Southern San Joaquin Valley
Field trip
November 12-13, 1988
co-hosts: San Joaquin Geological Society,
Pacific Section SEPM,
California State University, Bakersfield

DAY 1

Field trip Route..Exhibit 1.1 (in back pocket)

Stop 1 Wheeler Ridge

A. Refer to Namson and Davis, 1988 Geological Society of America Bulletin, v. 100, p. 257-273, specifically p. 267-271 and figures 1, 9.

B. Refer to SEPM Studies of the Geology of the San Joaquin Basin, 1988
   1. Davis and Lagoe... p. 65-88.
   2. Goodman and Malin... p. 89-108.
   3. Hirst... p. 207-222.

Stop 2 San Emigdio Canyon (Devil's Kitchen Syncline)

Refer to Namson and Davis, 1988 Geological Society of America Bulletin, v. 100, specifically p. 267-271 and figures 1, 10.

Stop 3 Crocker Canyon (Also Lunch Stop)

A. Refer to SEPM Studies of the Geology of the San Joaquin Basin, 1988
   1. Fischer and Surdan... p.233-248.
   2. Gilbert... p. 249-260.

B. Refer to SJGS Selected Papers, 1988
   1. Kiser et al... p. 22-31.

C. Refer to attachments included in back pocket as:

Exhibit 1.2 Geologic Map, Crocker Canyon area
1.3 Regional Cross Section
1.4 J.R. Gilbert ,. 1988, Upper Miocene Williams, Republic and Crocker Canyon Sandstones, Westside Southern San Joaquin Valley, California (Abs).

Stop 4 Cymric

A. Refer to inserts included in back pocket as:

Exhibit 1.5 Farley, T. and J. Marquez, 1988, Shallow Detachment Faults and Associated Folds in the Tulare Formation, Cymric Field, Kern County, California (Abs).
1.6 Baehr, S., 1988, Tulare Measured Section in Cymric.

B. Refer to Kiser et al 1988 (SJGS Selected Papers)... p. 14-21.

DAY 2

Field trip Route..Exhibit 1.1 (in back pocket)

Stop 1 Kettleman Hills

A. Refer to Metz, 1988 (included in back pocket).

B. Refer to Namson and Davis, 1988 Geological Society of America Bulletin, v. 100, p. 257-273, specifically p. 257-266, and figures 1-8.

C. Refer to attached geologic map, Exhibit 2.1.

Stop 2 Big Tar Canyon (Also Lunch Stop)

A. Refer to attached modified copy of geology as described by Williams et al, 1982 (Road log in Monterey Formation and Associated Coarse Clastic Rocks, Central San Joaquin Basin, California, Volume and Guidebook, Book 25).

Stop 3 Chico Martinez

A. Refer to SEPM Studies of the Geology of the San Joaquin Basin
   1. Schwartz... p. 281-303.

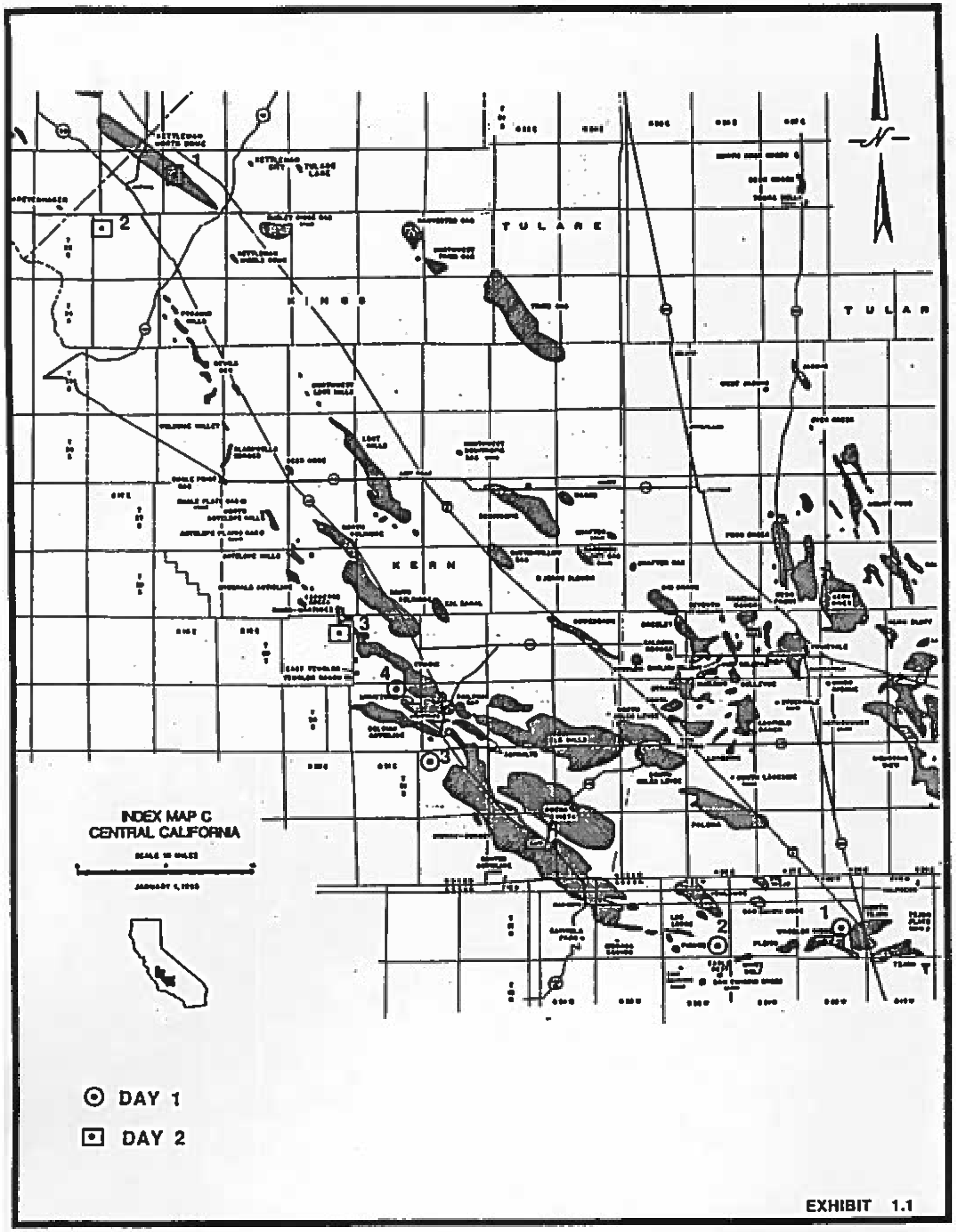


EXHIBIT 1.1

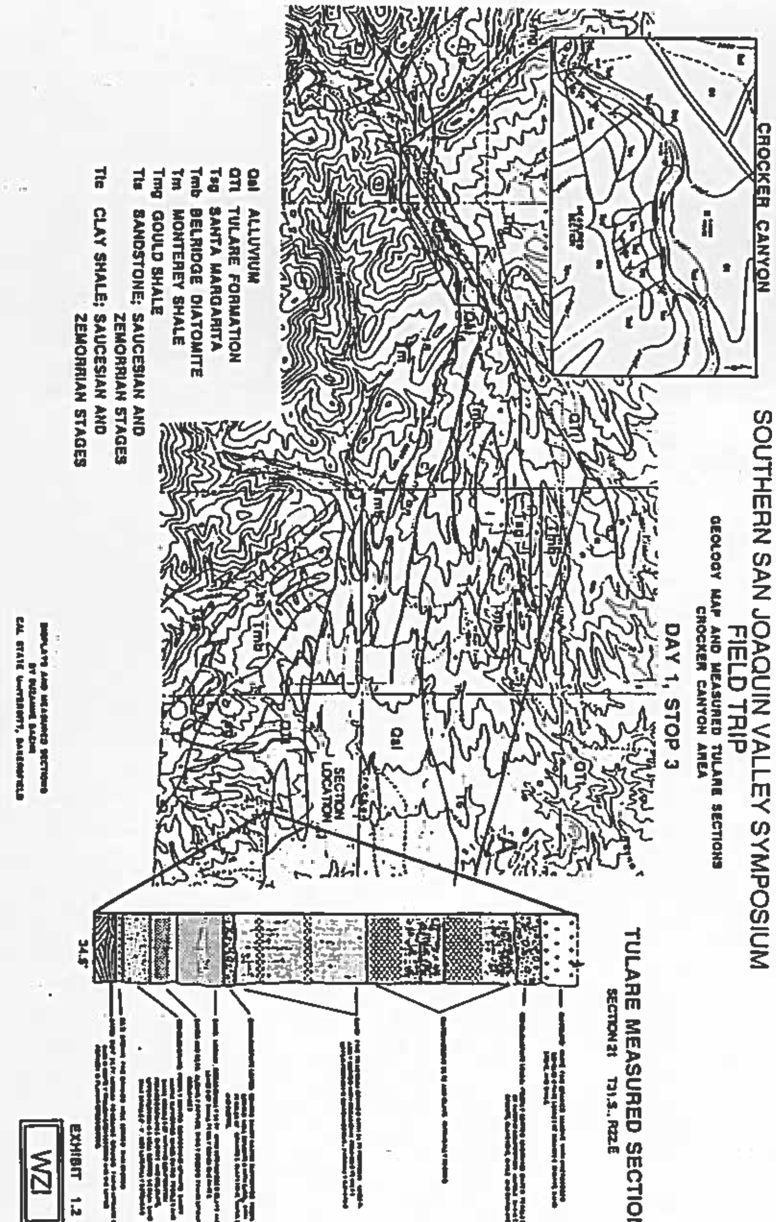
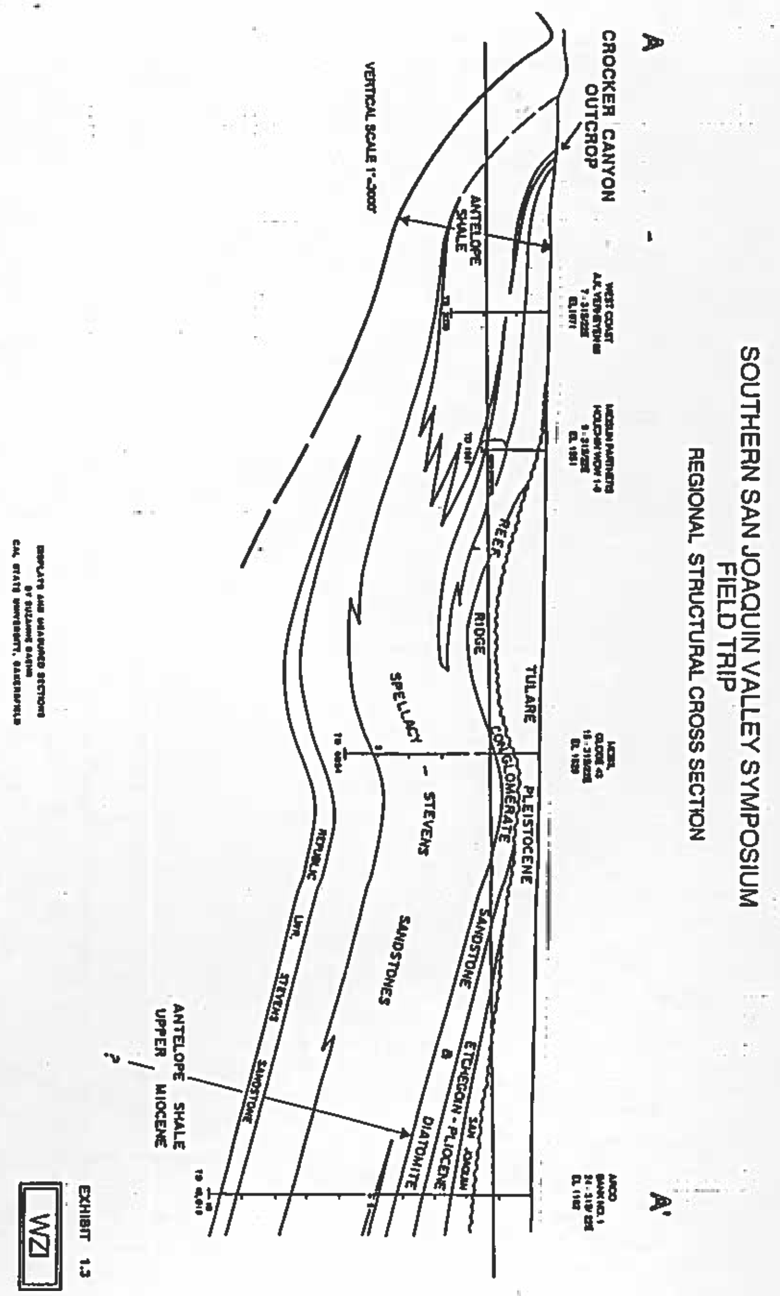


EXHIBIT 1.2



UPPER MIOCENE WILLIAMS, REPUBLIC, AND CROCKER CANYON SANDSTONES
WEST SIDE SOUTHERN SAN JOAQUIN VALLEY, CALIFORNIA

John R. Gilbert, Jr., Chevron U.S.A. Inc.

Upper Miocene Williams, Republic, and Crocker Canyon Sandstones were deposited as small, separate, relatively sand-rich submarine fans. These turbidite sandstones interfinger with the siliceous Antelope shales of the Monterey Formation and outcrop in the southeastern Temblor Range along the southwest margin of the San Joaquin Valley, California. Just north and east of their respective outcrops, Williams and Republic Sandstones produce oil and gas from relatively small anticlinal closures forming separate pools in the central Midway-Sunset Field. All three sandstone bodies are stratigraphically equivalent to the Stevens Sandstone, which is a widespread, coarse-grained turbidite underlying much of the southern San Joaquin Valley.

Williams, Republic, and Crocker Canyon Sandstones were most likely derived from a source located to the west across the San Andreas fault, based on petrographic data and limited paleocurrent analysis. The proposed source area is the granite-metamorphic basement rock of the northern Gabilan Range, which during the late Miocene was an emergant landmass only a few miles to the southwest. Since upper Mohnian time, the sandstone bodies have been offset approximately 150 miles (241 km) from the Gabilan Range source by right-slip on the San Andreas fault.

EXHIBIT 1.4

SHALLOW DETACHMENT FAULTS AND ASSOCIATED FOLDS IN THE TULARE FORMATION, CYMRIC FIELD, KERN COUNTY, CALIFORNIA

Thomas Farley
Chevron U.S.A. Inc., P. O. Box 1392
Bakersfield, California 93302

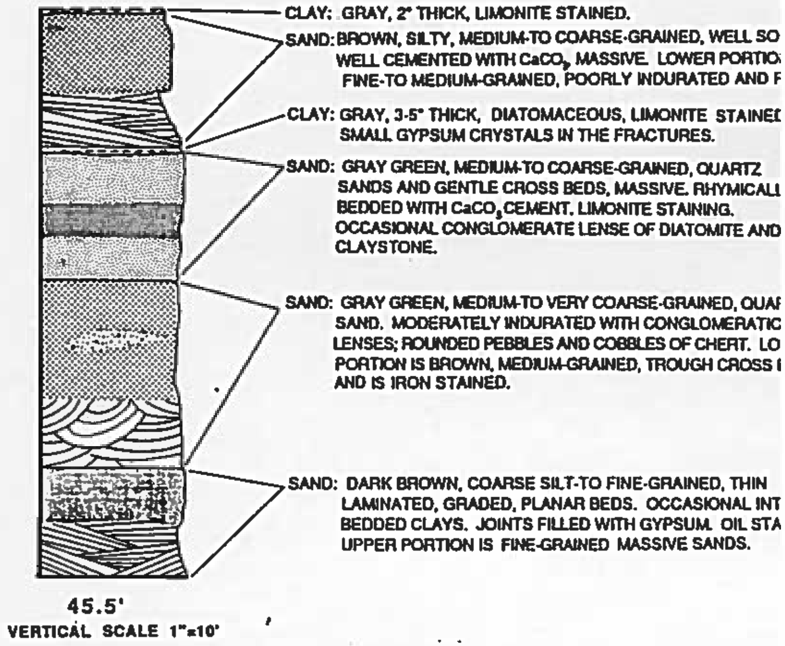
Joe Marquez
Chevron U.S.A. Inc., P. O. Box 5042
San Ramon, California 94583-0942

The Pleistocene Tulare Formation is the main productive unit in the Cymric Field and is currently undergoing active development by thermal recovery techniques. At the intersection of the Welport and McKittrick Front areas of the field, the Tulare section is deformed into a northwest-trending belt of assymetric anticlines and synclines locally decoupled along detachment faults. The best-constrained detachment surface separates tightly folded fluvio-deltaic sands from flatter, underlying, lacustrine Annicola sands along a roughly horizontal slippage surface. Balanced cross-sections reveal an additional detachment higher in the Tulare section and a third detachment located below the Tulare in the San Joaquin Formation. Uplift of the Tulare fold belt in section 1Y (30S/21E) permits surface viewing of both the tight (fault propagation) folding as well as the unroofed heavy oil reservoir that is currently being processed in down-dip thermal recovery projects.

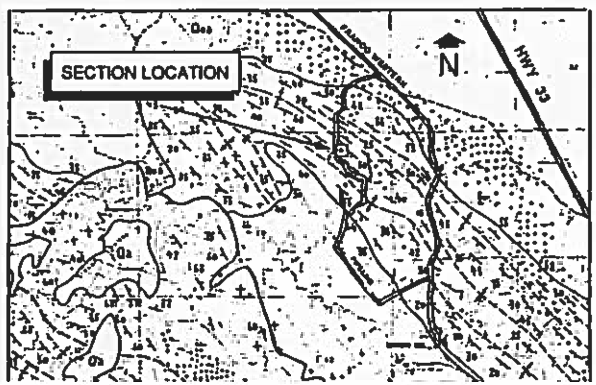
Proper recognition of shallow structure and its relationship to reservoir fluid distribution is crucial to steam drive design and performance. Modification of the original anticlinal hyrocarbon traps to present-day fluid level traps due to a lowered groundwater table has resulted in depleted anticlinal crests and hydrocarbon accumulation by gravity drainage in down-structure locations. These down-structure locations include both synclines as well as the homoclinal flanks of anticlines downdip from depleted anticlinal crests. Successful steam drive design must accomodate both the configuration of the fluid level traps as well

MEASURED TULARE SECTION

SEC.1, T30S, R21E



LOCATION MAP



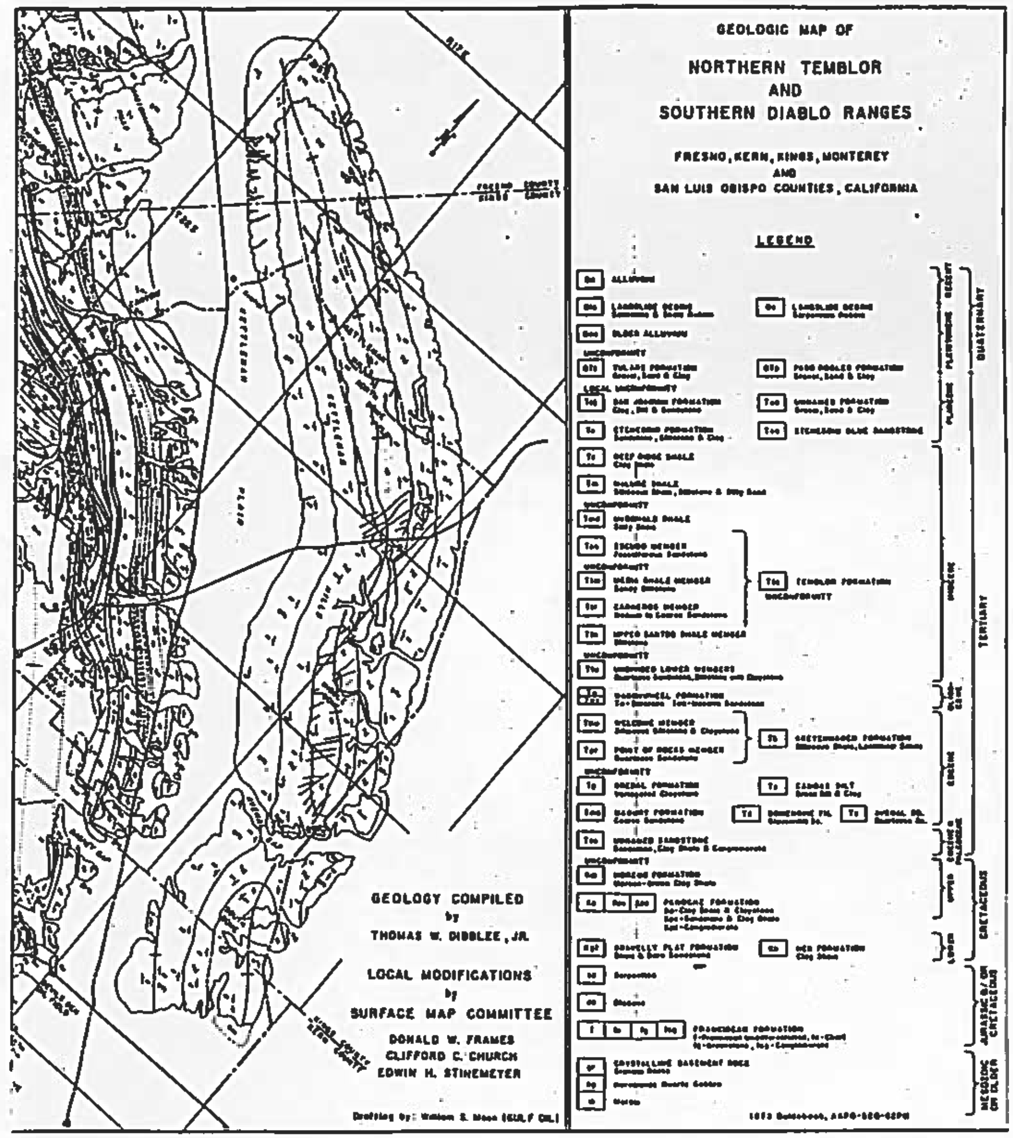

GEOLOGIC MAP OF
NORTHERN TEMBLOR
AND
SOUTHERN DIABLO RANGES
FRESNO, KERN, KINGS, MONTEREY
AND
SAN LUIS OBISPO COUNTIES, CALIFORNIA
LEGEND
GEOLOGY COMPILED
by
THOMAS W. DIBBLEE, JR.
LOCAL MODIFICATIONS
by
SURFACE MAP COMMITTEE
DONALD W. FRAMES
CLIFFORD C. CHURCH
EDWIN H. STINEMETER
QUATERNARY
TERTIARY
CRETACEOUS

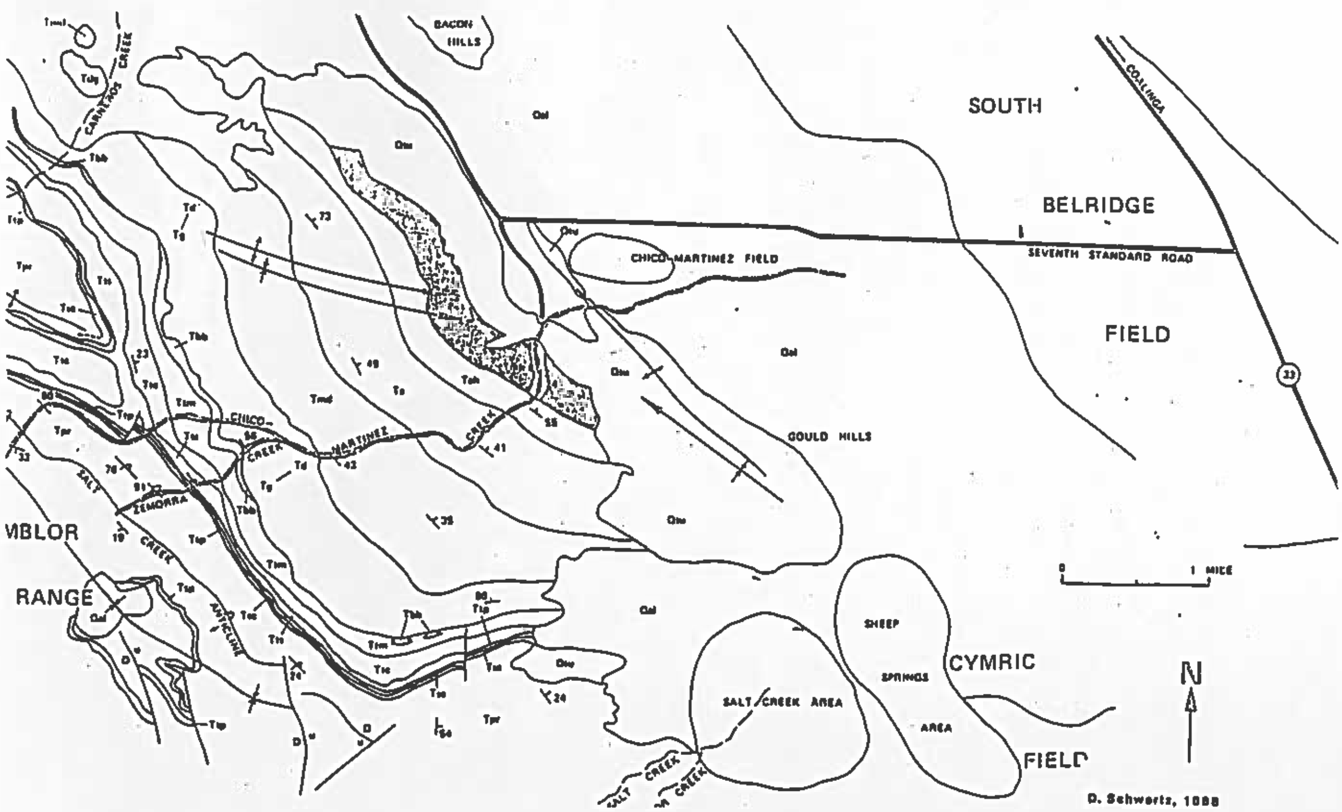
EXHIBIT 2.1

Chico-Martinez and Zemorra Creek
Kern County, California

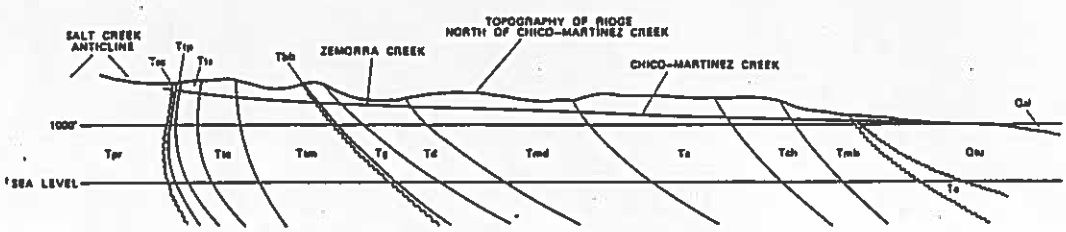
Chico-Martinez and Zemorra creeks are located in the northwestern border of Kern County in the central part of the Temblor Range. Access to these creeks is from a ranch road which begins at Seventh Standard Road and continues about seven miles up Chico-Martinez creek (see map).

Exposed in these creeks are outcrops of Quaternary and Tertiary sediments which are significant in the area for generating hydrocarbons and as reservoir rocks. Of particular importance are the shales, cherts and diatomites of the Monterey formation and the sands and shales of the Temblor formation (see cross section).

The outcropping rocks are the exposed eastern flank of the Salt Creek Anticline.



GEOLOGIC CROSS-SECTION OF
CHICO-MARTINEZ AND ZEMORRA CREEK SECTIONS,
KERN COUNTY, CALIFORNIA



AGE M.Y.	PERIOD	EPOCH	SYMBOL	FORMATION	MEMBER
	QUATERNARY	HOLOCENE	Qal	ALLUVIUM	
		PLEISTOCENE	Qtu	TULARE FORMATION	
1	TERTIARY	PLIOCENE	Te	ETCHEGOIN FORMATION	
11		? MIOCENE	Tmb	MONTEREY SHALE	BELRIDGE DIATOMITE (REEF RIDGE) MEMBER
			Tch		CHICO-MARTINEZ CHERT MEMBER (McLURE SHALE)
			Ta		ANTELOPE SHALE MEMBER (McLURE SHALE)
			Tmd		McDONALD SHALE MEMBER (McLURE SHALE)
			Td		DEVILWATER SHALE MEMBER
			Tg		GOULD SHALE MEMBER
19			Tbb	TEMBLOR FORMATION	BUTTONBED SHALE MEMBER
			Tsm		MEDIA SHALE MEMBER
			Tcs		CARNEROS SANDSTONE MEMBER
28		? OLIGOCENE (?)	Tss		SANTOS SHALE MEMBER
			Tsp		PHACOIDES (WYGAL) SANDSTONE MEMBER
			Tsc		SALT CREEK (CYMRIC) SHALE MEMBER
33		EOCENE	Tpr	POINT OF ROCKS FORMATION	

(TIME SCALE BASED ON SHELL PACIFIC COAST DIVISION, 1963)

D. Schwartz, 1988

An Introduction to the
KETTLEMAN HILLS OIL FIELD

Southern San Joaquin Valley Symposium, 1988
R. T. Metz

The Kettleman Hills oil field is located in the southwestern and northwestern portions of Fresno and Kings Counties, respectively. The Kettleman Hills are the surface expression of three large folds. The surface relief is very rugged and extends about 750 feet above the valley floor.

Structure

The Kettleman Hills oil field is composed of three northwestward-trending anticlines - the North Dome, Middle Dome and South Dome. These structures lie along a trend running parallel to the Coast Ranges and extending from Coalinga to Lost Hills. Abundant normal faulting is seen at the surface, and in the central part of the Kettleman Hills oil field there occurs a complex downthrown graben, but these faults die out with depth in the Etchegoin formation.

Stratigraphy

Outcrops of up to 6,000 feet in thickness consist of Tulare, San Joaquin and Etchegoin formations of Pleistocene (?) and Pliocene age. Below the surface wells have penetrated up to 15,700 feet of Pliocene (?) to Cretaceous age sediments including the Upper Miocene Reef Ridge and McLure shales (Monterey Shale member) and the Miocene Temblor sandstone. Oligocene and Eocene deposits consist of the Tumey and Kreyenhagen shales. Below the base of the Upper Eocene correlations are uncertain due to the lack of well control. Regional studies suggest that the Lower Eocene and Paleocene sediments consist of Domengine sands and shales, Gatchell sands, Lodi Formation shales (see columnar section).

Outcropping Sediments

Below the recent alluvium, the youngest strata is the Tulare Formation for which the Kettleman Hills are regarded as the type region. The Tulare formation consists of cross-bedded, silty, and pebbly sandstones and conglomerates of fluvial origin and thin-bedded clay, silt, fine-grained sandstone, tuff and limestone which are interpreted to be lake deposits. Woodring, Stewart and Richards (1940) considered a white, diatomaceous silty clay as the basal bed of the Tulare formation. The boundary between the Tulare and the underlying San Joaquin formation was drawn at the top of the *Mya* zone which represents the last marine sedimentation before the non-marine Tulare formation was deposited.

The San Joaquin formation consists primarily of fine-grained silty sandstone, silt and clay of nonmarine and marine origin. At the North Dome, the San Joaquin formation is about 1,700 feet in thickness. Characteristic suites of fossils in the marine beds are used for zonation. Named after the principal fossils the zones in descending order are the *Mya* zone (10 feet thick), the *Acila* zone (30 feet thick), the *Pecten* zone (50 feet thick), the *Neverita* zone (50 feet thick) and the Cascajo conglomerate member (50 feet thick). The Cascajo conglomerate is widespread and is considered to be the base of the San Joaquin formation. The Cascajo conglomerate is relatively resistant and forms hills and ridges.

The oldest strata outcropping in the Kettleman Hills is the Etchegoin formation. At the North Dome the Etchegoin has a maximum thickness of about 700 feet and consists chiefly of marine silty sands, silt, and sandstone. Zones in the Etchegoin formation are in descending order the *Littorina, Pseudocardium* (upper *Mulinia*), *Siphonalia, Macoma,* and *Patinopecten.*

Oil Production

The Temblor zone of middle Miocene age is the shallowest and most important producing horizon. Production also comes from lower Temblor sands (Vaqueros), Kreyenhagen sands (Leda) and shales, and Domengine sands (Upper and Lower McAdams). Depths for these horizons extend from 6,000 to below 11,000 feet (drilled depth). Discovery dates are Temblor - 1928 by the Milham Exploration Company, Upper McAdams - 1938 by the Kettleman North Dome Association, Vaqueros - 1938 by the Kettleman North Dome Association, Lower McAdams - 1940 by the Kettleman North Dome Association, and Kreyenhagen - 1957 by Standard Oil of California.

Production, reserves and significant statistics are shown on the attached table.

References

HILL, F. L., 1965, Kettleman Middle Dome Oil Field: California Oil Fields, Vol. 51, No. 1, pp. 39-46.

RENNIE, E. W., Jr, (Editor) 1972, West Side Central San Joaquin Valley Guidebook: Pacific Section AAPG, SEG, SEPM, 102 p.

SULLIVAN, J. C., 1966, Kettleman North Dome Oil Field: California Oil Fields, Vol. 52, No. 1, pp. 5-22.

WOODRING, W. P., STEWART, R., and RICHARDS, R. W., 1940, Geology of the Kettleman Hills Oil Field California: U. S. Geol. Survey, Prof. Paper 195, 170 p.

KETTLEMAN HILLS OIL FIELD
PRODUCTION DATA*

	API Gravity (°)		Wells			Cum Production			Production		
	Range	Avg.	Producing	Shut In	Abandoned	Oil (BBL)	Gas (MMCF)	Water (MBBL)	Peak Yr	Peak OPD	Curr OPD
KETTLEMAN MIDDLE DOME			2	1	6	1,392,572	23,986				
Temblor					3	534,111	19,411		1938	416	
Lower Miocene		38.7			1	945	9		1971	2	
Kreyenhagen	29-39	36.3	2	1	1	491,080	694	82	1956	204	31
Eocene		49.0			1	366,436	3,872	793	1950	180	
KETTLEMAN NORTH DOME			42	267	214	456,228,711	2,907,591				
T emblor	27-51	32.5	27	200	171	404,720,287	1,777,186	304,471	1936	79,664	288
Whepl y		33.0	1		6	196,022	177		1978	91	57
Vaqueros	33-36	34.9	5	38	21	26,694,826	48,553	6,291	1948	6,590	86
Upper McAdams	31-43	35.3	4	21	7	15,278,276	1,065,299	5,881	1941	4,045	6
Lower McAdams	24-31	29.0	5	8	9	9,337,300	16,373	1,144	1958	2,806	65

* "Annual Review of California Oil and Gas Production", 1987, Conservation Committee of California Oil Producers

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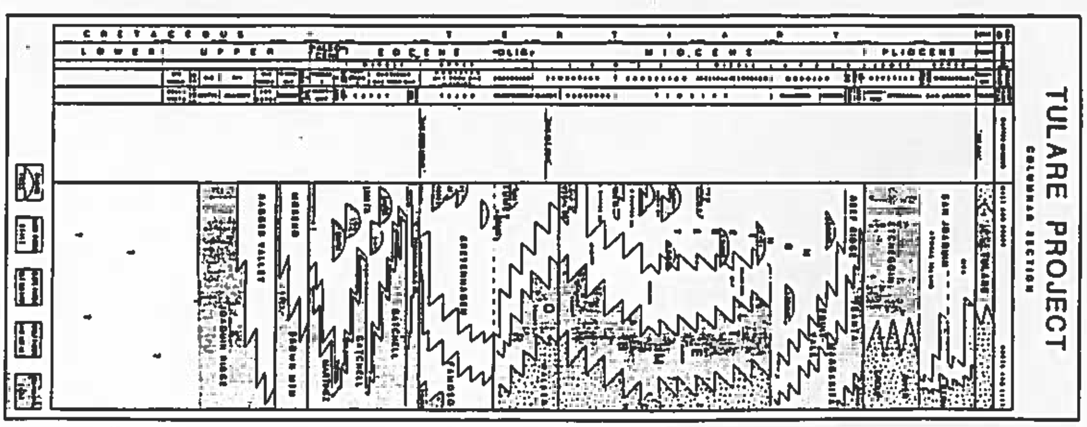

B M HIRST
1988
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