

# AMACKER TIPPETT WOLFCAMP FIELD UPTON COUNTY, TEXAS

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## ABSTRACT

Amacker Tippett Wolfcamp field is a large stratigraphic trap located in the southwestern corner of the Midland Basin in south central Upton County, Texas. It has produced over 16 MMBO and 26 BCF gas since discovery in 1954. Extensive field development occurred during 1978-83.

The field produces from deep water carbonate grainflows, debris flows, and large fractured slide blocks of Wolfcamp age, which were deposited on the downthrown side of an active fault zone; Wolfcamp shelf rocks were deposited on the upthrown southern side.

## INTRODUCTION

Amacker Tippett Wolfcamp field, a large, enigmatic stratigraphic trap, is located in the southwestern corner of the Midland Basin in south central Upton County, Texas (Figure 1). From eleven different Texas Railroad Commission field classifications of approximately the same stratigraphic unit, it has produced over 16 MMBO and 26 BCF gas from 87 wells. There is also production in the Amacker Tippett area from structural traps in the Ellenburger, Fusselman, Devonian and structural-stratigraphic accumulations in the Bend and Strawn. Those horizons will not be discussed in this paper.

First Wolfcamp production was established in 1954. However, the most significant field development did not occur until about 1978 through 1983, when the most prolific Wolfcamp production was discovered during drilling to deeper objectives. Depositional setting and age of the producing horizons has been and continues to be a subject of much discussion and interest.

## METHODS

This study was initiated in 1986 to evaluate BHP Petroleum (Americas) Inc.'s working interests in the Wolfcamp producing horizons. A network of cross sections and a series of maps were constructed on different correlatable log markers and used to develop the interpretation presented here. All available commercial sample logs and commercial paleontological (Hollingsworth) data were used. Cuttings were examined on five wells, and cores in two wells were described. Based on examination of commercial sample logs, two cores, and cuttings from five wells, a correlation was made from observed lithology to electric log character.

### Geologic Description

The Amacker Tippett Wolfcamp Field pay zone is a mappable limestone and shale body 250' (76m) to 800' (259m) thick, at a depth of 8,700' (2650m). It has a characteristic, correlatable electric log signature (Figure 2). Clean, thick bedded limestones which are locally present and porous at the base of the pay zone, shale upward to thin bedded shaley limestones and interbedded shales, which are in turn capped by 100' of shale. Laterally, this correlative unit extends both to the west and east of the Amacker

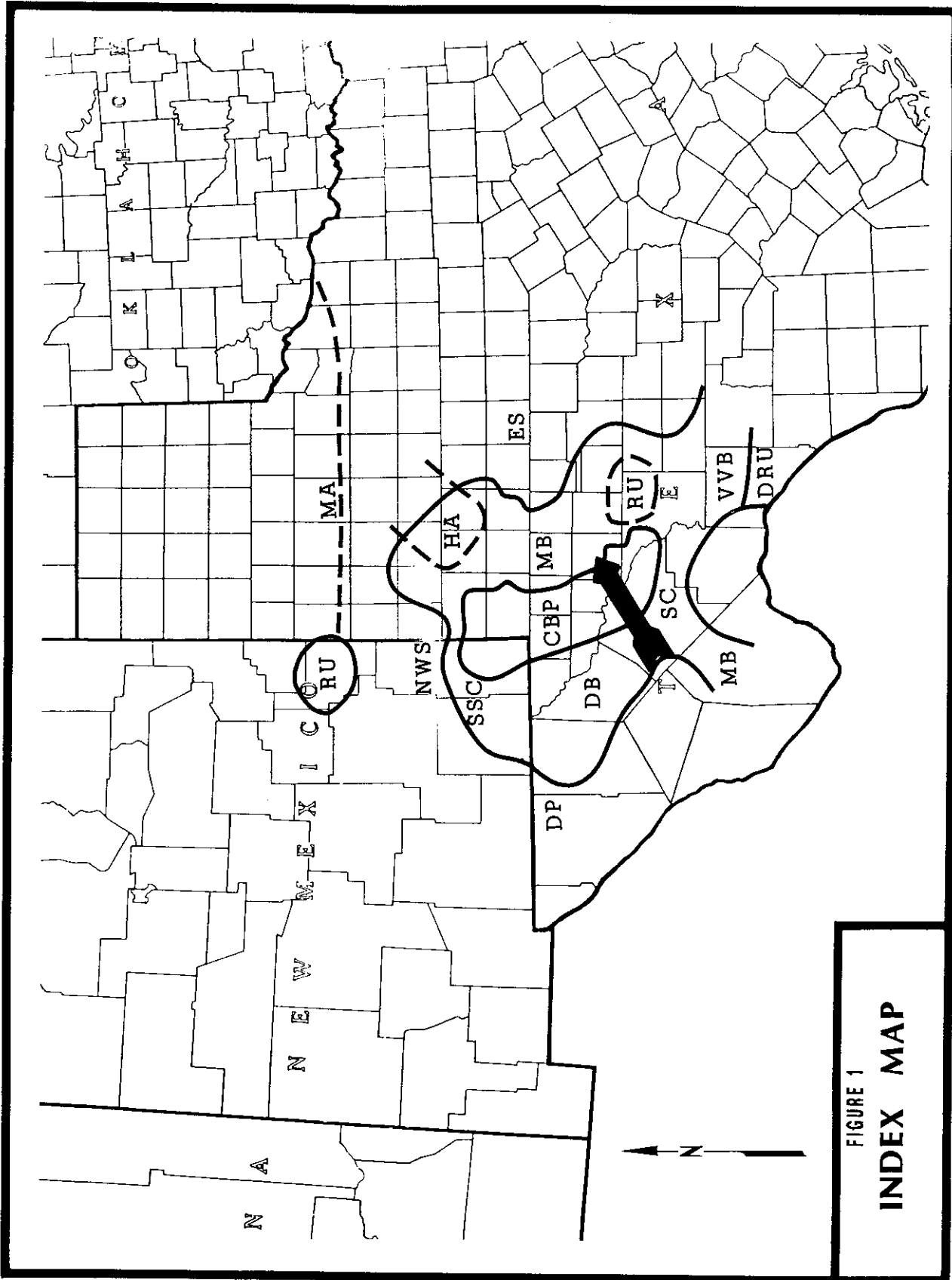
Tippett area. It thins markedly northward (Figure 3) into the basin (Figure 4), and to the south (shelfward), it makes an abrupt transition to blocky limestone and loses its definitive log character.

Underlying the Amacker Tippett unit are black and brown shales and shaley, spiculitic, siliceous limestones. The contact of this unit and the underlying shales is highly undulatory, with up to 350' (107m) of structural relief (Figure 5, 6). Dipmeter data from the shales directly underlying the base of the unit document up to 16° of anomalously directed dip compared to regional dip of 2° to the northeast.

The thick bedded, clean basal limestones are white to buff fusulinid-algal packstones and grainstones, locally cross bedded and rarely dolomitized (Figure 7). Cross bedding in the cores appeared to be in opposing directions. This fusulinid algal grainstone is commonly porous and comprises the major pay interval. It correlates on the log with zones that have  $\leq 25$  GR API unit readings (Figure 2). An isopach of the inferred fusulinid algal grainstone shows a number of NE-SW trending thicks, which correspond to structural lows on the base-of-unit structure map (Figure 8). By comparing logs and production histories, pay can be defined as  $\leq 25$  GR API units and  $\geq 3\%$  porosity. There are only a few instances where wells produced from porous zones with  $\geq 25$  GR API unit readings. Examination of cores in these rare intervals suggests they are dolomitized zones. Quality of the pay is highly variable, with stacked zones 10-50' thick and porosity ranging from 3 to 15% (Figure 9).

Overlying the fusulinid-algal grainstone beds, in gradational contact, is a shaling upward sequence which, in core, is a poorly sorted gray intraclastic limestone with clasts ranging in size from 5" (13cm) to 6' (1.8m) (Figure 10a). This boulder-cobble bed in turn grades upward into a gray to black shaley limestone with abundant crinoids and small ( $\leq 1$ cm) intraclasts (Figure 10b,c). The entire unit is capped by a dark gray shale about 100' (30m) thick. Structure at the top of the dark shale cap seems to drape over the underlying thicks (Figure 3, 4).

In one area within the Amacker Tippett Field (NW/4 Section 78, Block Y, GC&SF), three wells have encountered an anomalous, thick (850', 259m) body of limestone, with a markedly different log character (all clean  $\leq 25$  GR unit API, "chattery" 5-6% porosity, no fining upward sequence) and a different facies



**FIGURE 1**  
**INDEX MAP**

Figure 1. Index map showing location of field in Permian Basin of West Texas. Arrow points to Amacker Tippet Wolfcamp field. Permian Basin sub-provinces as follows: RU Roosevelt Uplift; MA Matador Arch; NWS Northwest Shelf; SSC San Simon Channel; HA Horseshoe Atoll; DP Diablo Platform; DB Delaware Basin; CBP Central Basin Platform; MB Midland Basin; ES Eastern Shelf; SC Sheffield Channel; OP Ozona Platform; VVB Val Verde Basin; DRU Devils River Uplift.

**HUNT OIL CO.**  
**V. T. AMACKER 77 #1**  
 1980' FNL & 760' FWL SEC. 77  
 BLK Y - G C & S F SURVEY

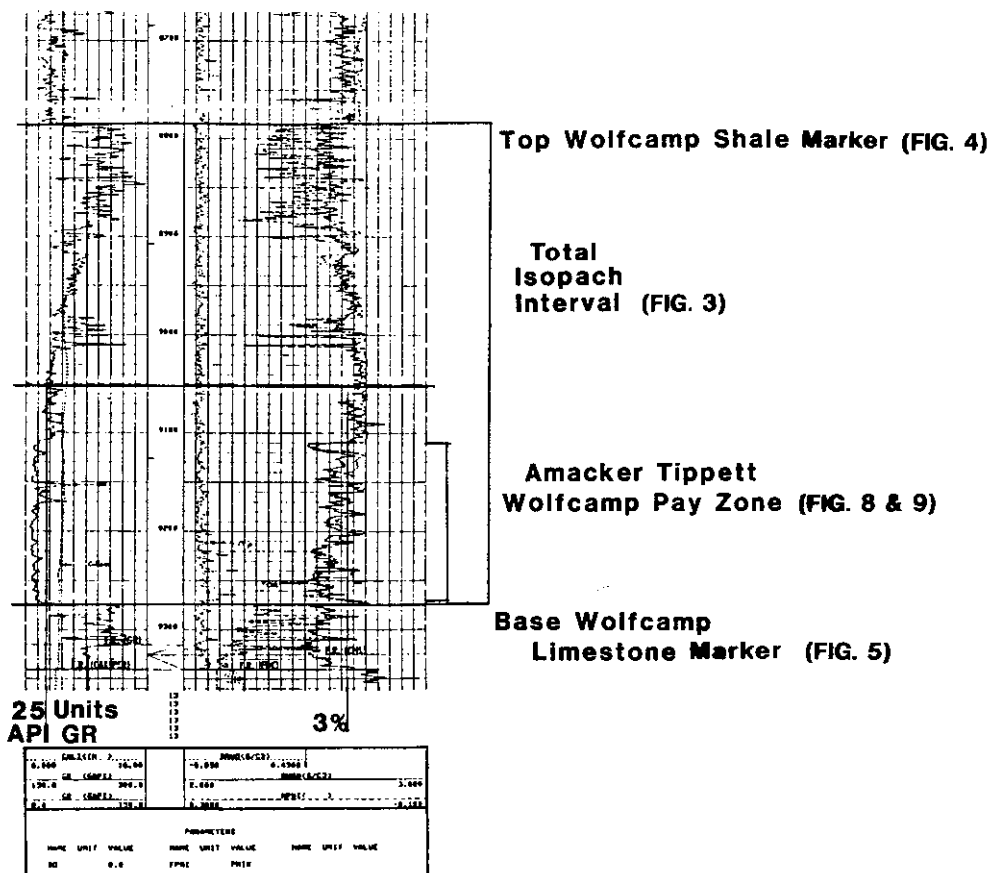


Figure 2. Type log for Amacker Tippett Wolfcamp field study.

(Figure 11). Cuttings studies suggest that this unit is a white to light buff Tubiphytes-algal wackestone to grainstone, with bryozoans, forams, crinoids, fusulinids, and some dasycladacean algae. No cores are available from this unit. This unit, and the immediate surrounding area, is the most prolific pay in the field.

**Paleontology**

The Dean Sand (Figure 12), an extensive regional marker bed deposited over the whole Midland basin, blankets the Amacker Tippett area. Below the Dean Sand lie 300-400' of gray and brown shaley intraclastic basinal limestones. These have been dated Wolfcamp "Upper Hueco" from fusulinid identifications by Hollingsworth Paleontological laboratories. However, recent work (Jeary, 1978; Mazzullo, et al, 1987; Vechan, et al, 1985; Gawlowski, 1987) has redated these beds as Early Leonard, based on basin-wide correlations to Glasscock County and other areas. Underlying these limestones is a significant regional shale marker that can be traced by log correlations, with only local difficulty, over most of the Midland Basin. This marker has customarily been called the "Wolfcamp Shale Marker". Underlying this shale lies the Amacker Tippett producing complex. The producing horizons have also been dated Wolfcamp "Upper

Hueco" by Hollingsworth. Underlying the Amacker Tippett producing horizons are 300-600' of dark shales with brown, gray and white intraclastic limestones, dated Wolfcamp "Lower Hueco" by Hollingsworth. No Cisco and Canyon fusulinids are reported in this area and this section is assumed to be represented by a starved Basin shale section (Adams, et al, 1951).

The Amacker Tippett pay zone has recently been re-dated Early Leonard by Al Reid (personal communication, 1990). This redating is based on re-examination of Hollingsworth fusulinid data from the Amacker Tippett field, and on fusulinid identifications in the Chevron #21 McElroy Ranch M core, Sec. 141, Block E, CSCDRGNG in the King Mountain field, three miles west of the Amacker Tippett field (Becher & Von Der Hoya, 1990). However, in a core from the BHP Petroleum #3 Amacker, Section 80, Block Y, GCSF, Garner Wilde identified Middle and Upper Wolfcamp fusulinids in the Amacker Tippett pay zone (Garner Wilde, personal communication 1988).

This age discrepancy could be caused by Wolfcampian fusulinids being reworked in Early Leonard time, or by rapid lateral change in ages of the depositional units between the Amacker Tippett field and the King Mountain field. Based on the

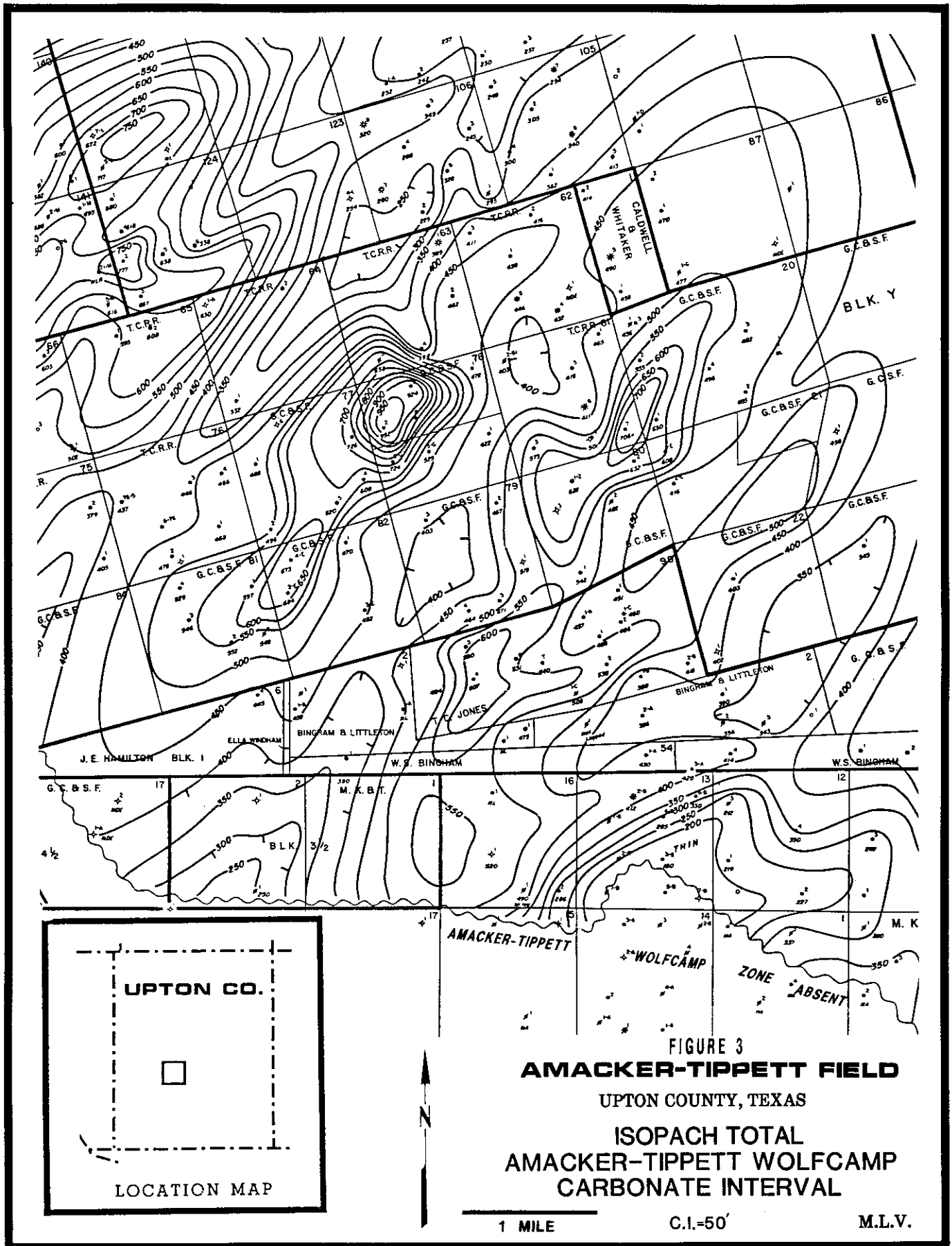


Figure 3. Isopach Map, total Amacker Tippett Wolfcamp carbonate interval. Amacker Tippett Unit is absent south of wavy line on map.



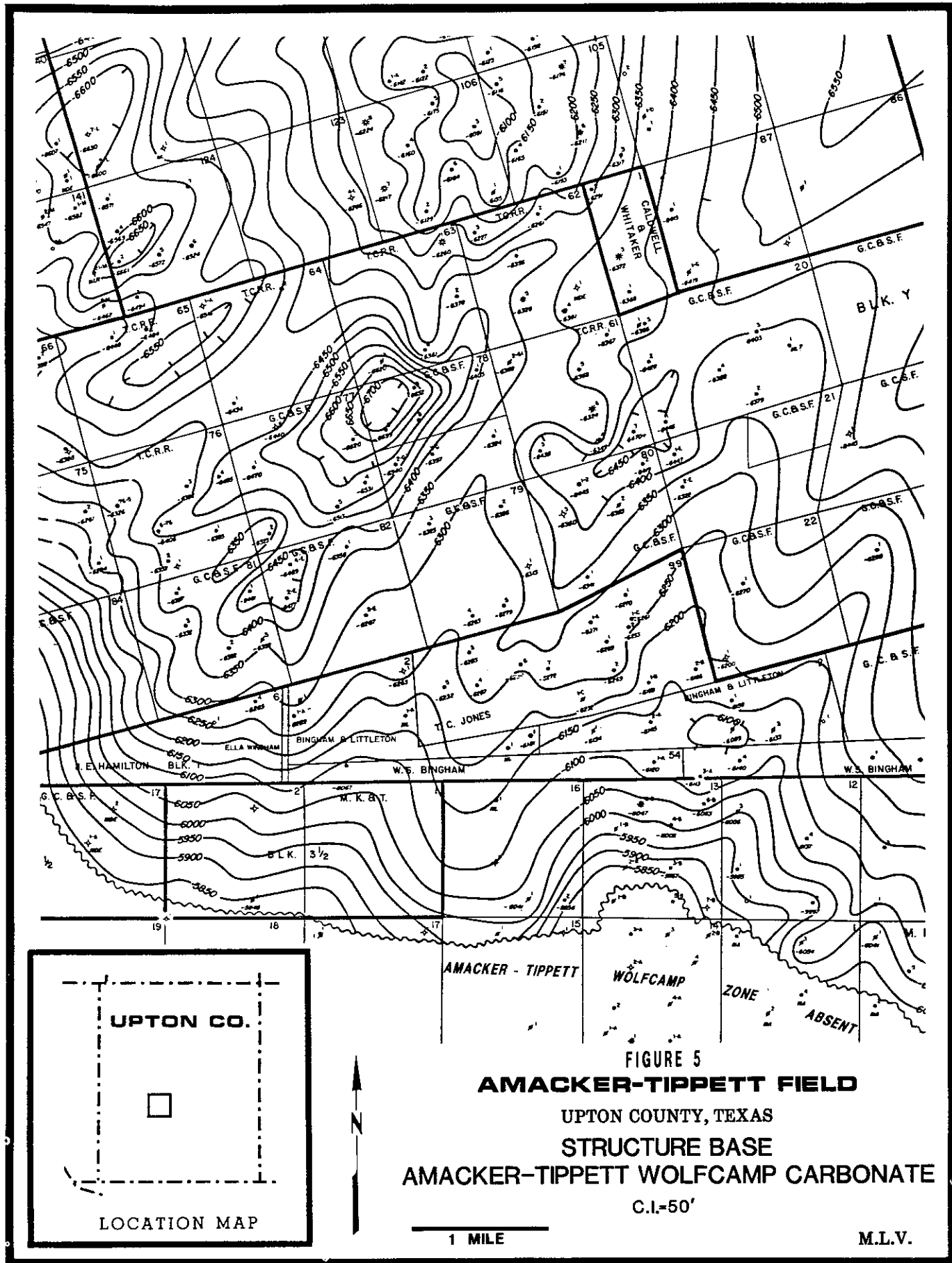


FIGURE 5  
**AMACKER-TIPPETT FIELD**  
 UPTON COUNTY, TEXAS  
**STRUCTURE BASE**  
**AMACKER-TIPPETT WOLF CAMP CARBONATE**  
 C.I.=50'  
 M.L.V.

Figure 5. Structure at base of Amacker Tippett Wolfcamp carbonate interval. Amacker Tippett Unit is absent south of way line.

NW

SE

● HUNT OIL CO. V.T. AMACKER 76+3  
 ● HUNT OIL CO. V.T. AMACKER 76+4  
 ● HUNT OIL CO. V.T. AMACKER 77+1  
 ● HUNT OIL CO. V.T. AMACKER 77+2  
 ● HUNT OIL CO. V.T. AMACKER 82-4E  
 ● HUNT OIL CO. V.T. AMACKER 82-2  
 ● HUNT OIL CO. V.T. AMACKER 82+3

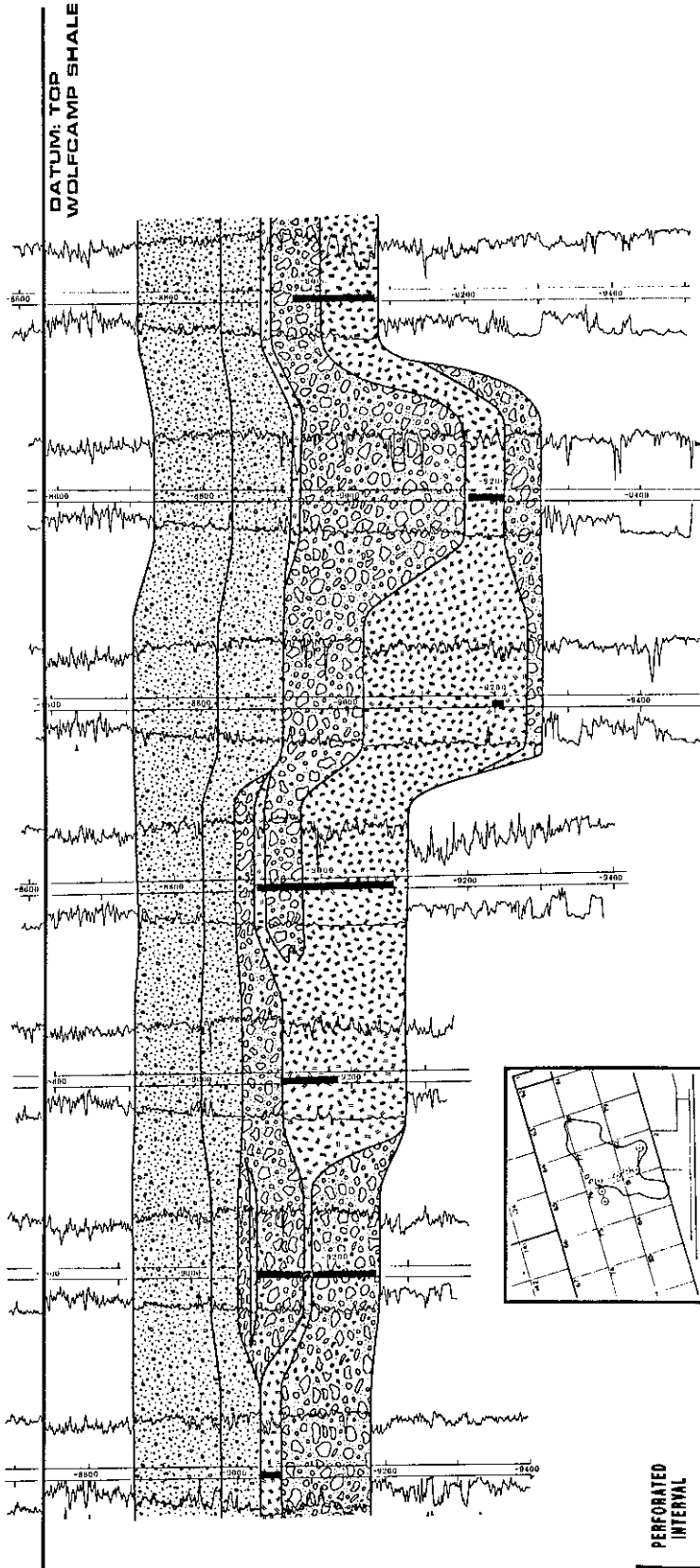


FIGURE 6

# AMACKER-TIPPETT FIELD

UPTON COUNTY, TEXAS

WOLFCAMP FACIES

M.L.V.

VERTICAL SCALE

INDEX MAP

PERFORATED INTERVAL

- SHALE FACIES
- CARBONATE DEBRIS FLOW, SMALL CLAST FACIES
- CARBONATE DEBRIS FLOW, LARGE CLAST FACIES
- GRAINSTONE-PACKSTONE POROUS FACIES
- SLIDE BLOCK FACIES

Figure 6. Stratigraphic facies cross section, Amacker Tippett Wolfcamp field, northwest to southeast through "D" (Section 81-82) reservoir of Table I.

above data and my own regional correlations, I propose the stratigraphic column in Figure 12, which was constructed with data from Ross (1962, 1963), Silver & Todd (1969), Jeary (1978), Wilde (1983), and Mazzullo et al (1987).

### Reserves

The Amacker Tippet Wolfcamp field can be mapped as two main depositional channels. These channels are defined by highs at the top of the Wolfcamp shale marker (Figure 4) which coincide with troughs at the base of the pay carbonate (Figure 5), and by isopachs of the gross interval (Figure 3), gross clean interval, net clean carbonate (Figure 8), and net clean porous (pay) carbonate (Figure 9). Within these channels, all wells which have greater than 50' of net pay carbonate (excluding the Section 78 anomalous feature) have an average production of 325 MBO, estimated ultimate recovery, per well. Field wide average production for every Wolfcamp completion (many were recompletions of deeper holes) is only 60 MBO per well. It is obvious the better reserves are within the channels, even though production at first glance seems erratically distributed.

The channels can be divided into seven or more isolated reservoirs or pods, five of which are included in Table 1. Each of the pods can be considered a separate reservoir, and each has a varying degree of pressure communication. A statistical analysis of drilling risk in development of the field has shown to be a 40% chance of economic completion. However, those wells which encountered the channel thicks (>250' clean carbonate, 77m) have a 75% chance of economic completion.

**TABLE I**

Pool	# Wells	Production MBOD	EUR MBOE	Reserves Per Well MBOE
A (Barnett F)	8	5,346	10,700	1,337
B (Sec. 77)	2	1,553	5,300	2,650
C (Sec. 75-76)	8	1,419	5,000	625
D (Sec. 81-82)	7	1,301	1,486	212
E (Four Corners)	8	3,674	4,406	551

### Regional Setting

Regionally, the Amacker Tippet reservoir rocks were deposited in a structural low, that apparently has persisted since early Pennsylvanian time (Figure 13). It is north of and on the downthrown side of the major east-west Big Lake Fault, which defines the southern boundary of the Midland Basin, and was active from Pennsylvanian (Atokan) through Wolfcampian time. The fault first became active sometime during the Atokan. The Amacker structural trough lies east (basinward) of the Central Basin Platform's major bounding fault (Hills, 1970). It accumulated up to 400' of Strawn detritus between two NW-SE trending eroded highs, the Amacker Ellenburger and King Mountain Ellenburger structures (Bebout and Meador, 1985).

About 350' of Cisco-Canyon shelf carbonates were deposited in Heluma and McCamey areas, 8 miles south and west of the Amacker area. However, no Cisco-Canyon age carbonates are reported in the Amacker area. This stratigraphic interval may be represented by a glauconitic shale (Jones, 1975; Adams et al,

1951) inferring that the entire Amacker area, including the two nearby Ellenburger fields, were in a basinal setting at Cisco-Canyon time.

Approximately 1100' (338m) to 1500' (462m) of dolomitized Upper and Lower Hueco (Wolfcampian) carbonates are reported on McCamey and Heluma fields on the Central Basin Platform (based on Hollingsworth Paleo data). The present structural position of these dolomitized carbonates is 1900-3700' higher than the present structural top of the Wolfcamp Shale marker in the Amacker area.

Early Permian time has been documented as a period of major fault activity in the Permian Basin (Young, 1960; King, 1962; Hills, 1970; Wilde, 1983; Font & Sayre, 1984) and consequently has affected sediment deposition. Two thousand feet of additional section on the downthrown (north) side of the Big Lake fault is documented by the Gulf #1 & 2 Ernestine Freeman wells (Section 22, Block 2, MK&T Survey) (Figure 14).

The Amacker Tippet unit is blanketed by 100' of dark basinal shales and by fine grained sands and basinal carbonate deposits of the Lower Leonard, Dean Sand, and Spraberry Sands (Jeary, 1978; Silver & Todd, 1969). The conclusion is then, of course, from facies seen in the cores and from the regional setting that the Amacker Tippet carbonate rocks were shallow water carbonates redeposited in a basinal setting during Early Permian time.

### Depositional Model

The Central Basin Platform was a periodically exposed positive feature rimmed by carbonate margins, which dropped off rapidly steepening shelf edges into a rapidly deepening shale basin (Mazzullo, 1983). Carbonate detritus in various forms was shed off these carbonate reefs and accumulated near the basin margins (Yusas, 1984; Hobson, et al, 1985 a & b; Becher & Von Der Hoya, 1990).

Two different depositional models have been proposed for the deposition of carbonate detritus:

#### A. Fan Model (from the clastic model)

##### I. Channelized flow from a point source

##### II. Components:

1. Inner fan - leveed fan valley
2. Mid fan - distributary channels
3. Lower fan - lobes

#### B. Apron Model (Mullins & Cook, 1986)

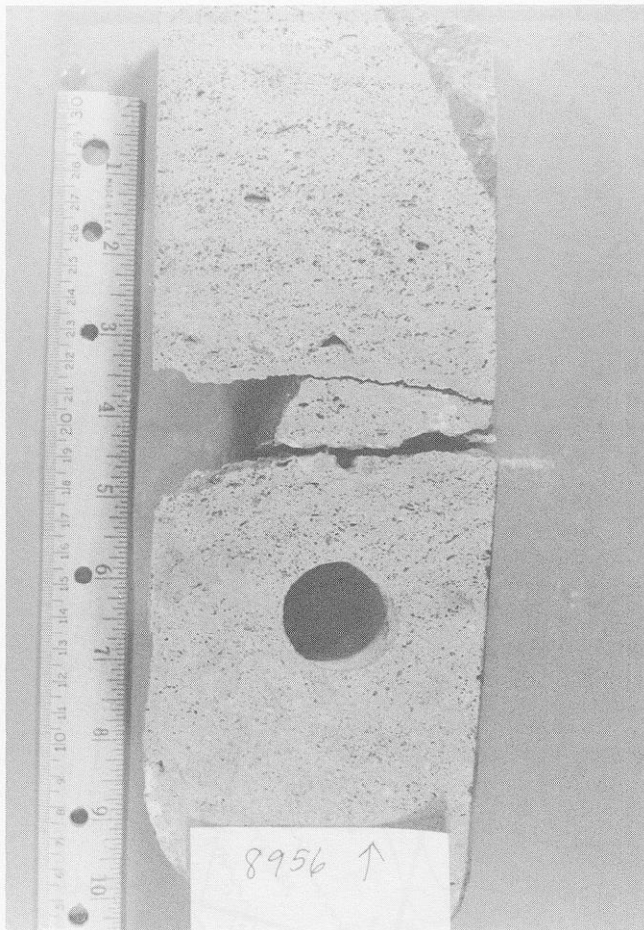
##### I. Line source rather than point source

##### II. Apron position relative to slope

1. Slope apron
  - a. Deposited on gentle slopes, 4° or less
  - b. No bypass zone
2. Base of slope apron
  - a. Deposited from steep slopes (4-15°)
  - b. Has bypass zones
  - c. Inner apron (thick conglomerate & megabreccias, coarse grained material)
  - d. Outer apron (finer grained, grain supported turbidites).

The deposit at Amacker Tippet compares more closely to the base of slope apron model. The following observations led to this conclusion: 1) The channels on isopach maps point to three sources along the faulted Lower Permian Shelf line; 2) the abrupt





**Figure 7. Core photograph, BHP Petroleum (Americas) Inc. #3 Amacker 80, 1698' FNL & 1142' FWL, Sec. 80, Blk. Y, GCSF, 8956'. Fusulinid algal packstone facies; medium grained well sorted, cross bedded algal packstone, with fusulinids, crinoid and other fossil fragments.**

change in log character at the "transition zone" to the south of the field suggests a bypass zone; 3) the grainstone texture of the Amacker Tippet reservoir requires a steep slope (9-30°) to generate a grainflow deposit; 4) the coarse grained debris flow seen in the cores is probably an inner apron deposit; 5) size of the anomalous carbonate body on the Barnett "F" lease implies a megabreccia containing a large slide block and requires a steep slope. Smaller slide blocks are also present in the field (Figure 15).

The Barnett "F" slide block, Section 78, Block Y, GC&SF (Figure 11) is 813' (248 M) thick, at least 4,000' (1200 M) long and at least 2,000' (610 M) wide. According to a graph constructed by Enos (1977), for such a "pebble" to fall would have required a 35° slope and 3275' (1000 m) of relief. Did such slope or relief occur at the time of deposition of the block? Movement along the regional fault system to the south coupled with overgrowth of Lower Permian shelf carbonates located three miles further to the southwest (Mazzullo, 1983) may have been the cause of the large slide block of carbonate found in Section 78.

The slide block is probably intensely fractured because its reservoir is in pressure communication with 5 surrounding wells which did not encounter the same facies. The slide block may have been prevented from sliding further basinward by the presence of the pre-existing Amacker Tippet Devonian-Ellenburger positive feature (Figure 16).

The literature on carbonate detritals cites evidence of megabreccias on a similar scale. Cropping out in the Sierra Diablo mountains of West Texas, a 150' (46 M) anomalous boulder known as the Kriz lens has been interpreted as a submarine slide block off the Victorio Flexure; it is Upper Hueco in age (Wilde, 1983). In Yugoslavia, Marjanac (1985) reported maximum thickness of a single carbonate detrital block in outcrop as 982' (300 M). Carbonate detrital deposits of greater magnitude have been reported in the Devonian of Canada; channels 600' (180 M) deep, 1200' (366 M) wide, with clasts to 325' (100 M) in size (McIlreath, 1977; Cook, 1983). A Miocene slide scar on the Florida escarpment is 18.6 miles (30 km) across and 900-1150' (300-350 M) deep (Mullins, et al, 1986). In the Delaware Basin, a slide block of Mississippian age rocks is 16 miles (26 km) x 9 miles (14 km) x 2000' (610 M), includes a recumbent fold, and is encased in Hueco (Wolfcampian) age shales (Guinan, 1971; Font and Sayre, 1984). Such deposits require either severe oversteepening of the shelf edge, earthquake activity, gravity induced collapse, or gravity sliding to create such megabreccias and/or slides, and the Lower Permian has been well documented as a time of severe structuring in the Permian Basin (Hills, 1970; Young, 1960; Wilde, 1983; Font & Sayre, 1984).

Early Permian (Middle Wolfcamp) time is documented as a major sea level lowstand in the entire Permian Basin, which resulted in the Middle Wolfcamp unconformity (Hills 1970). It has been proposed that the Amacker Tippet rocks were deposited in shallow water (Mazzullo, 1982; Farmer 1986), during a sea level lowstand. While such a lowstand certainly existed, certain lines of evidence suggest that these shallow water rocks accumulated as base of slope and basinal deposits; the dipmeter anomalies and channel-like structure map at the base of the carbonate both imply scour at time of deposition. In addition, reefs generally have a structurally high antecedent topography (Wilson, 1975; Mullins, 1983) yet structurally high portions of the Amacker area have thin Wolfcamp pay carbonates, and structurally low portions show a thicker accumulation. The best pay zones, predominantly the grainstone and slide block facies, are interbedded with and blanketed by thick deposits of coarse carbonate debris which decrease in clast size upward, and are mantled by thick basinal shale. It is interesting to note that this sequence has a basin floor fan covered by slope debris deposits and finally blanketed by basinal shales. Therefore, it is similar to the Vail model of deposition during a sea level lowstand and subsequent sea level rise (Vail, 1977).

## CONCLUSIONS

The highly productive Wolfcamp reservoir at Amacker Tippet Field is a basinal deposit. It is a carbonate debris flow which follows channelized lows, and is interbedded with grainflows and occasional large slide blocks of shallow water material. These reservoir sediments accumulated in a localized area in a structural trough at the foot of the juncture of two actively moving fault zones. Eroding and/or actively growing Lower Permian shelf edges lie on the upthrown sides of those adjacent faults. A deepwater barrier to this debris accumulation was provided by the growing basinal structure of the Amacker Ellenburger field. This carbonate debris deposit has proven to be a highly economic drilling target in this field.

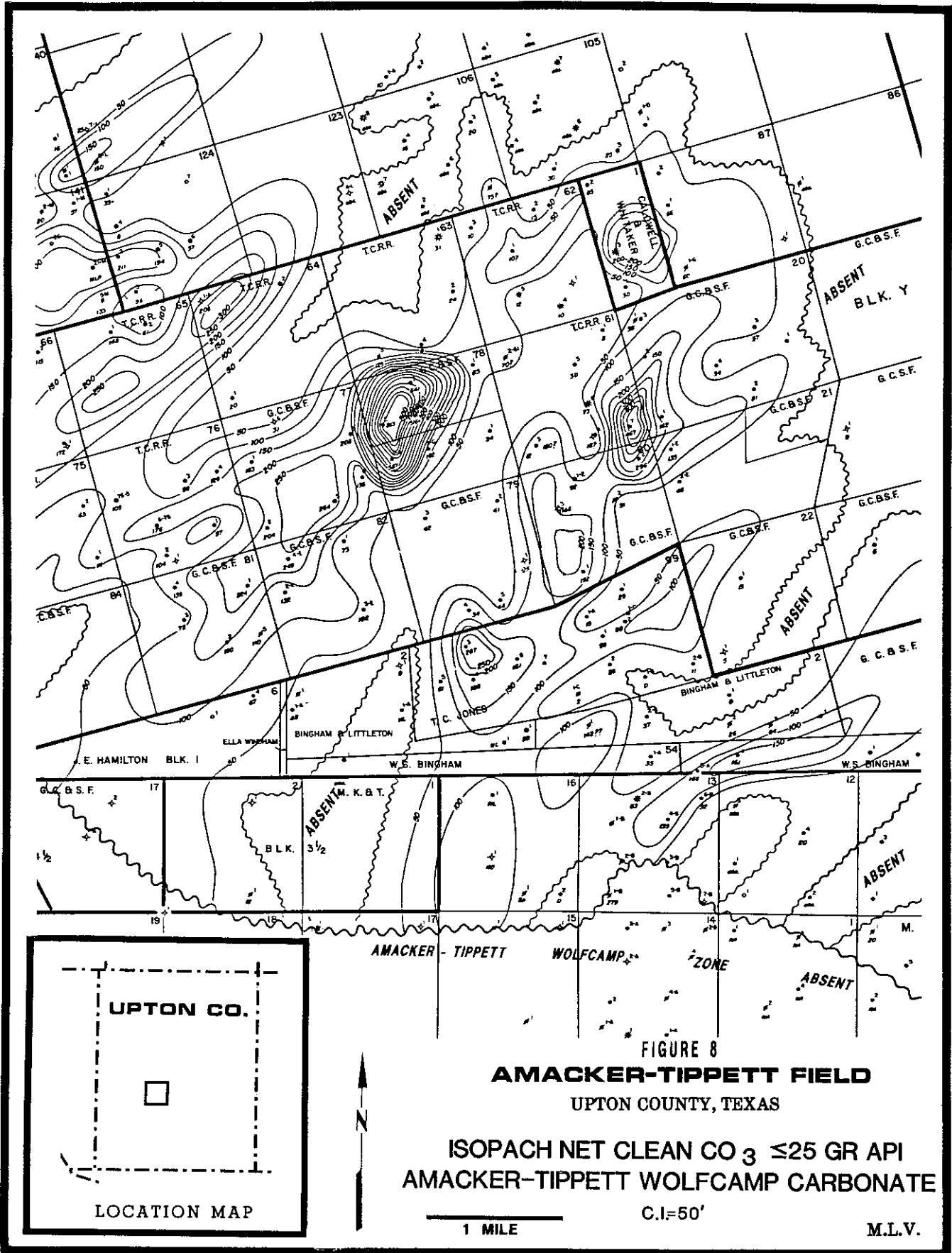


Figure 8. Isopach of the net clean carbonate ( $\leq 25$  GR API units) Amacker Tippett Wolfcamp carbonate interval.

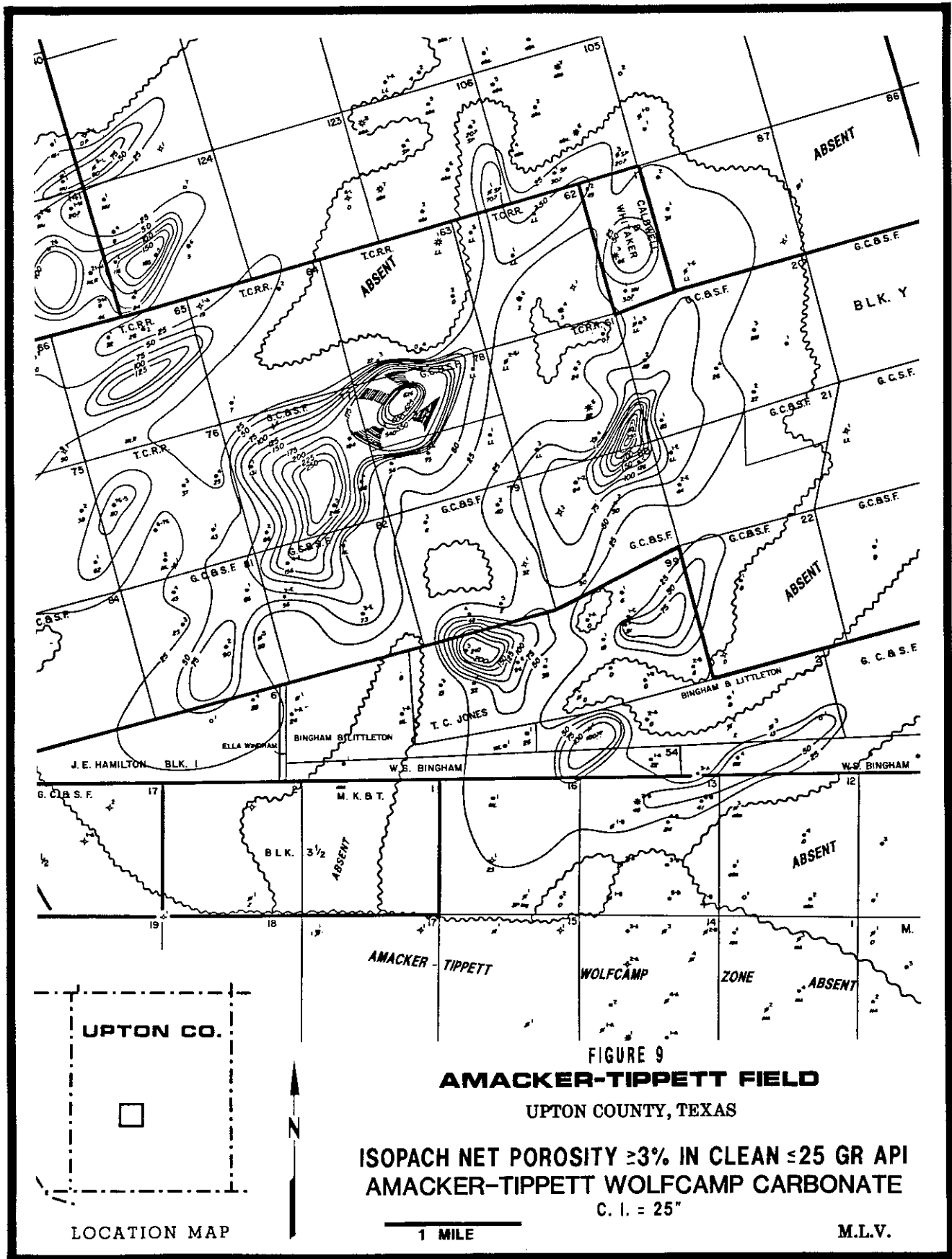
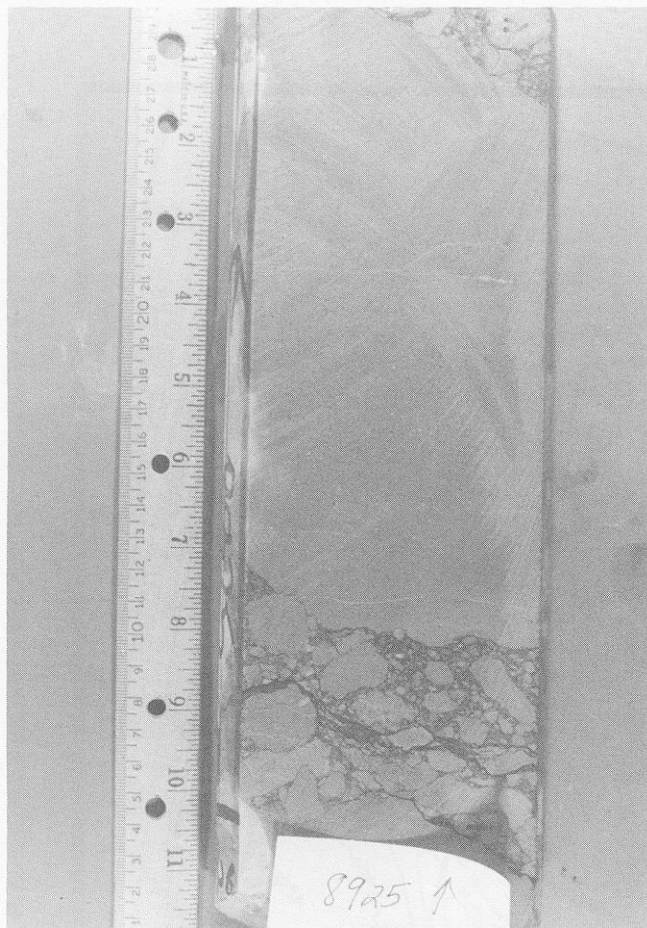
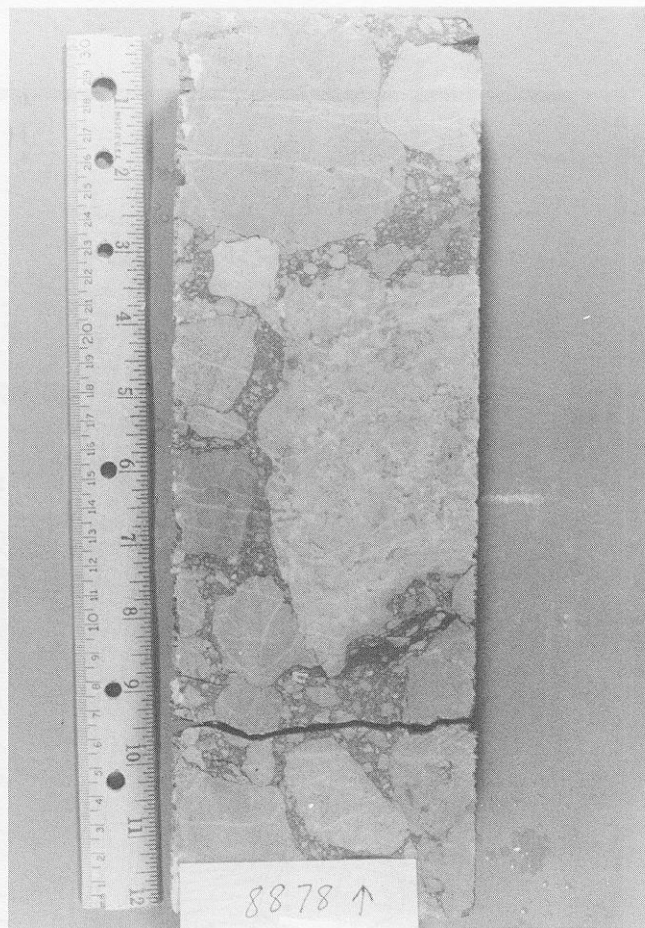


Figure 9. Isopach of the net porous ( $\geq 3\%$ ) clean ( $\leq 25$  GR API units) carbonate, Amacker Tippett Wolfcamp carbonate interval.



**Figure 10a.** Core photograph, BHP Petroleum (Americas) Inc. #3 Amacker 80, 1698' FNL & 1142' FWL, Sec. 80, Blk. Y, GCSF, 8925'. Carbonate debris flow, large clast facies. Clasts are crinoid algal wackestones and mudstones.



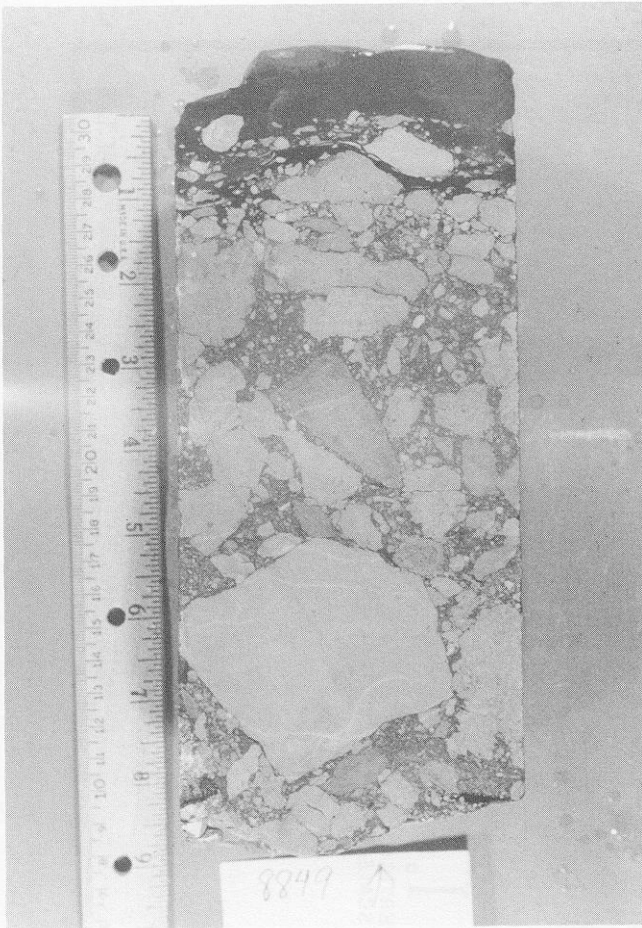
**Figure 10b.** Core photograph, BHP Petroleum (Americas) Inc. #3 Amacker 80, 1698' FNL & 1142' FWL, Sec. 80, Blk. Y, GCSF, 8925'. Carbonate debris flow, small clast facies. Clasts are black shales, mudstones, crinoid wackestones, and tubiphytes-coral-algal packstones.

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**Figure 10c. Core photograph, BHP Petroleum (Americas) Inc. #3 Amacker 80, 1698' FNL & 1142' FWL, Sec. 80 Blk. Y, GCSF, 8849'. Carbonate debris flow, small clast facies. Clasts are mudstones, fusulinid packstones. Loose crinoid columnals and fusulinids incorporated in gray shaley matrix. Note upward gradational contact with black shale.**

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