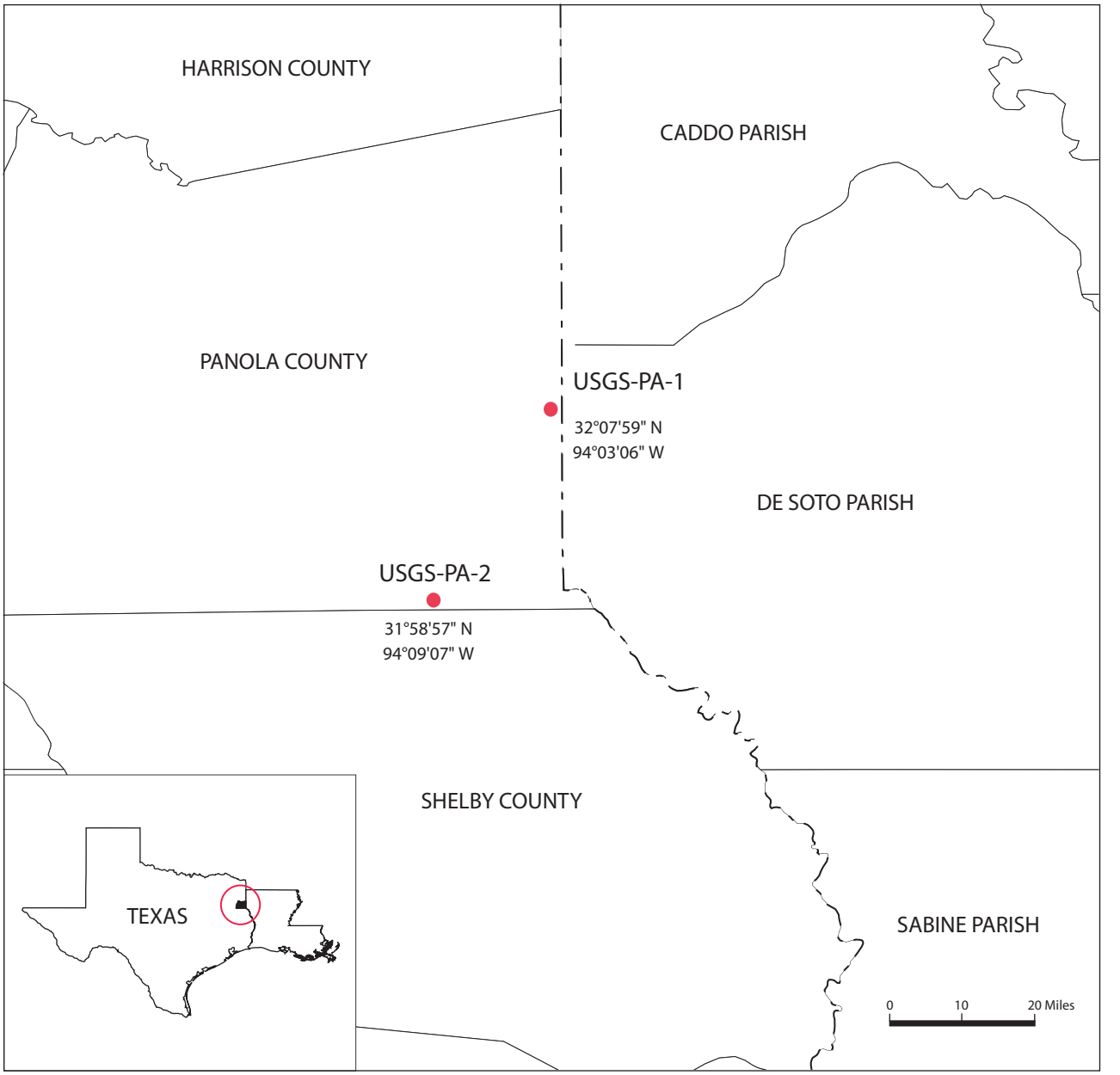

Figure 1. Locations of drill holes (red circles) in Panola County, Texas.

Chapter 2

Field core descriptions of boreholes USGS-PA-1 and USGS-PA-2

By John R. SanFilipo[1], Peter D. Warwick[1], Ronnie Tingook[2], Jennifer M. Klein[3], and Brenda McCaleb[3]

Chapter 2 *of*

Results of coalbed methane drilling in Panola County, Texas

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Borehole USGS–PA-1

Location: Arthur McFaddin Ranch, Panola Co. TX, about 0.5 mi west of the LA state line, 0.5 mi south of the intersection of county roads 467 and 463, Old Panola 7.5' topographic sheet.

Coordinates: lat 32°07'59.32" N, 94°03'06.37" W (GPS)

Ground elevation: 270 ft (estimated from topographic map)

Total depth: 380 ft

Driller: Lloyd Morris, Texas A&M University

Drill rig: truck-mounted Mobile Drill B-53

Drilling method: Continuous wireline coring, split 10 ft inner-tube or 5 ft spring loaded push tube with shoe (similar to Dennison sampler)

Bit type: tungsten-carbide/diamond HC 4.75" OD, 2.5" core

Drilling medium: bentonite mud

Casing: none (PVC to 6 ft)

Geophysical logs: Natural gamma, caliper, gamma-gamma density, resistivity

Dates drilled: 13 June 99 to 20 June 99

Rock descriptions by: J. SanFilipo, P. Warwick, R. Tingook (USGS), J. Klein, B. McCaleb (A&M)

Remarks: Drilled soft units with 5 ft solid push tube.
Drilled hard units and coal with 10 ft split tube, various run lengths.
Desorbed coal 129.8 – 130.7 ft (trace of gas) and 331.0 – 347.7 ft (no gas).
More detailed descriptions of coal beds done in laboratory settings after desorption completed can be found in Chapter 3, this volume.

Abbreviations used:

TOR –Top of run
BOR – Bottom of run
Elog – geophysical log
Carb - carbonaceous

Unit Number	Description (primary lithology in bold)	Thickness (Depth) ft
1.	**Siltstone**, dark-gray, organic-rich grassy zone……	0.5 (0.5)
2.	**Siltstone**, sandy, very fine-grained …….....	1.2 (1.7)
3.	**Siltstone**, gray with 0.25 in. reddish lenses, top of weathering……...	0.3 (2.0)
4.	**Siltstone**, light-gray, 0.5 in. carbonaceous bands near top, weathering orange from 5.0 to 5.4, very fine grained sand lenses throughout, becoming more sandy towards base…….	1.7 (5.7)
5.	**Core loss**, bottom of run (BOR), switched to 5 ft tube……	0.3 (6.0)
6.	**Core loss**……..	1.2 (7.2)
7.	**Siltstone** and very fine-grained sugary sandstone laminae, gray with scattered carbonaceous streaks, weathered from 7.5 to 9.0, BOR…….	2.8 (10.0)
8.	**Core loss**……	0.4 (10.4)
9.	**Siltstone**, similar to above, light-gray with reddish weathering bands, noncalcareous……	2.5 (12.9)
10.	**Siltstone**, laminated as above (tidal banding?), becoming more clay-rich downward, with dark-chocolate-brown bands (tidal?), BOR…….	2.1 (15.0)
11.	**Siltstone** with light- to dark-gray clay bands, bioturbated?, a few scattered reddish weathering layers……	1.5 (16.5)
12.	**Mudstone**, dark-gray, banded, bioturbated, silty, plant debris, becoming clayey at base with 1 cm thick carbonaceous band……	2.4 (18.9)
13.	**Claystone**, dark-gray, denses, highly organic, with silty and sandy laminations and a few cm thick burrows, pollen sample PA-1-A 19.8-19.9, BOR……...	1.1 (20.0)

14. **Mudstone**, dark-gray, carbonaceous, flat bedded, dense, with mm thick silty lenses……(22.4) 2.4

15. **Siltstone**, dark-gray, dense, hard, bioturbated, 1 mm thick fine-grained sand flasers.……...(24.1) 1.7

16. **Sandstone**, medium-gray, very fine to fine-grained, soft, with sandy carbonaceous laminae, BOR……(25.0) 0.9

17. **Sandstone**, medium-gray, with dark-gray 2 mm mud bands, flasered, soft……...(27.0) 2.0

18. **Coal** (plugged up long shoe on 5 ft push tube), sample USGS-PA-1-B (pollen) from here……..... (27.25) 0.25

19. Core loss in **coal** (elog)……...(28.1) 0.85

20. Core loss, probably **claystone** (gamma), BOR, switched to 10 split tube. (30.0) 1.9

21. Core loss, probably silty **claystone** (gamma)…….(30.65) 0.65

22. **Claystone**, medium-gray, faint silty laminae, burrowed, rooted?, sample PA-1-C 31.9-32.0 (pollen)……..(35.00) 4.35

23. **Mudstone**, faintly laminated with clay and silt < 1 mm thick, possibly flasered, becomes more silty below a 3 cm silt band at 38.7, sample PA-1-D 38.0-38.1 (pollen), BOR……..……...(40.0) 5.0

24. Core loss, probably **mudstone** as above (aa), tube not latched?……(44.6) 4.6

25. **Mudstone** like unit 23, burrowed, grading to siltstone at base, core badly broken, BOR…….(50.0) 5.4

26. **Siltstone**, medium-gray, thinly laminated, flasered, rippled?……(54.0) 4.0

27. **Siltstone**, medium-gray, very fine grained sand laminae, rippled?, becomes very sandy at base……(54.9) 0.9

28. Core loss, probably silty **sandstone** (elog), BOR……...(60.0) 5.1

4.0
29. Core loss, probably silty **sandstone** (elog)…….(64.0)

30. **Siltstone**, medium-gray, thin faint laminae of silt, clay and very fine 6.0
sand, flasered, rippled?, sample PA-1-2E 66.0-66.1 (pollen), BOR,
switched to 5 ft tube……... (70.0)

31. **Siltstone**, muddy, top 6 in. has abundant organic laminae and specks,
lower part has flat to wavy 2 mm silt and clay laminae, rippled, 5.0
burrowed, BOR……...(75.0)

1.0
32. **Siltstone**, with sandy and clayey laminations, similar to above…… (76.0)

33. **Sandstone**, very fine-grained, siltstone laminations, clay drapes, 3.5
organic flecks throughout……...(79.5)

34. **Sandstone**, medium-greenish-gray (glauconitic?), very fine grained, 0.5
silt and clay laminae, micaceous, BOR……..(80.0)

1.7
35. **Sandstone**, same as unit 34……..…….(81.7)

36. **Siltstone**, greenish-gray, finely laminated (tidal banding?), base 0.9
appears to be a flooding surface…….(82.6)

37. **Siltstone** bordering on sandstone, chocolate-brown, very organic, 1.4
burrowed, sample PA-1-F 83.5-83.6 (pollen)…… (84.0)

38. **Siltstone**, chocolate-brown, laminated, 2 cm horizontal burrows 1.0
filled with white silt or greenish clay, BOR……...(85.0)

0.7
39. **Siltstone**, same as unit 38, sample PA-1-G 85.3-85.4 (pollen)……. (85.7)

40. **Sandstone**, medium-gray, very fine-grained, flat-bedded tidal 1.3
laminae, organic lenses…….. (87.0)

41. **Sandstone**, greenish-gray, micaceous, laminated with sets of 1 cm 3.0
and mm scale tidal banding (photo), BOR…….(90.0)

42. **Siltstone**, with very fine-grained greenish-gray tidal sand laminae
which may be inclined 1 – 2 deg, burrowed, upper 2 ft is more sandy 5.0
and less laminated than bottom, BOR……...(95.0)

0.9
43. Core loss, probably **sandstone** similar to unit 44……...(95.9)

44. **Sandstone**, muddy, flat-bedded tidal-like laminae, carbonaceous flecks, base is more silty , core broken and compressed, sample PA-1-H 97.7-97.8 (pollen), BOR……..……...……(100.0) 4.1

45. **Sandstone**, medium-gray, very fine-grained, silty, clayey, micaceous, scattered carbonaceous flecks and burrows, 3 – 5 cm sets of cross-laminae with tidal mud? drapes, BOR……..(105.0) 5.0

0.2
46. Core loss, probably **siltstone** like unit 47…….(105.2)

47. **Siltstone**, sandy, sand very fine-grained, micaceous, organic flecks, less apparent bedding than above, no dark clay bands, becomes more massive and finer-grained downwards, BOR……...(110.0) 4.8

2.85
48. **Sandstone**, very fine-grained, silty, carbonaceous flecks, micaceous….(112.85)

0.15
49. **Coal**, brown, lignitic, entire interval sample PA-1-I (pollen)….…….(113.00)

0.7
50. **Claystone**, light-gray, rooted, carbonaceous streaks……...(113.7)

1.0
51. **Siltstone**, clayey……...(114.7)

52. **Sandstone**, very fine grained, silty, carbonaceous flecks, burrowed?, BOR……..(115.0) 0.3

1.0
53. Core loss, **sandstone** (elog)……..(116.0)

0.5
54. **Sandstone**, fine-grained, white clay rip up clasts in lower part……..…(116.5)

55. **Sandstone**, with carbonaceous laminae < 1 mm thick, at top is a 2 mm whispy white clay chip that may be a tonstein……...(116.9) 0.4

56. **Sandstone**, fine- to medium-grained, soft, quartz and organic flecks, scattered clay rip-up clasts, BOR…….(120.0) 3.1

57. **Sandstone**, medium-gray, fine- to medium-grained, micaceous, 2.85
carbonaceous flecks, white clay rip-up clasts scattered throughout…….(122.85)

0.15
58. Shale pebble **conglomerate**, hard layer of rip-up clasts, photo……...(123.00)

59. **Sandstone**, medium-gray, medium- to fine-grained, soft, massive 2.0
similar to unit 57, BOR……(125.0)

0.3
60. Core loss in **sandstone** (moved from BOR to reconcile e-log)……(125.3)

61. **Sandstone**, same as unit 59, described as sharp contact with unit 2.7
below but e-log indicates roof shale (lost shale and washed sand?)…... (128.0)

62. **Coal**, hard, brown, lignitic, sample USGS-PA-1.1, BOR, switched 1.8
to 10 ft split tube……...(129.8)

Unit 62 subsampled for geochemistry after reexamination in lab:
128.00-128.15 dark olive black mudstone with coal streaks, not analyzed
128.15-128.75 dirty coal, sample USGS-PA-1.1A
128.75-129.80 coal, sample USGS-PA-1.1B

63. **Coal**, hard, brittle, some pre-vitrain bands, desorbed in cannister 11 0.9
(trace of gas), sample USGS-PA-1.2…….…….. (130.7)

64. **Coal**, top is hard, brittle, slightly banded (pre-vitrain), slightly shaley, 2.1
some thin sand laminae, more towards base, sample USGS-PA-1.3……(132.8)

65. **Coal**, abundant <1mm thick sand laminae, not sampled, sharp 0.2
contact with unit 66 (nb: 4.6 ft total coal density log)…… (133.0)

66. **Claystone**, chocolate-brown, very fine-grained sand laminae
throughout, grading to sandy mudstone at base, sample PA-1-J (pollen) 0.9
133.0-133.1…….……...…….. (133.9)

1.1
67. Core loss, probably sandy **claystone**, BOR (switched to 5 ft tube)..…... (135.0)

68. **Claystone**, grayish-brown 5YR 3/2 (chocolate-brown), mm-scale
flat-bedded (i.e. horizontal, parallel, planar) fine- to very fine-grained
sand laminae throughout, some possible bioturbation in places, towards
base laminae increase in number and thickness to 20 mm sets which are
slightly rippled with carb debris along bedding, pollen sample PA-1-K 4.4
138.0-138.1, BOR……...……(140.0)

69. Core loss, probably sandy **claystone**……... 0.65 (140.65)

70. **Claystone** similar to unit 68, top mostly clay, base sandier…… 1.7 (141.7)

71. **Sandstone**, fine-grained, some dark minerals, possible ostracode, flat-laminated with some small ripples, abundant carbonaceous laminae near base……... 0.8 (142.5)

72. **Claystone** similar to unit 70, BOR……... 2.5 (145.0)

73. Core loss, probably **claystone** (elog), tube not latched? (washed hole before next run and recovered 0.9 ft broken core: chocolate mudstone and sandstone similar to unit 75)…….. 4.2 (149.2)

74. **Claystone**, similar to unit 72 but slightly silty, sharp contact with unit 75……... 0.6 (149.8)

75. **Sandstone**, fine-grained, wavy-bedded, some dark minerals, BOR…… 0.2 (150.0)

76. Core loss (probably **sandstone**)……... 1.7 (151.7)

77. **Sandstone**, fine-grained, mostly quartz, very muddy, some dark minerals, mica/gypsum? (altered pyrite) flakes, top foot is massive, middle contains disturbed (bioturbated?) carbonaceous laminae which grade down to slightly inclined thin parallel-bedded laminae, 20 cm clay band near base, base grades…….. 2.1 (153.8)

78. **Mudstone**, core badly broken, mostly fine-grained sandstone with clay laminae, base is very carbonaceous with leaf prints on bedding and grades into unit 79……... 0.6 (154.4)

79. **Sandstone**, fine-grained, with wavy carbonaceous claystone laminae, base gradational…… 0.2 (154.6)

80. **Claystone**, dusky-yellowish-brown 10YR 2/2, top is very carbonaceous with abundant marcasite specks, a few sandstone laminae throughout, BOR……. 0.4 (155.0)

81. Core loss, probably carbonaceous **claystone**……... 0.5 (155.5)

0.2
82. **Claystone**, chocolate-brown, carbonaceous…….(155.7)

83. **Carbonaceous shale** with a few clay bands a few cm thick, sample 0.25
PA-1-L 155.7-155.8 (pollen)...…….(155.95)

84. **Sandstone**, medium-gray, fine-grained, soft, banded, carbonaceous
streaks up to 1 cm thick near top and 2 – 5 mm rippled carbonaceous 1.85
laminae in places……..(157.80)

0.9
85. **Sandstone**, fine-grained, carb streaks throughout……... (158.7)

86. **Sandstone**, greenish-gray, fine-grained, mostly quartz with some 1.3
dark minerals or carbonaceous grains, BOR……(160.0)

0.4
87. Core loss, **sandstone** (elog)……..(160.4)

88. **Sandstone**, light-olive-gray 5Y 6/1, fine-grained, micaceous?
(gypsum?), some pyrite, salt and pepper with a few percent dark
minerals, mostly massive except a few wavy carbonaceous laminae 2.9
at top…….(163.3)

89. **Sandstone**, light-olive-gray, fine-grained, with wavy clay laminae 1.7
up to 2 mm thick, base is coaly, BOR……..(165.0)

0.3
90. Core loss, **sandstone** (elog)……..(165.3)

0.6
91. **Sandstone**, similar to unit 89 but no laminations, base grades……(165.9)

92. **Sandstone**, with mm-scale clay laminae which increase in number
towards base, a few carbonaceous laminae in middle, irregular
bedding, mostly flat at top, wavy in upper middlle, flat in lower middle,
and wavy at base. Appears to be soft sediment deformation (deltaic?) 4.1
as opposed to tidal in origin, BOR……...(170.0)

93. **Sandstone**, light-olive-gray 5Y 6/1, with abundant olive-gray 5Y4/1
claystone laminae, 30 – 40 pct clay, 60 – 70 pct sand, irregular bedding,
looks like soft sediment deformation, not rythmic, but possibly some 5.0
bi-directional ripple bedding that may be tidal in origin, BOR……(175.0)

94. Interlaminated **claystone** and sandstone similar to unit 93, grading to flat-bedded at about 175.3. Percent clay increases in the middle (about 90 pct clay at 178 ft) then becomes sandier at base (40 pct sand). from about 179 ft down bedding is rythmic showing possible tidal couplets 10 – 15 mm thick, 1 cm siderite band at 178.9, sample PA-1-M 179.9-180.0 (pollen), BOR (switched to 10 ft split tube)…….(180.0) 5.0

95. Interlaminated claystone and **sandstone** like unit 94, mostly sand……..(180.4) 0.4

96. Olive gray **claystone** (90 pct) with 10 pct light olive gray fine-grained sandstone similar to unit 94……..(182.0) 1.6

97. Core loss in **coal** (elog)…….(182.8) 0.8

98. **Coal**, dirty, fissile, very pyritic, abundant clay lenses, sample PA-1-N (pollen) from this interval (grab)……..(183.6) 0.8

99. Very carbonaceous **claystone**, dark-brown, base grades, sample PA-1-O 183.7-183.8 (pollen)……(183.8) 0.2

100. **Claystone**, chocolate-brown, moderately carbonaceous, massive, root traces, base grades, sample PA-1-P 184.7-184.8 (pollen)...…….(185.2) 1.4

101. Interlaminated **sandstone** and claystone like unit 95……...(185.9) (0.7)

102. **Sandstone**, gray, fine-grained, massive……...(186.5) 0.6

103. Core loss, **sandstone** like unit 102 (elog)……(189.6) 3.1

104. **Claystone**, chocolate-brown……(189.75) 0.15

105. **Sandstone**, similar to unit 102, carbonaceous streaks, BOR (switched to 5 ft solid tube)……...(190.0) 0.25

106. Core loss, probably **sandstone** similar to unit 102……...(190.5) 0.5

107. **Siltstone**, sandy, sand is very fine grained, 5 mm mud/clay laminae, rippled, burrowed, tidal banding, flasered……...(193.0) 2.5

108. **Mudstone**, consisting of interbedded 1 cm siltstone and claystone bands that are wavey to flaser bedded, BOR……(195.0) 2.0

109. **Mudstone**, consists of 10 mm clay drapes? (drilling artifacts?) that are rhythmically paired with similarly thick sets of interlaminated very fine grained sand and clay, laminae < 1 mm thick, sample PA-1-Q 198.0-198.1 (pollen), BOR……...……(200.0) 5.0

110. Core loss, probably **claystone** (elog)……(200.8) 0.8

111. **Mudstone** similar to unit 109, with chocolate-brown silty clay bands that are 1 – 3 cm thick rhythmically coupled with subequal sets of irregularly laminated sand and clay. Although these appear to be very rhythmic (e.g.13 clay band/laminar sets were counted from 204 – 205 ft), they need to be reexamined for possible drilling mud contamination as the core appeared to be spun at regular intervals, BOR……...(205.0) 4.2

112. **Claystone**, chocolate-brown, with very fine grained sandstone laminae that are flat- to slightly wavy-bedded, 70 pct clay, 30 pct sand……...(205.5) 0.5

113. Core loss, probably **claystone** similar to unit 112……(209.1) 3.6

114. **Claystone**, similar to unit 112 except more clayey at top, sample PA-1-R 209.5-209.6 (pollen), BOR……(210.0) 0.9

115. Core loss, probably **claystone** (elog)……(210.7) 0.7

116. **Siltstone**, with mm-scale sand laminations, tidal banded……(211.2) 0.5

117. **Shale**, carbonaceous, silty……(211.25) 0.05

118. **Sandstone**, with wavey-bedded silt and carbonaceous lamine, slightly burrowed……..(212.0) 0.75

119. **Sandstone**, medium-gray, fine- to medium-grained, micaceous, black minerals, soft, faintly laminated, flat-bedded……(214.5) 2.5

120. **Sandstone**, carbonaceous silt laminations, flasered, tidal, BOR…….(215.0) 0.5

121. Core loss in **sandstone** (elog)……...(216.3) 1.3

122. **Sandstone**, medium-gray, fine-grained, micaceous, flat-bedded…….(217.3) 1.0

123. **Sandstone**, same as unit 120, rippled……...(217.8) 0.5

124. **Siltstone**, chocolate-brown, laminated, slightly burrowed, clayey and carbonaceous near base……..(219.0) 1.2

125. **Claystone**, with silty stringers, base carbonaceous, dense, hard to drill, BOR (switched to 10 ft split tube)……...(220.0) 1.0

126. Core loss, probably **siltstone** (gamma log)……...(222.7) 2.7

127. **Claystone**, carbonaceous, grayish-brown 5YR 3/2 (chocolate) with darker bands (dusky-brown 5YR 2/2), silty, dense, compact, homogenous except for color-banding and streaks of very fine-grained quartz sand < 1 mm thick that are abundant throughout, sand is very well sorted (paralic?), sample PA-1-S 225.9-226.0 (pollen), BOR……..……(230.0) 7.3

128. Carbonaceous **claystone** same as unit 127……...(230.4) 0.4

129. Core loss, probably carb **claystone** (elog)……(231.5) 1.1

130. Carbonaceous **claystone** similar to unit 127, sand laminae more abundant in the middle part……..(238.8) 7.3

131. Carbonaceous **siltstone**, dark-yellowish-brown 10 YR 4/2, hard dense, possibly sideritic (no density kick ?)…….(238.9) 0.1

132. Carbonaceous **claystone** same as unit 127……...(239.1) 0.2

133. Carbonaceous **siltstone** similar to unit 131……..(239.4) 0.3

134. Carbonaceous **claystone** same as unit 127, sample PA-1-T 239.8-239.9 (pollen), BOR……(240.0) 0.6

2.0
135. Core loss, carbonaceous **claystone** and siltstone as above (elog)……(242.0)

136. Carbonaceous **siltstone**, similar to unit 131, but sandy, not 3.0
sideritic……(245.0)

137. Core loss, carbonaceous **claystone** as above (elog), repositioned 2.0
from TOR to match elog……...(247.0)

3.0
138. Core loss in **sandstone** (elog, repositioned from TOR), BOR…….(250.0)

10.0
139. Core loss in **sandstone** (elog), BOR (switched to 5 ft solid tube)……...(260.0)

3.0
140. Core loss in **sandstone** (elog)……...(263.0)

141. **Sandstone**, fine – medium grained, salt and pepper, a few pct dark
minerals, micaceous, subrounded, fairly mature looking, no bedding 2.0
evident but very unconsolidated, BOR (switched to split tube?)…….(265.0)

142. **Sandstone**, medium-grained, salt and pepper, 2 pct dark minerals 3.5
subrounded, clean, mature, faint bedding, BOR (switched to 5 ft tube)...(268.5)

0.4
143. Core loss, probably **sandstone** like unit 142……(268.9)

0.3
144. **Sandstone**, same as unit 142, sharp contact with unit 145……..(269.2)

145. **Claystone**, medium-dark-gray N 4 to olive-gray 5Y 4/1, thin
(< 1mm) laminae of silt to very fine-grained sandstone, sand is
quartz with some possible clay minerals (ash?), laminae are flat, 0.8
subparallel, with a few ripples, BOR……(270.0)

1.1
146. **Claystone**, same as unit 145, base grades……(271.10)

147. **Sandstone**, olive-gray 5Y 4/1, fine-grained, very muddy, micaceous?,
scattered pyrite grains, abundant coaly debris at base, possibly 2.1
fines up……(273.3)

1.7
148. Core loss, **sandstone** (elog), probably coarser than unit 147, BOR…….(275.0)

0.3
149. Core loss, **sandstone** (elog)……..(275.3)

0.4
150. **Sandstone**, similar to unit 147, base is coaly and grades into unit 151...(275.7)

151. **Mudstone**, olive-gray 5Y 4/1, subequal amounts of silt and very fine-grained sand, massive, rooted, vertical burrows filled with sand, hard compact, BOR……...(280.0) 4.3

1.2
152. **Mudstone**, same as unit 151, base grades……(281.2)

153. **Sandstone**, olive-gray, fine-grained, muddy, fines up, homogenous, probably bioturbated, coaly streaks at base……..(282.6) 1.4

2.4
154. Core loss, **sandstone** (elog), BOR……... (285.0)

155. **Sandstone**, light-olive-gray 5Y 6/1, fine-grained, salt and pepper, 1-2 pct dark minerals, faint bedding, friable, nodular bands of siderite? in places……(290.0) 5.0

2.5
156. **Sandstone** same as unit 155, 15 mm siderite band at 290.25 ft……(292.5)

0.1
157. **Siderite**, hard, plugged core catcher……(292.6)

158. Core loss, probably **mudstone** similar to unit 160, density log indicates possibly sideritic, BOR….……(295.0) 2.4

0.4
159. Core loss, probably **mudstone**, density log suggests sideritic……...(295.4)

160. **Mudstone**, grading downward from olive-black 5Y 2/1 mudstone consisting of an equal mix of clay, silt, and very fine to fine-grained sand, to greenish-black 5GY 2/1 siltstone to dusky yellowish brown 10 YR 2/2 sandy claystone, faintly laminated throughout, base grades, density log suggests most of unit is sideritic, sample PA-1-U (pollen) 297.9-298.0……...(299.3) 3.9

161. Carbonaceous **claystone**, dusky-brown 5YR 2/2, abundant pyritized 0.7
and coalified plant debris on bedding planes, BOR……..(300.0)

0.4
162. Core loss, coaly **shale** (elog), repositioned from BOR…… (300.4)

163. Carbonaceous **claystone**, similar to unit 161, sub-mm-scale sandy 0.1
laminations……... (300.5)

164. **Siltstone**, olive-black 5Y 2/1, with approximately 40 pct interlaminated
sandstone, sand is very fine-grained, clean, subangular, silt laminations
1- to 1+ mm thick, sand < 1 mm, mostly flat-bedded with some pseudo- 1.6
flasers and ripples, not bioturbated…….. (301.7)

165. Core loss, probably interlaminated **siltstone** and sandstone similar 3.3
to unit 164, BOR (switched to 10 ft split tube for next 5 ft run)……..(305.0)

166. Core loss, probably interlaminated **siltstone** and sandstone as above 5.0
(elog), BOR (switched to solid tube and fished 1 ft similar to unit 164).(310.0)

0.1
167. Core loss, interlaminated **siltstone** and sandstone……... (310.1)

168. Interlaminated clayey **siltstone** and sandstone, similar to unit 164, but
sandstone contains more (~3%) dark minerals, mostly flat-bedded, with
a few disturbed zones and coaly streaks, disturbed zones are often subjacent
to coaly streaks (storm surges? - no obvious bioturbation), towards base 4.9
lutaceous layers are thicker (< 2 mm) and more carbonaceous……... (315.0)

169. Interlaminated clayey **siltstone** and very fine-grained sandstone, similar
to above, but very regular couplets of 1-mm-thick siltstone laminations
and sub-mm sandstone laminations, sample PA-1-V 318.0-318.1 5.0
(pollen), BOR……..……. (320.0)

170. Interlaminated **siltstone** and sandstone same as unit 169 (excess 0.1
protruding from shoe from last run)……(320.1)

4.2
171. Core loss, interlaminated **siltstone** and sandstone (elog)…….(324.3)

172. Interlaminated **siltstone** and sandstone like unit 169, abundant coaly 0.7
fragments at base, BOR……(325.0)

173. Core loss, interlaminated **siltstone** and sandstone (elog), 0.4 ft 2.0
presumably from this interval fished next run, same as unit 169…….(327.0)

2.6

174. Core loss, interlaminated **sandstone** and subordinate siltstone (elog)….(329.6)

175. **Sandstone** with subordinate interlaminated siltstone, similar to unit 169, recovered from next run, BOR……(330.0) 0.4

176. Interlaminated **siltstone** and sandstone like unit 169, base is less sandy and grades into unit 177, sample PA-1-W (pollen) 330.5-330.6, (before run from 330 - 335 inner tube would not latch; tube got stuck while retrieving, had to cut cable and trip out, recovering 0.4 ft in unit 173. Did a run from 330 - 331 with long shoe and recovered 1.4 ft, units 175 – 178)……..……..(330.7) 0.7

0.1

177. **Carbonaceous shale**, dusky-brown 5YR 2/2……..…(330.8)

178. **Coal**, dirty, brownish-black 5YR 2/1, broken core recovered from shoe, BOR (switched to 10 ft split tube for short runs in coal)……(331.0) 0.2

179. **Coal**, with (reworked?) tonstein from 331.25 – 331.50 (Photo link). Coal was not described in order to be immediately sealed in desorption cannisters. Samples generally released no gas or absorbed head space gas and did so for several hours. Coal was rebagged on site for shipment to Reston and subsequent analysis as follows: USGS-PA-1.4 (331.0-334.0 ft, minus tonstein plus 0.10 coal 331.25 –331.50, sample USGS-PA-1.4T), USGS-PA-1.5 (334.0-337.0), USGS-PA-1.6 (337.0-340.0), USGS-PA-1.7 (340.0-343.0), USGS-PA-1.8 (343.0-346.0), USGS-PA-1.9 (346.0-347.7). 100 pct core recovery confirmed by elog. Coal was not described in detail before rebagging, but more detailed descriptions made in Reston occur in Chapter 3 of this volume (see cover sheet). BOR's at 335, 340, 345 ft, base grades……(347.7) 16.7

180. **Coal,** dirty**,** dusky-brown 5YR 2/2 to brownish-black 5YR 2/1, plant impressions along bedding, not desorbed, base grades……..……..(347.8) 0.1

181. **Claystone**, carbonaceous, dusky-brown 5YR 2/2, abundant coalified plant debris along bedding, base grades……...(348.1) 0.3

182. Core loss, **claystone** (elog), repositioned from unit 184 field description……(348.6) 0.5

183. **Siltstone**, olive-gray 5Y 4/1, clayey, with slightly irregular very fine-grained sandstone laminations < 1 mm thick, siltstone laminations < 5 mm….....(348.9) 0.3

0.8
183. Core loss, **siltstone** (elog)…… (349.7)

184. Interlaminated **siltstone** and sandstone like unit 183, subparallel 0.3
bedding, possibly some low-angle planar crossbedding, BOR……(350.0)

0.5
185. **Claystone**, dark-gray, laminated……..(350.5)

186. **Sandstone**, very fine grained, interlaminated with clayey and silty 0.9
carbonaceous layers, rippled with some cross-bedding……... (351.2)

187. **Siltstone**, interlaminated with very fine-grained sandstone and
claystone, flaser-type bedding, some burrows, laminae a few mm 3.8
thick, rippled in places, BOR……... (355.0)

188. **Sandstone** (50 pct), very fine-grained, with interlaminated olive-gray 0.5
clayey siltstone, flat parallel mm-scale laminations……(355.5)

189. **Sandstone** with interlaminated siltstone, similar to unit 188, but
bedding is more irregular, psuedo flasers, sandstone laminations 1.5
are up to 10 mm thick, a few carbonaceous laminae……... (357.0)

190. **Sandstone**, very fine-grained, olive gray 5Y 4/1, top massive, base 0.9
faintly bedded, a few pct dark minerals, micaceous, base grades……(357.9)

191. **Sandstone**, very fine-grained, with slightly irregular olive-gray siltstone
laminations, 70 pct sand, at base are some pseudo flasers, possible 2.1
ripples, possible horizontal burrows, BOR…….. (360.0)

0.2
192. Core loss, silty **sandstone** (elog)...…….(360.2)

193. **Sandstone** with interlaminated siltstone, similar to unit 191 except
bedding is flat subparallel to slightly disturbed, sandstone layers up to 3.0
30+ mm, some carbonaceous layers…….(363.2)

194. **Sandstone**, light-olive-gray 5Y 6/1 to greenish-gray 5GY 6/1, massive 1.3
to faintly bedded, few pct dark minerals and mica…….. (364.5)

195. **Siltstone** (60 pct), olive-gray, with flat-bedded sandstone laminations 0.5
as above, middle part more sandy, BOR……..(365.0)

0.2
196. Interlaminated **siltstone** and sandstone similar to unit 195……..(365.2)

1.6
197. **Sandstone**, light-olive-gray, massive, similar to unit 194……..……(366.8)

198. Interlaminated **siltstone** and sandstone similar to unit 195, flat 1.7
subparallel mm-scale laminations……(368.5)

1.5
199. **Sandstone**, light-olive-gray, similar to unit 194, BOR……(370.0)

200. **Sandstone**, similar to unit 194, silty matrix, some silty 2.9
laminations at base……...(372.9)

201. **Sandstone**, fine-grained, sideritic cement, very hard, very heavy, 0.2
micaceous, plugged the shoe……(373.1)

0.3
202. Core loss, **sideritic sandstone** (thickness from density log)……...(373.4)

203. **Core loss**, lithology undetermined (below gamma/resistivity TD), 1.6
BOR……..(375.0)

0.4
204. **Core loss**, lithology undetermined……...(375.4)

205. **Sandstone**, dark-gray N3 to olive-gray 5Y 4/1, very fine-grained,
silty, burrows, wavy laminations throughout, in places bedding 3.7
disrupted by bioturbation, grades into unit 206……(379.1)

206. **Sandstone**, light-olive-gray 5Y 6/1, low-angle cross-bed sets 3 cm 0.9
thick……..(380.0)

TOTAL DEPTH 380 FT

Borehole USGS–PA-2

Location: John Pilkington Ranch, Panola Co. TX, about 0.3 mi north of the Shelby Co. line and 8 mi west of the LA state line, 0.28 mi due SE of the intersection of county roads 430 and 439, Tenaha East 7.5' topographic sheet

Coordinates: lat 31°58'57.03" N, 94°09'07.38" W (GPS)

Ground elevation: 253 ft. (estimated from topographic map)

Total depth: 400 ft.

Driller: Lloyd Morris, Texas A&M University

Drill rig: truck-mounted Mobile Drill

Drilling method: Continuous wireline coring, split 10 ft inner-tube or 5 ft spring loaded push tube with shoe (similar to Dennison sampler)

Bit type: tungsten-carbide/diamond HC 4.75" OD, 2.5" core

Drilling medium: bentonite mud

Casing: none (PVC to 6 ft)

Geophysical logs: Natural gamma, caliper, gamma-gamma density, resistivity

Dates drilled: 21 June 99 to 28 June 99

Rock descriptions by: J. SanFilipo, P. Warwick, D. Torres Pulliza, W. Wallace, R. Tingook (USGS)

Remarks: Drilled soft units with 5 ft solid push tube
Drilled hard units and coal with 10 ft split tube, various run lengths
Desorbed coal from 355 to 373 feet with measurable but small quantities of gas recovered. Desorption was completed in the field by 6/29/99.
More detailed descriptions of coal beds done in laboratory settings after desorption completed can be found in Chapter 3, this volume.

Abbreviations used:

TOR –Top of run
BOR – Bottom of run
Elog – geophysical log
vfg - very fine-grained
carb - carbonaceous

Unit Number	Description (primary lithology in bold)	Thickness (Depth) ft.
1.	**Soil**, sandy loam, pale-brown 5YR 5/2……	0.6 (0.6)
2.	**Soil**, clay, mottled moderate-reddish brown 10R 4/6 to dark-yellowish-orange 10 YR 6/6, Bottom of Run (BOR)……...	1.4 (2.0)
3.	**Soil**, loamy, pale brown sand-like unit 1 grading into mottled clay-like unit 2, base grades……	0.4 (2.4)
4.	**Sandstone**, dark-yellowish-orange, very fine-grained, with yellowish-gray 5Y 7/2 clay matrix, weathered.....……	1.1 (3.5)
5.	**Sandstone**, pale-yellowish-orange 10 YR 8/6, very fine-grained, salt and pepper, a few pct dark minerals, weathered, BOR……	0.5 (4.0)
6.	**Claystone**, pale-yellowish-brown 10YR 6/2, with interlaminated weathered sandstone that is dark yellowish orange, a few pct dark minerals, micaceous.....……..	1.9 (5.9)
7.	**Sandstone**, grayish-orange 10YR 7/4, otherwise as above, slightly weathered, BOR (switched from augur coring to 5 ft push tube)……	0.1 (6.0)
8.	**Core loss**……...	0.5 (6.5)
9.	**Sandstone**, moderate-yellowish-brown 10YR 5/4, mottled with dark to pale-yellowish-orange streaks and pale-yellow clay bands, weathered, sand is very fine grained, clayey, salt and pepper, BOR……	3.5 (10.0)
10.	**Core loss**…….	0.4 (10.4)
11.	**Sandstone**, pale-yellowish-brown 10YR 6/2, very fine-grained, clayey, appears massive but base grades, hematite band at 11 ft a few mm thick	2.5 (12.9)
12.	Interlaminated pale-yellowish-orange **sandstone** and pale-yellowish-brown claystone, weathered, sandstone is very fine-grained, salt and pepper, laminae are 1 – 2 mm thick, sharp contact with unit 13……	1.7 (14.6)

13. **Sandstone**, pale-yellowish-brown, very fine-grained, salt and pepper, appears somewhat less weathered, BOR……(15.0) 0.4

14. **Sandstone**, similar to unit 13, but more weathered, a few dark-yellowish-orange streaks, clayey……(18.5) 3.5

15. Core loss, clayey **sandstone** (elog)……(19.5) 1.0

16. **Sandstone**, pale-yellowish-orange, similar to unit 14, BOR…….(20.0) 0.5

17. Core loss, sandy **claystone**? (elog)…… (21.0) 1.0

18. **Clayey** sandstone similar to unit 14, a few cm siderite at 22.7 ft……..(25.0) 4.0

19. Core loss, clayey **sandstone**? (elog)……..(26.2) 1.2

20. **Sandstone** similar to unit 14……..(26.9) 0.7

21. **Siderite**?, very hard……(27.2) 0.3

22. **Sandstone**, very fine-grained, pale-yellowish-brown, salt and pepper, micaceous, slightly weathered, similar to above but with carbonaceous cross-laminations < 1 mm thick, BOR……...(30.0) 1.8

23. Core loss, clayey **sandstone**? (elog)……..(30.8) 0.8

24. **Sandstone**, very fine-grained, pale-yellowish-brown with a few dark-yellowish-orange streaks, some weathered carbonaceous laminae, BOR (35.0) 4.2

25. Core loss, sandstone (elog)…….(37.0) 2.0

26. **Sandstone**, very fine-grained, similar to above, drilling too fast to describe in detail, BOR…….. (40.0) 3.0

27. Core loss in **sandstone** (elog)…… (41.2) 1.2

3.8
28. **Sandstone** similar to unit 26, BOR……(45.0)

5.0
29. Core loss in **sandstone** (elog), BOR……..(50.0)

30. **Sandstone**, similar to above, top is dark-yellowish-orange and still 2.3
very weathered, sharp contact with unit 31……(52.3)

31. **Claystone**, brownish-gray 5YR 4/1, moderately carbonaceous, silty,
massive, top is weathered dark-yellowish-orange (possibly siderite or 0.7
weathered coal), base grades, sample PA-2-A 52.9-53.0 (pollen)…….(53.0)

32. **Sandstone**, pale-yellowish-brown, very fine-grained, salt and pepper, 2.0
coal streaks at base, BOR……...(55.0)

0.6
33. Core loss in **sandstone** (elog)…… (55.6)

34. **Sandstone**, light-olive-gray 5Y 5/2 with a few dark-yellowish-orange
streaks, base of weathering about 57 ft, salt and pepper with abundant 4.4
dark minerals, a few oxidized carbonaceous streaks, BOR……... (60.0)

35. **Sandstone**, light-olive-gray, very fine-grained grading to fine-grained in
places, clean, salt and pepper, abundant (~2 pct) dark minerals, some
quartz grains are watery clear, slightly inclined carbonaceous 5.0
laminations from 61.4 to 64.8, otherwise massive, unweathered, BOR… (65.0)

0.4
36. Core loss, **sandstone** (elog)……... (65.4)

37. **Sandstone**, similar to unit 35, grains are subangular, watery clear quartz
grains throughout, faint crossbedding throughout - most obvious on 4.6
carbonaceous layers, BOR……(70.0)

3.2
38. Core loss in **sandstone** (elog)…… (73.2)

1.7
39. **Sandstone** like unit 37……...(74.9)

0.1
40. **Siderite**, may have come from higher up, BOR…… (75.0)
5.0
41. Core loss in **sandstone** (elog), BOR……..(80.0)

5.0
42. **Sandstone** like unit 37, coaly layer from 83.1-83.2, BOR……(85.0)

1.0
43. **Sandstone** like unit 37, 10 cm siderite at 85.2……...(86.0)

3.2
44. Core loss in **sandstone** (elog)…… (89.2)

0.5
45. **Sandstone** like unit 37……...(89.7)

46. **Sandstone**, coaly, with 10 cm siderite layer at 89.9, very coaly below 0.3
that, BOR……(90.0)

47. **Sandstone**, light-olive-gray 5Y 5/2, medium-grained, angular to subangular watery clear quartz, some doubly terminated, 2 – 3 pct dark minerals, some basaltic hornblende, coaly streaks top and base (nb: due to very fast penetration rate sand from 40 – 90 ft could not be adequately described on site; grain size may be coarser than vfg, 2.3
on gamma log looks like first increase came at about 76 ft)……..(92.3)

48. Core loss, **sandstone**, repositioned from TOR to match elog, base is 2.7
argillaceous, possibly coaly from about 93 – 94, BOR……..(95.0)

1.2
49. Core loss, **siderite**? (elog)……..(96.2)

0.1
50. **Sandstone** like unit 47, sharp contact with unit 51……(96.3)

0.2
51. **Coal**, base grades, sample PA-2-B (pollen)……...(96.5)

0.1
52. **Claystone**, light-olive-gray, sandy, sharp contact with unit 53……(96.6)

53. **Claystone**, yellowish-gray 5Y 8/1, tonstein?, siderite? (some fizzing 0.1
with 10 pct HCL), sample PA-2-R1, sharp contact with unit 54……...(96.7)

54. **Sandstone**, light-olive-gray, very fine-grained, interlaminated with olive-gray 5Y 4/1 silty claystone, bedding is flat to slightly inclined, planar to slightly wavy, 8 cm yellowish gray clay band at 98.3 (**tonstein**?), 3.3
sample PA-2-C 97.8-98.0 (pollen/dinocystss), BOR……...(100.0)

55. Interlaminated **sandstone** and claystone similar to unit 54, flat- to ripple-bedded, sharp contact with unit 56……(103.1) 3.1

56. Yellowish-gray **claystone** like unit 53 (tonstein?), (Photo) very clean, sharp contact with unit 57……(103.18) 0.08

57. Interlaminated **sandstone** and claystone similar to unit 55, base is more sandy (registers to 104 ft on gamma log?), a few yellowish-gray claystone layers like unit 56 but contacts less sharp, BOR…… (105.0) 1.82

58. **Claystone**, olive-gray 5Y 4/1 with light-brownish- gray bands in places, silty, interlaminated with light-olive-gray very fine grained sandstone as above, 70 pct clay, top(?) and base grade, sample PA-2-D (pollen) 107.9-108.0…… (108.5) 3.5

59. **Sandstone** interlaminated with claystone, similar to unit 58 but about 60 pct sand (contact picked from elog), BOR……(110.0) 1.5

60. **Mudstone**, subequal silty claystone and interlaminated very fine-grained sandstone similar to above, sharp contact with unit 61……...(112.4) 2.4

61. **Claystone**, yellowish-gray, very hard, probably sideritic…….……..(112.5) 0.1

62. Core loss, siderite, repositioned from TOR to match elog……...(112.8) 0.3

63. **Claystone**, with sandstone, lamiae, very disturbed bedding, probably a small (intraformational?) **fault** (Photo) ……...(113.2) 0.4

64. **Mudstone** similar to unit 60, base carbonaceous, BOR……..(115.0) 1.8

65. **Carbonaceous claystone**, greenish-black 5GY 2/1, sample PA-2-E 115.2-115.3 (pollen)……(115.5) 0.5

66. **Sandstone**, light-olive-gray, very fine grained, with silty olive-gray claystone laminations 1 – 2 mm thick, base grades……(115.9) 0.4

67. **Sandstone**, light-olive-gray with some greenish-black carbonaceous zones, somewhat dirty, consisting of very fine to fine-grained quartz with abundant dark minerals, very hard, sideritic cement, possible lithic fragments although these may actually be recrystallized zones, good density kick……(116.3) 0.4

68. Core loss, probably **sandstone** with interlaminated claystone similar to unit above (elog), BOR……..……... 3.7 (120.0)

69. Core loss, probably sandstone and interlaminated **claystone** (elog)…… 1.6 (121.6)

70. **Sandstone**, light-olive-gray, fine-grained, with light brownish gray 5YR 6/1 claystone laminae about 1 mm thick, a few sub-mm carbonaceous laminae throughout, some cross-bedding?, top is clean, base more clayey, BOR……. 3.4 (125.0)

71. **Sandstone**, light-olive-gray, very fine-grained, sugary, ~2 pct dark minerals, interlaminated with dusky yellowish brown 10YR 2/2 clayey siltstone, sandstone laminae <1 to 7mm thick, slst < 1 mm, 60 – 70 pct sand, flat- to wavy bedded…… 3.8 (128.8)

72. Core loss, probably sandy **siltstone** (elog, moved from TOR)…… 0.5 (129.3)

73. **Siltstone**, olive-gray 5Y 4/1 to dark-greenish-gray 5GY 4/1, clayey, has sandstone laminae < 1 mm thick regularly coupled with 5 mm siltstone laminae, BOR, this was excess recovered in next run……... 0.7 (130.0)

74. **Siltstone** similar to unit 73, top is rythmically bedded, base is color-banded but more massive and less sandy, sample PA-2-F (pollen) 134.0-134.2, BOR (switched to split tube)…… 5.0 135.0

75. **Siltstone**, dark-gray, laminated, scattered burrows, becomes more carbonaceous and black towards base…….. 2.5 (137.5)

76. **Carbonaceous shale**, dark-gray, silty, base grades, sample PA-2-G 137.9-138.0 (pollen)……. 0.7 (138.2)

77. **Coal**, black, blocky, cleated, base grades (elog coal thickness 0.8 ft), sample PA-2-H 138.2-138.4 (pollen)……... 0.4 (138.6)

78. **Carbonaceous shale**, dark-gray, plant debris, large stems and leaves, base grades, sample PA-2-I 140-140.2 (pollen)……... 1.6 (140.2)

79. **Siltstone**, dark-gray, laminated…… 1.1 (141.3)

80. **Siltstone**, coaly streaks, roots…….. 1.2 (142.5)

81. Core loss, probably very fine-grained **sandstone** with interlaminated 2.5
siltstone as above, BOR (swiched to 5 ft tube?)…….. (145.0)

2.6
82. Core loss, probably **sandstone** like unit 83 (elog)……...(147.6)

83. **Sandstone**, medium-gray, very fine-grained, with dark minerals,
mica, and organic debris, small cross beds and mm-scale clay lenses 2.4
in top part, bottom part is more silty and dense, BOR…….(150.0)

84. Core loss, probably very fine-grained **sandstone** with interlaminated 2.3
siltstone similar to unit 85 (elog)……..(152.3)

85 **Sandstone**, olive-gray 5Y 4/1, very fine-grained, silty, thin (< 1 mm)
siltstone laminae throughout, at 154.2 laminae are inclined, near base 2.7
some are carbonaceous, BOR……...(155.0)

86. **Sandstone** and interlaminated siltstone similar to unit 85, top is sandier,
middle part is rippled, base is more clayey, with lutaceous laminae up to 1.8
5 mm thick……(156.8)

3.2
87. Core loss, probably **sandstone** similar to unit 85, BOR……..(160.0)

1.2
88. Interlaminated **sandstone** and siltstone similar to unit 85……...(161.2)

89. **Carbonaceous claystone**, brownish-black 5YR 2/1 to greenish-black 0.4
5GY 2/1, plugged shoe, sample PA-2-J (pollen)……. (161.6)

90. Core loss, **carbonaceous claystone** (elog), 0.8 loss described as from 0.3
TOR in field repositioned to match unit 89 to elog……. (161.9)

91. Core loss, interlaminated **sandstone** and siltstone as above, possibly 3.1
more sandy (elog), BOR……...(165.0)

0.1
92 Core loss, interlaminated **sandstone** and siltstone as above……(165.1)

93. **Sandstone**, light-brownish-gray with light olive gray mottling, very fine-
grained, silty, top is massive to faintly bedded, base shows distinct 4.9
(climbing?) ripples that enhance mottling, BOR……. (170.0)

0.8
94. Ripple-bedded **sandstone**, same as base of unit 93……(170.8)

95. Core loss, probably **sandstone** similar to unit 94, contact with unit 96 looks sharp on resistivity log, BOR…… 4.2 (175.0)

96. **Mudstone**, sandy, clayey siltstone, olive-black 5Y2/1, faintly bedded abundant coaly debris on bedding, some sandy laminations, micaceous?, sharp contact with unit 97, some light-brown friable sand in sharp contact at top appears dropped from prior run……... 1.0 (176.0)

97. **Sandstone**, very fine to fine-grained, dirty, micaceous, abundant dark minerals and tan lithic fragments, well-indurated, faint bedding at base grades into unit 98…… 0.6 (176.6)

98. **Siltstone**, brownish-black 5YR 2/1 (chocolate), mostly massive, a few very fine grained sand laminae, base grades…… 1.7 (178.3)

99. **Siltstone**, olive-gray 5Y 4/1, with very fine grained sand streaks and flasers……. 0.9 (179.2)

100. Core loss, clayey **siltstone** (elog), BOR……... 0.8 (180.0)

101. **Siltstone**, olive-gray, with interlaminated light olive gray very fine-grained sandstone (5Y 6/1?), flat to slightly disturbed bedding, sub-mm scale laminations…… 1.7 (181.7)

102. Core loss, probably interlaminated **siltstone** and sandstone similar to units 99 and 101, BOR (tube not latching?)……. 3.3 (185.0)

103. **Siltstone**, similar to unit 101, flat-bedded, silt laminae are several mm thick, sand < 1 mm……... 3.0 (188.0)

104. Core loss, **claystone**? (elog), shoe plugged, stopped run short, BOR (switched to 10 ft split tube)……. 1.0 (189.0)

105. **Siltstone** like unit 103, slightly sandier, badly broken core, may be out of place, tube probably did not latch…….. 0.5 (189.5)

106. Core loss, interlaminated **siltstone** and sandstone (elog), BOR, tube would not latch for next run and could not be retrieved, pulled rods and switched to 5 ft solid tube, redrilled 190-195, again no recovery…. 5.5 (195.0)

107. Core loss, interlaminated **siltstone** and sandstone (elog)……. 0.3 (195.3)

108. **Siltstone**, olive-gray, with very disturbed sand laminations, may be disrupted by drilling problems, but lithology ok on elog……. 0.5 (195.8)

109. **Sandstone**, olive-gray, fine- to very fine-grained, silty, very bioturbated, 1.4
no obvious bedding, coal spars at 196.6-196.7, sharp contact at base….(196.9)

110. **Sandstone**, light-olive-gray, very fine-grained, salt and pepper, 2 – 3 pct 3.1
dark minerals, micaceous, massive, BOR……(200.0)

111. **Sandstone**, light-olive-gray, very fine-grained, micaceous, sub-mm 0.3
scale carbonaceous laminae, flat-bedded, in place?…….(200.3)

0.95
112. **Sandstone**, similar to unit 110 except some faint bedding……(201.25)

113. **Sandstone**, mottled: light-olive-gray, white, brownish-black, very fine-
grained, flat-bedded, coaly fragments on laminae, calcareous (fizzes 0.05
readily), very hard (plugged shoe), sharp contact with unit 114……(201.30)

114. **Siltstone** with interlaminated very fine-grained sandstone, soft, badly 0.3
broken (pushed from shoe), looks out of place on elog……...(201.6)

115. Calcareous **sandstone** similar to unit 113, except high angle planar
cross-bed sets at top scouring out flat laminar beds at base, no coal 0.2
fragments observed, BOR, switched to 10 ft split tube……(201.8)

116. Calcareous **sandstone**, flat-bedded, no coal fragments, (nb: units 113,
115, 116, fizz readily without powdering and are thus presumed to be 0.8
cemented by calcite, but high density kick may indicate high Fe/Mg)…(202.6)

117. Core loss, probably interlaminated **siltstone** and sandstone, more 2.3
sandy than unit 118 (elog)……(204.9)

118. **Siltstone**, olive-black 5Y 2/1 to olive-gray 5Y 4/1, with very fine- 1.7
grained sandstone laminations, core badly broken……...(206.6)

118. Calcareous **sandstone**, flat to disturbed bedding, some cross-beds, 1.0
very hard, cone-in-cone structures at several places, no coal frags……. (207.6)

119. Core loss, calcareous **sandstone** (elog), repositioned from unit 117 1.4
to match elog……(209.0)

0.8
120. Core loss, **sandstone** similar to unit 121 (elog)……...(209.8)

121. **Sandstone**, olive-gray, fine- to very fine-grained, silty, very 0.2
bioturbated, BOR (switched to split spoon)…….(210.0)

122. **Sandstone**, light-olive-gray, very fine-grained, finely bedded, 2.3
probably bioturbated, sharp contact with unit 123……...(212.3)

123. **Sandstone**, fine-grained, very dirty, about 5 pct dark minerals, no coal
spars, hard, heavy, does not effervesce with HCL, probably sideritic 0.1
cement, BOR (switched to 10 ft split tube)……..(212.4)

124. **Sandstone**, light-olive-gray mottled with iron staining, fine-grained,
disturbed bedding, generally hard but soft and uncemented in places, 4.9
slight HCL effervescence if powdered, sideritic and/or calcite cement...(217.3)

1.2
125. Core loss, probably sideritic **sandstone** as above (elog)……. (218.5)

1.5
126. **Sandstone** like unit 124, BOR…….(220.0)

127. **Sandstone**, olive-gray, very fine-grained, muddy, very bioturbated, 2.4
scattered coal spars, well-indurated but not cemented, base grades…… (222.4)

128. **Sandstone**, fine- to very fine-grained, siltier than unit 127, siderite?
band at top, sand is in lenses, well-indurated but not cemented, 2.6
sharp contact with unit 129…….. (225.0)

129. **Sandstone**, fine-grained, dirty matrix, more dark minerals and coal spars
than above, hard, no fizz, siderite? cement, bedding obscured by coring 0.5
grooves……..……... (225.5)

3.8
130. Core loss, probably **siltstone** similar to unit 131 (elog)……...(229.3)

131. **Siltstone**, olive-gray to brownish-gray, massive, a few very fine- 0.7
grained sand lenses, BOR (tube stuck, pulled rods before next run)…... (230.0)

132. **Siltstone**, dusky-yellowish-brown 10YR 2/2 to brownish-black 5 YR 2/1,
moderately carbonaceous, scattered horizontal sand-filled burrows,
abundant pyritized plant debris on bedding planes but appears massive, 9.9
compact, well-indurated, base grades…….. (239.9)

133. **Siltstone**, similar to unit 132, but with a few very fine to fine-grained 0.1
sand laminae that are disturbed, possibly by core being spun, BOR…... (240.0)

0.2
134. **Siltstone**, same as unit 133, excess from last run…… (240.2)

135. **Sandstone**, olive-gray 5Y 4/1, very fine to fine-grained, subrounded, 4.8
muddy, <1 pct dark minerals, some coal spars, very bioturbated, BOR..(245.0)

0.1
136. Core loss in **sandstone** (elog)…….. (245.1)

137. **Sandstone**, light-olive-gray 5Y 6/1, fine-grained, subrounded, mostly
massive but a few clayey layers and thin coaly laminae throughout,
a few carbonaceous laminae at base, top half bioturbated, sharp 4.7
contact with unit 138……(249.8)

138. **Siltstone**, olive-black, 5Y 2/1 (chocolate), moderately carbonaceous,
sub-mm scale sandstone laminae throughout, sand is very fine grained, 0.2
sugary, micaceous, sample PA-2-K 249.9-250.0 (pollen), BOR…….(250.0)

139. **Siltstone**, similar to unit 138, but some sandstone laminae are up to
several mm thick and show (internal?) scouring, base is more sandy 1.4
but contact with unit 140 is sharp…….(251.4)

140. **Sandstone**, light-olive-gray, very fine-grained, with watery clear quartz, 0.5
a few percent dark minerals, micaceous……...(251.9)

141. **Coal**, light splintery (fusain?), some previtrain bands, sample 0.2
PA-2-L 251.9-252.1 (pollen)……(252.1)

142. Core loss in **coal** (elog), repositioned from 251.8-253.5 to reconcile elog, 1.7
BOR (run stopped short due to coal)……(253.8)

143. Core loss, probably **dirty coal** (elog), repositioned from BOR, 1.3
placement is questionable, see unit 144……... (255.1)

144. Very carbonaceous **shale**, brownish-black 5YR 2/1, with black coaly
plant debris, fairly brittle, almost a coaly shale, massive except for coaly
debris, scattered matrix-supported sand grains, base grades (nb: this unit
may actually be part of the dirty coal ascribed to unit 143), sample 0.6
PA-2-M 255.1-255.3 (pollen)……...(255.7)

145. Carbonaceous **shale**, dusky-yellow-brown 10YR 2/2, less coaly than
unit 144, has an ashy texture (volcanic detritus?) and abundant very
pale orange 10YR 8/2, irregular kaolin streaks, sample USGS-PA-2-2R 0.7
(tonstein) from 255.9 – 256.0……...……(256.4)

146. **Coal**, black, dull, nonbanded, conchoidal fracture, pyritic lamella 0.03
on bedding……..(256.43)

147. **Carbonaceous shale** similar to unit 145 except has very fine to fine-grained sugary sandstone laminations……...(256.90) 0.47

148. **Coal**, black, dull, nonbanded, conchoidal fracture, sandy horizontal burrows…….(257.0) 0.1

149. Core loss, probably **sandstone** (elog), BOR……(260.0) 3.0

150. Core loss, probably coarsening-up **sandstone** (elog)……...(262.5) 2.5

151. Sandy **coal**, very dirty, out of place?, driller placed here, elog shows shaley zone in sand……...(262.8) 0.3

152. Core loss, probably coarsening-up **sandstone** (elog), BOR…… (265.0) 2.2

153. **Sandstone**, light-olive-gray, very fine grained, subangular, well-sorted, sugary, faintly flat-bedded to massive, some horizontal burrows, carbonaceous laminae in places, more in bottom half, BOR……... (270.0) 5.0

154. **Sandstone**, light-olive-gray 5Y 6/1, muddy, abundant small-scale low-angle cross-sets (ripples?) that show internal scouring, cross-sets are comprised of carbonaceous laminae < 1 mm thick and sand laminae from one to several mm thick, cross-sets are in regular 10 mm couplets that may be tidal in origin, also some flat parallel planar laminations, sharp contact with unit 155…….. (273.4) 3.4

155. **Coal**, brownish-black to black, nonbanded, brittle, sharp contact with unit 156……...(273.45) 0.05

156. **Sandstone**, similar to unit 154, but bedding is very disturbed, looks compaction or small-scale fault related, BOR……... (275.00) 1.55

157. Carbonaceous **siltstone**, dark-yellowish-brown 10YR 4/2 (chocolate), pyritized plant fragments on bedding, top is more carbonaceous, base grades……... (276.7) 1.7

158. **Siltstone**, light-brownish-gray 5YR 6/1, lighter color and less carbonaceous than unit 157, base grades……. (278.3) 1.6

159. **Sandstone**, light-olive-gray to light-brownish-gray, very fine-grained, muddy, faint flat-bedded laminations, some green minerals - possibly glauconite (see unit 168)……..(278.9) 0.6

160. Core loss, probably sandy **mudstone** similar to unit 161, repositioned 1.4
from BOR to reconcile unit 163 to resistivity log……(280.3)

161. **Mudstone**, light-olive-gray to olive-gray, sandy silt matrix with 0.7
abundant sand-filled burrows, sharp contact with unit 162……. (281.0)

162. **Sandstone**?, very hard, no effervescence with HCL, matrix is very
sparry and carbonate may dominate over quartz, large brick-red 0.8
broad-leaf impression……...(281.8)

0.2
163. Core loss, sideritic **sandstone** (elog), repositioned from BOR……(282.0)

164. **Sandstone**, very fine grained, light-olive-gray to light-gray, salt and 0.3
pepper……...(282.3)

165. Core loss, probably **sandstone** like unit 164, BOR (switched to 5 ft 2.7
solid tube)……(285.0)

166. **Sandstone**, light-olive-gray, very fine to fine-grained, salt and pepper, 4.0
a few pct dark minerals, micaceous, very faintly bedded…… (289.0)

1.0
167. Core loss, probably **sandstone** like unit 166, BOR……(290.0)

168. **Sandstone**, similar to unit 166, has light and dark green minerals
which appear to be epidote based on color and luster, but may 4.6
be glauconite, very friable……(294.6)

0.4
169. Core loss, **sandstone** as above (elog), BOR…… (295.0)

170. **Sandstone**, similar to unit 168, 1 – 2 pct dark minerals, BOR, 1.4
(switched to split tube).....……...(296.4)

171. **Sandstone**, light-olive-gray, very fine-grained?, hard, matrix effervesces
with HCL if powdered, siderite? (dolomite?), sub-mm-scale flat-bedded
laminations (artifacts of spun core?), abundant coalified plant debris 1.6
along bedding, abundant tannish-brown lithic? fragments throughout…(298.0)

172. Carbonaceous **siltstone**, dusky-yellowish-brown 10YR 2/2, with sand-
filled vertical burrows, grades downward to less-carbonaceous olive-gray 0.5
5Y 4/1 mudstone with light-olive-gray 5Y 6/1 muddy sand layers…….(298.5)

2.0
173. Core loss, probably sandy **mudstone** like the base of unit 172 (elog)….(300.5)

1.2
174. Core loss, probably muddy **sandstone** like unit 175 (elog)…….(301.7)

175. **Sandstone**, light-olive-gray, very fine to fine-grained, muddy, 0.6
massive, base grades…… (302.3)

176. **Siltstone**, brownish-gray 5YR 4/1, muddy, micaceous, vertical sand- 0.5
filled burrows……... (302.8)

177. Hard **sandstone**, similar to unit 171 but somewhat siltier and does not 0.2
effervesce, abundant carbonaceous laminae at base…… (303.0)

178. Core loss, probably **sandstone** similar to unit 175 (elog – repositioned 2.0
from units 173-174 to match 177 with density log), BOR…… (305.0)

179. **Sandstone**, olive-gray 5Y 4/1, very fine grained, very muddy, almost 0.4
a mudstone, massive…….(305.4)

0.6
180. Core loss, probably **sandstone** like unit 179……(306.0)

0.2
181. **Siltstone**, olive-black 5Y 2/1, slightly carbonaceous, base grades……..(306.2)

0.3
182. **Siltstone**, similar to unit 181, sandy…… (306.5)

0.5
183. **Siltstone**, same as unit 181, base grades……..(307.0)

0.5
184. **Mudstone**, olive-black, subequal amounts of sand silt and clay…….(307.5)

1.0
185. **Siltstone**, similar to unit 181, contains resin? specks, base grades……..(308.5)

186. **Siltstone**, olive-gray, grading down to olive-black, with very fine- 1.3
grained flat-bedded sand laminae < 1 mm thick in the bottom part…….(309.8)

2.2
187. Core loss, probably **siltstone** similar to unit 181 (elog)……...(312.0)

188. Core loss, probably sandy **siltstone** similar to bottom part of unit 186 (elog)……. 2.4 (314.4)

189. **Siltstone**, similar to bottom part unit 186, but bedding is disturbed, BOR (this was excess recovered in next run)…….. 0.6 (315.0)

190. **Siltstone**, olive-black, muddy, with sub-mm-scale sandstone laminae and thicker lenses, bedding is flat to slightly inclined and possibly internally scoured (ripples?), possible horizontal burrows, siderite? band at 318.3 ft, BOR (continuing short runs with split tube to minimize core loss)… 4.0 (319.0)

191. **Siltstone**, olive-black, clayey, sand laminations < 1 mm thick throughout, flat-bedded, base is less sandy with siltstone bands getting thicker (5-10 mm) towards base, sample PA-2-N 319.2-319.3 (pollen)……..(322.9) 3.9

192. Core loss, **siltstone**, BOR…….(323.0) 0.1

193. **Siltstone**, olive-gray, mostly massive, with some sub-mm-scale sand laminae and lenses……... (324.1) 1.1

194. **Siltstone**, same as above but bedding is disturbed, recovered by redrilling with 5 ft solid tube, placement is estimated from elog…….(325.1) 1.0

195. Core loss, **siltstone** slightly more sandy than unit 194 (elog), possibly sideritic in places (density), BOR, switched to 5 ft solid tube……(330.0) 4.9

196. **Siltstone**, olive-gray 5Y 4/1 to brownish-gray 5YR 4/1, very regular sub-mm to mm-scale sand laminations throughout, sets of thin laminae are coupled with thicker sand bands at very regular 25 mm intervals (tidal rhythmites?), 10 mm carbonaceous band at 334 ft, sample PA –2-3R for isotopes, BOR……(335.0) 5.0

197. **Siltstone**, olive-black 5Y 2/1, regular sandstone laminations throughout, sandstone is very fine grained, sugary, and micaceous, bedding is similar to unit 196 except at base cycles are compressed, sandier, and slightly inclined, carbonaceous layer at 338.6, pollen sample PA-2-O 338.6-338.7……...(340.0) 5.0

198. **Siltstone** same as unit 197 (excess recovered from prior run)……(340.1) 0.1

199. Core loss, **siltstone** similar to above (elog)……..(340.2) 0.2

200. **Siltstone** similar to above, olive-gray to olive-black, bedding is flat laminar to slightly inclined to slightly wavey, fairly regular cycles…… 3.3 (343.6)

201. **Siltstone**, olive-black, sideritic…… 0.1 (343.7)

202. Core loss, probably **siltstone** slightly more sandy than above, BOR (switched to 10 ft tube but doing 5 ft runs)……..(345.0) 1.3

203. **Siltstone**, similar to above, olive-black, sand laminae are flat-bedded to slightly inclined, becoming closer spaced and ripple bedded at 348.1, at 345.7 and 346.1 ft there are ash or sideritic bands 10 mm and 5 mm thick respectively (this unit was repositioned from 346.3-350), sample PA-2-P 346.6-346.7 (pollen)……(348.7) 3.7

204. Core loss, sandy **siltstone** (elog), BOR……(348.8) 0.1

205. **Siltstone**, similar to unit 203, but sand laminae are generally closer together and base is less sandy. This unit was recovered in run from 350-355, but has been repositioned from 350.4-354.7 to reconcile top of coal to elog. Apparently core dropped from several 5 ft runs drilled with 10 ft tube in place……. (353.1) 4.3

206. **Mudstone**, dusky-yellowish-brown 10YR 2/2, similar to laminated siltstones above, but sand is more disseminated in a silty matrix. Some lenses of very fine-grained sand, some horizontal burrows, possibly some flasers and current rippling at the top and middle. Unit was recovered in run from 355-360 (total recovery in run 5.3 ft)……...(355.0) 1.9

207. **Coal**, immediately placed in desorption canisters and not described at drill site. Sample numbers below refer to desorption canisters and any subsequent analysis (e.g. prox/ultimate). Depth adjustments were made to reconcile with elogs under the assumption that core was dropped from 5 ft runs made with the 10 ft split tube. Desorption was completed in the field, and some samples (CN8-17) were briefly described as noted below before rebagging for shipment. More detailed descriptions occur elsewhere in this volume (Chapter 3). CN1T is a (reworked?) tonstein estimated 80 pct clay/20 pct organic. It was included in the canister 1 desorption, but reserved for radiometric dating and not submitted for proximate/ultimate or trace element analyses with the other samples. BOR's at 360.0, 365.0, 370.0, and 375.0 ft.

USGS-PA-2-CN1T, 355.0-355.15 (adjusted from 356.6-356.75)
USGS-PA-2-CN1, 355.15-356.0 (adjusted from 356.6-357.6)

USGS-PA-2-CN2, 356.0-357.0 (adjusted from 357.6-358.6)
USGS-PA-2-CN3, 357.0-358.0 (adjusted from 358.6-359.6)
USGS-PA-2-CN4, 358.0-358.4 (adjusted from 359.6-360.0)
USGS-PA-2-CN5, 358.4-359.4 (adjusted from 360.0-361.0)
USGS-PA-2-CN6, 359.4-360.5 (adjusted from 361.0-362.1)
USGS-PA-2-CN7, 360.5-361.4 (adjusted from 362.1-363.0)
USGS-PA-2-CN8C, 361.4-361.95 (adjusted from 363.0-364.0), coal is very dull attritus (earthy) with plant fragments along bedding.
USGS-PA-CN8P **parting** from 361.95-362.44
USGS-PA-2-CN9C, 362.44-363.27 (adjusted from 364.0-365.0), dull attritus, olive black 5Y 2/1, earth-looking, plant impressions along bedding, poor cleat, not brittle, appears somewhat dirty.
USGS-PA-2-CN9P, 363.27-363.40 **parting**
CORE LOSS in coal, 363.4-365.0 (bit plugged at 365.0, pulled split tube and dropped 5 ft push tube with wireline to clear bit.
PA-2-Q, 365.0-365.1, coal, not desorbed, back-up pollen sample taken from push tube shoe after clearing bit. Depth adjustments reconciled to this point.
CORE LOSS in coal, 365.1-365.4 (nb: cannister 10 not used, seal broken)
USGS-PA-2-CN11, 365.4-366.5, core badly broken, dull but less earthy than above, brownish-black 5YR 2/1 to black, some previtrain bands, a little blockier than above, but still fractures irregularly on bedding.
USGS-PA-2-CN12, 366.5-367.5, core badly broken, similar to CN11, brownish-black.
USGS-PA-2-CN13, 367.5-368.8, core badly broken, very dull and earthy looking with a brownish cast, a few previtrain bands (possible parting on elog)
USGS-PA-2-CN14, 368.8-370.0, core badly broken, somewhat more banded than CN13 but still very earthy.
USGS-PA-2-CN15, 370.0-371.0, new run, core intact, more banded than CN14, but still earthy appearance on bedding planes and face.
USGS-PA-2-CN16, 371.0-372.0, similar to CN15
USGS-PA-2-CN17, 372.0-373.0, possibly slightly more banded going down
PA-2-R, back-up pollen sample, core chips from approximately 373 ft.
CORE LOSS in coal, 373.0-373.2

18.2
Total **coal** unit 207……... (373.2)

208. Core loss, probably **coaly shale** or dirty coal (elog), possibly a thin bed of sandstone, BOR (swiched to 5 ft solid tube)……(375.0) 1.8

209. Core loss, presumably **coaly shale** (recovered loose sand, probably from above, but possibly in place)……(375.3) 0.3

210. **Coaly shale**, olive black, slickensides, coaly layers, est 50-60 pct ash, bottom 0.1 recovered next run, sample PA-2-S 375.6-375.7 (pollen)….(375.8) 0.5

211. **Siltstone**, olive-black 5Y 2/1 to greenish-black 5GY 2/1 (chocolate), clayey, coal spars, horizontal sand filled burrows, massive, BOR (bit plugged, this unit excess recovered from next run, 10 ft split tube)…… 0.4 (376.2)

212. **Siltstone**, same as unit 211, some sandy and resinous laminae at bottom, sample PA-2-T 378.6-378.7 (pollen)……..(379.0) 2.8

213. **Sandstone**, olive-gray, 5Y 4/1, very muddy, top is very fine-grained, micaceous, faintly laminated, with some disturbed bedding, probably bioturbated, base is fine- to very fine-grained, poorly sorted, 4-5 pct dark minerals, contains sand-sized lithic fragments, organic debris, throughout, faint cross-laminations and possible ripples, BOR……...(385.0) 6.0

214. Core loss, probably **sandstone** similar to unit 214 (elog)……(390.4) 5.4

215. **Sandstone**, similar to unit 213, very fine to fine-grained, poorly sorted, micaceous, 3-4 pct dark minerals, very faint mm-scale laminations which increase towards base, flat- to ripple-bedded, fairly indurated except soft from 390.8-391.4, base grades, isotope sample PA-2-4R 393.2-393.33 (394.0) 3.6

216. Interlaminated olive-black **siltstone** and light-olive-gray sandstone, sandstone is very fine-grained, sugary, micaceous, laminations are ~ 1 mm thick throughout, very regular, looks tidal, sample PA-2-U 394.5-394.6 (pollen/dinocysts), sample PA-2-5R 395.6-395.7 (isotopes), BOR. (395.0) 1.0

217. Interlaminated olive-black 5Y 2/1 **siltstone** and light-olive-gray 5Y 6/1 dirty sandstone similar to unit 216, mostly flat-bedded with a few pseudo-flasers, tope of core is badly broken…….(396.7) 1.7

218. Core loss……...(400.0) 3.3

TOTAL DEPTH 400 FT

Chapter 3

Laboratory coal core and tonstein descriptions/photos from boreholes USGS-PA-1 and USGS-PA-2

By Ronald W. Stanton[1] and John R. SanFilipo[1]

Chapter 3 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

[1]U.S. Geological Survey, Reston, VA
[2]U.S. Geological Survey, Denver, CO

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-----NOT TO SCALE-------

Texas Core USGS-PA-1

Laboratory redescriptions by Stanton/SanFilipo

Except as noted, all samples desorbed with no gas observed.

Final thickness and reconciliation to core/elog depths (ft).

Sample 1.1A *not desorbed* Sample 1.1B *not desorbed*	128.00–128.15–128.75–129.8	1.5 " Light grey-yellow clay (not included in sample) 1.5-8.5" dark clay, organic rich, laminae bedded, clayey streak 8.5-18.5" Attrital coal; few vitrain laminae <1mm minor chip fusain on breaks
Sample 1.2 *trace of gas*	129.8–130.7	Mix of attrital coal and finely laminated broken pieces; 12 pieces one piece dense; one has vitrain spars; one has laminations vitrain 1mm/attritus 5mm; two vitrain 3mm/attritus 1-2mm
Sample 1.3 *not desorbed*	130.7–132.8	Attrital coal and very finely laminated Half of blocks are attrital coal with sand burrows and fusain on all breaks Remaining blocks are very finely laminated (vitrain 2-3 mm/attritus 8-10 mm)
Sample 1.4 331.25-331.50 removed as sample 1.4T	331.0–334.0	2/5 of blocks are attrital rich with clay blebs 3/5 of blocks are fusain rich, laminated vitrain <1mm/attritus 1mm; near top is reworked(?) tonstein: 1.8" yellow brown kaolinitic clay flasers with 20 % coaly stringers at top; 1.2" coal with clay filled burrows at base - SAMPLE 1.4T (age-dating)
Sample 1.5	334.0–337.0	1/3 fusain-rich laminated; about 2" canneloid; 4" clay-rich attrital; 1/3 attrital rich with fusain, some clay burrows; 1/3 finely laminated with little fusain; 4 " woody
Sample 1.6	337.0–340.0	Attrital/fusain laminated coal 2" woody chunk
Sample 1.7	340.0–343.0	Finely laminated, fusain-rich coal
Sample 1.8	343.0–346.0	Attrital-rich coal blocks with fusain chips; mostly attritus; no appreciable vitrain spars; one block has about 50/50 fusain-rich and attrital blocks
Sample 1.9	346.0–347.7	Attrital coal Few vitrain spars about 1mm 4 pieces about 3.5" of lam clay-rich/coal very fissile

(refer to core descriptions for sampling details)

Key to facies descriptions

- unlaminated attrital coal
- finely laminated attrital coal
- finely laminated vitrain/attrital coal
- moderately laminated vitrain/attrital coal
- fusain rich
- woody
- parting
- dirty coal

nb: orientation of facies within sample intervals was reconstructed to the degree possible but may not be correct. Borehole depths shown at top and base of sample intervals only.

Texas Core USGS-PA-2

-----NOT TO SCALE-------

Final thickness and reconciliation to core/elog depths (ft).

Laboratory redescriptions by Stanton/SanFilipo

CN refers to desorption cannister number and except as noted analytical samples

(refer to core descriptions for sampling details)

CN1	355.0 355.15 356.0	1.8" reworked(?) tonstein - yellowish brown kaolinitic clay flasers with approx 30% coal stringers top 0.7", 10% coal stringers base 1.1" - sample CN1T (age-dating) 10.2" finely laminated atttritus - fusain streak laminae < 1 mm thickness - sample CN1 (PHOTO LINK)
CN2	356.0 357.0	finely laminated attritus one piece conatins vitrain about 2 mm thick laminae < 1mm rich in fusain chips (PHOTO LINK) CH_4 isotherm sample CO_2 isotherm sample
CN3	357.0 358.0	finely laminated 2 pieces contain woody chip about 1 cm thick most laminae < 1mm rich in fusain (some chips contain white mineral filling)
CN4	358.0 358.4	attrital coal few laminae fusain-rich fine sand on cleat - drilling mud??
CN5	358.4 359.4	finely laminated with abundant chip fusain (PHOTO LINK) few small frag. of woody about 1 cm thick few vitrain. laminae (1 mm) half of blocks well cleated with 1 major cleat
CN6	359.4 360.5	about 40% of section is finely laminated vitrain 2-3 mm/attritus 10-12 mm 60% is moderately laminated vitrain 10 mm/attritus 8-10 mm CH_4 isotherm sample
CN7	360.5 361.4	broken into 6 pieces moderately laminated/some fusain along 6 broken surfaces vitrain 8-10mm/attritus 8-10 mm (some part consist of finely laminated interval with vitrain 1mm/attritus 2mm
CN8	361.4 361.95 362.4	5.5" coal - very woody and coarsely laminated (no attritus/no fusain) SAMPLE CN8C 1.1" coal - moderately laminated INCL SAMPLE CN8C w/ 5.5" above (PHOTO LINK) 5" parting - medium gray clay/shale - SAMPLE CN8P
CN9	362.4 362.44 363.27	0.5" parting (put into SAMPLE 8P) 8 " finely laminated vitrain 1-2 mm/attritus 1-2 mm grading to bottom where attritus dominates CN9C 2" attritus dominant - INCL SAMPLE CN9C with 8" above (PHOTO LINK) 1.5" shale dark gray very fissile (paper) SAMPLE CN9P
CN10 seal broken - not used	363.4	*0.1' coal recovered 363.4-365.4*
CN11	365.4 366.5	broken pieces one piece has very woody laminae moderately to coarsely woody frags - few layers of fusain
CN12	366.5 367.5	broken pieces (11 pieces 1-2" thick) most all are attritus rich with very little fusain dense piece is dark brown to black (clay rich) one piece has wood frag about 1 cm thick all other peices are attritus rich, vitrain <1mm CH_4 isotherm sample

CN13	367.5 – 368.8	broken pieces - dominantly attrital rich very little fusain one piece with vitrain band about 5 mm thick/ all others vitrain < 1mm attritus > 20 mm	
CN14	368.8 – 370.0	9" finely laminated vitrain-1mm/attritus 4-6 mm, well cleated 5 " woody - concoidal fracture, hard and uneven breakage	
CN15	370.0 – 371.0	0-3.5" attritus/fusain rich; no vitrain 3.5-7" moderate laminae; vitrain 4mm/attritus 2mm 7-12" moderate laminae; vitrain 5mm/attritus 2mm 12-12.5" attritus	
CN16	371.0 – 372.0	0-2" fine fusain laminae; vitrain-1 mm/fusain 1mm 2-6" moderate. laminae vitrain-10/fusain 2 mm 6-8" hard/ fusain rich layers w/ vitrain-1mm 8-12" hard fine laminae vitrain 1-2mm/fusain 10-12mm cleat at base 1-2 cm spacing	CH4 isotherm sample (PHOTO & X-RAY LINK)
CN17	372.0 – 373.0	finely laminated - broken pieces vitrain 2-5 mm/attritus 10-15 mm some resin on horizontal break plane in cleats and blebs	(PHOTO LINK)

Key to facies descriptions

- unlaminated attrital coal (PHOTO LINK-CN14)
- finely laminated attrital coal (PHOTO LINK-CN12)
- finely laminated vitrain/attrital coal (PHOTO LINK-CN1)
- moderately laminated vitrain/attrital coal (PHOTO LINK-CN8)
- fusain rich (PHOTO LINK-CN2 & CN5)
- woody (PHOTO LINK-CN13)
- parting (PHOTO LINK-CN9)

nb: orientation of facies within cannisters was reconstructed to the degree possible but may not be correct. Bore depths shown at top and base of cannister and sampled intervals only.

Detailed descriptions of suspected reworked tonsteins, boreholes, USGS-PA-1 and USGS-PA-2

Samples described by John SanFilipo at USGS Reston on Aug 25, 1999

USGS-PA-1 331.25 -331.50 ft. (see unit 179 of field core descriptions)

Top 0.15 ft is approximately 80% dusky yellowish brown 10YR 4/2 reworked flaser-like apparently kaolinitic clay and approximately 20% thin coal stringers; slightly more coal at very top, grading to overlying coal; base is fairly sharp, but vertical and inclined clay filled burrows (?) in bottom 0.10 ft. Sample USGS-PA-1-1.4T (age dating only)

USGS-PA-2 355.0 -335.15 ft (see unit 207 of field descriptions)

Top 0.06 ft is approximately 30% coal stringers with 70% reworked moderate yellowish brown 10YR 5/4 flaser-like homogenous apparently kaolinitic clay; basal 0.09 ft is similar, but approximately 90% reworked clay. No loss recorded in run, but top is spun and there could be lost coal above; base grades into underlying coal. Sample USGS-PA-2-CN1T (age dating only) re-estimated at 82% ash and 5% moisture to calculate DAF gas for Cannister 1.

Note: These detrital clay beds occupy the same interval in the top of the Naborton 2 coal bed with remarkable persistence throughout the Sabine uplift area of Louisiana and Texas, and are therefore thought to be quite likely reworked ash-falls (tonsteins; see Ruppert and Warwick, 1994). To date these have not provided dateable material using conventional HF acid digest (see below):

Additional notes from Geochronology lab analysis:

Sanidine and microcline were detected in samples USGS-PA-2-CN1T and OB94-WO1-C(54.8-55). Sanidine crystals were determined to be to small for age dating.

Literature Cited

Ruppert, L.F., and Warwick, P.D., 1994, Volcanic ash fall material in the Chemard Lake lignite, Naborton Formation, Desoto and Red River Parishes, Louisiana: The Society for Organic Petrology, Eleventh Annual Meeting Abstracts and Program, Jackson, Wyoming, v.11, p. 90.

Chapter 4

Geophysical logs from boreholes USGS-PA-1 and USGS-PA-2

By Alex W. Karlsen[1] and Peter D. Warwick[1]

Chapter 4 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

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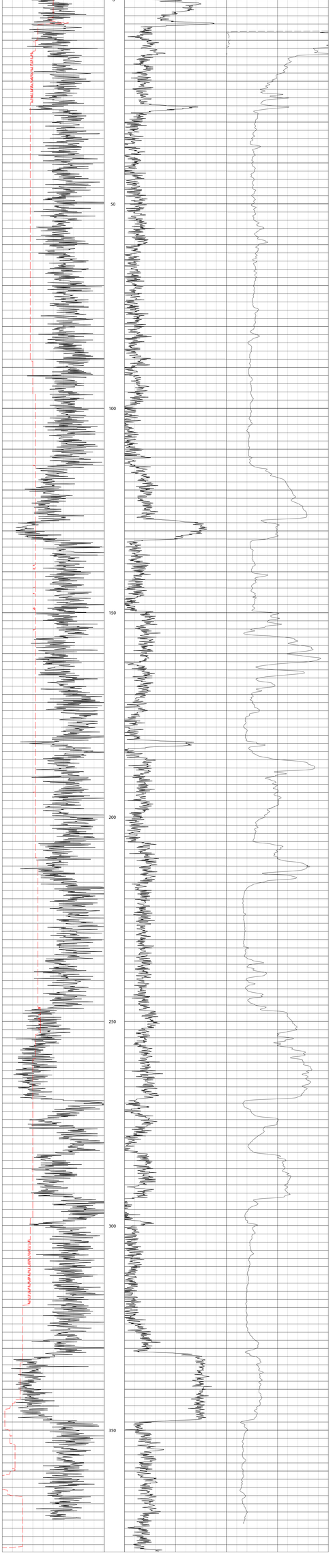
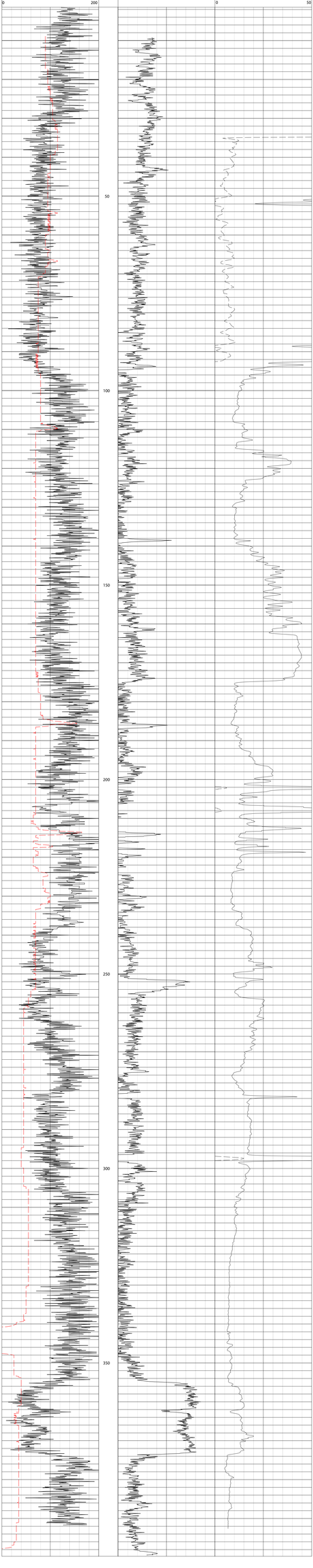
Borehole:	USGS-PA-1
Company or Agency:	U.S. Geological Survey
Location:	McFaddin Ranch, Panola County, TX, about 0.5 mi west of the LA/TX State Line, 0.5 mi south of the intersection of county roads 467 and 463, Old Panola 7.5' topographic sheet.
Coordinates:	32°07'59" N, 94°03'06" W
Ground Elevation:	270 ft. (estimated from topo)
Reference Datum:	Ground level
Coring Depth:	380 ft. (measured from ground elevation)
Total Logged Depth:	379.90 ft. (measured from ground elevation)
Driller:	Lloyd Morris, Texas A&M University
Drill Rig:	Truck-mounted Mobile B-53 drill rig
Drilling Method:	Continuous wireline coring, split 10 ft inner-tube or 5 ft spring loaded push tube with shoe (similar to Dennison sampler)
Bit type:	Tungsten-carbide/diamond HC 4.75" OD, 2.5" core
Drilling Medium:	Bentonite mud
Casing:	None (PVC to 6ft)
Geophysical Logs:	Natural gamma, caliper, gamma-gamma density, resistivity
Dates Drilled:	6/13/99-6/20/99
Date Logged:	6/20/99
Stratigraphic Log Scale:	1 inch = 10.00 feet



Borehole:	USGS-PA-2
Company or Agency:	U.S. Geological Survey
Location:	John Pilkington Ranch, Panola Co., TX, about 0.3 mi north of the Shelby Co. line and 8 mi west of the LA/TX state line, 0.28 mi due SE of the intersection of county roads 430 and 439, Tenaha East 7.5' topographic sheet.
Coordinates:	31°58'57"N, 94°09'07"W
Ground Elevation:	253 ft. (estimated from topo)
Reference Datum:	Ground level
Coring Depth:	400 ft. (measured from ground elevation)
Total Logged Depth:	399.70 ft. (measured from ground elevation)
Driller:	Lloyd Morris, Texas A&M University
Drill Rig:	Truck-mounted Mobile B-53 drill rig
Drilling Method:	Continuous wireline coring. split 10 ft inner-tube or 5 ft spring loaded push tube with shoe (similar to Dennison sampler)
Bit type:	Tungsten-carbide/diamond HE 4.75" OD, 2.5" core
Drilling Medium:	Bentonite mud
Casing:	None (PVC to 6ft)
Geophysical Logs:	Natural gamma, caliper, gamma-gamma density, resistivity
Dates Drilled:	6/21/99-6/28/99
Date Logged:	6/28/99
Stratigraphic Log Scale:	1 inch = 10.00 feet



Chapter 5

Petrographic data from borehole USGS-PA-2

By Ronald W. Stanton[1]

Chapter 5 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

[1]U.S. Geological Survey, Reston, VA
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Table 1. Preliminary petrographic data for coal samples from borehole USGS-PA-2. Percentages are based on a total of 500 (or fewer) point counts on duplicate particle pellets with white reflected light. No blue light (fluorescence) point counts are included. All values are volume percent on a mineral-matter-free basis. Refer to Chapter 2, this volume, for sample intervals. Tr = trace, or less than 1 percent.

Sample number	Telinite	Desmo-collinte	Vitro-detrinite	Corpocollinite in telinite	Corpocollinite in detrinite	**Total vitrinite**	Sporinite	Resinite	Cutinite	Lipto-detrinite	**Total liptinite**	Fusinite	Semi-fusinite	Inerto-detrinite	**Total inertinite**
PA2-CN12	24	27	14	2	4	**72**	2	6	2	1	**11**	4	6	7	**17**
PA2-CN2	15	30	6	2	1	**54**	7	2	0	0	**9**	2	9	26	**36**
PA2-CN6	6	37	14	7	2	**67**	9	0	3	0	**12**	4	9	8	**21**
PA2-CN16	22	35	9	6	2	**74**	8	1	1	Tr	**10**	4	8	5	**16**

Table 2. Mean vitrinite reflectance (%Ro) based on less than 25 spot measurements per sample.

Sample number	%Ro
PA2-CN12	0.38
PA2-CN2	0.45
PA2-CN6	0.43
PA2-CN16	0.37

Chapter 6

Pollen data from boreholes USGS-PA-1 and USGS-PA-2

By Douglas J. Nichols[2]

Chapter 6 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

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POLLEN SAMPLES FROM CORE USGS PA-1

This is the final report on palynological analyses of samples from USGS Core PA-1, Panola County, Texas. This report covers 11 rock samples collected from the part of the core stored at Texas A&M University (TAMU) (see Tables 1 and 3) which lists interpretations of age and depositional environments. A list of palynomorphs is included in Table 2. Such species lists contribute toward compilation of a palynostratigraphic database for the Gulf Coast Tertiary. Photomicrographs of selected specimens are available.

The age of most samples analyzed from this core is late Paleocene, both on the basis of fossil pollen species known to have restricted stratigraphic ranges in the Gulf Coast region and on the basis of the presence of a species known to be a key palynostratigraphic guide fossil in the Rocky Mountain region. One sample from near the bottom of the hole yielded a species that in the Rockies is indicative of middle Paleocene age (its range in the Gulf Coast is uncertain), but the sample below that one appears still to be late Paleocene. Thus, the interesting possibility that we had pinpointed the age of the cored interval more narrowly than late Paleocene apparently was not substantiated. In future analyses such possibilities will be continue to be pursued.

All but one of these samples yielded marine dinoflagellate cysts (dinocysts). Their presence is indicative of marine influence in the depositional environment, although the assemblages from all samples are overwhelmingly of nonmarine origin, and freshwater algal cysts are present in some samples. An estuarine depositional environment could have such a mix of palynomorphs.

Table 1. Age and depositional environments of selected samples from core USGS-PA-1.

Sample	**Depth**	**Lithology**	**Results**
D9154-A	19.8-19.9 ft	laminated claystone	Sample yielded a very diverse palynomorph assemblage indicative of late Paleocene age. Assemblage is composed predominantly of terrestrial pollen, but includes freshwater algae. It also includes dinoflagellate cysts of marine origin. Thus, marine influence in the depositional environment is indicated.
D9154-D	38.0-38.1	mudstone with flaser bedding	Pollen and spore assemblage indicative of late Paleocene age. Cysts of freshwater algae are relatively abundant. Marine dinocysts are present also, indicating marine

			influence in the depositional environment.
D9154-F	83.5-83.6	"chocolate" siltstone	Pollen indicative of late Paleocene age. Some freshwater algae present. Marine dinocysts rare but present.
D9154-H	97.7-97.8	argillaceous sandstone	Pollen indicative of late Paleocene age present. Sample was collected at request of TAMU staff because it was suspected that it might contain marine dinocysts. Dinocysts indicating marine influence are present.
D9154-K	138.0-138.1	"chocolate" claystone	Pollen indicative of late Paleocene age. Marine dinocysts rare but present.
D9154-M	179.9-180.0	olive laminated claystone	Pollen indicative of late Paleocene age. Marine dinocysts relatively abundant. This sample shows the most marine influence in the depositional environment of any collected from this core.
D9154-P	184.7-184.8	"chocolate" claystone	Pollen indicative of late Paleocene age. Marine dinocysts present.
D9154-R	209.5-209.6	"chocolate" claystone	Pollen indicative of late Paleocene age. Marine dinocysts present.
D9154-T	239.8-239.9	carbonaceous claystone	Pollen indicative of late Paleocene age. Marine dinocysts present.
D9154-V	318.0-318.1	laminated claystone	Assemblage indicative of Paleocene age, but no species definitive of late Paleocene age was observed, and one species indicative of middle Paleocene age in the Rocky Mountain region is present. Marine dinocysts present.
D9154-W	330.5-330.6	carbonaceous mudstone or dirty coal	Some pollen indicative of late Paleocene age is present in the assemblage. No marine dinocysts observed.

Table 2. List of palynomorphs for selected samples from core USGS-PA-1.

Sample	**Palynomorphs**
D9154-A	*Arecipites* sp.
	Caryapollenites inelegans
	Caryapollenites veripites
	Caryapollenites wodehousei
	Cicatricosisporites sp.
	Corollina sp.
	Erdtmanipollis sp.
	Extratriporopollenites sp.
	Laevigatosporites sp.
	Momipites coryloides
	Momipites ventifluminis
	Myocolpopollenites reticulatus
	Nyssapollenites sp.
	Osmundacidites sp.
	Pityosporites sp.
	Quadrapollenites vagus
	Retitriletes sp. ("*Lycopodiumsporites*")
	Rhoipites sp.
	Sernapollenites duratus
	Stereisporites spp.
	Taxodiaceaepollenites hiatus
	Thomsonipollis magnificus
	Tricolpites spp.
	"Tricolpopollenites baculoferus"
	Triporopollenites spp.
	Pediastrum sp.
	Tetraporina sp.
	unidentified trilete spores
	unidentified acritarch
	unidentified dinocysts
D9154-D	*Alnus speciipites*
	Arecipites sp.
	Caryapollenites prodromus
	Caryapollenites veripites
	Caryapollenites wodehousei
	Cicatricosisporites sp.
	Corollina sp.
	Hamulatisporis amplus
	Laevigatosporites sp.
	Momipites coryloides
	Momipites tenuipolus

Momipites ventifluminis
Nyssapollenites sp.
Pityosporites sp.
Reticuloidosporites pseudomurii
Rhoipites sp.
Stereisporites spp.
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Tilia vescipites
Tricolpites spp.
Ulmipollenites sp.
Pediastrum sp. [relatively abundant]
unidentified dinocyst

D9154-F

Arecipites sp.
Caryapollenites veripites
Cicatricosisporites sp.
Deltoidospora sp.
Holkopollenites chemardensis
Laevigatosporites sp.
Momipites ventifluminis
Reticuloidosporites pseudomurii
Rhoipites sp.
Stereisporites spp.
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Tilia vescipites
Tricolpites spp.
Triporopollenites spp.
Trudopollis pertrudens
Pediastrum sp.
unidentified trilete spore
unidentified dinocyst

D9154-H

Caryapollenites veripites [relatively abundant]
Caryapollenites wodehousei
Cicatricosisporites sp.
Laevigatosporites sp.
Momipites coryloides
Momipites triradiatus
Momipites ventifluminis
Nyssapollenites sp.
Pityosporites sp.

Sernapollenites duratus
Simplicepollis rallus
Sparganiaceaepollenites sp.
Taxodiaceaepollenites hiatus [relatively abundant]
Tricolpites spp.
Triporopollenites spp.
Ulmipollenites sp.
Pediastrum sp. [relatively abundant]

D9154-K

Arecipites spp.
Corollina sp.
Laevigatosporites sp.
Liliacidites sp.
Momipites coryloides
Momipites tenuipolus
Nyssapollenites sp.
"Palaeoisoetes" sp.
Sernapollenites duratus
Simplicepollis rallus
Stereisporites spp.
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
"Tricolpopollenites baculoferus"
Triporopollenites spp.
Ulmipollenites sp.
Zlivisporis sp.

D9154-M

Arecipites spp.
Caryapollenites veripites
Caryapollenites wodehousei
Chenopodipollis sp.
Corollina sp.
Laevigatosporites spp.
Momipites coryloides
Momipites ventifluminis
"Palaeoisoetes" sp.
Pistillipollenites mcgregorii
Pityosporites sp.
Stereisporites spp.
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Triporopollenites spp.
Ulmipollenites sp.
Schizophacus sp.

unidentified dinocysts

D9154-P

Arecipites sp.
Caryapollenites veripites
Corollina sp.
Extratriporopollenites sp.
Laevigatosporites sp.
Momipites coryloides
Momipites tenuipolus
Momipites ventifluminis
Nyssapollenites sp.
"Palaeoisoetes" sp.
Stereisporites spp.
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Tilia vescipites
Tricolpites sp.
"Tricolpopollenites baculoferus"
Triporopollenites spp.
unidentified dinocysts

D9154-R

Arecipites sp.
Caryapollenites veripites
Caryapollenites wodehousei
Chenopodipollis sp.
Choanopollenites eximius
Cicatricosisporites sp.
Corollina sp.
Cyathidites sp.
Gleicheniidites sp.
Hamulatisporis amplus
Holkopollenites chemardensis
Laevigatosporites sp.
Momipites coryloides
Momipites tenuipolus
Momipites ventifluminis
Nyssapollenites sp.
Pityosporites sp.
Proteacidites sp. [reworked?]
Stereisporites sp.
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Tilia vescipites
Tricolpites spp.

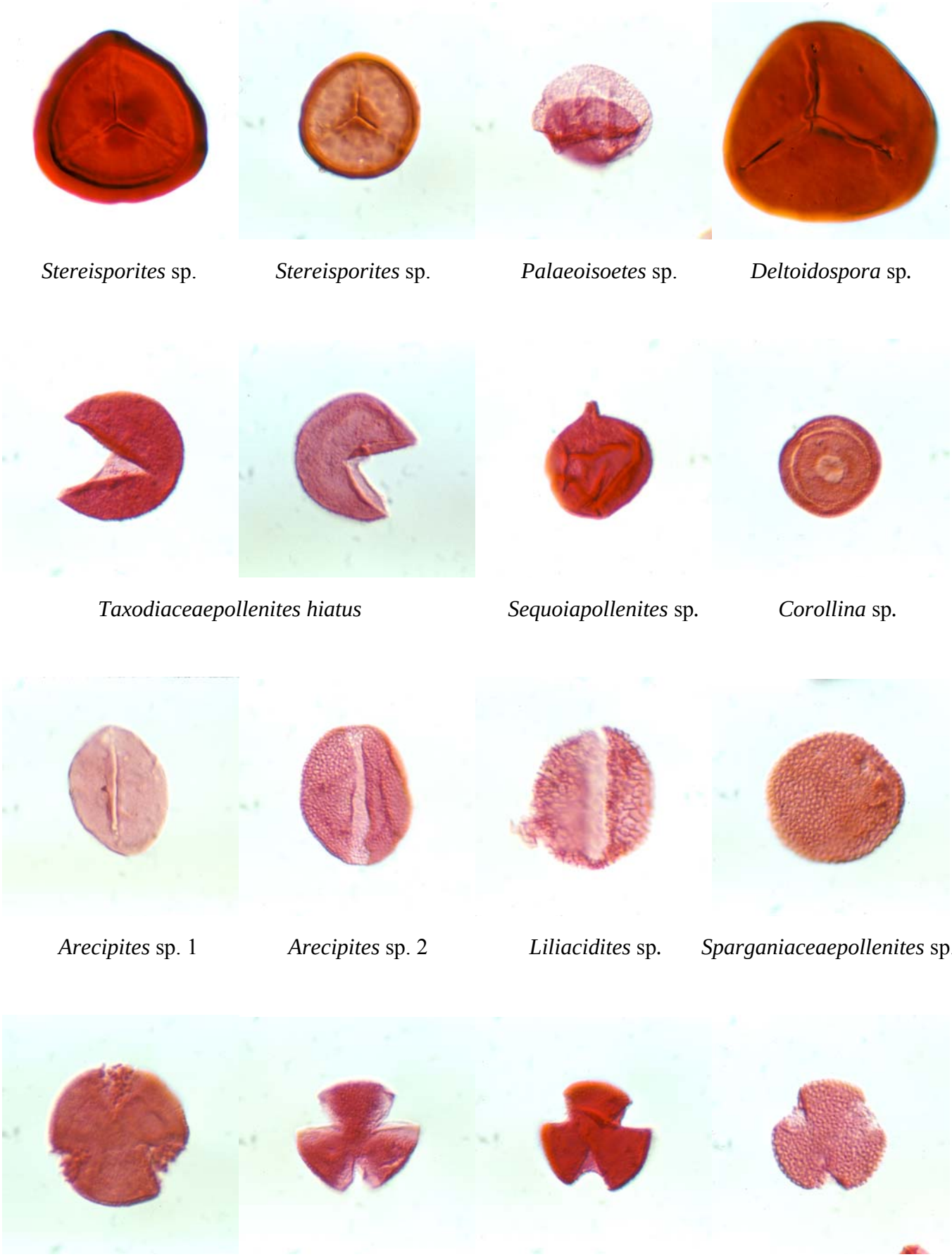
	Triporopollenites spp.
	Ulmipollenites sp.
	unidentified acritarch
	unidentified dinocysts [fairly common]
D9154-T	*Caryapollenites veripites*
	Cyathidites sp.
	Laevigatosporites sp.
	Momipites coryloides
	Momipites ventifluminis
	Nyssapollenites sp.
	Quadrapollenites vagus
	Reticuloidosporites pseudomurii
	Rhoipites sp.
	Sparganiaceaepollenites sp.
	Stereisporites spp.
	Taxodiaceaepollenites hiatus
	Thomsonipollis magnificus
	Tilia vescipites
	Tricolpites spp.
	"Tricolpopollenites baculoferus"
	Triporopollenites spp.
	unidentified dinocysts
D9154-V	*Chenopodipollis* sp.
	Cicatricosisporites sp.
	Extratriporopollenites sp.
	Momipites actinus
	Momipites ventifluminis
	Nyssapollenites sp.
	Pityosporites spp.
	Retitriletes sp. ("*Lycopodiumsporites*")
	Stereisporites spp.
	Taxodiaceaepollenites hiatus
	Thomsonipollis magnificus
	Tricolpites sp.
	Triporopollenites spp.
	unidentified dinocysts
D9154-W	*Arecipites* sp.
	Cicatricosisporites sp.
	Hamulatisporis amplus
	Momipites dilatus
	Momipites tenuipolus

Nudopollis terminalis [relatively abundant]
Pityosporites sp.
Sernapollenites duratus
Stereisporites spp.
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Tricolpites spp.
Triporopollenites spp. [common]

Table 3. Palynology Sample Index, Borehole USGS-PA-1
[Note abbreviations: clyst=claystone, arg=argillaceous, mudst=mudstone, sltst=siltstone, carb sh=carbonaceous shale]

Field No.	Lab No.	Depth (ft)	Remarks (as of 6/21/04)
		Sampled in field (Hotel pre-shipping)	
PA-1.1	**D9153-A**	128.7-129.8	coal; slide prepared, not examined
PA-1.2	**-B**	129.8-130.7	coal; slide prepared, not examined
PA-1.3	**-C**	130.7-132.8	coal; slide broken, not examined
PA-1.4	**-D**	331.0-334.0 (~331.20 ?)	coal; slide prepared, not examined
PA-1.5	**-E**	334.0-337.0	coal; slide prepared, not examined
PA-1.6	**-F**	337.0-340.0	coal; slide prepared, not examined
PA-1.7	**-G**	340.0-343.0	coal; slide prepared, not examined
PA-1.8	**-H**	343.0-346.0	coal; slide prepared, not examined
PA-1.9	**-I**	346.0-347.7	coal; slide prepared, not examined
		Sampled at Texas A&M storage	
PA-1-A	**D9154-A**	19.8-19.9	clyst; processed and examined
PA-1-B	**-B**	ca 27.0-27.25	coal; not processed
PA-1-C	**-C**	31.9-32.0	clyst; not processed
PA-1-D	**-D**	38.0-38.1	mudst; processed and examined
PA-1-E	**-E**	66.0-66.1	sltst; not processed
PA-1-F	**-F**	83.5-83.6	sltst; processed and examined
PA-1-G	**-G**	85.3-85.4	sltst; not processed
PA-1-H	**-H**	97.7-97.8	arg ss; processed and examined
PA-1-I	**-I**	112.85-113.0	coal; not processed
PA-1-J	**-J**	133.0-133.1	clyst; not processed
PA-1-K	**-K**	138.0-138.1	clyst; processed and examined
PA-1-L	**-L**	155.7-155.8	carb sh; not processed
PA-1-M	**-M**	179.9-180.0	clyst; processed and examined
PA-1-N	**-N**	182.8-183.6	mudst; not processed
PA-1-O	**-O**	183.7-183.8	clyst; not processed
PA-1-P	**-P**	184.7-184.8	clyst; processed and examined
PA-1-Q	**-Q**	198.0-198.1	mudst; not processed
PA-1-R	**-R**	209.5-209.6	clyst; processed and examined
PA-1-S	**-S**	225.9-226.0	clyst; not processed
PA-1-T	**-T**	239.8-239.9	clyst; processed and examined
PA-1-U	**-U**	297.9-298.0	clyst; not processed
PA-1-V	**-V**	318.0-318.1	clyst; processed and examined
PA-1-W	**-W**	330.5-330.6	coal?; processed and examined

Plate 1. Photomicrographs of pollen from core USGS-PA-1



Stereisporites sp. *Stereisporites* sp. *Palaeoisoetes* sp. *Deltoidospora* sp.

Taxodiaceaepollenites hiatus *Sequoiapollenites* sp. *Corollina* sp.

Arecipites sp. 1 *Arecipites* sp. 2 *Liliacidites* sp. *Sparganiaceaepollenites* sp.

Tricolpites sp. 1 *Tricolpites* sp. 2 *Tricolpites* sp. 3 *Tricolpites* sp. 4

POLLEN SAMPLES FROM CORE USGS-PA-2

This is the final report on palynological analyses of samples from USGS Core PA-2, Panola County, Texas (lat 31° 58′ 58.21″, long 94° 09′ 07.05″). This report covers 11 rock samples from the core collected in the field in June 1999 (see Table 6). Interpretations of age and depositional environments are provided in Table 4 and lists of palynomorphs in Table 5. Species lists contribute toward compilation of a palynostratigraphic database for the Gulf Coast Tertiary.

On the basis of fossil pollen species known to be key palynostratigraphic guide fossils in the Rocky Mountain region, the ages of samples from this core range from middle to late Paleocene. Results from analyses of these samples constitute clear indication that palynostratigraphic zones well documented in the Rocky mountain region are applicable also to the Gulf Coast region.

Several of these samples yielded marine dinoflagellate cysts (dinocysts). Their presence is indicative of marine influence in the depositional environment, although the assemblages from all samples are overwhelmingly of nonmarine origin, and freshwater algal cysts are present in some samples. Such mixed assemblages of palynomorphs could occur in rocks deposited in estuarine depositional environments; the other samples appear to represent overbank deposits associated with coal-depositional environments.

Table 4. Age and depositional environment of selected samples from core USGS-PA-2.

Sample	**Depth (ft)**	**Lithology**	**Results**
D9152-A	52.9-53.0	gray claystone	The sample yielded a diverse palynomorph assemblage indicative of late Paleocene age. The assemblage is composed predominantly of terrestrial pollen, but includes freshwater algae.
D9152-C	97.8-98.0	laminated gray siltstone	Assemblage dominated by terrestrial pollen and spores indicative of late Paleocene age but including dinoflagellate cysts (dinocysts) and acritarchs indicative of marine influence in the depositional environment.
D9152-F	134.0-134.2	olive green to gray siltstone	Diverse assemblage of terrestrial pollen and spores indicative of late Paleocene age;

			also includes freshwater algae (common) and marine dinocysts.
D9152-I	140.0-140.2	carbonaceous shale with leaf marine fragments	Low-diversity assemblage with two co-dominant fern-spore species. No influence noted.
D9152-J	161.2-161.6	carbonaceous claystone	Sparse, low-diversity assemblage including one late Paleocene guide species.
D9152-K	249.9-250.0	"chocolate" siltstone	Diverse assemblage of terrestrial pollen and spores. No freshwater or marine palynomorphs present. No late Paleocene guide species present; guide species present indicate mid-Paleocene age (comparable to palynostratigraphic Zone P4 in the Rocky Mountain region).
D9152-M	255.1-255.3	carbonaceous shale	Exceedingly sparse assemblage presumably of Paleocene age. No marine species observed.
D9152-N	319.2-319.3	olive-black claystone	Diverse assemblage evidently of mid-Paleocene age. Marine dinocysts present, indicating marine influence in depositional environment.
D9152-O	338.6-338.7	carbonaceous silty claystone	Assemblage evidently of mid-Paleocene age. No marine species observed.
D9152-S	375.6-375.7	carbonaceous shale or dirty coal	Sparse assemblage evidently of mid-Paleocene age. No marine influence detected.
D9152-U	394.5-394.6	laminated olive siltstone	Diverse assemblage clearly of mid-Paleocene age. Marine dinocysts and acritarchs are present.

Note that the mid-Paleocene to late Paleocene transition is within the interval bracketed by samples at about 162 and 250 ft in this core.

Table 5. List of palynomorphs for selected samples from core USGS-PA-2.

Sample	**Palynomorphs**
D9152-A	*Arecipites* sp.
	Caryapollenites veripites [dominant among Jugl. pollen]
	Caryapollenites wodehousei
	Cicatricosisporites sp.
	Cyathidites sp.
	Laevigatosporites sp.
	Liliacidites sp.
	Momipites coryloides
	Momipites ventifluminis
	Nyssapollenites sp.
	"*Palaeoisoetes*" sp.
	Pityosporites sp.
	Rhoipites sp.
	Sequoiapollenites sp.
	Sernapollenites duratus
	Sparganiaceaepollenites sp.
	Stereisporites spp.
	Taxodiaceaepollenites hiatus
	Thomsonipollis magnificus
	Toroisporis sp.
	Tricolpites spp.
	Triporopollenites spp.
	Ulmipollenites sp.
	Pediastrum sp.
D9152-C	*Caryapollenites veripites*
	Caryapollenites wodehousei
	Chenopodipollis sp.
	Laevigatosporites sp.
	Momipites coryloides
	Momipites ventifluminis
	Myocolpopollenites reticulatus
	"*Palaeoisoetes*" sp.
	Pityosporites sp.
	Taxodiaceaepollenites hiatus
	Toroisporis sp.
	Tricolpites sp.
	Triporopollenites spp.
	Ulmipollenites sp.
	marine acritarch (*Baltisphaeridium* sp.)
	marine dinocysts [unidentified]
D9152-F	*Basopollis basalis*

Caryapollenites inelegans
Caryapollenites veripites [dominant among Jugl. pollen]
Caryapollenites wodehousei
Deltoidospora sp.
Holkopollenites chemardensis
Laevigatosporites sp.
Liliacidites sp.
Momipites coryloides
Momipites triradiatus
Momipites ventifluminis
Nyssapollenites sp.
Pistillipollenites mcgregorii
Rhoipites sp.
Sernapollenites duratus
Stereisporites sp.
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Tricolpites spp.
"*Tricolpopollenites*" *baculoferus*
Triporopollenites spp.
Ulmipollenites sp.
Pediastrum sp. [common]
marine dinocysts [unidentified]

D9152-I

Deltoidospora sp.
Laevigatosporites sp. [common]
Pistillipollenites mcgregorii
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Tilia vescipites
Toroisporis sp. [common]
Triporopollenites spp.

D9152-J

Caryapollenites veripites
Thomsonipollis magnificus
Stereisporites sp.
Triporopollenites spp.

D9152-K

Alnus speciipites
Aquilapollenites spinulosus

Arecipites spp.
Basopollis basalis
Bombacacidites sp.
Caryapollenites wodehousei
Chenopodipollis sp.
Cicatricosisporites sp.
Gleicheniidites sp.
Holkopollenites chemardensis
Insulapollenites rugulatus
Laevigatosporites spp.
Liliacidites sp.
Momipites actinus
Momipites coryloides
Momipites tenuipolus
Momipites triletipollenites
Momipites triorbicularis
Momipites ventifluminis
Nudopollis terminalis
Nyssapollenites spp.
Pityosporites sp.
Retitriletes sp. ("*Lycopodiumsporites*")
Rhoipites spp.
Simplicepollis rallus
Stereisporites spp.
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Tricolpites sp. cf. *T. hians* [common]
Tricolpites spp.
Triporopollenites spp.
Trudopollis pertrudens
Ulmipollenites sp.

D9152-M

Momipites tenuipolus
Momipites sp.
Taxodiaceaepollenites hiatus
Tricolpites sp.
Triporopollenites sp.

D9152-N

Alnus speciipites
Basopollis basalis
Cicatricosisporites sp.
Cyathidites sp.
Insulapollenites rugulatus
Laevigatosporites sp.
Momipites tenuipolus
Momipites ventifluminis
Nudopollis terminalis
Nyssapollenites sp.
Osmundacidites sp.
Pandaniidites sp.
Pityosporites sp.
Reticuloidosporites pseudomurii
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Tilia vescipites
Triporopollenites spp.
Trudopollis pertrudens
Stereisporites spp.
acritarch [unidentified]
marine dinocysts [unidentified]

D9152-O

Alnus speciipites
Basopollis basalis
Cicatricosisporites sp.
Laevigatosporites sp.
Lygodiumsporites sp.
Momipites tenuipolus
Nudopollis terminalis
Nyssapollenites sp.
Osmundacidites sp.
Retitriletes sp. ("*Lycopodiumsporites*")
Rhoipites sp.
Taxodiaceaepollenites hiatus
Thomsonipollis magnificus
Toroisporis sp.
Tricolpites sp.
Triporopollenites spp.
Stereisporites spp.

D9152-S	*Alnus speciipites* *Laevigatosporites* sp. *Momipites coryloides* *Momipites tenuipolus* *Nyssapollenites* sp. *Taxodiaceaepollenites hiatus* *Tricolpites* spp.
D9152-U	*Alnipollenites scoticus* *Alnus speciipites* *Aquilapollenites spinulosus* *Arecipites* sp. *Chenopodipollis* sp. *Erdtmanipollis* sp. *Laevigatosporites* sp. *Momipites actinus* *Momipites tenuipolus* *Nyssapollenites* sp. *Pityosporites* spp. *Retitriletes* sp. ("*Lycopodiumsporites*") *Stereisporites* spp. *Taxodiaceaepollenites hiatus* *Thomsonipollis magnificus* *Tricolpites* spp. *Triporopollenites* spp. *Ulmipollenites* sp. marine acritarchs including *Pterospermella* sp. marine dinocysts [unidentified]

Table 6. Palynology Sample Index, Borehole USGS-PA-2 (All Sampled on site)

Field No.	Lab No.	Depth (ft)	Remarks (as of 6/21/04)
PA-2-A	**D9152-A**	52.9-53.0	clyst; processed and examined
PA-2-B	**-B**	96.3-96.5	coal; processed - not examined
PA-2-C	**-C**	97.8-98.0	sltst; processed and examined
PA-2-D	**-D**	107.9-108.0	sltst; not processed
PA-2-E	**-E**	115.2-115.3	clyst; not processed
PA-2-F	**-F**	134.0-134.2	sltst; processed and examined
PA-2-G	**-G**	137.9-138.0	clyst; not processed
PA-2-H	**-H**	138.2-138.4	coal; processed - not examined
PA-2-I	**-I**	140.0-140.2	carb sh; processed and examined
PA-2-J	**-J**	161.2-161.6	clyst; processed and examined
PA-2-K	**-K**	249.9-250.0	sltst; processed and examined
PA-2-L	**-L**	251.9-252.1	coal; not processed
PA-2-M	**-M**	255.1-255.3	carb sh; processed and examined
PA-2-N	**-N**	319.2-319.3	clyst; processed and examined
PA-2-O	**-O**	338.6-338.7	clyst; processed and examined
PA-2-P	**-P**	346.6-346.7	clyst; not processed
PA-2-Q	**-Q**	365.0-365.1	coal; processed - not examined
PA-2-R	**-R**	ca. 373 ft	coal; not processed
PA-2-S	**-S**	375.6-375.7	carb sh; processed and examined
PA-2-T	**-T**	378.6-378.7	sltst; not processed
PA-2-U	**-U**	394.5-394.6	sltst; processed and examined

Plate 2. Photomicrographs of pollen from core USGS-PA-2

Momipites sp.

Momipites sp.

M. tenuipolus

M. ventifluminis

M. triradiatus

M. actinus

Caryapollenites prodromus

C. wodehousei

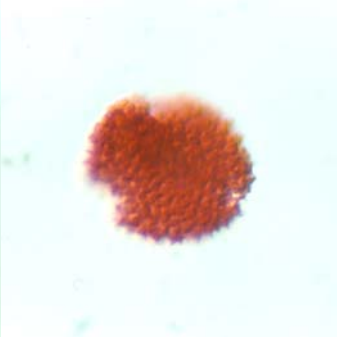
C. inelegans

C. veripites

C. veripites

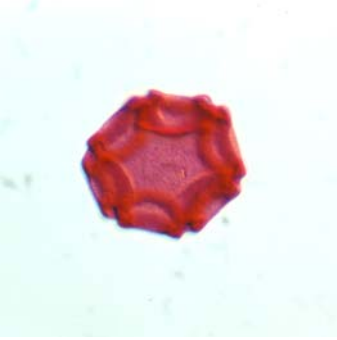
Thomsonipollis magnificus

Trudopollis pertrudens



Sernapollenites duratus

Triporopollenites sp.



Alnus speciipites

Chapter 7

Dinocyst data from borehole USGS-PA-2

By Lucy E. Edwards[2]

Chapter 7 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

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U.S. Geological Survey

DINOCYST SAMPLES FROM CORE USGS-PA-2

This chapter summarizes marine dinoflagellate studies on samples from core USGS-PA-2, Panola County, Texas, lat. 31 deg., 58'57.03" N, long. 94 deg., 09'07.38"W (GPS), elevation 253 ft (estimated from topographic map). Processing was completed on all 23 samples taken. However, twelve samples were selected for examination.

All but one sample contained dinocysts, although no sample contained abundant dinocysts. Pollen is present in all. Nearly all studied samples contained dinocysts of Cretaceous age that are presumed to be reworked. The freshwater alga, *Pediastrum*, is present in most samples. Preservation is fair to poor.

Samples from 393.7 to 277.0 ft (uncorrected depth, corrected depths are provided in Chapter 2) are dominated by species of *Spinidinium* and miscellaneous peridiniacean forms. These are generally not age-diagnostic, although the samples resemble those reported in the literature from the Paleocene Cannonball Formation in South Dakota (Stanley, 1965). The environment of deposition is marine, but most likely nearshore to estuarine.

Samples from 231.0 to 57.1 ft (uncorrected depth, corrected depths are provided in Chapter 2) contain members of the *Apectodinium homomorphum* (Deflandre & Cookson) Lentin & Williams species-complex. This complex has its lowest stratigraphic occurrence in the late Paleocene (Thanetian) in strata that have been correlated to calcareous nannofossil Zone NP 9 or possibly NP 8. A single, questionably identified specimen of *Damassadinium californicum* (Drugg) Fensome et al. restricts the age to Paleocene. The environment of deposition is marine, but most likely nearshore.

The pollen from PA-2 should be studied in conjunction with the dinoflagellates in order to determine the extent of the reworking. Many of the samples, especially in the lower part of the core, contain no dinocysts that restrict the age, other than the Cretaceous dinocysts. Further study is needed to determine whether these samples are:
(1) Cretaceous in age, marine,
(2) Tertiary in age, nonmarine, with extensive Cretaceous reworking, or
(3) Tertiary in age, marginal marine, with less extensive reworking.

Full information to date is given in Table 1 and Figure 1.

Table 1. Dinocyst data on selected samples from core USGS-PA-2

R6141 A (393.5-393.7 ft depth)
Preservation: fair. Diversity: moderately low. Dominated by small peridiniacean forms (not a lot of dinocyst specimens).
Age: includes Cretaceous material, probably both Early and Late.
Environment: Includes marine (but marginal/nearshore) dinocysts that may or may not be in place.
Fibrocysta Stover & Evitt sp.
Chatangiella Vozzhennikova sp.
Cribroperidinium Neale & Sarjeant ? sp.
Muderongia Cookson & Eisenack ? sp.
Senegalinium microgranulatum (Stanley) Stover & Evitt
Spinidinium styloniferum Cookson & Eisenack
Spinidinium Cookson & Eisenack sp.
Spiniferites Mantell spp.
Spongodinium delitiense (Ehrenberg) Deflandre
miscellaneous areoligeracean forms
small peridiniacean forms
freshwater alga *Pediastrum*

R6141 B (377.1-377.5 ft depth)
Preservation: fair. Diversity: moderately low. No particular species dominant (not a lot of dinocyst specimens).
Age: includes Late Cretaceous material.
Environment: Includes marine (but marginal/nearshore) dinocysts that may or may not be in place.
Chatangiella Vozzhennikova ? sp.
Cordosphaeridium Eisenack sp.
Oligosphaeridium Davey & Williams sp.
Senegalinium microgranulatum (Stanley) Stover & Evitt
Spinidinium Cookson & Eisenack sp.
Spiniferites Mantell spp.
Spongodinium delitiense (Ehrenberg) Deflandre
miscellaneous areoligeracean forms
small peridiniacean forms
freshwater alga *Pediastrum*

R6141 C (355.2-355.4 ft depth)
Preservation: fair. Diversity: moderately low. No particular species dominant (not a lot of dinocyst specimens).
Age: includes Late Cretaceous material.
Environment: Includes marine (but marginal/nearshore) dinocysts that may or may not be in place.
Isabelidinium Lentin & Williams ? sp.
Oligosphaeridium Davey & Williams spp.
Operculodinium Wall sp.
Palaeohystrichophora infusorioides Deflandre

Palaeoperindinium Deflandre sp.
Senegalinium microgranulatum (Stanley) Stover & Evitt
Spinidinium densispinaturm Stanley
Spinidinium Cookson & Eisenack spp.
Spiniferites Mantell spp.
Spongodinium delitiense (Ehrenberg) Deflandre ?
miscellaneous areoligeracean form ?
small peridiniacean forms
freshwater alga *Pediastrum*

R6141 D (345.8-346.0 ft depth)
Preservation: poor. Diversity: low. Dominated by small peridiniacean forms (not a lot of dinocyst specimens).
Age: includes Late Cretaceous material.
Environment: Includes marine (but marginal/nearshore) dinocysts that may or may not be in place.
Chatangiella Vozzhennikova sp.
Hystrichosphaeridium Deflandre sp.
Odontochitina Deflandre ? sp.
Palaeocystodinium golzowense Alberti
Palaeohystrichophora infusorioides Deflandre
Spinidinium Cookson & Eisenack spp.
Spiniferites Mantell spp.
small peridiniacean forms
freshwater alga *Pediastrum*

R6141 E (331.5-331.7 ft depth)
Preservation: fair. Diversity: low. Dominated by small peridiniacean forms (not a lot of dinocyst specimens).
Age: includes Late Cretaceous material.
Environment: Includes marine (but marginal/nearshore) dinocysts that may or may not be in place.
Chatangiella Vozzhennikova ? sp.
Hystrichosphaeridium tubiferum (Ehrenberg) Deflandre
Operculodinium Wall sp.
Palaeocystodinium Alberti ? sp.
Palaeoperidinium Deflandre sp.
Spinidinium densispinaturm Stanley
Spinidinium Cookson & Eisenack sp.
Spiniferites Mantell spp.
small peridiniacean forms

R6141 H (277.0-277.2 ft depth)
Preservation: poor. Diversity: low. Dominated by small peridiniacean forms (not a lot of dinocyst specimens).
Age: includes Late Cretaceous material.
Environment: Includes marine (but marginal/nearshore) dinocysts that may or may not be in place.

Chatangiella Vozzhennikova sp.
Palaeoperidinium pyrophorum (Ehrenberg) Sarjeant
Phelodinium magnificum (Stanley) Stover & Evitt
Spinidinium densispinaturm Stanley
Spinidinium Cookson & Eisenack sp.
Spiniferites Mantell sp.
miscellaneous areoligeracean forms
small peridiniacean forms
freshwater alga *Pediastrum*

R6141 J (258.9-259.0 ft depth)
Preservation: fair. No dinocysts observed.
Age: unknown
Environment: presumably nonmarine.

R6141 L (230.8-231.0 ft depth)
Preservation: poor to fair. Diversity: low. No particular species dominant.
Age: late Paleocene or Eocene.
Environment: Marginal or nearshore marine.
Apectodinium homomorphum (Deflandre & Cookson) Lentin & Williams complex
Fibrocysta radiata (Morgenroth) Stover & Evitt
Hystrichosphaeridium Deflandre ? sp.
Polysphaeridium subtile Davey & Williams
Spinidinium Cookson & Eisenack sp.
Spiniferites pseudofurcatus (Klumpp) Sarjeant ?
Spiniferites Mantell sp.
Thalassiphora delicata Williams & Downie
small peridiniacean forms
freshwater alga *Pediastrum*

R6141 N (186.8-187.0 ft depth)
Preservation: fair to poor. Diversity: low. No particular species dominant (not a lot of dinocyst specimens).
Age: late Paleocene ? with Late Cretaceous reworked material
[Note absence of small peridiniaceans and *Spinidinium*s.]
Environment: Nearshore marine.
Apectodinium homomorphum (Deflandre & Cookson) Lentin & Williams complex
Chatangiella verrucosa (Manum) Lentin & Williams
Damassadinium californicum (Drugg) Fensome et al. ?
Diphyes colligerum (Deflandre & Cookson) Cookson
Palaeohystrichophora infusorioides Deflandre
Spiniferites pseudofurcatus (Klumpp) Sarjeant
Spiniferites Mantell spp.
miscellaneous areoligeracean form
freshwater alga *Pediastrum*

R6141 R (130.7-130.9 ft depth)

Preservation: fair to poor. Diversity: low. No particular species dominant (not a lot of dinocyst specimens).
Age: late Paleocene or Eocene with Late Cretaceous reworked material
[Note absence of small peridiniaceans and *Spinidinium*s.]
Environment: Nearshore marine.
Apectodinium homomorphum (Deflandre & Cookson) Lentin & Williams complex
Chatangiella Vozzhennikova sp.
Cordosphaeridium Eisenack sp.
Cribroperidinium Neale & Sarjeant sp.
Eocladopyxis peniculata Morgenroth ??
Operculodinium Wall sp.
Spiniferites pseudofurcatus (Klumpp) Sarjeant
Spiniferites Mantell spp.
Spongodinium delitiense (Ehrenberg) Deflandre ??
miscellaneous areoligeracean form
freshwater alga *Pediastrum*

R6141 V (57.1-57.3 ft depth)
Preservation: fair. Diversity: low. No particular species dominant (not a lot of dinocyst specimens).
Age: late Paleocene or Eocene with Late Cretaceous reworked material
[Note absence of *Spinidinium*s, but not small peridiniaceans.]
Environment: Nearshore marine.
Apectodinium homomorphum (Deflandre & Cookson) Lentin & Williams complex
Chatangiella verrucosa (Manum) Lentin & Williams
Exochosphaeridium Davey et al. sp.
Isabelidinium Lentin & Williams sp.
Operculodinium Wall sp.
Spiniferites Mantell spp.
Trithyrodinium Drugg sp.
miscellaneous areoligeracean forms
small peridiniacean forms
freshwater alga *Pediastrum*

R6141 W (32.8-33.1 ft depth)
Preservation: poor. Diversity: very low. One specimen observed
Age: unknown
Environment: unknown

Figure 1. Dinocyst data from core USGS-PA-2

	Taxa	Depth (feet - uncorrected; corrected values in Chapter 2, this volume)										
		R6141 A (393.5-393.7)	R6141 B (377.1-377.5)	R6141 C (355.2-355.4)	R6141 D (345.8-346.0)	R6141 E (331.5-331.7)	R6141 H (277.0-277.2)	R6141 L (230.8-231.0)	R6141 N (186.8-187.0)	R6141 R (130.7-130.9)	R6141 V (57.1-57.3)	R6141 W (32.8-33.1)
Paleocene (or younger)	*Apectodinium homomorphum* species complex	.	.	.	.	.	.	X	X	X	X	.
	Damassadinium californicum (Drugg) Fensome et al.	.	.	.	.	.	.	.	?	.	.	.
	Eocladopyxis peniculata Morgenroth	.	.	.	.	.	.	.	.	??	.	.
	Fibrocysta radiata (Morgenroth) Stover & Evitt	.	.	.	.	.	.	X	.	.	.	.
	Palaeocystodinium golzowense Alberti	.	.	.	X	.	.	.	.	.	.	.
	Polysphaeridium subtile Davey & Williams	.	.	.	.	.	.	X	.	.	.	.
	Spiniferites pseudofurcatus (Klumpp) Sarjeant	.	.	.	.	.	.	?	X	X	.	.
	Thalassiphora delicata Williams & Downie	.	.	.	.	.	.	X	.	.	.	.
	Cordosphaeridium Eisenack sp.	.	X	.	.	.	.	.	.	X	.	.
	Cribroperidinium Neale & Sarjeant sp.	?	.	.	.	.	.	.	.	X	.	?
	Diphyes colligerum (Deflandre & Cookson) Cookson	.	.	.	.	.	.	.	X	.	.	.
	Exochosphaeridium Davey et al. 1966 sp.	.	.	.	.	.	.	.	.	.	X	.
	Fibrocysta sp.	X	.	.	.	.	.	.	.	.	.	.
	Hystrichosphaeridium Deflandre sp.	.	.	.	X	.	.	?	.	.	.	.
	Hystrichosphaeridium tubiferum (Ehrenberg) Deflandre	.	.	.	.	X	.	.	.	.	.	.
	Oligosphaeridium Davey & Williams spp.	.	X	X	.	.	.	.	.	.	.	.
	Operculodinium Wall sp.	.	.	X	.	X	.	.	.	X	X	.
	Palaeocystodinium Alberti sp.	.	.	.	.	?	.	.	.	.	.	.
	Palaeoperidinium pyrophorum (Ehrenberg) Sarjeant	.	.	.	.	.	X	.	.	.	.	.
	Palaeoperidinium Deflandre sp.	.	.	X	.	X	.	.	.	.	.	.
	Phelodinium magnificum (Stanley) Stover & Evitt	.	.	.	.	.	X	.	.	.	.	.
	Senegalinium microgranulatum (Stanley) Stover & Evitt	X	X	X	.	.	.	.	.	.	.	.
	Spinidinium Cookson & Eisenack spp.	X	X	X	X	X	X	X	.	.	.	.
	Spinidinium densispinaturm Stanley	.	.	X	.	X	X	.	.	.	.	.
	Spiniferites Mantell spp.	X	X	X	X	X	X	X	X	X	X	.
	miscellaneous areoligeracean forms	X	X	?	.	.	X	.	X	X	X	.
	small peridiniacean forms	X	X	X	X	X	X	X	.	.	X	.
Cretaceous	*Chatangiella verrucosa* (Manum) Lentin & Williams	.	.	.	.	.	.	.	X	.	X	.
	Chatangiella Vozzhennikova spp.	X	?	.	X	?	X	.	.	X	.	.
	Isabelidinium Lentin & Williams spp.	.	.	?	.	.	.	.	.	.	X	.
	Muderongia Cookson & Eisenack sp.	?	.	.	.	.	.	.	.	.	.	.
	Odontochitina Deflandre sp.	.	.	.	?	.	.	.	.	.	.	.
	Palaeohystrichophora infusorioides Deflandre	.	.	X	X	.	.	.	X	.	.	.
	Spinidinium styloniferum Cookson & Eisenack	X	.	.	.	.	.	.	.	.	.	.
	Spongodinium delitiense (Ehrenberg) Deflandre	X	X	?	.	.	.	.	.	??	.	.
	Trithyrodinium Drugg sp.	.	.	.	.	.	.	.	.	.	X	.
	freshwater alga *Pediastrum*	X	X	X	X	.	X	X	X	X	X	.

sample R6141 J (258.9-259.0 ft) barren

Chapter 8

Methane desorption data from borehole USGS-PA-2

By Charles E. Barker[2], and Ronnie Tingook[2]

Chapter 8 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

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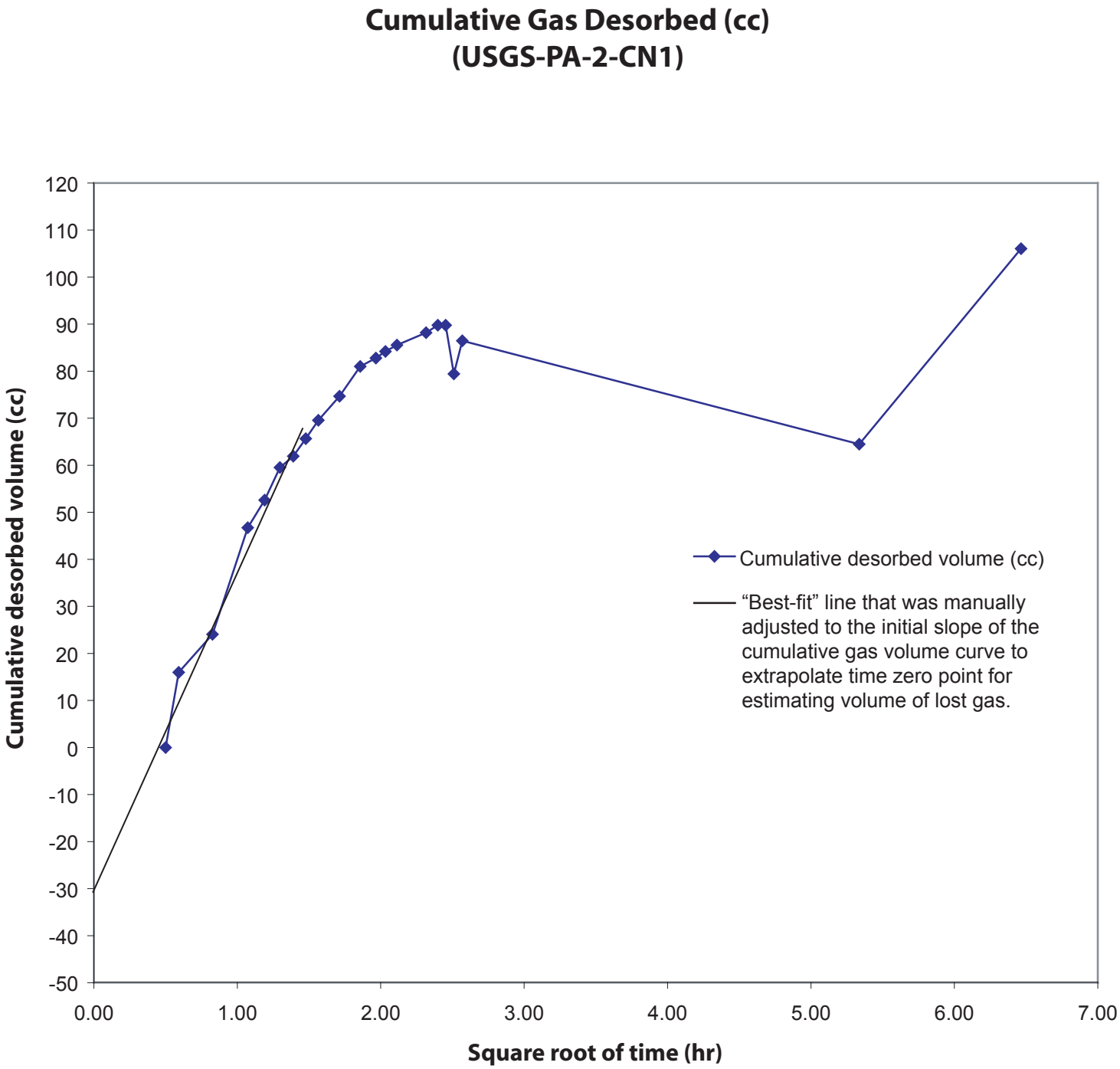
U.S. Department of the Interior
U.S. Geological Survey

Introduction

The following Excel spreadsheets and graphs present methane desorption field data from timed measurements of pressure, volume, and temperature that are corrected to standard pressure and temperature (STP) using methods following Barker and others (2002). Corrected depths for the samples are listed in Chapter 2, and do not match this chapter. Lost gas estimate values were interpreted from graphical representations of the cumulative desorped volume of gas from each sample canister. A " best-fit" line was manually adjusted to the initial slope of the cumulative gas volume curves to extrapolate back to time zero to determine the estimated volume of lost gas. Appendix 7 provides links to the raw data files for these figures and tables.

References Cited

Barker, C.E., Dallegge, T.A., and Clark, A.C., 2002, USGS Coal desorption equipment and a spreadsheet for analysis of lost and total gas from canister desorption measurements: U.S. Geological Survey Open-File Report 02-496, un-paginated. http://pubs.usgs.gov/of/2002/ofr-02-496/



Lost Gas Estimate= 30 cc
Raw Total Gas= 0.13 g/cc (4.19 SCF/ton)
DAF Total Gas= 0.28 g/cc (7.68 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 1

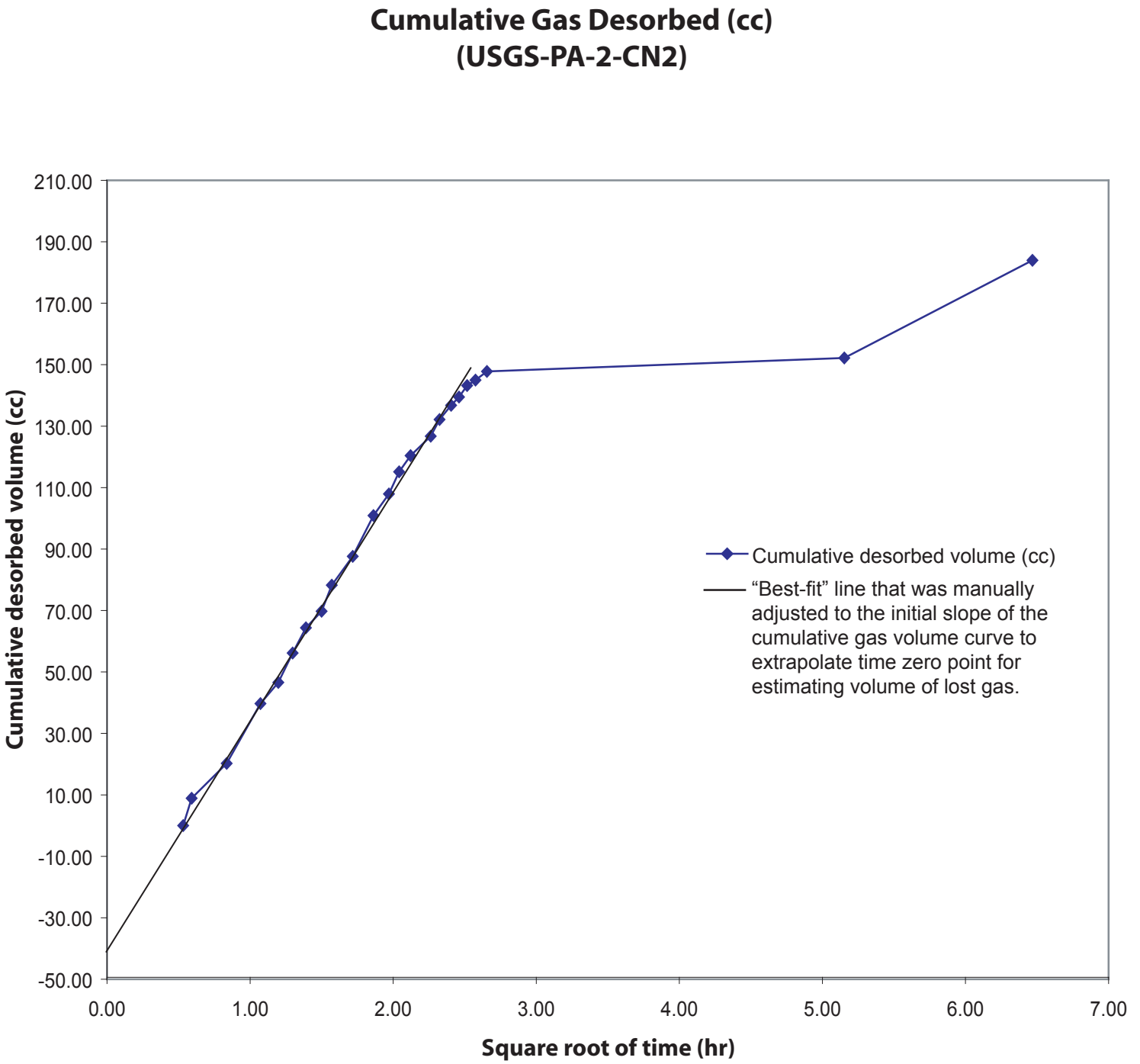
Table 1

Borehole ID:	pa2				
Canister number:	99-1				
Sample Interval (ft): From:	356.6	To:	357.6	Cumulative volume @ STP:	106.0
Core Date: (enter in box: mm/dd/yr)			6/27/1999		
Time Zero (hh:mm)			13:19	Milliliters/gram raw coal:	0.10
Raw coal mass (air-dry): (grams)			1040		
Coal mass (d.a.f.): (grams)			490*	Milliliter/gram coal d.a.f.:	0.22
Headspace volume:			1806	(excluding lost gas)	

Lost gas estimate (CC)	30
Raw total gas content	0.13
DAF total gas content	0.28

read#	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Press. inches Hg	Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	mL/gram Raw Coal Mass	mL/g d.a.f Coal Mass	Headspace Corrected Cumulative Volume @ STP (milliliter)	Headspace Corrected Cumulative Gas Content scf/ton	Ambient Temp °F	Ambient temp oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	13:34	*29.68*	89.24	21	19.73	0.00	0.01	0.25	0.50	0.000	0.000	0	0	89.06	31.7	89.06	31.8	89.24
2	6/27/1999	13:40	*29.68*	88.3	15	14.12	14.12	0.01	0.35	0.59	0.014	0.029	15.968	0.4918813	89.06	31.7	89.06	31.3	88.34
3	6/27/1999	14:00	*29.68*	91.0	18	16.86	30.98	0.03	0.68	0.83	0.030	0.063	24.071	1.2333761	89.6	32	89.6	32.8	91.04
4	6/27/1999	14:28	*29.68*	88.2	16	15.06	46.04	0.05	1.15	1.07	0.044	0.094	46.714	2.6723956	88.52	31.4	88.52	31.2	88.16
5	6/27/1999	14:44	29.65	89.2	12	11.26	57.31	0.06	1.42	1.19	0.055	0.117	52.591	4.2924466	88.7	31.5	88.7	31.8	89.24
6	6/27/1999	15:00	29.65	89.6	9	8.44	65.75	0.07	1.68	1.30	0.063	0.134	59.537	6.1264662	88.7	31.5	88.7	32	89.6
7	6/27/1999	15:15	29.65	91.2	8	7.48	73.23	0.08	1.93	1.39	0.070	0.149	61.934	8.034331	88.7	31.5	88.7	32.9	91.22
8	6/27/1999	15:30	29.62	91.2	6	5.61	78.84	0.09	2.18	1.48	0.076	0.161	65.646	10.05652	88.52	31.4	88.52	32.9	91.22
9	6/27/1999	15:46	29.62	91.4	5	4.67	83.51	0.10	2.45	1.57	0.080	0.170	69.560	12.199278	89.06	31.7	89.06	33	91.4
10	6/27/1999	16:15	29.62	90.9	4	3.74	87.25	0.12	2.93	1.71	0.084	0.178	74.676	14.499639	88.52	31.4	88.52	32.7	90.86
11	6/27/1999	16:46	29.62	89.6	3	2.81	90.06	0.14	3.45	1.86	0.087	0.184	81.004	16.994939	88.16	31.2	88.16	32	89.6
12	6/27/1999	17:11	29.62	89.6	2	1.87	91.94	0.16	3.87	1.97	0.088	0.188	82.781	19.544977	88.16	31.2	88.16	32	89.6
13	6/27/1999	17:27	29.62	89.4	1	0.94	92.87	0.17	4.13	2.03	0.089	0.190	84.194	22.138546	88.16	31.2	88.16	31.9	89.42
14	6/27/1999	17:47	29.59	88.7	1	0.94	93.81	0.19	4.47	2.11	0.090	0.191	85.561	24.774209	87.8	31	87.8	31.5	88.7
15	6/27/1999	18:41	29.59	87.8	0	0.00	93.81	0.22	5.37	2.32	0.090	0.191	88.193	27.490966	87.44	30.8	87.44	31	87.8
16	6/27/1999	19:04	29.59	87.3	0	0.00	93.81	0.24	5.75	2.40	0.090	0.191	89.777	30.256507	87.44	30.8	87.44	30.7	87.26
17	6/27/1999	19:20	29.59	87.3	0	0.00	93.81	0.25	6.02	2.45	0.090	0.191	89.777	33.022047	87.26	30.7	87.26	30.7	87.26
18	6/27/1999	19:37	29.37	86.7	0	0.00	93.81	0.26	6.30	2.51	0.090	0.191	79.414	35.468367	87.44	30.8	87.44	30.4	86.72
19	6/27/1999	19:55	29.50	86.7	0	0.00	93.81	0.28	6.60	2.57	0.090	0.191	86.475	38.132202	87.44	30.8	87.44	30.4	86.72
20	6/28/1999	17:48	29.53	99.1	14	12.86	106.67	1.19	28.48	5.34	0.103	0.218	64.482	40.118559	105.26	40.7	105.26	37.3	99.14
21	6/29/1999	7:07	29.59	85.8	0	0.00	106.67	1.74	41.80	6.47	0.103	0.218	106.041	43.38511	86.72	30.4	86.72	29.9	85.82

*estimated value - assumes tonstein sample CN1T is 82% ash/5% moisture (no proximate analysis)



Lost Gas Estimate= 40 cc
Raw Total Gas= 0.21 g/cc (6.62 SCF/ton)
DAF Total Gas= 0.34 g/cc (10.78 SCF/ton)

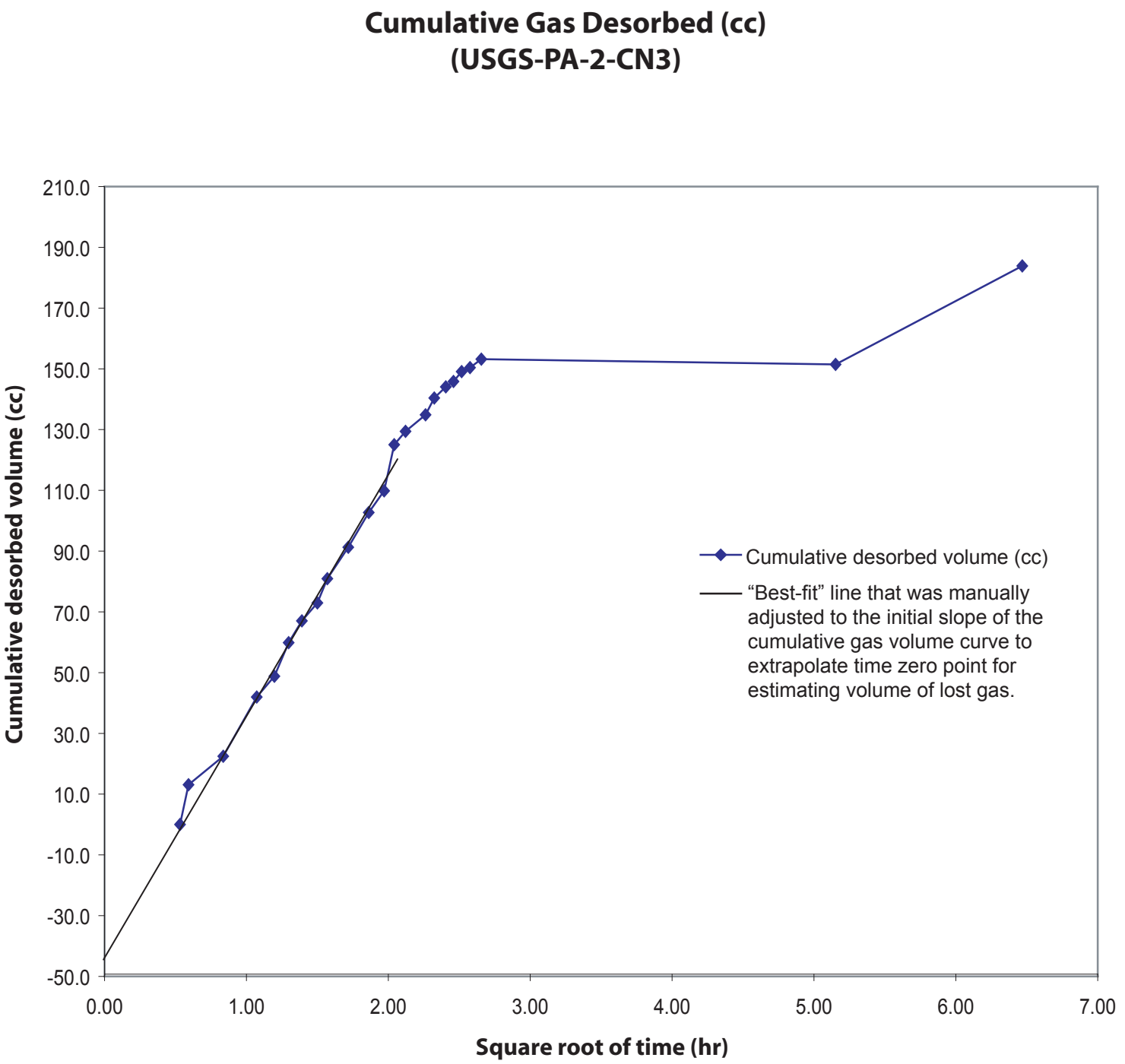
g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 2

Table 2

Borehole ID:	PA 2						
Canister number:	99-2						
Sample Interval (ft): From:	357.6	To:	358.6	Cumulative volume @ STP:	184.0	Lost gas estimate (cc)	40	Lost gas estimate (cc)	40
Core Date: (enter in box: mm/dd/yr)			6/27/1999						
Time Zero (hh:mm)			13:19	Milliliters/gram raw coal:	0.17	Raw total gas (cc/g)	0.21	Raw total gas (SCF/ton)	6.62
Raw coal mass (air-dry): (grams)			1082						
Coal mass (d.a.f.): (grams)			665	Milliliter/gram coal d.a.f.:	0.28	DAF total gas (cc/g)	0.34	DAF total gas (SCF/ton)	10.78
Headspace volume:			1693	(excluding lost gas)					

read#	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Press. inches Hg	Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	mL/gram Raw Coal Mass	mL/g d.a.f Coal Mass	Headspace Correction Cumulative Volume @ STP (milliliter)	Headspace Correction Cumulative Gas Content (SCF)	Ambient Temp °F	Optional Temperature Conversions: Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	13:36	29.68	87.8	13	12.25	0.00	0.01	0.28	0.53	0.00	0.00	0.00	0.00	89.06	31.7	89.1	17.0	62.6
2	6/27/1999	13:40	29.68	87.8	10	9.42	9.42	0.01	0.35	0.59	0.01	0.01	8.89	0.26	89.06	31.7	89.1	20.4	68.7
3	6/27/1999	14:01	29.68	88.5	15	14.11	23.54	0.03	0.70	0.84	0.02	0.04	20.24	0.86	89.24	31.8	89.2	19.6	67.3
4	6/27/1999	14:28	29.68	87.3	18	16.98	40.51	0.05	1.15	1.07	0.04	0.06	39.72	2.04	88.52	31.4	88.5	20.2	68.4
5	6/27/1999	14:45	29.65	89.1	15	14.09	54.60	0.06	1.43	1.20	0.05	0.08	46.57	3.42	88.7	31.5	88.7	21.0	69.8
6	6/27/1999	15:00	29.65	89.8	13	12.19	66.79	0.07	1.68	1.30	0.06	0.10	56.16	5.08	88.7	31.5	88.7	21.5	70.7
7	6/27/1999	15:15	29.65	90.7	12	11.24	78.02	0.08	1.93	1.39	0.07	0.12	64.36	6.99	88.7	31.5	88.7	21.8	71.2
8	6/27/1999	15:34	29.62	91.4	10	9.34	87.37	0.09	2.25	1.50	0.08	0.13	69.77	9.05	88.52	31.4	88.5	22.0	71.6
9	6/27/1999	15:47	29.62	91.2	9	8.41	95.78	0.10	2.47	1.57	0.09	0.14	78.24	11.37	89.06	31.7	89.1	22.3	72.1
10	6/27/1999	16:16	29.62	91.0	10	9.35	105.12	0.12	2.95	1.72	0.10	0.16	87.61	13.96	88.52	31.4	88.5	22.6	72.7
11	6/27/1999	16:47	29.62	89.4	10	9.37	114.50	0.14	3.47	1.86	0.11	0.17	100.91	16.95	88.16	31.2	88.2	22.6	72.7
12	6/27/1999	17:12	29.62	89.8	9	8.43	122.93	0.16	3.88	1.97	0.11	0.18	107.92	20.15	88.16	31.2	88.2	22.7	72.9
13	6/27/1999	17:29	29.62	89.4	7	6.56	129.49	0.17	4.17	2.04	0.12	0.19	115.12	23.55	88.16	31.2	88.2	23.0	73.4
14	6/27/1999	17:49	29.59	88.9	6	5.62	135.12	0.19	4.50	2.12	0.12	0.20	120.41	27.12	87.8	31.0	87.8	23.3	73.9
15	6/27/1999	18:26	29.59	88.5	6	5.63	140.75	0.21	5.12	2.26	0.13	0.21	126.72	30.87	87.98	31.1	88.0	23.4	74.1
16	6/27/1999	18:43	29.59	88.2	5	4.69	145.44	0.23	5.40	2.32	0.13	0.22	132.15	34.78	87.44	30.8	87.4	23.9	75.0
17	6/27/1999	19:06	29.59	87.4	3	2.82	148.26	0.24	5.78	2.40	0.14	0.22	136.80	38.83	87.44	30.8	87.4	23.9	75.0
18	6/27/1999	19:22	29.59	87.4	3	2.82	151.08	0.25	6.05	2.46	0.14	0.23	139.46	42.96	87.26	30.7	87.3	23.9	75.0
19	6/27/1999	19:39	29.59	86.7	2	1.88	152.96	0.26	6.33	2.52	0.14	0.23	143.22	47.20	87.26	30.7	87.3	23.8	74.8
20	6/27/1999	19:57	29.59	86.7	2	1.88	154.84	0.28	6.63	2.58	0.14	0.23	145.00	51.50	87.44	30.8	87.4	24.0	75.2
21	6/27/1999	20:22	29.62	86.9	2	1.88	156.73	0.29	7.05	2.66	0.14	0.24	147.81	55.87	87.26	30.7	87.3	24.0	75.2
22	6/28/1999	15:52	29.53	96.6	41	37.82	194.55	1.11	26.55	5.15	0.18	0.29	152.18	60.38	105.44	40.8	105.4	24.3	75.7
23	6/29/1999	7:09	29.59	86.0	0	0.00	194.55	1.74	41.83	6.47	0.18	0.29	183.98	65.83	86.9	30.5	86.9	24.3	75.7



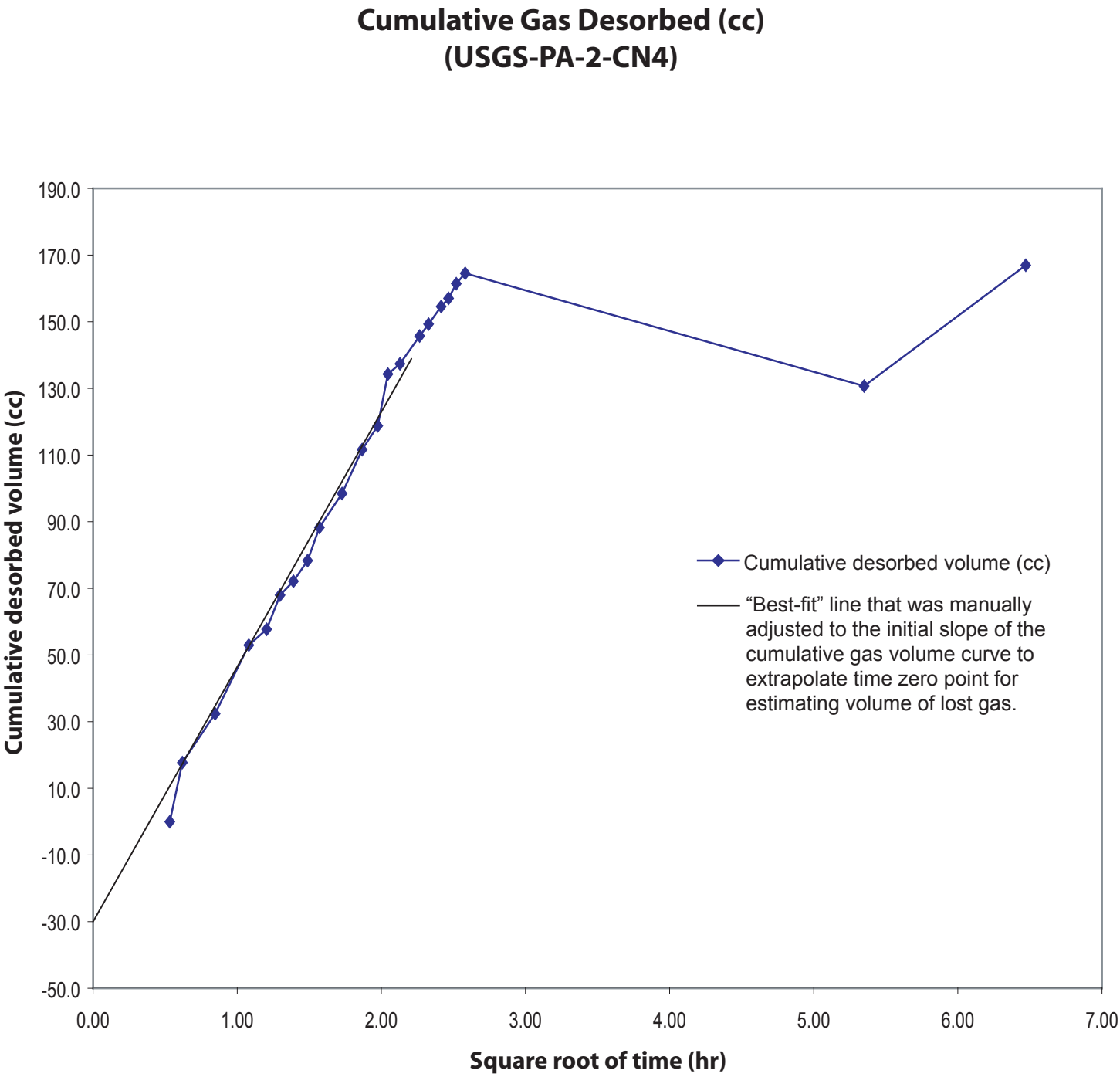
Lost Gas Estimate= 45 cc
Raw Total Gas= 0.22 g/cc (6.92 SCF/ton)
DAF Total Gas= 0.36 g/cc (11.39 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 3

Table 3

Project	Wilcox																		
Well ID	PA 2	Can no.	99-3																
Sample Interval (ft): From:		358.6	To:	359.6				Cumulative volume @ STP:	183.9	Lost gas estimate (cc)	45.00					Raw total gas (SCF/ton)	6.92		
Core Date: (enter in box: mm/dd/yr)				6/27/1999															
Time Zero (hh:mm)				13:19				Milliliters/gram raw coal:	0.17	Raw total gas (cc/g)	0.22					DAF total gas (SCF/ton)	11.39		
Raw coal mass (air-dry): (grams)				1058															
Coal mass (d.a.f.): (grams)				643.00				Milliliter/gram coal d.a.f.:	0.29	DAF total gas (cc/g)	0.36								
Headspace volume:				1700				(excluding lost gas)											
													Headspace Correction			Optional Temperature Conversions			
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	13:36	29.68	86.7	8	7.55	0.00	0.01	0.28	0.53	0.00	0.00	0.0	0.0	89.1	31.7	89.1	30.4	86.7
2	6/27/1999	13:40	29.68	87.4	17	16.03	16.03	0.01	0.35	0.59	0.02	0.02	13.1	0.4	89.1	31.7	89.1	30.8	87.4
3	6/27/1999	14:01	29.68	88.9	15	14.10	30.13	0.03	0.70	0.84	0.03	0.05	22.5	1.1	89.2	31.8	89.2	31.6	88.9
4	6/27/1999	14:28	29.68	87.6	18	16.96	47.10	0.05	1.15	1.07	0.04	0.07	42.0	2.3	88.5	31.4	88.5	30.9	87.6
5	6/27/1999	14:45	29.65	89.4	15	14.08	61.17	0.06	1.43	1.20	0.06	0.10	48.8	3.8	88.7	31.5	88.7	31.9	89.4
6	6/27/1999	15:00	29.65	89.6	13	12.20	73.37	0.07	1.68	1.30	0.07	0.11	59.8	5.6	88.7	31.5	88.7	32.0	89.6
7	6/27/1999	15:15	29.65	90.9	12	11.23	84.60	0.08	1.93	1.39	0.08	0.13	67.1	7.7	88.7	31.5	88.7	32.7	90.9
8	6/27/1999	15:34	29.62	91.4	10	9.34	93.94	0.09	2.25	1.50	0.09	0.15	72.9	9.9	88.5	31.4	88.5	33.0	91.4
9	6/27/1999	15:47	29.62	91.4	9	8.41	102.35	0.10	2.47	1.57	0.10	0.16	80.9	12.3	89.1	31.7	89.1	33.0	91.4
10	6/27/1999	16:16	29.62	90.9	10	9.35	111.70	0.12	2.95	1.72	0.11	0.17	91.3	15.1	88.5	31.4	88.5	32.7	90.9
11	6/27/1999	16:47	29.62	89.6	9	8.43	120.13	0.14	3.47	1.86	0.11	0.19	102.7	18.2	88.2	31.2	88.2	32.0	89.6
12	6/27/1999	17:12	29.62	89.6	8	7.50	127.63	0.16	3.88	1.97	0.12	0.20	109.8	21.5	88.2	31.2	88.2	32.0	89.6
13	6/27/1999	17:29	29.62	89.2	16	15.00	142.64	0.17	4.17	2.04	0.13	0.22	125.0	25.3	88.2	31.2	88.2	31.8	89.2
14	6/27/1999	17:49	29.59	88.7	5	4.69	147.33	0.19	4.50	2.12	0.14	0.23	129.4	29.2	87.8	31.0	87.8	31.5	88.7
15	6/27/1999	18:26	29.59	88.3	5	4.69	152.02	0.21	5.12	2.26	0.14	0.24	134.9	33.3	88.0	31.1	88.0	31.3	88.3
16	6/27/1999	18:43	29.59	87.6	4	3.76	155.78	0.23	5.40	2.32	0.15	0.24	140.4	37.6	87.4	30.8	87.4	30.9	87.6
17	6/27/1999	19:06	29.59	87.3	3	2.82	158.60	0.24	5.78	2.40	0.15	0.25	144.1	41.9	87.4	30.8	87.4	30.7	87.3
18	6/27/1999	19:22	29.59	87.3	2	1.88	160.48	0.25	6.05	2.46	0.15	0.25	145.8	46.3	87.3	30.7	87.3	30.7	87.3
19	6/27/1999	19:39	29.59	86.7	2	1.88	162.36	0.26	6.33	2.52	0.15	0.25	149.1	50.9	87.3	30.7	87.3	30.4	86.7
20	6/27/1999	19:57	29.59	86.9	2	1.88	164.24	0.28	6.63	2.58	0.16	0.26	150.4	55.4	87.4	30.8	87.4	30.5	86.9
21	6/27/1999	20:22	29.62	87.1	2	1.88	166.12	0.29	7.05	2.66	0.16	0.26	153.2	60.1	87.4	30.8	87.4	30.6	87.1
22	6/28/1999	15:52	29.53	96.8	34	31.36	197.48	1.11	26.55	5.15	0.19	0.31	151.5	64.6	105.1	40.6	105.1	36.0	96.8
23	6/29/1999	7:09	29.59	86.0	0	0.00	197.48	1.74	41.83	6.47	0.19	0.31	183.9	70.2	86.9	30.5	86.9	30.0	86.0



Lost Gas Estimate= 30 cc
Raw Total Gas= 0.64 g/cc (20.46 SCF/ton)
DAF Total Gas= 1.05 g/cc (33.53 SCF/ton)

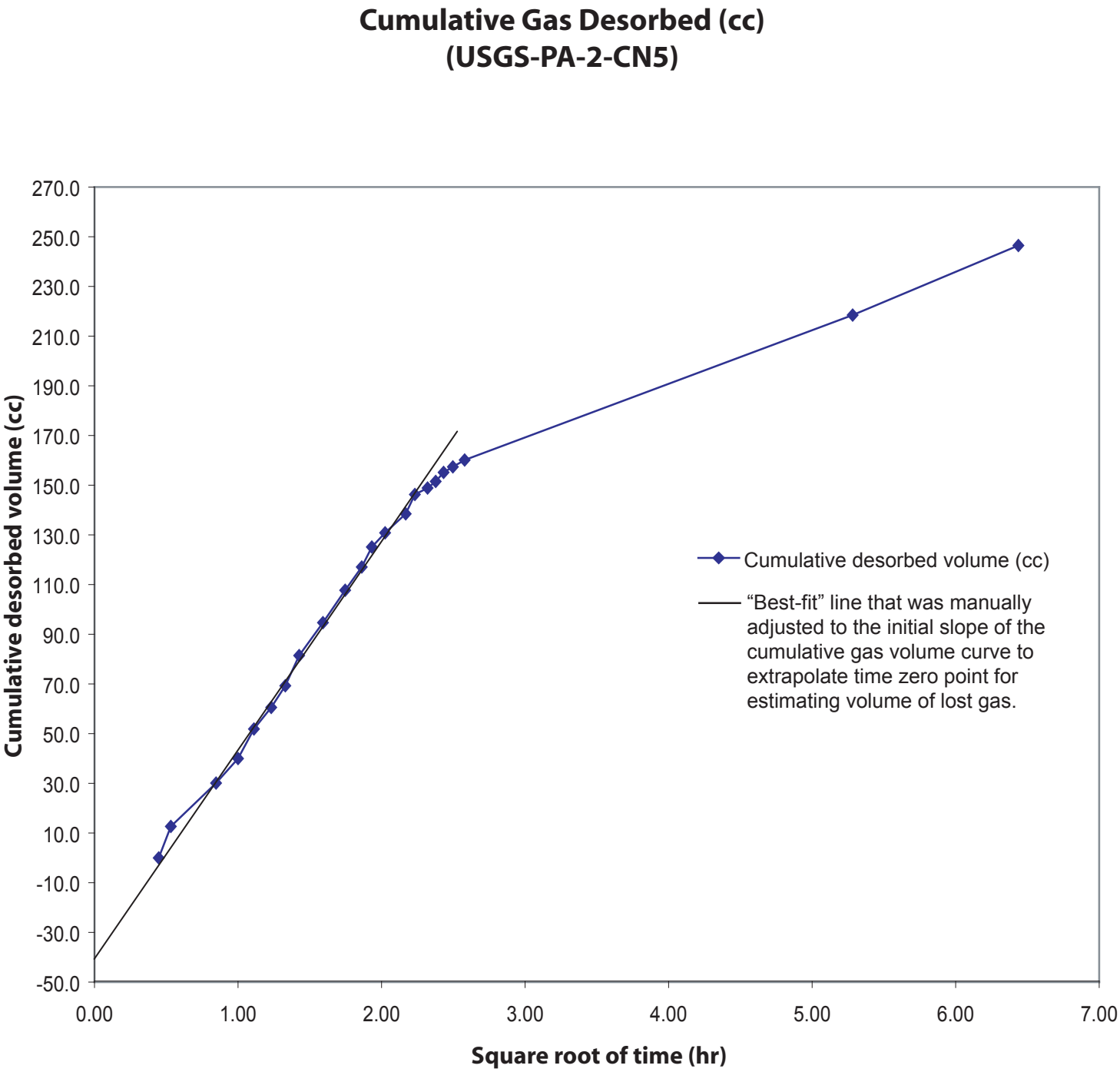
g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 4

Table 4

Project	Wilcox									
Well ID:	PA 2	Can no.	99-4							
Sample Interval (ft):	From:	359.6	To:	360	Cumulative volume @ STP:	167.0	Lost gas estimate (cc)	30.0	Raw total gas (SCF/ton)	20.46
Core Date: (enter in box: mm/dd/yr)				6/27/1999						
Time Zero (hh:mm)				13:19	Milliliters/gram raw coal:	0.54	Raw total gas (cc/g)	0.64	DAF total gas (SCF/ton)	33.53
Raw coal mass (air-dry): (grams)				308						
Coal mass (d.a.f.): (grams)				188.00	Milliliter/gram coal d.a.f.:	0.89	DAF total gas (cc/g)	1.05		
Headspace volume:				2249	(excluding lost gas)					

													Headspace Correction			Optional Temperature Conversions			
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	13:36	29.68	90.3	8	7.50	0.00	0.01	0.28	0.53	0.00	0.00	0.0	0.0	89.1	31.7	89.1	32.4	90.3
2	6/27/1999	13:42	29.68	89.6	17	15.96	15.96	0.02	0.38	0.62	0.05	0.08	17.7	1.8	89.1	31.7	89.1	32.0	89.6
3	6/27/1999	14:02	29.68	89.2	15	14.10	30.06	0.03	0.72	0.85	0.10	0.16	32.4	5.2	89.2	31.8	89.2	31.8	89.2
4	6/27/1999	14:29	29.68	88.0	18	16.95	47.01	0.05	1.17	1.08	0.15	0.25	53.0	10.7	88.5	31.4	88.5	31.1	88.0
5	6/27/1999	14:46	29.65	89.8	15	14.07	61.08	0.06	1.45	1.20	0.20	0.32	57.7	16.7	88.7	31.5	88.7	32.1	89.8
6	6/27/1999	15:00	29.65	90.1	13	12.18	73.26	0.07	1.68	1.30	0.24	0.39	68.0	23.8	88.7	31.5	88.7	32.3	90.1
7	6/27/1999	15:15	29.65	91.9	12	11.21	84.47	0.08	1.93	1.39	0.27	0.45	72.1	31.3	88.7	31.5	88.7	33.3	91.9
8	6/27/1999	15:32	29.62	92.1	10	9.33	93.80	0.09	2.22	1.49	0.30	0.50	78.3	39.4	88.5	31.4	88.5	33.4	92.1
9	6/27/1999	15:47	29.62	91.6	9	8.40	102.21	0.10	2.47	1.57	0.33	0.54	88.3	48.6	89.1	31.7	89.1	33.1	91.6
10	6/27/1999	16:18	29.62	91.2	10	9.34	111.55	0.12	2.98	1.73	0.36	0.59	98.5	58.9	88.5	31.4	88.5	32.9	91.2
11	6/27/1999	16:48	29.62	89.8	9	8.43	119.98	0.15	3.48	1.87	0.39	0.64	111.7	70.5	88.2	31.2	88.2	32.1	89.8
12	6/27/1999	17:13	29.62	89.8	8	7.50	127.48	0.16	3.90	1.97	0.41	0.68	118.8	82.8	88.2	31.2	88.2	32.1	89.8
13	6/27/1999	17:30	29.62	89.4	16	15.00	142.48	0.17	4.18	2.05	0.46	0.76	134.3	96.8	88.2	31.2	88.2	31.9	89.4
14	6/27/1999	17:51	29.59	89.2	5	4.68	147.16	0.19	4.53	2.13	0.48	0.78	137.4	111.1	87.8	31.0	87.8	31.8	89.2
15	6/27/1999	18:27	29.59	88.2	5	4.69	151.86	0.21	5.13	2.27	0.49	0.81	145.7	126.2	88.0	31.1	88.0	31.2	88.2
16	6/27/1999	18:44	29.59	88.2	4	3.75	155.61	0.23	5.42	2.33	0.51	0.83	149.3	141.8	87.4	30.8	87.4	31.2	88.2
17	6/27/1999	19:09	29.59	87.4	3	2.82	158.43	0.24	5.83	2.42	0.51	0.84	154.6	157.9	87.4	30.8	87.4	30.8	87.4
18	6/27/1999	19:24	29.59	87.3	2	1.88	160.31	0.25	6.08	2.47	0.52	0.85	157.0	174.2	87.3	30.7	87.3	30.7	87.3
19	6/27/1999	19:40	29.59	86.5	2	1.88	162.19	0.26	6.35	2.52	0.53	0.86	161.4	191.0	87.3	30.7	87.3	30.3	86.5
20	6/27/1999	19:59	29.59	86.2	2	1.88	164.08	0.28	6.67	2.58	0.53	0.87	164.5	208.1	87.4	30.8	87.4	30.1	86.2
21	6/28/1999	17:56	29.62	96.6	2	1.85	165.93	1.19	28.62	5.35	0.54	0.88	130.7	221.7	87.4	30.8	87.4	35.9	96.6
22	6/29/1999	7:12	29.59	86.0	0	0.00	165.93	1.75	41.88	6.47	0.54	0.88	167.0	239.1	87.4	30.8	87.4	30.0	86.0



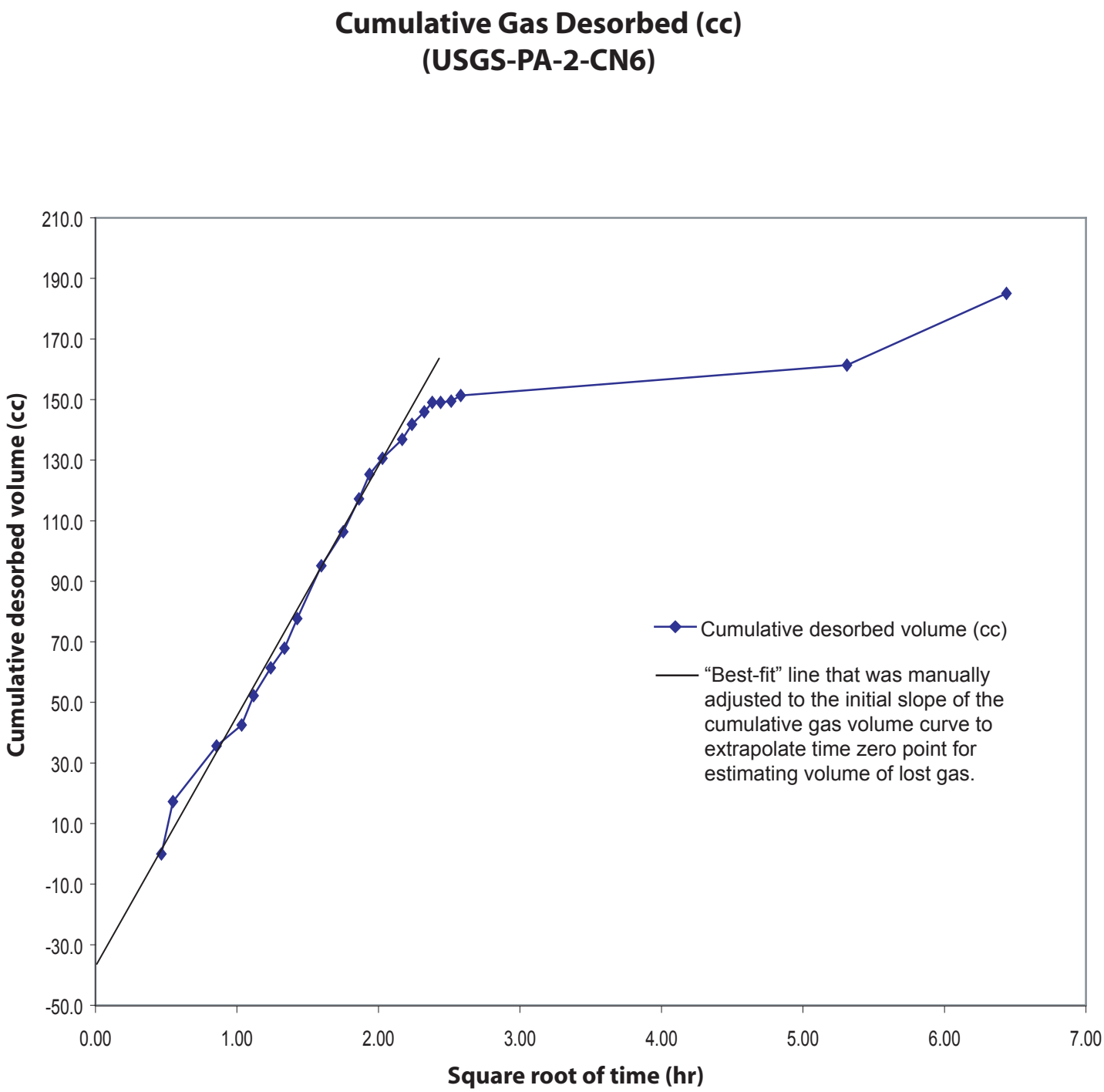
Lost Gas Estimate= 40 cc
Raw Total Gas= 0.26 g/cc (8.46 SCF/ton)
DAF Total Gas= 0.43 g/cc (13.62 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 5

Table 5

Project	Wilcox, Panola Co., TX																		
Well ID:	PA 2	Can no.	99-5																
Sample Interval (ft):	From:	360	To:	361			Cumulative volume @ STP:	246.4	Lost gas estimate (cc)	40.0			Raw total gas (SCF/ton)	8.46					
Core Date: (enter in box: mm/dd/yr)				6/27/1999															
Time Zero (hh:mm)				13:46			Milliliters/gram raw coal:	0.23	Raw total gas (cc/g)	0.26			DAF total gas (SCF/ton)	13.62					
Raw coal mass (air-dry): (grams)				1084															
Coal mass (d.a.f.): (grams)				673			Milliliter/gram coal d.a.f.:	0.37	DAF total gas (cc/g)	0.43									
Headspace volume:				1624			(excluding lost gas)												
													Headspace Correction			Optional Temperature Conversions			
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	13:58	29.68	89.8	14	13.14	0.00	0.01	0.20	0.45	0.00	0.00	0.0	0.0	89.6	32.0	89.6	32.1	89.8
2	6/27/1999	14:03	29.68	88.3	10	9.41	9.41	0.01	0.28	0.53	0.01	0.01	12.7	0.4	89.2	31.8	89.2	31.3	88.3
3	6/27/1999	14:29	29.68	87.8	18	16.96	26.37	0.03	0.72	0.85	0.02	0.04	30.1	1.3	88.5	31.4	88.5	31.0	87.8
4	6/27/1999	14:46	29.65	89.2	17	15.96	42.33	0.04	1.00	1.00	0.04	0.06	40.0	2.4	88.5	31.4	88.5	31.8	89.2
5	6/27/1999	15:00	29.65	89.8	15	14.07	56.40	0.05	1.23	1.11	0.05	0.08	51.9	4.0	88.7	31.5	88.7	32.1	89.8
6	6/27/1999	15:17	29.65	91.2	14	13.10	69.49	0.06	1.52	1.23	0.06	0.10	60.6	5.8	88.7	31.5	88.7	32.9	91.2
7	6/27/1999	15:32	29.62	91.4	12	11.21	80.70	0.07	1.77	1.33	0.07	0.12	69.3	7.8	88.5	31.4	88.5	33.0	91.4
8	6/27/1999	15:48	29.62	90.1	10	9.36	90.06	0.08	2.03	1.43	0.08	0.13	81.4	10.2	89.1	31.7	89.1	32.3	90.1
9	6/27/1999	16:18	29.62	90.9	17	15.90	105.96	0.11	2.53	1.59	0.10	0.16	94.7	13.0	88.5	31.4	88.5	32.7	90.9
10	6/27/1999	16:49	29.62	89.6	11	10.31	116.27	0.13	3.05	1.75	0.11	0.17	107.7	16.2	88.2	31.2	88.2	32.0	89.6
11	6/27/1999	17:14	29.62	89.4	10	9.37	125.64	0.14	3.47	1.86	0.12	0.19	117.1	19.7	88.2	31.2	88.2	31.9	89.4
12	6/27/1999	17:30	29.62	89.1	8	7.50	133.15	0.16	3.73	1.93	0.12	0.20	125.1	23.4	88.2	31.2	88.2	31.7	89.1
13	6/27/1999	17:52	29.59	88.7	7	6.56	139.71	0.17	4.10	2.02	0.13	0.21	130.8	27.2	87.8	31.0	87.8	31.5	88.7
14	6/27/1999	18:28	29.59	88.2	7	6.57	146.28	0.20	4.70	2.17	0.13	0.22	138.5	31.3	88.0	31.1	88.0	31.2	88.2
15	6/27/1999	18:45	29.59	86.9	5	4.70	150.99	0.21	4.98	2.23	0.14	0.22	146.2	35.6	88.0	31.1	88.0	30.5	86.9
16	6/27/1999	19:09	29.59	87.3	4	3.76	154.75	0.22	5.38	2.32	0.14	0.23	148.8	40.0	87.4	30.8	87.4	30.7	87.3
17	6/27/1999	19:25	29.59	87.3	3	2.82	157.57	0.24	5.65	2.38	0.15	0.23	151.5	44.5	87.3	30.7	87.3	30.7	87.3
18	6/27/1999	19:41	29.59	86.9	3	2.82	160.39	0.25	5.92	2.43	0.15	0.24	155.1	49.1	87.4	30.8	87.4	30.5	86.9
19	6/27/1999	20:00	29.59	86.7	2	1.88	162.28	0.26	6.23	2.50	0.15	0.24	157.4	53.8	87.4	30.8	87.4	30.4	86.7
20	6/27/1999	20:25	29.59	86.4	2	1.88	164.16	0.28	6.65	2.58	0.15	0.24	160.1	58.5	87.6	30.9	87.6	30.2	86.4
21	6/28/1999	17:40	29.62	99.0	104	95.83	259.99	1.16	27.90	5.28	0.24	0.39	218.4	64.9	105.8	41.0	105.8	37.2	99.0
22	6/29/1999	7:12	29.56	86.0	-3	0.00	259.99	1.73	41.43	6.44	0.24	0.39	246.4	72.2	86.9	30.5	86.9	30.0	86.0



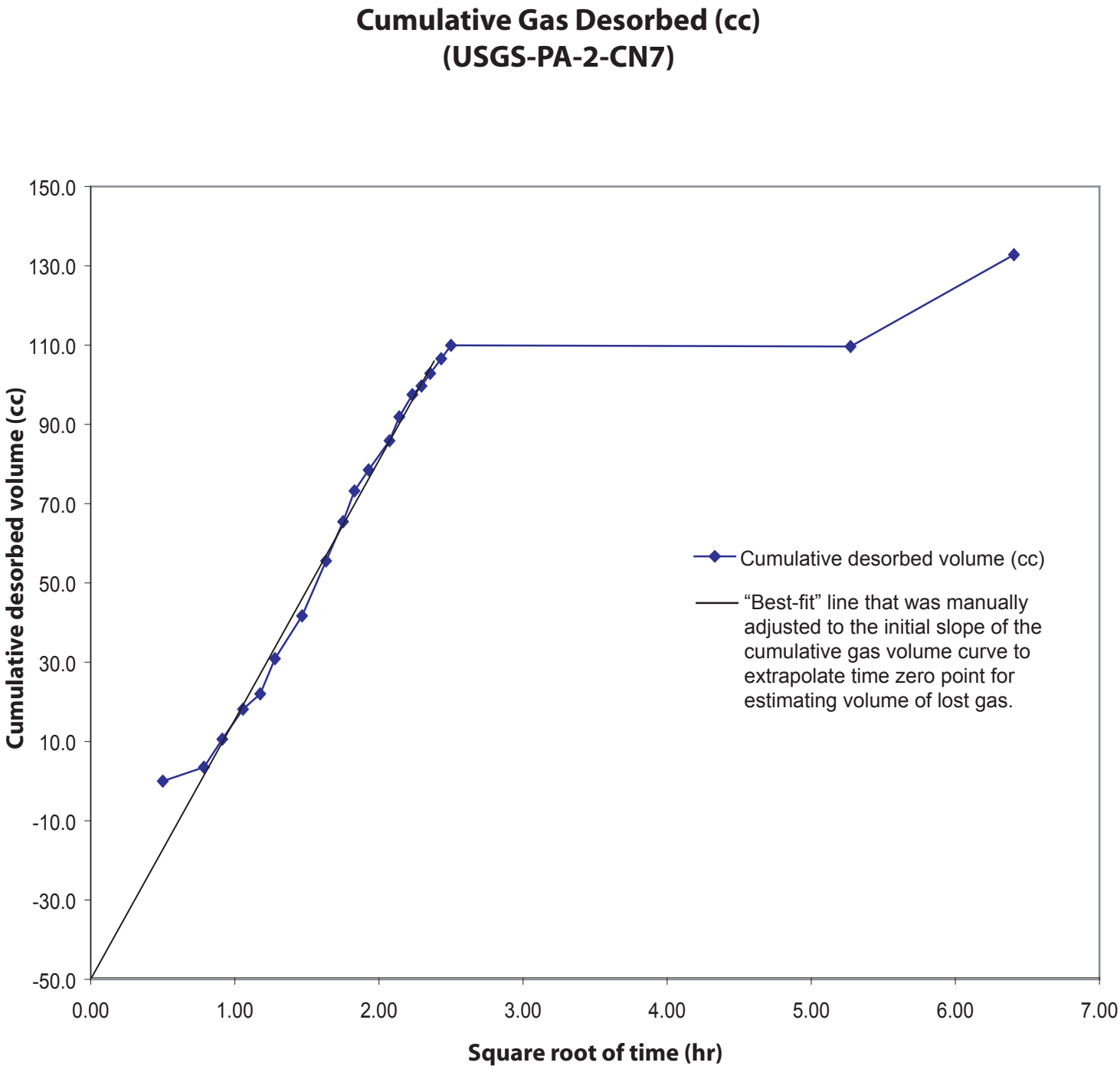
Lost Gas Estimate= 35 cc
Raw Total Gas= 0.20 g/cc (6.46 SCF/ton)
DAF Total Gas= 0.29 g/cc (9.35 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 6

Table 6

Project	Wilcox, Panola Co., TX																		
Well ID:	PA 2	Can no.	99-6																
Sample Interval (ft):	From:	360	To:	361			Cumulative volume @ STP:	185.0	Lost gas estimate (cc)	35.0			Raw total gas (SCF/ton)	6.46					
Core Date: (enter in box: mm/dd/yr)				6/27/1999															
Time Zero (hh:mm)				13:46			Milliliters/gram raw coal:	0.17	Raw total gas (cc/g)	0.20			DAF total gas (SCF/ton)	9.35					
Raw coal mass (air-dry): (grams)				1088															
Coal mass (d.a.f.): (grams)				751			Milliliter/gram coal d.a.f.:	0.25	DAF total gas (cc/g)	0.29									
Headspace volume:				1525			(excluding lost gas)												
													Headspace Correction		Optional Temperature Conversions				
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	13:59	29.68	90.9	19	17.80	0.00	0.01	0.22	0.47	0.00	0.00	0.0	0.0	89.6	32.0	89.6	32.7	90.9
2	6/27/1999	14:04	29.68	88.7	13	12.23	12.23	0.01	0.30	0.55	0.01	0.02	16.9	0.5	89.2	31.8	89.2	31.5	88.7
3	6/27/1999	14:30	29.68	87.8	18	16.96	29.19	0.03	0.73	0.86	0.03	0.04	35.1	1.5	88.5	31.4	88.5	31.0	87.8
4	6/27/1999	14:50	29.65	90.7	18	16.85	46.04	0.04	1.07	1.03	0.04	0.06	42.6	2.8	88.5	31.4	88.5	32.6	90.7
5	6/27/1999	15:01	29.65	91.8	14	13.08	59.12	0.05	1.25	1.12	0.05	0.08	52.4	4.3	88.7	31.5	88.7	33.2	91.8
6	6/27/1999	15:18	29.65	92.7	13	12.13	71.25	0.06	1.53	1.24	0.07	0.09	61.8	6.1	88.7	31.5	88.7	33.7	92.7
7	6/27/1999	15:33	29.62	93.4	11	10.24	81.49	0.07	1.78	1.34	0.07	0.11	68.4	8.2	88.5	31.4	88.5	34.1	93.4
8	6/27/1999	15:48	29.62	93.0	10	9.31	90.80	0.08	2.03	1.43	0.08	0.12	78.2	10.5	89.1	31.7	89.1	33.9	93.0
9	6/27/1999	16:19	29.62	91.8	16	14.94	105.74	0.11	2.55	1.60	0.10	0.14	95.5	13.3	88.5	31.4	88.5	33.2	91.8
10	6/27/1999	16:50	29.62	90.9	10	9.35	115.09	0.13	3.07	1.75	0.11	0.15	106.6	16.4	88.2	31.2	88.2	32.7	90.9
11	6/27/1999	17:14	29.62	89.8	9	8.43	123.52	0.14	3.47	1.86	0.11	0.16	117.2	19.9	88.2	31.2	88.2	32.1	89.8
12	6/27/1999	17:31	29.62	89.1	7	6.57	130.09	0.16	3.75	1.94	0.12	0.17	125.2	23.6	88.2	31.2	88.2	31.7	89.1
13	6/27/1999	17:53	29.59	88.5	6	5.63	135.72	0.17	4.12	2.03	0.12	0.18	130.5	27.4	87.8	31.0	87.8	31.4	88.5
14	6/27/1999	18:28	29.59	88.2	6	5.63	141.35	0.20	4.70	2.17	0.13	0.19	136.7	31.4	88.0	31.1	88.0	31.2	88.2
15	6/27/1999	18:46	29.59	87.6	4	3.76	145.11	0.21	5.00	2.24	0.13	0.19	141.6	35.6	88.0	31.1	88.0	30.9	87.6
16	6/27/1999	19:10	29.59	87.1	3	2.82	147.93	0.23	5.40	2.32	0.14	0.20	145.6	39.9	87.4	30.8	87.4	30.6	87.1
17	6/27/1999	19:26	29.59	86.9	3	2.82	150.75	0.24	5.67	2.38	0.14	0.20	148.7	44.3	87.3	30.7	87.3	30.5	86.9
18	6/27/1999	19:43	29.59	86.9	0	0.00	150.75	0.25	5.95	2.44	0.14	0.20	148.7	48.6	87.4	30.8	87.4	30.5	86.9
19	6/27/1999	20:05	29.59	87.1	1	0.94	151.69	0.26	6.32	2.51	0.14	0.20	149.1	53.0	87.4	30.8	87.4	30.6	87.1
20	6/27/1999	20:26	29.62	87.3	1	0.94	152.63	0.28	6.67	2.58	0.14	0.20	151.0	57.5	87.6	30.9	87.6	30.7	87.3
21	6/28/1999	17:58	29.53	93.9	37	34.30	186.93	1.18	28.20	5.31	0.17	0.25	162.3	62.2	105.8	41.0	105.8	34.4	93.9
22	6/29/1999	7:13	29.59	85.6	-1	0.00	186.93	1.73	41.45	6.44	0.17	0.25	184.5	67.7	86.9	30.5	86.9	29.8	85.6



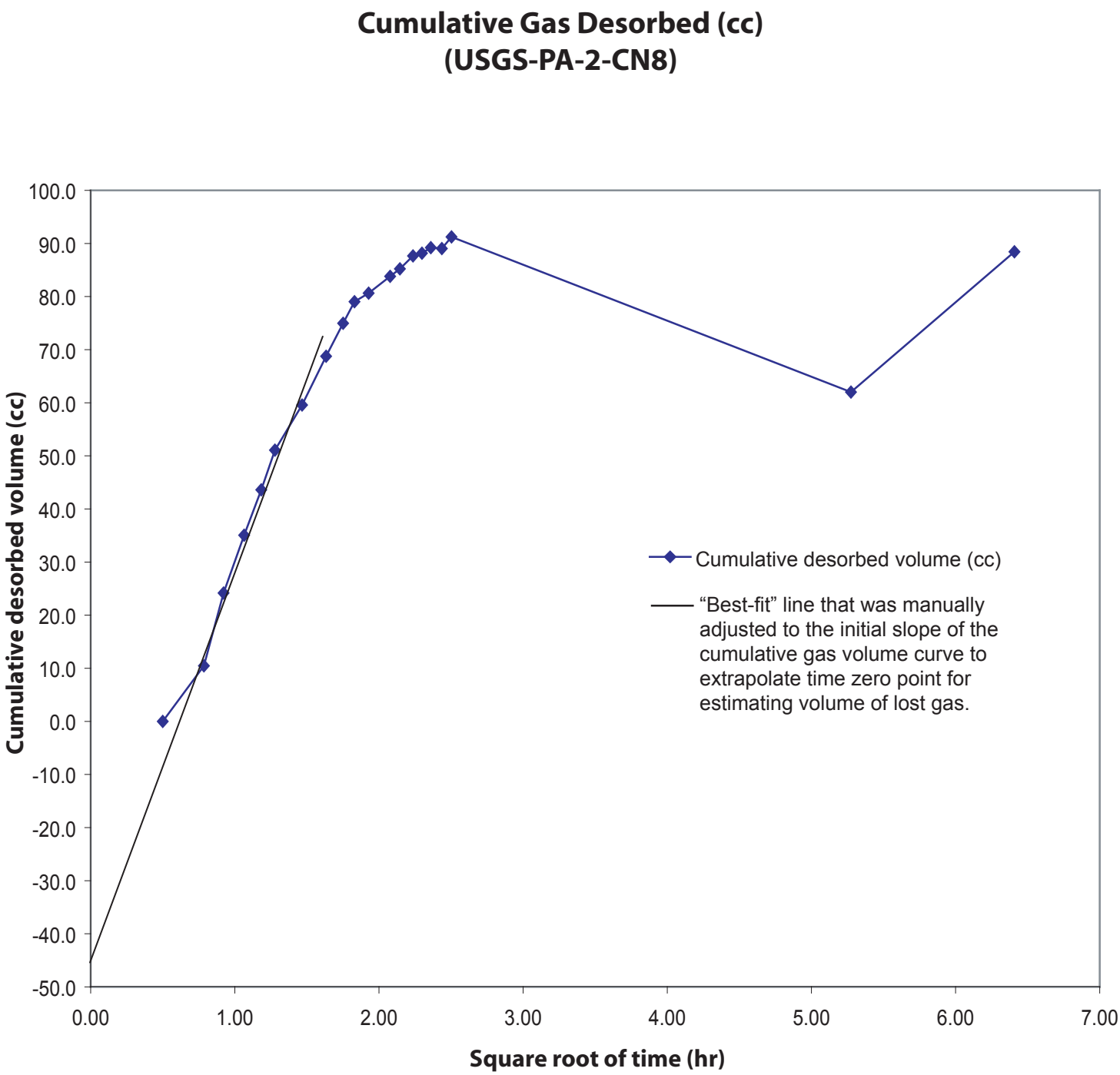
Lost Gas Estimate= 50 cc
Raw Total Gas= 0.19 g/cc (6.02 SCF/ton)
DAF Total Gas= 0.30 g/cc (9.73 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 7

Table 7

Project	Wilcox, Panola Co., TX																		
Well ID:	PA 2	Can no.	99-7																
Sample Interval (ft):	From:	362.1	To:	363			Cumulative volume @ STP:	132.8	Lost gas estimate (cc)	50.0						Raw total gas (SCF/ton)	6.02		
Core Date: (enter in box: mm/dd/yr)				6/27/1999															
Time Zero (hh:mm) (24 hour clock)				14:11			Milliliters/gram raw coal:	0.14	Raw total gas (cc/g)	0.19						DAF total gas (SCF/ton)	9.73		
Raw coal mass (air-dry): (grams)				972															
Coal mass (d.a.f.): (grams)				601			Milliliter/gram coal d.a.f.:	0.22	DAF total gas (cc/g)	0.30									
Headspace volume:				1769			(excluding lost gas)												
													Headspace Correction			Optional Temperature Conversions			
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure In. Hg	Internal Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	14:26	29.68	86.9	5	4.72	0.00	0.01	0.25	0.50	0.00	0.00	0.0	0.0	88.5	31.4	88.5	30.5	86.9
2	6/27/1999	14:48	29.65	88.5	11	10.34	10.34	0.03	0.62	0.79	0.01	0.02	3.5	0.1	88.5	31.4	88.5	31.4	88.5
3	6/27/1999	15:01	29.65	89.8	12	11.25	21.59	0.03	0.83	0.91	0.02	0.04	10.6	0.5	88.7	31.5	88.7	32.1	89.8
4	6/27/1999	15:18	29.65	90.9	12	11.23	32.83	0.05	1.12	1.06	0.03	0.05	18.2	1.1	88.7	31.5	88.7	32.7	90.9
5	6/27/1999	15:34	29.62	91.8	9	8.40	41.23	0.06	1.38	1.18	0.04	0.07	22.0	1.8	88.5	31.4	88.5	33.2	91.8
6	6/27/1999	15:49	29.62	91.8	10	9.34	50.56	0.07	1.63	1.28	0.05	0.08	30.9	2.8	89.1	31.7	89.1	33.2	91.8
7	6/27/1999	16:20	29.62	91.4	11	10.28	60.84	0.09	2.15	1.47	0.06	0.10	41.7	4.2	88.5	31.4	88.5	33.0	91.4
8	6/27/1999	16:51	29.62	90.0	11	10.30	71.14	0.11	2.67	1.63	0.07	0.12	55.5	6.0	88.2	31.2	88.2	32.2	90.0
9	6/27/1999	17:15	29.62	89.6	10	9.37	80.51	0.13	3.07	1.75	0.08	0.13	65.5	8.2	88.2	31.2	88.2	32.0	89.6
10	6/27/1999	17:32	29.62	89.1	7	6.57	87.08	0.14	3.35	1.83	0.09	0.14	73.2	10.6	88.2	31.2	88.2	31.7	89.1
11	6/27/1999	17:54	29.59	88.5	6	5.63	92.71	0.15	3.72	1.93	0.10	0.15	78.5	13.2	87.8	31.0	87.8	31.4	88.5
12	6/27/1999	18:29	29.59	87.8	6	5.64	98.34	0.18	4.30	2.07	0.10	0.16	85.9	16.0	87.8	31.0	87.8	31.0	87.8
13	6/27/1999	18:46	29.59	87.3	5	4.70	103.04	0.19	4.58	2.14	0.11	0.17	91.9	19.0	87.4	30.8	87.4	30.7	87.3
14	6/27/1999	19:10	29.59	86.5	4	3.77	106.81	0.21	4.98	2.23	0.11	0.18	97.5	22.2	87.4	30.8	87.4	30.3	86.5
15	6/27/1999	19:27	29.59	86.7	3	2.82	109.63	0.22	5.27	2.29	0.11	0.18	99.7	25.5	87.3	30.7	87.3	30.4	86.7
16	6/27/1999	19:44	29.59	86.5	3	2.82	112.46	0.23	5.55	2.36	0.12	0.19	102.8	28.9	87.3	30.7	87.3	30.3	86.5
17	6/27/1999	20:06	29.59	86.2	3	2.83	115.28	0.25	5.92	2.43	0.12	0.19	106.6	32.4	87.4	30.8	87.4	30.1	86.2
18	6/27/1999	20:26	29.62	86.2	2	1.89	117.17	0.26	6.25	2.50	0.12	0.19	109.9	36.1	87.6	30.9	87.6	30.1	86.2
19	6/28/1999	17:59	29.53	94.3	32	29.65	146.82	1.16	27.80	5.27	0.15	0.24	109.6	39.7	104.9	40.5	104.9	34.6	94.3
20	6/29/1999	7:14	29.59	86.0	-4	-3.77	143.05	1.71	41.05	6.41	0.15	0.24	132.8	44.0	86.9	30.5	86.9	30.0	86.0



Lost Gas Estimate= 45 cc
Raw Total Gas= 0.12 g/cc (3.77 SCF/ton)
DAF Total Gas= 0.30 g/cc (9.75 SCF/ton)

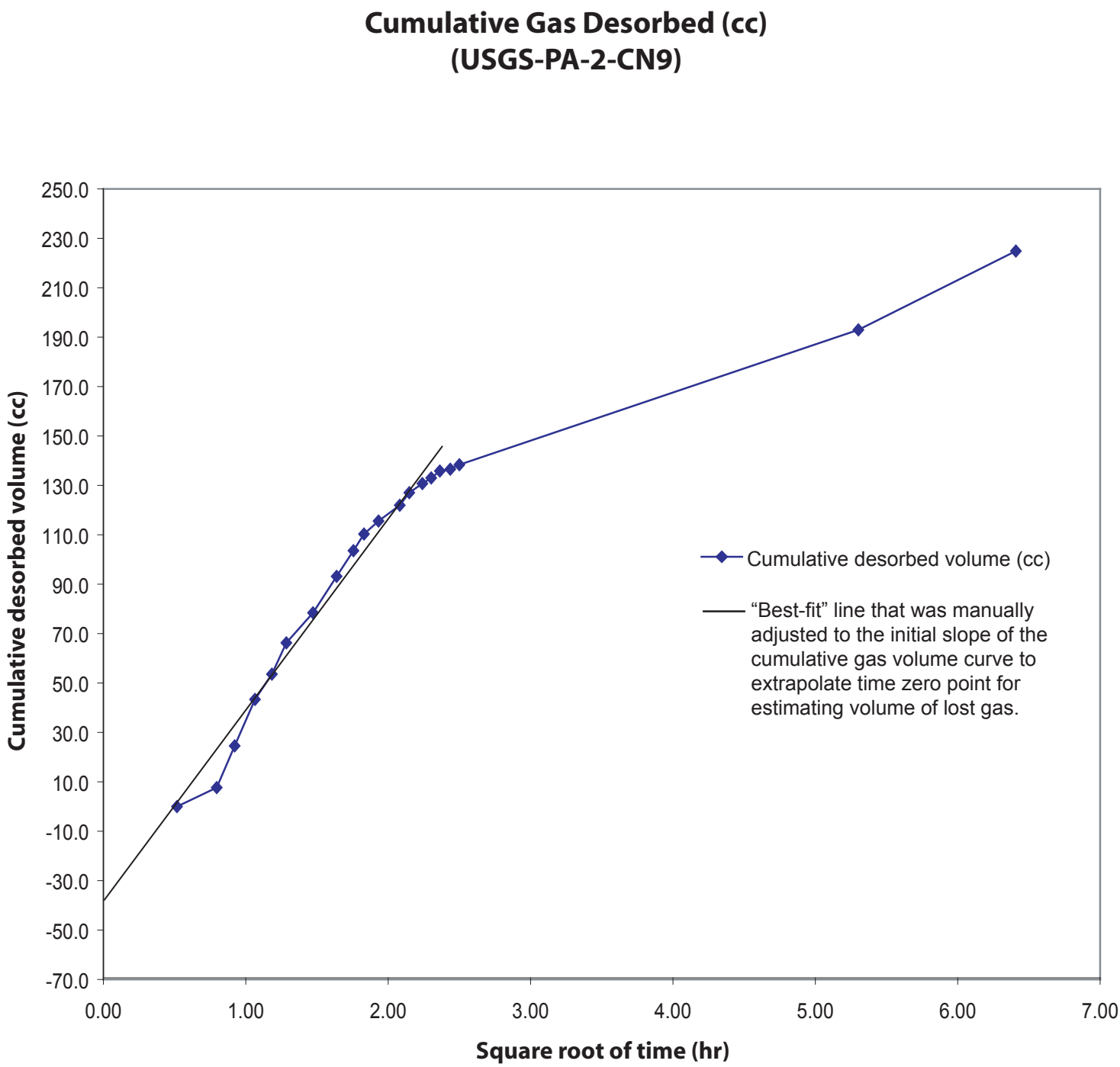
g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 8

Table 8

Project	Wilcox, Panola Co., TX																			
Well ID:	PA 2	Can no.	99-8																	
Sample Interval (ft):	From:	363	To:	364				Cumulative volume @ STP:	91.2	Lost gas estimate (cc)	45.0							Raw total gas (SCF/ton)	3.77	
Core Date: (enter in box: mm/dd/yr)				6/27/1999																
Time Zero (hh:mm) (24 hour clock)				14:11				Milliliters/gram raw coal:	0.08	Raw total gas (cc/g)	0.08							DAF total gas (SCF/ton)	9.75	
Raw coal mass (air-dry): (grams)				1155																
Coal mass (d.a.f.): (grams)				447*				Milliliter/gram coal d.a.f.:	0.20	DAF total gas (cc/g)	0.30									
Headspace volume:				1770				(excluding lost gas)												
													Headspace Correction			Optional Temperature Conversions			
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Internal Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	14:26	29.68	86.5	21	19.83	0.00	0.01	0.25	0.50	0.00	0.00	0.0	0.0	88.5	31.4	88.5	30.3	86.5
2	6/27/1999	14:48	29.65	88.5	20	18.80	18.80	0.03	0.62	0.79	0.02	0.04	10.5	0.3	88.7	31.5	88.7	31.4	88.5
3	6/27/1999	15:02	29.65	88.7	16	15.03	33.83	0.04	0.85	0.92	0.03	0.08	24.2	1.0	88.7	31.5	88.7	31.5	88.7
4	6/27/1999	15:19	29.65	89.2	14	13.14	46.98	0.05	1.13	1.06	0.04	0.11	35.1	1.9	88.7	31.5	88.7	31.8	89.2
5	6/27/1999	15:35	29.62	89.4	12	11.25	58.23	0.06	1.40	1.18	0.05	0.13	43.6	3.1	88.5	31.4	88.5	31.9	89.4
6	6/27/1999	15:49	29.62	89.6	9	8.43	66.66	0.07	1.63	1.28	0.06	0.15	51.1	4.6	89.1	31.7	89.1	32.0	89.6
7	6/27/1999	16:20	29.62	89.4	9	8.44	75.10	0.09	2.15	1.47	0.07	0.17	59.6	6.2	88.5	31.4	88.5	31.9	89.4
8	6/27/1999	16:51	29.62	88.7	8	7.51	82.61	0.11	2.67	1.63	0.07	0.18	68.8	8.1	88.2	31.2	88.2	31.5	88.7
9	6/27/1999	17:15	29.62	88.7	7	6.57	89.18	0.13	3.07	1.75	0.08	0.20	75.0	10.2	88.2	31.2	88.2	31.5	88.7
10	6/27/1999	17:32	29.62	88.5	4	3.76	92.94	0.14	3.35	1.83	0.08	0.21	79.0	12.4	88.2	31.2	88.2	31.4	88.5
11	6/27/1999	17:54	29.59	88.3	3	2.82	95.75	0.15	3.72	1.93	0.08	0.21	80.6	14.6	87.8	31.0	87.8	31.3	88.3
12	6/27/1999	18:30	29.59	88.2	3	2.82	98.57	0.18	4.32	2.08	0.09	0.22	83.8	17.0	87.8	31.0	87.8	31.2	88.2
13	6/27/1999	18:47	29.59	88.0	1	0.94	99.51	0.19	4.60	2.14	0.09	0.22	85.2	19.3	87.4	30.8	87.4	31.1	88.0
14	6/27/1999	19:11	29.59	87.4	1	0.94	100.45	0.21	5.00	2.24	0.09	0.22	87.7	21.7	87.4	30.8	87.4	30.8	87.4
15	6/27/1999	19:28	29.59	87.3	0	0.00	100.45	0.22	5.28	2.30	0.09	0.22	88.2	24.2	87.3	30.7	87.3	30.7	87.3
16	6/27/1999	19:45	29.59	86.9	0	0.00	100.45	0.23	5.57	2.36	0.09	0.22	89.2	26.7	87.3	30.7	87.3	30.5	86.9
17	6/27/1999	20:07	29.59	86.9	-0.2	-0.19	100.26	0.25	5.93	2.44	0.09	0.22	89.0	29.1	87.3	30.7	87.3	30.5	86.9
18	6/27/1999	20:27	29.62	86.5	-0.5	-0.47	99.79	0.26	6.27	2.50	0.09	0.22	91.2	31.7	87.3	30.7	87.3	30.3	86.5
19	6/28/1999	18:00	29.53	96.1	3	2.77	102.56	1.16	27.82	5.27	0.09	0.23	62.0	33.4	104.7	40.4	104.7	35.6	96.1
20	6/29/1999	7:15	29.59	86.0	-6	-5.65	96.90	1.71	41.07	6.41	0.08	0.22	88.4	35.8	86.9	30.5	86.9	30.0	86.0

*estimated value from proximate analysis using relative apparent specific gravity of samples CN8 and CN8P.



Lost Gas Estimate= 36 cc
Raw Total Gas= 0.27 g/cc (8.54 SCF/ton)
DAF Total Gas= 0.53 g/cc (16.82 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

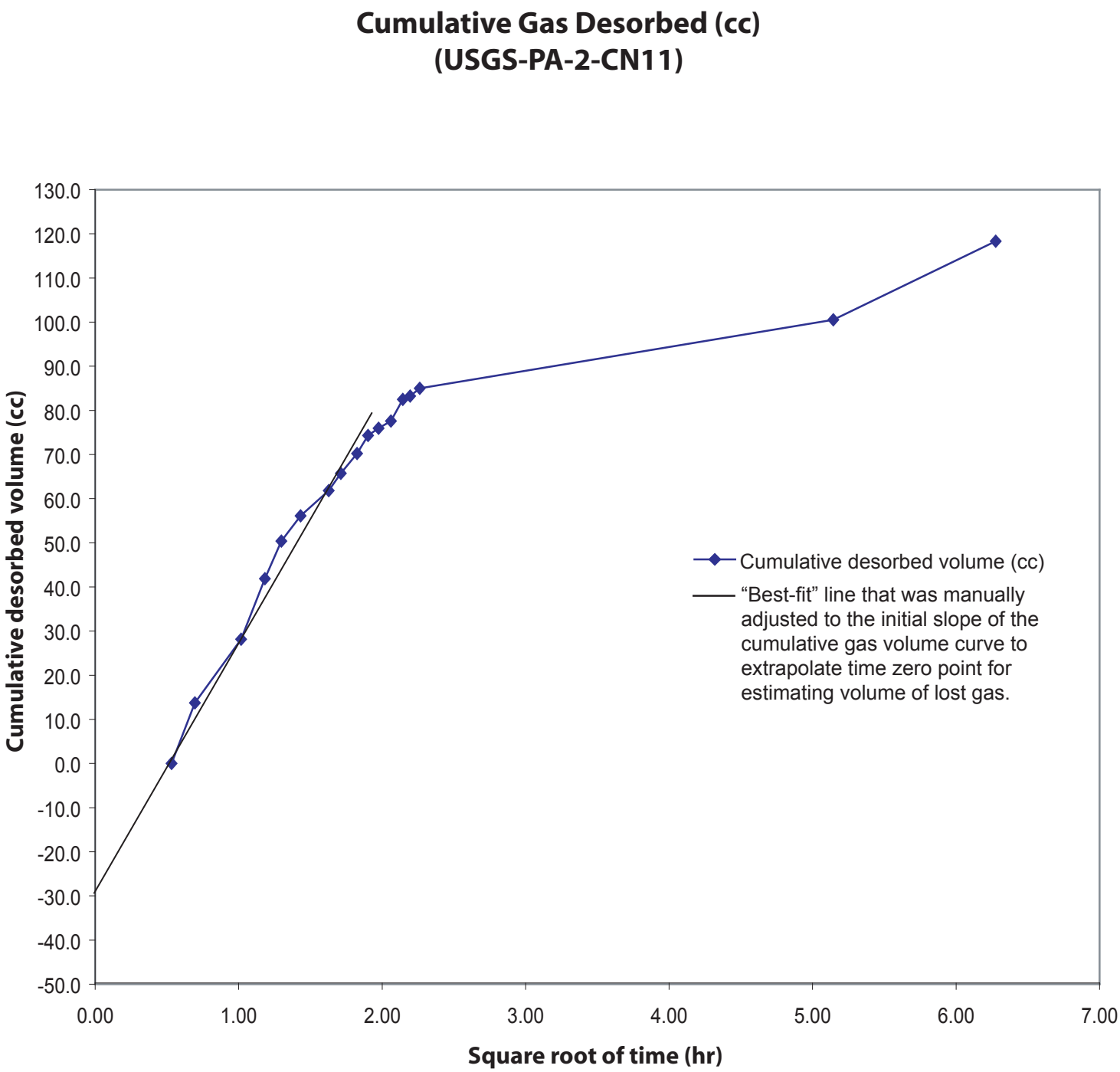
Figure 9

Table 9

Project	Wilcox, Panola Co., TX								
Well ID:	PA 2	Can no.	99-9						
Sample Interval (ft):	From:	364	To:	365	Cumulative volume @ STP:	224.9	Lost gas estimate (cc)	36.0	Raw total gas (SCF/ton) 8.54
Core Date: (enter in box: mm/dd/yr)				6/27/1999					
Time Zero (hh:mm) (24 hour clock)				14:11	Milliliters/gram raw coal:	0.21	Raw total gas (cc/g)	0.21	DAF total gas (SCF/ton) 16.82
Raw coal mass (air-dry): (grams)				1068					
Coal mass (d.a.f.): (grams)				542*	Milliliter/gram coal d.a.f.:	0.41	DAF total gas (cc/g)	0.53	
Headspace volume:				1757	(excluding lost gas)				

	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Internal Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Headspace Correction Cumulative Volume @ STP (milliliter)	Headspace Correction Cumulative Gas Content (SCF)	Ambient Temp °F	Optional Temperature Conversions Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	14:27	29.68	86.2	19	17.95	0.00	0.01	0.27	0.52	0.00	0.00	0.0	0.0	88.5	31.4	88.5	30.1	86.2
2	6/27/1999	14:49	29.65	89.8	22	20.63	20.63	0.03	0.63	0.80	0.02	0.04	7.7	0.2	88.7	31.5	88.7	32.1	89.8
3	6/27/1999	15:02	29.65	89.8	19	17.82	38.45	0.04	0.85	0.92	0.04	0.07	24.6	1.0	88.7	31.5	88.7	32.1	89.8
4	6/27/1999	15:19	29.65	91.9	28	26.16	64.61	0.05	1.13	1.06	0.06	0.12	43.3	2.3	88.7	31.5	88.7	33.3	91.9
5	6/27/1999	15:35	29.62	92.5	15	13.98	78.59	0.06	1.40	1.18	0.07	0.15	53.6	3.9	88.5	31.4	88.5	33.6	92.5
6	6/27/1999	15:50	29.62	91.8	12	11.20	89.79	0.07	1.65	1.28	0.08	0.17	66.2	5.9	89.1	31.7	89.1	33.2	91.8
7	6/27/1999	16:21	29.62	91.2	12	11.21	101.01	0.09	2.17	1.47	0.09	0.19	78.4	8.2	88.5	31.4	88.5	32.9	91.2
8	6/27/1999	16:52	29.62	89.8	12	11.24	112.25	0.11	2.68	1.64	0.11	0.21	93.1	11.0	88.2	31.2	88.2	32.1	89.8
9	6/27/1999	17:16	29.62	89.2	10	9.38	121.63	0.13	3.08	1.76	0.11	0.22	103.6	14.1	88.2	31.2	88.2	31.8	89.2
10	6/27/1999	17:32	29.62	89.1	7	6.57	128.19	0.14	3.35	1.83	0.12	0.24	110.3	17.4	88.2	31.2	88.2	31.7	89.1
11	6/27/1999	17:55	29.59	88.5	6	5.63	133.82	0.16	3.73	1.93	0.13	0.25	115.6	20.9	87.8	31.0	87.8	31.4	88.5
12	6/27/1999	18:31	29.59	88.2	6	5.63	139.45	0.18	4.33	2.08	0.13	0.26	121.9	24.5	88.0	31.1	88.0	31.2	88.2
13	6/27/1999	18:48	29.59	87.6	4	3.76	143.21	0.19	4.62	2.15	0.13	0.26	127.0	28.4	87.4	30.8	87.4	30.9	87.6
14	6/27/1999	19:12	29.59	87.3	3	2.82	146.03	0.21	5.02	2.24	0.14	0.27	130.7	32.3	87.4	30.8	87.4	30.7	87.3
15	6/27/1999	19:29	29.59	87.1	2	1.88	147.92	0.22	5.30	2.30	0.14	0.27	133.0	36.3	87.3	30.7	87.3	30.6	87.1
16	6/27/1999	19:46	29.59	86.7	2	1.88	149.80	0.23	5.58	2.36	0.14	0.28	135.8	40.3	87.4	30.8	87.4	30.4	86.7
17	6/27/1999	20:07	29.59	87.1	2	1.88	151.68	0.25	5.93	2.44	0.14	0.28	136.6	44.4	87.4	30.8	87.4	30.6	87.1
18	6/27/1999	20:26	29.62	87.6	2	1.88	153.56	0.26	6.25	2.50	0.14	0.28	138.4	48.6	87.3	30.7	87.3	30.9	87.6
19	6/28/1999	18:18	29.53	96.3	97	89.54	243.10	1.17	28.12	5.30	0.23	0.45	192.9	54.4	104.0	40.0	104.0	35.7	96.3
20	6/29/1999	7:15	29.59	85.1	-3	-2.83	240.27	1.71	41.07	6.41	0.22	0.44	224.9	61.1	86.9	30.5	86.9	29.5	85.1

*estimated value from proximate analysis using relative apparent specific gravity of samples CN8P, CN9C and CN9P..



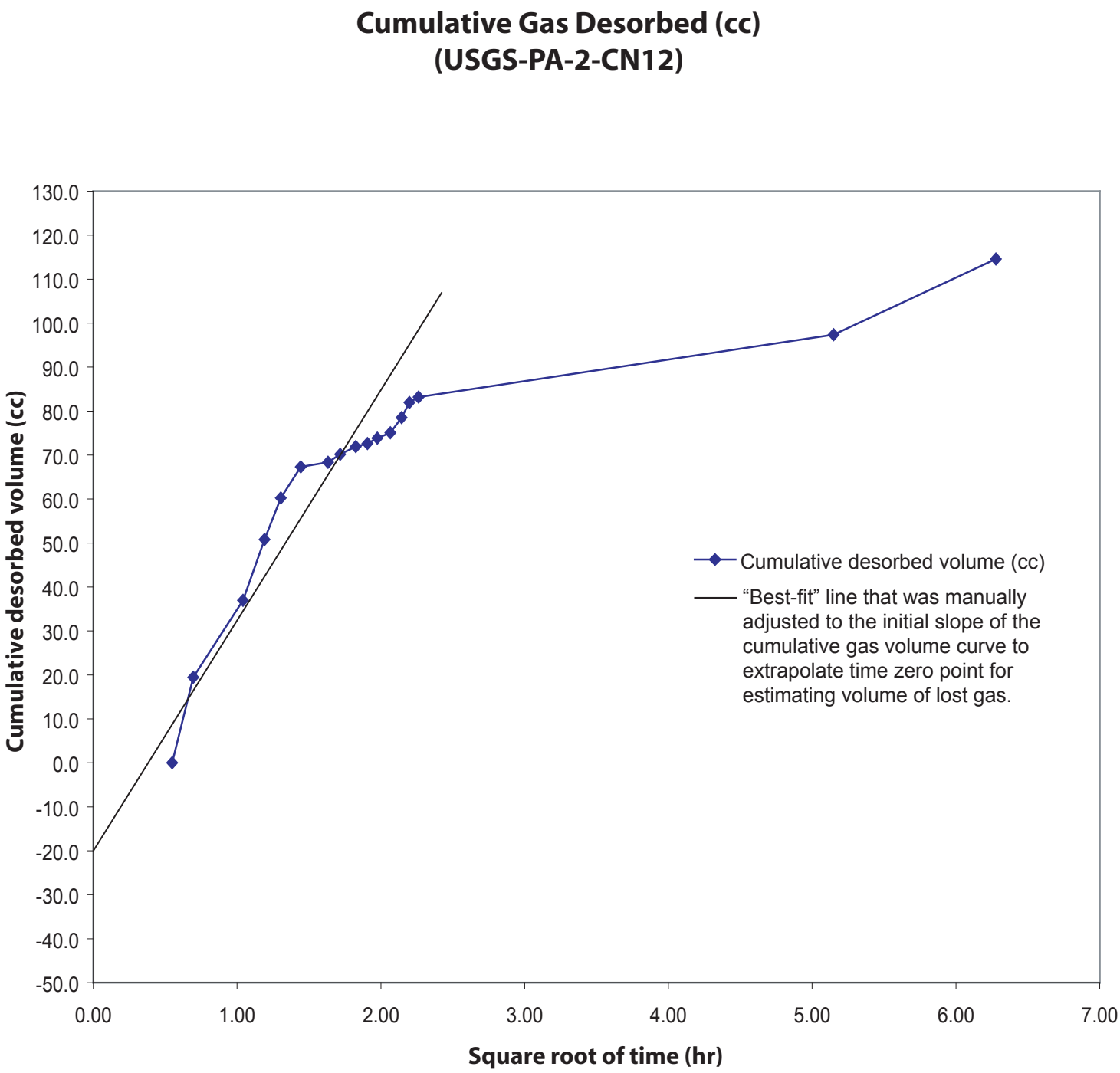
Lost Gas Estimate= 30 cc
Raw Total Gas= 0.16 g/cc (4.96 SCF/ton)
DAF Total Gas= 0.25 g/cc (8.02 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 10

Table 10

Project	Wilcox, Panola Co., TX																			
Well ID:	PA 2	Can no.	99-11																	
Sample Interval (ft):	From:	365.4	To:	366.5				Cumulative volume @ STP:	118.3	Lost gas estimate (cc)	30						Raw total gas (SCF/ton)	4.96		
Core Date: (enter in box: mm/dd/yr)				6/27/1999																
Time Zero (hh:mm) (24 hour clock)				15:53				Milliliters/gram raw coal:	0.12	Raw total gas (cc/g)	0.16						DAF total gas (SCF/ton)	8.02		
Raw coal mass (air-dry): (grams)				956																
Coal mass (d.a.f.): (grams)				592				Milliliter/gram coal d.a.f.:	0.20	DAF total gas (cc/g)	0.25									
Headspace volume: (cc)				1755				(excluding lost gas)												
													Headspace Correction			Optional Temperature Conversions			
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Internal Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	16:10	29.62	85.8	22	20.76	0.00	0.01	0.28	0.53	0.00	0.00	0.0	0.0	86.5	30.3	86.5	29.9	85.8
2	6/27/1999	16:22	29.62	86.0	16	15.09	15.09	0.02	0.48	0.70	0.02	0.03	13.8	0.5	86.2	30.1	86.2	30.0	86.0
3	6/27/1999	16:55	29.62	85.6	15	14.16	29.25	0.04	1.03	1.02	0.03	0.05	28.2	1.4	85.6	29.8	85.6	29.8	85.6
4	6/27/1999	17:17	29.62	84.9	13	12.29	41.54	0.06	1.40	1.18	0.04	0.07	41.8	2.8	85.6	29.8	85.6	29.4	84.9
5	6/27/1999	17:34	29.62	84.7	9	8.51	50.05	0.07	1.68	1.30	0.05	0.08	50.4	4.5	86.0	30.0	86.0	29.3	84.7
6	6/27/1999	17:56	29.59	84.4	7	6.62	56.67	0.09	2.05	1.43	0.06	0.10	56.1	6.4	85.5	29.7	85.5	29.1	84.4
7	6/27/1999	18:32	29.59	84.6	7	6.61	63.28	0.11	2.65	1.63	0.07	0.11	61.8	8.4	85.8	29.9	85.8	29.2	84.6
8	6/27/1999	18:49	29.59	84.7	5	4.72	68.01	0.12	2.93	1.71	0.07	0.11	65.7	10.7	85.5	29.7	85.5	29.3	84.7
9	6/27/1999	19:13	29.59	84.7	5	4.72	72.73	0.14	3.33	1.83	0.08	0.12	70.2	13.0	85.3	29.6	85.3	29.3	84.7
10	6/27/1999	19:30	29.59	84.6	4	3.78	76.51	0.15	3.62	1.90	0.08	0.13	74.3	15.5	86.4	30.2	86.4	29.2	84.6
11	6/27/1999	19:47	29.59	84.9	3	2.83	79.34	0.16	3.90	1.97	0.08	0.13	75.9	18.0	86.2	30.1	86.2	29.4	84.9
12	6/27/1999	20:08	29.59	85.3	3	2.83	82.17	0.18	4.25	2.06	0.09	0.14	77.6	20.6	86.4	30.2	86.4	29.6	85.3
13	6/27/1999	20:29	29.62	84.7	2	1.89	84.06	0.19	4.60	2.14	0.09	0.14	82.5	23.4	86.4	30.2	86.4	29.3	84.7
14	6/27/1999	20:42	29.62	85.1	2	1.89	85.95	0.20	4.82	2.19	0.09	0.15	83.2	26.2	86.5	30.3	86.5	29.5	85.1
15	6/27/1999	21:00	29.62	85.1	2	1.89	87.84	0.21	5.12	2.26	0.09	0.15	85.0	29.0	86.5	30.3	86.5	29.5	85.1
16	6/28/1999	18:21	29.53	100.6	74	67.79	155.63	1.10	26.47	5.14	0.16	0.26	100.5	32.4	106.0	41.1	106.0	38.1	100.6
17	6/29/1999	7:17	29.59	94.3	-3	-2.78	152.84	1.64	39.40	6.28	0.16	0.26	118.3	36.4	95.7	35.4	95.7	34.6	94.3



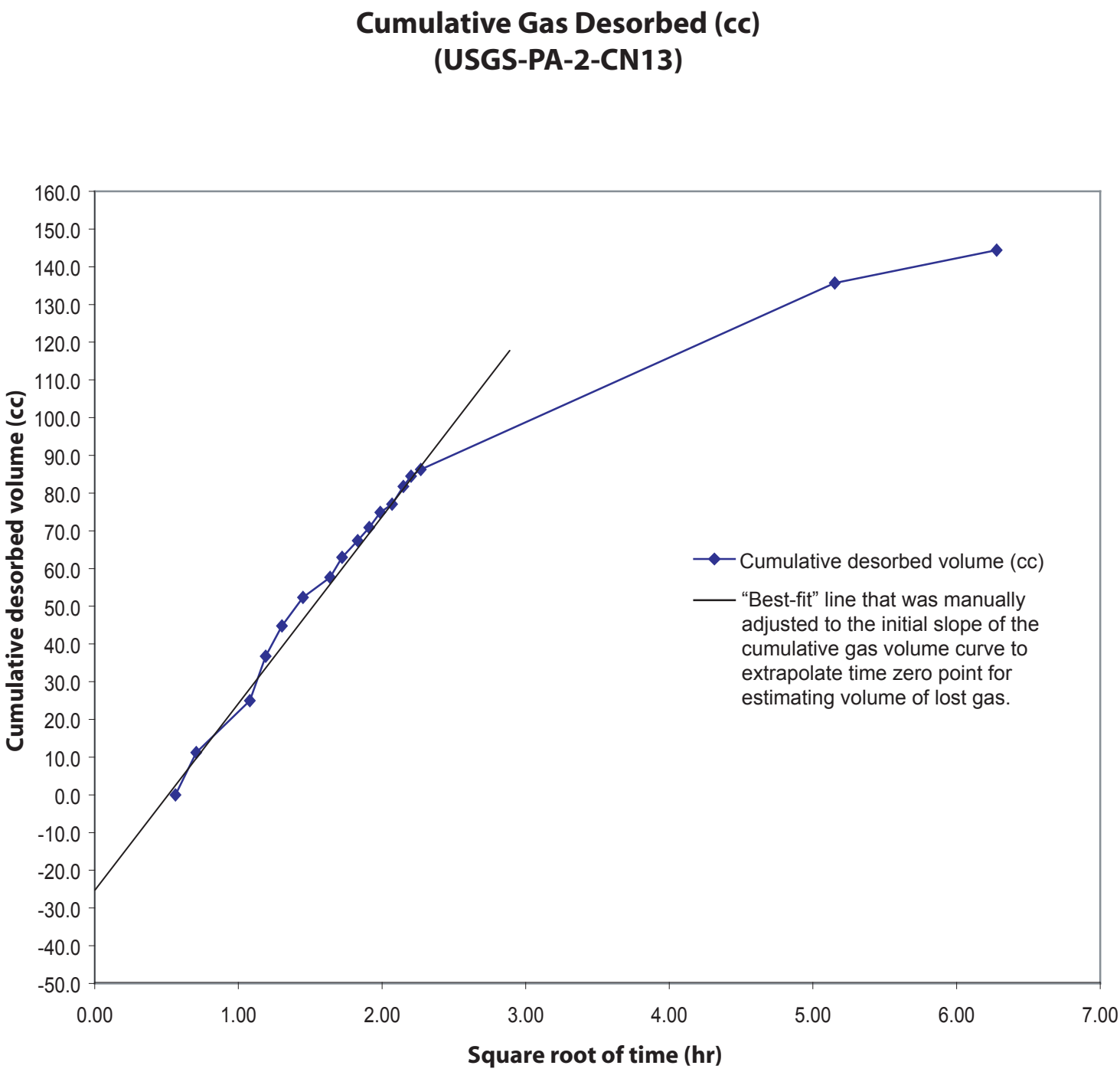
Lost Gas Estimate= 20 cc
Raw Total Gas= 0.14 g/cc (4.63 SCF/ton)
DAF Total Gas= 0.25 g/cc (8.00 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 11

Table 11

Project	Wilcox, Panola Co., TX																			
Well ID:	PA 2		Can no.	99-12																
Sample Interval (ft):		From:	366.5	To:	367.5			Cumulative volume @ STP:		114.6		Lost gas estimate (cc)		20			Raw total gas (SCF/ton)		4.63	
Core Date: (enter in box: mm/dd/yr)					6/27/1999															
Time Zero (hh:mm) (24 hour clock)					15:53			Milliliters/gram raw coal:		0.12		Raw total gas (cc/g)		0.14			DAF total gas (SCF/ton)		8.00	
Raw coal mass (air-dry): (grams)					930															
Coal mass (d.a.f.): (grams)					538			Milliliter/gram coal d.a.f.:		0.21		DAF total gas (cc/g)		0.25						
Headspace volume: (cc)					1856			(excluding lost gas)												
													Headspace Correction			Optional Temperature Conversions			
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Internal Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	16:11	29.62	86.4	28	26.40	0.00	0.01	0.30	0.55	0.00	0.00	0.0	0.0	86.5	30.3	86.5	30.2	86.4
2	6/27/1999	16:22	29.62	85.8	20	18.87	18.87	0.02	0.48	0.70	0.02	0.04	19.5	0.7	86.2	30.1	86.2	29.9	85.8
3	6/27/1999	16:58	29.62	85.6	19	17.94	36.81	0.05	1.08	1.04	0.04	0.07	37.0	1.9	85.6	29.8	85.6	29.8	85.6
4	6/27/1999	17:18	29.62	84.9	13	12.29	49.10	0.06	1.42	1.19	0.05	0.09	50.8	3.7	85.6	29.8	85.6	29.4	84.9
5	6/27/1999	17:35	29.62	84.7	10	9.46	58.55	0.07	1.70	1.30	0.06	0.11	60.2	5.8	86.0	30.0	86.0	29.3	84.7
6	6/27/1999	17:58	29.59	84.2	8	7.56	66.12	0.09	2.08	1.44	0.07	0.12	67.3	8.1	86.0	30.0	86.0	29.0	84.2
7	6/27/1999	18:33	29.59	84.7	3	2.83	68.95	0.11	2.67	1.63	0.07	0.13	68.4	10.4	85.8	29.9	85.8	29.3	84.7
8	6/27/1999	18:50	29.59	84.7	2	1.89	70.84	0.12	2.95	1.72	0.08	0.13	70.1	12.9	85.5	29.7	85.5	29.3	84.7
9	6/27/1999	19:13	29.59	84.7	2	1.89	72.73	0.14	3.33	1.83	0.08	0.14	71.9	15.3	85.3	29.6	85.3	29.3	84.7
10	6/27/1999	19:31	29.59	85.1	2	1.89	74.62	0.15	3.63	1.91	0.08	0.14	72.6	17.8	86.0	30.0	86.0	29.5	85.1
11	6/27/1999	19:47	29.59	85.3	2	1.89	76.50	0.16	3.90	1.97	0.08	0.14	73.9	20.4	86.2	30.1	86.2	29.6	85.3
12	6/27/1999	20:09	29.59	85.5	2	1.89	78.39	0.18	4.27	2.07	0.08	0.15	75.1	23.0	86.0	30.0	86.0	29.7	85.5
13	6/27/1999	20:29	29.62	85.5	2	1.89	80.28	0.19	4.60	2.14	0.09	0.15	78.5	25.7	86.2	30.1	86.2	29.7	85.5
14	6/27/1999	20:43	29.62	84.9	2	1.89	82.17	0.20	4.83	2.20	0.09	0.15	82.0	28.5	86.5	30.3	86.5	29.4	84.9
15	6/27/1999	21:00	29.62	85.1	2	1.89	84.06	0.21	5.12	2.26	0.09	0.16	83.2	31.4	86.5	30.3	86.5	29.5	85.1
16	6/28/1999	18:24	29.53	100.4	75	68.72	152.78	1.10	26.52	5.15	0.16	0.28	97.4	34.7	106.0	41.1	106.0	38.0	100.4
17	6/29/1999	7:18	29.59	94.1	-5	-4.64	148.14	1.64	39.42	6.28	0.16	0.28	114.6	38.7	95.7	35.4	95.7	34.5	94.1



Lost Gas Estimate= 25 cc
Raw Total Gas= 0.15 g/cc (4.80 SCF/ton)
DAF Total Gas= 0.25 g/cc (8.02 SCF/ton)

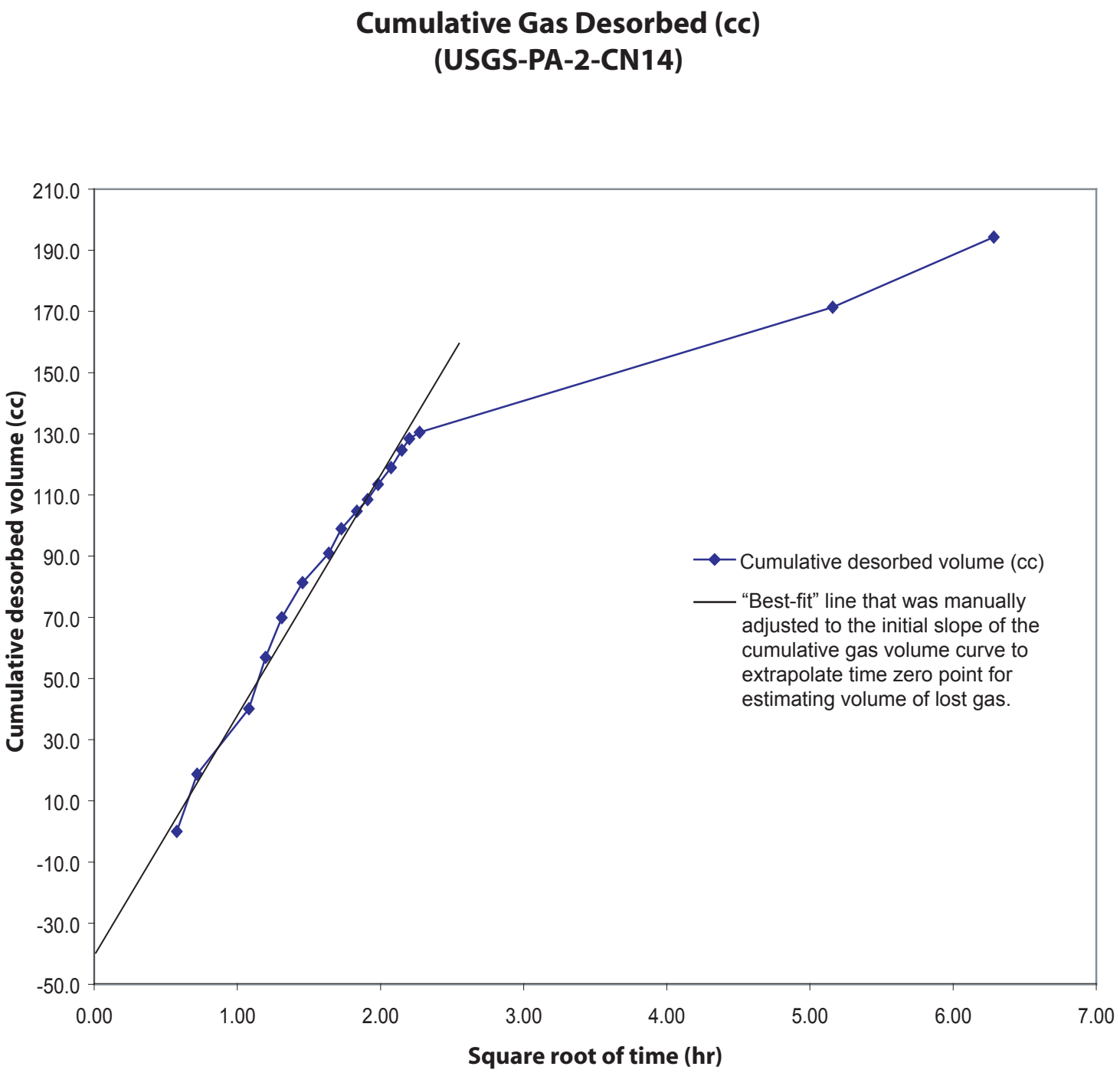
g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 12

Table 12

Project	Wilcox, Panola Co., TX								
Well ID:	PA 2	Can no.	99-13						
Sample Interval (ft):	From:	367.5	To:	368.8	Cumulative volume @ STP:	144.4	Lost gas estimate (cc)	25	Raw total gas (SCF/ton) 4.80
Core Date: (enter in box: mm/dd/yr)				6/27/1999					
Time Zero (hh:mm) (24 hour clock)				15:53	Milliliters/gram raw coal:	0.13	Raw total gas (cc/g)	0.15	DAF total gas (SCF/ton) 8.02
Raw coal mass (air-dry): (grams)				1129					
Coal mass (d.a.f.): (grams)				676	Milliliter/gram coal d.a.f.:	0.21	DAF total gas (cc/g)	0.25	
Headspace volume: (cc)				1660	(excluding lost gas)				

	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Internal Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Headspace Correction Cumulative Volume @ STP (milliliter)	Headspace Correction Cumulative Gas Content (SCF)	Ambient Temp °F	Optional Temperature Conversions Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	16:12	29.62	85.5	14	13.22	0.00	0.01	0.32	0.56	0.00	0.00	0.0	0.0	86.5	30.3	86.5	29.7	85.5
2	6/27/1999	16:23	29.62	85.3	12	11.34	11.34	0.02	0.50	0.71	0.01	0.02	11.2	0.3	86.2	30.1	86.2	29.6	85.3
3	6/27/1999	17:03	29.62	85.5	16	15.11	26.44	0.05	1.17	1.08	0.02	0.04	25.0	1.0	85.6	29.8	85.6	29.7	85.5
4	6/27/1999	17:18	29.62	84.7	11	10.40	36.85	0.06	1.42	1.19	0.03	0.05	36.8	2.1	85.6	29.8	85.6	29.3	84.7
5	6/27/1999	17:35	29.62	84.7	9	8.51	45.36	0.07	1.70	1.30	0.04	0.07	44.8	3.3	86.0	30.0	86.0	29.3	84.7
6	6/27/1999	17:59	29.59	84.0	8	7.57	52.92	0.09	2.10	1.45	0.05	0.08	52.4	4.8	86.0	30.0	86.0	28.9	84.0
7	6/27/1999	18:34	29.59	84.4	7	6.62	59.54	0.11	2.68	1.64	0.05	0.09	57.6	6.5	85.8	29.9	85.8	29.1	84.4
8	6/27/1999	18:51	29.59	84.4	6	5.67	65.21	0.12	2.97	1.72	0.06	0.10	63.0	8.2	85.5	29.7	85.5	29.1	84.4
9	6/27/1999	19:14	29.59	84.7	6	5.67	70.88	0.14	3.35	1.83	0.06	0.10	67.4	10.2	85.3	29.6	85.3	29.3	84.7
10	6/27/1999	19:32	29.59	85.1	5	4.72	75.60	0.15	3.65	1.91	0.07	0.11	70.8	12.2	86.2	30.1	86.2	29.5	85.1
11	6/27/1999	19:50	29.59	84.9	4	3.78	79.37	0.16	3.95	1.99	0.07	0.12	74.9	14.3	86.4	30.2	86.4	29.4	84.9
12	6/27/1999	20:10	29.59	85.1	3	2.83	82.21	0.18	4.28	2.07	0.07	0.12	77.1	16.5	86.2	30.1	86.2	29.5	85.1
13	6/27/1999	20:30	29.62	84.9	3	2.84	85.04	0.19	4.62	2.15	0.08	0.13	81.7	18.8	86.0	30.0	86.0	29.4	84.9
14	6/27/1999	20:44	29.62	84.6	2	1.89	86.93	0.20	4.85	2.20	0.08	0.13	84.5	21.2	86.0	30.0	86.0	29.2	84.6
15	6/27/1999	21:02	29.62	84.6	2	1.89	88.83	0.21	5.15	2.27	0.08	0.13	86.3	23.6	86.5	30.3	86.5	29.2	84.6
16	6/28/1999	18:26	29.53	97.9	104	95.73	184.55	1.11	26.55	5.15	0.16	0.27	135.7	27.5	105.6	40.9	105.6	36.6	97.9
17	6/29/1999	7:19	29.59	95.0	-2	-1.85	182.70	1.64	39.43	6.28	0.16	0.27	144.4	31.6	95.7	35.4	95.7	35.0	95.0



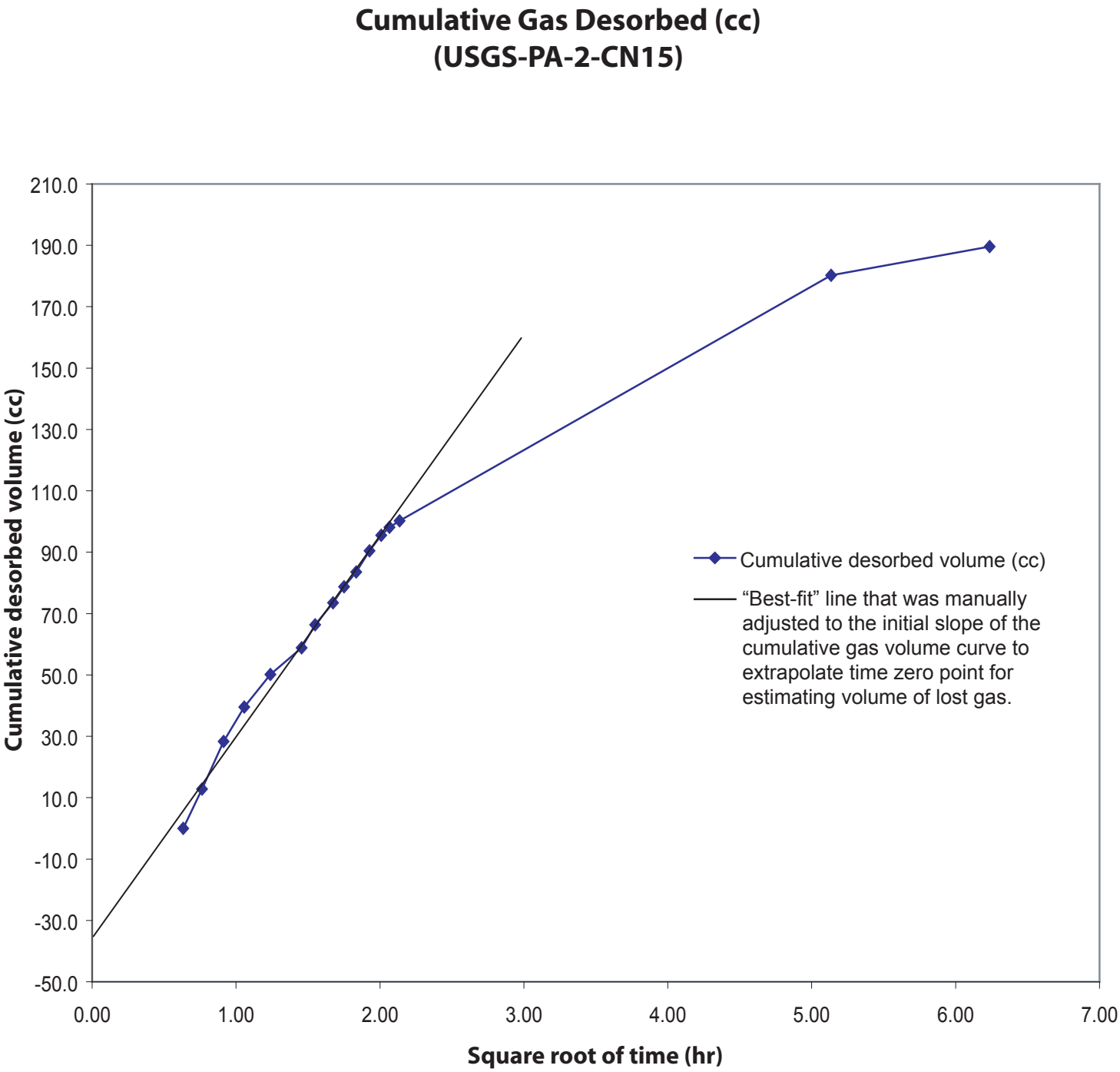
Lost Gas Estimate= 40 cc
Raw Total Gas= 0.25 g/cc (7.94 SCF/ton)
DAF Total Gas= 0.40 g/cc (12.95 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 13

Table 13

Project	Wilcox, Panola Co., TX																		
Well ID:	PA 2	Can no.	99-14																
Sample Interval (ft):	From:	368.8	To:	370			Cumulative volume @ STP:	194.3	Lost gas estimate (cc)	40					Raw total gas (SCF/ton)	7.94			
Core Date: (enter in box: mm/dd/yr)				6/27/1999															
Time Zero (hh:mm) (24 hour clock)				15:53			Milliliters/gram raw coal:	0.21	Raw total gas (cc/g)	0.25					DAF total gas (SCF/ton)	12.95			
Raw coal mass (air-dry): (grams)				944															
Coal mass (d.a.f.): (grams)				579			Milliliter/gram coal d.a.f.:	0.34	DAF total gas (cc/g)	0.40									
Headspace volume: (cc)				1787			(excluding lost gas)												
													Headspace Correction			Optional Temperature Conversions			
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Internal Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	16:13	29.62	85.3	28	26.45	0.00	0.01	0.33	0.58	0.00	0.00	0.0	0.0	86.5	30.3	86.5	29.6	85.3
2	6/27/1999	16:24	29.62	85.3	21	19.84	19.84	0.02	0.52	0.72	0.02	0.03	18.7	0.6	86.2	30.1	86.2	29.6	85.3
3	6/27/1999	17:03	29.62	85.3	24	22.67	42.51	0.05	1.17	1.08	0.05	0.07	40.1	2.0	85.6	29.8	85.6	29.6	85.3
4	6/27/1999	17:19	29.62	84.7	17	16.07	58.58	0.06	1.43	1.20	0.06	0.10	56.9	3.9	85.6	29.8	85.6	29.3	84.7
5	6/27/1999	17:36	29.62	84.6	14	13.24	71.82	0.07	1.72	1.31	0.08	0.12	69.9	6.3	86.0	30.0	86.0	29.2	84.6
6	6/27/1999	18:00	29.59	84.4	14	13.23	85.06	0.09	2.12	1.45	0.09	0.15	81.3	9.1	86.0	30.0	86.0	29.1	84.4
7	6/27/1999	18:34	29.59	84.7	12	11.34	96.39	0.11	2.68	1.64	0.10	0.17	90.9	12.1	85.8	29.9	85.8	29.3	84.7
8	6/27/1999	18:52	29.59	84.7	9	8.50	104.89	0.12	2.98	1.73	0.11	0.18	99.0	15.5	85.5	29.7	85.5	29.3	84.7
9	6/27/1999	19:15	29.59	84.9	7	6.61	111.50	0.14	3.37	1.83	0.12	0.19	104.7	19.1	85.3	29.6	85.3	29.4	84.9
10	6/27/1999	19:32	29.59	85.5	6	5.66	117.16	0.15	3.65	1.91	0.12	0.20	108.5	22.7	86.4	30.2	86.4	29.7	85.5
11	6/27/1999	19:49	29.59	85.3	5	4.72	121.88	0.16	3.93	1.98	0.13	0.21	113.4	26.6	86.2	30.1	86.2	29.6	85.3
12	6/27/1999	20:11	29.59	84.9	5	4.72	126.60	0.18	4.30	2.07	0.13	0.22	118.9	30.6	86.2	30.1	86.2	29.4	84.9
13	6/27/1999	20:30	29.62	84.7	4	3.78	130.39	0.19	4.62	2.15	0.14	0.23	124.7	34.9	86.0	30.0	86.0	29.3	84.7
14	6/27/1999	20:44	29.62	84.4	3	2.84	133.22	0.20	4.85	2.20	0.14	0.23	128.4	39.2	86.5	30.3	86.5	29.1	84.4
15	6/27/1999	21:03	29.62	84.6	3	2.84	136.06	0.22	5.17	2.27	0.14	0.23	130.5	43.6	86.2	30.1	86.2	29.2	84.6
16	6/28/1999	18:30	29.53	98.6	100	91.93	227.99	1.11	26.62	5.16	0.24	0.39	171.4	49.5	105.8	41.0	105.8	37.0	98.6
17	6/29/1999	7:22	29.59	92.8	4	3.72	231.71	1.65	39.48	6.28	0.25	0.40	194.3	56.1	95.7	35.4	95.7	33.8	92.8



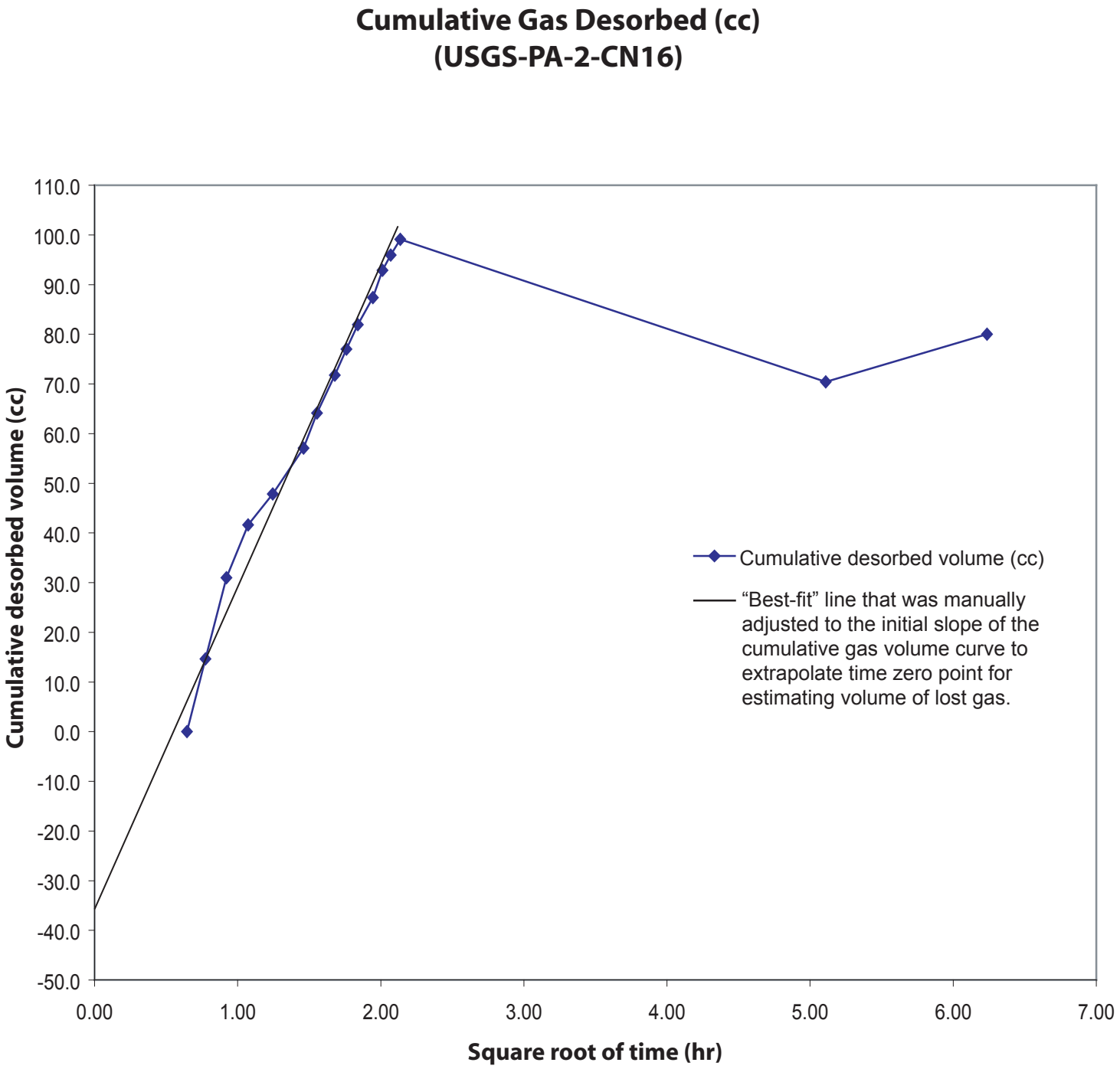
Lost Gas Estimate= 35 cc
Raw Total Gas= 0.23 g/cc (7.27 SCF/ton)
DAF Total Gas= 0.37 g/cc (11.74 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 14

Table 14

Project	Wilcox, Panola Co., TX																		
Well ID:	PA 2	Can no.	99-15																
Sample Interval (ft):	From:	370	To:	371			Cumulative volume @ STP:	189.6		Lost gas estimate (cc)	35				Raw total gas (SCF/ton)	7.27			
Core Date: (enter in box: mm/dd/yr)				6/27/1999															
Time Zero (hh:mm) (24 hour clock)				16:29			Milliliters/gram raw coal:	0.19		Raw total gas (cc/g)	0.23				DAF total gas (SCF/ton)	11.74			
Raw coal mass (air-dry): (grams)				988															
Coal mass (d.a.f.): (grams)				612			Milliliter/gram coal d.a.f.:	0.31		DAF total gas (cc/g)	0.37								
Headspace volume: (cc)				1707			(excluding lost gas)												
													Headspace Correction			Optional Temperature Conversions			
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Internal Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	16:53	29.62	84.9	19	17.96	0.00	0.02	0.40	0.63	0.00	0.00	0.0	0.0	85.6	29.8	85.6	29.4	84.9
2	6/27/1999	17:04	29.62	85.5	16	15.11	15.11	0.02	0.58	0.76	0.02	0.02	12.8	0.4	85.6	29.8	85.6	29.7	85.5
3	6/27/1999	17:19	29.62	84.4	14	13.25	28.36	0.03	0.83	0.91	0.03	0.05	28.3	1.3	85.6	29.8	85.6	29.1	84.4
4	6/27/1999	17:36	29.62	84.2	12	11.36	39.71	0.05	1.12	1.06	0.04	0.06	39.5	2.6	86.0	30.0	86.0	29.0	84.2
5	6/27/1999	18:01	29.59	83.7	12	11.36	51.07	0.06	1.53	1.24	0.05	0.08	50.2	4.2	86.0	30.0	86.0	28.7	83.7
6	6/27/1999	18:36	29.59	84.4	12	11.34	62.41	0.09	2.12	1.45	0.06	0.10	58.8	6.1	85.8	29.9	85.8	29.1	84.4
7	6/27/1999	18:53	29.59	84.6	9	8.50	70.92	0.10	2.40	1.55	0.07	0.12	66.4	8.3	85.5	29.7	85.5	29.2	84.6
8	6/27/1999	19:17	29.59	84.6	8	7.56	78.48	0.12	2.80	1.67	0.08	0.13	73.5	10.7	85.3	29.6	85.3	29.2	84.6
9	6/27/1999	19:33	29.59	84.9	7	6.61	85.09	0.13	3.07	1.75	0.09	0.14	78.7	13.2	86.0	30.0	86.0	29.4	84.9
10	6/27/1999	19:51	29.59	85.1	6	5.66	90.75	0.14	3.37	1.83	0.09	0.15	83.6	15.9	86.2	30.1	86.2	29.5	85.1
11	6/27/1999	20:12	29.62	85.1	6	5.67	96.42	0.15	3.72	1.93	0.10	0.16	90.5	18.9	86.2	30.1	86.2	29.5	85.1
12	6/27/1999	20:31	29.62	84.6	4	3.78	100.20	0.17	4.03	2.01	0.10	0.16	95.5	22.0	86.0	30.0	86.0	29.2	84.6
13	6/27/1999	20:45	29.62	84.9	4	3.78	103.98	0.18	4.27	2.07	0.11	0.17	98.1	25.2	86.4	30.2	86.4	29.4	84.9
14	6/27/1999	21:03	29.62	85.1	3	2.83	106.82	0.19	4.57	2.14	0.11	0.17	100.3	28.4	86.4	30.2	86.4	29.5	85.1
15	6/28/1999	18:51	29.53	94.1	127	117.70	224.52	1.10	26.37	5.13	0.23	0.37	180.3	34.3	104.0	40.0	104.0	34.5	94.1
16	6/29/1999	7:22	29.59	90.5	-4	-3.74	220.78	1.62	38.88	6.24	0.22	0.36	189.6	40.4	95.7	35.4	95.7	32.5	90.5



Lost Gas Estimate= 35 cc
Raw Total Gas= 0.12 g/cc (3.91 SCF/ton)
DAF Total Gas= 0.18 g/cc (5.73 SCF/ton)

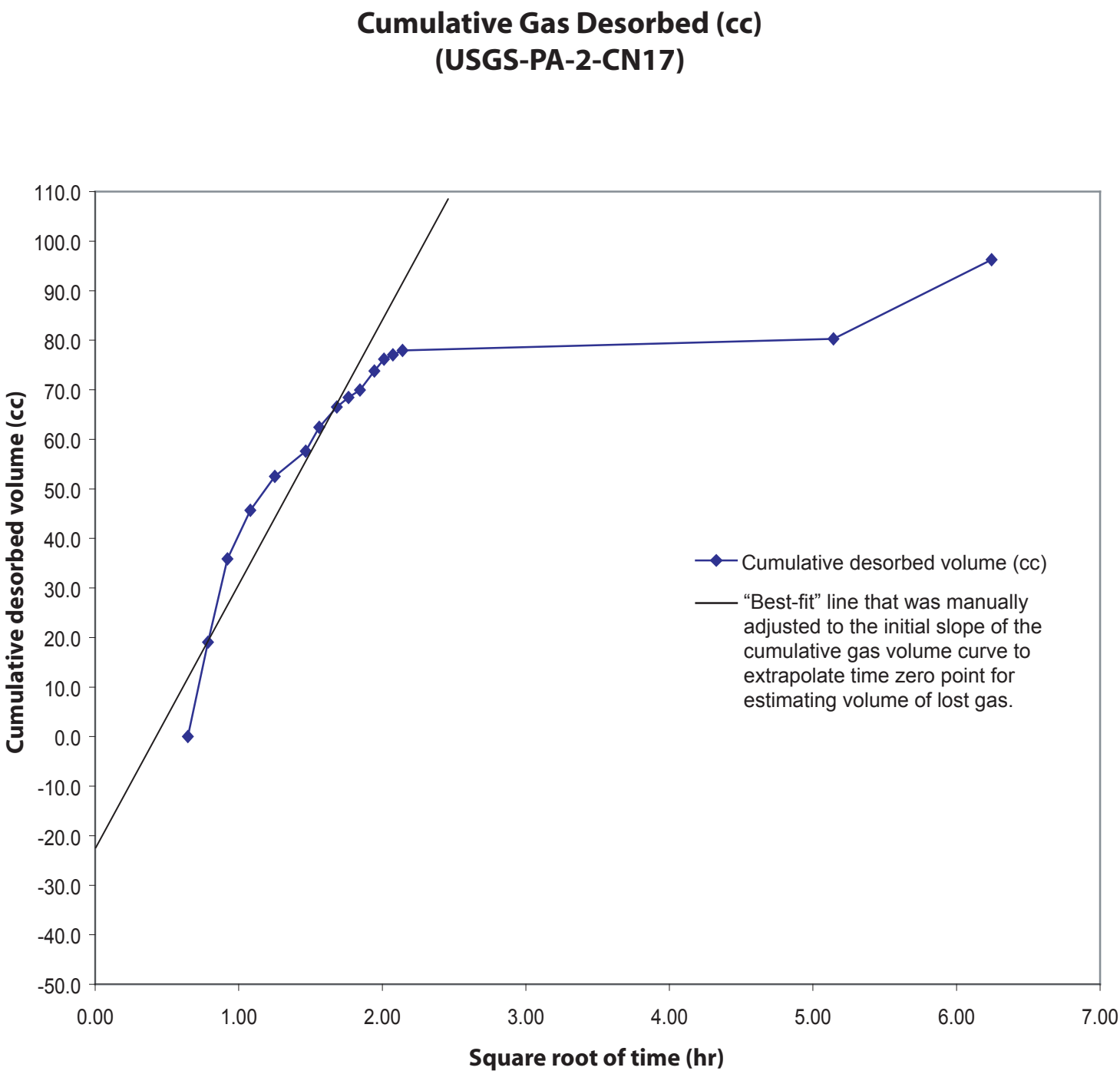
g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 15

Table 15

Project	Wilcox, Panola Co., TX								
Well ID:	PA 2	Can no.	99-16						
Sample Interval (ft):	From:	371	To:	372	Cumulative volume @ STP:	99.1	Lost gas estimate (cc)	35	Raw total gas (SCF/ton) 3.91
Core Date: (enter in box: mm/dd/yr)				6/27/1999					
Time Zero (hh:mm) (24 hour clock)				16:29	Milliliters/gram raw coal:	0.09	Raw total gas (cc/g)	0.12	DAF total gas (SCF/ton) 5.73
Raw coal mass (air-dry): (grams)				1097					
Coal mass (d.a.f.): (grams)				749	Milliliter/gram coal d.a.f.:	0.13	DAF total gas (cc/g)	0.18	
Headspace volume: (cc)				1619	(excluding lost gas)				

	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Internal Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Headspace Correction Cumulative Volume @ STP (milliliter)	Headspace Correction Cumulative Gas Content (SCF)	Ambient Temp °F	Optional Temperature Conversions: Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	16:54	29.62	84.4	24	22.71	0.00	0.02	0.42	0.65	0.00	0.00	0.0	0.0	85.6	29.8	85.6	29.1	84.4
2	6/27/1999	17:05	29.62	84.9	18	17.01	17.01	0.02	0.60	0.77	0.02	0.02	14.6	0.4	85.6	29.8	85.6	29.4	84.9
3	6/27/1999	17:20	29.62	83.5	14	13.27	30.28	0.04	0.85	0.92	0.03	0.04	31.0	1.3	85.6	29.8	85.6	28.6	83.5
4	6/27/1999	17:38	29.62	83.8	13	12.31	42.60	0.05	1.15	1.07	0.04	0.06	41.6	2.5	86.0	30.0	86.0	28.8	83.8
5	6/27/1999	18:02	29.52	83.7	12	11.33	53.93	0.06	1.55	1.24	0.05	0.07	47.8	3.9	86.0	30.0	86.0	28.7	83.7
6	6/27/1999	18:37	29.52	84.2	12	11.32	65.25	0.09	2.13	1.46	0.06	0.09	57.1	5.6	85.8	29.9	85.8	29.0	84.2
7	6/27/1999	18:54	29.52	84.6	9	8.48	73.73	0.10	2.42	1.55	0.07	0.10	64.1	7.5	85.5	29.7	85.5	29.2	84.6
8	6/27/1999	19:18	29.52	84.4	8	7.54	81.27	0.12	2.82	1.68	0.07	0.11	71.7	9.6	85.3	29.6	85.3	29.1	84.4
9	6/27/1999	19:35	29.52	84.7	7	6.60	87.87	0.13	3.10	1.76	0.08	0.12	77.0	11.8	86.4	30.2	86.4	29.3	84.7
10	6/27/1999	19:52	29.59	86.2	6	5.65	93.52	0.14	3.38	1.84	0.09	0.12	82.0	14.2	86.2	30.1	86.2	30.1	86.2
11	6/27/1999	20:16	29.62	86.4	5	4.71	98.24	0.16	3.78	1.95	0.09	0.13	87.4	16.8	86.2	30.1	86.2	30.2	86.4
12	6/27/1999	20:32	29.62	85.6	4	3.78	102.01	0.17	4.05	2.01	0.09	0.14	92.9	19.5	86.0	30.0	86.0	29.8	85.6
13	6/27/1999	20:46	29.62	85.8	4	3.77	105.79	0.18	4.28	2.07	0.10	0.14	96.0	22.3	86.4	30.2	86.4	29.9	85.8
14	6/27/1999	21:03	29.62	85.6	3	2.83	108.62	0.19	4.57	2.14	0.10	0.15	99.1	25.2	86.2	30.1	86.2	29.8	85.6
15	6/28/1999	18:35	29.53	95.0	0	0.00	108.62	1.09	26.10	5.11	0.10	0.15	70.4	27.2	104.0	40.0	104.0	35.0	95.0
16	6/29/1999	7:23	29.59	91.0	-4	-3.74	104.88	1.62	38.90	6.24	0.10	0.14	80.0	29.6	95.7	35.4	95.7	32.8	91.0



Lost Gas Estimate= 23 cc
Raw Total Gas= 0.15 g/cc (4.89 SCF/ton)
DAF Total Gas= 0.24 g/cc (7.79 SCF/ton)

g/cc - grams per cubic centimeter
SCF/Ton - Standard Cubic Feet per ton

Figure 16

Table 16

Project	Wilcox, Panola Co., TX																		
Well ID:	PA 2	Can no.	99-17																
Sample Interval (ft):	From:	372	To:	373			Cumulative volume @ STP:	96.2	Lost gas estimate (cc)	23			Raw total gas (SCF/ton)	4.89					
Core Date: (enter in box: mm/dd/yr)				6/27/1999															
Time Zero (hh:mm) (24 hour clock)				16:29			Milliliters/gram raw coal:	0.12	Raw total gas (cc/g)	0.15			DAF total gas (SCF/ton)	7.79					
Raw coal mass (air-dry): (grams)				781															
Coal mass (d.a.f.): (grams)				490			Milliliter/gram coal d.a.f.:	0.20	DAF total gas (cc/g)	0.24									
Headspace volume: (cc)				1909			(excluding lost gas)												
													Headspace Correction			Optional Temperature Conversions			
	Date (mm/dd/yr)	Time 24 hour Clock HH:MM	Pressure inches Hg	Internal Canister Temp. °F	Delta Gas Volume (milliliter)	Delta Volume @ STP (milliliter)	Cumulative Volume @ STP (milliliter)	Elapsed Time (Time value)	Elapsed Time (Hrs)	Sq. Root Elapsed Time ($Hrs^{1/2}$)	ml/gram Raw Coal Mass	ml/g d.a.f Coal Mass	Cumulative Volume @ STP (milliliter)	Cumulative Gas Content (SCF)	Ambient Temp °F	Ambient temp in oC	Convert deg C to deg F	Canister temp in oC	Convert deg C to deg F
1	6/27/1999	16:54	29.62	85.3	31	29.28	0.00	0.02	0.42	0.65	0.00	0.00	0.0	0.0	85.6	29.8	85.6	29.6	85.3
2	6/27/1999	17:06	29.62	85.5	22	20.77	20.77	0.03	0.62	0.79	0.03	0.04	19.1	0.8	85.6	29.8	85.6	29.7	85.5
3	6/27/1999	17:20	29.62	84.4	15	14.19	34.97	0.04	0.85	0.92	0.04	0.07	35.8	2.3	85.6	29.8	85.6	29.1	84.4
4	6/27/1999	17:39	29.62	84.4	11	10.41	45.38	0.05	1.17	1.08	0.06	0.09	45.7	4.1	86.0	30.0	86.0	29.1	84.4
5	6/27/1999	18:03	29.59	84.2	9	8.51	53.88	0.07	1.57	1.25	0.07	0.11	52.5	6.3	86.0	30.0	86.0	29.0	84.2
6	6/27/1999	18:38	29.59	84.6	7	6.61	60.50	0.09	2.15	1.47	0.08	0.12	57.6	8.6	85.8	29.9	85.8	29.2	84.6
7	6/27/1999	18:55	29.59	84.7	6	5.67	66.17	0.10	2.43	1.56	0.08	0.14	62.4	11.2	85.5	29.7	85.5	29.3	84.7
8	6/27/1999	19:19	29.59	84.6	4	3.78	69.95	0.12	2.83	1.68	0.09	0.14	66.5	13.9	85.3	29.6	85.3	29.2	84.6
9	6/27/1999	19:36	29.59	85.1	4	3.78	73.72	0.13	3.12	1.77	0.09	0.15	68.4	16.7	86.2	30.1	86.2	29.5	85.1
10	6/27/1999	19:53	29.59	85.5	3	2.83	76.55	0.14	3.40	1.84	0.10	0.16	70.0	19.6	86.2	30.1	86.2	29.7	85.5
11	6/27/1999	20:16	29.62	85.6	3	2.83	79.38	0.16	3.78	1.95	0.10	0.16	73.8	22.6	86.4	30.2	86.4	29.8	85.6
12	6/27/1999	20:32	29.62	85.5	2	1.89	81.27	0.17	4.05	2.01	0.10	0.17	76.1	25.8	86.2	30.1	86.2	29.7	85.5
13	6/27/1999	20:47	29.62	85.5	1	0.94	82.22	0.18	4.30	2.07	0.11	0.17	77.0	28.9	86.2	30.1	86.2	29.7	85.5
14	6/27/1999	21:04	29.62	85.5	1	0.94	83.16	0.19	4.58	2.14	0.11	0.17	77.9	32.1	86.4	30.2	86.4	29.7	85.5
15	6/28/1999	18:56	29.53	93.9	39	36.15	119.32	1.10	26.45	5.14	0.15	0.24	80.3	35.4	105.1	40.6	105.1	34.4	93.9
16	6/29/1999	7:28	29.59	89.2	-2	-1.87	117.44	1.62	38.98	6.24	0.15	0.24	96.2	39.4	95.7	35.4	95.7	31.8	89.2

Appendix 1

Coal chemistry data from boreholes USGS-PA-1 and USGS-PA-2

Appendix 1 *of*

Results of coalbed methane drilling in Panola County, Texas

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U.S. Geological Survey

Appendix 1. Results of proximate, ultimate, forms of sulfur, and ash fusion temperature coal sample analyses for USGS-PA-1 and USGS-PA-2. All values in percent unless otherwise noted. Ultimate and proximate analyses, calorific value, and sulfur forms on an as-received basis. Note: Btu/lb=British thermal units per pound; g/cc=grams per cubic centimeter.

Sample Number	Field Identification	Top (ft)	Base (ft)	Remarks (as of 6/04)	Equilibrium Moisture	Residual Moisture	Air Dry Loss	Total Moisture	Ash	Volitile Matter	Fixed Carbon	Hydrogen	Carbon	Nitrogen	Sulfur	Oxygen	Btu/lb	---- Forms of Sylfur (AR) ---- Sulfate	Pyrite	Organic	Fluorine Dry basis	Chlorine Dry basis	-------Ash Fusion Temperatures °F ------- Initial	Spherical	Hemispherical	Fluid	Free Swelling Index	Apparent Specific Gravity g/cc
19681	USGS-PA-1.1A	128.15	128.75		29.55	5.57	25.93	30.06	32.57	18.56	18.81	5.16	27.66	0.44	0.26	33.91	4591	0.01	0.04	0.21	0.015	<0.02	2260	2470	2650	2780	0	1.57
19733	USGS-PA-1.1B	128.75	129.80		36.22	6.32	32.86	37.1	6.9	28.32	27.68	7.1	41.52	0.89	0.44	43.15	7116	0.01	0.02	0.41	0.003	<0.01	2060	2080	2090	2100	0	1.29
19734	USGS-PA-1.2	129.80	130.70		37.34	11.1	30.98	38.64	6.94	26.66	27.76	7.13	40.3	0.91	0.48	44.24	6903	0.01	0.01	0.46	0.002	<0.01	2070	2090	2100	2110	0	1.26
19735	USGS-PA-1.3	130.70	132.80		31.95	4.11	27.98	30.94	29.08	21.12	18.86	5.67	29.28	0.6	0.84	34.53	5025	0.02	0.36	0.46	0.006	<0.01	2230	2380	2690	2740	0	1.42
19736	USGS-PA-1.4	331.00	334.00	tonstein 331.25-331.50 est 80% ash not included	31.74	12.21	23.9	33.19	8.74	28.33	29.74	6.75	43.97	0.91	0.52	39.11	7565	0.01	0.02	0.49	0.003	<0.01	1980	2020	2070	2130	0	1.28
19737	USGS-PA-1.5	334.00	337.00		33.64	10.76	26.77	34.65	6.18	28.7	30.47	7.05	44.75	0.96	0.51	40.55	7721	0.01	0.01	0.49	0.002	<0.01	1960	2040	2050	2060	0	1.25
19738	USGS-PA-1.6	337.00	340.00		33.77	13.58	24.88	35.08	5.55	28.55	30.82	7.07	44.78	0.94	0.5	41.16	7724	0.01	0.01	0.48	0.001	<0.01	1940	1990	2030	2050	0	1.26
19739	USGS-PA-1.7	340.00	343.00		33.41	11.43	26.56	34.95	5.96	28.08	31.01	6.94	45.09	0.9	0.48	40.63	7670	0.01	0.01	0.46	0.002	<0.01	1980	2070	2090	2100	0	1.25
19740	USGS-PA-1.8	343.00	346.00		33.61	13.8	24.49	34.91	5.66	28.67	30.76	6.96	45.01	0.97	0.42	40.98	7727	0.01	0.02	0.39	<0.001	<0.01	1970	2050	2080	2160	0	1.26
19741	USGS-PA-1.9	346.00	347.70		35.1	10.41	29.84	37.14	8.38	27.41	27.07	7.1	40.67	0.98	0.44	42.43	7041	0.01	0.01	0.42	0.006	<0.01	1960	2020	2180	2290	0	1.28
19617	USGS-PA-2-CN1	355.15	356.00	tonstein 355.0-355.15 est 82% ash not analyzed	28.88	5.82	25.41	29.75	15.76	27.01	27.48	6.36	40.49	0.86	0.56	35.97	7044	0.01	0.04	0.51	0.005	<0.01	2290	2320	2390	2490	0.5	1.32
21862	USGS-PA-2-CN2	356.00	357.00		30.37	6.85	25.79	30.87	7.68	32.01	29.44	6.43	46.59	1.04	0.53	37.73	8006	0.01	0.01	0.51	0.002	<0.01	1980	2000	2030	2110	0	1.37
19618	USGS-PA-2-CN3	357.00	358.00		31.81	13.41	23.13	33.44	5.76	27.32	33.48	6.88	46	0.93	0.48	39.95	7964	0.01	0.02	0.45	0.004	<0.01	2020	2070	2090	2110	0.5	1.23
19619	USGS-PA-2-CN4	358.00	358.40		32.68	6.76	29.87	34.61	4.46	28.54	32.39	7.1	45.8	1.02	0.47	41.15	7789	0.01	0.01	0.45	0.003	<0.01	2100	2140	2190	2240	0.5	1.18
19620	USGS-PA-2-CN5	358.40	359.40		30.17	13.24	22.2	32.5	5.4	29.9	32.2	6.9	46.97	1.01	0.44	39.28	8130	0.02	0.01	0.41	0.004	<0.01	1970	2010	2060	2110	0.5	1.23
21863	USGS-PA-2-CN6	359.40	360.50		29.75	7.63	19.22	25.38	5.61	33.92	35.09	6.49	51.77	1.16	0.51	34.46	8999	0.01	0.01	0.49	0.002	<0.01	2040	2120	2170	2200	0	1.28
19621	USGS-PA-2-CN7	360.50	361.40		31.14	10.03	23.86	31.5	6.69	28.79	33.02	6.8	46.6	0.98	0.47	38.46	7923	0.02	0.01	0.44	0.002	<0.01	1990	2020	2070	2110	0.5	1.22
19622	USGS-PA-2-CN8C	361.40	361.95		31.11	8.63	25.47	31.9	8.97	28.64	30.49	6.73	43.68	0.96	0.48	39.18	7606	0.02	0.01	0.45	0.004	<0.01	2020	2070	2090	2120	0.5	1.24
19623	USGS-PA-2-CN8P	361.95	362.44		30.73	3.55	18.73	21.62	56.99	13.23	8.16	3.84	13.69	0.26	0.33	24.89	2286	0.02	0.08	0.23	0.035	<0.02	2700	2740	2780	2800+	0.5	1.79
19624	USGS-PA-2-CN9C	362.44	363.27		30.99	9.41	23.52	30.72	13.66	25.91	29.71	6.37	41.53	0.85	0.62	36.97	7146	0.02	0.05	0.55	0.008	<0.01	2250	2290	2320	2390	0.5	1.31
19675	USGS-PA-2-CN9P	363.27	363.40		26.34	4.65	20.8	24.48	41.6	18.84	15.08	4.7	23.65	0.39	0.97	28.69	4144	0.05	0.59	0.33	0.033	0.04	2560	2630	2640	2750	0	1.46
19676	USGS-PA-2-CN11	365.40	366.50		30.44	7.24	26.88	32.17	5.92	30.21	31.7	6.75	46.6	0.9	0.47	39.36	8011	0.01	0.01	0.45	0.004	<0.01	1950	2020	2030	2100	0	1.27
21864	USGS-PA-2-CN12	366.50	367.50		24.24	4.25	16.72	20.26	21.8	31.33	26.61	5.45	42.92	1.02	0.62	28.19	7569	0.01	0.02	0.59	0.005	<0.01	2160	2290	2440	2780	0	1.41
19677	USGS-PA-2-CN13	367.50	368.80		28.53	5.42	23.54	27.68	12.41	31.03	28.88	6.37	44.75	0.89	0.64	34.94	7859	0.01	0.02	0.61	0.004	<0.01	2010	2110	2190	2480	0	1.3
19678	USGS-PA-2-CN14	368.80	370.00		28.96	7.41	27.77	33.12	5.58	27.72	33.58	6.6	46.29	0.96	0.49	40.08	7874	0	0.01	0.48	0.003	<0.01	1930	2050	2060	2100	0	1.29
19679	USGS-PA-2-CN15	370.00	371.00		31.4	7.5	27.14	32.6	5.5	27.89	34.01	6.63	47.06	0.97	0.42	39.42	7962	0	0.01	0.41	0.003	<0.01	1920	2030	2050	2070	0	1.27
21865	USGS-PA-2-CN16	371.00	372.00		30.24	8.15	20.04	26.56	5.18	33.53	34.73	6.48	51.16	1.2	0.47	35.51	8849	0.02	0.01	0.44	0.002	<0.01	1980	2100	2150	2220	0	1.27
19680	USGS-PA-2-CN17	372.00	373.00		31.98	7.64	26.89	32.48	4.77	30.14	32.61	6.99	47.17	1.05	0.5	39.52	8108	0.01	0.01	0.48	0.002	<0.01	1980	2030	2060	2130	0	1.23

Major, minor and trace element data, USGS boreholes PA-1 and PA-2

All data shown on dry, whole-coal basis

Samples were ground to -60 in Pittsburgh and shipped to Denver for analysis

Job ERP 00067 represents samples that were run for adsorbtion isotherms

see Bullock and others, 2002, Analytical methods utilized by the United States Geological Survey for the analysis of coal and coal combustion by-products, USGS OFR 02-389, 14 p., for explanation of methodologies

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Job Number
ERP-00062

Lab No.	Field No.	Sample Description	Si Weight %	Al Weight %	Ca Weight %	Mg Weight %	Na Weight %	K Weight %	Fe Weight %	Ti Weight %	P Weight %	S* Weight %	Ag ppm	As ppm	Au ppm	B ppm	Ba ppm	Be ppm	Bi ppm	Cd ppm	Cl ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Ga ppm	Ge ppm	Hg ppm	Li ppm	Mn ppm	Mo ppm	Nb ppm	Ni ppm	Pb ppm	Rb ppm	Sb ppm	Sc ppm	Se ppm	Sn ppm	Sr ppm	Te ppm	Th ppm	Tl ppm	U ppm	V ppm	Y ppm	Zn ppm	Zr ppm
E-141534	USGS-PA-2-CN1	USGS BOREHOLE PA-2 CBM CANNISTER 1	355.15-356.0 FT	0.0267	0.14	0.123	0.00125	0.37	0.0604	0.0338	52.7	1.26	<0.53	0.0676	0.0172	19.5	<0.053	1.7	0.125	1.66	0.16	3.6	3.63	0.874	3.59	0.224	1.14	4.2	3.63	4.04	2.44	1.74	1.25	0.224	0.322	0.0218	146		0.051	1.12	0.541	8.89	0.338		2.39	2.93	1.05	0.827
E-141535	USGS-PA-2-CN3	USGS BOREHOLE PA-2 CBM CANNISTER 3	357.0-358.0 FT	0.0553	0.956	0.384	0.302	0.154	0.273	0.00853	697	1.1	<1.3	0.159	0.0293	22.8	<0.13	3.84	0.0244	2.39	0.15	6.22	11.8	0.342	6.64	0.671	1.04	12	9.63	8.77	1.15	0.232	3.21	0.183	0.512	0.329	1850		0.0366	1.92	0.476	19.6	0.525		4.12	2.94	1.83	2.7
E-141536	USGS-PA-2-CN4	USGS BOREHOLE PA-2 CBM CANNISTER 4	358.0-358.4 FT	0.0177	0.619	0.31	0.101	0.0831	0.198	0.0122	318	0.425	<0.71	0.0588	0.0112	8.19	<0.071	4.49	0.0273	1.26	0.07	2.39	5.05	0.343	3.77	0.455	0.28	13	6.7	6.88	0.763	0.371	3.13	0.112	0.56	0.119	875		0.0259	<0.57	0.175	9.1	0.322		1.52	2.6	0.938	1.53
E-141537	USGS-PA-2-CN5	USGS BOREHOLE PA-2 CBM CANNISTER 5	358.4-359.4 FT	0.0701	1.05	0.465	0.226	0.102	0.322	0.00874	628	1.17	<1.3	0.103	0.0175	26.6	<0.13	3.85	0.0225	1.91	0.08	6.25	12.2	0.3	7.1	0.7	1.08	13	9.74	7.79	1.66	0.225	3	0.15	0.75	0.3	1810		<0.013	2.09	0.55	19.8	0.625		2.83	2.53	1.7	2.7
E-141538	USGS-PA-2-CN7	USGS BOREHOLE PA-2 CBM CANNISTER 7	360.5-361.4 FT	0.0614	0.722	0.318	0.0975	0.262	0.218	0.00707	322	1.38	<1.1	0.121	0.0263	24.7	<0.11	2.66	0.0192	1.96	0.18	5.69	11.1	0.263	9.59	0.667	1.11	10	6.08	5.12	1.62	0.162	2.48	0.273	0.798	0.242	1150		0.0141	1.98	0.465	16.5	0.505		5.13	1.59	1.56	1.81
E-141539	USGS-PA-2-CN8C	USGS BOREHOLE PA-2 CBM CANNISTER 8	361.4-361.95 FT	0.0281	0.423	0.258	0.00467	0.242	0.157	0.0517	145	1.47	<0.87	0.0525	0.0181	14.5	<0.087	2.27	0.361	2.68	0.47	8.86	3.66	0.748	12	0.507	0.929	7.4	3.79	4.44	2.55	3.54	3.41	0.757	1.62	0.0301	465		0.0464	1.21	0.68	24.3	0.421		4.02	1.91	1.8	1.32
E-141540	USGS-PA-2-CN9C	USGS BOREHOLE PA-2 CBM CANNISTER 9	362.44-363.27 FT	0.0473	0.321	0.243	0.00166	0.143	0.137	0.0837	111	2.01	<0.93	0.0607	0.0294	18.7	<0.093	1.73	0.589	2.37	0.21	8.67	5.17	0.478	10.7	0.69	1.24	4.5	2.98	3.94	2.31	5.85	1.89	0.524	0.57	0.0653	262		0.0589	1.33	0.736	21.8	0.506		2.35	4.13	2.13	1.17
E-141541	USGS-PA-2-CN11	USGS BOREHOLE PA-2 CBM CANNISTER 11	365.4-366.5 FT	0.0346	0.554	0.297	0.0186	0.08	0.179	0.0145	201	1.11	<0.78	0.0585	0.0362	14.8	0.0847	2.36	0.0531	1.96	0.18	5.65	10.6	0.762	6.05	0.947	1.19	12	6.73	3.45	1.8	0.631	2.14	0.97	0.755	0.154	766		0.0631	0.97	0.531	12.8	0.416		1.73	8.24	1.02	1.64
E-141542	USGS-PA-2-CN13	USGS BOREHOLE PA-2 CBM CANNISTER 13	367.5-368.8 FT	0.0337	0.219	0.112	0.000724	0.049	0.0697	0.021	79.5	1.52	<0.61	0.045	0.0108	15.4	<0.061	1.28	0.084	1.34	0.17	6.42	11.4	0.282	3.92	0.516	0.918	5.4	2.37	1.73	1.86	1.04	1.84	0.42	0.342	0.084	288		0.024	1.97	0.522	12.2	0.384		1.36	1.49	0.72	0.756
E-141543	USGS-PA-2-CN14	USGS BOREHOLE PA-2 CBM CANNISTER 14	368.8-370.0 FT	0.0321	0.595	0.268	0.000941	0.0694	0.188	0.00709	189	0.95	<0.79	0.0741	0.0694	14	<0.079	2.26	0.0179	1.37	0.1	4	6.62	0.281	7.72	0.765	0.632	13	6.55	5.67	1.55	0.203	1.83	0.289	0.702	0.164	804		0.0148	0.975	0.312	11.9	0.296		1.76	4.42	1.05	1.63
E-141544	USGS-PA-2-CN15	USGS BOREHOLE PA-2 CBM CANNISTER 15	370.0-371.0 FT	0.0298	0.599	0.272	0.000917	0.0564	0.183	0.00691	204	0.889	<0.77	0.0836	0.0243	13.8	<0.077	2.32	0.016	1.23	0.09	3.22	5.88	0.274	6.8	0.532	0.578	13	6.59	5.84	1.46	0.137	1.82	0.213	0.646	0.16	813		0.0129	1.54	0.266	12	0.281		1.6	3.37	1.07	1.47
E-141545	USGS-PA-2-CN17	USGS BOREHOLE PA-2 CBM CANNISTER 17	372.0-373.0 FT	0.0199	0.632	0.364	0.000917	2.24	0.215	0.00957	186	0.607	<0.77	0.0737	0.0198	9.27	<0.077	5.66	0.0395	3.8	0.03	5.49	9.81	18.2	4.59	0.905	1.03	18	10.8	18.5	2.08	0.38	3.98	4.07	0.791	0.175	1000		0.0167	0.958	1.04	15.3	0.213		11.9	3.15	0.981	2.14
E-141546	USGS-PA-1.1a	USGS BOREHOLE PA-1	128.15 - 128.75 FT	0.0226	0.116	0.131	0.00214	0.337	0.0735	0.0784	31.8	1.78	<0.6	0.033	0.0649	14.8	<0.06	1.35	0.307	1.19	0.03	3.04	1.83	1.15	1.94	0.124	0.661	1.3	20.9	1.42	1.8	4.38	1.3	0.124	0.277	<0.006	77.9		0.026	0.897	0.437	4.79	0.23		2.67	6.02	0.749	0.389
E-141547	USGS-PA-1.1b	USGS BOREHOLE PA-1	128.75 - 129.8 FT	0.02	0.656	0.254	0.000808	1.27	0.211	0.0361	109	0.962	<0.68	0.0804	0.0295	9.85	<0.068	3.65	0.188	3.67	<0.021	3.71	3	5.51	2.02	0.308	0.65	1.7	123	6	1.27	2.14	1.88	0.496	0.382	0.0596	424		0.0154	1.76	0.429	8.58	0.201		6.7	4.29	0.871	1.04
E-141548	USGS-PA-1.2	USGS BOREHOLE PA-1	129.8 - 130.7 FT	0.0445	0.974	0.421	0.00129	0.302	0.284	0.0225	157	1.99	<1.1	0.15	0.0278	20.2	<0.11	3.85	0.0578	2.8	<0.021	4.46	6.72	0.749	2.57	0.193	1.02	1.6	185	7.39	1.52	0.995	1.85	0.235	0.61	0.118	612		<0.011	1.74	0.46	9.14	0.385		3.61	3.24	0.845	7.24
E-141549	USGS-PA-1.3	USGS BOREHOLE PA-1	130.7 - 132.8 FT	0.0143	0.0896	0.111	0.000567	0.0628	0.0351	0.046	20.4	1.6	<0.48	0.0174	0.0127	9.82	<0.048	0.522	0.127	0.733	0.34	2.21	0.221	0.625	1.37	0.0658	0.418	0.66	14.9	4.13	0.62	2.13	0.32	0.0334	0.141	<0.0048	49.8		0.108	0.832	0.136	2.8	0.207		0.639	1.9	0.409	3.41
E-141550	USGS-PA-1.4	USGS BOREHOLE PA-1	331.0 - 334.0 FT	0.0759	0.657	0.307	0.0126	0.818	0.202	0.0187	197	1.99	<1.2	0.162	0.029	30.5	<0.12	4.25	0.0835	4.14	0.08	6.97	13.7	2.63	10.7	0.603	2.39	7.2	23.1	9.21	3.87	0.766	3.96	0.592	1.49	0.186	660		0.0383	2.07	1.07	20.4	0.592		6.33	3.98	2.36	1.88
E-141551	USGS-PA-1.5	USGS BOREHOLE PA-1	334.0 - 337.0 FT	0.0572	0.799	0.357	0.0511	0.136	0.237	0.00928	267	1.26	<1.1	0.122	0.0367	23.4	<0.11	3.77	0.0194	1.93	0.28	6.31	14.2	0.316	12.2	0.765	1.45	12	24	6.45	1.56	0.194	3.43	0.418	0.745	0.235	928		0.0184	1.11	0.602	21	0.632		2.87	2.06	1.61	1.93
E-141552	USGS-PA-1.6	USGS BOREHOLE PA-1	337.0 - 340.0 FT	0.0586	1.1	0.485	0.0255	0.152	0.319	0.0107	276	1.34	<1.3	0.141	0.0512	25.5	<0.13	3.93	0.0294	2.51	0.14	6.77	13.7	0.486	15.4	1.18	1.15	12	25.2	6.48	1.96	0.282	3.19	0.448	0.768	0.307	1180		0.023	1.32	0.666	22.8	0.743		3.17	3.14	2.05	2.74
E-141553	USGS-PA-1.7	USGS BOREHOLE PA-1	340.0 - 343.0 FT	0.0505	0.783	0.371	0.0013	0.0962	0.26	0.00982	241	1.34	<1.1	0.13	0.0184	21.8	<0.11	2.81	0.0227	1.99	0.11	5.25	10.9	0.302	12.6	0.508	1.1	11	17.1	4.95	1.7	0.248	2.64	0.173	0.756	0.184	819		0.0691	1.94	0.454	17.5	0.497		2.39	1.78	1.83	2.12
E-141554	USGS-PA-1.8	USGS BOREHOLE PA-1	343.0 - 346.0 FT	0.0567	1.1	0.526	0.00156	0.182	0.353	0.0117	282	1.55	<1.3	0.155	0.0181	23.2	<0.13	3.77	0.0297	2.21	0.1	5.46	11.1	0.387	11.7	0.645	0.89	11	21.7	11.8	2.04	0.297	2.9	0.128	1.05	0.232	1100		0.219	1.35	0.464	19	0.568		3.35	3.06	2.08	4.35
E-141555	USGS-PA-1.9	USGS BOREHOLE PA-1	346.0 - 347.7 FT	0.0338	0.461	0.375	0.00119	1.14	0.214	0.0831	135	2.04	<1	0.0753	0.0515	15.1	<0.1	3.35	0.733	2.57	0.2	8.25	12.6	9.02	4.54	0.574	0.822	7.4	18.6	10.5	3	5.76	2.46	1.31	1.09	0.0376	449		0.0525	1.46	0.495	19.2	0.376		5.83	4.76	1.61	1.3

*Sulfur is det

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Job Number
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Lab No.	Field No.	Sample Description	Si Weight %	Al Weight %	Ca Weight %	Mg Weight %	Na Weight %	K Weight %	Fe Weight %	Ti Weight %	P Weight %	S* Weight %	Ag ppm	As ppm	Au ppm	B ppm	Ba ppm	Be ppm	Bi ppm	Cd ppm	Cl ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Ga ppm	Ge ppm	Hg ppm	Li ppm	Mn ppm	Mo ppm	Nb ppm	Ni ppm	Pb ppm	Rb ppm	Sb ppm	Sc ppm	Se ppm	Sn ppm	Sr ppm	Te ppm	Th ppm	Tl ppm	U ppm	V ppm	Y ppm	Zn ppm	Zr ppm
E-146368	USGS-PA-2-CN2	USGS BOREHOLE PA-2 CBM CANNISTER 2	356.0-357.0 FT	0.0398	0.425	0.213	0.03	0.29	0.13	0.00944	170	1.02	<0.72	0.114	0.0156	15.1	<0.072	2.06	0.0312	1.88	0.19	4.22	7.74	0.398	6.65	0.298	0.675	8.5	5.16	4.83	1.65	0.369	1.93	0.17	0.54	0.0554	669		0.0398	<0.57	0.426	12.1	0.334		3.61	1.25	1.42	1.32
E-146369	USGS-PA-2-CN6	USGS BOREHOLE PA-2 CBM CANNISTER 6	359.4-360.5 FT	0.0234	0.701	0.336	0.125	0.109	0.205	0.007	354	0.51	<0.78	0.077	0.0223	9.7	<0.078	2.08	0.02	1.19	0.19	2.89	6.01	0.185	3.69	0.477	0.354	13	6.34	6.35	0.701	0.177	1.29	0.116	<0.24	0.0508	1100		0.0193	<0.62	0.239	9.32	0.385		2.33	1.72	1.09	1.51
E-146370	USGS-PA-2-CN12	USGS BOREHOLE PA-2 CBM CANNISTER 12	366.5-367.5 FT	0.0334	0.103	0.0583	0.000923	0.0378	0.0381	0.0264	43.1	1.54	<0.52	0.0296	0.00561	13.3	<0.052	0.796	0.117	0.979	0.22	1.52	6.94	0.219	2.49	0.321	0.939	3	1.15	0.643	1.47	1.26	1.02	0.245	0.296	0.0255	113		0.0163	0.546	0.459	9.13	0.281		0.852	0.347	0.612	0.357
E-146371	USGS-PA-2-CN16	USGS BOREHOLE PA-2 CBM CANNISTER 16	371.0-372.0 FT	0.0228	0.72	0.36	0.00101	0.337	0.23	0.00646	225	0.704	<0.85	0.0823	0.026	12.7	<0.085	2.37	0.021	1.15	0.11	2.86	7.03	0.311	4.54	0.638	0.437	14	9.07	9.91	0.907	0.16	1.02	0.168	0.386	0.0613	983		0.016	<0.68	0.235	9.41	0.235		3.9	2.04	0.949	1.43

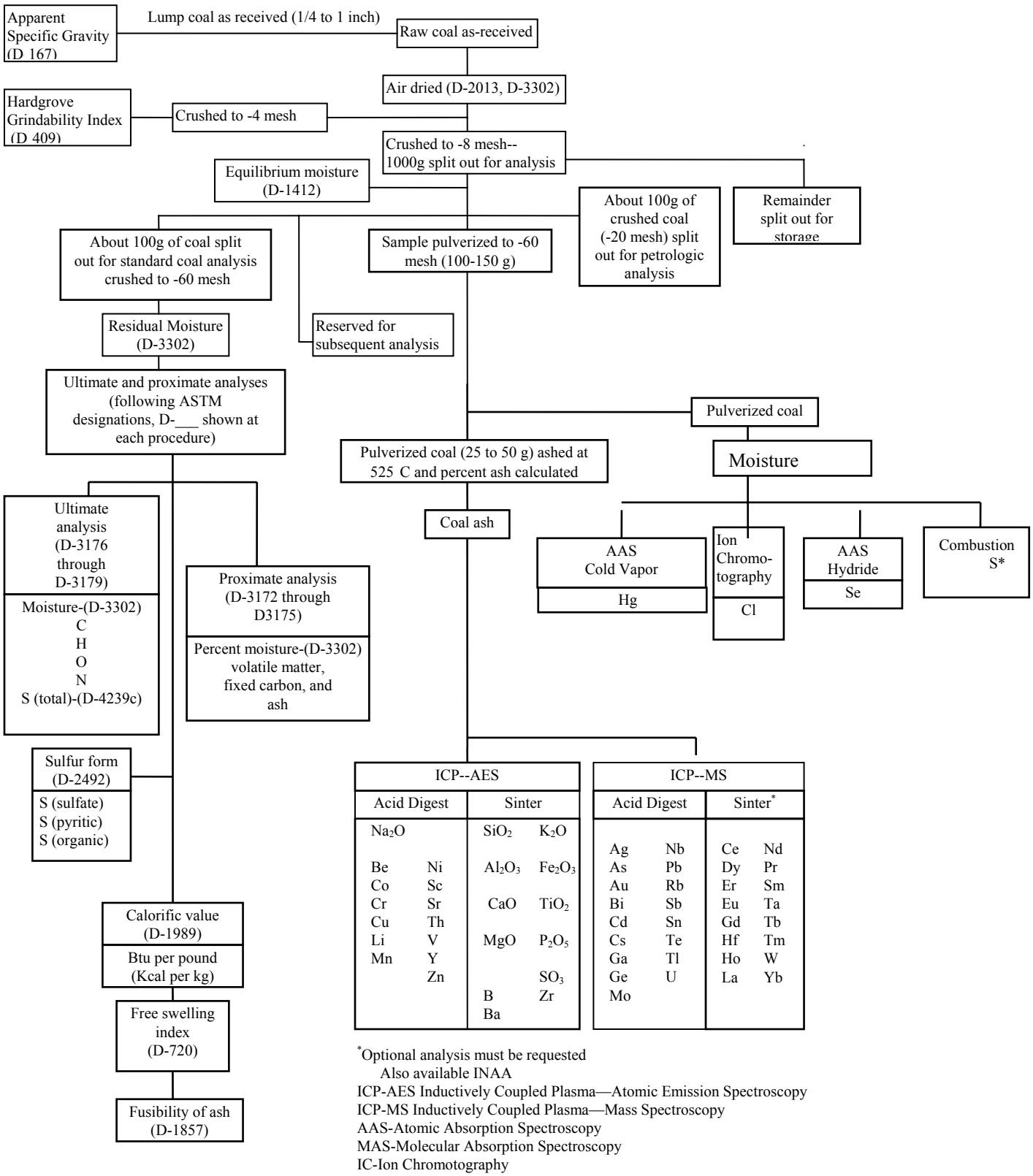

Figure 1. Flow diagram of procedures used after December 1994, for the analysis of coal samples collected. (Current ASTM procedures effective July, 1991) (ASTM-American Society for Testing and Materials, USGS-United States Geological Survey.)

Appendix 2

Methane adsorption data from borehole USGS-PA-2

Appendix 2 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

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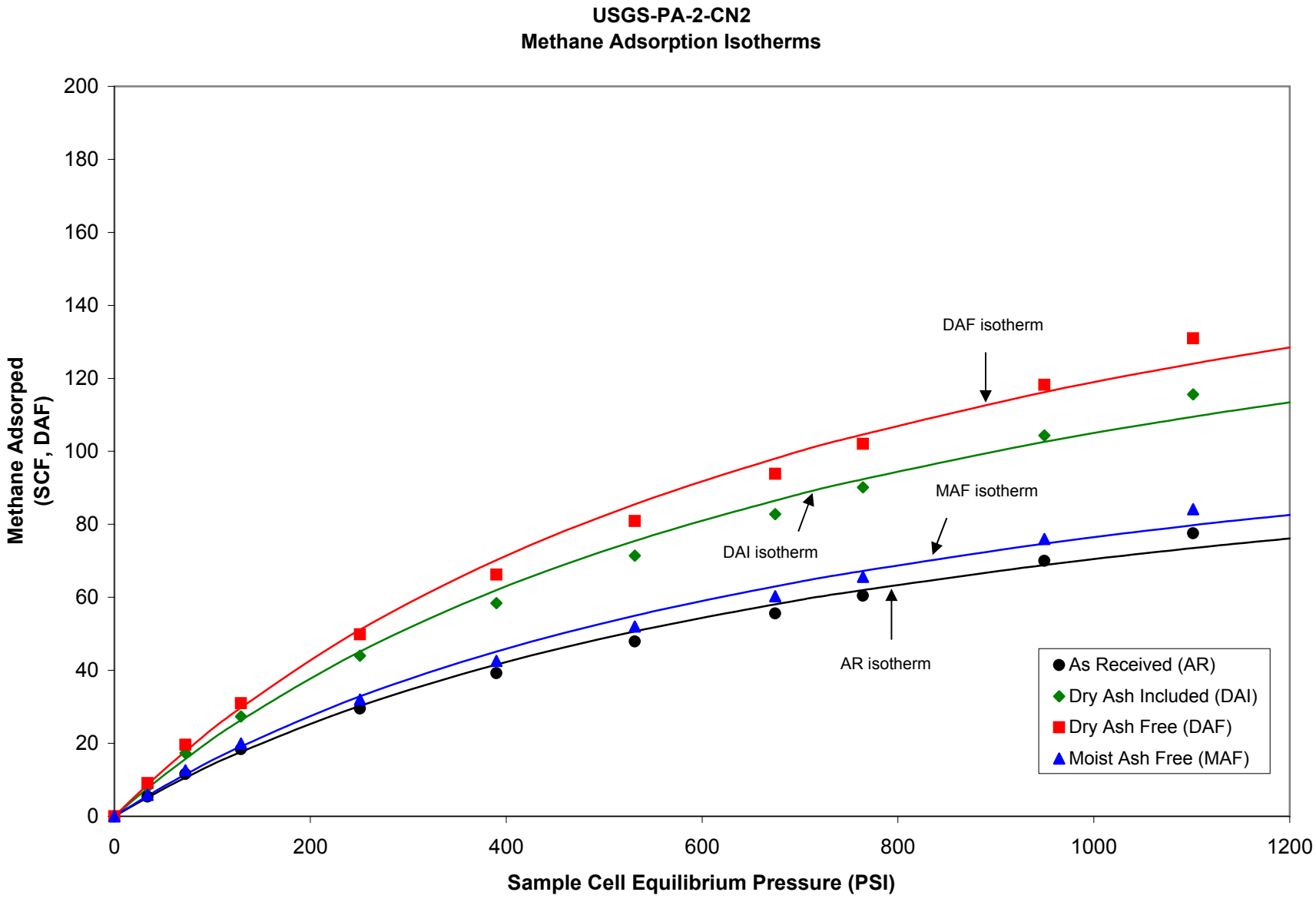

USGS-PA-2-CN2
Methane Adsorption Isotherms
Methane Adsorped (SCF, DAF)
Sample Cell Equilibrium Pressure (PSI)
0
20
40
60
80
100
120
140
160
180
200
0
200
400
600
800
1000
1200
DAF isotherm
MAF isotherm
DAI isotherm
AR isotherm
As Received (AR)
Dry Ash Included (DAI)
Dry Ash Free (DAF)
Moist Ash Free (MAF)

USGS-PA-2-CN2
METHANE ADSORPTION ISOTHERM CFG UNITS

Sample I.D. :	USGS-PA-2-CN2	**Moisture Content (EQ) % :**	32.91
Isotherm Temperature º F:	86	**Dry Ash Content, % :**	7.87
Correlation Coefficient:	0.97	**Helium Density g/cc**	1.333

AS RECEIVED BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
34	5.4	6.29
73	11.6	6.25
129	18.4	7.04
251	29.5	8.50
390	39.2	9.95
531	47.9	11.09
675	55.6	12.15
764	60.5	12.64
950	70.0	13.57
1101	77.5	14.20

Saturated Monolayer Volume (SCF/ton, as-received): 127
Langmuir Pressure (PSI): 799

DRY ASH FREE BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
34	9.1	3.73
73	19.6	3.70
129	31.0	4.17
251	49.8	5.03
390	66.2	5.89
531	80.9	6.57
675	93.8	7.19
764	102.1	7.49
950	118.2	8.03
1101	130.9	8.41

Saturated Monolayer Volume (SCF/ton, daf): 214
Langmuir Pressure (PSI): 799

DRY ASH INCLUDED BASIS

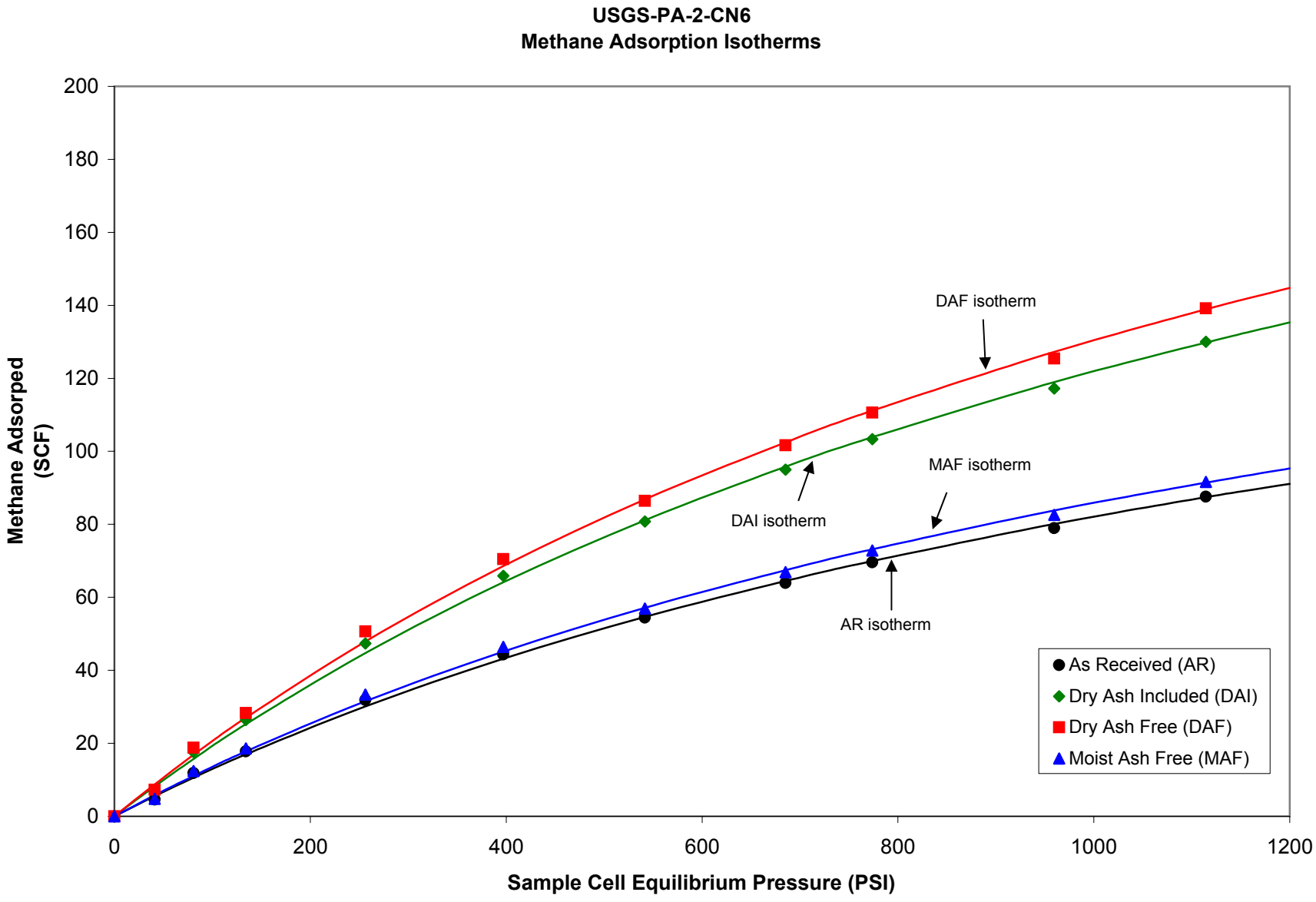
PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
34	8.0	4.22
73	17.3	4.19
129	27.4	4.72
251	44.0	5.70
390	58.4	6.68
531	71.4	7.44
675	82.8	8.15
764	90.1	8.48
950	104.3	9.10
1101	115.6	9.53

Saturated Monolayer Volume (SCF/ton, dai): 189
Langmuir Pressure (PSI): 799

MOIST ASH FREE BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
34	5.8	5.80
73	12.6	5.75
129	19.9	6.48
251	32.0	7.83
390	42.6	9.17
531	52.0	10.22
675	60.3	11.19
764	65.6	11.65
950	76.0	12.50
1101	84.2	13.08

Saturated Monolayer Volume (SCF/ton, maf): 138
Langmuir Pressure (PSI): 799


USGS-PA-2-CN6
Methane Adsorption Isotherms
Methane Adsorped (SCF)
Sample Cell Equilibrium Pressure (PSI)
0
20
40
60
80
100
120
140
160
180
200
0
200
400
600
800
1000
1200
DAF isotherm
DAI isotherm
MAF isotherm
AR isotherm
As Received (AR)
Dry Ash Included (DAI)
Dry Ash Free (DAF)
Moist Ash Free (MAF)

USGS-PA2-CN6
METHANE ADSORPTION ISOTHERM CFG UNITS

Sample I.D. :	USGS-PA2-CN6	**Moisture Content (EQ) % :**	32.67
Isotherm Temperature º F:	86	**Dry Ash Content, % :**	4.41
Correlation Coefficient:	0.90	**Helium Density g/cc**	1.223

AS RECEIVED BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
41	4.6	8.98
81	11.8	6.83
134	17.8	7.55
256	31.9	8.04
397	44.3	8.96
542	54.4	9.96
685	64.0	10.71
774	69.6	11.12
960	78.9	12.16
1114	87.6	12.73

Saturated Monolayer Volume (SCF/ton, as-received): 202
Langmuir Pressure (PSI): 1464

DRY ASH FREE BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
41	7.3	5.65
81	18.8	4.30
134	28.3	4.75
256	50.7	5.06
397	70.5	5.64
542	86.5	6.26
685	101.6	6.74
774	110.6	7.00
960	125.4	7.65
1114	139.2	8.01

Saturated Monolayer Volume (SCF/ton, daf): 321
Langmuir Pressure (PSI): 1464

DRY ASH INCLUDED BASIS

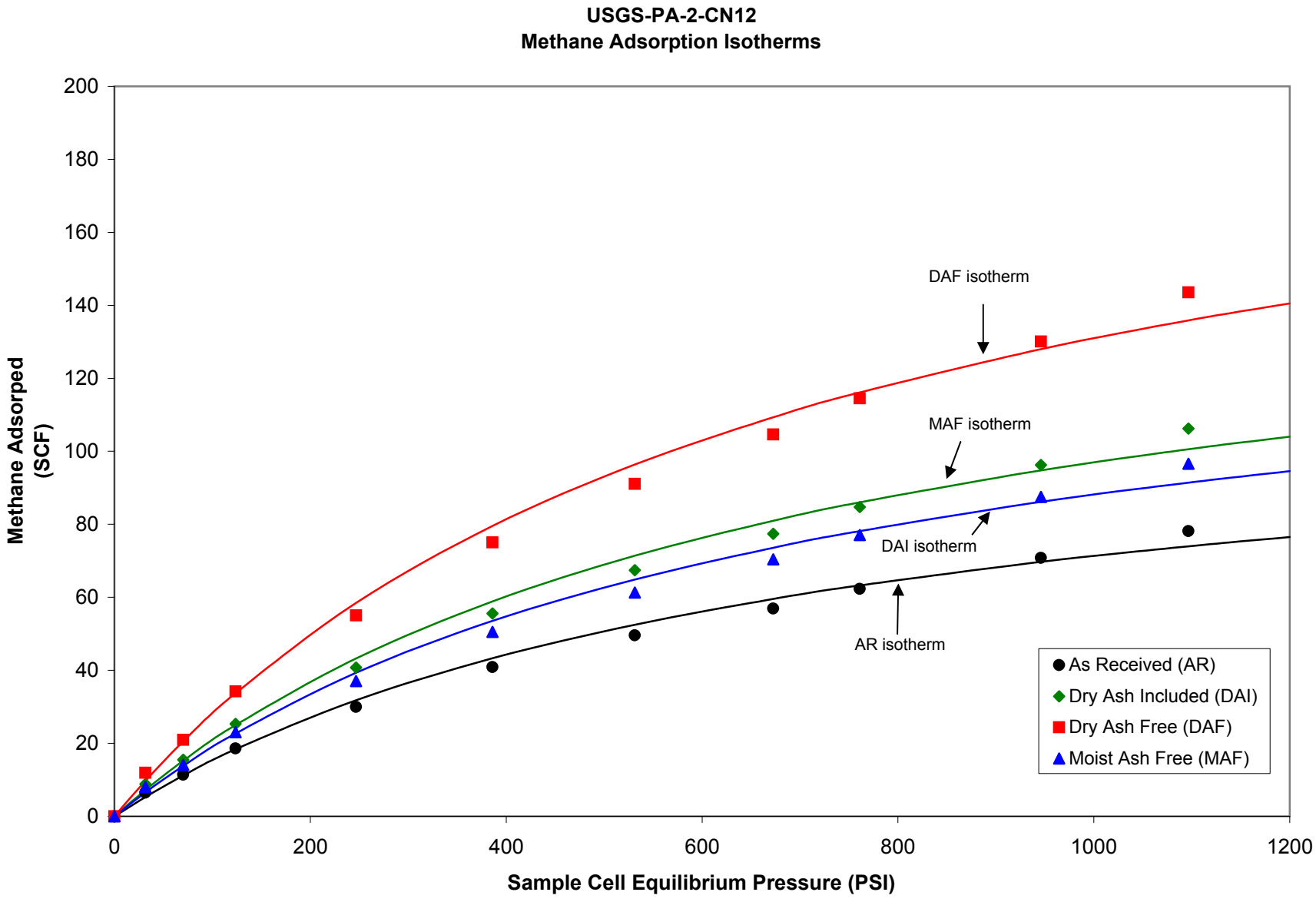
PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
41	6.8	6.05
81	17.6	4.60
134	26.4	5.08
256	47.3	5.41
397	65.9	6.03
542	80.8	6.70
685	95.0	7.21
774	103.3	7.49
960	117.2	8.19
1114	130.0	8.57

Saturated Monolayer Volume (SCF/ton, dai): 300
Langmuir Pressure (PSI): 1464

MOIST ASH FREE BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
41	4.8	8.59
81	12.4	6.53
134	18.6	7.22
256	33.3	7.68
397	46.4	8.56
542	56.9	9.52
685	66.9	10.24
774	72.8	10.63
960	82.6	11.62
1114	91.6	12.17

Saturated Monolayer Volume (SCF/ton, maf): 212
Langmuir Pressure (PSI): 1464


USGS-PA-2-CN12
Methane Adsorption Isotherms
Methane Adsorped (SCF)
Sample Cell Equilibrium Pressure (PSI)
0
20
40
60
80
100
120
140
160
180
200
0
200
400
600
800
1000
1200
DAF isotherm
MAF isotherm
DAI isotherm
AR isotherm
As Received (AR)
Dry Ash Included (DAI)
Dry Ash Free (DAF)
Moist Ash Free (MAF)

USGS-PA-2-CN12
METHANE ADSORPTION ISOTHERM CFG UNITS

Sample I.D. :	USGS-PA-2-CN12	**Moisture Content (EQ) % :**	26.46
Isotherm Temperature º F:	86	**Dry Ash Content, % :**	19.10
Correlation Coefficient:	0.97	**Helium Density g/cc**	1.355

AS RECEIVED BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
32	6.5	4.87
70	11.4	6.17
124	18.6	6.65
247	30.0	8.24
386	40.9	9.45
531	49.6	10.72
673	56.9	11.81
761	62.3	12.21
946	70.8	13.36
1097	78.1	14.03

Saturated Monolayer Volume (SCF/ton, as-received): 120
Langmuir Pressure (PSI): 685

DRY ASH FREE BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
32	11.9	2.65
70	20.9	3.36
124	34.2	3.62
247	55.0	4.48
386	75.1	5.14
531	91.1	5.84
673	104.6	6.43
761	114.5	6.65
946	130.1	7.27
1097	143.5	7.64

Saturated Monolayer Volume (SCF/ton, daf): 221
Langmuir Pressure (PSI): 685

DRY ASH INCLUDED BASIS

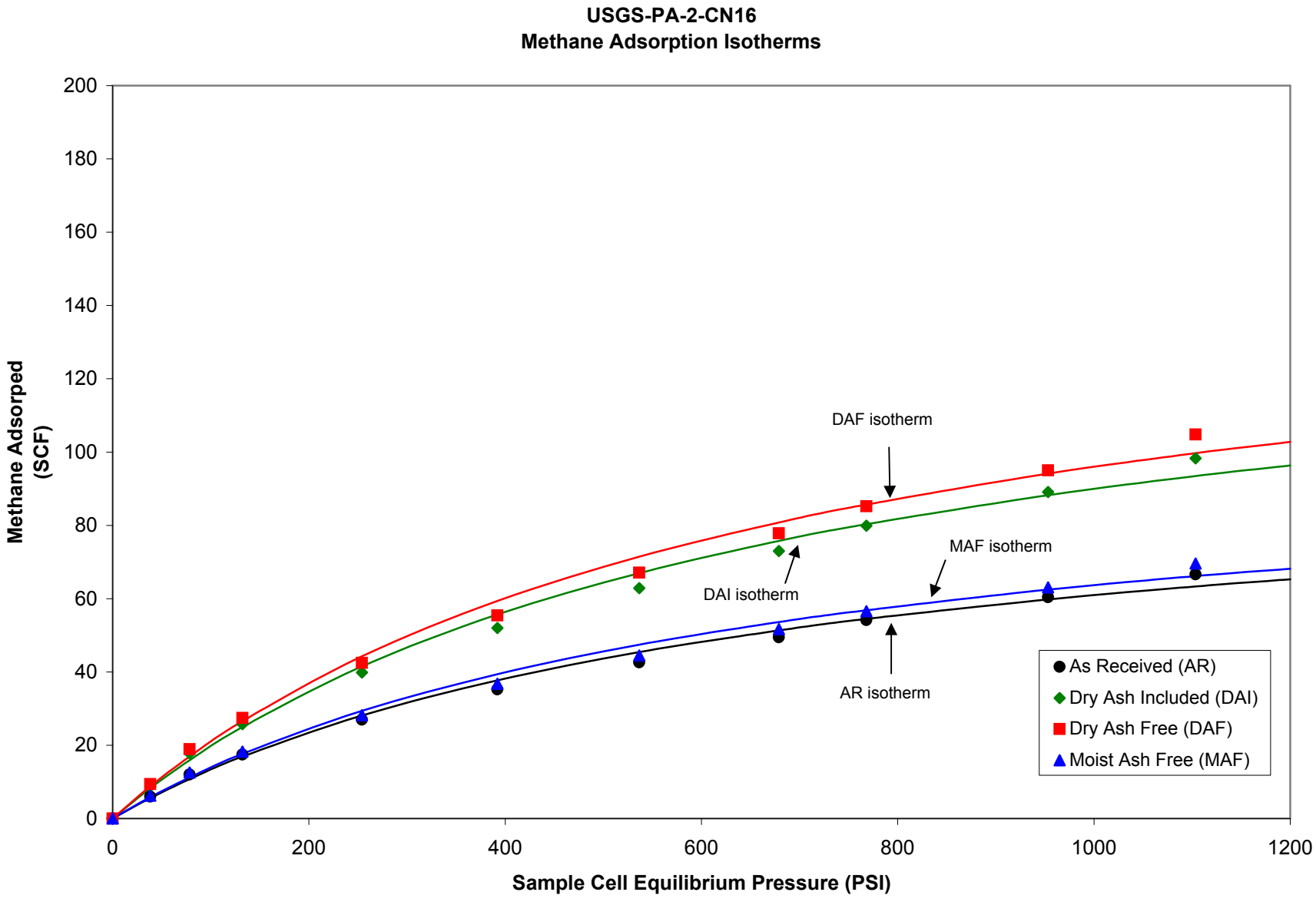
PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
32	8.8	3.58
70	15.5	4.53
124	25.3	4.89
247	40.7	6.06
386	55.6	6.95
531	67.4	7.88
673	77.4	8.69
761	84.8	8.98
946	96.3	9.82
1097	106.2	10.32

Saturated Monolayer Volume (SCF/ton, dai): 163
Langmuir Pressure (PSI): 685

MOIST ASH FREE BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
32	8.0	3.94
70	14.1	4.99
124	23.0	5.38
247	37.0	6.66
386	50.5	7.64
531	61.3	8.67
673	70.4	9.56
761	77.0	9.88
946	87.5	10.81
1097	96.6	11.35

Saturated Monolayer Volume (SCF/ton, maf): 149
Langmuir Pressure (PSI): 685


USGS-PA-2-CN16
Methane Adsorption Isotherms
Methane Adsorped (SCF)
Sample Cell Equilibrium Pressure (PSI)
0
20
40
60
80
100
120
140
160
180
200
0
200
400
600
800
1000
1200
DAF isotherm
MAF isotherm
DAI isotherm
AR isotherm
As Received (AR)
Dry Ash Included (DAI)
Dry Ash Free (DAF)
Moist Ash Free (MAF)

USGS-PA-2-CN16
METHANE ADSORPTION ISOTHERM CFG UNITS

Sample I.D. :	USGS-PA-2-CN16	**Moisture Content (EQ) % :**	32.22
Isotherm Temperature º F:	86	**Dry Ash Content, % :**	4.24
Correlation Coefficient:	0.98	**Helium Density g/cc**	1.309

AS RECEIVED BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
38	5.9	6.46
78	12.0	6.52
132	17.5	7.58
254	27.0	9.41
392	35.2	11.13
537	42.6	12.59
679	49.5	13.73
768	54.2	14.19
953	60.4	15.79
1103	66.6	16.57

Saturated Monolayer Volume (SCF/ton, as-received): 101
Langmuir Pressure (PSI): 660

DRY ASH FREE BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
38	9.4	4.11
78	18.9	4.14
132	27.5	4.82
254	42.5	5.98
392	55.4	7.07
537	67.1	8.00
679	77.8	8.72
768	85.2	9.01
953	95.0	10.03
1103	104.8	10.53

Saturated Monolayer Volume (SCF/ton, daf): 159
Langmuir Pressure (PSI): 660

DRY ASH INCLUDED BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
38	8.8	4.38
78	17.8	4.42
132	25.8	5.14
254	39.8	6.38
392	52.0	7.54
537	62.9	8.53
679	73.0	9.30
768	79.9	9.62
953	89.1	10.70
1103	98.3	11.23

Saturated Monolayer Volume (SCF/ton, dai): 149
Langmuir Pressure (PSI): 660

MOIST ASH FREE BASIS

PRESSURE (PSI)	ADSORPED METHANE (SCF/ton)	P / V
38	6.2	6.19
78	12.6	6.24
132	18.2	7.26
254	28.2	9.01
392	36.8	10.66
537	44.5	12.05
679	51.6	13.14
768	56.5	13.58
953	63.0	15.12
1103	69.6	15.87

Saturated Monolayer Volume (SCF/ton, maf): 106
Langmuir Pressure (PSI): 660

Appendix 3

Carbon dioxide adsorption isotherms for sample USGS-PA-2-CN2

Appendix 3 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

[1]U.S. Geological Survey, Reston, VA
[2]U.S. Geological Survey, Denver, CO

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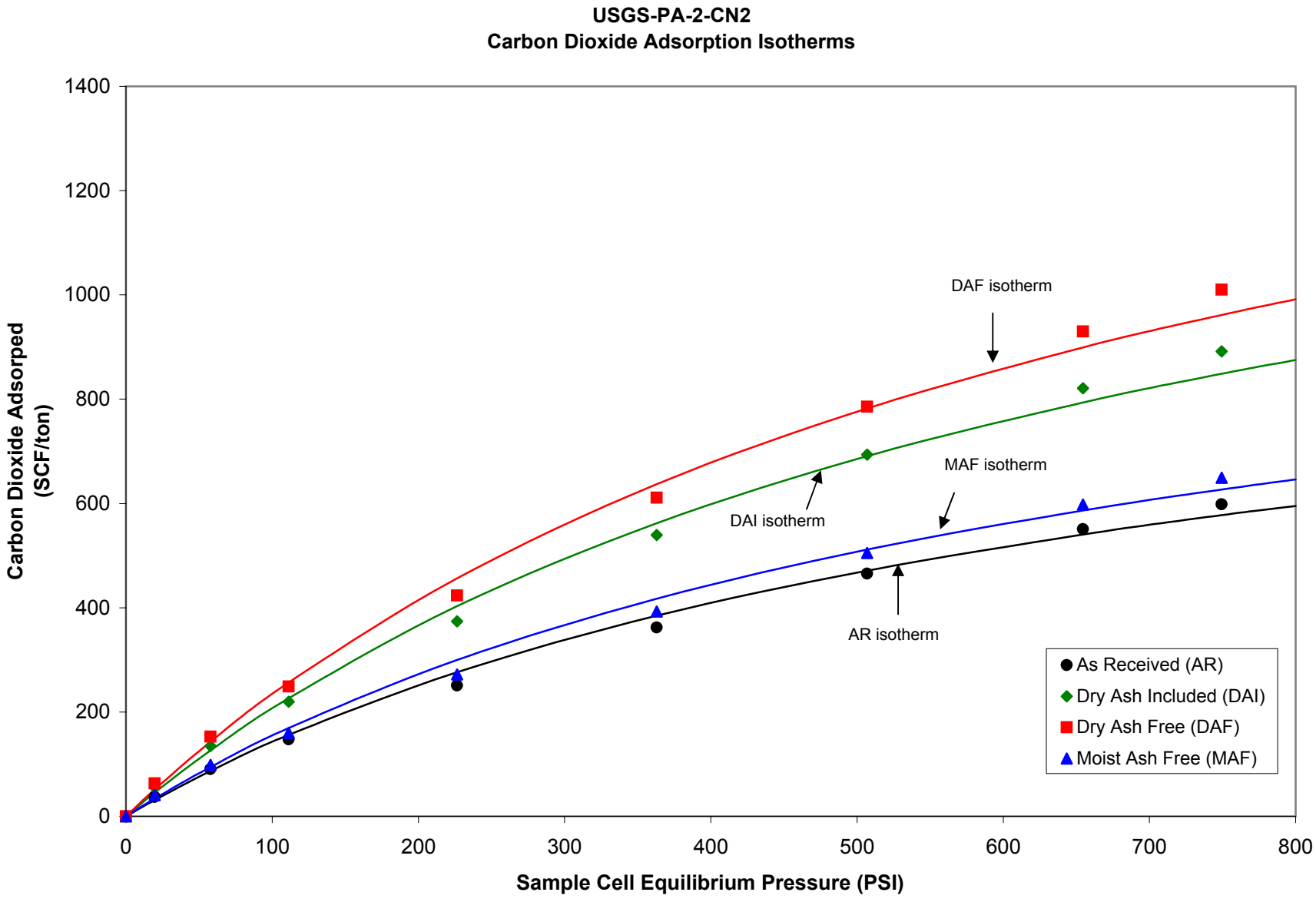
USGS-PA-2-CN2
Carbon Dioxide Adsorption Isotherms
Carbon Dioxide Adsorped (SCF/ton)
Sample Cell Equilibrium Pressure (PSI)
0
200
400
600
800
1000
1200
1400
0
100
200
300
400
500
600
700
800
DAF isotherm
MAF isotherm
DAI isotherm
AR isotherm
As Received (AR)
Dry Ash Included (DAI)
Dry Ash Free (DAF)
Moist Ash Free (MAF)

USGS-PA-2-CN2
CARBON DIOXIDE ADSORPTION ISOTHERM IMPERIAL UNITS

Sample I.D. :	USGS-PA-2-CN2	**Moisture Content (EQ) % :**	32.91
Isotherm Temperature º F:	86	**Dry Ash Content % :**	7.87
Correlation Coefficient:	0.95	**Helium Density g/cc**	1.333

AS RECEIVED BASIS

PRESSURE (PSI)	ADSORPED CARBON DIOXIDE (SCF/ton)	P / V
20	37.4	0.53
58	90.6	0.64
111	147.4	0.75
226	250.7	0.90
363	361.9	1.00
507	465.4	1.09
655	550.7	1.19
749	598.2	1.25

Saturated Monolayer Volume (SCF/ton, as-received): 1093
Langmuir Pressure (PSI): 668

DRY ASH FREE BASIS

PRESSURE (PSI)	ADSORPED CARBON DIOXIDE (SCF/ton)	P / V
20	63.2	0.31
58	153.0	0.38
111	248.9	0.45
226	423.4	0.53
363	611.1	0.59
507	785.8	0.65
655	929.8	0.70
749	1010.2	0.74

Saturated Monolayer Volume (SCF/ton, daf): 1845
Langmuir Pressure (PSI): 668

DRY ASH INCLUDED BASIS

PRESSURE (PSI)	ADSORPED CARBON DIOXIDE (SCF/ton)	P / V
20	55.8	0.35
58	135.0	0.43
111	219.7	0.51
226	373.7	0.61
363	539.4	0.67
507	693.6	0.73
655	820.8	0.80
749	891.7	0.84

Saturated Monolayer Volume (SCF/ton, dai): 1629
Langmuir Pressure (PSI): 668

MOIST ASH FREE BASIS

PRESSURE (PSI)	ADSORPED CARBON DIOXIDE (SCF/ton)	P / V
20	40.6	0.48
58	98.3	0.59
111	160.0	0.70
226	272.1	0.83
363	392.8	0.92
507	505.1	1.00
655	597.7	1.10
749	649.3	1.15

Saturated Monolayer Volume (SCF/ton, mai): 1186
Langmuir Pressure (PSI): 668

Appendix 4

Extended Langmuir modeling data for sample USGS-PA-2-CN2

Appendix 4 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

[1]U.S. Geological Survey, Reston, VA
[2]U.S. Geological Survey, Denver, CO

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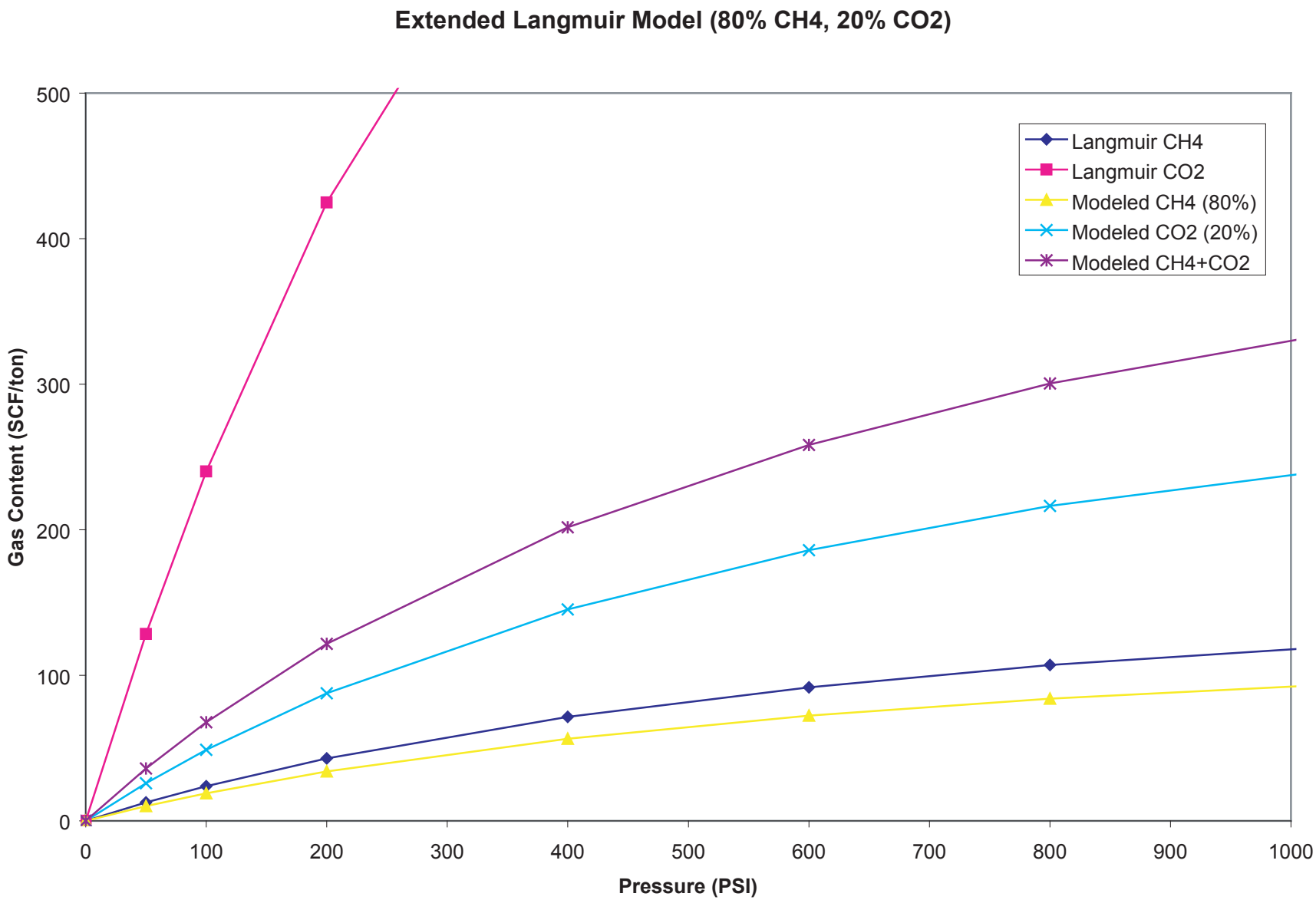
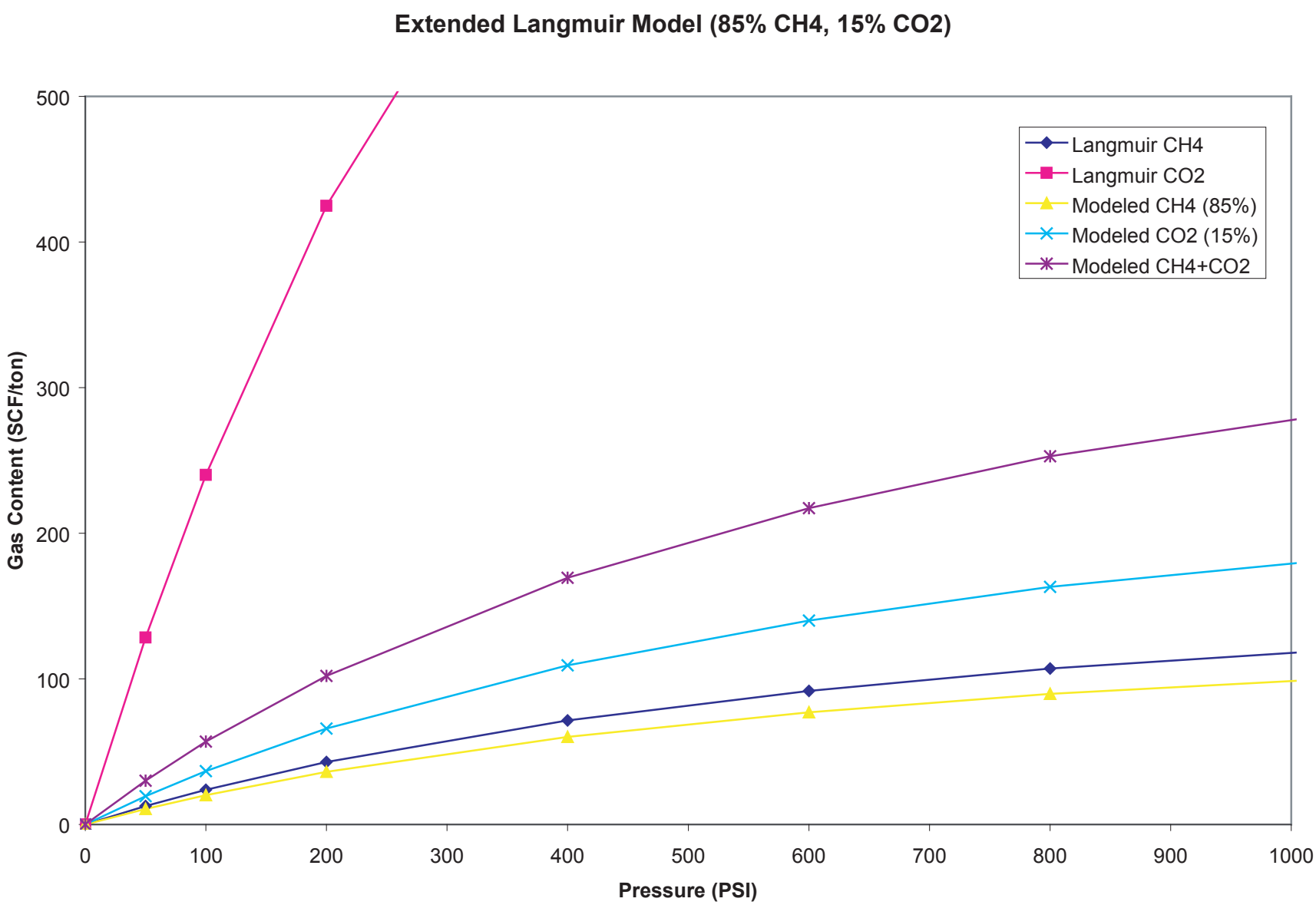
U.S. Department of the Interior
U.S. Geological Survey


Extended Langmuir Model (80% CH4, 20% CO2)
Gas Content (SCF/ton)
Pressure (PSI)
0
100
200
300
400
500
600
700
800
900
1000
Langmuir CH4
Langmuir CO2
Modeled CH4 (80%)
Modeled CO2 (20%)
Modeled CH4+CO2

USGS-PA-2-CN2

EXTENDED LANGMUIR MODEL (80% CH4 AND 20% CO2)
DRY ASH FREE BASIS (SCF/TON)

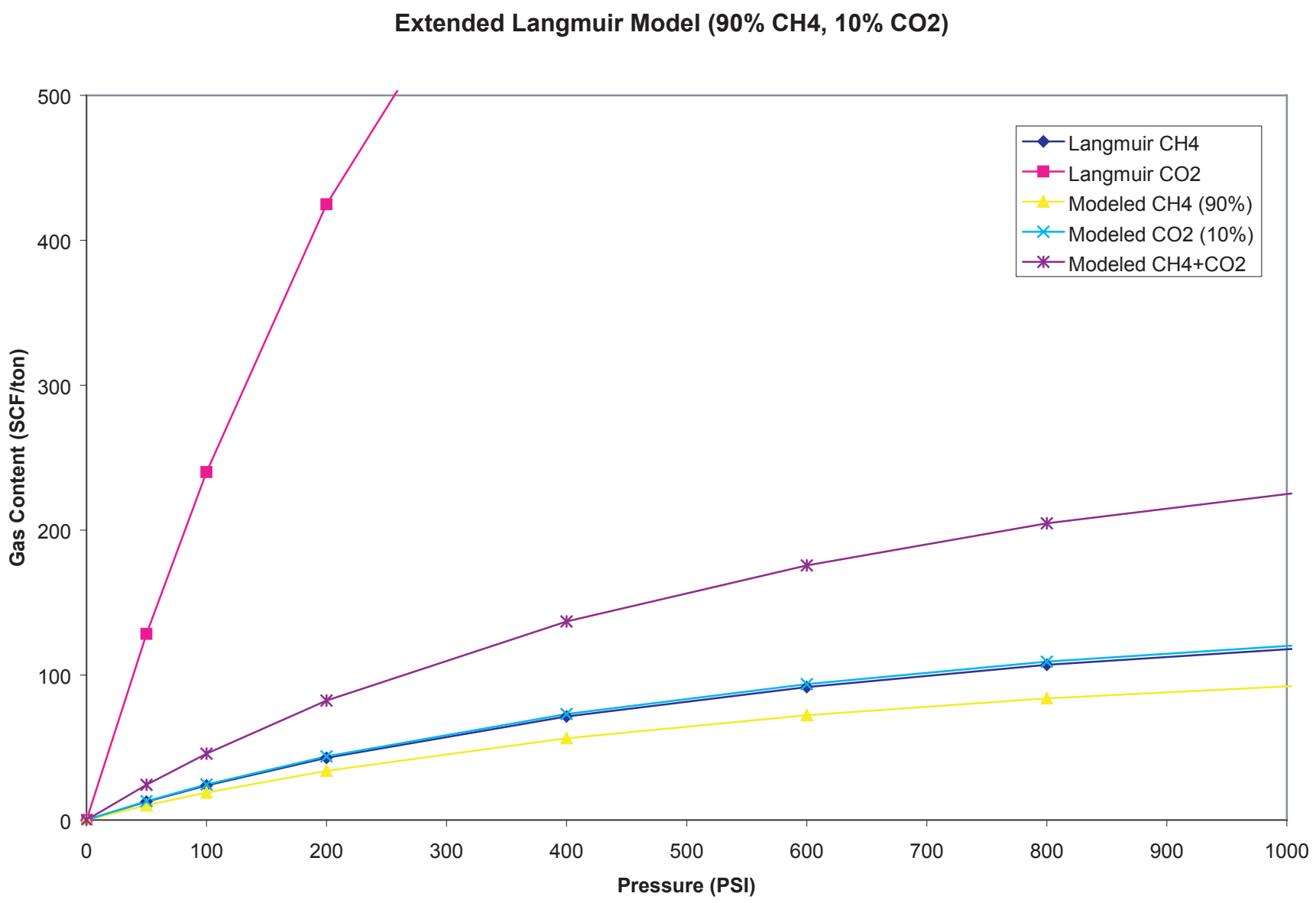
Pressure PSI	Langmuir CH4	Langmuir CO2	Modeled CH4 (80%)	Modeled C02 (20%)	Modeled CH4 +CO2
0	0	0	0	0	0
50	13	128	10	26	36
100	24	240	19	49	68
200	43	425	34	88	122
400	71	691	56	145	202
600	92	873	72	186	258
800	107	1005	84	216	300
1200	128	1185	100	259	359
1600	143	1301	111	287	398
Langmuir Volume (SCF/ton)	214.026	1844.985	165	424	589
Langmuir Pressure (PSI)	798.925	668.481	769	769	769


Extended Langmuir Model (85% CH4, 15% CO2)
Gas Content (SCF/ton)
Pressure (PSI)
0
100
200
300
400
500
0
100
200
300
400
500
600
700
800
900
1000
Langmuir CH4
Langmuir CO2
Modeled CH4 (85%)
Modeled CO2 (15%)
Modeled CH4+CO2

USGS-PA-2-CN2

EXTENDED LANGMUIR MODEL (85% CH4 AND 15% CO2)
DRY ASH FREE BASIS (SCF/TON)

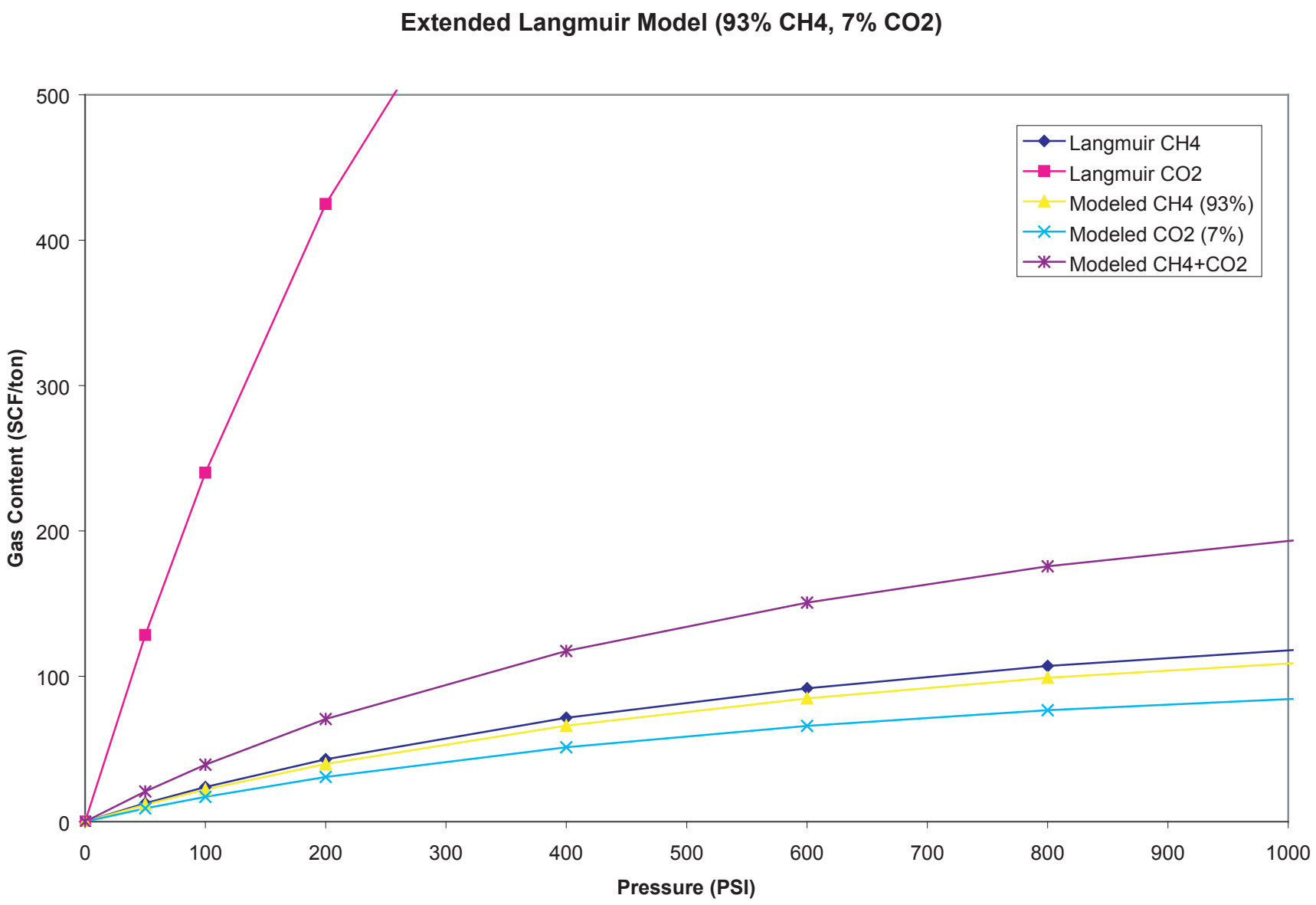
Pressure PSI	Langmuir CH4	Langmuir CO2	Modeled CH4 (85%)	Modeled C02 (15%)	Modeled CH4 +CO2
0	0	0	0	0	0
50	13	128	11	19	30
100	24	240	20	37	57
200	43	425	36	66	102
400	71	691	60	109	169
600	92	873	77	140	217
800	107	1005	90	163	253
1200	128	1185	107	195	302
1600	143	1301	119	216	335
Langmuir Volume (SCF/ton)	214.026	1844.985	177	321	498
Langmuir Pressure (PSI)	798.925	668.481	776	776	776


Extended Langmuir Model (90% CH4, 10% CO2)
Gas Content (SCF/ton)
Pressure (PSI)
0
100
200
300
400
500
600
700
800
900
1000
Langmuir CH4
Langmuir CO2
Modeled CH4 (90%)
Modeled CO2 (10%)
Modeled CH4+CO2

USGS-PA-2-CN2

EXTENDED LANGMUIR MODEL (90% CH4 AND 10% CO2)
DRY ASH FREE BASIS (SCF/TON)

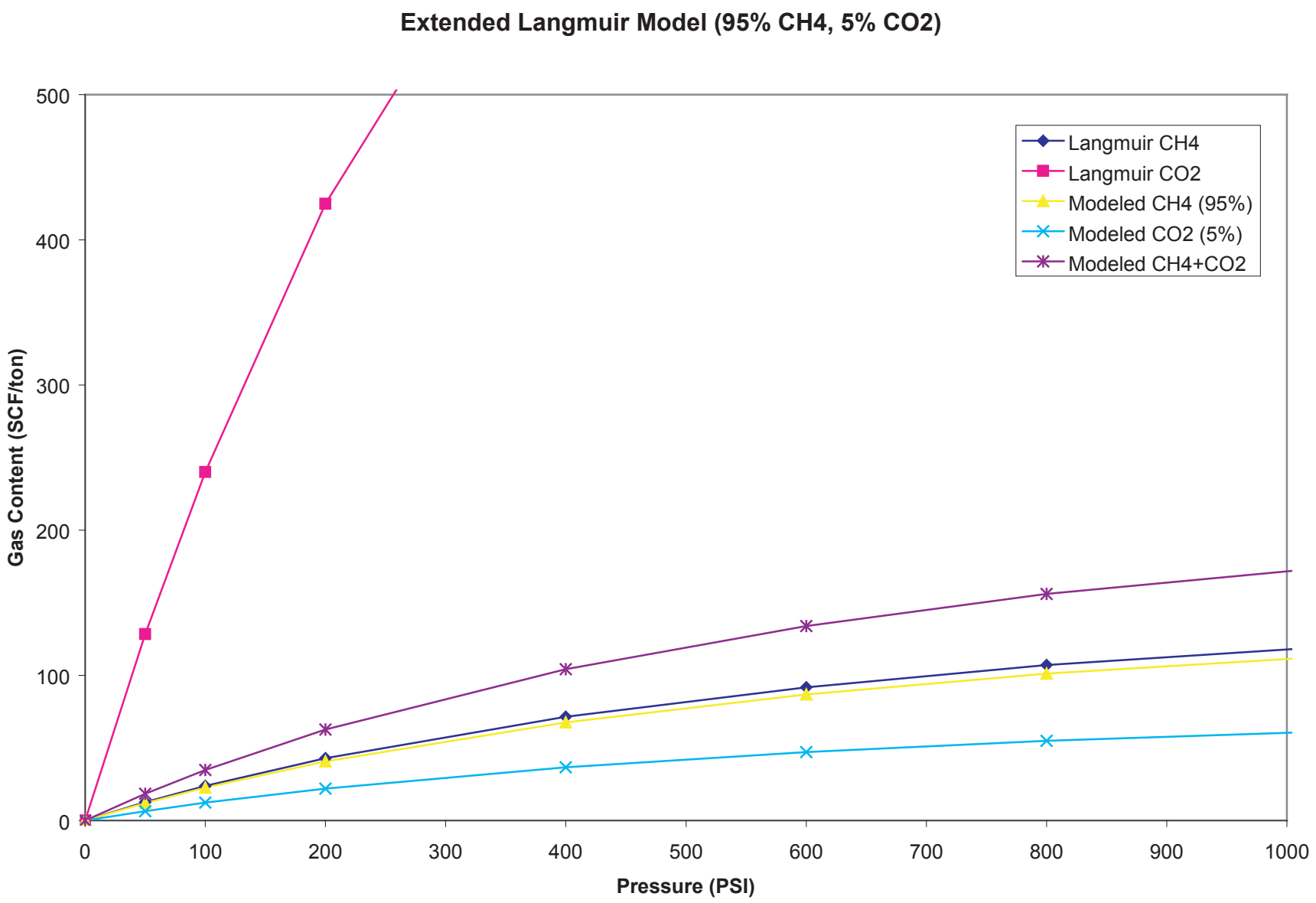
Pressure PSI	Langmuir CH4	Langmuir CO2	Modeled CH4 (90%)	Modeled C02 (10%)	Modeled CH4 +CO2
0	0	0	0	0	0
50	13	128	11	13	24
100	24	240	21	24	46
200	43	425	38	44	82
400	71	691	64	73	137
600	92	873	82	94	176
800	107	1005	95	109	205
1200	128	1185	114	131	245
1600	143	1301	127	145	272
Langmuir Volume (SCF/ton)	214.026	1844.985	189	216	405
Langmuir Pressure (PSI)	798.925	668.481	784	784	784


Extended Langmuir Model (93% CH4, 7% CO2)
Gas Content (SCF/ton)
Pressure (PSI)
0
100
200
300
400
500
600
700
800
900
1000
Langmuir CH4
Langmuir CO2
Modeled CH4 (93%)
Modeled CO2 (7%)
Modeled CH4+CO2

USGS-PA-2-CN2

EXTENDED LANGMUIR MODEL (93% CH4 AND 7% CO2)
DRY ASH FREE BASIS (SCF/TON)

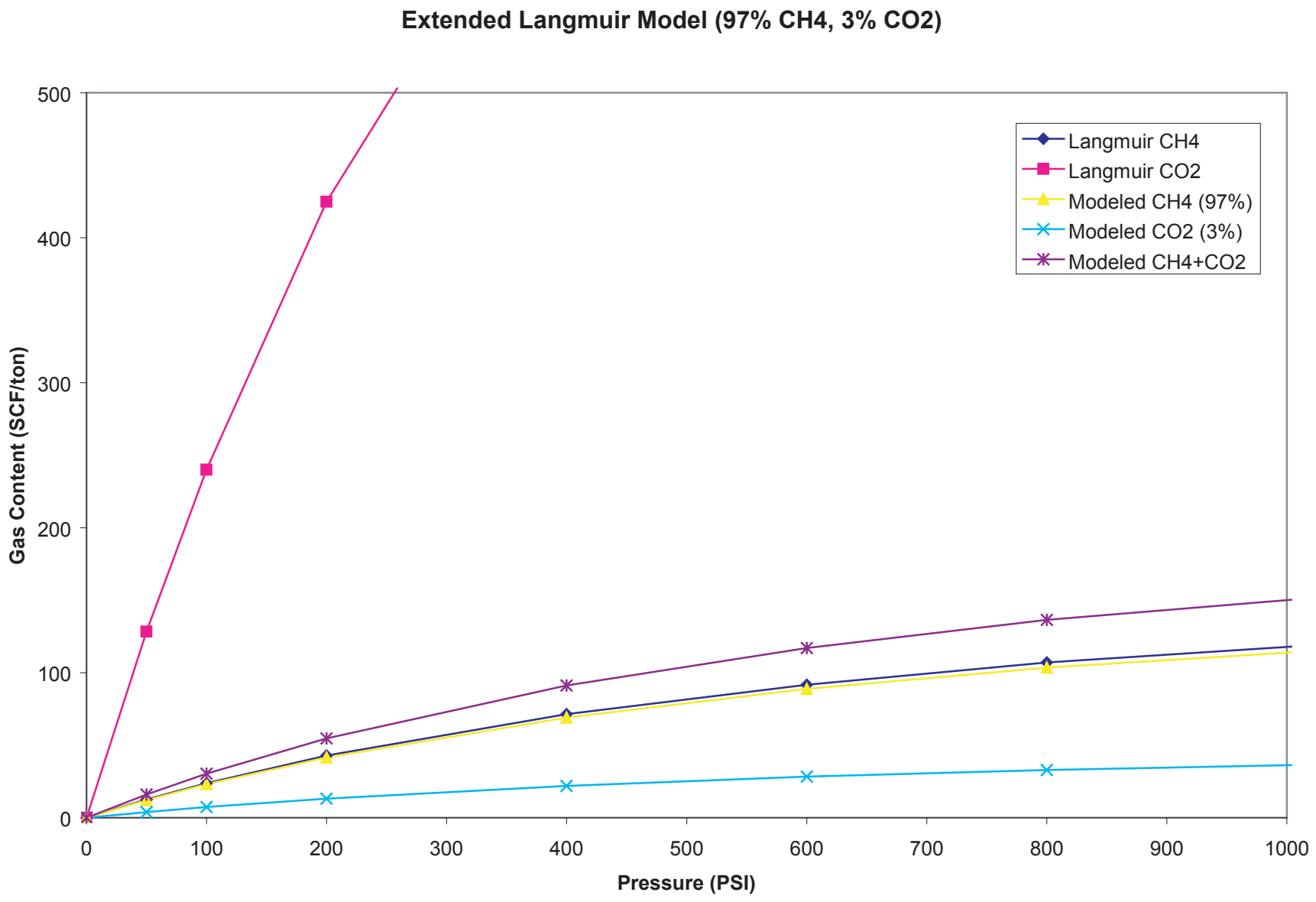
Pressure PSI	Langmuir CH4	Langmuir CO2	Modeled CH4 (93%)	Modeled C02 (7%)	Modeled CH4 +CO2
0	0	0	0	0	0
50	13	128	12	9	21
100	24	240	22	17	39
200	43	425	40	31	71
400	71	691	66	51	117
600	92	873	85	66	151
800	107	1005	99	77	176
1200	128	1185	119	92	210
1600	143	1301	132	102	234
Langmuir Volume (SCF/ton)	214.026	1844.985	196	152	349
Langmuir Pressure (PSI)	798.925	668.481	788	788	788


Extended Langmuir Model (95% CH4, 5% CO2)
Gas Content (SCF/ton)
Pressure (PSI)
0
100
200
300
400
500
600
700
800
900
1000
Langmuir CH4
Langmuir CO2
Modeled CH4 (95%)
Modeled CO2 (5%)
Modeled CH4+CO2

USGS-PA-2-CN2

EXTENDED LANGMUIR MODEL (95% CH4 AND 5% CO2)
DRY ASH FREE BASIS (SCF/TON)

Pressure PSI	Langmuir CH4	Langmuir CO2	Modeled CH4 (95%)	Modeled C02 (5%)	Modeled CH4 +CO2
0	0	0	0	0	0
50	13	128	12	6	18
100	24	240	23	12	35
200	43	425	41	22	63
400	71	691	68	37	104
600	92	873	87	47	134
800	107	1005	101	55	156
1200	128	1185	121	66	187
1600	143	1301	135	73	208
Langmuir Volume (SCF/ton)	214.026	1844.985	201	109	311
Langmuir Pressure (PSI)	798.925	668.481	791	791	791


Extended Langmuir Model (97% CH4, 3% CO2)
Gas Content (SCF/ton)
Pressure (PSI)
0
100
200
300
400
500
600
700
800
900
1000
Langmuir CH4
Langmuir CO2
Modeled CH4 (97%)
Modeled CO2 (3%)
Modeled CH4+CO2

USGS-PA-2-CN2

EXTENDED LANGMUIR MODEL (97% CH4 AND 3% CO2)
DRY ASH FREE BASIS (SCF/TON)

Pressure PSI	Langmuir CH4	Langmuir CO2	Modeled CH4 (97%)	Modeled C02 (3%)	Modeled CH4 +CO2
0	0	0	0	0	0
50	13	128	12	4	16
100	24	240	23	7	30
200	43	425	42	13	55
400	71	691	69	22	91
600	92	873	89	28	117
800	107	1005	104	33	137
1200	128	1185	124	40	164
1600	143	1301	138	44	182
Langmuir Volume (SCF/ton)	214.026	1844.985	206	66	272
Langmuir Pressure (PSI)	798.925	668.481	794	794	794

Appendix 5

Gas analysis of sample USGS-PA-2-CN13

Appendix 5 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

[1]U.S. Geological Survey, Reston, VA
[2]U.S. Geological Survey, Denver, CO

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U.S. Department of the Interior
U.S. Geological Survey

ANALYSIS REPORT

FAXED 1150 7/9/99

Lab #: 21397 Job #: 1888
Sample Name/Number: 99-13 PA-2
Company: U.S. Geological Survey, Denver CO
Date Sampled: / /
Container: Cylinder
Field/Site Name: Wilcox CBM
Location:
Formation/Depth:
Sampling Point:
Date Received: 7/08/1999 Date Reported: 7/09/1999

Component	Chemical mol. %	Delta C-13 per mil	Delta D per mil	C-14 conc. pMC	Tritium TU
Carbon Monoxide	nd				
Helium	nd				
Hydrogen	nd				
Argon	0.63				
Oxygen	7.25				
Nitrogen	75.22				
Carbon Dioxide	0.49	-11.22	.		
Methane	16.37	-55.82	-194.6		
Ethane	0.0097				
Ethylene	nd				
Propane	0.0011				
Iso-butane	nd				
N-butane	0.0021				
Iso-pentane	0.0020				
N-pentane	0.0020				
Hexanes +	0.026				

Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 167
Specific gravity, calculated: 0.916

nd = not detected. na = not analyzed. Isotopic composition of carbon is relative to VPDB. Isotopic composition of hydrogen is relative to VSMOW. Calcualtions for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100 percent. Mol. % is approximately equal to vol. %

ISOTECH Laboratories, Inc. 1308 Parkland Ct. Champaign, IL 61821 217/398-3490

Appendix 6

Drilling permit for boreholes USGS-PA-1 and USGS-PA-2

Appendix 6 *of*

Results of coalbed methane drilling in Panola County, Texas

Edited By Peter D. Warwick[1], John R. SanFilipo[1], Alex W. Karlsen[1], and Charles E. Barker[2]

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U.S. Department of the Interior
U.S. Geological Survey

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

In Reply Refer To:
MS 956

June 4, 1999

Mr. Timothy G. Walter
Railroad Commission of Texas
Surface Mining and Reclamation Division
1701 N. Congress Avenue
P.O.B. 12967
Austin, TX 78711-2967

Dear Tim,

Please find enclosed three copies of a "Notice of Plan to Conduct Coal Exploration Activities, " (Railroad Commission of Texas form SMRD-3C (04/97)). As indicated on the form, we plan to drill in Panola County starting about June 14, 1999. Thank you for sending us copies of the form. If you have any questions, please call me at (703) 648-6469.

Sincerely,

Peter D. Warwick
Geologist,
Eastern Energy Resources Team
pwarwick@usgs.gov

encl.
cc: EERS Chron file

RAILROAD COMMISSION OF TEXAS
SURFACE MINING AND RECLAMATION DIVISION

1701 N. CONGRESS CAPITOL STATION - P.O. BOX 12967 AUSTIN, TEXAS 78711-2967

NOTICE OF PLAN TO CONDUCT COAL EXPLORATION ACTIVITIES IN WHICH 250 TONS OR LESS WILL BE REMOVED

All items should be addressed completely. File in triplicate with the Director of the Surface Mining and Reclamation Division.

I. Name of Registrant Peter D. Warwick

Mailing Address U.S. Geological Survey, MS 956
(Street or P.O. Box)

Reston	Virginia	20192	703-648-6469
(City)	(State)	(Zip Code)	(Telephone)

II. Name of Operator Lloyd E. Morris, Texas A&M University

Mailing Address Department of Geology & Geophysics, 109 Halbouty Bldg
(Street or P.O. Box)

College Station	Texas	77843-3115	409-845-0119
(City)	(State)	(Zip Code)	(Telephone)

III. Required Information (16 *Texas Admin. Code* §12.110)

A. Describe the basis upon which the registrant and operator claim the right to enter the exploration area for the purpose of conducting exploration and reclamation activities. This description should state the type(s) of exploration agreement (i.e., lease, letter, etc.) provided by the surface owner. This information may be withheld from public files if requested pursuant to §12.115.

We have the surface owners written permission.

B. Exploration for: [ ] Coal [X] Lignite
Amount to be removed: about 0.02 tons

C. Provide the geographic location, by description and map, showing the boundaries of the area, referred to in part III. A., in which the company intends to explore.

Panola County, TX, about 15 miles east of Carthage (Lat. 31° 58'55"N, Long. 94°09'07"W) and about 15 miles southeast of Carthage (Lat. 32° 07'58"N Long. 94°03'06"W)

SMRD-3C (04/97)

Map scale must be 1:24,000 or larger. The name of the county(s) in which exploration activities are to occur should be provided in the description.

See attached 7.5' USGS maps.

D. Describe the method of exploration to be used (i.e., drill holes, pits or trenches, etc.), and the equipment used.

Two 500 ft drill holes are planned using a Mobile B-53 Drilling Rig.

E. Describe the extent of anticipated exploration, including the proposed depth of penetration and the estimated number of acres that will be disturbed by exploration activities.

Two 500 ft drill holes are planned, portable mud pits will be used, and less than 0.125 acres will be disturbed at each site.

F. Indicate the approximate time period during which exploration activities will be performed. Permits are issued for a period of one (1) year, and are renewable by application to the Commission.

Drilling activities will take place from June 12 to July 15, 1999

IV. Reclamation (16 *Texas Admin. Code* §12.110)

A. Identify plans for reclamation activities, including backfilling, grading, and revegetation methods to be used, and plans for disposal of any toxic or radioactive material.

The site will be cleaned after drilling is complete to remove excess drilling mud; no backfilling or grading will be necessary because we are using portable mud pits, no revegetation will be required. There will be no toxic or radioactive materials left at the site.

B. Describe plans necessary for the protection of surface and underground water in the exploration and adjacent affected areas.

The surface and underground water in the surface and adjacent areas will not be affected. The holes will be plugged with "Hole Plug" ~~gel~~ Bentonite and concrete plugs set ~~3 ft~~ 3' to 10' below the ground surface.

I,(name) Peter D. Warwick, (title: Geologist) state that I have knowledge of the facts herein set forth and that the same are true and correct to the best of my knowledge and belief. I further state that to the best of my knowledge and belief, the project for which application is made will not in any way violate any law, rule, ordinance, or decree of any duly authorized governmental entity having jurisdiction.

Date: 6-4-99 Signature: Peter D. Warwick (Registrant)

Date: 6-4-99 Signature: Lloyd Morris (Operator)

USGS-PA-1
UTM 15N
3,555,490 m N
400,793 m E

INTERIOR-GEOLOGICAL SURVEY, RESTON, VIRGINIA-1983

:24 000

ES 5000 6000 7000 8000 9000 10 000

T TERS 1 2

RS 1000 2000

RVAL 10 FEET

AL MAP ACCURACY STANDARDS
RVEY, DENVER, COLORADO 80225
RGINIA 22092

QUADRANGLE LOCATION

1	2	3	1 De Berry 2 Panola 3 Spring Ridge 4 River Hill 5 Keatchie 6 Old Center 7 Logan 8 Longstreet
4		5	
6	7	8	

ADJOINING 7.5' QUADRANGLE NAMES
3294-114

ROAD LEGEND

Improved Road . . . . . .
Unimproved Road . . . . . .
Trail . . . . . .

Interstate Route U.S. Route State Route

OLD PANOLA, TEXAS-LOUISIANA

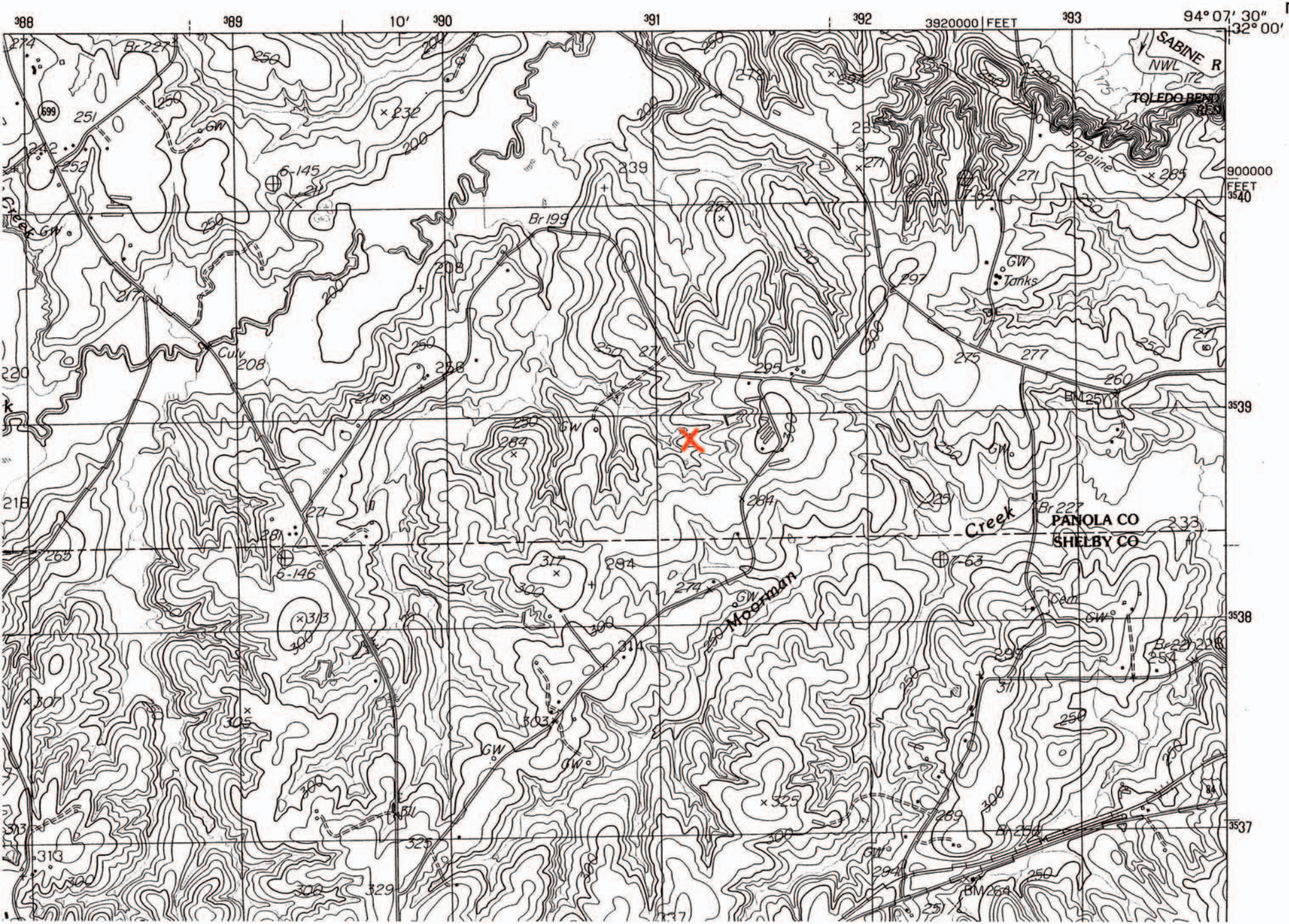
PROVISIONAL EDITION 1983

32094-B1-TF-024

LD PANOLA
D-607-53431-1 TX 024
TF
9 780607 534313

USGS-PA-2
UTM Zone 15N
3,553,888 m N
391,156 m E

TENAHA EAST QUADRANGLE
TEXAS
7.5 MINUTE SERIES (TOPOGRAPHIC)



TONY GARZA, *CHAIRMAN*
CHARLES R. MATTHEWS, *COMMISSIONER*
MICHAEL L. WILLIAMS, *COMMISSIONER*

MELVIN B. HODGKISS, P.E., *DIRECTOR*

RAILROAD COMMISSION OF TEXAS

SURFACE MINING AND RECLAMATION DIVISION

June 11, 1999

Peter D. Warwick, Geologist
U.S. Geological Survey
Eastern Energy Resources Team
MS 956
Reston, Virginia 20192

RE: Coal Exploration Registration No. 328

Dear Mr. Warwick:

Coal Exploration Registration No. 328 has been assigned to the application received on June 7, 1999. Please refer to Exploration Registration No. 328 in future correspondence regarding this site. This notice expires on June 10, 2000.

Holes drilled to a depth not exceeding 500 feet are addressed in this notice. Separation between the lowest lignite seam and the top of any useable aquifers is necessary. Your proposal to plug all holes with Baroid's bentonite HOLEPLUG™ from total depth up to 13 feet below the ground surface, provided it is emplaced via downhole tubing, is satisfactory. In addition as proposed, all holes shall also have a cement surface plug placed at a depth from 3 to 13 feet below the ground surface and the surface area reclaimed.

Pursuant to requirements of §§12.331, 12.332, and 12.333, any hole not already identified in the application that is not plugged immediately or is cased for use as a monitoring well, test well, or piezometer well, must be identified on a map or by State Plane coordinates, and the information promptly submitted to our office. Well depth and completion information, and measures taken for marking and protecting each well, must also be provided.

This registration must be renewed annually until all wells are either properly plugged and abandoned, or are transferred to the landowner with Commission approval. If a valid surface mining permit for the area is issued by the Commission, the drilling and plugging requirements contained in the approved permit document will also apply.

The Commission's Tyler Field Office must be notified at (903) 595-5501 prior to commencing any drilling and plugging activities. Should you have any questions concerning this registration, please contact Mr. Timothy Walter at (512) 463-7243.

Sincerely,

Melvin B. Hodgkiss

Melvin B. Hodgkiss, Director
Surface Mining and Reclamation Division

MBH/TGW/flj
File Reference No. 199915802

Appendix 7

Raw Digital Files

(Please note: raw digital data files associated with this chapter are accessible in the PDF version of this report or directly from the CD-ROM)

Appendix 7 *of*

Results of coalbed methane drilling in Panola County, Texas

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U.S. Department of the Interior
U.S. Geological Survey

Links to Raw Digital Files

(Click on the tabbed links below or bookmarks to the left to open the associated file)

Coal Chemistry (Excel format)

USGS-PA-1 & USGS-PA-2 Proximate/Ultimate Data
USGS-PA-1 & USGS-PA-2 Trace Element Data

Methane Desorption (Excel format)

USGS-PA-2-CN1
USGS-PA-2-CN2
USGS-PA-2-CN3
USGS-PA-2-CN4
USGS-PA-2-CN5
USGS-PA-2-CN6
USGS-PA-2-CN7
USGS-PA-2-CN8
USGS-PA-2-CN9
USGS-PA-2-CN11
USGS-PA-2-CN12
USGS-PA-2-CN13
USGS-PA-2-CN14
USGS-PA-2-CN15
USGS-PA-2-CN16
USGS-PA-2-CN17

Methane Adsorption Isotherms (Excel format)

USGS-PA-2-CN2
USGS-PA-2-CN6
USGS-PA-2-CN12
USGS-PA-2-CN16

Carbon Dioxide Adsorption Isotherms (Excel format)

USGS-PA-2_CN2

Extended Langmuir Modeling (Excel format)

USGS-PA-2_CN2

Petrographic Data (Excel format)

USGS-PA-2

Core LAS Files (ASCII format)

USGS-PA-1
USGS-PA-2