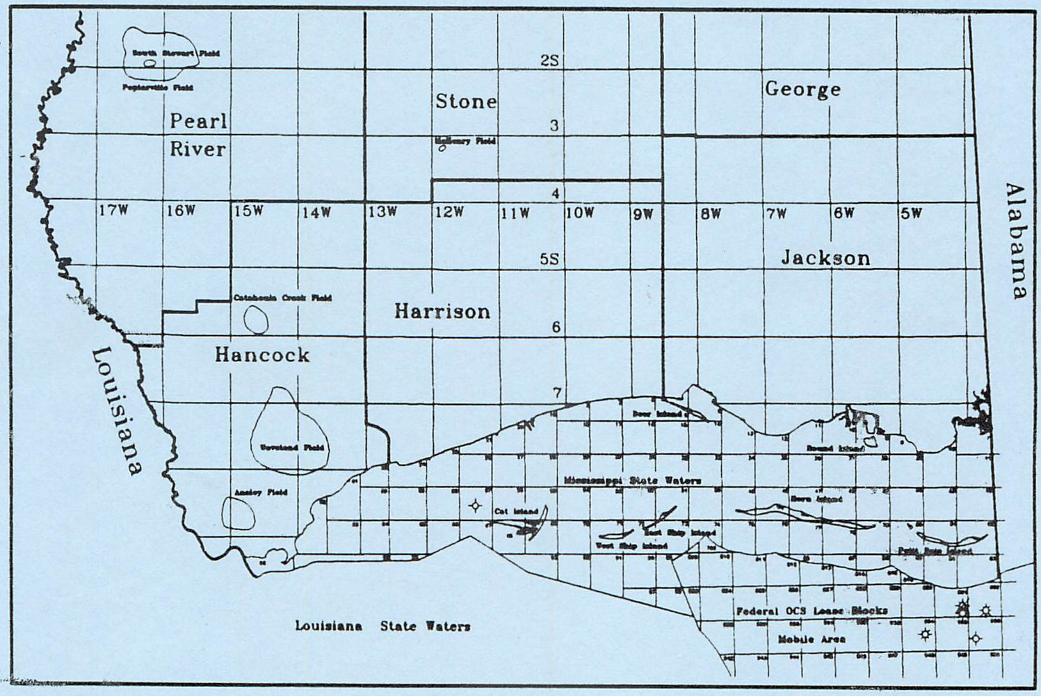
REGIONAL JURASSIC GEOLOGIC FRAMEWORK AND PETROLEUM GEOLOGY, COASTAL MISSISSIPPI AND ADJACENT OFFSHORE STATE AND FEDERAL WATERS

Rick L. Ericksen and Stanley C. Thieling

OPEN-FILE REPORT 22



Mississippi Department of Environmental Quality
Office of Geology
S. Cragin Knox, Director

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Energy Section

Energy and Coastal Division

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by

Rick L. Ericksen and Stanley C. Thieling

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TABLE OF CONTENTS

List of Tables, Figures, and Plates

Tables

Figures

Plates

REGIONAL JURASSIC GEOLOGIC FRAMEWORK AND PETROLEUM GEOLOGY, COASTAL MISSISSIPPI AND ADJACENT OFFSHORE STATE AND FEDERAL WATERS

ABSTRACT

Mississippi's coastal counties and adjacent state waters may contain large reserves of hydrocarbons in Jurassic-age sediments of the Cotton Valley, Haynesville, Smackover, and Norphlet formations. A geologic study was conducted to determine the composition and hydrocarbon potential of the Jurassic-age sediments encountered in the subsurface of the southern portion of onshore Mississippi and the adjacent offshore state and federal waters. This study found sediments favorable for the accumulation of hydrocarbons and hydrocarbon reservoirs over a large portion of the study area in Jurassic-age sediments. Because of limited data in the study area, the conclusions are the result of trend analysis and studies of petrophysical logs, well cuttings, core analyses, and a limited amount of seismic data which were obtained from companies and other entities that have drilled wells or have otherwise evaluated portions of the study area.

ACKNOWLEDGMENTS

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INTRODUCTION

The only commercial quantities of natural gas produced to date from Jurassic-age sediments of the Mississippi coastal plain are at Catahoula Creek Field, which is located on the south flank of the Wiggins Arch (Figure 1). Production from Catahoula Creek is from the Jurassic-age Cotton Valley Group. The discovery well for Catahoula Creek was the Hunt Energy Corporation, No. 1 Rhoda Lee Brown, completed on August 14, 1981. The No. 1 Brown well is located in section 28, Township 6 South, Range 15 West, Hancock County, Mississippi. The initial production rate on test for the discovery well was 7,030 MCFGPD, 48 BWPD, on a 30/64 inch choke and flowing tubing pressure of 6,549 p.s.i., from perforations in a lower Cotton Valley sandstone at 19,820 to 20,196 feet measured depths (Mississippi Geological Society, 1986). The gas stream contains 32 ppm H_2S and 4.8% CO_2 as reported to the Mississippi State Oil and Gas Board. Production from the field, which contained two producing wells on January 1, 1993, has reached a cumulative volume of 5.250 BCFG. The average pay thickness encountered at Catahoula Creek Field is 114 feet with 10 percent average porosity, 0.3 millidarcies average permeability, and bottom hole pressure of 16,297 p.s.i. There has been no other commercial production of hydrocarbons from Jurassic-age sediments in Mississippi's coastal counties or state waters.

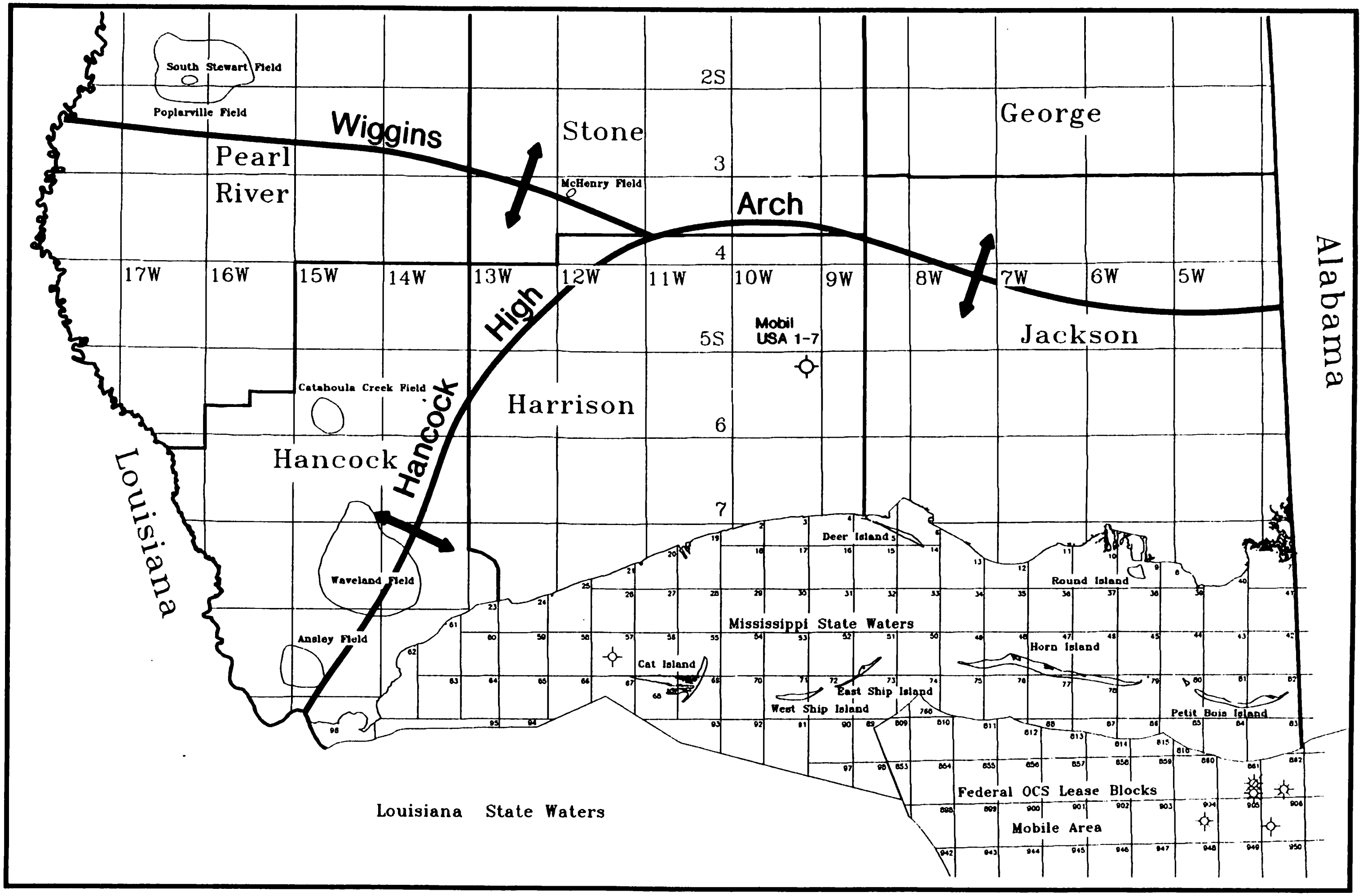

Figure 1. Structural features and oil and gas field location map.

Significant Jurassic-age Norphlet production has been encountered adjacent to Mississippi state waters on federal lease blocks OCS 861 862, and 904 (Figure 1). Chevron, U.S.A., Inc., established hydrocarbon production in blocks 861 and 862, and Unocal et al. in Block 904. The Unocal Exploration Corporation test well, the Mobile Block 904, OCS-G 5749, No. 1 (Figure 1), was the last of the three blocks to test commercially significant volumes of hydrocarbons. The Unocal well was drilled in approximately 60 feet of water in federal waters of the Mobile Area, approximately four and one-half miles from Mississippi's three mile state waters boundary. Unocal reported a maximum flow rate of 97.6 MMCFGPD through a 42/62 inch choke. The well was drilled to a total depth of 22,400 feet, penetrating a reported 185 feet of gas pay in the Norphlet, with perforations from 22,130 to 22,290 feet, measured depth. This well had the highest natural gas flow rate from the Norphlet reported to date in the Mobile OCS area and also one of the highest recorded for the entire Gulf of Mexico producing area (Southeastern Oil Review, 1992).

The Mobile Block 904, OCS-G 5749 well is roughly four miles west-southwest of an earlier Chevron test well located in OCS Mobile Block 861, which is less than two miles south of Mississippi's state waters. The Block 861 well encountered high pressures while drilling in the Norphlet Formation. Due to difficulties, the well was shut in and a reported underground blowout occurred, i.e., high-pressure formation fluid and natural gas from the Norphlet entered the well bore and escaped uphole into Miocene strata not protected by casing. This resulted in the Miocene sands being charged with the formation fluid (gas) from the Norphlet. To remediate this problem, Chevron drilled four shallow, relief wells and two deeper wells in an attempt to intersect the well bore of the out-of-control well. Before the completion of the deeper intercept wells and the shallow, pressure-relief wells, the original hole bridged over and further remediation efforts were canceled. A second Jurassic test well, the Chevron No. 8, OCS-G-5062-F, was drilled on the same block in approximately 51 feet of water, and reached a total depth of 22,500 feet, measured depth. Neither the perforation interval nor the initial potential of this well have been released. It is assumed that the well was completed in the same Norphlet sandstone that was encountered in the initial test well.

STRUCTURE AND STRATIGRAPHY

JURASSIC REGIONAL OVERVIEW

The Jurassic stratigraphic section of coastal Mississippi consists of over 5000 feet of clastics, evaporites and carbonates. Jurassic deposition in Mississippi was controlled by factors resulting from rifting and continental margin tectonics including differential basement movement, Louann Salt movement (Mink et al., 1987), and the presence of regional pre-Jurassic and Jurassic paleohighs.

The Jurassic section includes, from youngest to oldest, the Cotton Valley Group, the Haynesville Formation, the Buckner Anhydrite Member of the Haynesville Formation, the Smackover and Norphlet formations, the Pine Hill Anhydrite Member of the Louann Salt, the Louann Salt, and the Werner Formation (Figure 2). Underlying the Werner is the Jurassic to Triassic age Eagle Mills Formation, if present, or undifferentiated Paleozoic and Proterozoic "basement" rocks.

PRE-LOUANN SALT STRATA

BASEMENT STRATA

No wells are known to have penetrated the middle Jurassic Werner Formation or upper Triassic Eagle Mills Formation within the study area, although undifferentiated Paleozoic and Proterozoic basement rocks have been

MESOZOIC	CRETACEOUS	UPPER	SELMA GROUP		Chalk, massive chalk, shale
			EUTAW FORMATION		Sandstone, glauconitic sandstone, shale
			TUSCALOOSA GROUP	Upper	Sandstone with shale and claystone interbeds
				Marine	Shale with sandy streaks and thin sandstone beds
				Lower	Sandstone, thin to massive with shale interbeds
		LOWER	LOWER CRETACEOUS UNDIFFERENTIATED		Sandstone, fine to medium grained with traces of nodular limestone, thin anhydrite unit near middle
	?	?	?		
	JURASSIC	UPPER	COTTON VALLEY GROUP		Sandstone, fine to coarse grained, conglomeratic in part, with traces of metamorphic rock fragments, shale and sandy shale, thin limestones locally
			HAYNESVILLE FORMATION		Shale, thin anhydrite, dolomitic limestone, sandstone beds
			BUCKNER ANHYDRITE		Anhydrite, thin, silty, anhydritic and dolomitic shale beds
			SMACKOVER FORMATION		Limestone, microcrystalline to crystalline, oolitic in part, dolomitic in part, grades to dolomite; grades to shale and siltstone downdip
			NORPHLET FORMATION		Sandstone, fine grained, quartzose, calcareous in part; grades to shale and siltstone downdip
			PINE HILL ANHYDRITE		Anhydrite with salt interbeds where present
		MIDDLE	LOUANN SALT		Salt, massive with thin anhydrite and shale beds
			WERNER FORMATION		Anhydrite with sand and metamorphic rock fragments
	TRIASSIC		EAGLE MILLS FORMATION		Sandstone, arkosic with red shale

Figure 2. Generalized Mesozoic stratigraphic column for coastal Mississippi. (modified from Mink et al., 1987).

encountered in the subsurface in the Wiggins Arch area. The Paleozoic and Proterozoic basement strata consist of sedimentary, igneous, and metamorphic rocks over which the Mesozoic and Cenozoic strata were deposited (Mink et al., 1990).

EAGLE MILLS FORMATION

The Eagle Mills Formation, which has not been encountered in the study area but may underlie it, has been described as dark reddish brown, partly silty to sandy, calcareous to light gray mudstone, with occasional veins and nodules of calcite and nodular limestone and/or anhydrite (Shearer, 1938; Weeks, 1938; Scott et al., 1961; and Dinkins, 1968). Salvador (1987) and Tolson et al. (1983) have described it as a nonmarine, siliciclastic redbed sequence with related mafic dikes and sills that was deposited as alluvial fan, lacustrine, and/or delta plain and fluvial sediments.

WERNER FORMATION

The Werner Formation conformably overlies the Eagle Mills. The Werner Formation has not been definitively recognized in the regionally downdip area of southern Mississippi. Where present in Alabama, the Werner consists predominantly of white to pinkish gray anhydrite containing disseminated, frosted, rounded, medium-grained quartz sand, localized beds of salt, with occasional black, red and gray shales, terrigenous sandstones, metamorphic rock fragments, and conglomerates that occur in the basal portion of the formation (Hazzard et al., 1947; Dinkins, 1968; Mink et al., 1987).

LOUANN SALT

The Louann Salt conformably overlies the Werner Formation. Where the Werner is absent, the relationship is disconformable, with salt resting on either the Eagle Mills Formation or basement. The updip limit of the Louann Salt lies north of the study area. In the study area, the Louann Salt ranges in thickness from zero to several thousand feet (Tew et al., 1993) and has been described as massive, silty, sandy, white halite with some interlayered anhydrite (Imlay, 1940; Hazzard et al., 1947; Andrews, 1960; Tolson et al., 1983).

Louann Salt is present across the study area, as shown on Plate 1. Wells in the Norphlet producing area near Alabama state waters generally have tested only the top of the Norphlet and do not penetrate to salt. In MIssissippi Sound Block 57, Chevron penetrated approximately 200 feet of Louann Salt according to the mudlog of the well and a Chevron paleontology report (Table 1). While salt is present in the western portion of the study area at Catahoula Creek Field in the Hunt No. 1, Rhoda Lee Brown, Hunt does not believe that the field structure is salt induced, but rather is related to block faulting associated with the continental breakup of Pangea (Hunt Energy Corporation, internal report, courtesy of Petro-Hunt Corporation).

TABLE 1

CHEVRON U.S.A., INC.
NO. 1 MS 87-01-OS
MISSISSIPPI SOUND BLOCK 57

NANNOFOSSIL SUMMARY

Measured Depth (in feet)		Tops/Nannofossil/Period/Epoch/Age
(1)	4630	*Sphenolithus heteromorphus*
(2)	5110	*Helicosphaera ampliaperta*
(3)	5230	*Sphenolithus belemnos*
(4)	5710	Early Oligocene
(5)	5770	Upper Early Eocene
(6)	5830	Middle Early Eocene
(7)	6730	Late Paleocene
(8)	6990	Early Paleocene
(9)	8540	Top Cretaceous
(10)	8745	Campanian
(11)	9330	Santonian/Coniacian
(12)	9450	Turonian
(13)	15630	Aptian
(14)	15810	Aptian, *Nannoconus wassalli*
(15)	18660	Barremian, *Nannoconus steinmanni*
(16)	19590	Berriasian, *Nannoconus bronnimanni*

FORAMINIFERA SUMMARY

Measured Depth (in feet)		Tops/Foraminifera/Period/Epoch/Age
(1)	8750	Cretaceous, *Globotruncana* spp.
(2)	12710	Albian, *Coskinolinoides texana*
(3)	14600	Middle Albian, *Orbitolina texana*
(4)	16160	Early Aptian, *Choffatella decipiens*
(5)	19610	Cotton Valley
(6)	23350	? Smackover Equivalent
(7)	23470	? Pine Hill Anhydrite
(8)	23550	? Louann Salt

Information contained within this table modified from data supplied to the authors by Chevron, U.S.A., Inc.
Note that the tops contained herein are those of Chevron and may not necessarily agree with those of the authors.

PINE HILL ANHYDRITE MEMBER OF THE LOUANN SALT

The Pine Hill Anhydrite Member of the Louann Salt has not been previously recognized in the subsurface of Mississippi's state waters. In the samples recovered from the wellbore of the Chevron U.S.A., Inc., No. 1 State of Mississippi, Block 57 well there is an anhydrite approximately 55 feet thick which overlies the Louann Salt (Plate 1 and Figure 3-D). This anhydrite is stratigraphically equivalent to the Pine Hill Anhydrite Member of the Louann Salt and is classified as such in this report. The Pine Hill has been described as a white, finely crystalline anhydrite, with random reddish inclusions and occasional interbeds of salt (Shearer, 1938, and Raymond et al., 1988). The thickness ranges from zero to 100 feet (Raymond et al., 1988). The anhydrite encountered in the Chevron well is described on the mudlog as clear to white, crystalline to sucrosic, with some gray shale (uphole contamination ?).

An anomalously thick, pure anhydrite was penetrated from 19,840 feet to total depth of 20,290 feet (450 feet thick) in the Mobil, No. 1 USA 1-7, section 1, Township 6 South, Range 10 West, Harrison County (Figure 1). This anhydrite is below a normal Smackover and Norphlet section and is considered to be the Pine Hill. It is unlikely that this is part of the Werner due to its stratigraphic position and lack of salt in the anhydrite.

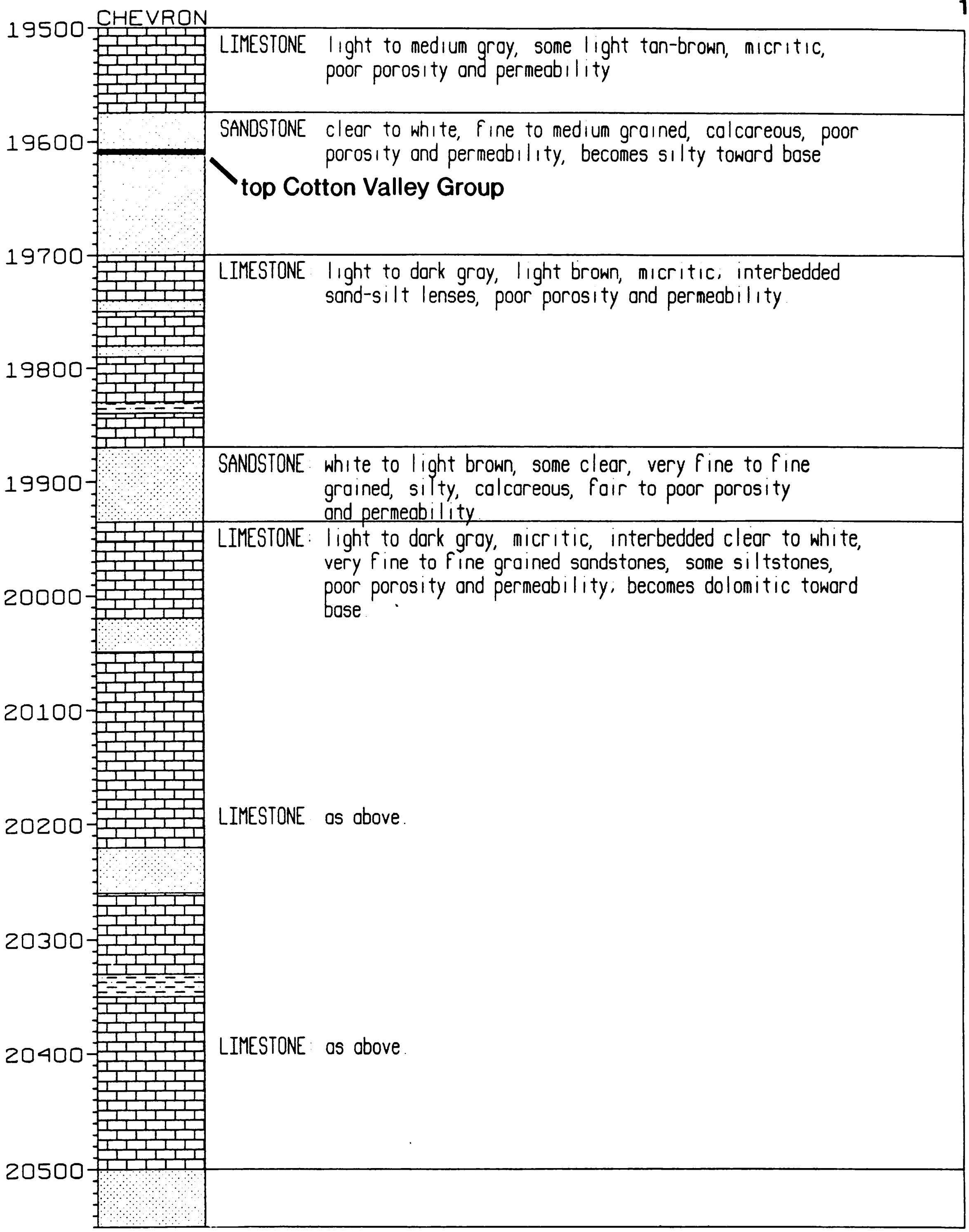

Figure 3-A. Lithologic log of Chevron USA Inc. No.1 MS87-01-OS, Mississippi Sound Block 57. All correlated tops by authors.

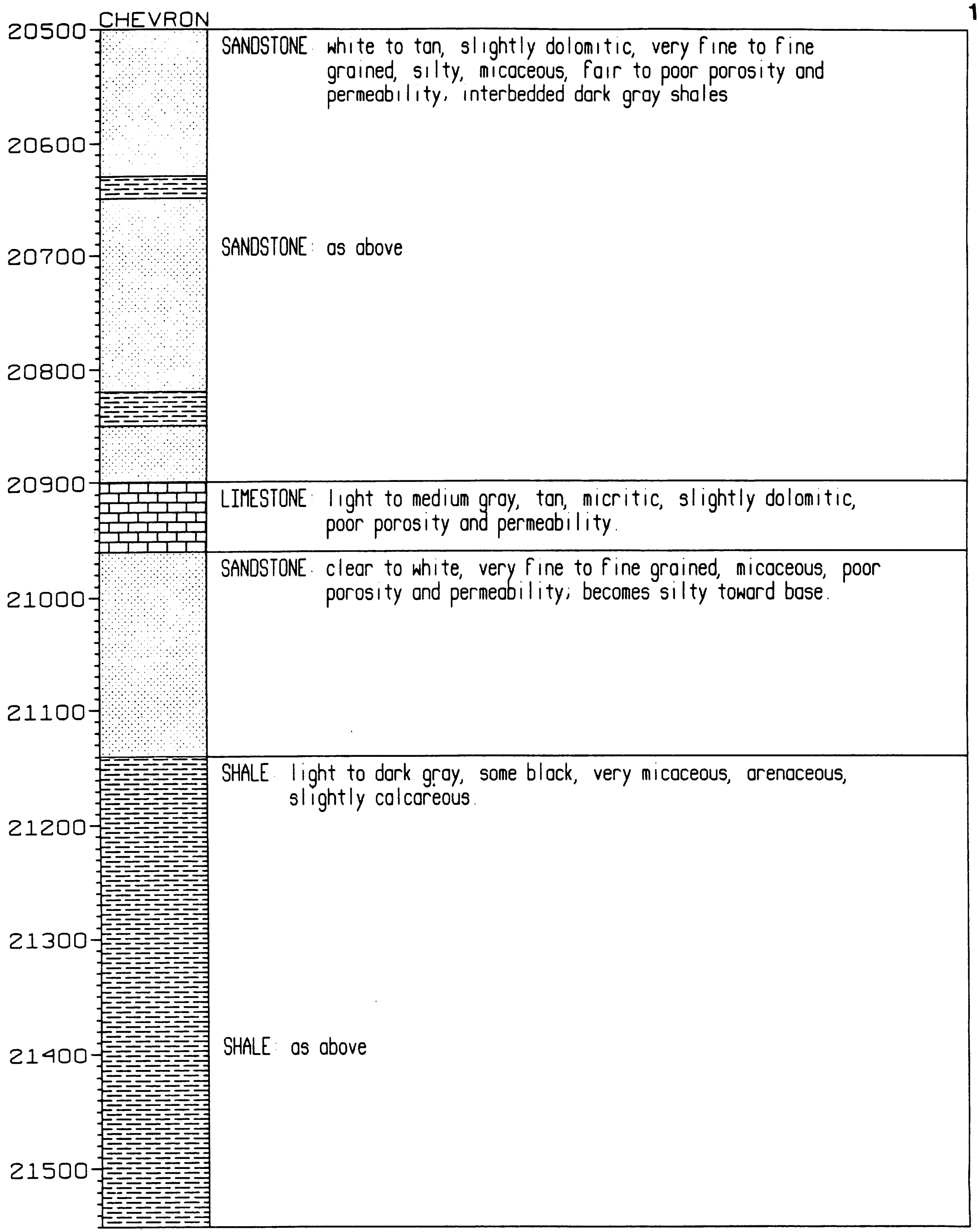

Figure 3-B. Lithologic log of Chevron USA Inc. No.1 MS87-01-OS, Mississippi Sound Block 57.

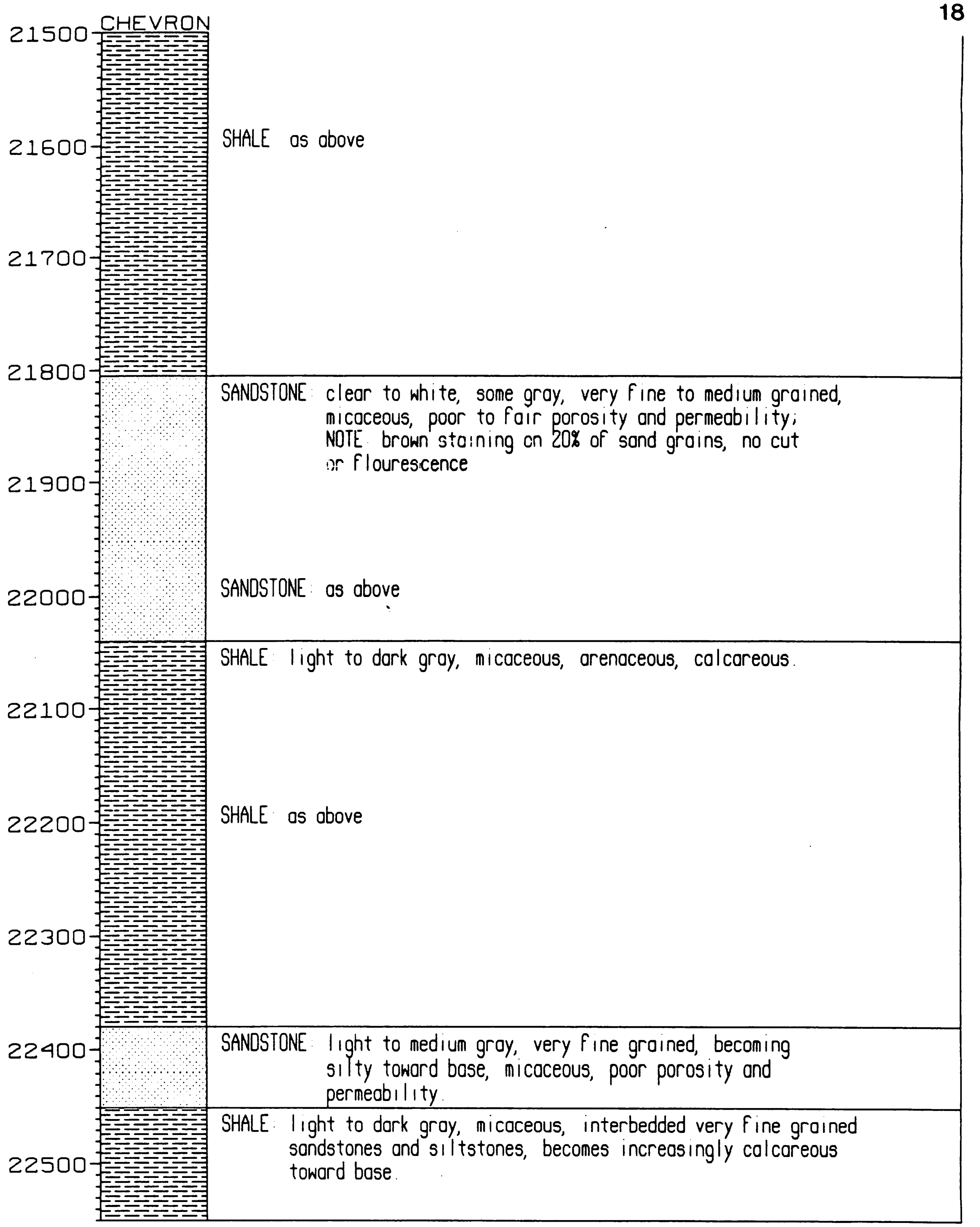

Figure 3-C. Lithologic log of Chevron USA Inc. No.1 MS87-01-OS, Mississippi Sound Block 57.

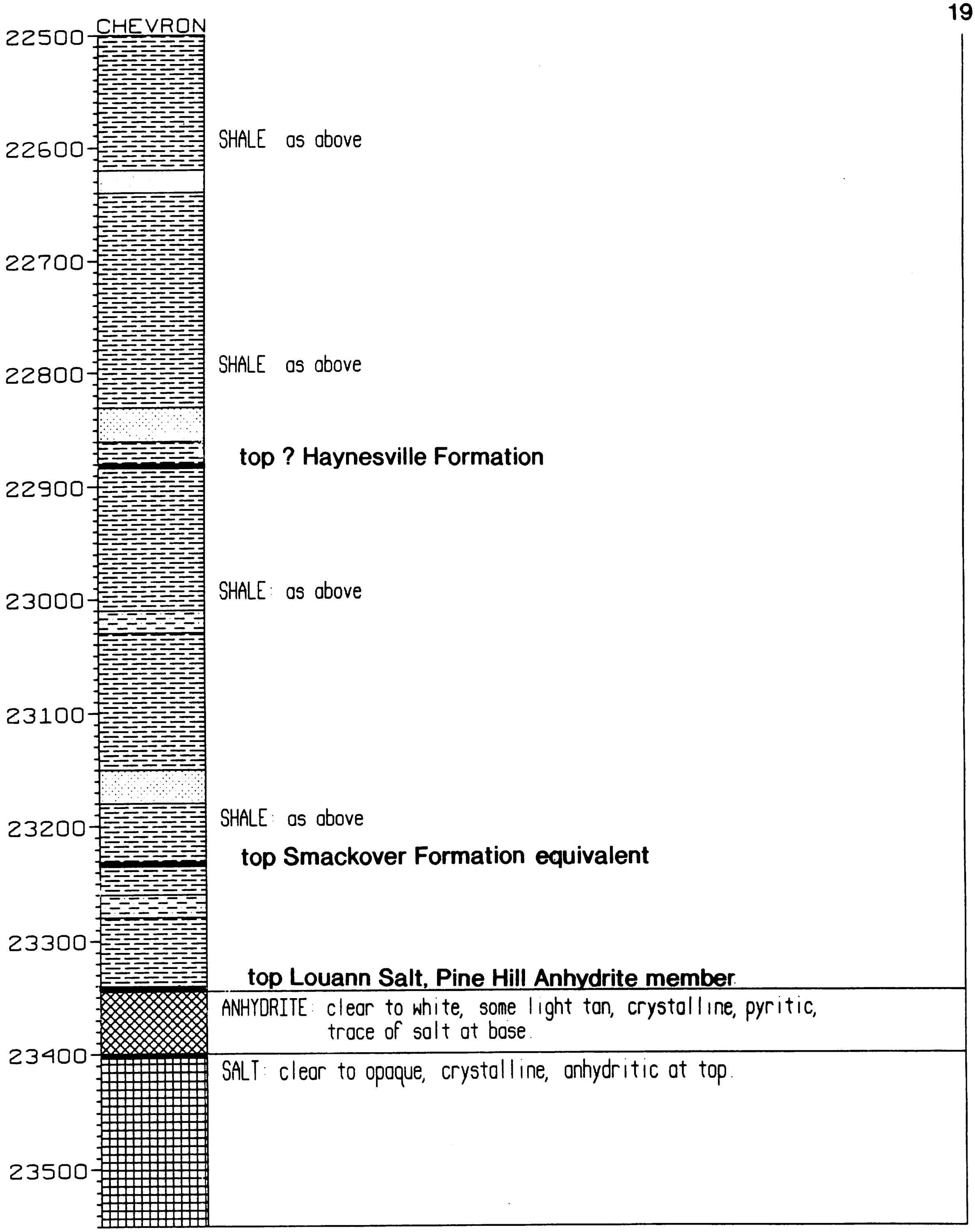

Figure 3-D. Lithologic log of Chevron USA Inc. No.1 MS87-01-OS, Mississippi Sound Block 57.

POST- LOUANN SALT STRATA

NORPHLET FORMATION

The Norphlet Formation of Late Jurassic age lies unconformably on the Louann Salt. The Norphlet appears to be present across all but the southwestern portion of the study area and the location where the Chevron U.S.A., Inc., Block 57 well was drilled (Figure 4). Within the study area, the Norphlet ranges in thickness from zero to 300 feet and has been described as consisting of a gray to brown, very fine to medium grained, well-sorted, subarkosic sandstone (Raymond et al., 1988).

An interval Chevron paleontologic report on the Block 57 well does not show the presence of the Norphlet at this location. If present it has undergone a change to a non-sandy facies. While the Norphlet is absent or is represented by a condensed section or changed to a deep-water shale facies in the south-central and southwest part of the study area, it is not present or recognizable in the western part in the Hunt No. 1 R.L. Brown at Catahoula Creek Field or in the Saga Petroleum No. 1 Seal, both of which drilled from carbonate directly into Louann Salt (Plate 1).

SMACKOVER FORMATION

The Smackover Formation is an olive gray to brownish gray to dark gray, partly dolomitic limestone and dolostone. In the upper part it is generally an oolitic,

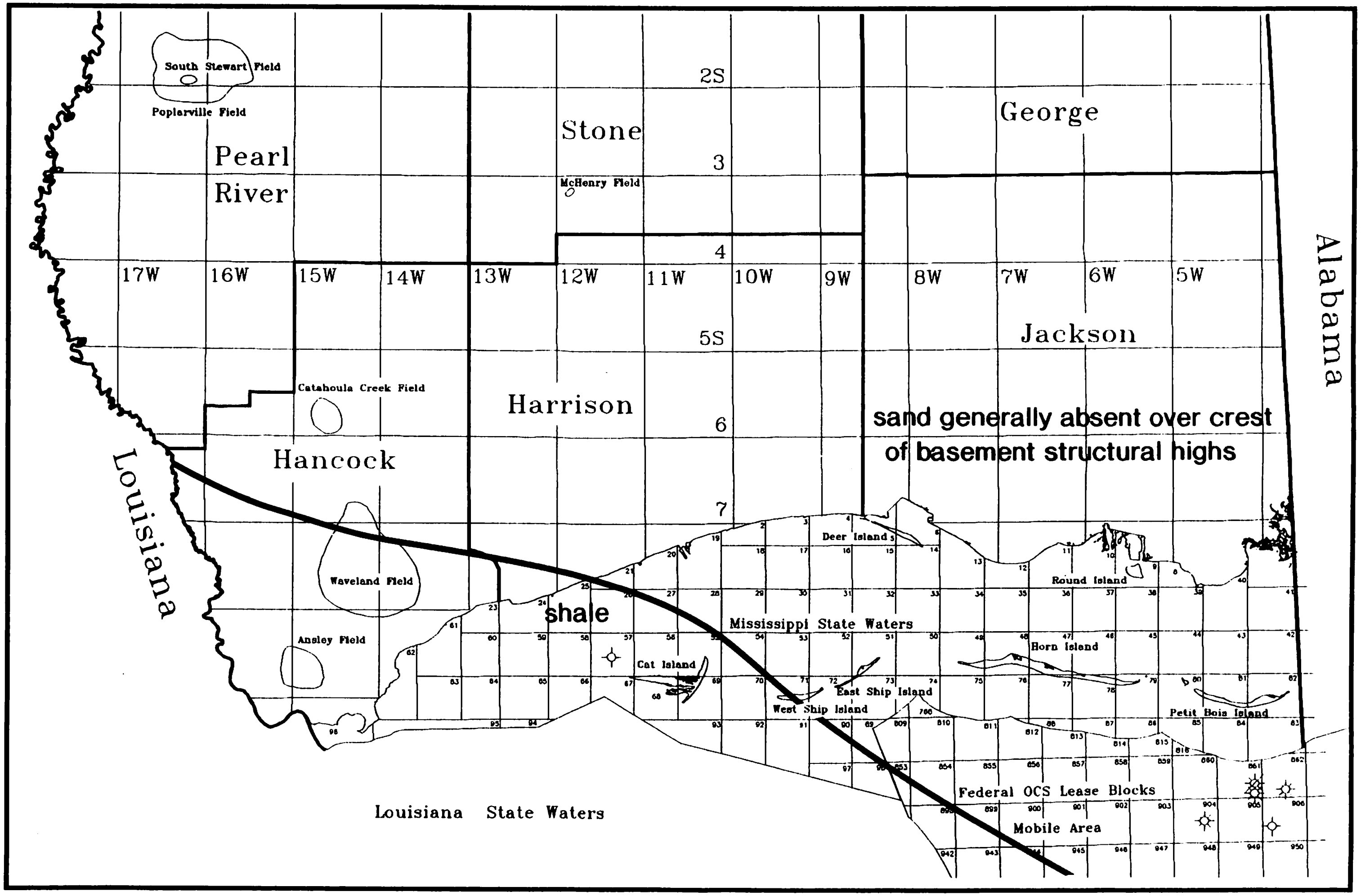

Figure 4. Norphlet Formation lithofacies map.

peloidal or oncolitic grainstone to wackestone. In the lower portion it is generally a dense, laminated mudstone, dolostone, or wackestone, with an overall thickness ranging from zero to more than 900 feet (William H. Moore, personal communication, 1993; Mancini and Benson, 1980). Within the area of this study, the Smackover appears to have undergone a major facies change that has been alluded to but not documented (Marzano et al., 1988). The Chevron U.S.A., Inc., No. 1 State of Mississippi, Block 57 well encountered strata which have been tentatively identified as Smackover from 23,230 to 23,350 feet. The Smackover Formation at this location consists of gray shale, probably deposited in deep water. The carbonate facies of the Smackover, by which it is most commonly recognized, is absent. There appears to be either a major facies change from a carbonate into a deep-water, very fine grained clastic shale sequence, or the well was not positioned correctly to encounter a normal, full Smackover section. If one assumes the latter explanation, the Chevron test well may have been drilled on or near the structural crest of a Smackover bald feature.

The Smackover was not reached in the deepest well in southern Hancock County, to the northwest of Mississippi Sound Block 57, the Hunt Energy, No. 1 Crosby in Waveland Field (Plate 1 and Figure 1). It is possible that the Smackover was reached in this well but not recognized as such. No carbonate facies is present in the lower part of this well. We are not aware of any paleontologic studies done at this depth in the Waveland Field area.

The Hunt Energy, No. 1 Rhoda Lee Brown at Catahoula Creek Field has a thick carbonate section from 20,770 to 23,190 feet. This section is interpreted as being combined Haynesville and Smackover. The top of Smackover correlation is questionable (Plate 1).

HAYNESVILLE FORMATION

The Haynesville has been described as a lithologic sequence of evaporites and associated sediments. Shales are red, silty, micaceous, and locally anhydritic. Sandstones are red to gray, fine- to coarse-grained, quartzose, partly calcareous, and partly conglomeratic. Anhydrite and salt occur as separate beds or as accessory minerals within the clastic sequence. Limestones are light gray to brownish gray, microcrystalline, and argillaceous to oolitic. Dolomite when encountered is dusky brown in color (Philpott and Hazzard, 1949; Goebel, 1950; Oxley et al., 1967; and Moore, 1984). The Haynesville ranges in thickness from 200 to 800 feet within the study area.

This typical Haynesville lithology is present on the east side of the study area in Chevron's Block 862 well (Plate 1) and in eastern Harrison County in the Mobil No. 1, USA 1-7 (Figure 1). The correlation in Mississippi Sound Block 57 is uncertain largely because the evaporites and carbonates are missing. It is also possible that the Haynesville is either faulted out, which is considered unlikely, or missing due to erosion or non-deposition.

The petroleum industry's conventional Haynesville correlation in Hancock County is based more on stratigraphic position and log character changes than on normal Haynesville lithology. A whole core from 23,733 to 23,765 feet in the Hunt, No. 1 Crosby (Plate 1) was described by Core Laboratories, Inc., as predominantly gray shale and siltstone with some very fine-grained sand (Table 2-B and 2-C). In north-central and central Hancock County the Haynesville correlations in the Saga Petroleum, No. 1 Seal and the Hunt, No. 1 Gordon Brown/Rhoda Lee Brown are questionable (Plate 1). In these wells the entire lower portion of the hole is predominantly carbonate.

BUCKNER MEMBER OF THE HAYNESVILLE FORMATION

The Buckner has been described as a massive, white anhydrite with finely crystalline dolomite laminations and intercalated, thin, dolomitic, anhydritic shale, fine grained sandstone beds, and bedded salt (Shearer, 1938). The thickness of the Buckner ranges from zero to nearly 80 feet within the study area.

HUNT ENERGY CORPORATION
NO. 1 CROSBY
WAVELAND FIELD
HANCOCK COUNTY, MISSISSIPPI

DATE: 2-3-81
FORMATION: SMACKOVER
DRLG. FLUID: WATER BASE MUD
LOCATION: SECTION: 22-8S-15W

FILE NO: 2106-0962C
LABORATORY: MOBILE, ALABAMA
ANALYSTS: DH-ML-JH
ELEVATION:

CONVENTIONAL CORE ANALYSIS

SMP NO.	DEPTH FEET	PERM MD HORZ(KA)	POR %	OIL% PORE	WTR% PORE	PROB PROD	DESCRIPTION	ODOR	FLU
	CORE NUMBER 3	22689-22749 CUT 60 FEET - RECOVERED 57 FEET							
	22689.0-93.0						NO ANALYSIS		
1	22693.0-94.0	<0.01	2.2	4.0	70.2	(6)	SD GRY VFG	NO	NO
	22694.0-95.5						NO ANALYSIS		
2	22695.5-96.3	<0.01	2.0	2.2	76.4	(6)	SD GRY VFG	NO	NO
	22696.3-04.0						NO ANALYSIS		
3	22704.0-04.5	<0.01	1.7	2.6	77.1	(6)	SD GRY VFG	NO	NO
	22704.5-07.0						NO ANALYSIS		
4	22707.0-08.0	<0.01	2.3	7.6	76.4	(6)	SD GRY VFG	NO	NO
	22708.0-25.5						NO ANALYSIS		
5	22725.5-26.0	<0.01	1.4	4.0	64.3	(6)	SD GRY VFG	NO	NO
	22726.0-28.0						NO ANALYSIS		
6	22728.0-29.0	<0.01	1.6	19.2	61.7	(6)	SD GRY VFG	NO	NO
7	22729.0-30.0	<0.01	1.8	3.6	72.7	(6)	SD GRY VFG	NO	NO
	22730.0-38.0						NO ANALYSIS		
8	22738.0-38.5	<0.01	2.2	14.6	69.2	(6)	SD GRY VFG	NO	NO
	22738.5-43.0						NO ANALYSIS		
9	22743.0-44.0	<0.01	1.4	6.1	61.4	(6)	SD GRY VFG	NO	NO
	22744.0-45.5						NO ANALYSIS		
10	22745.5-46.0	<0.01	1.3	3.5	62.3	(6)	SD GRY VFG	NO	NO
	22746.0-49.0	LOST CORE							
	CORE NUMBER 4	22749-22811 CUT 62 FEET - RECOVERED 62 FEET							
11	22749.0-50.0	<0.01	1.4	4.1	48.8	(6)	SD GRY VFG	NO	NO
12	22750.0-51.0	<0.01	2.3	2.8	56.8	(6)	SD GRY VFG SHY	NO	NO
	22751.0-11.0						NO ANALYSIS		

Table 2-A. Core analysis from the Hunt Energy No.1 Crosby, Waveland Field, Hancock County, Mississippi. Courtesy of Petro-Hunt Corporation

HUNT ENERGY CORPORATION DATE: 2-3-81 FILE NO: 2106-0962C
NO. 1 CROSBY FORMATION: SMACKOVER LABORATORY: MOBILE, ALABAMA

SMP NO	DEPTH FEET	PERM MD HORZ(KA)	POR %	OIL% PORE	WTR% PORE	PROB PROD	DESCRIPTION	ODOR	FLU
	CORE NUMBER 5	22811-22874	CUT 63 FEET - RECOVERED 63 FEET						
	22811.0-51.0						NO ANALYSIS		
13	22851.0-52.0	<0.01	1.2	5.5	66.1	(6)	SD GRY VFG	NO	NO
	22852.0-74.0						NO ANALYSIS		
	CORE NUMBER 6	23200-23260	CUT 60 FEET - RECOVERED 8 FEET						
	23200.0-08.0						NO ANALYSIS		
	23208.0-60.0	LOST CORE							
	CORE NUMBER 7	23733-23763	CUT 30 FEET - RECOVERED 25.5 FEET						
14	23733.0-34.0	<0.01	1.1	3.9	57.8	(6)	SILTSTONE GRY SHY	NO	NO
15	23734.0-35.0	<0.01	0.9	5.1	50.8	(6)	SILTSTONE GRY SHY	NO	NO
16	23735.0-36.0	<0.01	1.1	0.0	61.3	(6)	SD GRY VFG SHY	NO	NO
17	23736.0-37.0	<0.01	1.5	6.4	53.7	(6)	SD GRY VFG	NO	NO
18	23737.0-38.0	<0.01	0.8	0.0	57.3	(6)	SD GRY VFG	NO	NO
19	23738.0-39.0	<0.01	1.5	6.6	59.2	(6)	SD GRY VFG	NO	NO
20	23739.0-40.0	<0.01	1.1	4.1	61.9	(6)	SILTSTONE GRY SHY	NO	NO
21	23740.0-41.0	<0.01	1.2	0.0	53.6	(6)	SILTSTONE GRY SHY	NO	NO
22	23741.0-42.0	<0.01	0.8	5.6	56.0	(6)	SILTSTONE GRY SHY	NO	NO
23	23742.0-43.0	<0.01	1.3	3.3	50.1	(6)	SILTSTONE GRY SHY	NO	NO
24	23743.0-44.0	<0.01	0.8	0.0	51.9	(6)	SILTSTONE GRY SHY	NO	NO
25	23744.0-45.0	<0.01	1.1	4.1	62.1	(6)	SILTSTONE GRY SHY	NO	NO
26	23745.0-46.0	<0.01	1.0	6.3	62.8	(6)	SILTSTONE GRY SHY	NO	NO
27	23746.0-47.0	<0.01	0.7	0.0	65.4	(6)	SILTSTONE GRY SHY	NO	NO
28	23747.0-48.0	<0.01	1.3	3.4	68.2	(6)	SILTSTONE GRY SHY	NO	NO
29	23748.0-49.0	<0.01	1.0	4.4	65.5	(6)	SILTSTONE GRY SHY	NO	NO
30	23749.0-50.0	<0.01	1.0	4.5	67.3	(6)	SILTSTONE GRY SHY	NO	NO
31	23750.0-51.0	<0.01	0.8	5.3	53.4	(6)	SILTSTONE GRY SHY	NO	NO

Table 2-B. Core analysis from the Hunt Energy No.1 Crosby, Waveland Field, Hancock County, Mississippi
Courtesy of Petro-Hunt Corporation

HUNT ENERGY CORPORATION — DATE: 2-3-81 — FILE NO: 2106-0962C
NO. 1 CROSBY — FORMATION: SMACKOVER — LABORATORY: MOBILE, ALABAMA

SMP NO	DEPTH FEET	PERM MD HORZ(KA)	POR %	OIL% PORE	WTR% PORE	PROB PROD	DESCRIPTION	ODOR	FLU
32	23751.0-52.0	<0.01	1.8	9.1	66.8	(6)	SD GRY VFG	NO	NO
33	23752.0-53.0	<0.01	1.8	6.9	67.8	(6)	SD GRY VFG	NO	NO
34	23753.0-54.0	<0.01	1.5	6.0	62.8	(6)	SD GRY VFG	NO	NO
35	23754.0-55.0	<0.01	1.2	0.0	73.7	(6)	SD GRY VFG VSHY	NO	NO
36	23755.0-56.0	<0.01	0.8	5.8	57.7	(6)	SILTSTONE GRY SHY	NO	NO
37	23756.0-57.0	<0.01	1.0	4.2	63.4	(6)	SILTSTONE GRY SHY	NO	NO
38	23757.0-58.0	<0.01	0.9	0.0	69.3	(6)	SILTSTONE GRY SHY	NO	NO
39	23758.0-58.5	<0.01	1.4	7.9	67.9	(6)	SILTSTONE GRY SHY	NO	NO
	23758.5-63.0	LOST CORE							

(6) LOW PERMEABILITY

Table 2-C. Core analysis from the Hunt Energy No.1 Crosby, Waveland Field, Hancock County, Mississippi. Courtesy of Petro-Hunt Corporation

The Buckner Anhydrite is present as far west as section 1, Township 6 South, Range 10 West, Harrison County, in the Mobil No. 1 USA 1-7 (Plate 1). Examination of subsurface control indicates that the Buckner does not appear to be present to the southwest and west of this well.

COTTON VALLEY GROUP

The Cotton Valley consists of a series of alternating sandstones, shales, carbonates, and very minor amounts of anhydrite. The sands are moderate to pale red to a light gray, fine to very coarse grained to conglomeratic, angular to subrounded, quartzose, and friable. The mudstones and shales are red to gray, silty, sandy, micaceous, calcareous, and rarely fossiliferous, and may locally contain limestone nodules (Shearer, 1938; Oxley et al., 1967; Tolson, 1983; Moore, 1983; Forgotson, 1954). The Cotton Valley may locally contain chert, metamorphic rock fragments, and lignite. The Cotton Valley Group of Late Jurassic age conformably overlies the Haynesville Formation, and ranges in thickness from 1,100 to 5,000 feet within the study area.

As previously discussed, the Cotton Valley Group is the only productive Jurassic reservoir currently found within the study area. At Catahoula Creek Field the upper Cotton Valley consists of sandstone with interbedded limestone. The sandstones are very fine to silty quartz sand, with silica, dolomite, and/or calcite cement. The middle Cotton Valley consists of shales, limestones, and sandstones. Productive porosity in the middle Cotton Valley averages six to seven percent. The lower Cotton Valley is the hydrocarbon-productive interval and is a section approximately 400 to 500 feet thick of shales, siltstones, and sandstones. Porosity in the lower Cotton Valley varies from one to eighteen percent. Permeability is rather low and ranges from less than 0.01 to 0.5 millidarcies (Figure 5).

Figures 6-A through 6-E are core photographs of the lower Cotton Valley by Reservoirs, Inc. of the Hunt, No. 1 Gordon Brown. The Gordon Brown was perforated and was productive from the gross interval of 19,702 to 20,130 feet; a portion of this productive interval is represented in Figures 6-A through 6-E. Figure 5 is a lithologic description and summary of permeability and porosity determinations performed on the cores shown in the photographs (Figures 6-A through 6-E).

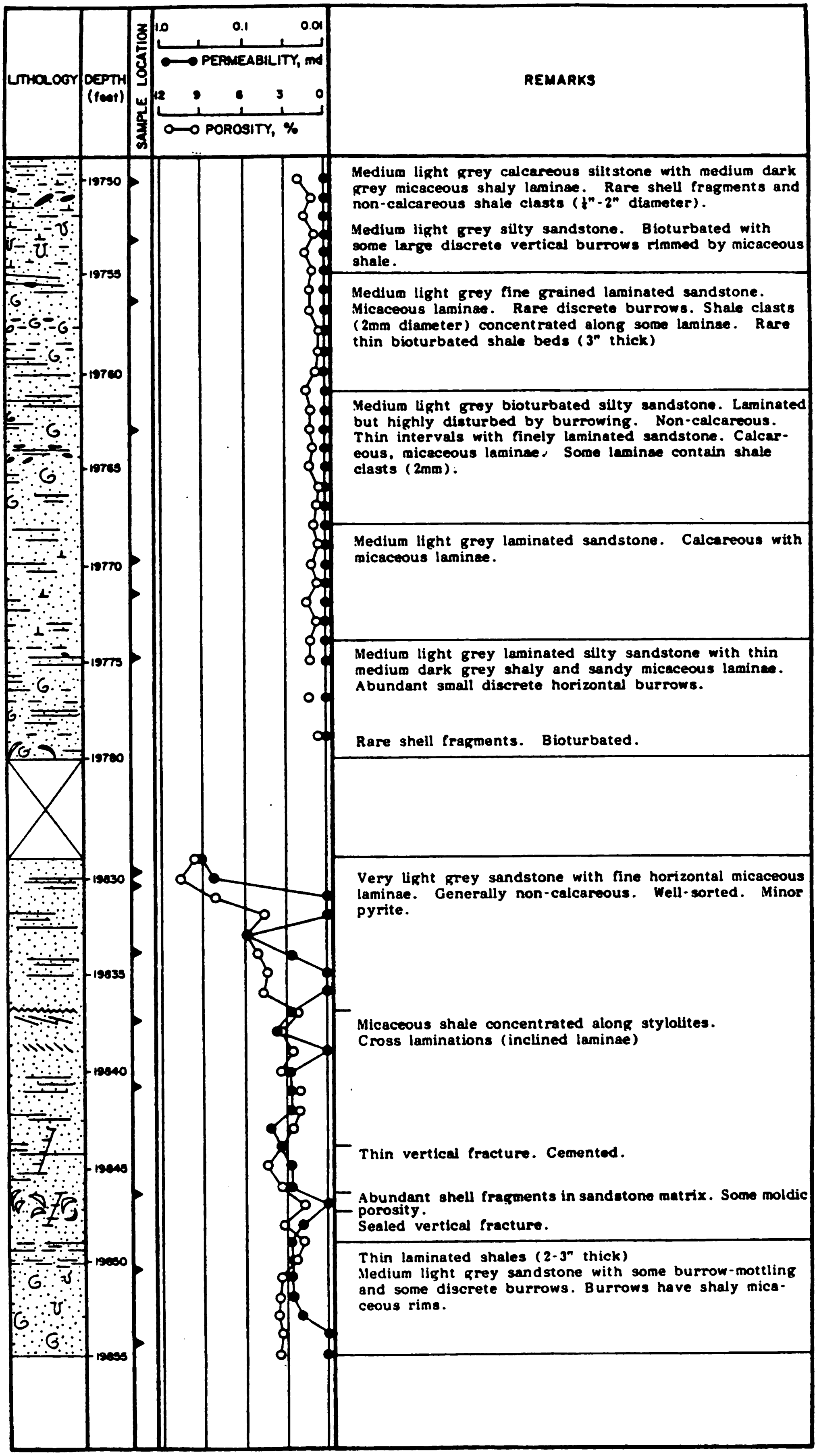

Figure 5. Lithologic description of Cotton Valley cores from the Hunt Energy No. 1 Gordon Brown, Catahoula Creek Field, Hancock County, Mississippi. Courtesy of Petro–Hunt Corporation.

Figure 6–A. Conventional core photograph. Courtesy of Petro–Hunt Corporation

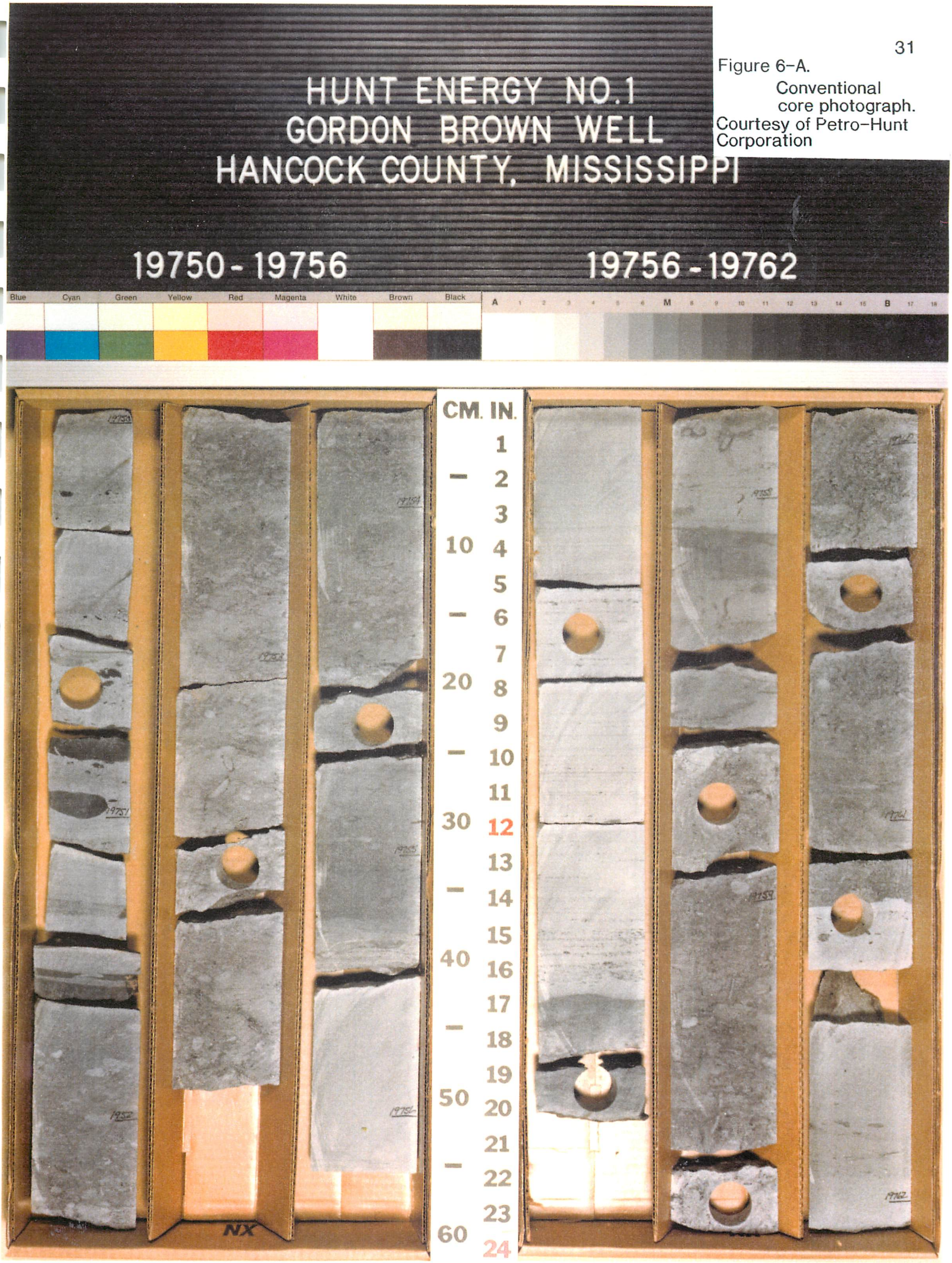

Figure 6–B. Conventional core photograph. Courtesy of Petro–Hunt Corporation

Figure 6–C. Conventional core photograph.
Courtesy of Petro–Hunt Corporation

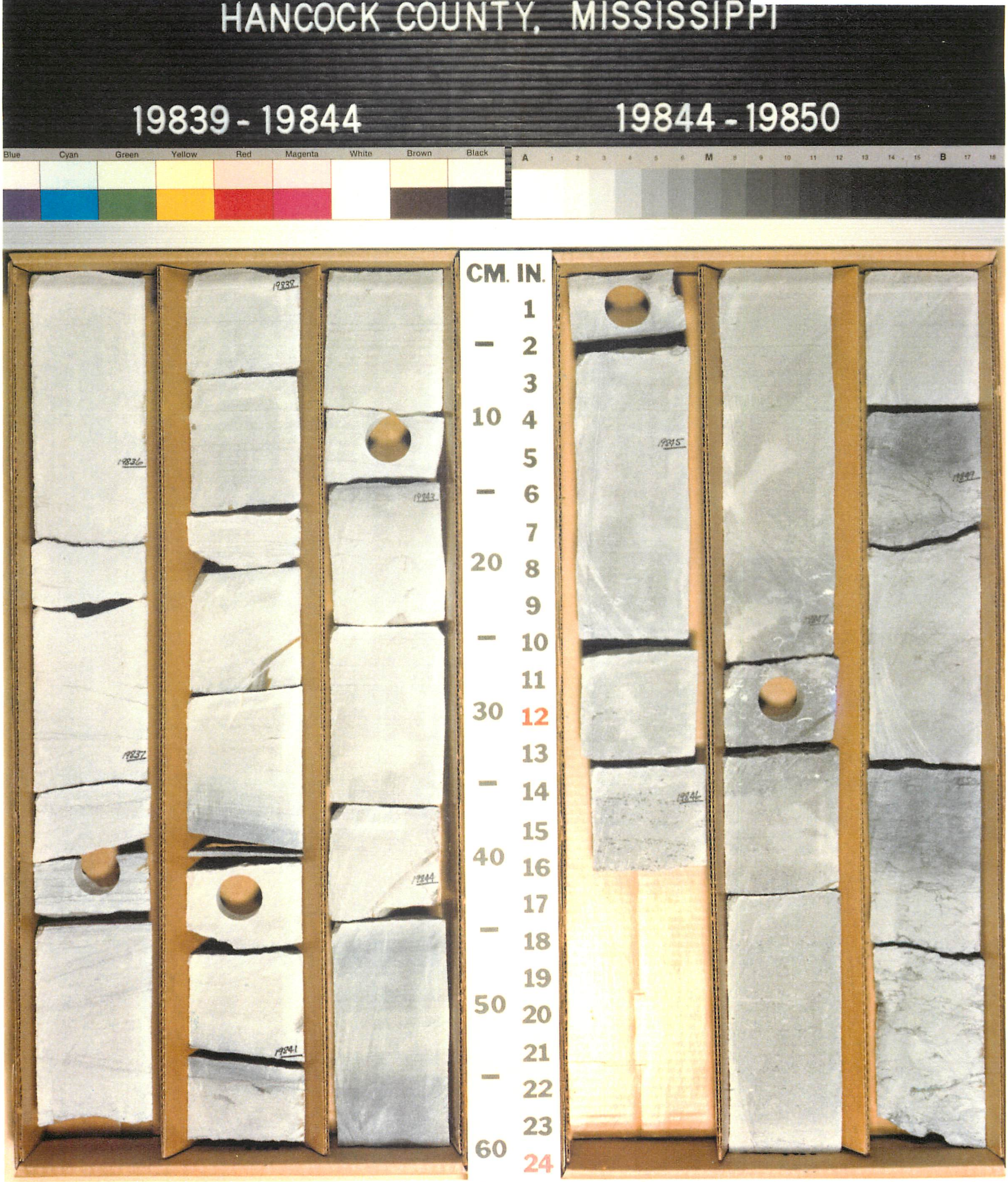

Figure 6-D. Conventional core photograph. Courtesy of Petro-Hunt Corporation

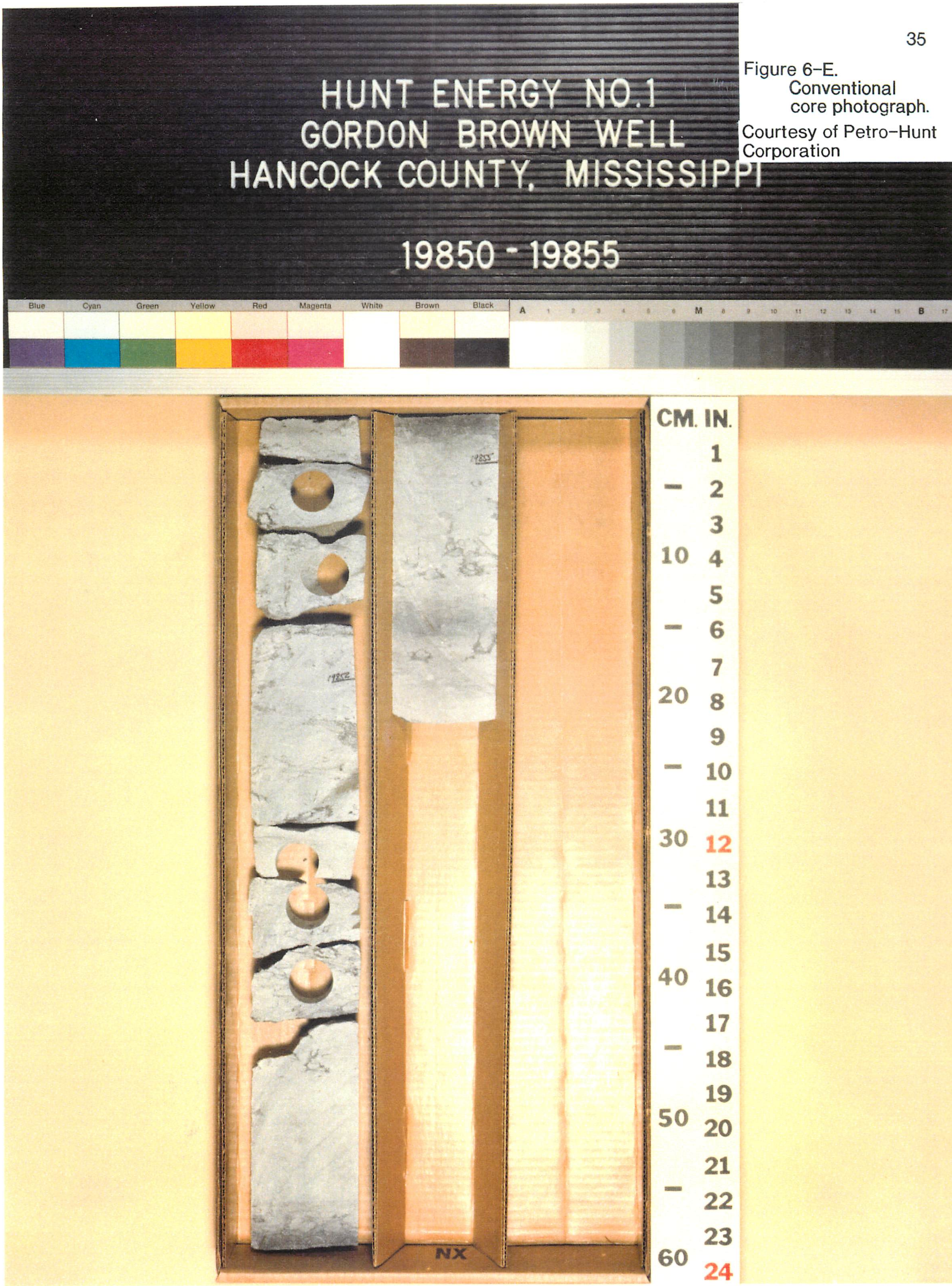

Figure 6–E. Conventional core photograph.

Courtesy of Petro–Hunt Corporation

PETROLEUM GEOLOGY

OVERVIEW OF SOUTHERN MISSISSIPPI AND ADJACENT OFFSHORE WATERS

PREFACE

The following discussion relates to the oil and gas potential of the Jurassic section within the study area. Reported production data and productive horizon designations are in accordance with the terminology of the Mississippi State Oil and Gas Board in its monthly and annual production reports.

STRUCTURE

No information is available in the literature concerning geologic structure, at any depth, in Mississippi state waters. Only three wells have been drilled in this area, and only one of these has penetrated the Jurassic section. While seismic coverage is available, and numerous private companies have mapped this area, this information is unavailable.

Sparse onshore drilling to the Jurassic south of the Wiggins Arch has shown that there appear to be numerous large structures within the Jurassic-age sediments. Some of these structures may be salt induced; however it is probable that most of the area between the Wiggins Arch and the coast does not have the thickness of salt necessary for salt kinetics. It is probable that as the Alabama state line is approached the likelihood increases of salt thick enough for salt-induced structures to form. Most structures in Mississippi south of the Wiggins Arch are probably due to movement of, or drape over, crustal blocks which are remnants of the breakup of the Pangea supercontinent.

A seismic structure map by Mr. W. L. Harper, included in this study as Plate 2, covers the Petit Bois Island area in Mississippi state waters adjacent to Alabama. This map, contoured on a near top Norphlet datum, shows numerous structures large enough to be of interest to the petroleum industry. Near the south edge of the map, in Federal OCS blocks 861 and 862, adjacent to Mississippi state waters, Chevron U.S.A., Inc. has completed discovery wells in the Jurassic-age Norphlet sands. Structures in this area are probably the result of salt movement.

In Mississippi Sound Block 57, there were numerous minor hydrocarbon mudlog shows in the Cotton Valley and Lower Cretaceous Hosston Formation (Plate 1). Drill cuttings were used to make thin sections over the intervals of these hydrocarbon shows. Photomicrographs and petrographic descriptions of representative rock types from each thin section were prepared, as were X-ray powder diffraction patterns from additional cuttings from the same intervals as the thin sections. An edited copy of these data compiled by Dr. Daniel A. Sundeen is included in this report as Appendix A. The hydrocarbon shows occurred predominantly in quartz sandstone, often calcareous, and bioclastic limestone with partial dolomitization. According to Dr. Sundeen, the diagenetic replacement history of these rocks is quite complex, and may involve some dissolution of quartz and feldspar framework grains. There appears to be more than one episode of dissolution of several carbonate minerals (Appendix A).

COTTON VALLEY GROUP

Within Mississippi the first commercial production of hydrocarbons from the Cotton Valley Group was at Soso Field, located in Jasper County in 1958. The Cotton Valley has produced nearly 93.4 million barrels of oil and 104.7 BCFG through January, 1993. Figures 7, 8, and 9 and Table 3 show locations, cumulative production by field, and the graphical representation of these data. The Cotton Valley Group is productive from 42 fields located in the following twelve counties: Clarke, Copiah, Covington, Hancock, Hinds, Jasper, Jones, Simpson, Smith, Warren, Wayne, and Yazoo.

The first commercial hydrocarbon production from the Jurassic within the study area was established at Catahoula Creek Field in August of 1981. Catahoula Creek is located in Township 6 South, Range 15 West, Hancock County,

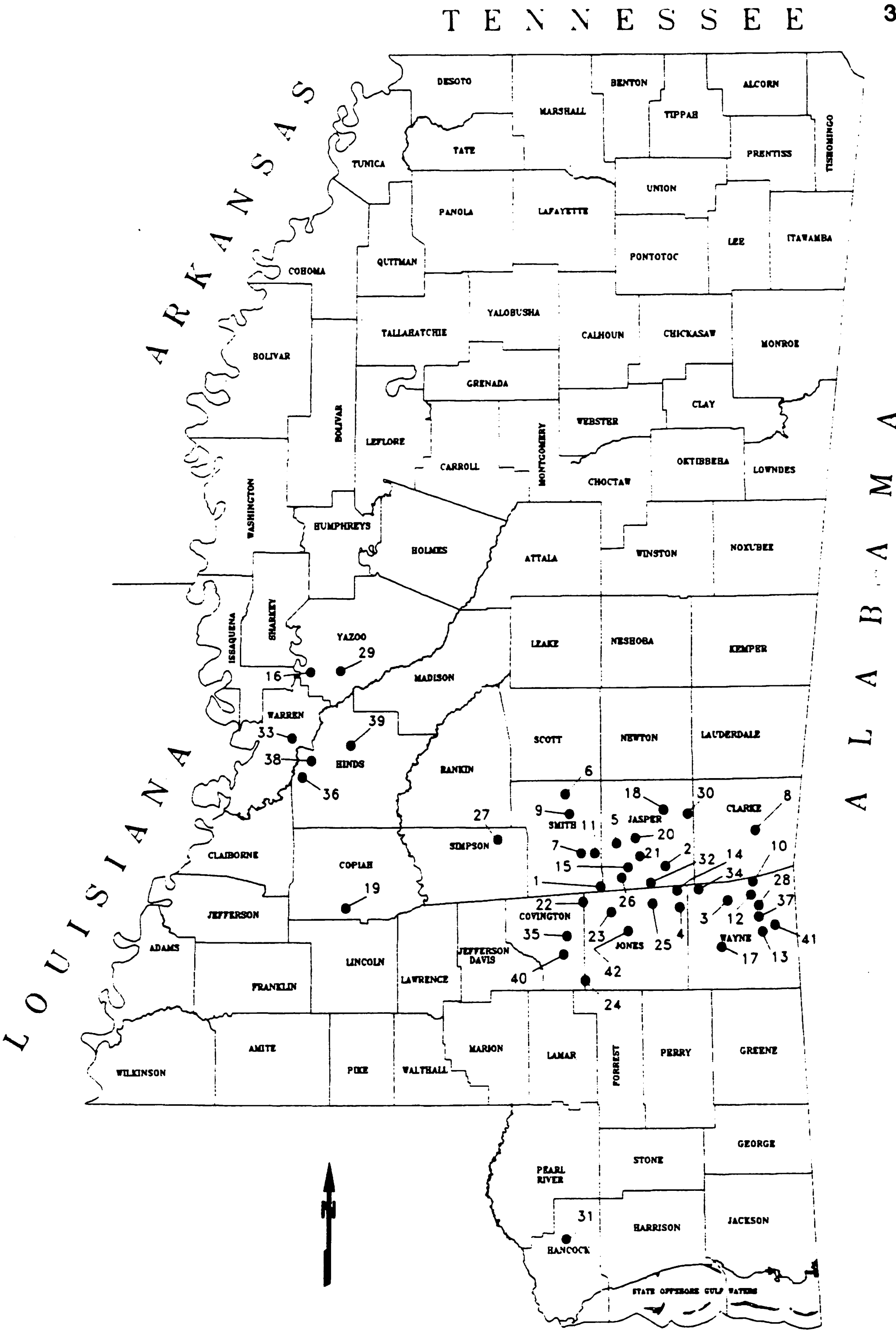

Figure 7. Cotton Valley production index map with field number designations from Table 3.

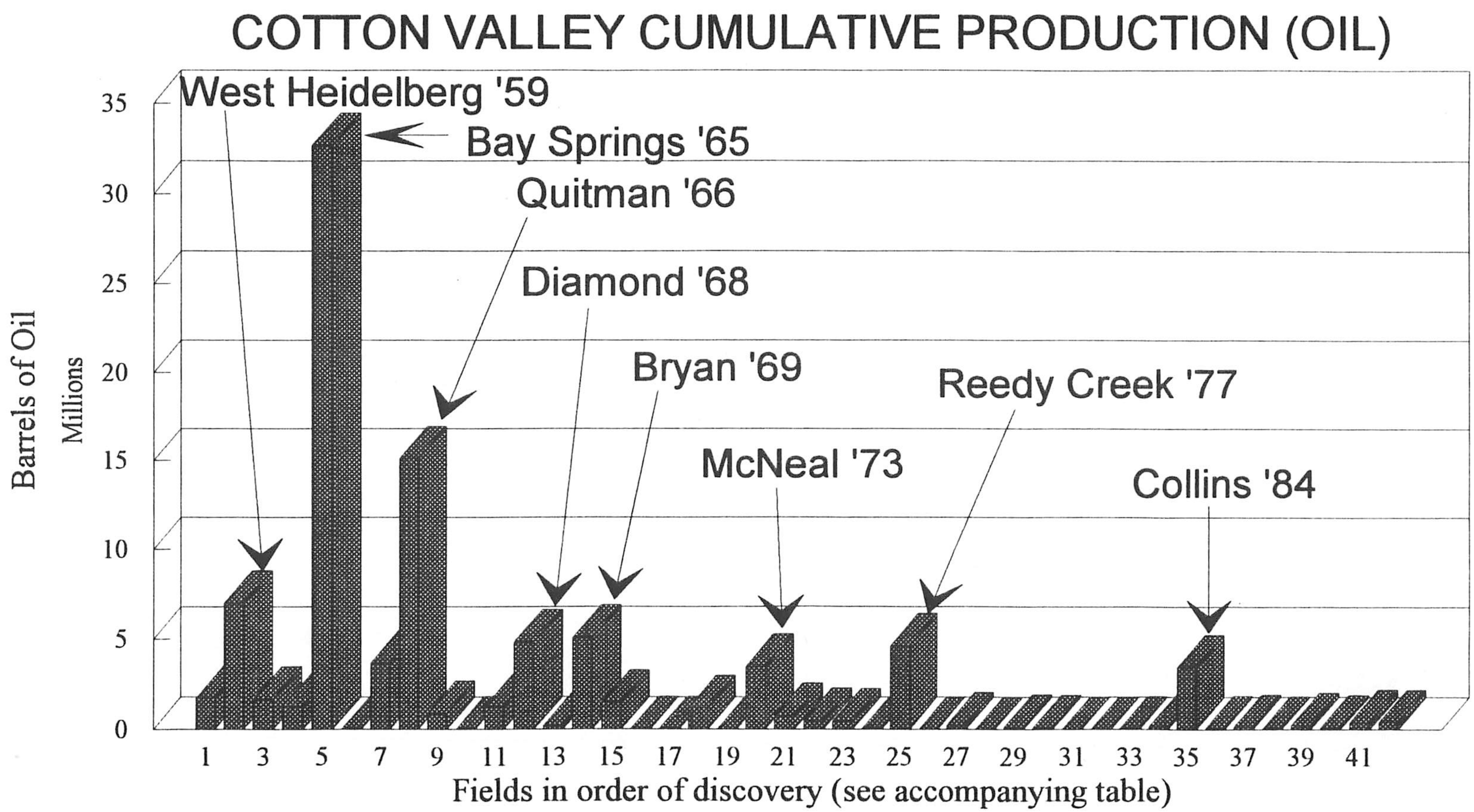

Figure 8. Cotton Valley cumulative oil production.

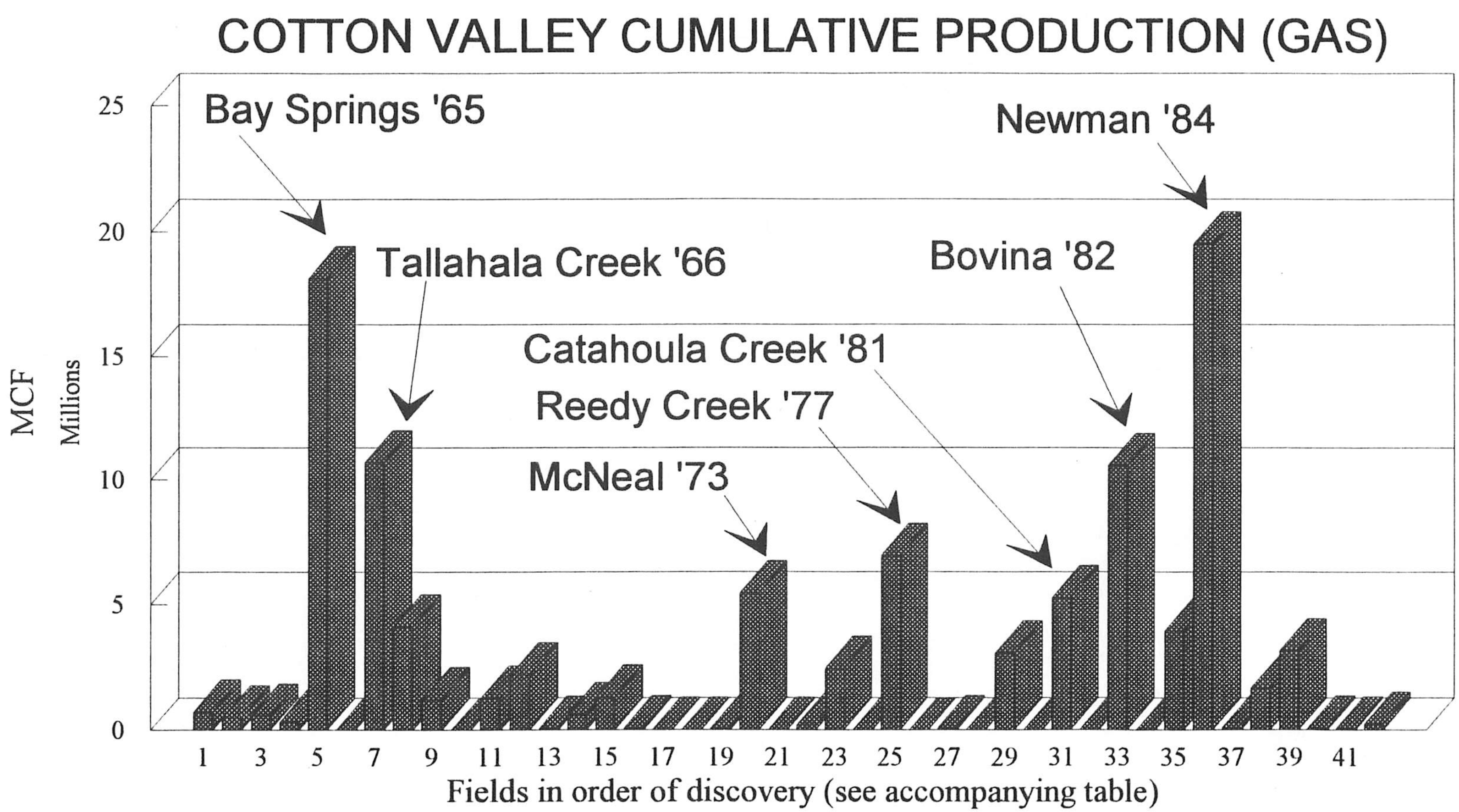

Figure 9. Cotton Valley cumulative gas production.

COTTON VALLEY OIL & GAS PRODUCTION

	FIELD *		COUNTY	OIL BBLS.	GAS MCF
1	Soso '58	Abandoned	Jasper	1,722,694	713,231
2	West Heidelberg '59		Jasper	7,006,843	495,842
3	West Yellow Creek '62		Wayne	1,676,044	561,282
4	Pool Creek '64		Jones	1,278,280	326,467
5	Bay Springs '65		Jasper	32,681,896	18,141,185
6	Lorena '65	Abandoned	Smith	31,690	3,587
7	Tallahala Creek '66		Smith	3,686,977	10,712,491
8	Quitman '66		Clarke	15,133,062	4,097,436
9	Shongelo '66		Smith	874,240	1,220,010
10	Chaparral '68		Wayne	18,139	495
11	East Tallahala Creek '68		Smith	1,248,553	1,260,510
12	Diamond '68		Wayne	4,837,252	2,176,149
13	Winchester '69		Wayne	190,649	65,645
14	Bryan '69		Jones	5,090,159	598,177
15	Stringer '69		Jasper	1,477,512	1,300,773
16	Satartia '70	Abandoned	Yazoo	12,377	82,124
17	West Clara '70	Abandoned	Wayne	32,846	17,430
18	Missionary '71		Jasper	1,193,113	4,248
19	Glancy '71	Abandoned	Copiah	870	94,172
20	McNeal '73		Jasper	3,460,158	5,446,517
21	Waldrup '73		Jasper	766,281	22,956
22	South Summerland '74	Abandoned	Jones	495,445	188,504
23	Calhoun '75		Jones	453,031	2,440,302
24	Shelton Creek '76	Abandoned	Jones	22,050	12,992
25	Reedy Creek '77		Jones	4,617,378	6,950,929
26	Mossville '77	Abandoned	Jasper	1,447	0
27	Martinville '77	Abandoned	Simpson	236,746	95,843
28	Mill Creek '79	Abandoned	Wayne	2,366	0
29	Mechanicsburg '80		Yazoo	114,134	3,055,076
30	Orange '80	Abandoned	Jasper	103,861	0
31	Catahoula Creek '81		Hancock	0	5,250,206
32	Sharon '81	Abandoned	Jasper	10,382	9,450
33	Bovina '82		Warren	17,429	10,594,111
34	West Eucutta '84		Wayne	122,025	0
35	Collins '84		Covington	3,448,266	3,946,464
36	Newman '84		Hinds	64,082	19,498,862
37	Waynesboro '85		Wayne	117,967	83,428
38	Edwards '85		Hinds	43,396	1,666,709
39	Bolton '87		Hinds	230,723	3,152,931
40	Seminary '88		Covington	105,224	87,896
41	East Waynesboro '89		Wayne	386,405	50,808
42	Tallahoma Creek '90		Jones	396,911	234,900

Total number of Fields with Cotton Valley production = 42

Total oil produced = 93,408,903 BO
Total gas produced = 104,660,138 MCF

Cumulative production to 1/1/93.
*** Year of discovery**

Table 3. Cotton Valley cumulative oil and gas production.

Mississippi (Figures 1 and 10). Catahoula Creek Field is located on the south flank of the Wiggins Arch, which forms the northern rim of the Gulf of Mexico Salt Basin. It appears that the Wiggins Arch was formed during the Late Triassic as a result of the breakup of the supercontinent of Pangea when the North American, South American, and African plates began drifting away from one another. The Cotton Valley Group at Catahoula Creek Field may be divided into three units: upper, middle and lower.

The upper Cotton Valley is described as consisting of interbedded sandstone and limestone (Figures 3A-D and 5). The sandstones are comprised of very fine to silty quartz sand and are cemented with calcite, dolomite, and/or silica. The middle Cotton Valley consists of limestones, sandstones and shales. The porosities measured from conventional cores within this interval range from six to seven percent (Figure 5). The productive interval at Catahoula Creek, the lower Cotton Valley, comprises a 400 to 500 foot thick section of shale, siltstone, and sandstone. Measured porosities range from four to eighteen percent and permeabilities range from 0.3 to 0.01 md or less (Figure 5). There is the indication of vertical fracturing in whole core samples which may increase the actual permeabilities to over four md.

The depositional environment of the lower Cotton Valley at Catahoula Creek appears to be an offshore barrier island system. Internal company studies

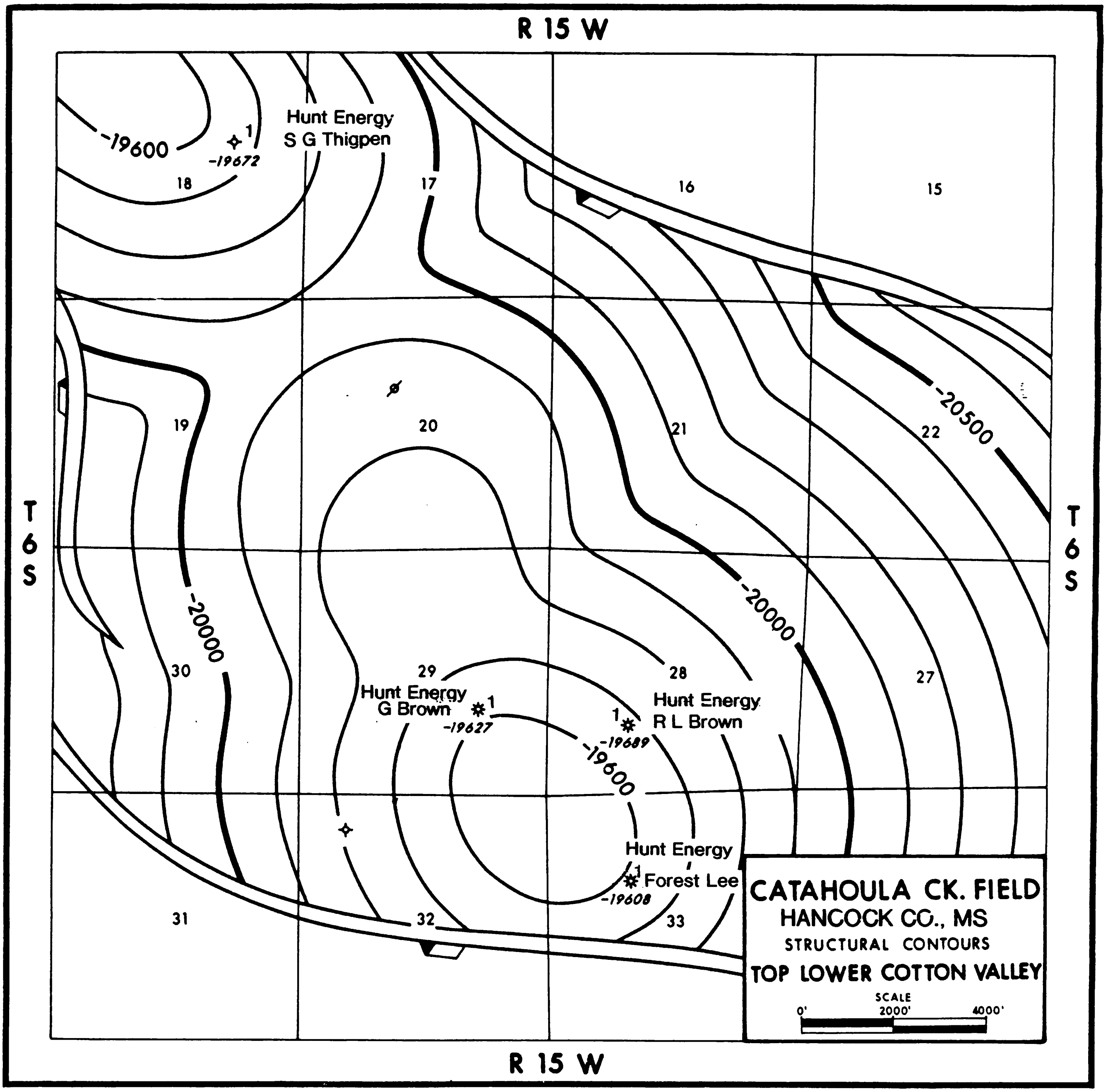

Figure 10. Catahoula Creek Field structure map. Modified from Mississippi Geological Society, 1986.

obtained from Hunt Energy Corporation support the nearshore-offshore barrier system and are substantiated with the following observations:

(1) cores and sample cuttings contain clastic and shallow marine sediments which are indicative of a nearshore environment;

(2) the presence of burrowing and shallow marine fauna (gastropods and pelecypods);

(3) the formation of ooids, which is indicative of a nearshore, wave-dominated environment required to form coated grains.

The discovery well for the field, the No. 1 Rhoda Lee Brown, as well as two subsequent wells, the No. 1 Forest Lee and the No. 1 Gordon Brown, encountered sediments of a similar depositional environment. The No. 1 Thigpen encountered sediments indicative of a lower energy, deeper water environment than the other test wells.

HAYNESVILLE/BUCKNER

The first commercial production from the Jurassic Haynesville/Buckner in Mississippi was established in 1969 at West Paulding Field in Jasper County. As of January 1, 1993, the Haynesville/Buckner interval has produced oil and gas from 13 fields in five counties. These counties are Clarke, Jasper, Jones, Rankin, and Smith. Production to January 1, 1993, totals approximately 4.9 million barrels of oil and condensate, 133.9 BCF of CO_2, and 7.4 BCF of natural gas. Figure 11 is a location map of the Haynesville/Buckner fields and Table 4

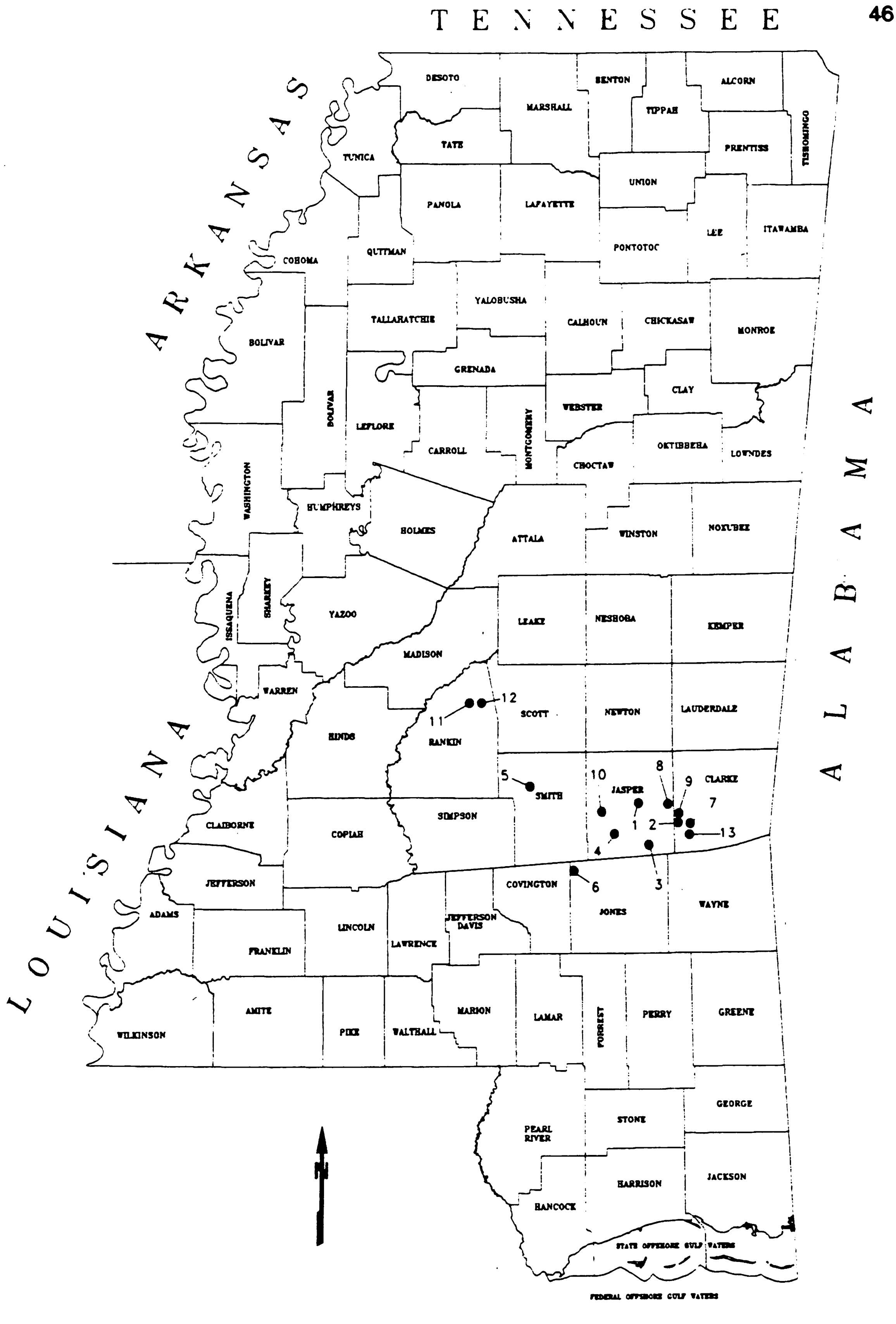

Figure 11. Haynesville/Buckner production index map with field number designations from Table 4.

HAYNESVILLE/BUCKNER OIL & GAS PRODUCTION

	FIELD *		COUNTY	OIL BBLS.	GAS MCF
1	West Paulding '69		Jasper	336,347	1,295,031
2	West Nancy '70		Clarke	355,293	1,265,537
3	Stafford Springs '70		Jasper	59,326	257,665
4	Stringer '70		Jasper	489	147
5	Boykin Church '71		Smith	3,737	810
6	South Summerland '74		Jones	2,414,549	2,521,153
7	North Nancy '74		Clarke	28,865	1,427
8	West Barnett '75		Jasper	210,764	75,748
9	Barnett '75		Clarke	5,491	0
10	Bay Springs '78		Jasper	1,443,200	1,961,063
11	South Pisgah '81	(CO2)	Rankin	0	126,392,622
12	Hollybush Creek '82	(CO2)	Rankin	0	7,526,074
13	Nancy '92		Clarke	8,704	591

Total number of Haynesville/Buckner fields = 13

Total oil produced = 4,866,765 BO
Total gas produced = 141,297,868 MCF

Cumulative production to 1/1/93.
*** Year of discovery**

Table 4. Haynesville/Buckner cumulative oil and gas production.

is a tabular listing of all the Haynesville/Buckner oil and gas production within Mississippi. Figures 12 and 13 are graphical representations of Haynesville/Buckner cumulative oil and gas production by field.

Haynesville/Buckner production within Mississippi has been generally related to porous and permeable sands overlying faulted, structural highs. These structural features are salt induced. Currently there has been no production established from the Haynesville/Buckner which is similiar to that established at North Frisco City Field, Monroe County, Alabama. The production at North Frisco City is the result of reservoir-quality sands being deposited on and/or around basement paleohighs. This trend may also extend into Mississippi. However, the estimated depth required to reach this objective, 19,000 feet or more, would be too deep to economically explore for unless seismic definition and success rates dramatically improve.

SMACKOVER FORMATION

The first commercial production in Mississippi from the Jurassic Smackover Formation occurred in 1954 at Loring Field, Madison County. As of January 1, 1993, the Smackover has produced hydrocarbons from 83 fields located in 13 counties. These counties are Clarke, Greene, Holmes, Humphreys, Jasper, Jones, Madison, Perry, Rankin, Scott, Smith, Wayne, and Yazoo. Production to January 1, 1993, totals over 165.1 million barrels of oil and condensate and

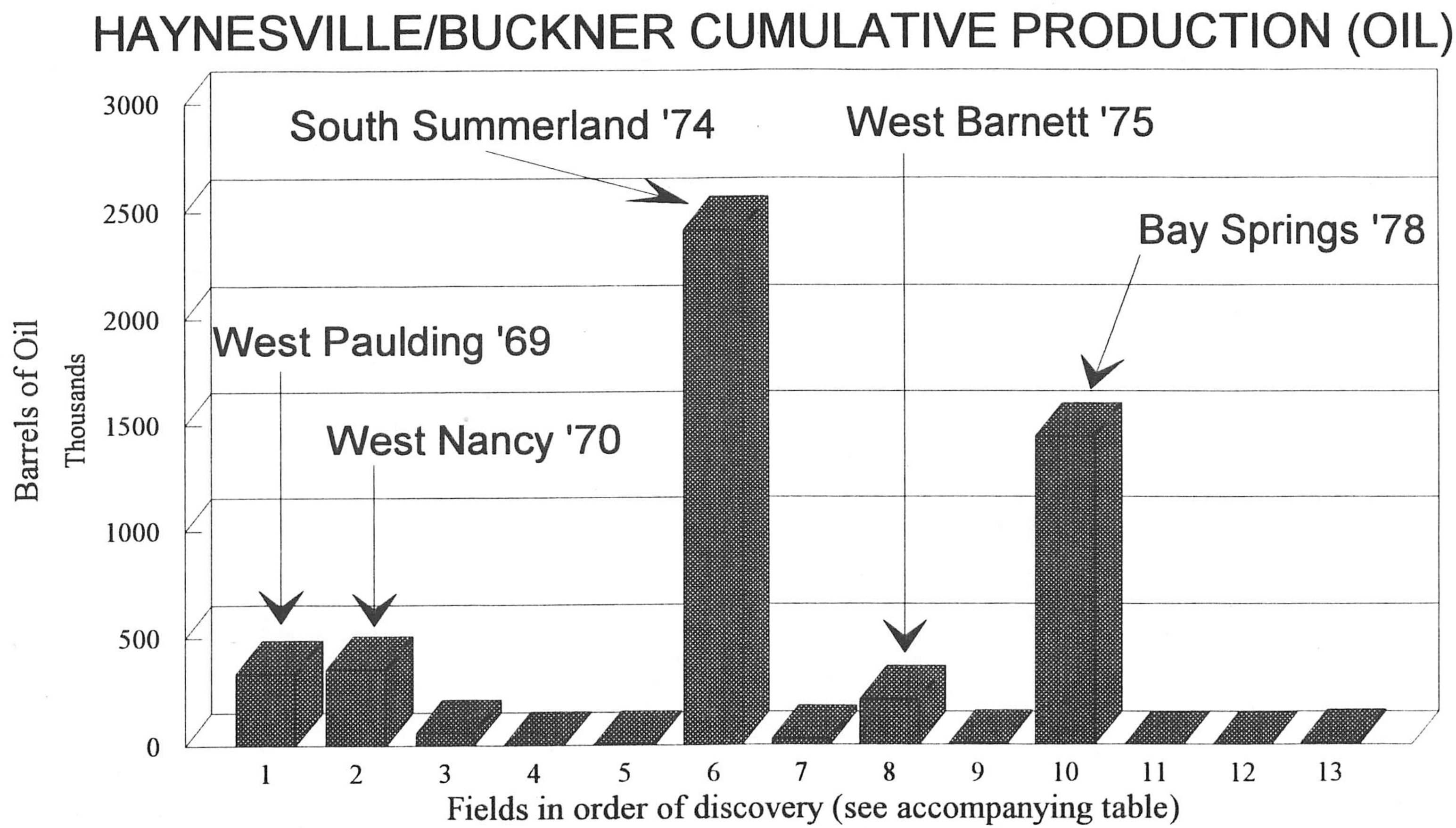

Figure 12. Haynesville/Buckner cumulative oil production.

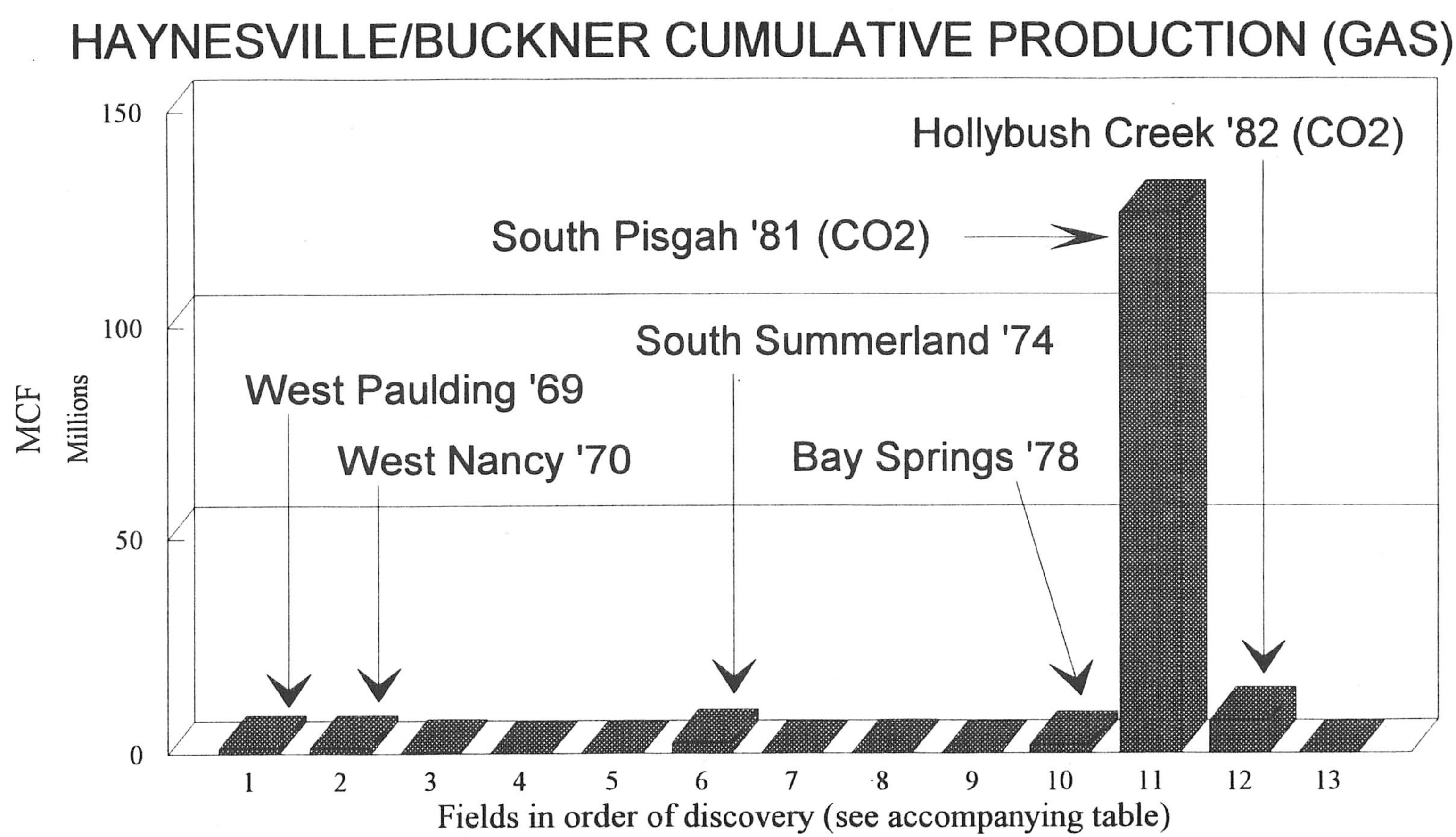

Figure 13. Haynesville/Buckner cumulative gas production.

806.0 BCF of natural gas. Figure 14 is a location map of the Smackover fields and Table 5 is a tabular listing of all the Smackover oil and gas production within Mississippi. Figures 15 and 16 show cumulative Smackover oil and gas production by field.

Jurassic Smackover production has not been established in the southern coastal counties, state waters of Mississippi, or the adjacent federal waters. In southwestern Alabama, Smackover production has been established in the onshore coastal counties, state waters, and adjacent federal waters. It appears that there is potential Smackover production within the coastal counties of Mississippi in the same trend which has been actively explored in Alabama. The nature of Smackover and Haynesville/Buckner hydrocarbon trapping in the Alabama play has been centered around basement or paleohighs, where these formations were deposited in relatively shallow water. During deposition some of these highs were either emergent or near-emergent features. Most of these traps in the Smackover are small, with one to three wells spaced on 80 acre spacing. The small areal extent is offset by the high recovery on a per well basis of up to one million barrels. This same play should also be present in Mississippi based on trend and geophysical information reviewed by the authors. However, the depths needed to be drilled in Mississippi approach 20,000 feet or deeper. This is much deeper than Alabama, and current economics do not justify exploratory efforts at this time.

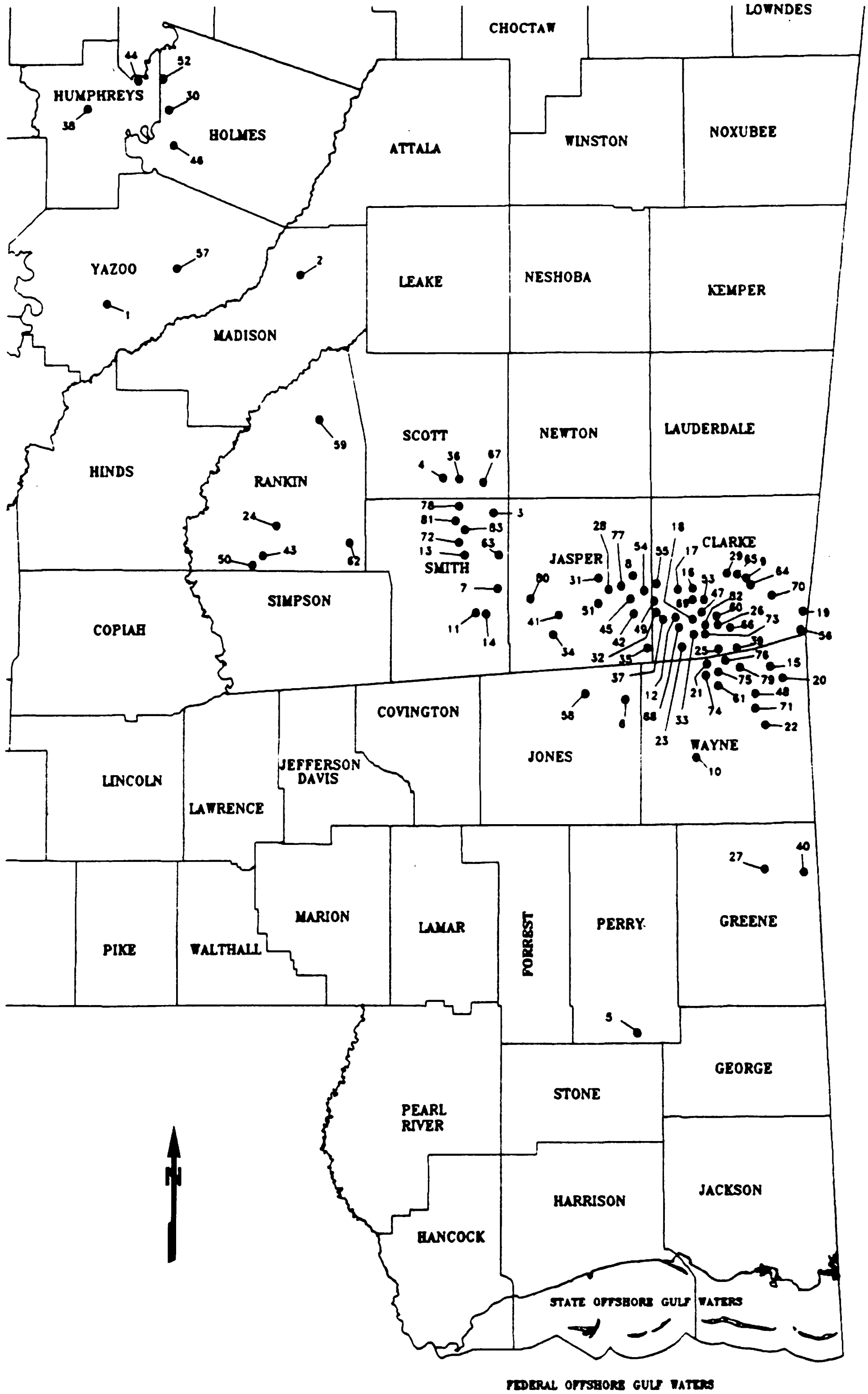

Figure 14. Smackover production index map with field number designations from Table 5.

SMACKOVER OIL & GAS PRODUCTION

FIELD *		COUNTY	OIL BBLS.	GAS MCF
1 Tinsley '51	Abandoned	Yazoo	NA	NA
2 Loring '54		Madison	1,161,638	63,941,269
3 Bienville Forest '63		Smith	380,118	179,251
4 Barber Creek '64		Scott	964,548	302,514
5 Black Creek '65	Abandoned	Perry	0	6,900
6 Pool Creek '65		Jones	1,881,309	648,351
7 Sylvarena '65	Abandoned	Smith	55,982	52,542
8 East Paulding '65		Jasper	29,762	4,882
9 Quitman '66		Clarke	5,329,840	583,660
10 West Clara '66		Wayne	564,124	288,910
11 Tallahala Creek '67		Smith	9,892,313	15,282,701
12 Nancy '67		Clarke	5,338,402	3,224,729
13 Shongelo Creek '67		Smith	83,900	63,031
14 East Tallahala Creek '67		Smith	4,767,503	3,945,625
15 Cypress Creek '68		Wayne	3,198,854	729,222
16 Harmony '68	Abandoned	Clarke	1,788,594	639,827
17 Pachuta Creek '68		Clarke	50,565,068	23,788,483
18 East Nancy '68		Clarke	6,243,281	3,205,486
19 Double Creek '68	Abandoned	Clarke	116,123	0
20 South Cypress Creek '68		Wayne	11,683,696	3,220,489
21 Wolf Creek '69		Wayne	1,538,653	1,486,646
22 Winchester '69		Wayne	256,227	124,302
23 Goodwater '69		Clarke	4,479,915	7,805,286
24 Thomasville '69		Rankin	4,230	380,337,988
25 Shubuta '69		Clarke	1,187,051	896,444
26 Watts Creek '69	Abandoned	Clarke	866,072	190,787
27 Jonathan '69	Abandoned	Greene	NA	NA
28 Paulding '69	Abandoned	Jasper	85,389	41,910
29 Davis '69	Abandoned	Clarke	68,075	0
30 Tchula Lake '69		Holmes	548,258	7,089,306
31 West Paulding '69		Jasper	1,357,535	239,797
32 West Nancy '70		Clarke	18,274,707	12,191,555
33 North Shubuta '70		Clarke	750,056	1,916,506
34 Stringer '70	Abandoned	Jasper	1,534	0
35 Stafford Springs '70		Jasper	815,751	2,259,091
36 East Barber Creek '70		Scott	751,451	418,158
37 Prairie Branch '70		Clarke	4,107,344	2,882,966
38 Belzoni '71	Abandoned	Humphreys	44,203	3,887
39 Garland Creek '71	Abandoned	Clarke	88,034	3,025
40 South State Line '71		Greene	485,959	23,756,092
41 Lake Como '71		Jasper	9,597,131	14,814,331
42 Lake Utopia '71		Jasper	4,546,184	3,044,073
43 Piney Woods '71		Rankin	0	59,677,790
44 Fomosla '71	Abandoned	Humphreys	135,543	1,475,586
45 Vossburg '72	Abandoned	Jasper	646,646	260,244
46 Thornton '73	Abandoned	Holmes	17,324	474,990
47 Hale '73	Abandoned	Clarke	1,018,285	270,554
48 Boyce '73	Abandoned	Wayne	221,407	309,768
49 Barnett '74		Clarke	940,081	278,954
50 S. W. Piney Woods '74		Rankin	0	106,593,304

Table 5. Smackover cumulative oil and gas production.

51 South Paulding '75		Jasper	456,172	253,436
52 Horseshoe Lake '76		Holmes	783,036	7,160,539
53 South Harmony '76		Clarke	139,468	2,755
54 West Barnett '76	Abandoned	Jasper	6,511	1,621
55 Stagecoach Road '76	Abandoned	Clarke	2,536	7,325
56 Bucatunna Creek '77		Clarke	895,961	76
57 Benton '77	Abandoned	Yazoo	13,278	122,014
58 Reedy Creek '77	Abandoned	Jones	69,484	135,618
59 South Pisgah '78		Rankin	0	547,000
60 DeSoto '78	Abandoned	Clarke	56,176	0
61 East Yellow Creek '80	Abandoned	Wayne	11,307	0
62 Johns '80		Rankin	0	45,537,290
63 Pineville '80	Abandoned	Smith	19,034	602
64 East Quitman '81	Abandoned	Clarke	37,612	0
65 Northwest Quitman '81	Abandoned	Clarke	32,569	0
66 Sumrall '82	Abandoned	Clarke	163,434	1,009
67 Otho '82		Scott	1,454,721	415,750
68 Fluffer Creek '83	Abandoned	Clarke	444	0
69 Pleasant Ridge '84		Clarke	203,601	49,563
70 Mannassa '85	Abandoned	Clarke	4,129	0
71 Waynesboro '85	Abandoned	Wayne	185,582	454,983
72 Bowling Creek '85	Abandoned	Smith	13,494	0
73 Mike Creek '86		Clarke	241,163	11,891
74 South Wolf Creek '86		Wayne	219,835	78,457
75 Clear Creek '88		Wayne	744,074	886,008
76 North Hiwanee '88		Wayne	73,874	288,513
77 Beaver Dam '89		Jasper	110,717	15,001
78 Tallabogue Creek '89		Smith	64,444	22,770
79 Chaparral '90		Wayne	1,789,472	773,872
80 Bay Springs '90		Jasper	260,921	265,833
81 Union Grove '90	Abandoned	Smith	20,463	0
82 Addie Mae '92		Clarke	103,374	31,289
83 West Pineville '92		Smith	29,164	0

Total number of Fields with Smackover production = 83

Total oil produced = 165,084,150 BO
Total gas produced = 806,014,427 MCF

Cumulative production to 1/1/93.
*** Year of discovery**

Table 5 continued.

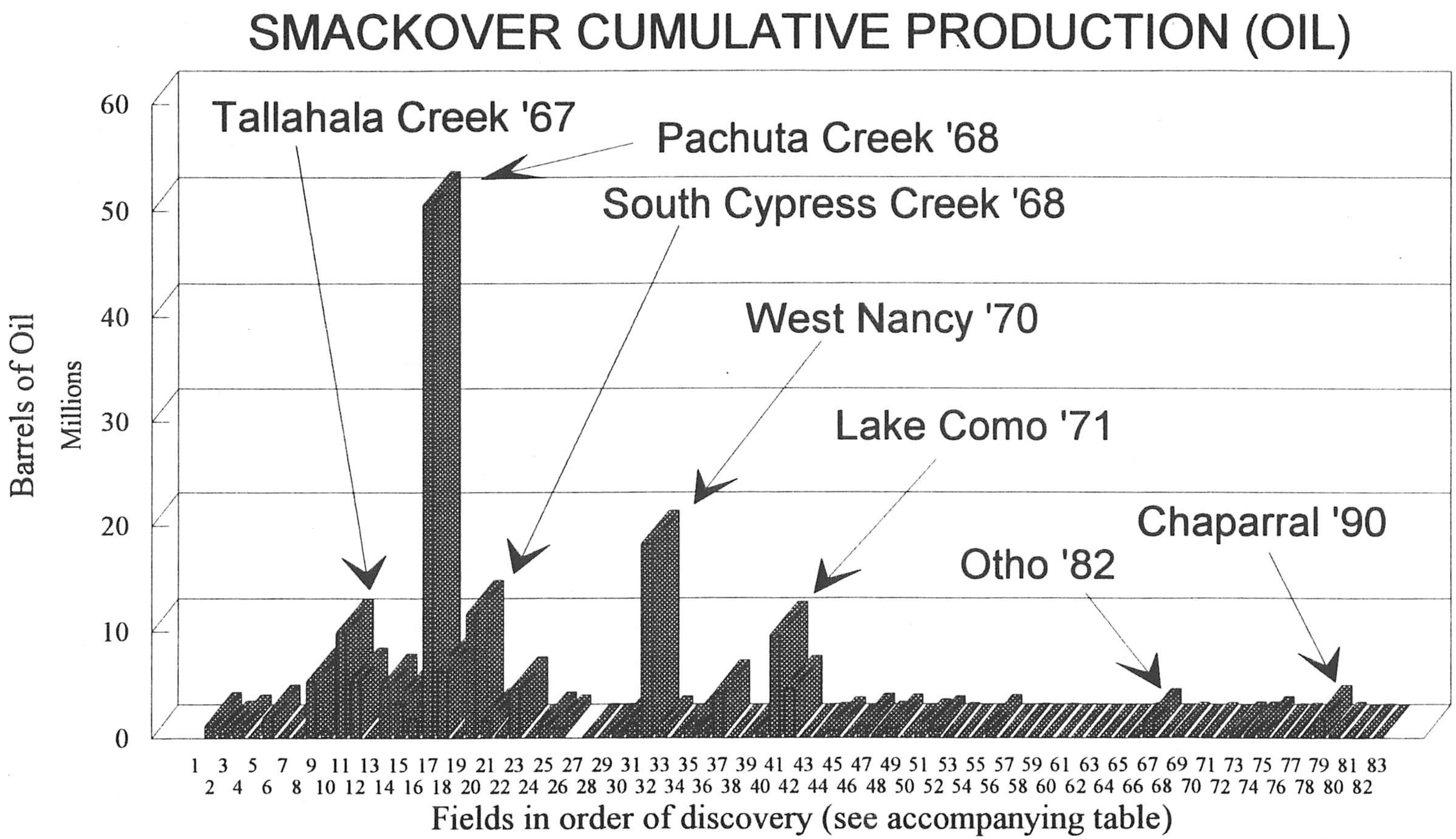

Figure 15. Smackover cumulative oil production.

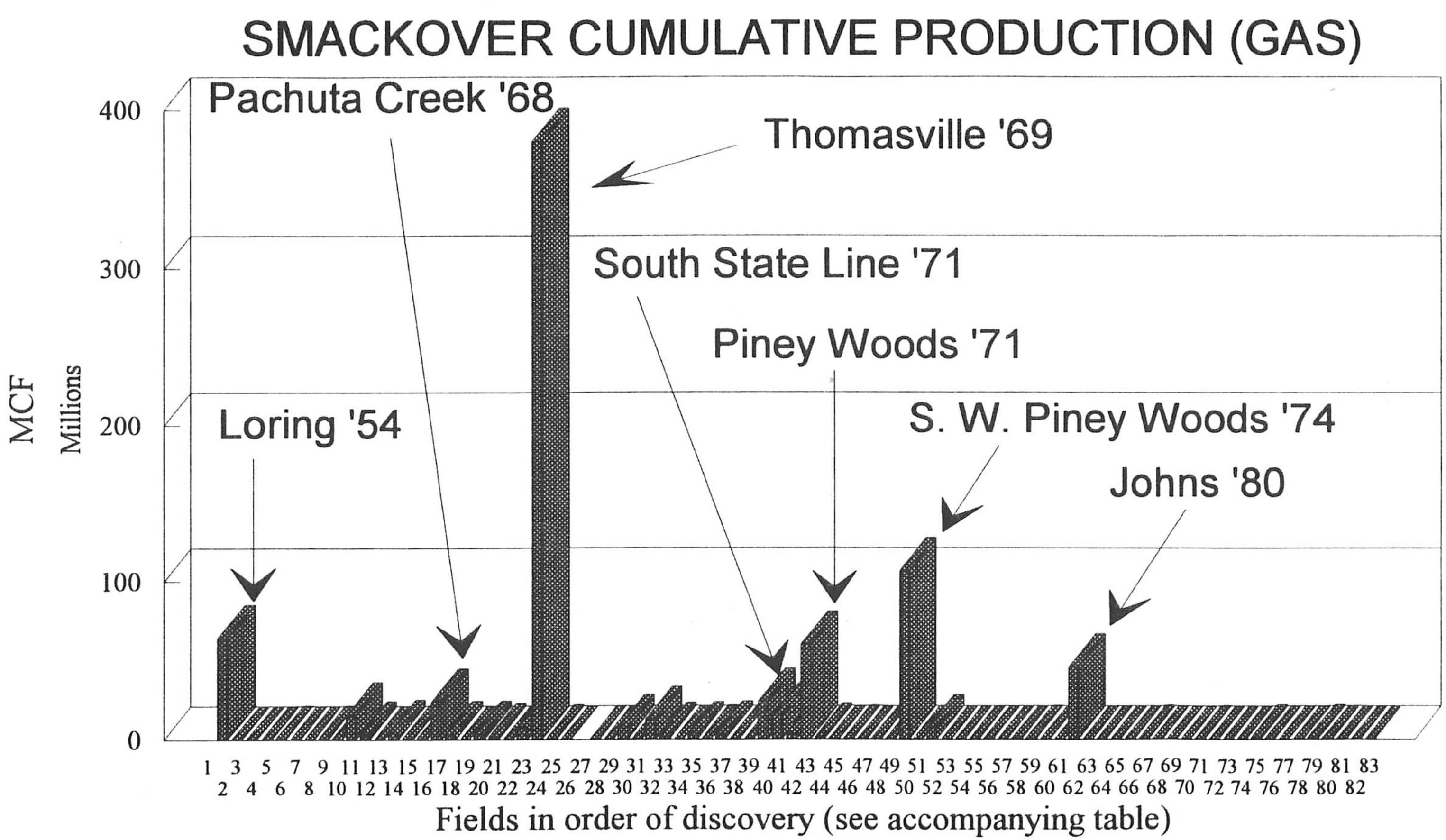

Figure 16. Smackover cumulative gas production.

NORPHLET FORMATION

Jurassic Norphlet production in Mississippi is from 15 onshore fields (Figure 17), which are either structural or combination stratigraphic-structural traps. Commercial production from the Norphlet Formation was first established in Mississippi at Pelahatchie Field, located in Rankin County, in 1967. As of January 1, 1993, the Norphlet has produced 11.5 million barrels of oil and condensate, 103.8 BCF of CO_2, and 6.8 BCF of natural gas. The Norphlet is productive in five Mississippi counties: Clarke, Greene, Madison, Rankin, and Wayne. Figures 17, 18, and 19 and Table 6 show locations, cumulative production, and graphical representation of these data.

The Norphlet Formation in Mississippi is interpreted to be the result of a marine transgression which encroached upon an existing desert/dune area. Figure 4 is a diagrammatic representation of the inferred limits of the Norphlet sands. Alluvial fan and fluvial facies are present in the updip areas which grade into eolian sheet sand and further downdip into eolian dune sands. The areal extent of the sand to the west-southwest is problematic within the state and federal waters offshore Mississippi. However, the Norphlet is known to be present and productive from the federal waters adjacent and just south of Mississippi state waters in the Mobile area, Blocks 861, 862, and 904. The Norphlet was absent in the Chevron U.S.A., Inc., State of Mississippi, Block 57 well to the west of the federal blocks. Therefore, within the study area the

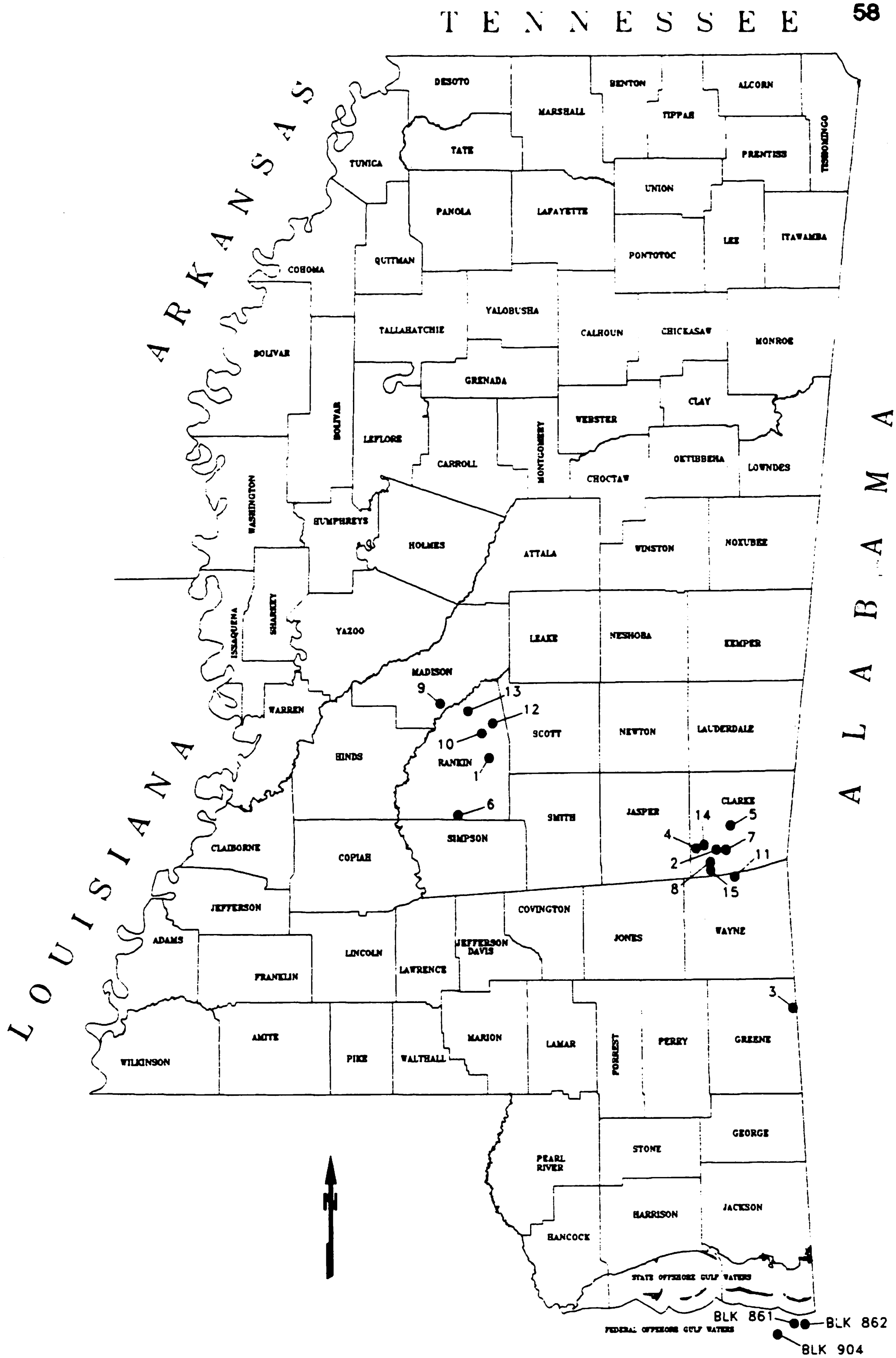

Figure 17. Norphlet production index map with field number designations from Table 6.

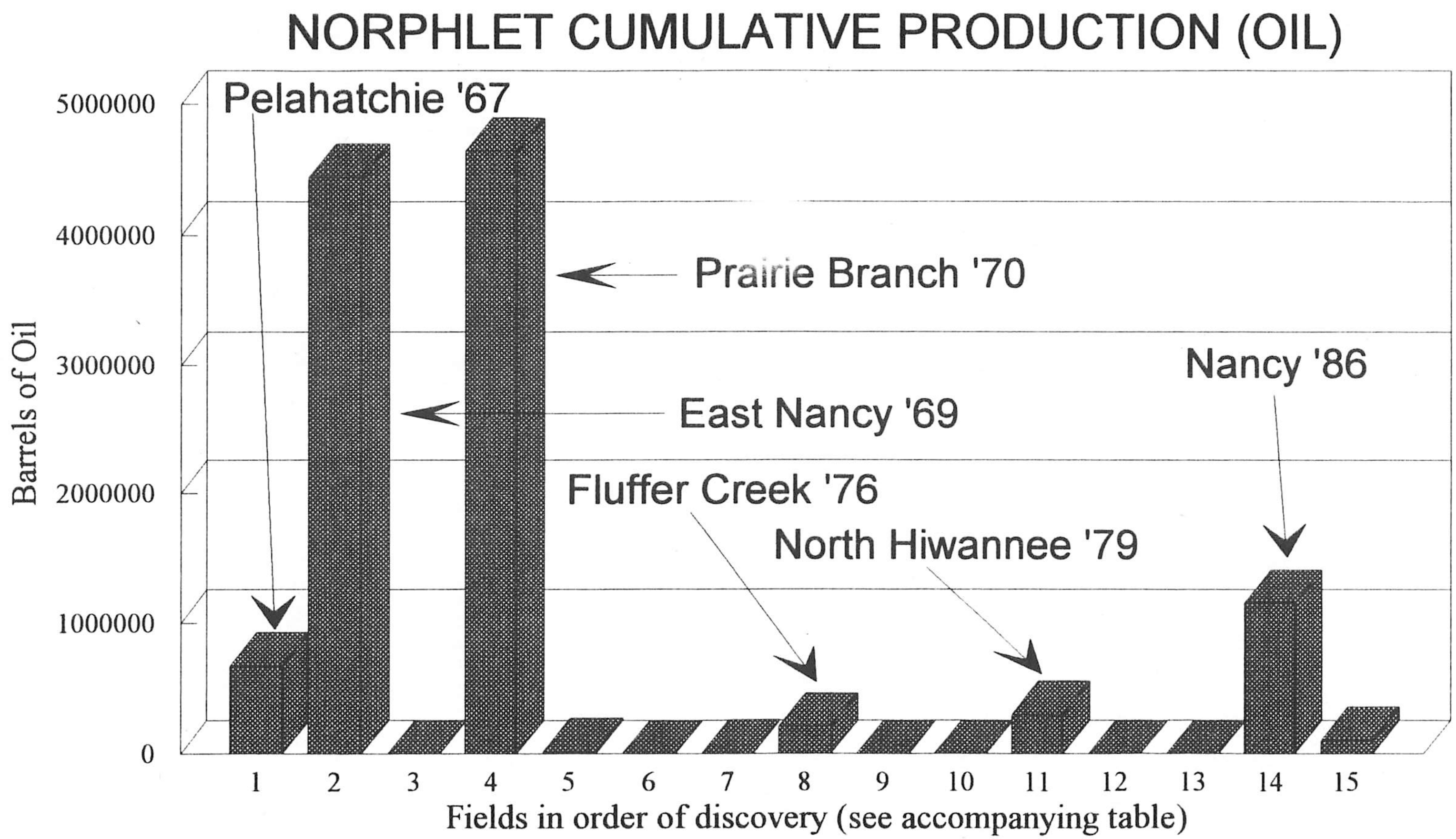

Figure 18. Norphlet cumulative oil production.

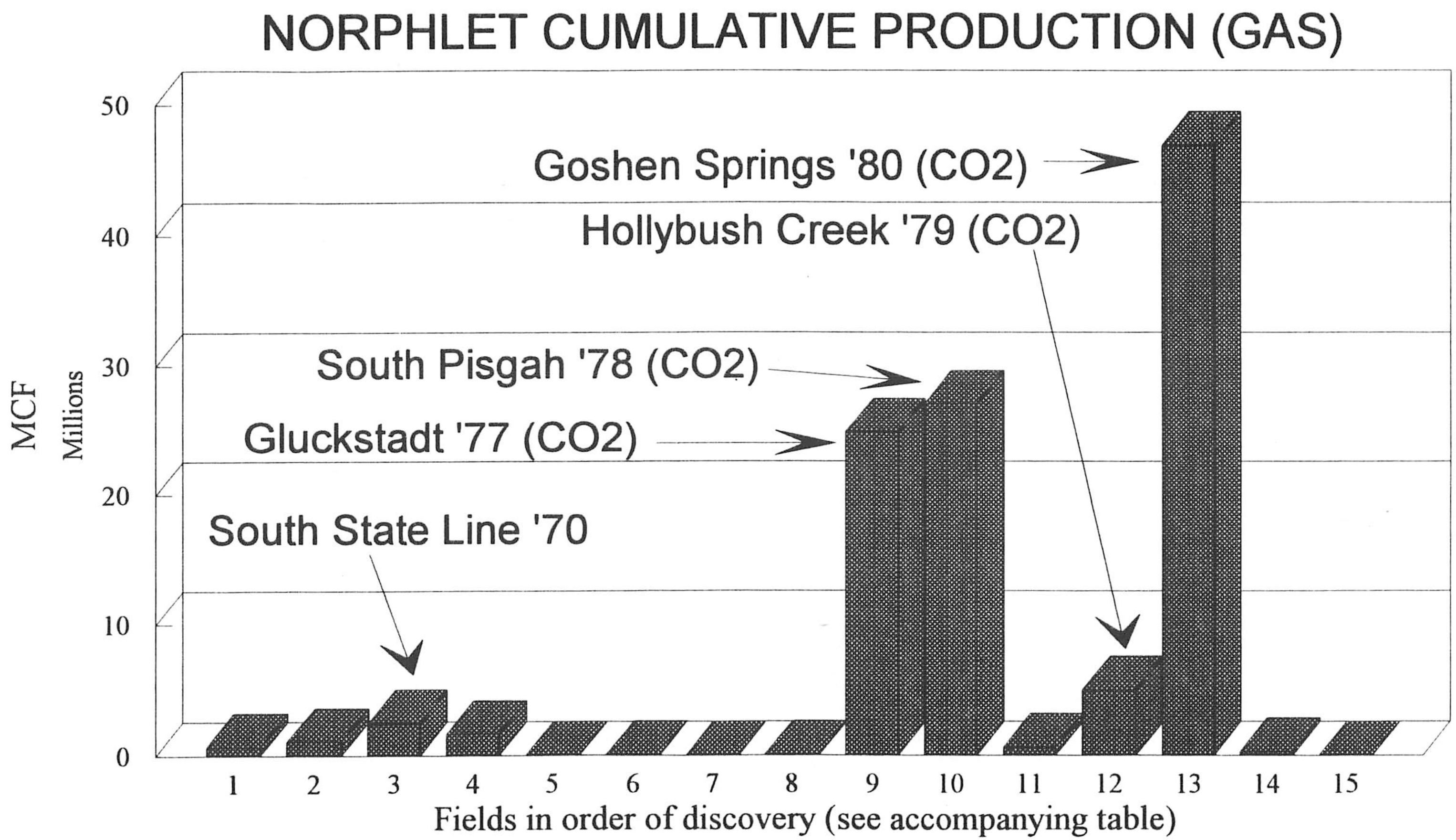

Figure 19. Norphlet cumulative gas production.

NORPHLET OIL & GAS PRODUCTION

	FIELD *		COUNTY	OIL BBLS.	GAS MCF
1	Pelahatchie '67	Abandoned	Rankin	668,908	676,879
2	East Nancy '69		Clarke	4,441,672	1,061,074
3	South State Line '70	Abandoned	Greene	0	2,448,508
4	Prairie Branch '70		Clarke	4,641,111	1,635,088
5	Archusa Springs '71	Abandoned	Clarke	15,126	5,704
6	Piney Woods '76	Abandoned	Rankin	0	66,791
7	Watts Creek '76	Abandoned	Clarke	3,144	0
8	Fluffer Creek '76	Abandoned	Clarke	207,514	55,644
9	Gluckstadt '77	(CO2)	Madison	167	24,876,456
10	South Pisgah '78	(CO2)	Rankin	0	27,040,293
11	North Hiwannee '79		Wayne	300,465	608,827
12	Hollybush Creek '79	(CO2)	Rankin	0	4,976,736
13	Goshen Springs '80	(CO2)	Rankin	0	46,879,927
14	Nancy '86		Clarke	1,151,898	298,134
15	Goodwater '90		Clarke	101,963	0

Total number of Norphlet fields = 15

Total oil produced = 11,531,968 BO
Total gas produced = 110,630,061 MCF

Cumulative production to 1/1/93.
*** Year of discovery**

Table 6. Norphlet cumulative oil and gas production.

Norphlet sand terminates. The boundary of termination has yet to be precisely defined in the subsurface. The terminus of the Norphlet Formation may be more accurately defined in the future by the use of high quality seismic data.

CONCLUSIONS

No commercial accumulations of hydrocarbons have been found in the Jurassic-age Haynesville, Buckner Member of the Haynesville, Smackover, or Norphlet formations within the study area to date. The only commercial production of Jurassic-age hydrocarbons within the study area has been from the Cotton Valley Group at Catahoula Creek Field in Hancock County, Mississippi. Further, all of the potential Jurassic reservoirs with the exception of the Norphlet Formation are yet to have commerical production established in the coastal counties of Alabama, the panhandle of Florida, or in the adjacent parts of the Mobile, Pensacola, Viosca Knoll, Destin Dome, or Chandelier OCS areas. Commercial production from the Jurassic Norphlet Formation has been established from both on and offshore Alabama and offshore Mississippi in the adjacent federal waters of the Mobile area. Linear to sub-linear production trends indicate the Norphlet play should extend into Mississippi's state waters. The potential for Norphlet production in this area is substantiated by the presence of structural closures within the areally small portion of the state and federal waters mapped for this report (Plate 2).

Commercial production from the Smackover Formation is rated low due to the following two factors:

1) Loss of reservoir facies, i.e., the Smackover facies changes from carbonates to shales in the southwestern portion of the study area;

2) Where the carbonate facies may be present, drilling depths are too deep for development under existing market conditions. Anticipated drilling depths are approximately 20,000 feet or deeper.

The Haynesville Formation and the Buckner Member of the Haynesville Formation are also located at depths too great for commercial development.

The Cotton Valley Group has potential for commercial hydrocarbon production if drilling costs are minimized, perhaps by the use of the latest, state-of-the-art geophysical techniques.

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APPENDIX

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

DEPARTMENT OF GEOLOGY

May 10, 1993

Mr. Jack Moody
Office of Geology
P. O. Box 20307
Jackson, MS 39289-1307

Dear Jack:

Enclosed please find descriptions of eight samples from the Chevron Mississippi Sound well from the following depths:

18,500-510
19,500-
19,650
20.220-230
21,960-970
22,390-400
22,240-450
22,880-890 ?

The descriptions include:

1. Petrographic reports on stained thin sections of well cuttings impregnated with blue casting resin

2. Photomicrographs of representative rock types from each thin section

3. X-ray powder diffraction patterns prepared from cuttings

   Thin sections and cutting splits were supplied by your office.

We proceeded on our study with the assumption that the dominant rock type present in each thin section was the object of the report for the given sample depth. Bioclastic limestones with partial dolomitization, and calcareous fine-grained quartz sandstones were the two dominant rock types observed. Detailed reports were prepared on the dominant rock for each thin section.

This reconnaissance-level petrographic examination indicated that the diagenetic replacement history of these rocks from 18,500 to 22,890 is quite complex and may involve some dissolution of quartz and feldspar framework grains. Also, there appears to be more than one episode of dissolution of several carbonate minerals.

Preparation techniques for thin sections and X-ray diffraction patterns may account for some discrepancies in what minerals are observed in a given interval.

We hope the data in these reports will be useful in your work.

Yours truly,

Dan Sundeen

Daniel A. Sundeen

Box 5044 • Hattiesburg, Mississippi • 39406-5044 • (601) 266-4526

PETROGRAPHIC REPORT

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-18,500

FIELD OCCURRENCE: Mississippi Sound Block 57

MACROSCOPIC DESCRIPTION: Two types of rock are present in thin thin section: 1. slightly arenaceous, calcareous siltstone, and 2. fossiliferous, slightly arenaceous & argillaceous limestone.

MINERALS	%	SIZE(mm)	ALTERATION PRODUCTS	OPTICAL DATA
MAJOR (> 10%)				
calcite matrix	50%			red stain
bioclasts				
shells	45%			
micro fossils	5%			
MINOR (< 10%)				
fine grained dolomite	5%			occurs in clusters of rhombs
ACCESSORY (not used for classification)				
pyrite	trace			associated with dolomite

ALTERATION PRODUCTS

none

OTHER DATA:

PHOTOMICROGRAPHS: Yes

3 different compositions

X-RAY POWDER DIFFRACTION DATA: Yes

whole rock powder pattern 50°-70°

SCANNING SCOPE DATA: No

PETROGRAPHIC REPORT (continued)

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER:

MICROSCOPIC DESCRIPTION:

Most of the rocks represented in the thin section are bioclastic limestone with some dolomitization present. The matrix is predominantly fine grained calcite with some dolomite recrystal ization. The bioclasts are predominantly shells with some micro-fossils.

The siltstone may not be representative of the depth where sam ples were taken (cavings?). The siltstone is slightly arenaceous and in some places, calcite cement and pyrite are observed.

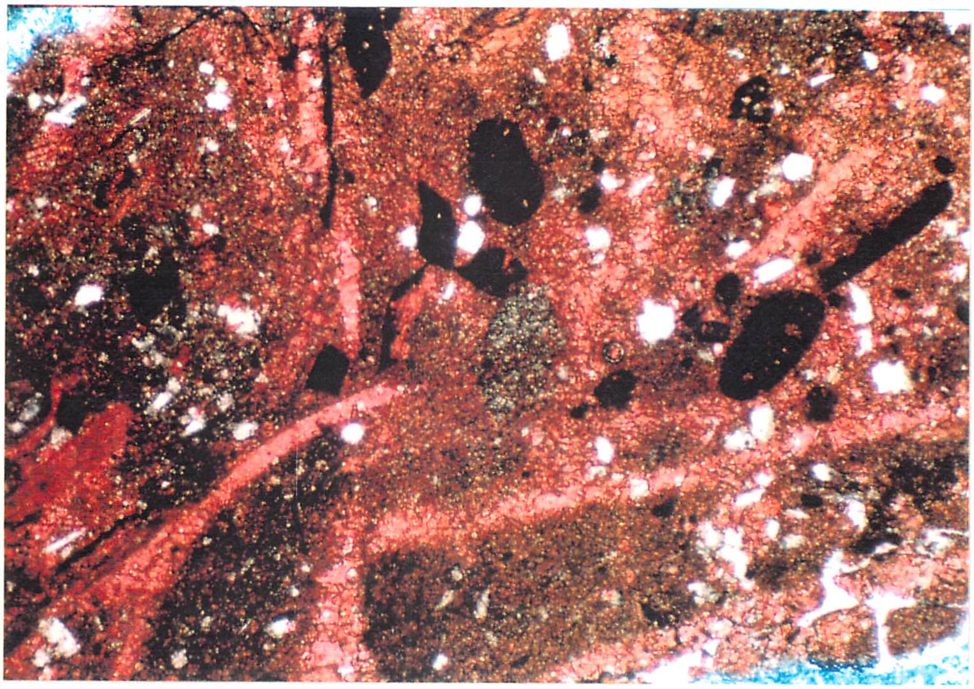


Figure CM-18500 1A. Fine grained calcite with shell and foram bioclasts, quartz and feldspar grains (ppl). Scale 4x.

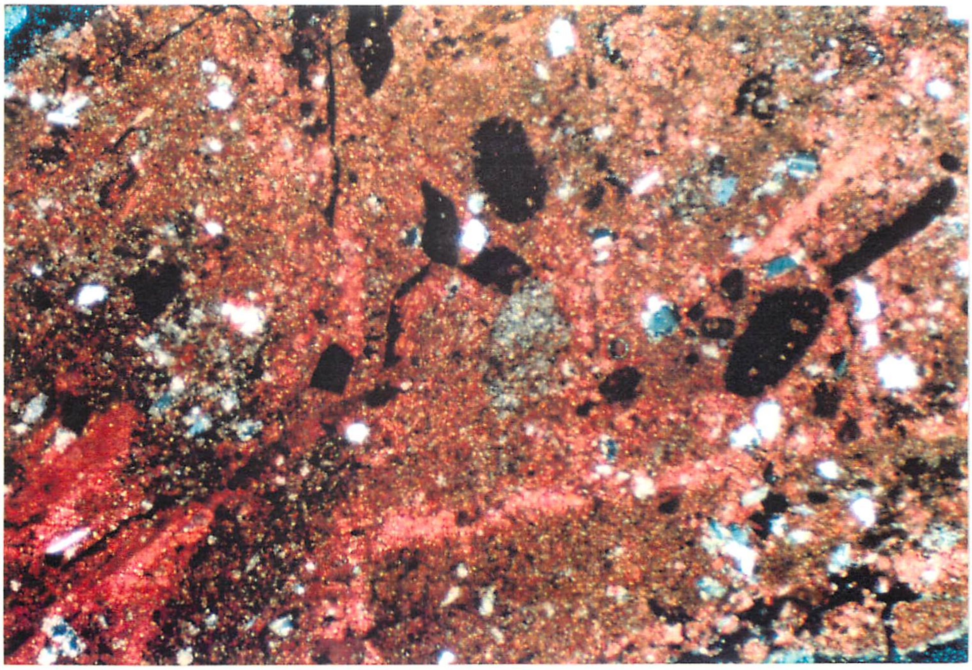
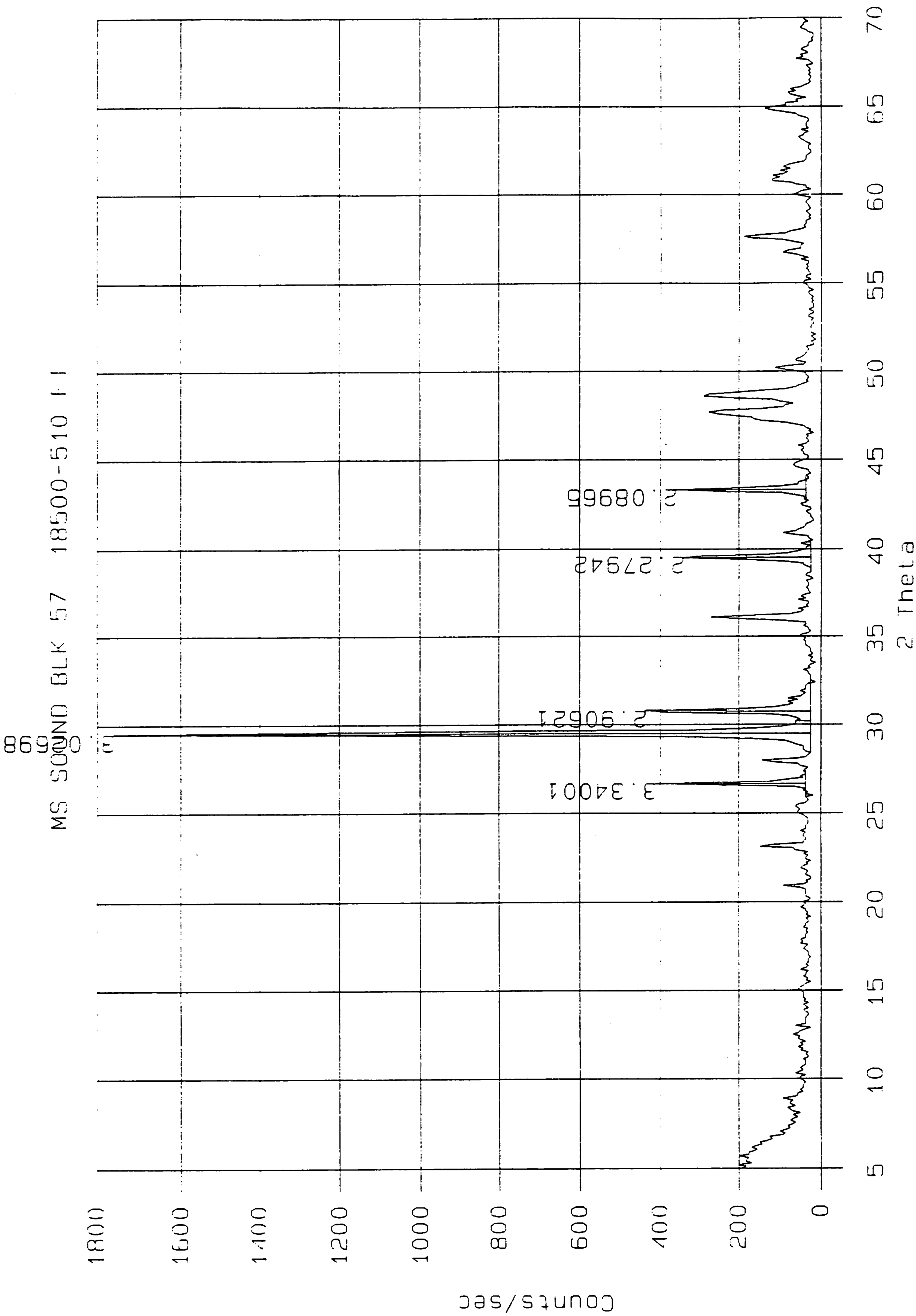


Figure CM-18500 1B. Fine grained calcite with shell and foram bioclasts, quartz and feldspar grains (crossed polars). Scale 4x.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2.90621
2.27942
2.08965
Counts/sec
2 Theta
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200
400
600
800
1000
1200
1400
1600
1800
5
10
15
20
25
30
35
40
45
50
55
60
65
70

PETROGRAPHIC REPORT

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-19,500

FIELD OCCURRENCE: Mississippi Sound Block 57

MACROSCOPIC DESCRIPTION: The rocks present in thin section are calcareous quartz sandstone and siltstone. Most of the cuttings are calcareous sandstone.

MINERALS	%	SIZE(mm)	ALTERATION PRODUCTS	OPTICAL DATA
MAJOR (> 10%)				
calcite	5-30%			both primary & matrix
quartz	70-90%	0.1-0.5		angular/subangular, w/both sharp & wavey extinction; mostly monocrystalline
plagioclase	0-10%	0.1-0.5	slight, clay & sericite	clear w/Albite twinning
MINOR (< 10%)				
chert	trace			

ACCESSORY (not used for classification)

ALTERATION PRODUCTS

clay and sericite after plagioclase

OTHER DATA:

PHOTOMICROGRAPHS: Yes

3 different views

X-RAY POWDER DIFFRACTION DATA: Yes

whole rock powder pattern 5°-70°

SCANNING SCOPE DATA: No

PETROGRAPHIC REPORT (continued)

PETROGRAPHER: Dan Sundeen

DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1

SAMPLE NUMBER: CM-19,500

MICROSCOPIC DESCRIPTION:

Most of the rocks in this thin section are calcareous sandstone. The other rocks are siltstone, a laminated, slightly brownish-gray w/pyrite. The siltstone may not be in-place. The limestone is the same as described in sample CM-18,500.

The calcareous quartz sandstone has calcite cement and calcite clasts. Some of the calcite has been replaced with a clear carbonate (dolomite?), and has trace amounts of pyrite in association with the dolomite (?).

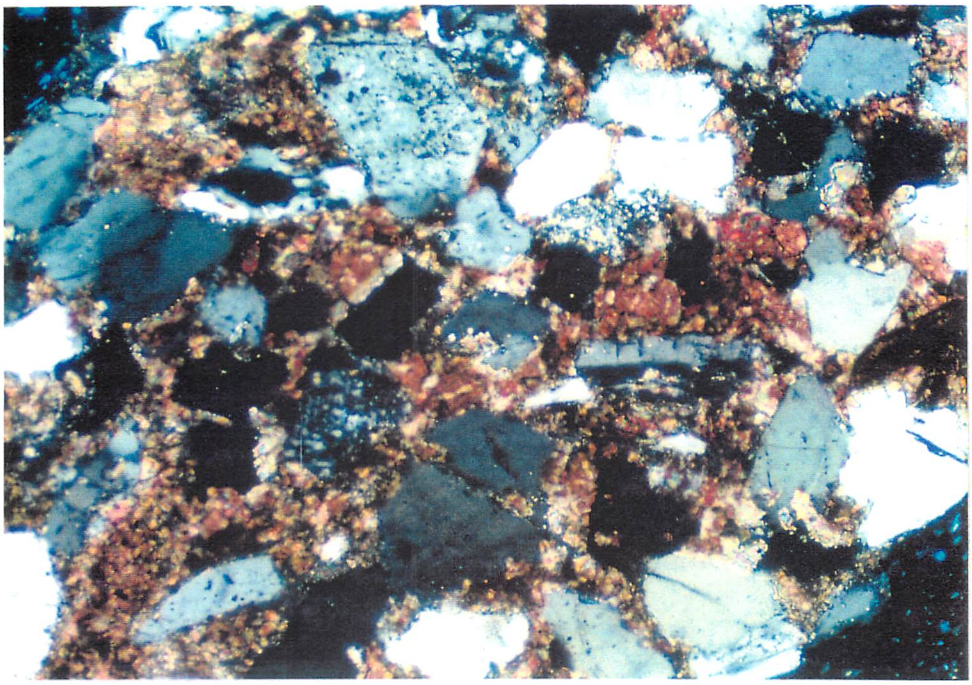


Figure CM-19500 1A. Quartz with calcite cement showing partial replacement (dolomite ?). Also present is chert, altered feldspar, and pyrite in dolomite(?) (crossed polars). Scale 10x.

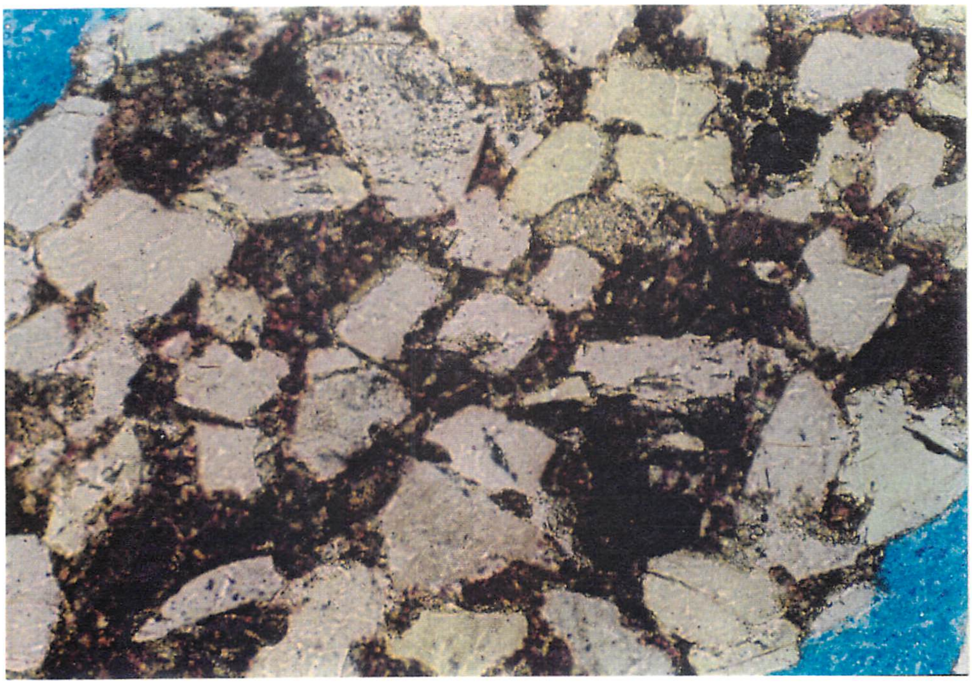
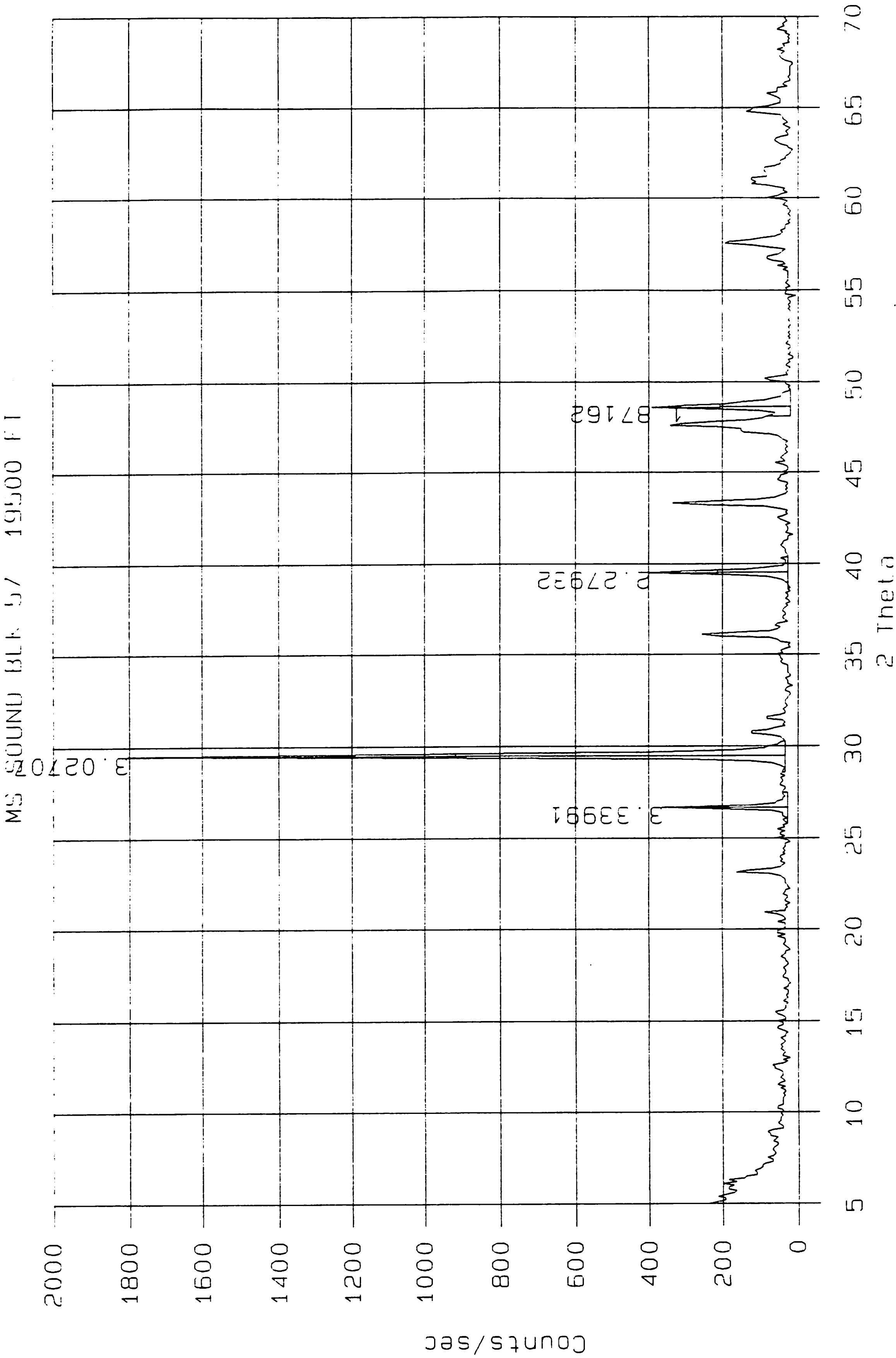


Figure CM-19500 1B. Quartz with calcite cement showing partial replacement (dolomite ?). Also present is chert, altered feldspar, and pyrite in dolomite(?) (ppl). Scale 10x.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3.33991
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2 Theta
Counts/sec
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40
45
50
55
60
65
70
0
200
400
600
800
1000
1200
1400
1600
1800
2000

PETROGRAPHIC REPORT
PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-19,650

FIELD OCCURRENCE: Mississippi Sound Block 57

MACROSCOPIC DESCRIPTION: Cuttings in thin section exhibit two rock types: 1. about 30% slightly arenaceous, pyritiferous siltstone, and 2. bioclastic limestone with dolomite(?) and quartz.

MINERALS	%	SIZE(mm)	ALTERATION PRODUCTS	OPTICAL DATA
MAJOR (> 10%)				
calcite matrix	5-35%			fine grained
calcite crystals	5-10%	0.2-1.0		
micro fossils (calcite)	0-10%	0.3		
macro fossils (calcite)	10-50%	0.1-0.4		
pellets (calcite)	0-30%	0.2-0.5		
MINOR (< 10%)				
dolomite(?)	5-10%	0.1-0.2		clear rhombs replacing calcite; occurs as clots in limestone
quartz	0-5%	0.05-0.1		angular, w/sharp ext
feldspar	trace	0.05-0.1		albite twinning?
muscovite	trace	- -		
ACCESSORY (not used for classification)				
pyrite	trace	0.01-0.02		small anhedral forms seen w/ dolomite(?)

ALTERATION PRODUCTS

OTHER DATA:

PHOTOMICROGRAPHS: Yes

4 different views

X-RAY POWDER DIFFRACTION DATA: Yes

whole rock powder diffraction pattern

SCANNING SCOPE DATA: No

PETROGRAPHIC REPORT (continued)

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-19,650

MICROSCOPIC DESCRIPTION:

Most of the rocks in this thin section are bioclastic limestones, with a small amount of arenaceous siltstones. The limestone matrix is fine-grained and encloses pellets, macro fossils (shells), and some micro fossils.

Siltstone may not represent an "in-place" lithology.

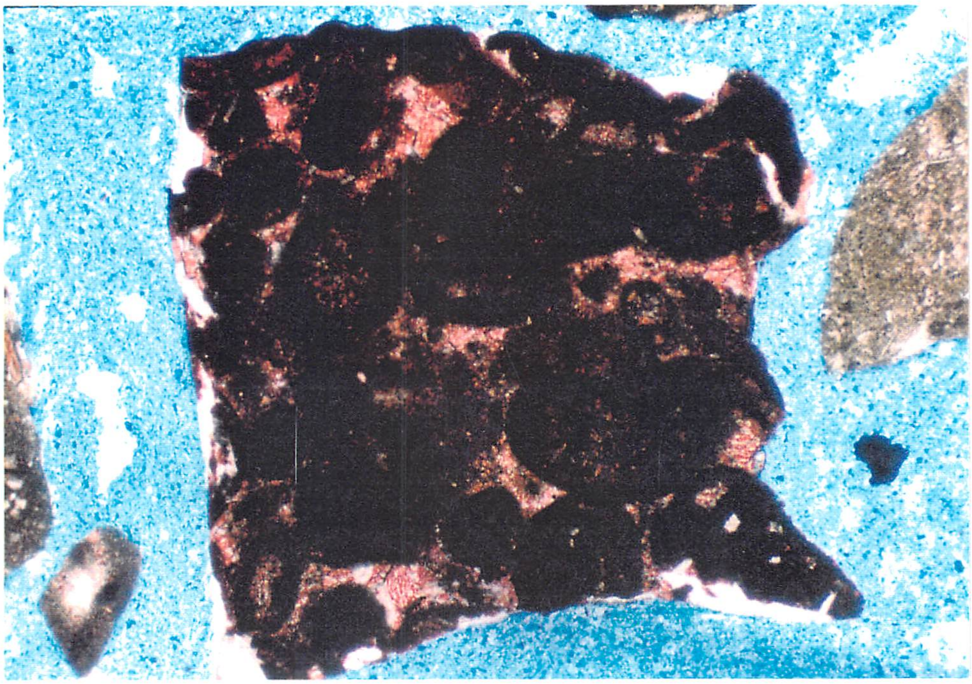


Figure CM-19650 1A. Pelletoidal limestone with calcite partially replaced with dolomite(?). Quartz is present in trace amounts. (ppl) Scale 4x.

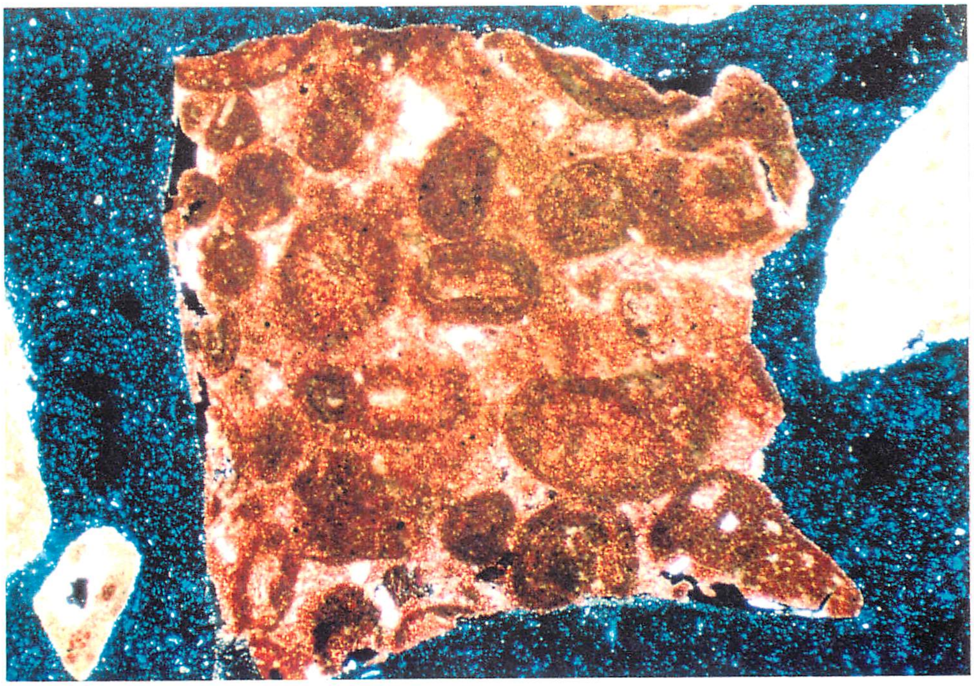


Figure CM-19650 1B. Pelletoidal limestone with calcite partially replaced with dolomite(?). Quartz is present in trace amounts. (crossed polars) Scale 4x.

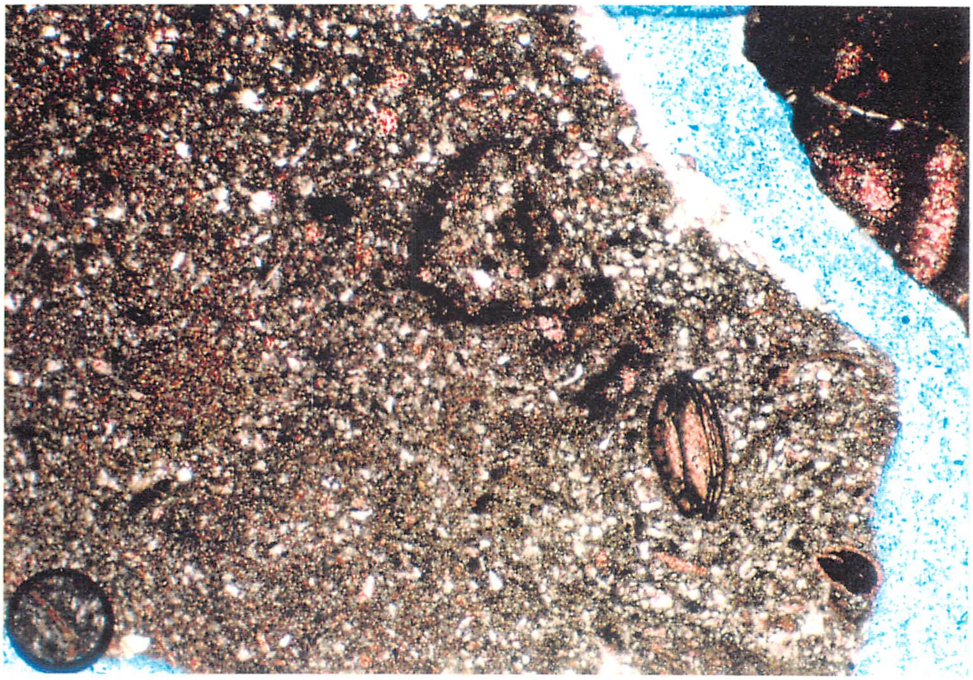


Figure CM-19650 2A. Fine-grained limestone with microfossils, opaque fossil replaced by pyrite. (ppl) Scale 4x.

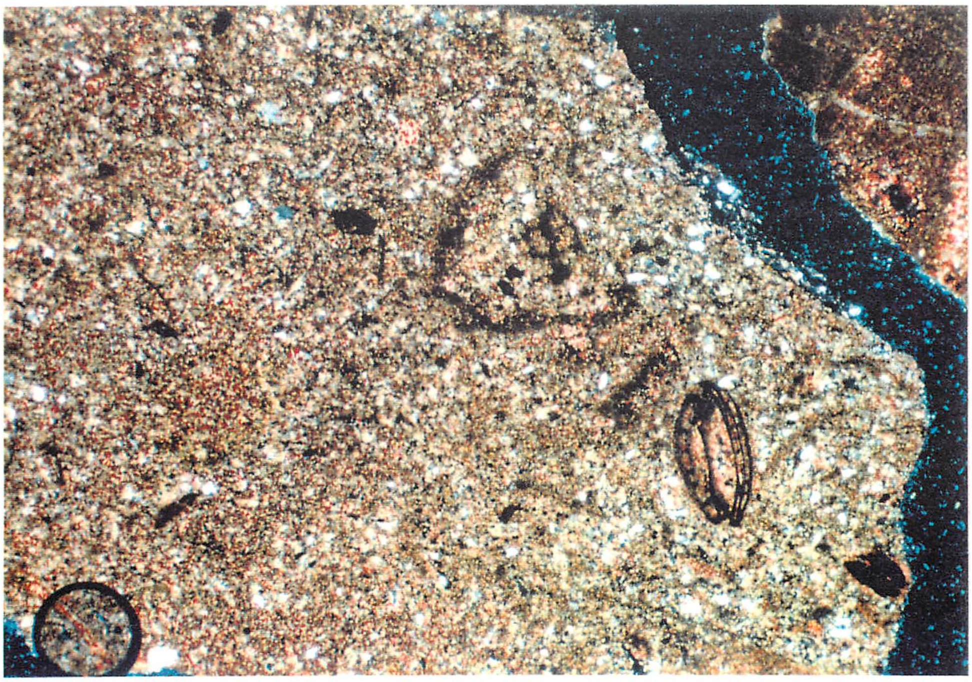
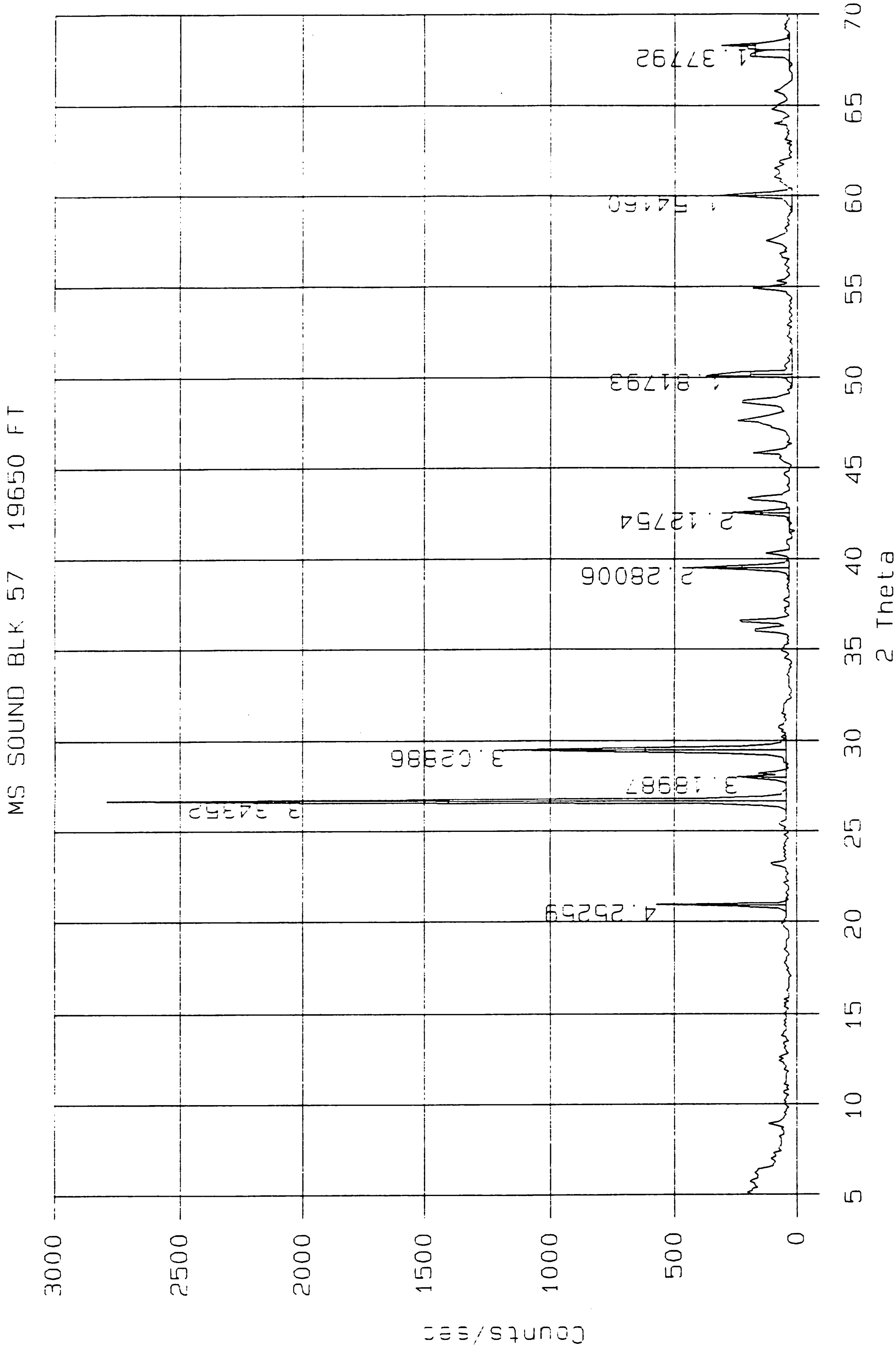


Figure CM-19650 2B. Fine-grained limestone with microfossils, opaque fossil replaced by pyrite. (crossed polars) Scale 4x.



MS SOUND BLK 57 19650 FT
2 Theta
Counts/sec
1.37792
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2.12754
2.28006
3.02986
3.18987
4.25259

PETROGRAPHIC REPORT

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-20,220

FIELD OCCURRENCE: Mississippi Sound Block 57

MACROSCOPIC DESCRIPTION: Most of the rocks in this thin section are fine-grained sandstones with various cements/matrix (calcite, clay/mica, silt, and petroliferous pyritiferous clay).

MINERALS	%	SIZE(mm)	ALTERATION PRODUCTS	OPTICAL DATA
MAJOR (> 10%)				
Quartz	10-80%	0.1-0.3		mostly sharp extinction and monocrystalline
clasts	10-70%			
chert	0-5%			
polycrystalline	0-2%			
Calcite	2-15%	<0.05		very fine-grained, red
Dolomite(?)	0-15%	0.05-0.1		clear rhombohedrons
MINOR (< 10%)				
Plagioclase	0-2%	0.1-0.2		albite twinning
Muscovite	<1%			clear in ppl; high biref
Biotite	trace		chlorite	pale to dark brown pleochroism
ACCESSORY (not used for classification)				
Pyrite	<1%	0.1		
Bitumen	0-1%			occurs in thin streaks, opaque, black, vitreous in reflected light
ALTERATION PRODUCTS				
Chlorite			after biotite	brown and Berlin blue anomalous birefringence; very pale green in ppl

OTHER DATA:

PHOTOMICROGRAPHS: Yes

4 different views

X-RAY POWDER DIFFRACTION DATA: Yes

whole rock powder diffraction pattern 5°-70° two theta

SCANNING SCOPE DATA: No

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-20,220

MICROSCOPIC DESCRIPTION:

Most of the cuttings in this thin section are composed of various types of fine-grained quartz sandstone. Other rocks include relatively small percentages of bioclastic limestone and arenaceous siltstone and mudstone.

Silica clasts include angular quartz with mostly sharp extinction (small % is wavey), chert, polycrystalline quartz; some clasts are bioclasts, and the rest are muscovite and biotite. Dolomite is a replacement mineral after calcite. Pyrite and bitumen are present as accessories.

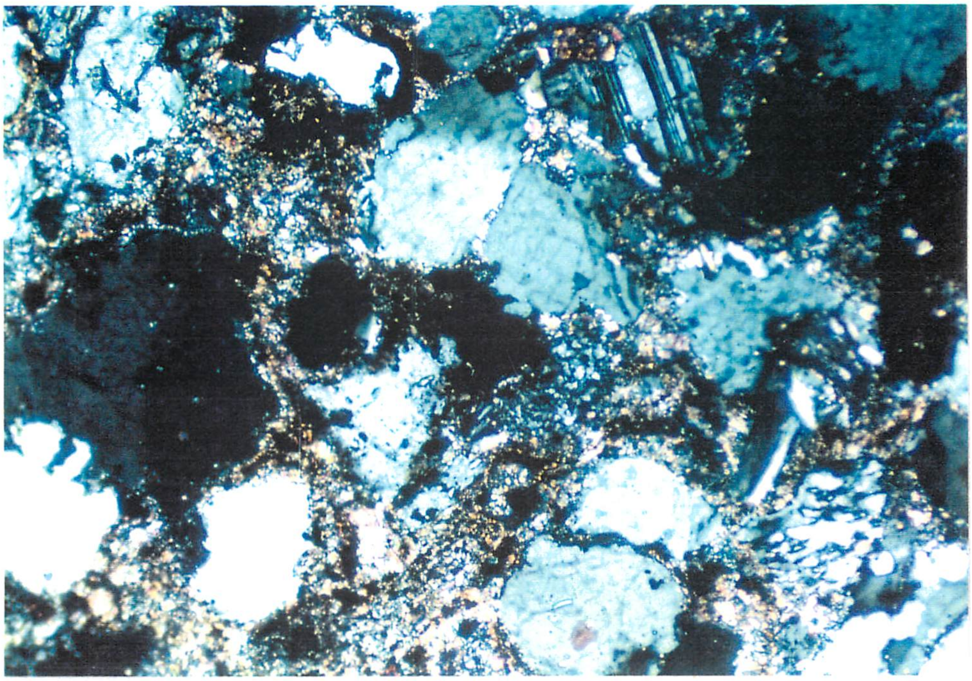


Figure CM-20220 2A. Quartz sandstone with monocrystalline quartz, lesser amounts of chert, polycrystalline quartz, and plagioclase feldspar. Matrix is composed of calcite and clay/mud. (crossed polars) Scale 10x.

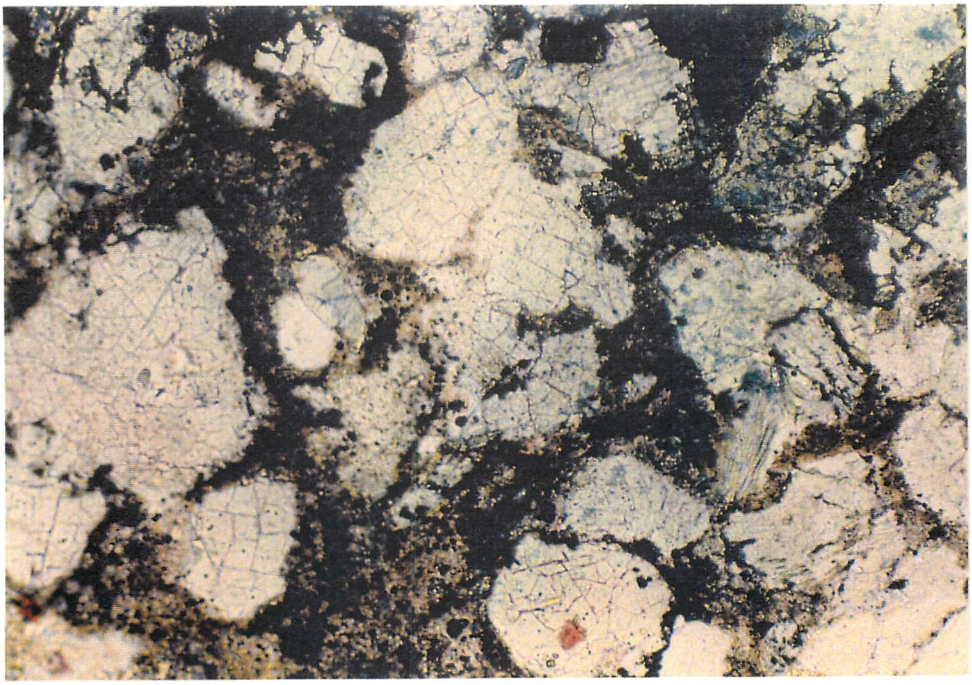


Figure CM-20220 2B. Quartz sandstone with monocrystalline quartz, lesser amounts of chert, polycrystalline quartz, and plagioclase feldspar. Matrix is composed of calcite and clay/mud. (ppl) Scale 10x.

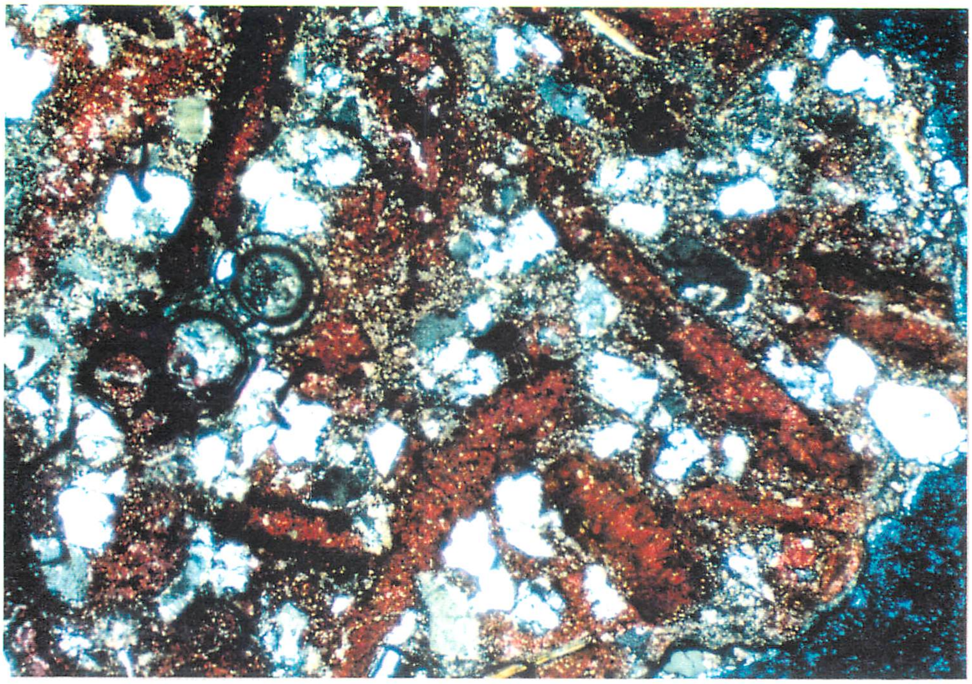


Figure CM-20220 4A. View of both quartz and calcite bioclasts in a matrix of bitumen, muscovite, dolomite(?), and clay. (crossed polars) Scale 4x.

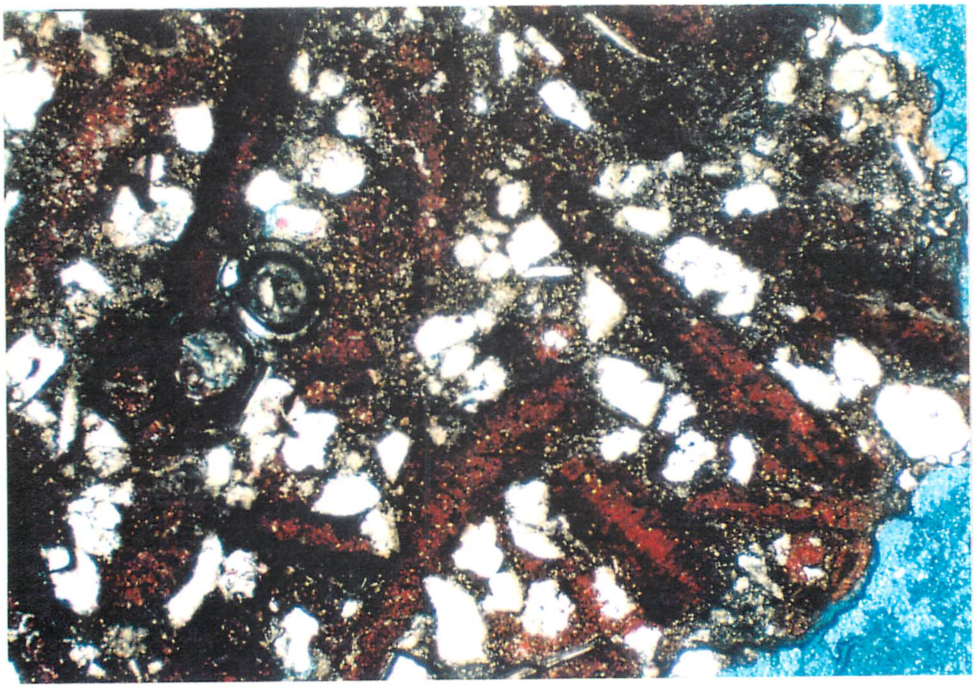
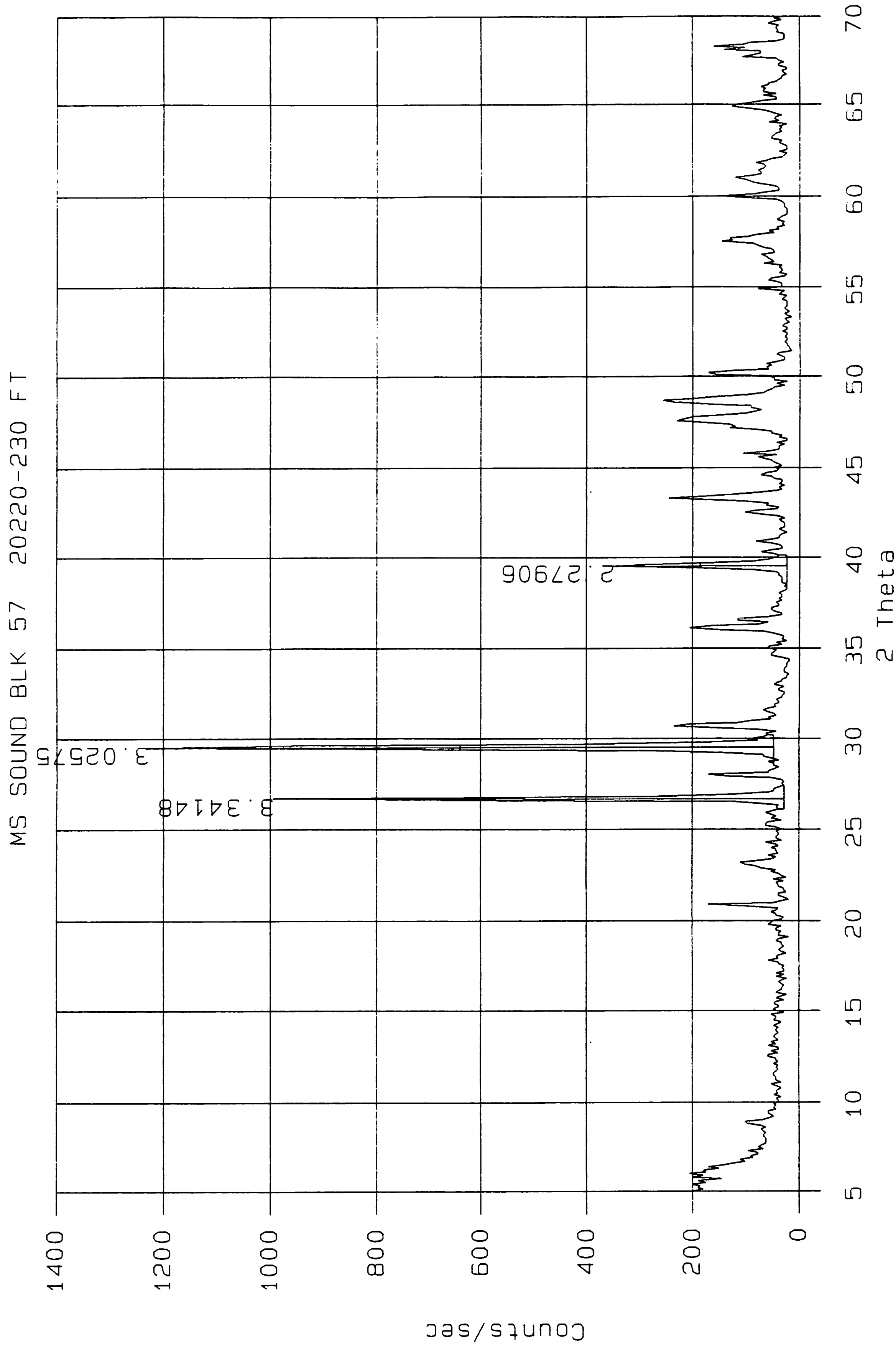


Figure CM-20220 4B. View of both quartz and calcite bioclasts in a matrix of bitumen, muscovite, dolomite(?), and clay. (ppl) Scale 4x.


MS SOUND BLK 57 20220-230 FT
3.34148
3.02575
2.27906
2 Theta
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Counts/sec
0
200
400
600
800
1000
1200
1400

PETROGRAPHIC REPORT

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-21,880/CM-21,960

FIELD OCCURRENCE: Mississippi Sound Block 57

MACROSCOPIC DESCRIPTION: Cuttings in both samples are composed of quartz sandstone with varying amounts of carbonate (mostly dolomite) cement.

MINERALS	%	SIZE(mm)	ALTERATION PRODUCTS	OPTICAL DATA
MAJOR (> 10%)				
Quartz	80-95%	0.1-0.5		mostly w/sharp ext & monocrystalline
Carbonate	5-20%	0.1-0.4		in clusters or single rhombohedrons
dolomite	4-18%			
calcite	1-2%			
MINOR (< 10%)				
Chert	< 1%	0.1-0.3		
Plagioclase	1-2%		sericite, clay	albite twinning; pressure kinks
Muscovite	trace			
ACCESSORY (not used for classification)				
Pyrite	trace	0.05-0.1		
Bitumen(?)	trace			dark brown, vitreous

ALTERATION PRODUCTS

clay, sericite after plagioclase

OTHER DATA:

PHOTOMICROGRAPHS: Yes

2 different views (CM-21,880); 1 view (CM-21,960)

X-RAY POWDER DIFFRACTION DATA: Yes

whole rock powder pattern 5°-70°

SCANNING SCOPE DATA: No

PETROGRAPHIC REPORT (continued)

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-21-880/CM-21,960

MICROSCOPIC DESCRIPTION:

Cuttings in both thin sections are of quartz sandstone. Quartz mostly subangular, monocrystalline, and displays mostly sharp extinction. Some chert is present. Some of the sandstones are lithified as a grain-boundary contact with no cement; about 50% has a carbonate (mostly dolomite?) cement/matrix.

Plagioclase and calcite are also present. Plagioclase is slightly altered, and the calcite is seen as a residual(?) matrix mineral.

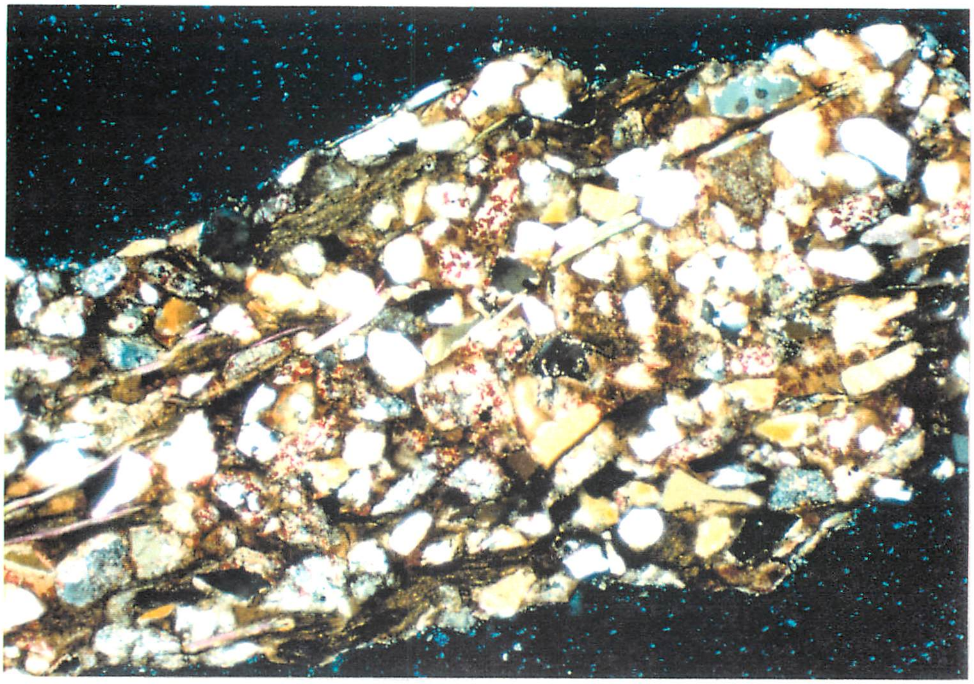


Figure CM-21880 2A. View of abundant quartz in dolomite(?) matrix. Muscovite appears as high birefringent/relief elongate grains. (crossed polars) Scale 4x.

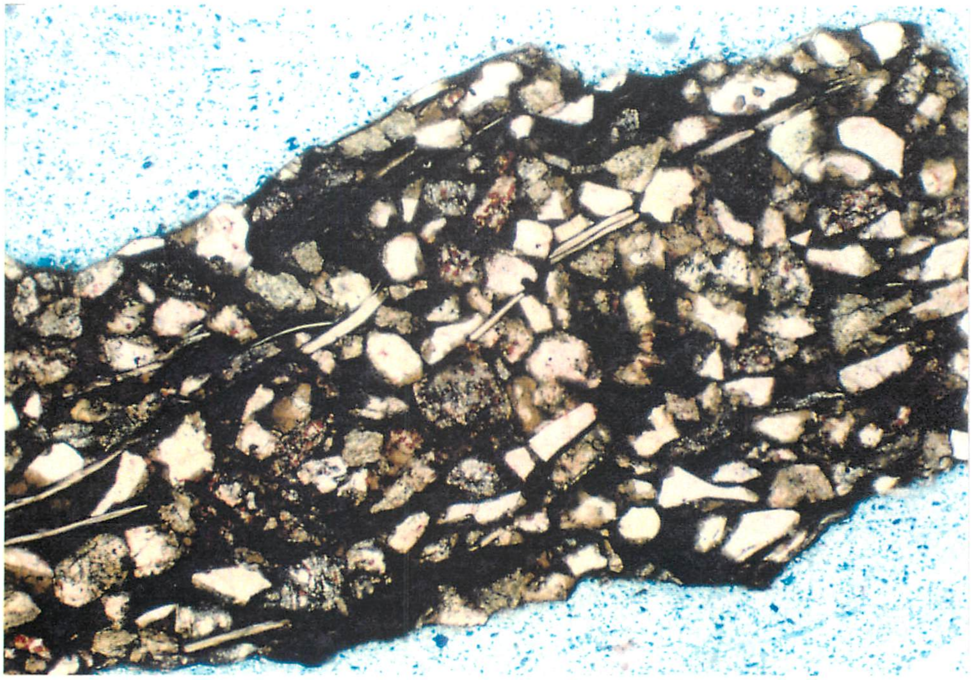
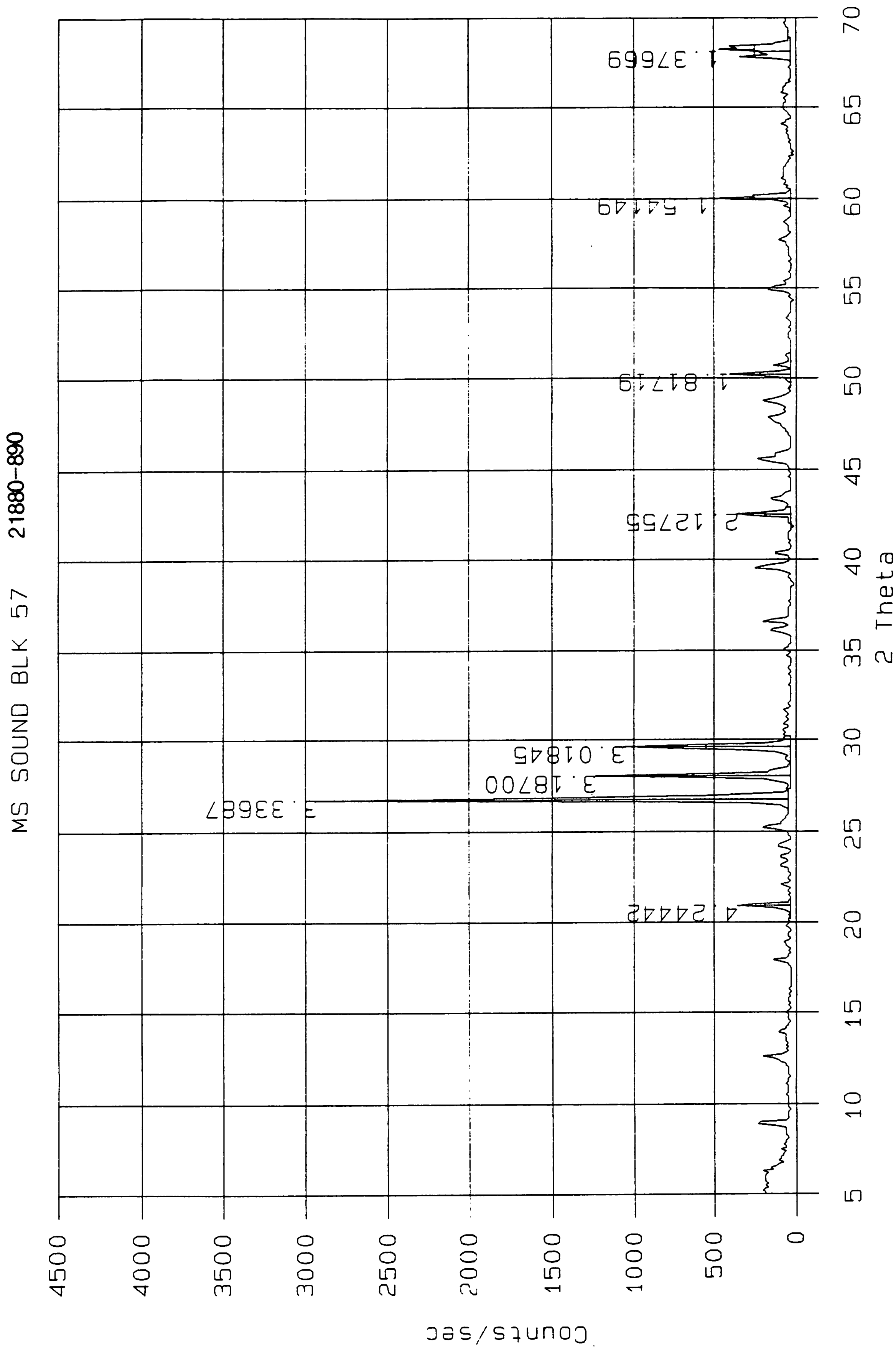


Figure CM-21880 2B. View of abundant quartz in dolomite(?) matrix. Muscovite appears as high birefringent/relief elongate grains. (ppl) Scale 4x.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1.54149
1.81719
2.12755
3.01845
3.18700
3.33687
4.24442
5
10
15
20
25
30
35
40
45
50
55
60
65
70
2 Theta
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Counts/sec

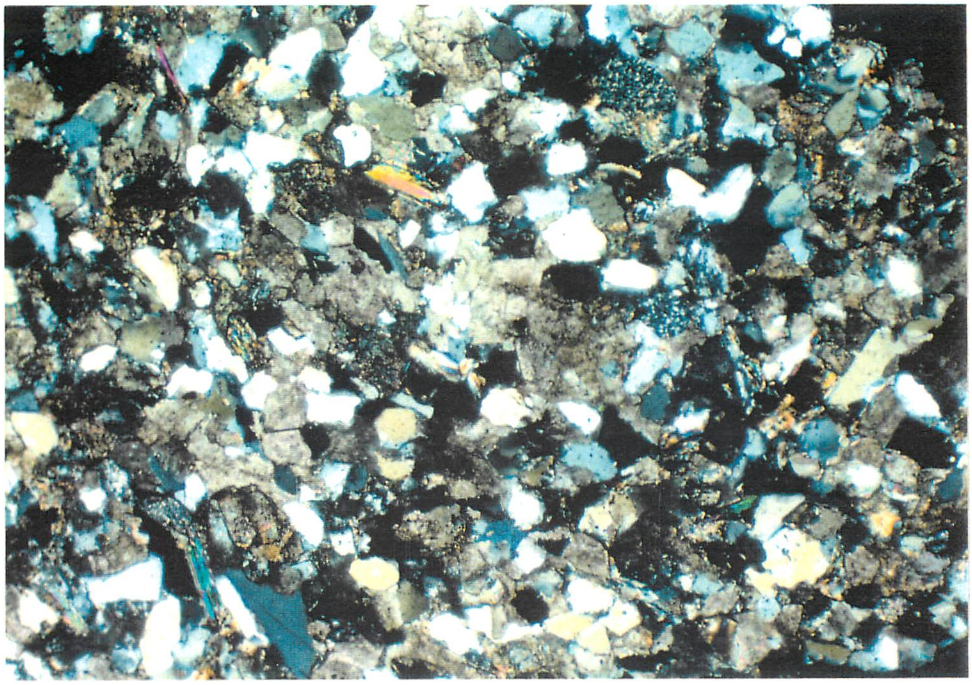


Figure CM-21960 1A. View of quartz sandstone with some plagioclase present surrounded by carbonate matrix of calcite (red) and dolomite(? pale brown rhombohedrons). (crossed polars) Scale 4x.

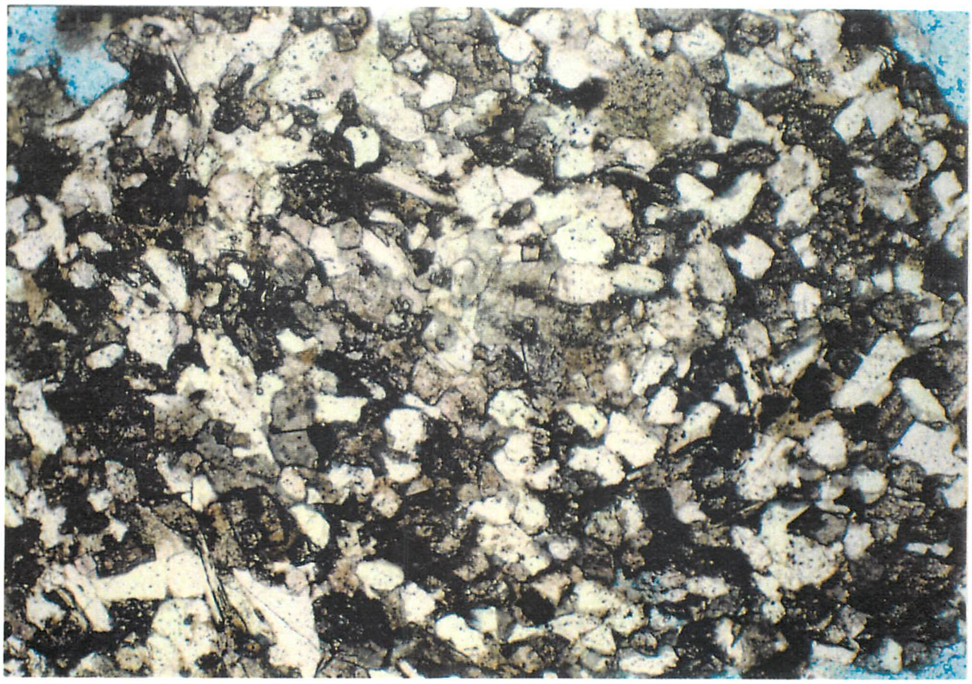
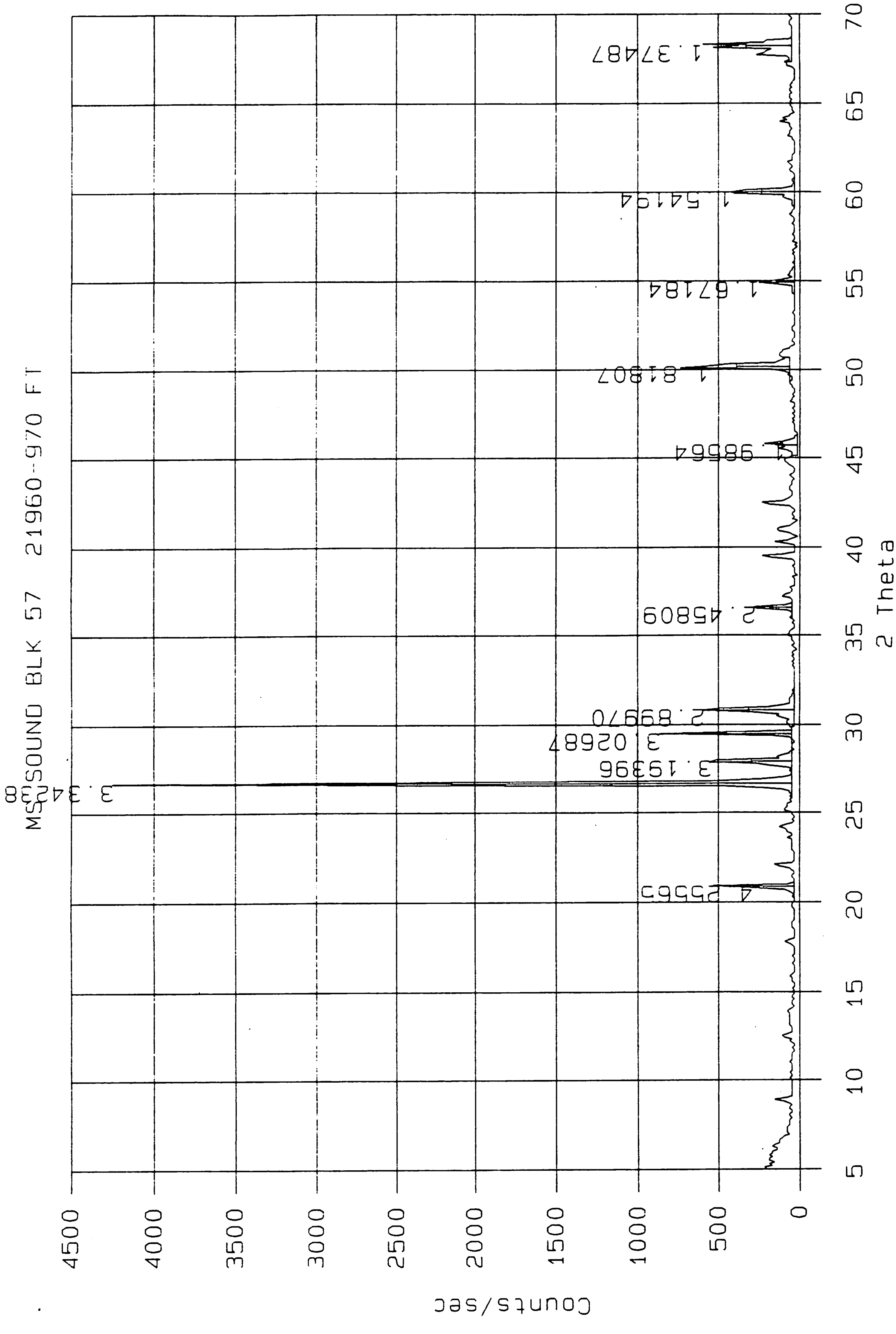


Figure CM-21960 1B. View of quartz sandstone with some plagioclase present surrounded by carbonate matrix of calcite (red) and dolomite(?) (pale brown rhombohedrons). (ppl) Scale 4x.


MS SOUND BLK 57 21960-970 FT
2 Theta
Counts/sec
0
500
1000
1500
2000
2500
3000
3500
4000
4500
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25
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40
45
50
55
60
65
70
4.25565
3.34238
3.19396
3.02687
2.89970
2.45809
1.98564
1.81807
1.67184
1.54194
1.37487

PETROGRAPHIC REPORT

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-22390

FIELD OCCURRENCE: Mississippi Sound Block 57

MACROSCOPIC DESCRIPTION: All cuttings are composed of calcareous quartz sandstone. Most of the carbonate is dolomite(?) replacing calcite. Several chips show significant bitumen & pyrite content.

MINERALS	%	SIZE(mm)	ALTERATION PRODUCTS	OPTICAL DATA
MAJOR (> 10%)				
Quartz	60-80%	0.1-0.4		angular to subangular mostly sharp extinction, monocrystalline
Carbonate	15-35%	0.1-0.4		
calcite	5-10%			
dolomite?	10-39%			
and other unidentified carbonates				
MINOR (< 10%)				
Muscovite	1-5%	0.1-0.4		
Biotite	< 1%	0.1-0.2	chlorite	pale brown pleochroism
Plagioclase	1-5%	0.1-0.3		polysynthetic twinning (Albite Law)
ACCESSORY (not used for classification)				
Pyrite	1%	0.01-0.05		
Bitumen				
ALTERATION PRODUCTS				
Chlorite			after biotite	brown and blue anomalous birefringence; pale green pleochroism

OTHER DATA:

PHOTOMICROGRAPHS: Yes

1 view (several magnifications)

X-RAY POWDER DIFFRACTION DATA: Yes

whole rock powder diffraction pattern 5°-70°

SCANNING SCOPE DATA: No

PETROGRAPHIC REPORT (continued)

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-22390

MICROSCOPIC DESCRIPTION:

All cuttings in the thin section are quartz sandstone with variable amounts and types of cement and matrix. The quartz grains are angular to subangular, show mostly sharp extinction, are primarily monocrystalline. A small amount (< 1%) of chert is present. Carbonate minerals include calcite (stained red), dolomite? (colorless rhombs replacing calcite), and possible other carbonates, possibly siderite or ankerite. They occur in the cement/matrix.

Muscovite is common and is usually seen in sub-parallel alignment. Pleochroic biotite is also present, and it alters to pale green pleochroic chlorite.

Bitumen and pyrite are present in small amounts and occur in the matrix.

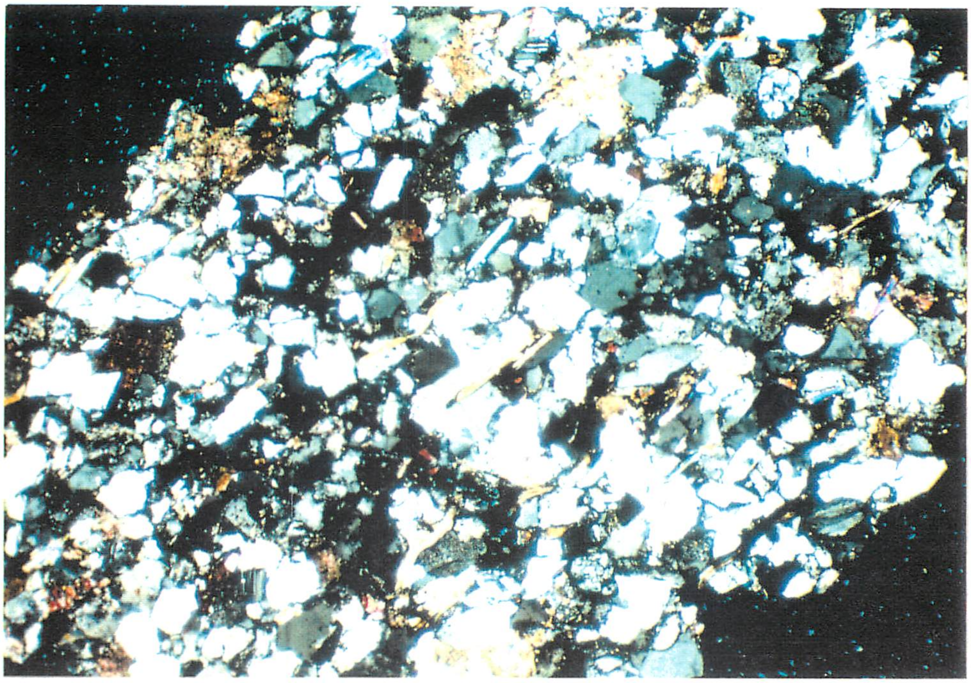


Figure CM-22390 1A. Photomicrograph showing quartz in colorless carbonate (dolomite?) cement. Muscovite (high birefringence /relief) and some altered biotite (brown pleochroism) are also present in small amounts. Blue area indicates porosity. Opaque minerals are pyrite and bitumen. (Crossed polars) Scale 4x.

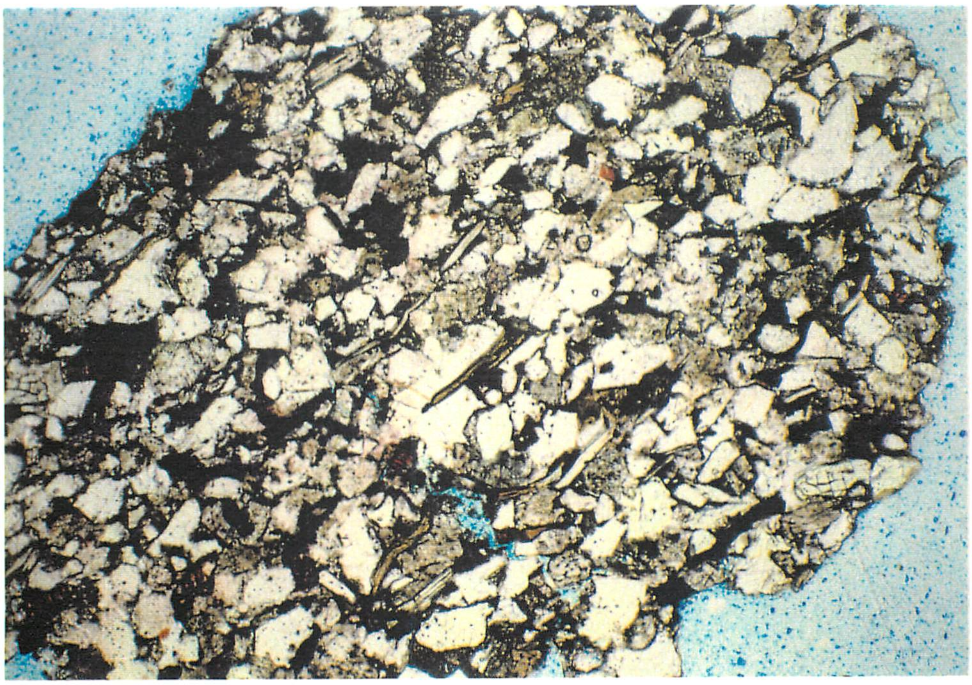
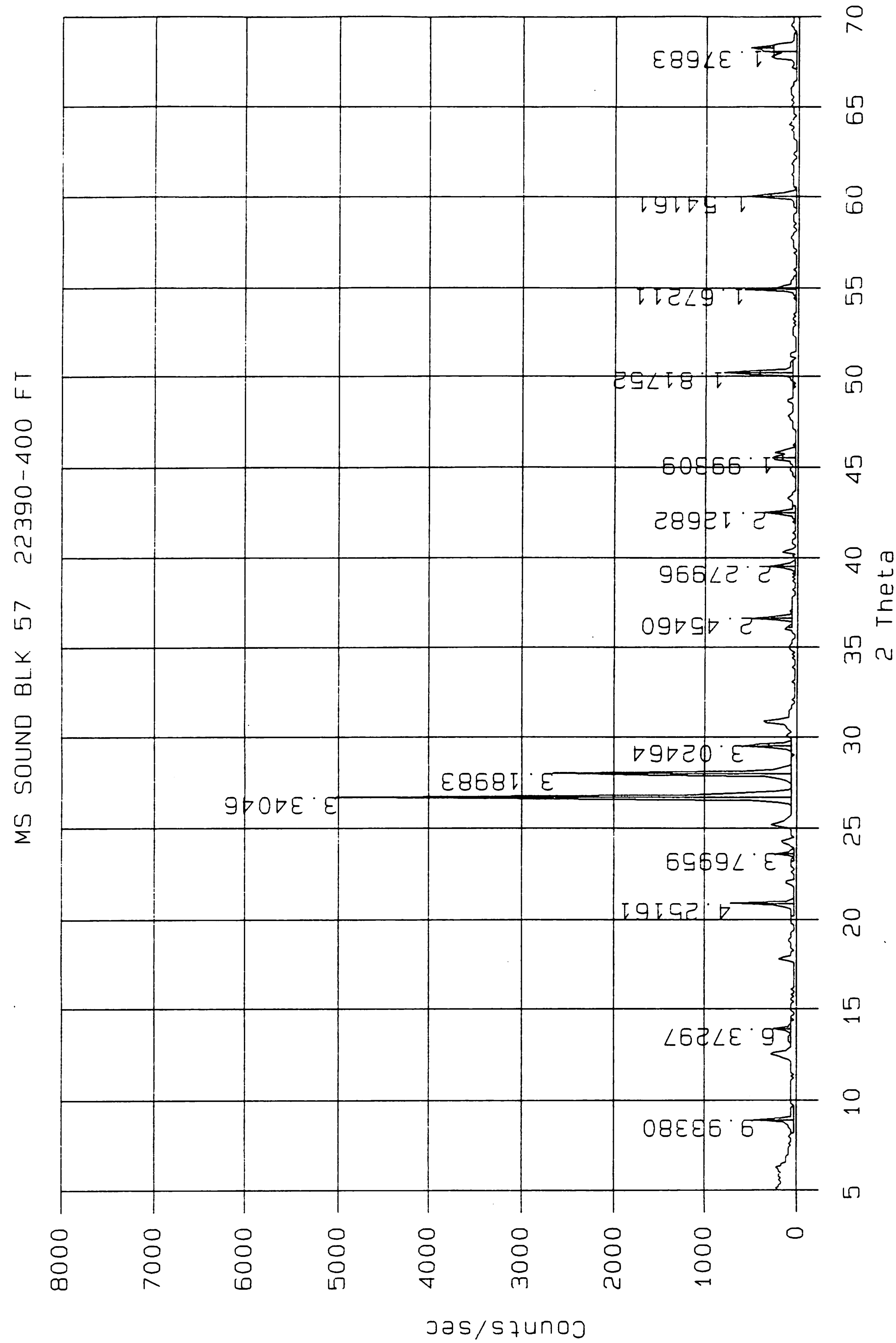


Figure CM-22390 1B. Photomicrograph showing quartz in colorless carbonate (dolomite?) cement. Muscovite (high birefringence /relief) and some altered biotite (brown pleochroism) are also present in small amounts. Blue area indicates porosity. Opaque minerals are pyrite and bitumen. (ppl) Scale 4x.


MS SOUND BLK 57 22390-400 FT
Counts/sec
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7000
6000
5000
4000
3000
2000
1000
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
9.93380
6.37297
4.25161
3.76959
3.34046
3.18983
3.02464
2.45460
2.27996
2.12682
1.99309
1.81752
1.67211
1.54161
1.37683

PETROGRAPHIC REPORT

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-22440

FIELD OCCURRENCE: Mississippi Sound Block 57

MACROSCOPIC DESCRIPTION: All cuttings are carbonate-cemented quartz sandstones. Cement/matrix is pale brown, distinctly different from cement/matrix of shallower samples (Fe carbonate?)

MINERALS	%	SIZE(mm)	ALTERATION PRODUCTS	OPTICAL DATA
MAJOR (> 10%)				
Quartz	50-80%	0.2-0.4		subangular to sub-rounded grains; sharp extinction & monocrystalline
Carbonate	20-35%	0.1-0.3		
siderite?	20-25%			pale brown
calcite	0-5%			stained red
MINOR (< 10%)				
Muscovite	5-10%			clear, hi relief/ppl intense biref (Xpol)
Biotite	2-5%		chlorite	pale brown pleochroism
Plagioclase	2-5%		clay	cloudy w/albite twin
ACCESSORY (not used for classification)				
Pyrite	1%	0.05-0.1		euhedral forms, octahedral faces
Bitumen	trace			vitreous, dark brown
ALTERATION PRODUCTS				
Clay			after plagioclase	makes grains appear cloudy
Chlorite			after biotite	pale green pleochro; anomalous brown & blue birefringence

OTHER DATA:

PHOTOMICROGRAPHS: Yes

3 different views

X-RAY POWDER DIFFRACTION DATA: Yes

whole rock powder diffraction pattern 5°-70°

SCANNING SCOPE DATA: No

PETROGRAPHIC REPORT (continued)

PETROGRAPHER: Dan Sundeen DATE: May 10, 1993

LOCATION: Chevron MS-87-1-OS#1 SAMPLE NUMBER: CM-22440

MICROSCOPIC DESCRIPTION:

In thin section, the rock is a iron-carbonate (siderite?) cemented quartz sandstone. Muscovite and biotite are present as minor minerals.

Quartz is subangular to subrounded, displays mostly sharp extinction, and is primarily monocrystalline.

Muscovite and biotite are aligned in a subparallel orientation. Biotite has a brown pleochroism and as often altered to pale green chlorite. Plagioclase displays albite twinning when fresh; when altered, it appears cloudy to opaque in ppl with clay and sericite as alteration products.

Accessory minerals include pyrite and bitumen. Pyrite appears as euhedral crystals, and bitumen is a dark brown to black, vitreous opaque mass.

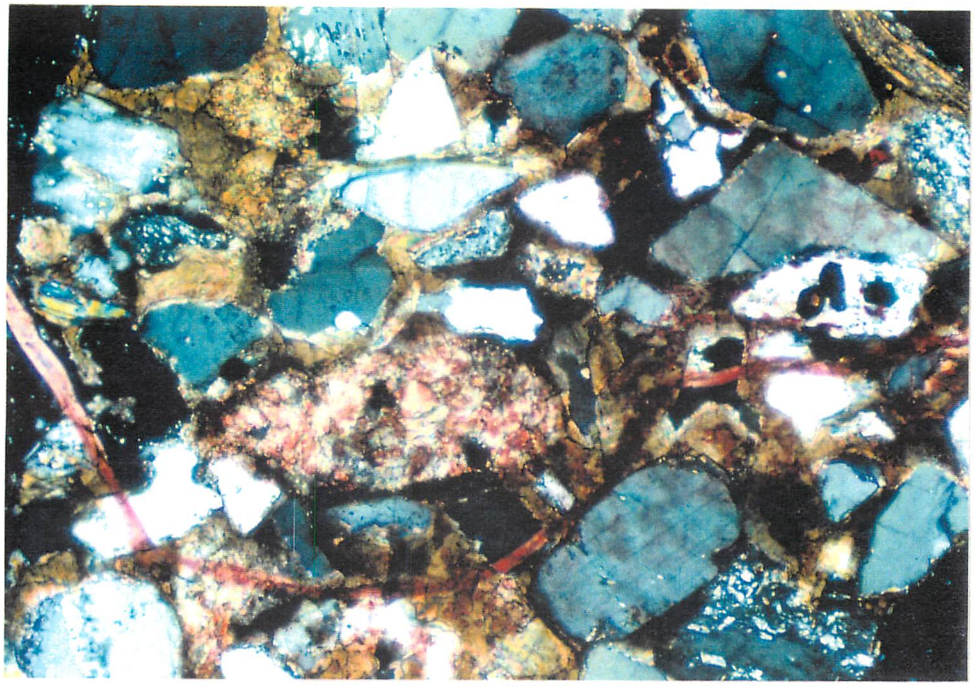


Figure CM-22440 1A. Photomicrograph displaying calcareous quartz sandstone, quartz grains in a matrix of siderite(?). Also present are calcite, plagioclase (fresh and altered), and euhedral pyrite. (Crossed polars) Scale 10x.

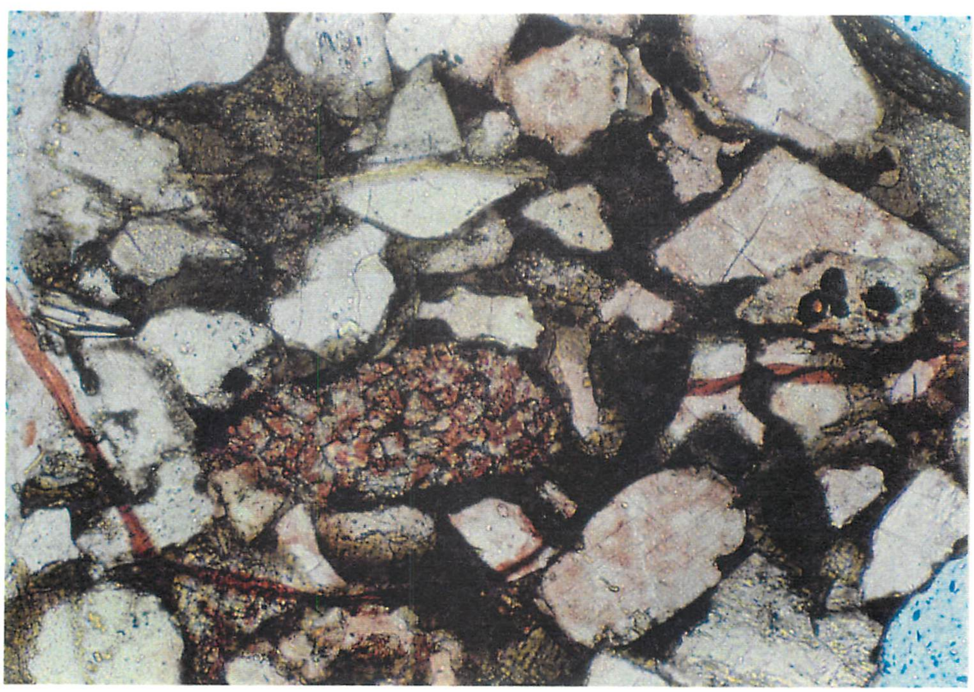


Figure CM-22440 1B. Photomicrograph displaying calcareous quartz sandstone, quartz grains in a matrix of siderite(?). Also present are calcite, plagioclase (fresh and altered), and euhedral pyrite. (ppl) Scale 10x.

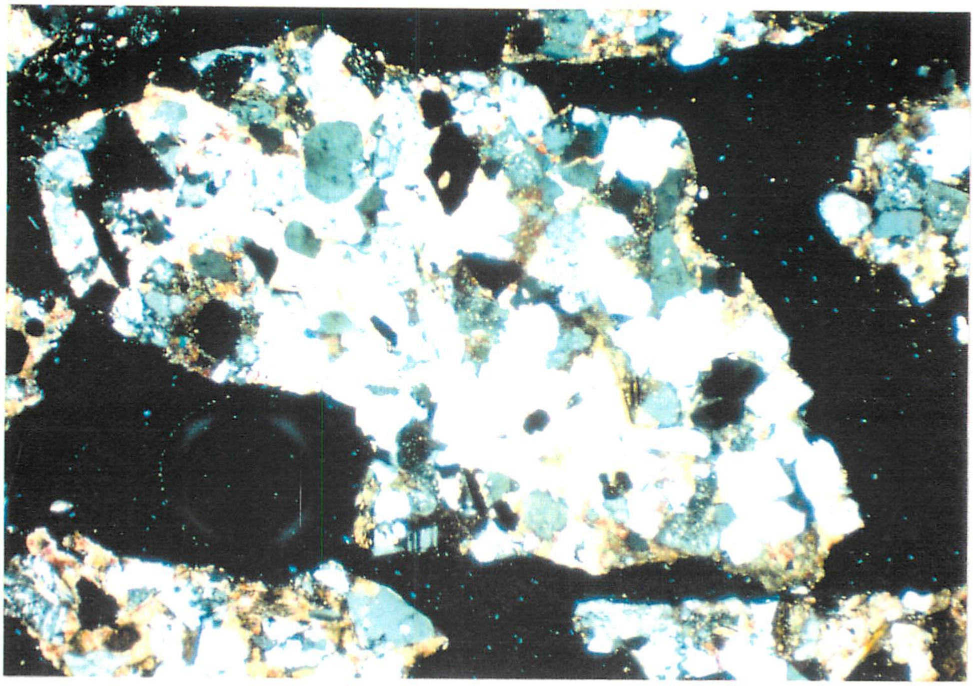


Figure CM-22440 3B. Photomicrograph of quartz sandstone in matrix of siderite(?). Other minerals include muscovite, and fresh and altered biotite and plagioclase. (Crossed polars) Scale 4x.

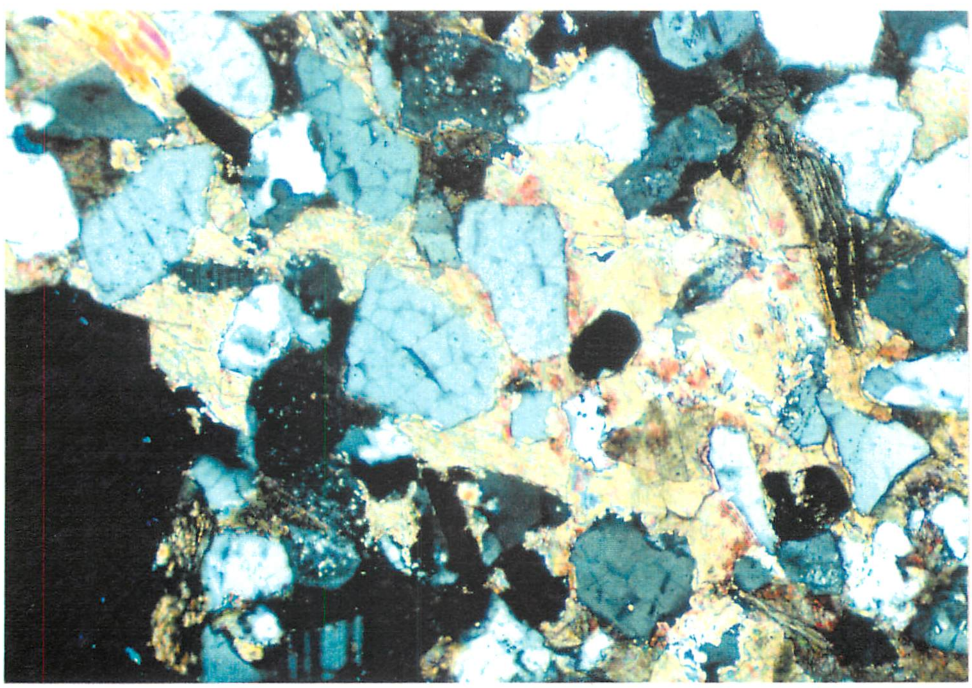
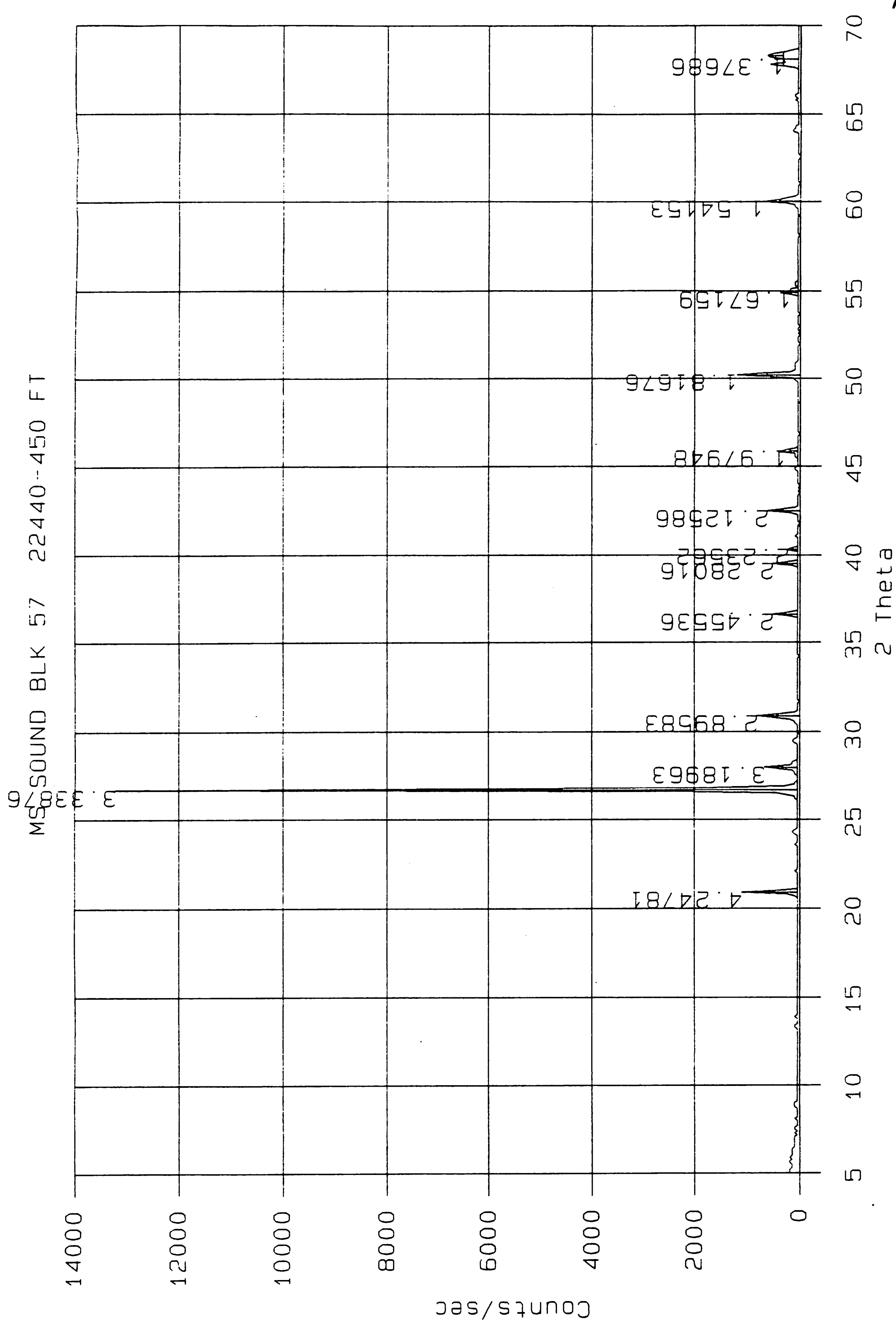


Figure CM-22440 3C. Photomicrograph of quartz sandstone in matrix of siderite(?). Other minerals include muscovite, and fresh and altered biotite and plagioclase. (Crossed polars) Scale 10x.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Counts/sec
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12000
10000
8000
6000
4000
2000
0
2 Theta
5
10
15
20
25
30
35
40
45
50
55
60
65
70
4.24781
3.33876
3.18963
2.89583
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1.37686

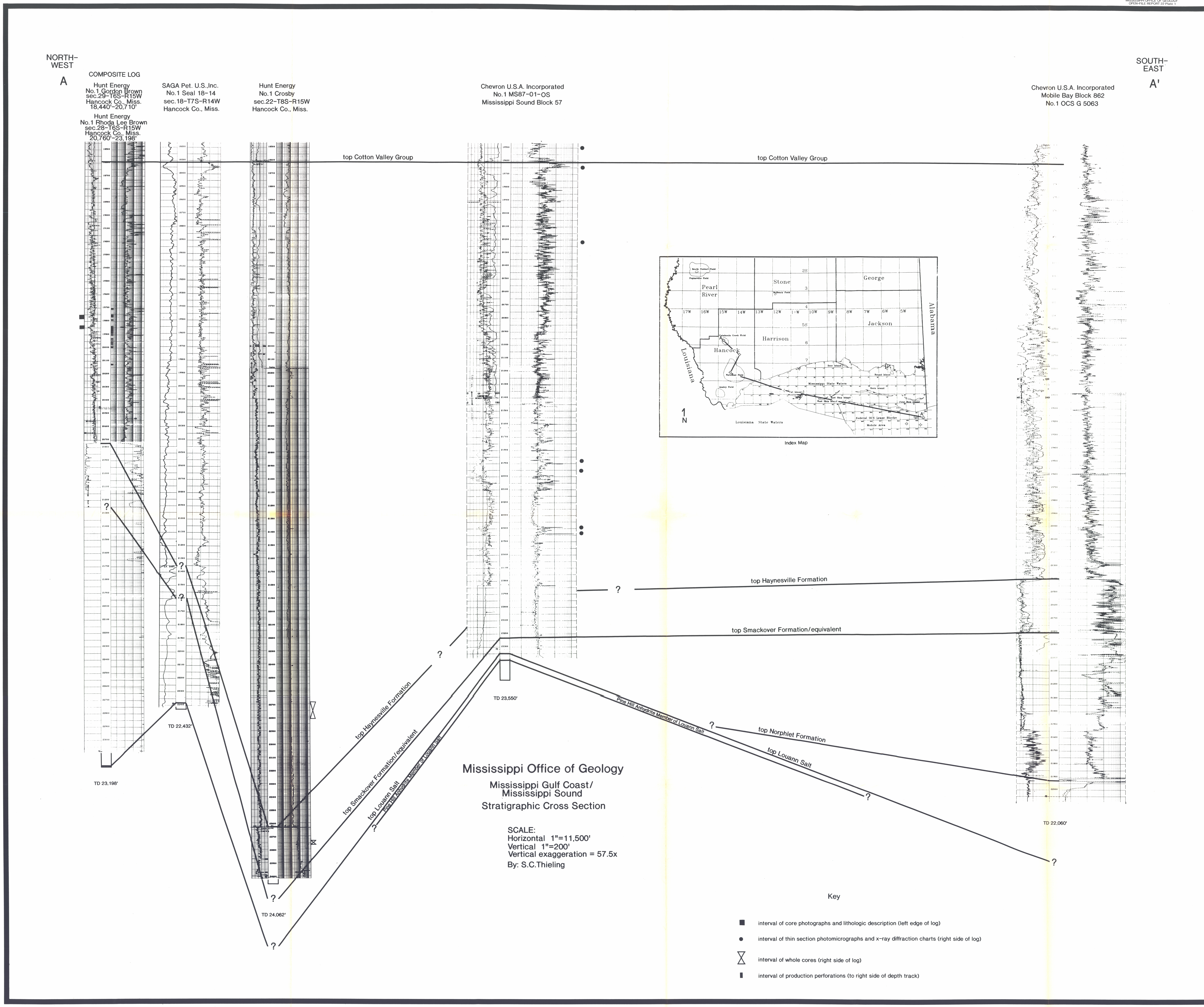
NORTH-WEST
A
COMPOSITE LOG
Hunt Energy
No.1 Gordon Brown
sec.29-T6S-R15W
Hancock Co., Miss.
18,440'-20,710'
Hunt Energy
No.1 Rhoda Lee Brown
sec.28-T6S-R15W
Hancock Co., Miss.
20,760'-23,198'
SAGA Pet. U.S.,Inc.
No.1 Seal 18-14
sec.18-T7S-R14W
Hancock Co., Miss.
Hunt Energy
No.1 Crosby
sec.22-T8S-R15W
Hancock Co., Miss.
Chevron U.S.A. Incorporated
No.1 MS87-01-OS
Mississippi Sound Block 57
Chevron U.S.A. Incorporated
Mobile Bay Block 862
No.1 OCS G 5063
SOUTH-EAST
A'
top Cotton Valley Group
top Cotton Valley Group
top Haynesville Formation
top Haynesville Formation
top Smackover Formation/equivalent
top Smackover Formation/equivalent
top Louann Salt
Pine Hill Anhydrite Member of Louann Salt
Pine Hill Anhydrite Member of Louann Salt
top Norphlet Formation
top Louann Salt
TD 23,198'
TD 22,432'
TD 24,062'
TD 23,550'
TD 22,060'
Pearl River
Stone
George
Hancock
Harrison
Jackson
Louisiana
Alabama
Louisiana State Waters
N
Index Map
Mississippi Office of Geology
Mississippi Gulf Coast/
Mississippi Sound
Stratigraphic Cross Section
SCALE:
Horizontal 1"=11,500'
Vertical 1"=200'
Vertical exaggeration = 57.5x
By: S.C.Thieling
Key
interval of core photographs and lithologic description (left edge of log)
interval of thin section photomicrographs and x-ray diffraction charts (right side of log)
interval of whole cores (right side of log)
interval of production perforations (to right side of depth track)

Plate 1.

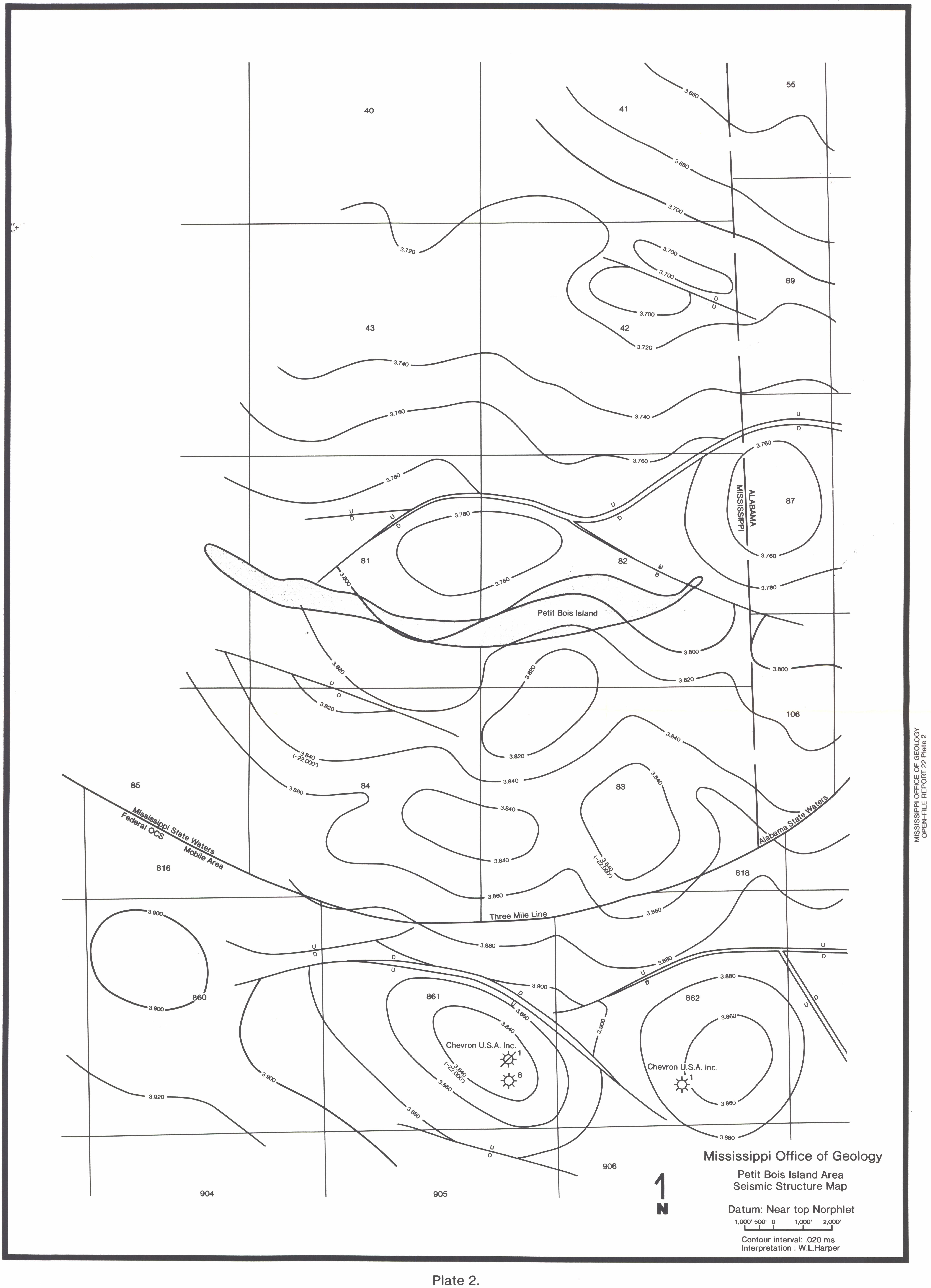
Mississippi Office of Geology
Petit Bois Island Area
Seismic Structure Map
Datum: Near top Norphlet
Contour interval: .020 ms
Interpretation : W.L.Harper
Petit Bois Island
ALABAMA
MISSISSIPPI
Mississippi State Waters
Federal OCS
Mobile Area
Alabama State Waters
Three Mile Line
Chevron U.S.A. Inc.
Chevron U.S.A. Inc.
N
MISSISSIPPI OFFICE OF GEOLOGY
OPEN-FILE REPORT 22 Plate 2

Plate 2.