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CHARACTERIZATION OF NATURAL FRACTURES IN MESAVERDE CORE FROM THE MULTIWELL EXPERIMENT

BY

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ABSTRACT

Natural fractures dominate the permeability of tight sandstone reservoirs in the Mesaverde Formation of the Piceance Creek Basin, northwestern Colorado. Roughly 1900 natural fractures, detected in 4200 ft of Mesaverde core from the U.S. Department of Energy's Multiwell Experiment (MWX), have been differentiated into 10 different fracture types on the basis of fracture morphology, inclination, the presence of slickensides, the presence of dickite mineralization and/or host lithology. Approximately 75 percent of the MWX core fractures are dewatering planes in mudstone and are probably unimportant to reservoir permeability. The remaining 25 percent of the MWX core fractures include 275 mostly calcite-mineralized, vertical extension fractures, 61 irregular, dickite-mineralized extension fractures, 27 mostly calcite-mineralized, horizontal extension fractures, and 90 slickensided, occasionally mineralized shear fractures. These extension and shear fractures are all potentially important to reservoir permeability and consequently productivity.

DATABASE AVAILABILITY

The MWX fracture database is available as an ASCII file on a 5-1/4 inch formatted floppy disk. If interested contact Sharon J. Finley, John C. Lorenz, or Norman R. Warpinski at: Sandia National Laboratories, Division 6253, P.O. Box 5800, Albuquerque, NM 87185.

DISCLAIMER

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ACKNOWLEDGMENTS

We would like to acknowledge the initial descriptions of natural fractures in MWX core performed by J. A. Clark, D. D. Madsen, and L. W. Teufel. We especially thank N. R. Warpinski, who assisted in the computer aspects of the data base and F. E. Hensley, who assisted by washing, moving, and sorting roughly 70,000 lbs. of rock. Thanks also go to D. A. Northrop, J. T. Neal, and N. R. Warpinski for their helpful reviews of this report.

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CONTENTS

A. INTRODUCTION

The Mesaverde Formation is fractured throughout the section at the Department of Energy's Multiwell Experiment (MWX) site. Well tests indicate that the natural fractures dominate permeability and, therefore, are the primary mechanism of gas production in these low-permeability sandstones. About 4200 ft of mostly 4-inch-diameter core was cut from three closely spaced wells at the MWX site. A comprehensive database of core fractures is presented in this report, and all natural fractures identified in the MWX core are described and discussed.

The three MWX wells are located within the Rulison Field (natural gas) near Rifle, Colorado. Figure 1 shows the well spacings, and the cored intervals are listed in Table 1. Approximately 30 percent of the core was oriented using standard multishot techniques. In addition to the characterization of core fractures presented in this report, a detailed sedimentologic description of the core was made (Lorenz, 1987). Also, numerous routine and special core analyses were conducted on the MWX core by several commercial and government laboratories (Sattler, 1984).

The top of the Cretaceous Mesaverde Formation is at a depth of roughly 4000 ft and the Mesaverde section is approximately 4300 ft thick at the MWX site. The Mesaverde is comprised of rocks from five different depositional environments as illustrated in Figure 2. In descending stratigraphic order, these environments include the upper, paralic zone (4000 to 4400 ft), characterized by distributary and estuary sandstones; the fluvial zone (4400 to 6000 ft), characterized by wide meanderbelt sandstones; the coastal zone or upper delta plain (6000 to 6600 ft), characterized by lenticular distributary channel sandstones; the paludal zone or lower delta plain (6600 to 7450 ft), characterized by lenticular distributary channel sandstones and coals; and the lower marine-shoreline zone (7450 to 8300 ft), characterized by blanket sandstones (Lorenz, 1987).

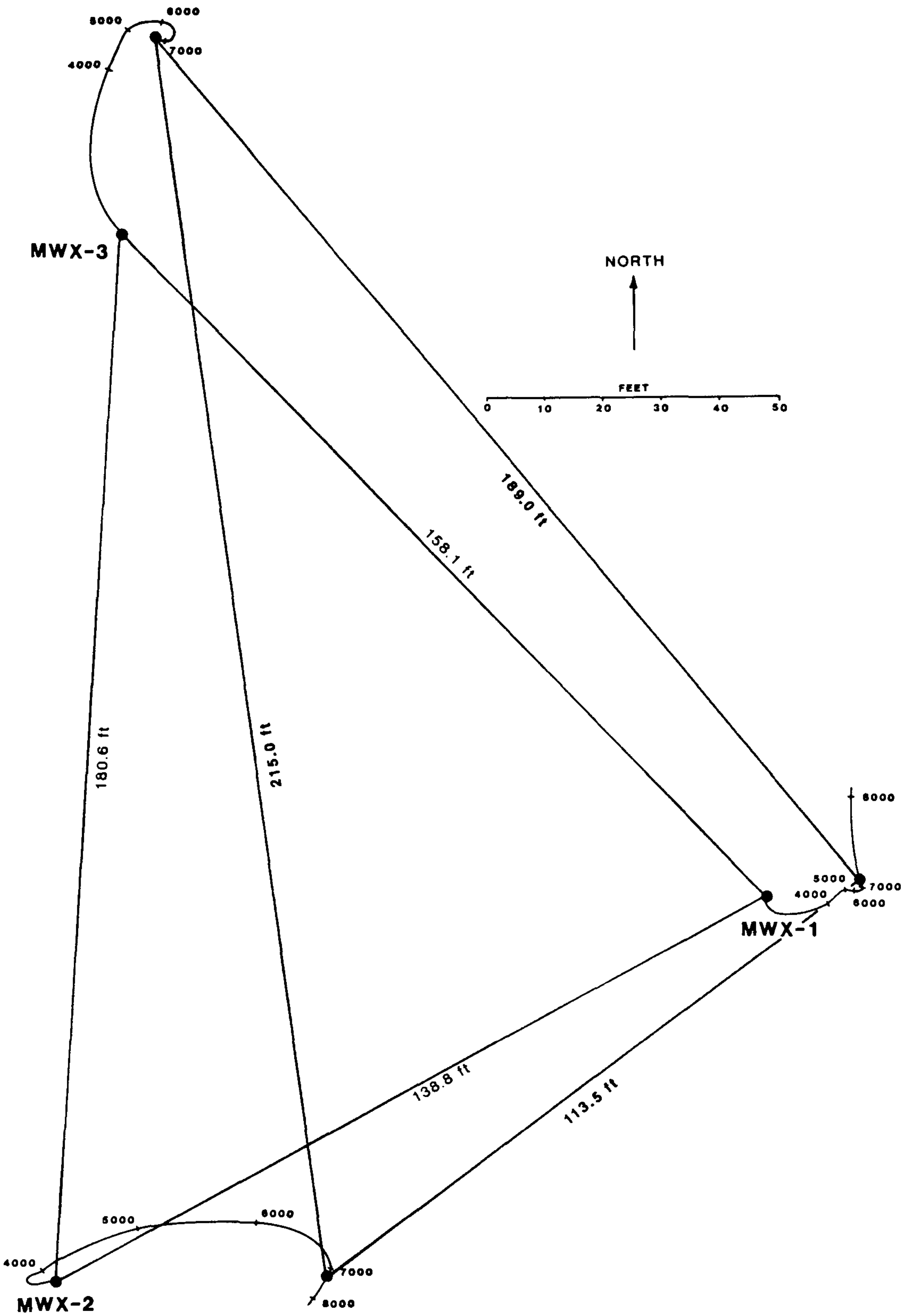


Figure 1. Relative Well Spacings at Surface and at 7300 ft (the deepest survey in all three wells).

Table 1

Core Intervals in MWX Wells

Well	Interval Cored (ft)	Footage Cored (ft)	Footage Recovered (ft)
MWX-1	4170-6836	2666	2666
	7870-7960	90	90
MWX-2	4870-4956	86	84
	*5485-5500	15	15
	*5551-5581	30	26
	5700-5880	180	177
	6390-6568	178	178
	7080-7388	308	305
	7817-7907	90	90
	8100-8141	41	41
MWX-3	4886-4928	42	42
	5690-5870	180	178
	6431-6528	97	97
	6875-6910	35	35
	7071-7160	89	89
	7536-7564	28	28
Total core footage (all wells)		4155	4141

*2-inch-diameter pressure core.

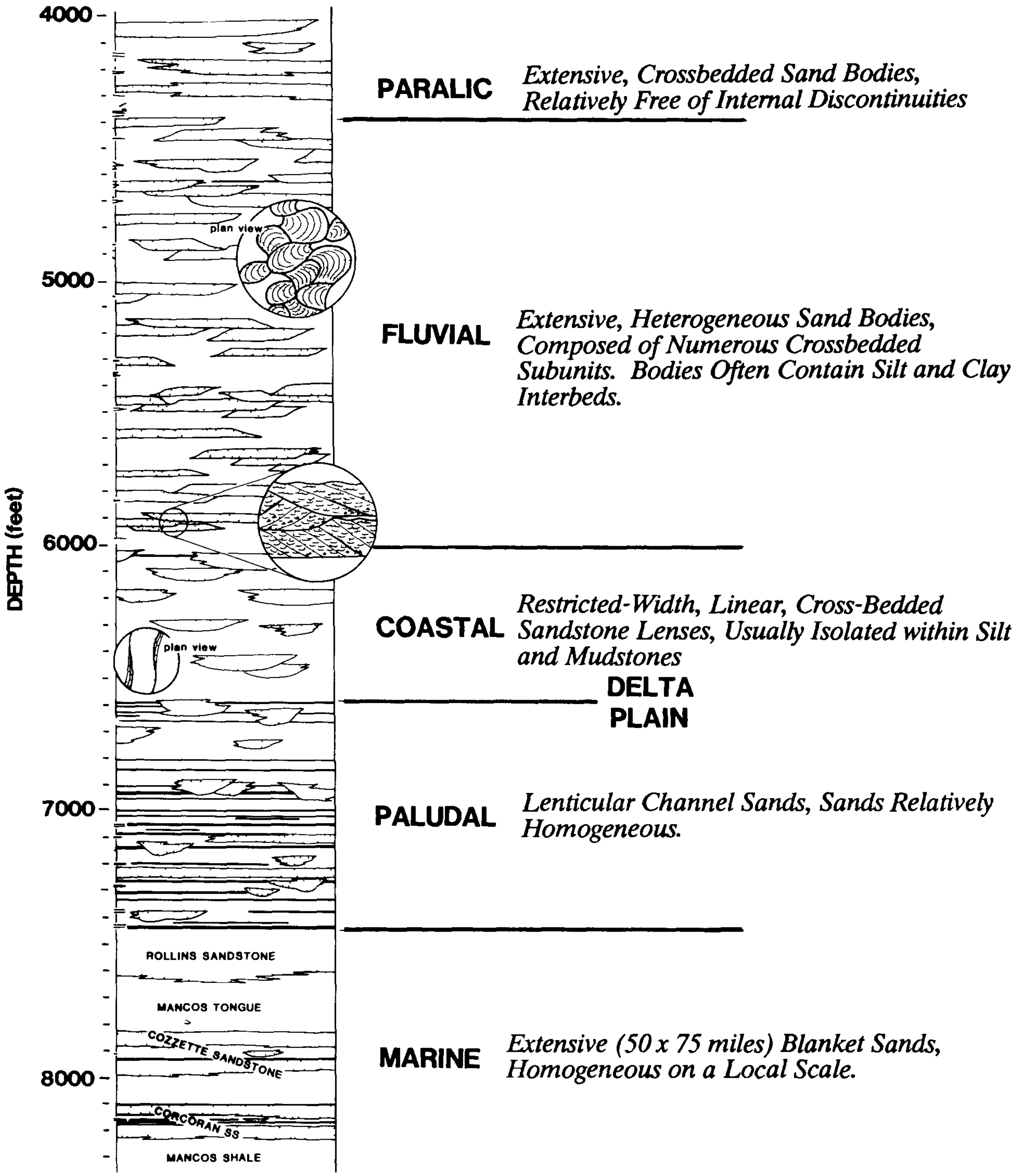


Figure 2. Geologic Characteristics of Mesaverde Formation Sandstones in the MWX Wells (J. C. Lorenz, 1987)

The MWX fracture database, discussed in this paper and presented in Appendix A, is comprised of all the naturally occurring fractures identified in the MWX core plus two types of drilling- and/or coring-induced fractures. Roughly 110 drilling-induced petal fractures and 16 scribe-line fractures are included in the MWX fracture database. They are designated type P and type B, respectively, in Appendix A. These mechanically induced petal and scribe-line fractures have been discussed in detail in Lorenz and Finley (1988) and will not be discussed further in this paper. All of the natural fractures that have been identified in MWX core are either mineralized to some extent and/or slickensided.

B. METHODOLOGY

All of the available core from the three MWX wells was scrutinized for natural fractures and all fractures were classified and described in detail. Due to core sampling for various analyses prior to fracture logging, an occasional fracture may have been overlooked. However, every effort was made to minimize such omissions. D. D. Madsen prepared an informal, preliminary set of fracture notes on MWX-1 and MWX-2 core (J. A. Clark, 1983), and data from these notes were used in the MWX fracture database presented in this report if the core was unavailable for re-examination.

Each piece of core was washed and scrubbed thoroughly prior to examination for fractures. Fracture measurements were carefully made, and occasionally the core was cut to determine the relationship between individual fracture strands or fracture orientations. Most of the core had been previously slabbed for a sedimentology review, making detection of very thin fractures easier. A binocular microscope was used for the identification of fracture mineralization; however, occasionally the use of a petrographic microscope, x-ray diffractometer, or scanning electron miscroscope was necessary to confirm the presence of mineralization or determine its composition. Classifying the MWX core fractures by fracture type was a tedious and cumbersome task. Large intervals of core were examined and reexamined several times in order to assure that the fractures were classified consistently, and that all fractures were noted.

Describing and classifying fractures in core is by no means a completely empirical process. For example, some of the fractures consist of a number of individual fracture strands. Since the relationship between fracture strands was often impossible to verify, we used arbitrary but consistent interpretations. If the strands appeared to be an echelon or closely spaced (<0.1 ft apart) and oriented the same, they were considered to be part of the same fracture. Other interpretations that affect fracture descriptions are identified later in this paper, when the fracture type affected is discussed.

The fracture database in Appendix A includes the following, where applicable, about each fracture or fracture group:

- well number
- fracture depth
- number of fractures
- fracture height
- fracture width
- fracture strike
- dip inclination
- dip direction
- slickenside bearing
- type of motion
- type and amount of mineralization
- fracture terminations
- rock type
- fracture type.

The well number designates the well that the core came from. The fracture depth is the depth of the top of the fracture; both core and log depths are given. The number of fractures indicates how many fractures fit the description given. If the number of fractures is greater than one, the database provides a general description of the fracture group, which may not fit every individual fracture within that group. Fracture height refers to the height of the fracture in the core (depth of bottom of fracture minus depth of top of fracture). In the case of a fracture group, fracture height refers to the core length of the entire group. Fracture width in the database is the maximum width of a single fracture or of the widest fracture in a group.

Fracture strike is the true strike of a fracture, oriented with respect to north using multishot orientation data or paleomagnetic techniques (Geissman, 1988). Paleomagnetic techniques were used to determine the orientation of six MWX fractured core samples, whereas roughly 1260 ft of MWX core was oriented using multishot techniques. Paleomagnetic data or multishot orientation data were used in conjunction with the core logs prepared by CER Corporation in order to accurately extend the orientation data beyond the piece of core where it was taken. (These core logs provide an invaluable record of breaks in and deviation of the principal scribe line, as well as tops of core runs and connections; all data that can be used to help determine the validity of any multishot orientation points.) Dip inclination is the angle between the plane of the fracture and a horizontal plane. Dip azimuth refers to the true down-dip azimuth as determined from oriented core data. Slickenside bearing, where available, is also a true orientation. Type of motion indicates a specific type of shear fracture or fault, either normal, reverse, or strike-slip.

Type of mineralization is a mineral identification of the fracture fill, and fill amount is described as either partial or complete. A notation is made if the mineralization is crystalline and subhedral. The presence of subhedral mineralization indicates that the crystals were partially unconfined during crystal growth. Fracture terminations refer to the terminations of the fracture within the core. Rock type refers to the principal lithology of the core hosting the fracture.

All of the fractures were categorized by an arbitrarily defined fracture type. Each fracture type was assigned an arbitrary number or letter designation immediately after identification, and since different fracture types were later grouped into larger classifications, the specific types are not discussed in numerical order. Some fracture types were only recognized in very localized core intervals. Description of these localized fractures occasionally defined a new fracture type, and previously logged core intervals were then rechecked for fractures that might best fit the new type. The fracture types were defined specifically to fit the MWX core fractures. Rather than fit the data to a preconceived classification system, the data dictated the fracture types used in this database.

All fractures of a particular type have similar morphologies and other characteristics like inclination and host lithology suggesting a similar fracture origin. However, all or some of the different fracture types may be related, whereas some fractures with similar morphologies may be unrelated. Fracture origins are briefly mentioned where data is available; they will be the subject of future research and publications.

For the purpose of this paper, the different fracture types were initially categorized as either extension or shear fractures. The extension fracture types are discussed in order of their relative abundance in MWX core. The shear fractures lend themselves more readily to discussion by host lithology. Those fracture types occurring in sandstone and siltstone are discussed before those types occurring in mudstone lithologies.

Extension Fractures

- Types 1 and S: vertical, mostly calcite-mineralized fractures (275 fractures).
- Type 8: dickite-mineralized fractures imparting a "frac blast" texture to the rock (61 fractures).
- Type 7: horizontal, mostly calcite mineralized fractures (27 fractures).

- Type C: mineralized coal cleats (4 cleats).
- Type N: calcite-mineralized fractures within a sandstone clast encased in mudstone (2 clasts).

Shear Fractures

- Type 4: low angle shear fractures in sandstone and siltstone lithologies (4 fractures).
- Type 5: near vertical shear fractures in sandstone and siltstone lithologies (1 fracture).
- Type 2: shear fractures confined to carbonaceous mudstone laminations in sandstone and siltstone lithologies (77 fractures).
- Type 3: conical to undulating dewatering/compaction fractures in mudstone (1425 fractures).
- Type 6: planar shear fractures in mudstone lithologies (8 fractures).

The discussion section of this report includes comprehensive descriptions of the different types of MWX core fractures. These descriptions include core photographs, sketches, photomicrographs, distribution histograms, scatter plots of fracture widths, inclinations, orientations, and/or rosette diagrams of orientations.

Unless otherwise noted, all histograms of fracture frequency with respect to depth plus figures 14 and 27 consist of data from MWX-1, where approximately 2700 ft of continuous core was taken. Data from MWX-2 were used only where there was no core from MWX-1. Although they are not all obvious on the histograms due to the 250-ft bar width, the following are uncored intervals in MWX-1 and MWX-2: 4000-4170 ft (paralic); 6838-7080 ft (paludal); 7388-7817 ft (paludal and marine); 8141 to 8500 ft (marine). See Table 1 for cored intervals. If fracture data from MWX-2 or MWX-3 is used in lieu of MWX-1 data, the fracture distribution with depth is essentially unchanged.

C. DISCUSSION OF FRACTURE TYPES

1. EXTENSION FRACTURES

The extension fractures in MWX core have been divided into five different types. Here the term extension fracture is used to refer to any fracture that has been pulled apart perpendicular to the plane of the fracture, with no evidence of shear motion. The most common type of extension fractures observed in MWX core are simply referred to as extension fractures (Type 1 and Type S). The second most commonly observed type of extension fractures, although they occur in a very localized zone, are the "frac blast" fractures (Type 8), and the third subgroup of extension fractures in MWX core are horizontal fractures (Type 7). Type C and N extension fractures occur very rarely in the MWX core and are briefly described at the end of this section.

a. Extension Fractures (Type 1 and Type S)

Roughly 275 of Type 1 and S extension fractures are identified and described in Appendix A. Figures 3, 4, 5, and 6 show photographs of typical fractures belonging to this subgroup. Type 1 fractures are vertical to subvertical, roughly planar, mostly calcite-mineralized extension fractures occurring predominantly in sandstone and siltstone lithologies. These fractures are commonly stranded or branched, and fracture strands often appear en echelon in the core. Figure 7 is an artist's conception of this typical en echelon pattern. Because observation or corroboration of the relationship of individual fracture strands is not likely in a 4-in.-diameter core, we were careful to use consistent interpretations in order to compile a meaningful database. Where fracture strands appear en echelon and essentially parallel, they are considered to be part of the same fracture. This was also the case if two

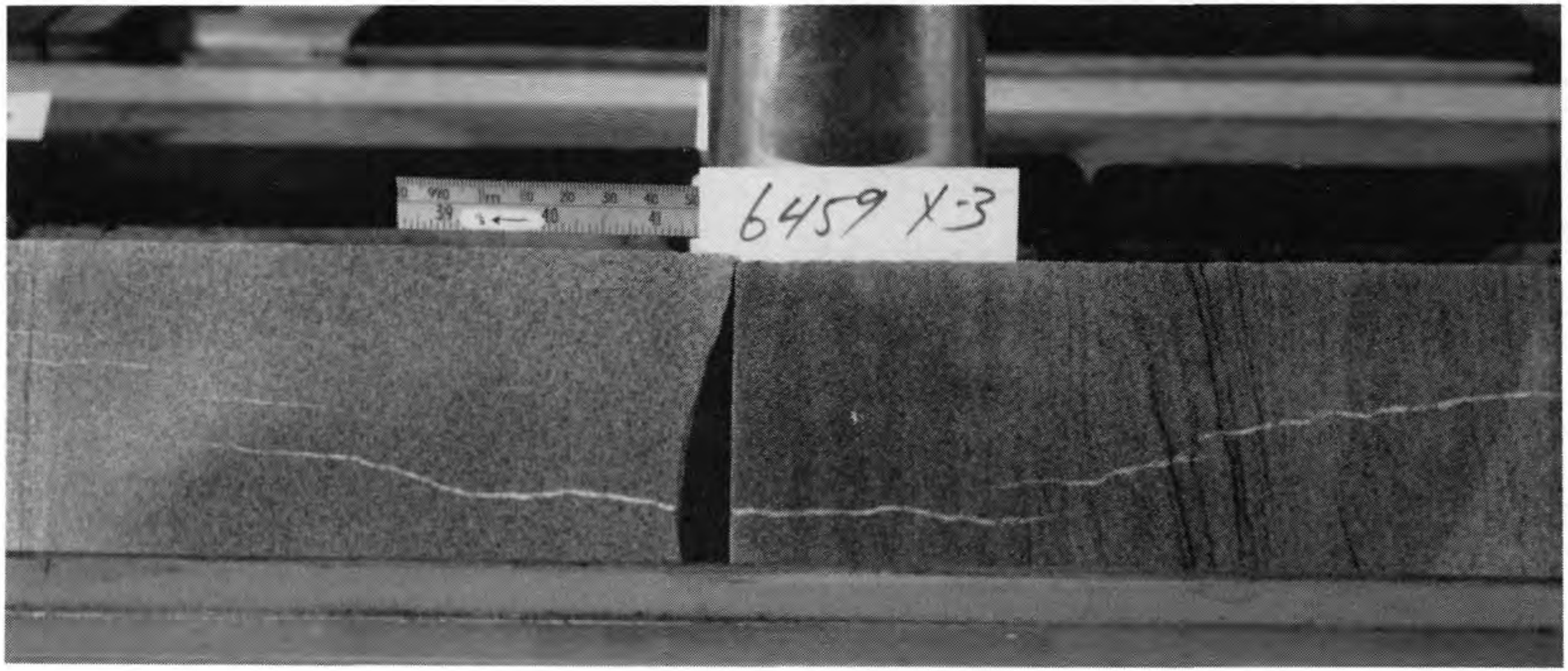


Figure 3. An En Echelon Type 1 Fracture

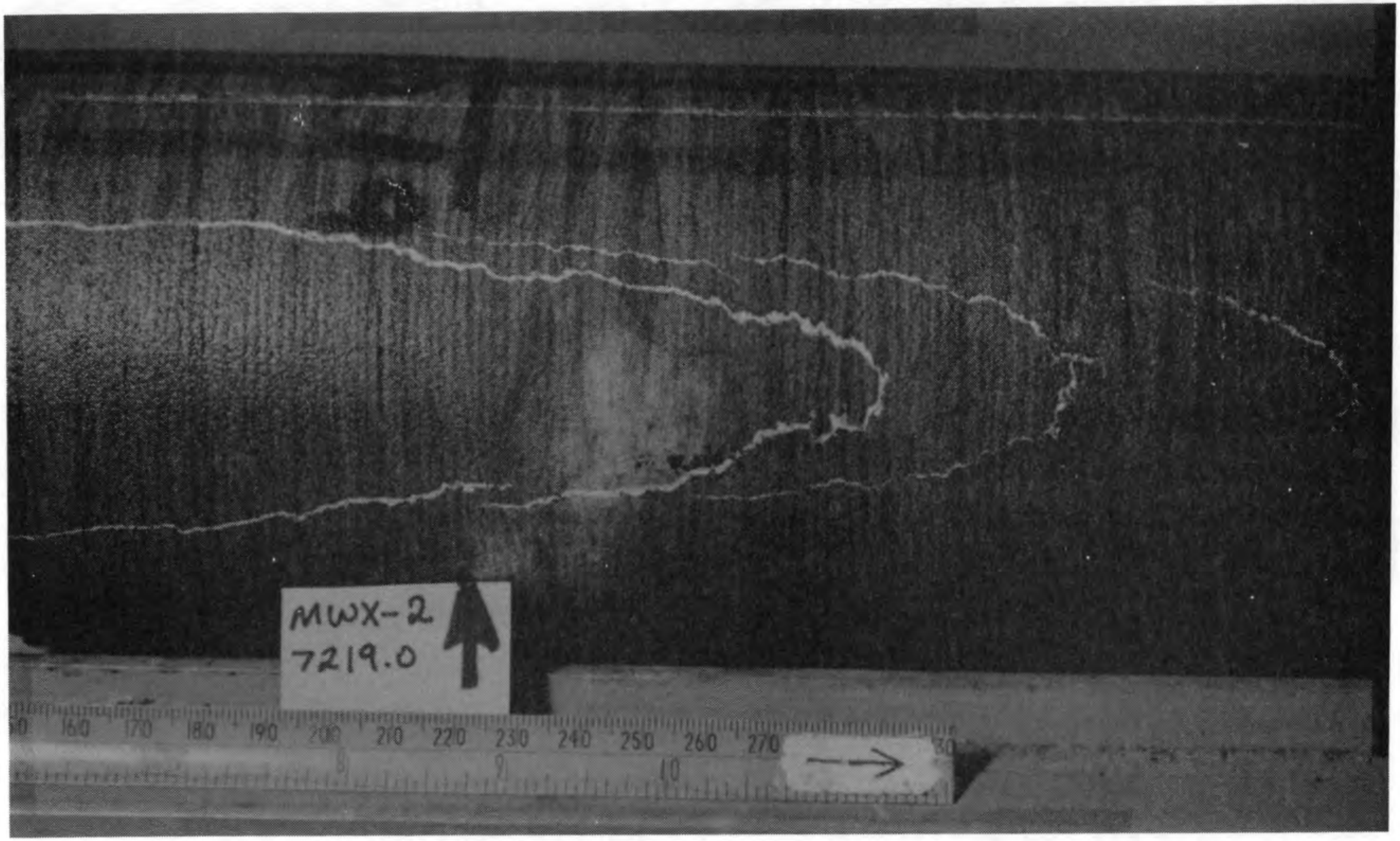


Figure 4. An En Echelon Type 1 Extension Fracture

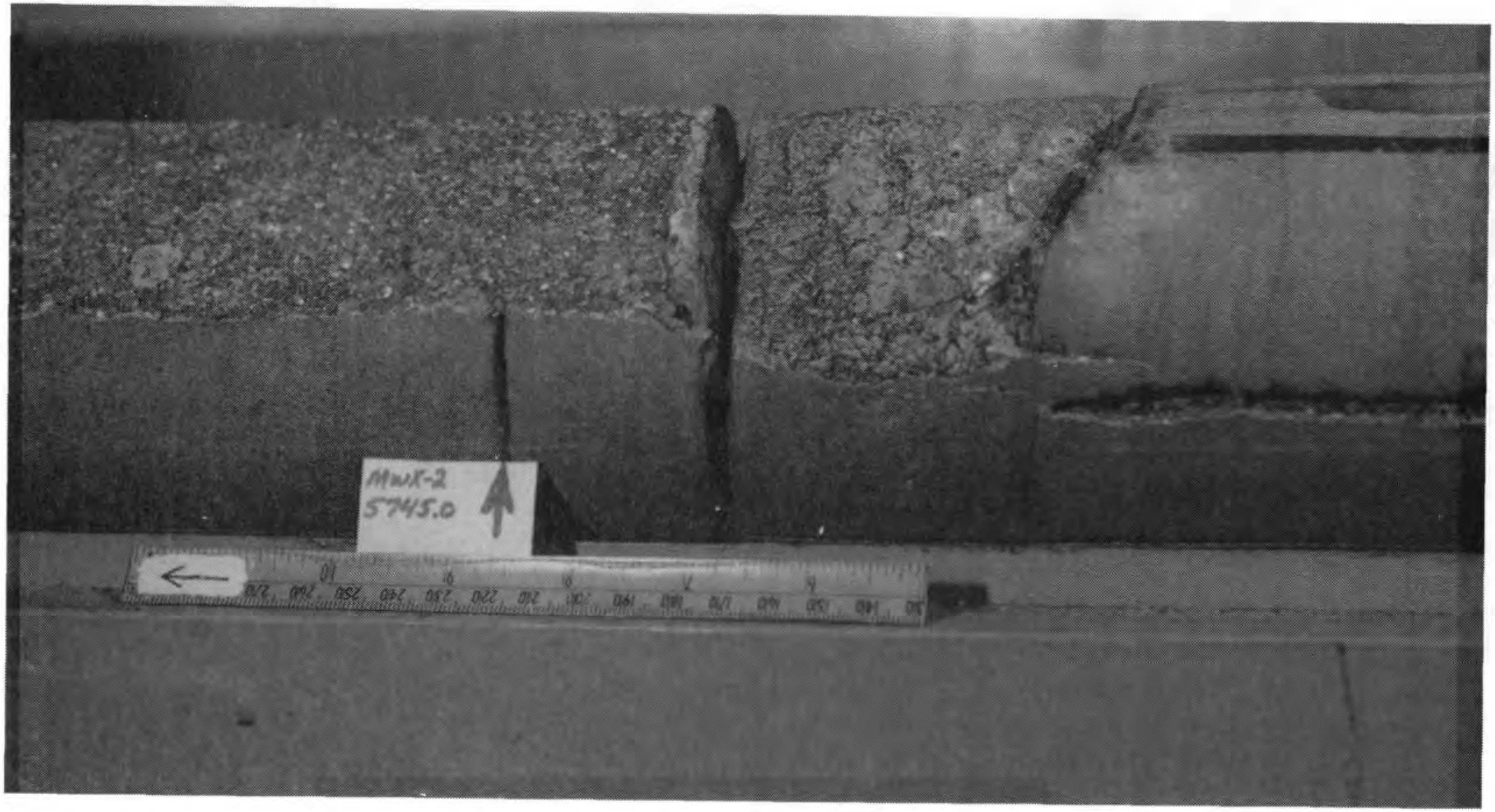


Figure 5. A Stranded Type 1 Fracture With Subhedral Calcite Mineralization

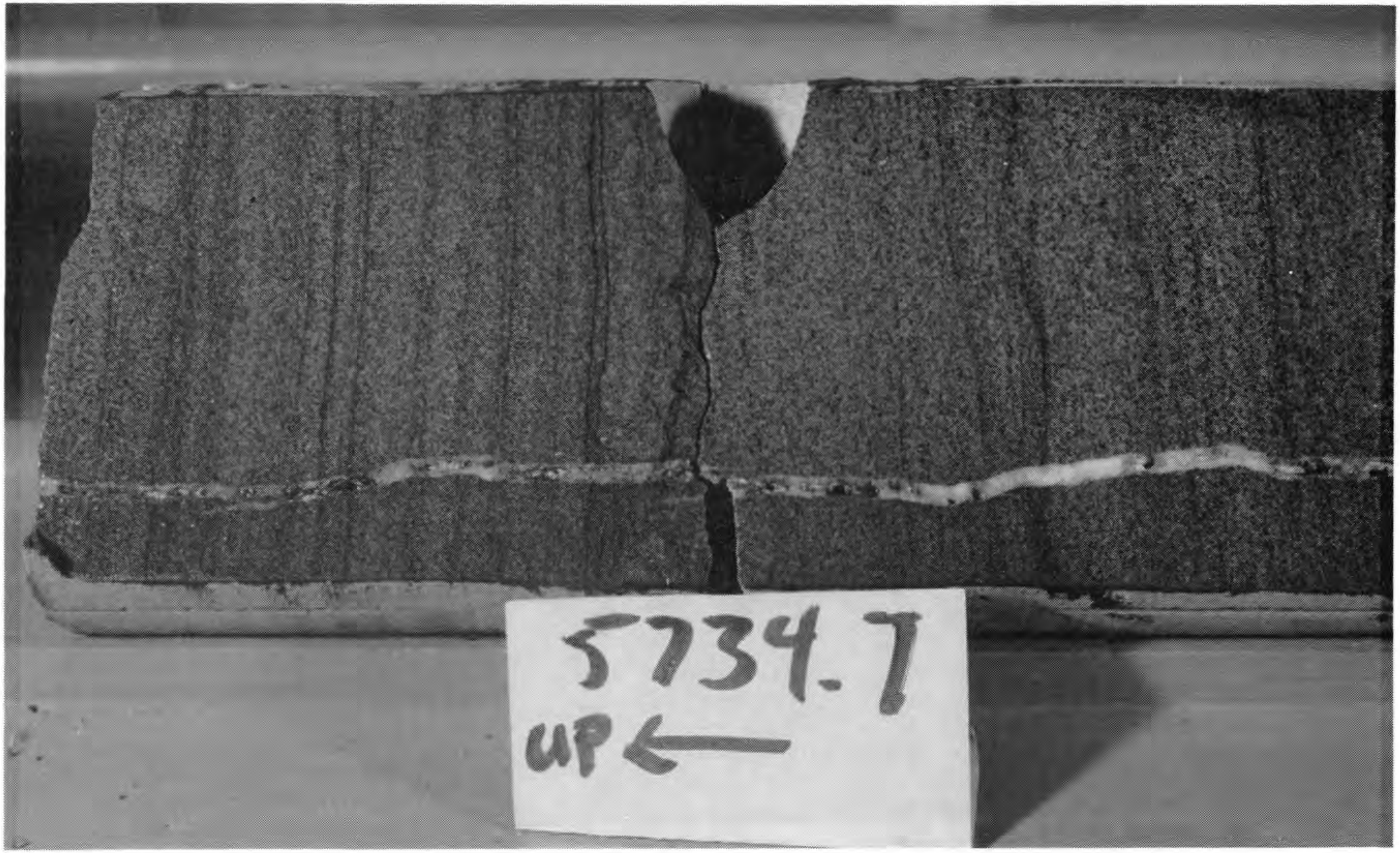


Figure 6. Type 1 Fracture in MWX-1

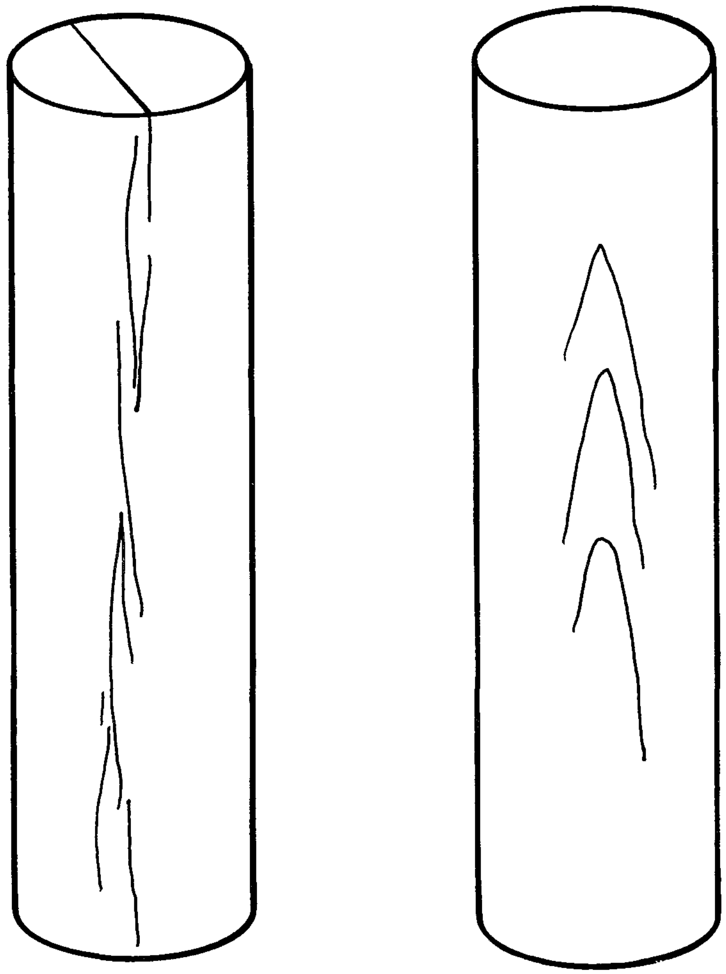


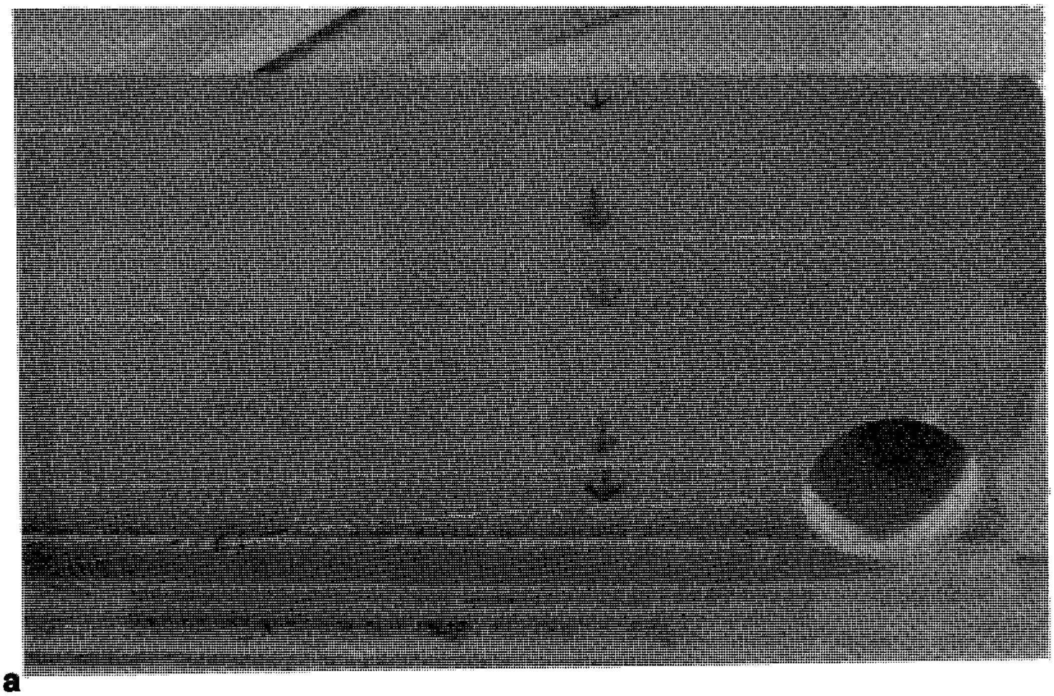
Figure 7. Examples of En Echelon Pattern of Stranded Type 1 Fractures in Core

fracture strands are the same length, parallel and <0.1 ft apart. If the strands are the same length, parallel or not, and ≥0.1 ft apart, they are arbitrarily counted as two individual fractures. If three or more fracture strands intersect the same piece of core such that most horizontal cross sections through the core would intersect three or more fracture strands, the fractures are collectively referred to as a fracture swarm (see Figure 8). In the observed fracture swarms, the individual fracture strands have similar widths; therefore, no single strand stands out as being the main fracture.

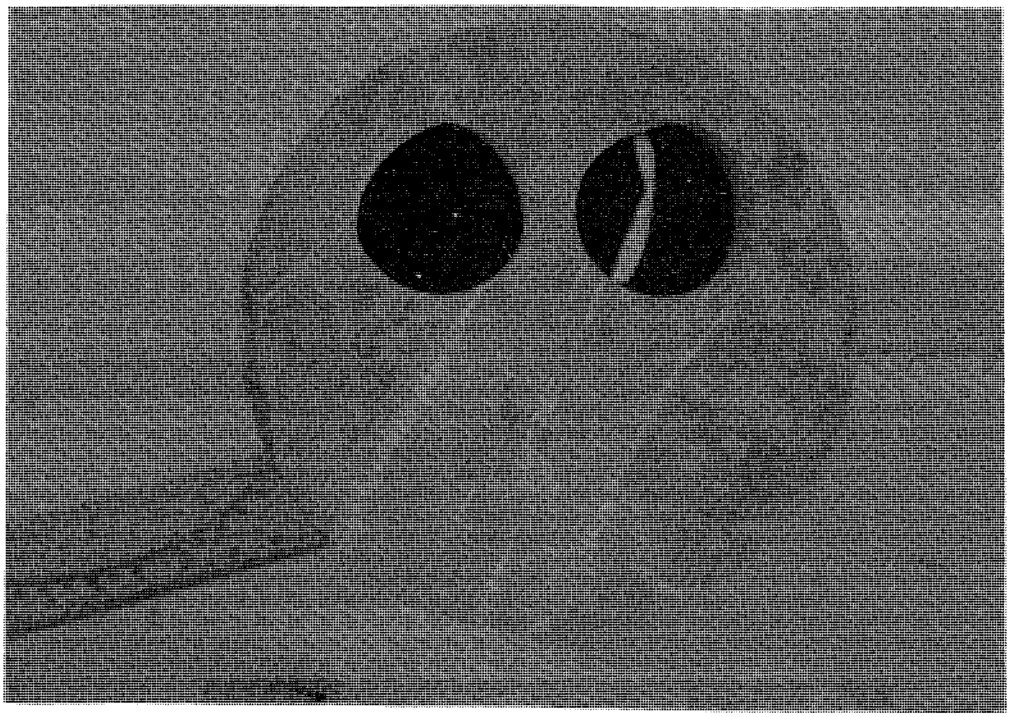
In the database, individual extension fractures are denoted Type 1 and swarms of these fractures are denoted Type S. Arbitrarily, the number of fractures is recorded as 3 for all fracture swarms. In general, all fractures within a fracture swarm have the same orientation and inclination. They may be stranded just like individual extension fractures. At a depth of ~5532 ft in MWX-1, there is a fracture within a fracture swarm with a strike roughly 40° different than the strike of the other fractures within the swarm; this fracture was listed separately. Figure 9 shows the distribution of Type 1 and S extension fractures with depth.

As is obvious in Figure 9, this particular subgroup of extension fractures is densely concentrated in the fluvial interval particularly between 5250 and 5750 ft in the wells. These extension fractures are nearly vertical to vertical (70° to 90°), and roughly 80 percent of those that have been oriented with respect to true north strike west-northwest. Lorenz et al. (1986) discussed the origin and significance of these west-northwest-striking extension fractures. (Note: Orientation data for core fractures presented in this paper supersedes the preliminary orientation data presented in that paper.)

Twenty-five percent (62 fractures) of these Type 1 and S extension fractures have been oriented with respect to true north. Roughly one-third of these oriented fractures are associated with fracture swarms. The predominant west-northwest fracture strike shows up in all three rosette



a



b

Figure 8. Examples of Fracture Swarms (Type S);
(a) MWX-1, 5678 ft; (b) MWX-2, 8123.3 ft

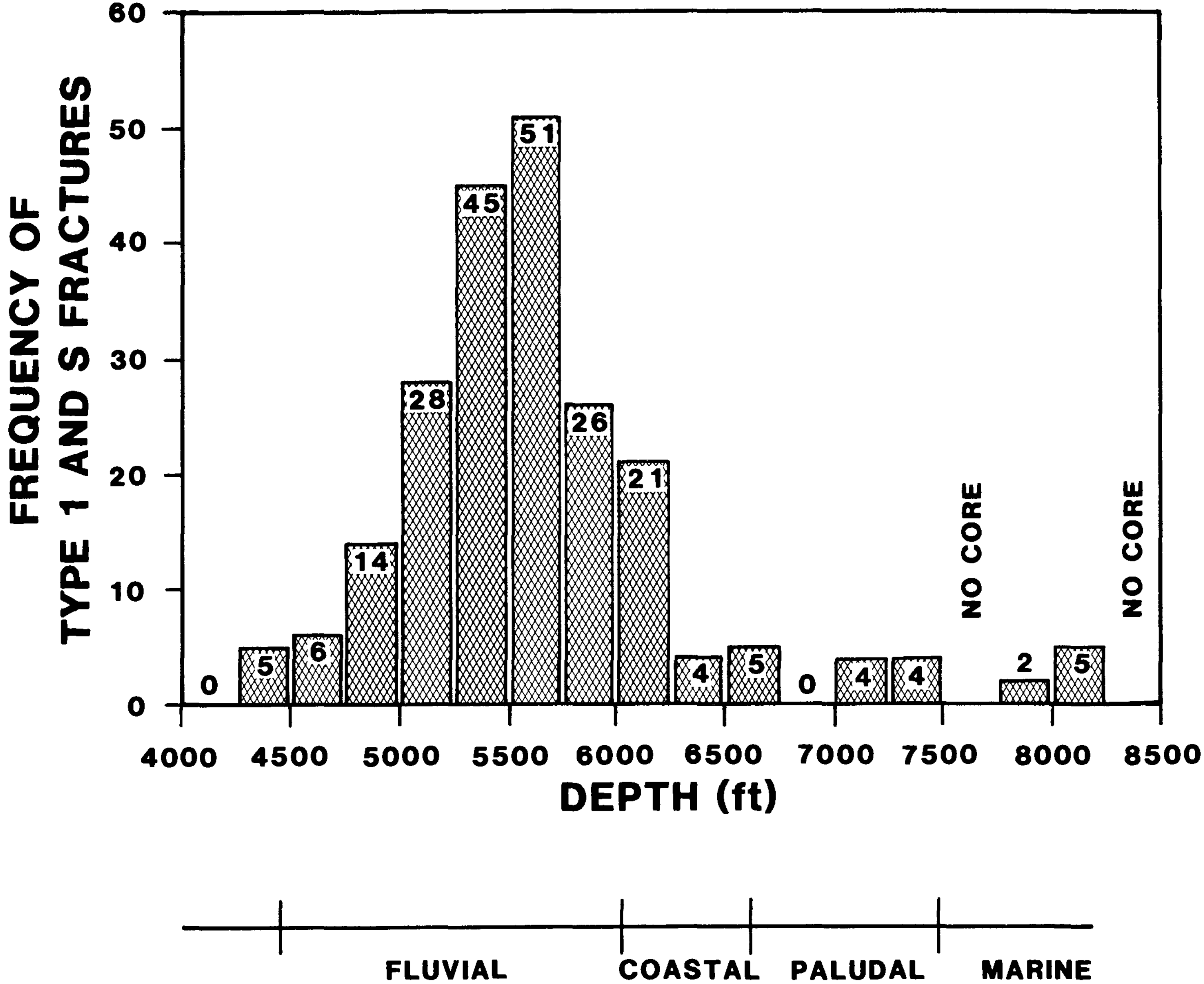


Figure 9. Frequency Distribution of Type 1 and S Fractures with Respect to Depth; Core Data from MWX-1 and MWX-2

diagrams in Figure 10. In addition to the predominant fracture strike, the core intersected fractures striking north-northwest in the marine zone (~8120 ft) and in the fluvial zone (~5440 and 5530 ft). Fractures striking northeast were also detected in core from the fluvial zone (~5505 ft). Figure 11 shows the distribution of fracture strikes with respect to depth. Data from all three MWX wells were used to generate this figure.

Although there is a good deal of scatter in the fracture orientation data due to scatter in the multishot data, the additional fracture orientations are real. The fractures striking north-northwest were either detected in the same piece of core, or in an unbroken and unrotated core run where fractures striking west-northwest were also observed. The orientation of fractures striking northeast was first determined using multishot-oriented core data and later corroborated with paleomagnetic data. In addition to the the multiple fracture strikes in the fluvial and marine zones, two extension fractures, with strikes differing by 50°, intersect each other in core at about 6196 ft in MWX-1 (Figure 12). There are no orientation data available for this piece of core or any core in close proximity to these fractures.

Close inspection of thin sections across intersections of calcite-filled fractures with distinctly different strikes has offered no clue to the relative ages of these apparently different Type 1 fracture sets. No offset is observed and, with the exception of the north-northwest marine fractures, mineralization appears similar and continuous (Figure 13). The identification of chamosite in the north-northwest marine fractures suggests this fracture set may be older than the predominant west-northwest fractures.

All of the Type 1 and S fractures are filled with some combination of calcite, quartz, chamosite, barite and/or dickite mineralization. Figure 14 shows the distribution of the three most common types of mineralization. Calcite is by far the most common mineral phase. Calcite occurs as either the only mineral phase present, or in conjunction with quartz, dickite, barite, and/or chamosite. The calcite crystals are

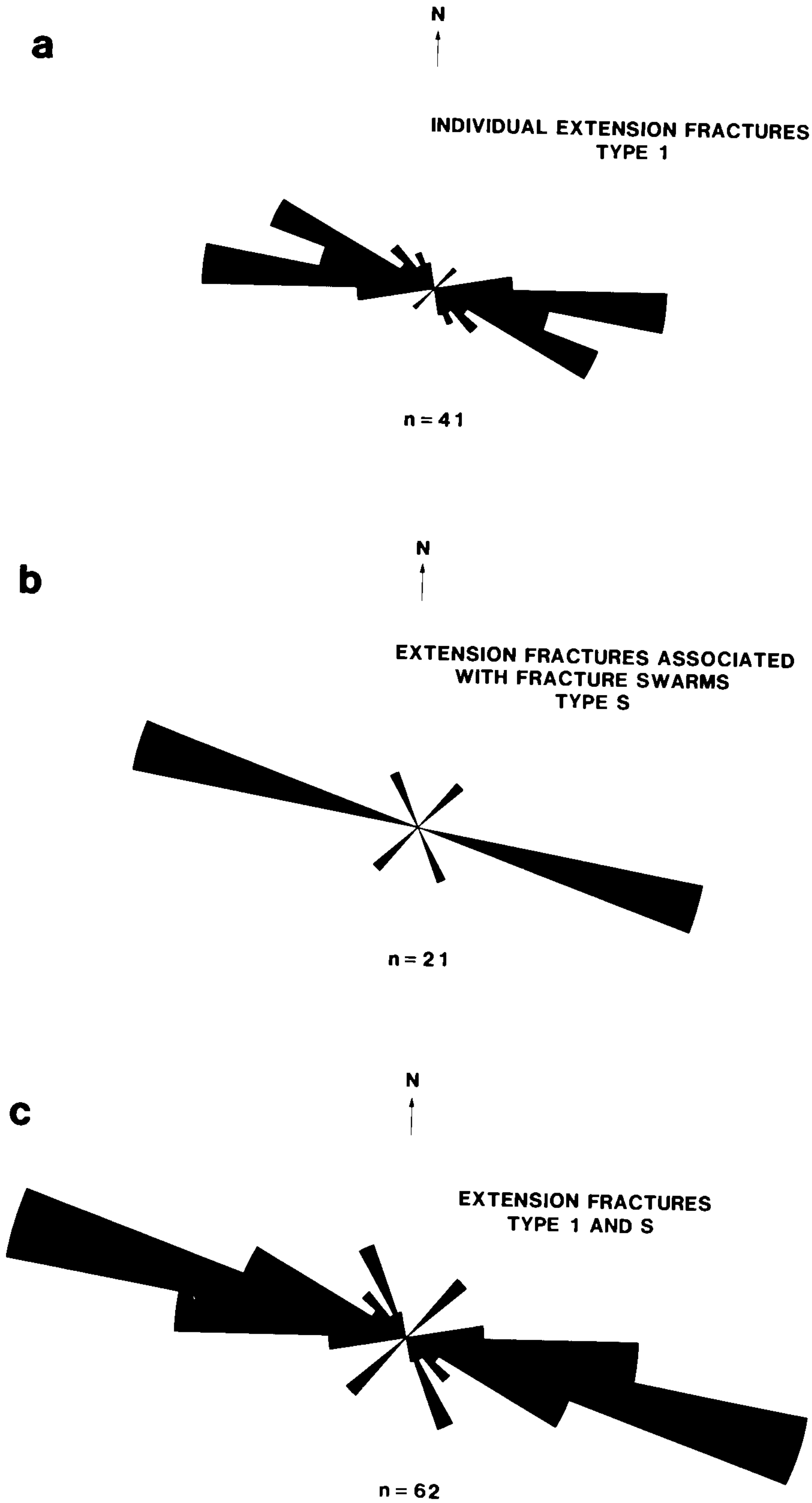


Figure 10. Strikes of Type 1 and Type S Fractures Plotted in Rosette Diagrams; (a) Type 1 Fractures; (b) Type S Fractures; (c) Both Type 1 and Type S Fractures

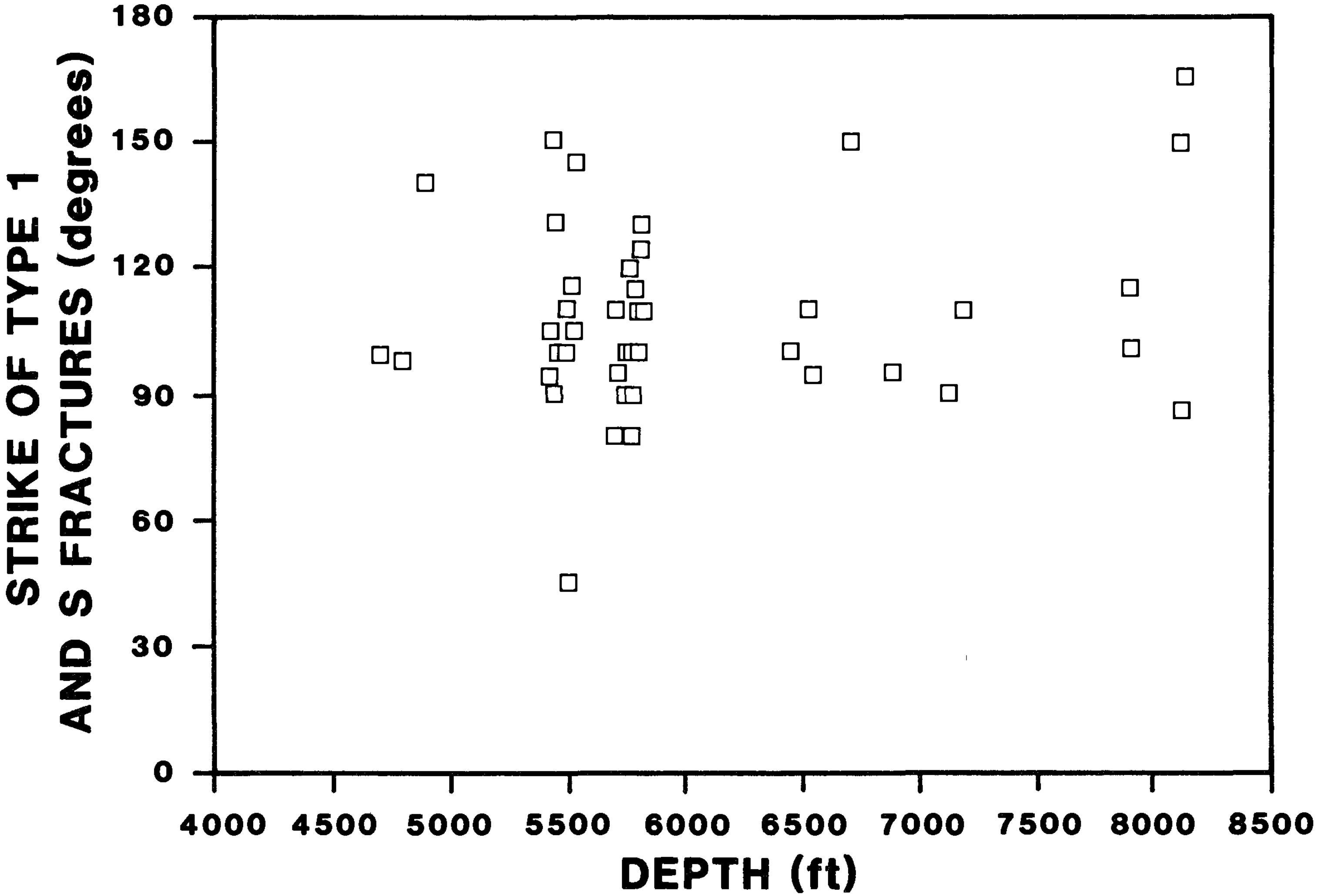


Figure 11. Distribution of Type 1 and S Fracture Strikes Plotted With Respect to Depth; Oriented Core Data From all Three MWX Wells

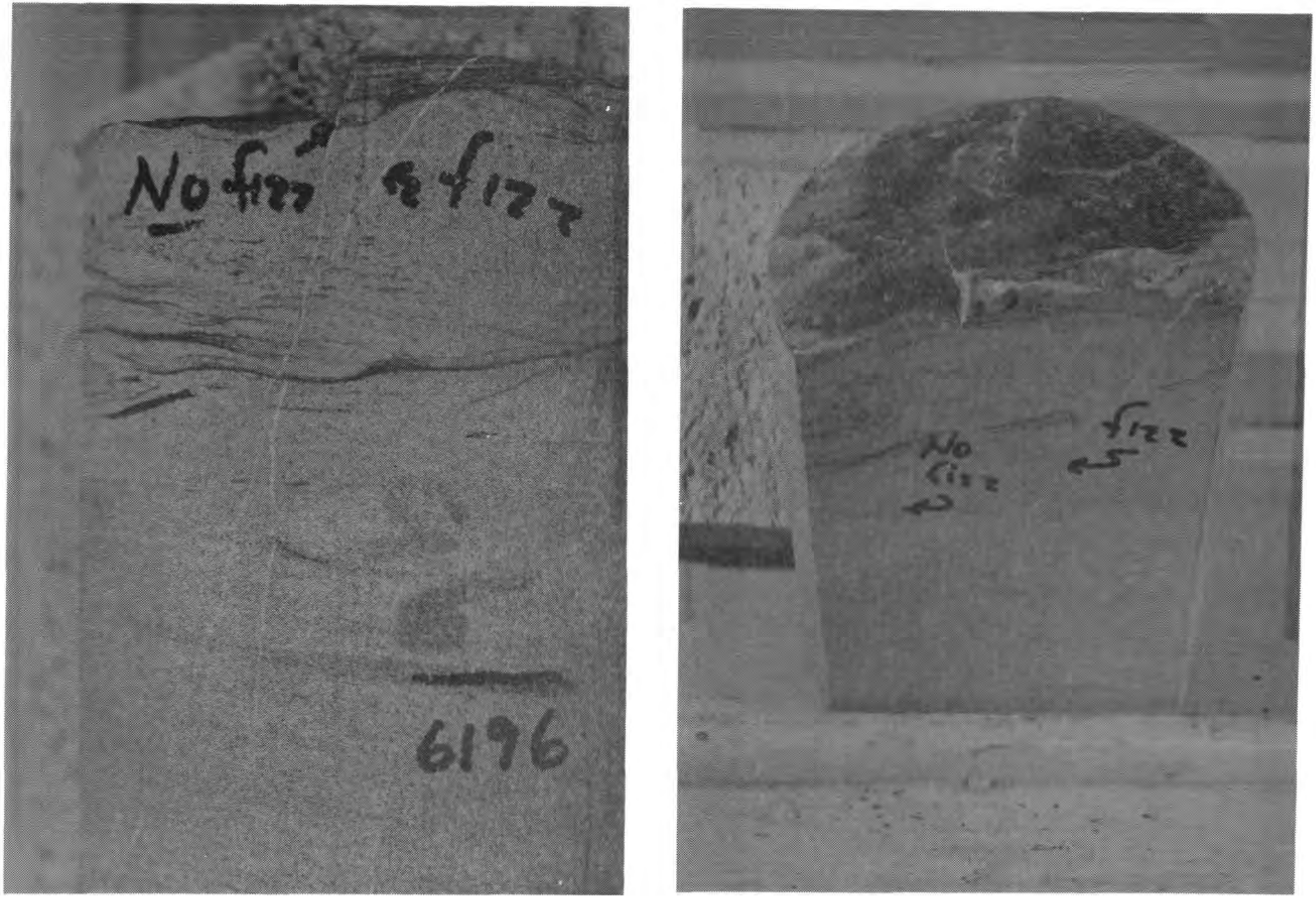


Figure 12. Intersecting Type 1 Fractures at 6196 ft in MWX-1

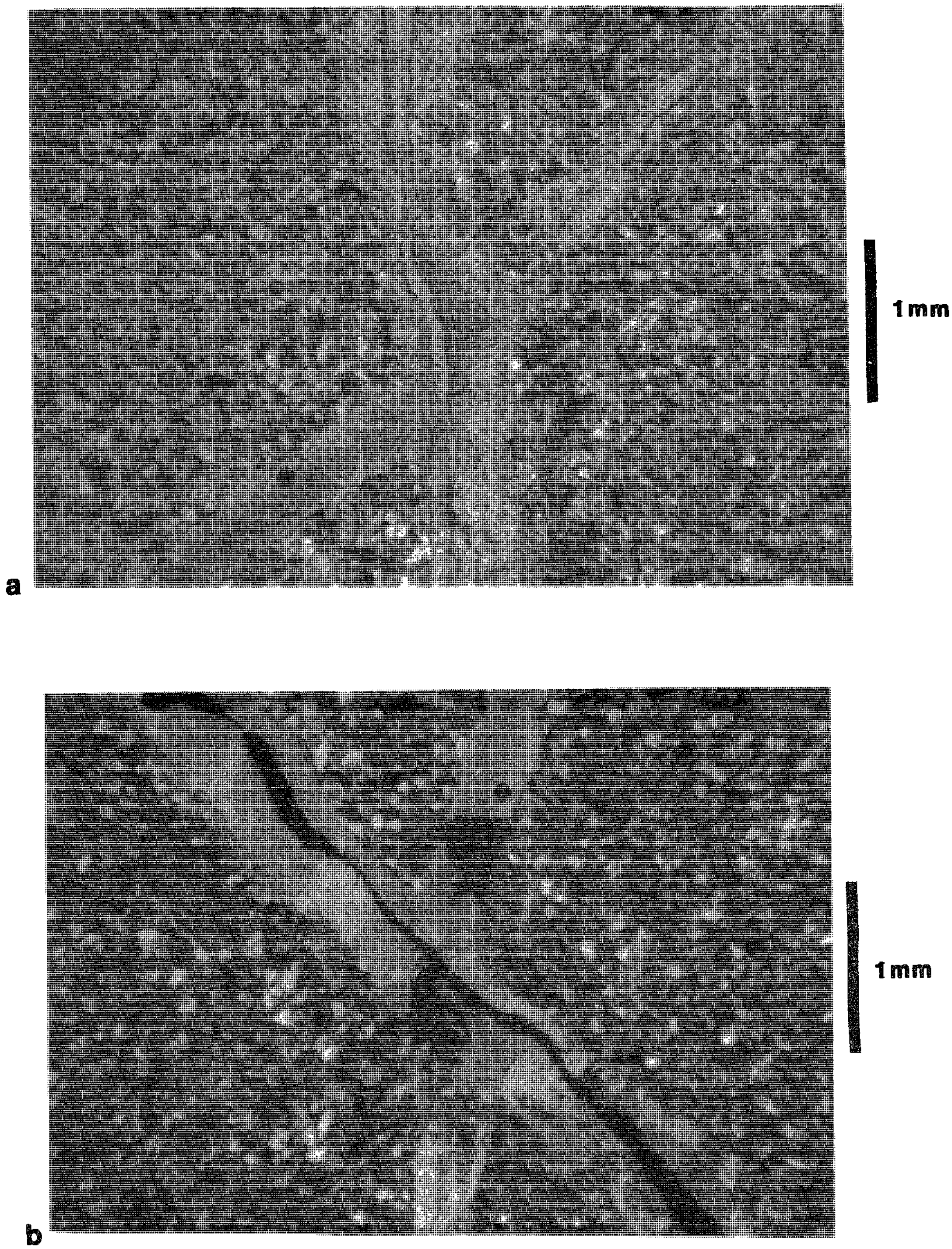


Figure 13. Photomicrograph of Intersecting Type 1 Fractures at 5532.2 ft in MWX-1; (a) Plane Light; (b) Polarized Light

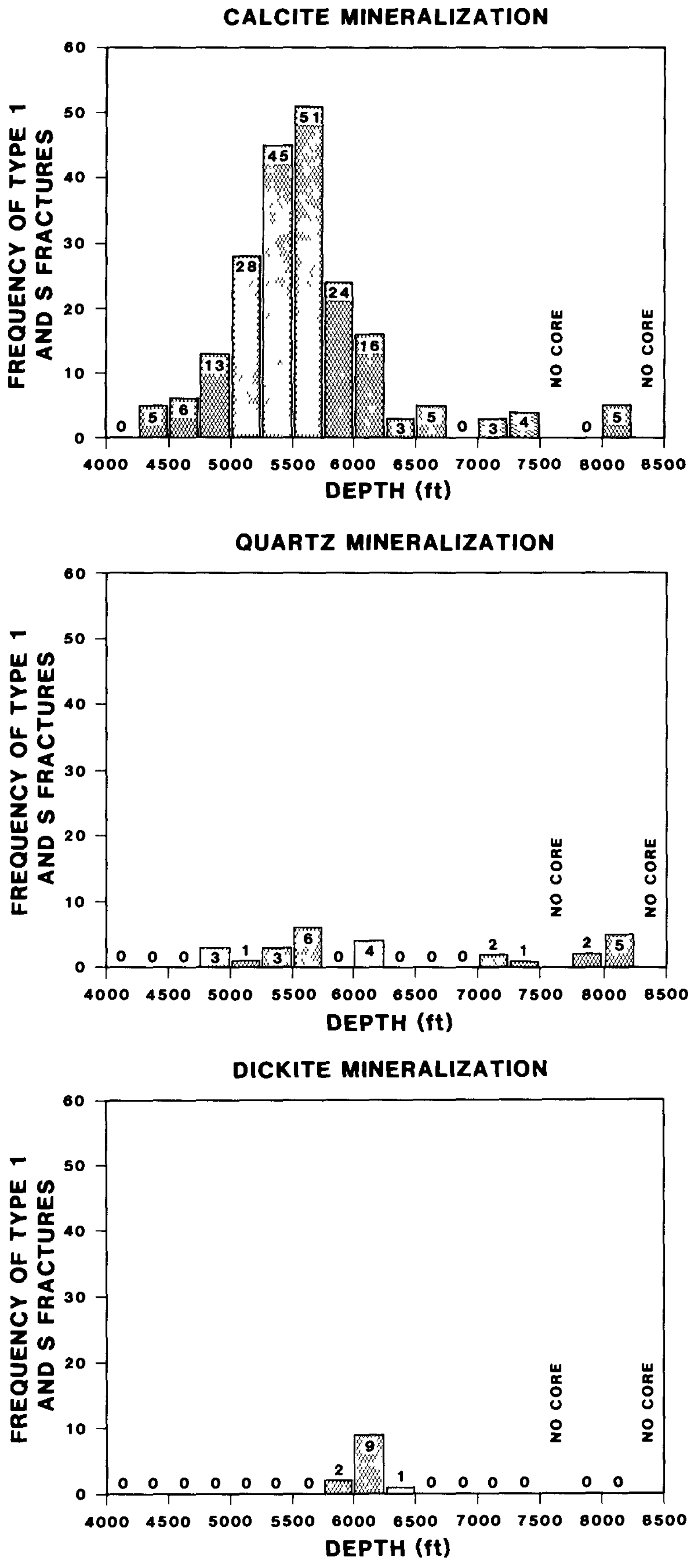


Figure 14. Distribution of Different Fracture Mineralization With Respect to Depth; Core Data From MWX-1 and MWX-2

sometimes subhedral and frequently twinned (Figure 15). Quartz is the only mineral phase identified in one fracture in the paludal interval (~7122 ft) and two fractures in the marine interval (~7903 ft); however, in Type 1 and S fractures, quartz is typically found with calcite and/or dickite and frequently appears to have been the first mineral phase to precipitate. The quartz often appears as subhedral crystals nucleated on sand grains at the fracture wall (Figure 16).

Dickite apparently completely fills fractures or fills void in fractures previously mineralized with quartz and calcite. The photomicrographs in Figure 17 suggest that at this location calcite may have been partially dissolved or altered by the fluids precipitating dickite. Calcite and/or quartz sometimes occur in only microscopic quantities in the dickite-filled Type 1 fractures. Since petrographic analysis wasn't routinely done, calcite and/or quartz may have been overlooked in some of these fractures. Dickite has been identified by x-ray diffraction analysis and has only been detected in 12 of the Type 1 extension fractures between 5980 and 6400 ft in MWX-1. This particular interval was not cored in either of the other two MWX wells. The presence of dickite is used as an identifying characteristic of the subgroup of extension fractures called "frac blast" fractures (Type 8) discussed later.

The mineral chamosite only occurs in the fractures striking north-northwest in the marine interval in MWX core. Where it occurs, chamosite lines fracture walls or completely fills fracture strands, indicating it was the first mineralization to precipitate from solution (Figure 18). Calcite and quartz are also present in these same fractures. The presence of early chamosite in north-northwest marine fractures coupled with its absence in west-northwest striking marine fractures suggests that at least in the marine interval, the north-northwest fractures are older. (There are a number of inconsistencies in the literature regarding the mineral name "chamosite." Usage of "chamosite" in this paper is based on the definition provided by Maynard (1986). He suggests using "chamosite" to refer to Fe-rich chlorites with a measurable 14 angstrom basal spacing.)

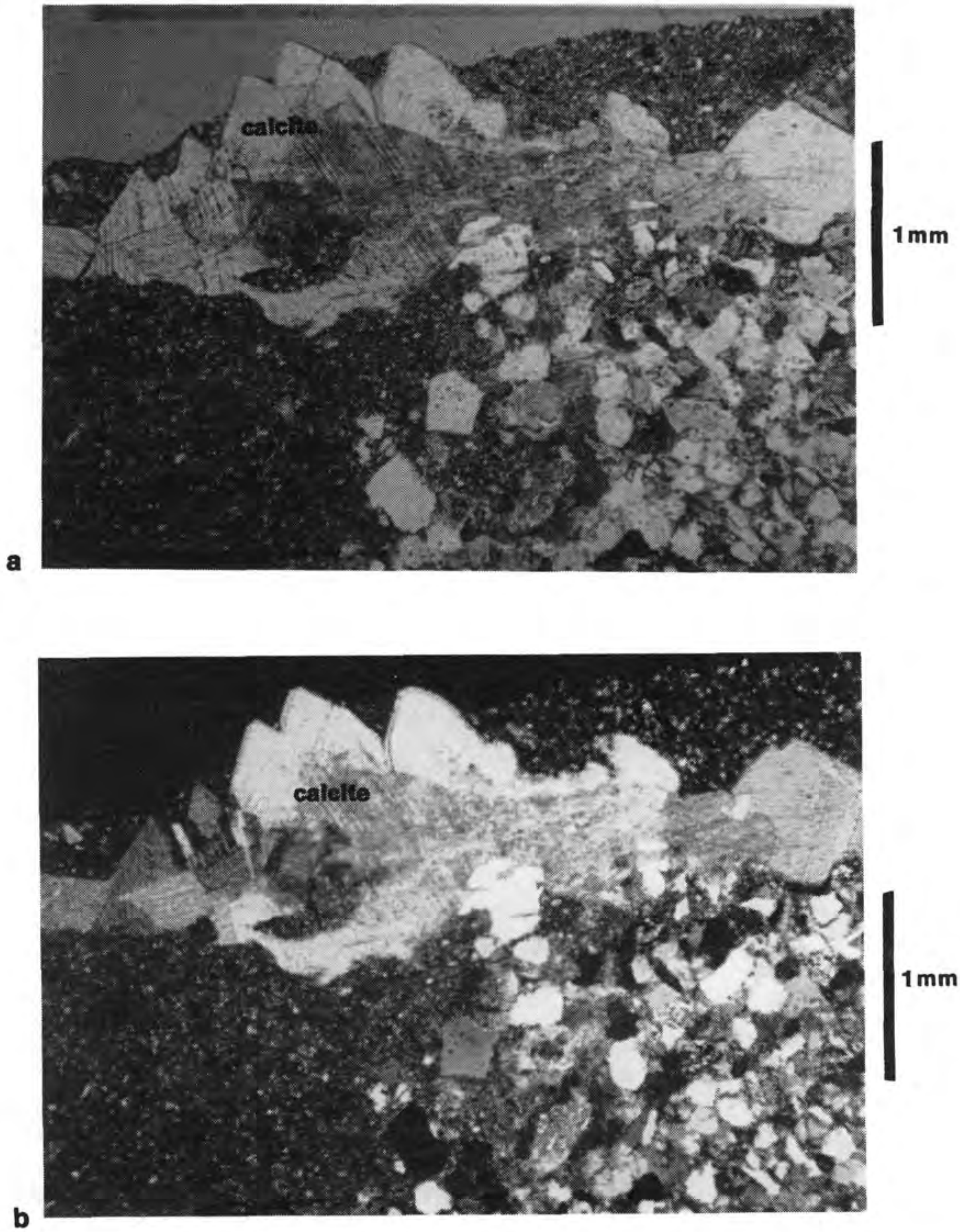


Figure 15. Photomicrographs of Subhedral and Twinned Calcite in a Type 1 Fracture 6008.6 ft in MWX-1; (a) Plane Light; (b) Polarized Light

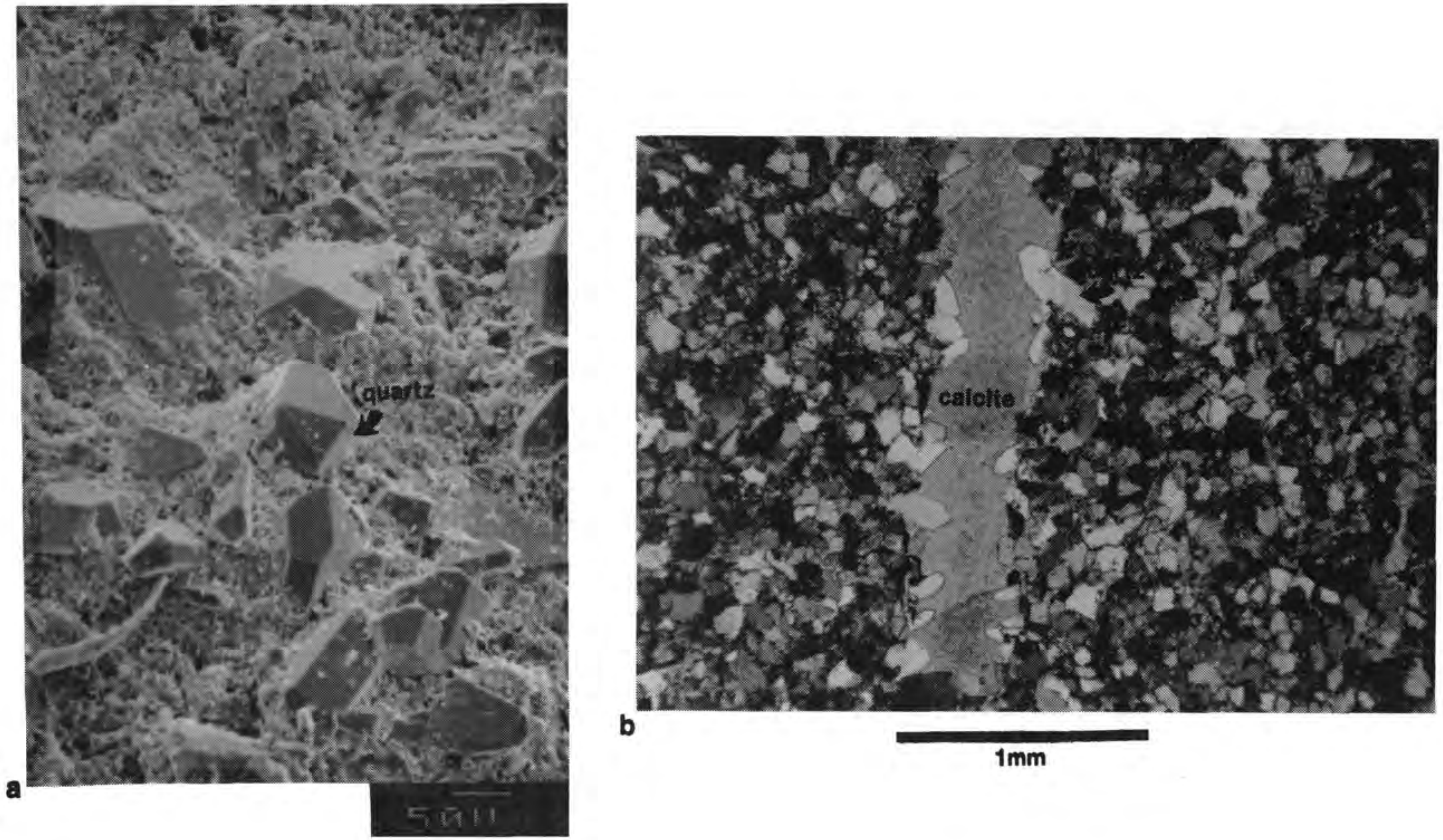


Figure 16. Photomicrographs of Quartz Nucleated on Sand Grains Along Fracture Walls; (a) SEM Photo of Subhedral Quartz in Fracture at ~7122 ft in MWX-2; (b) Photo of Thinsection of Mostly Calcite Filled Fracture at 5504.3 ft in MWX-1 (polarized light)

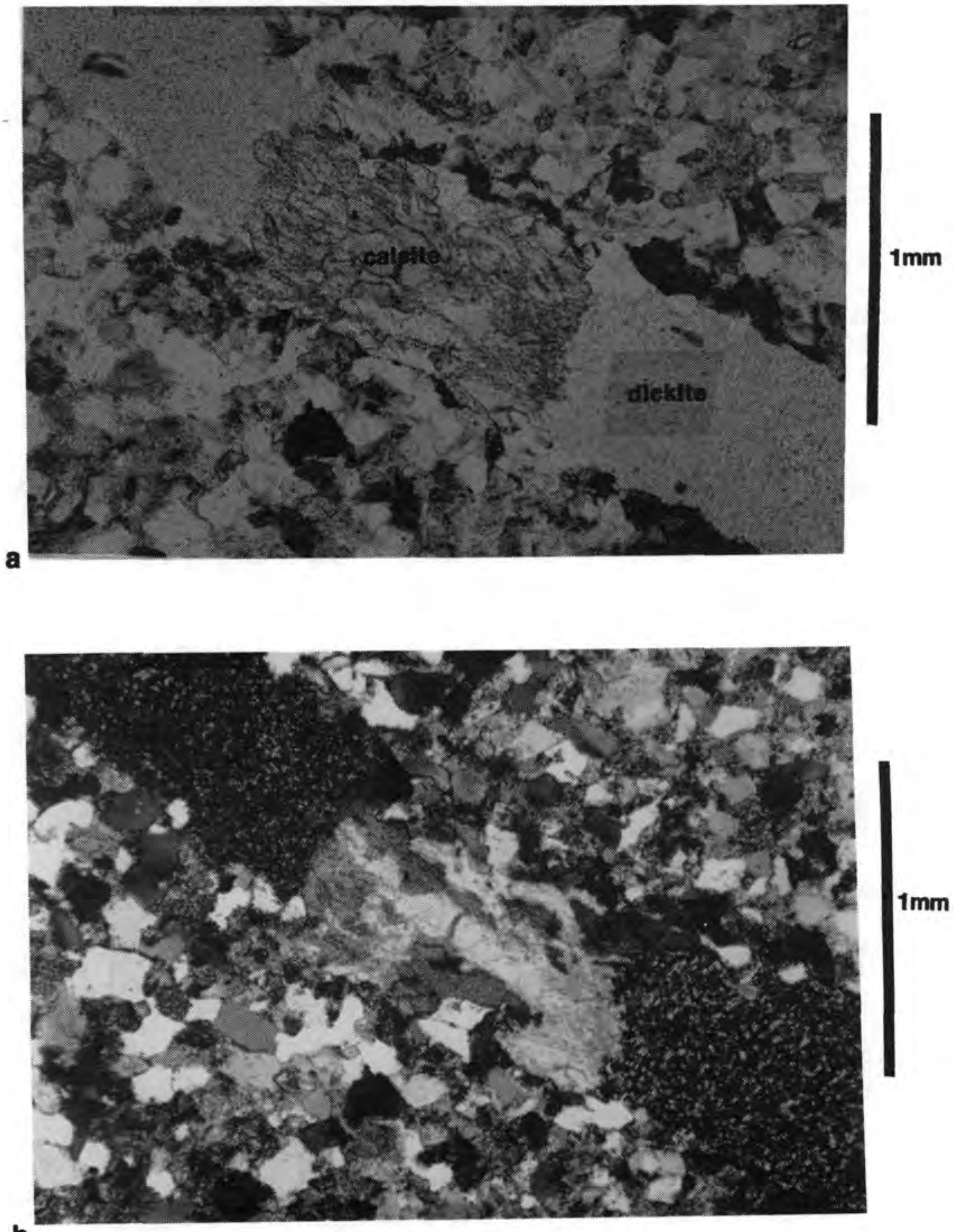


Figure 17. Photomicrographs of Calcite and Dickite in Type 1 Fracture at 6047.2 ft in MWX-1; (a) Plane Light; (b) Polarized Light

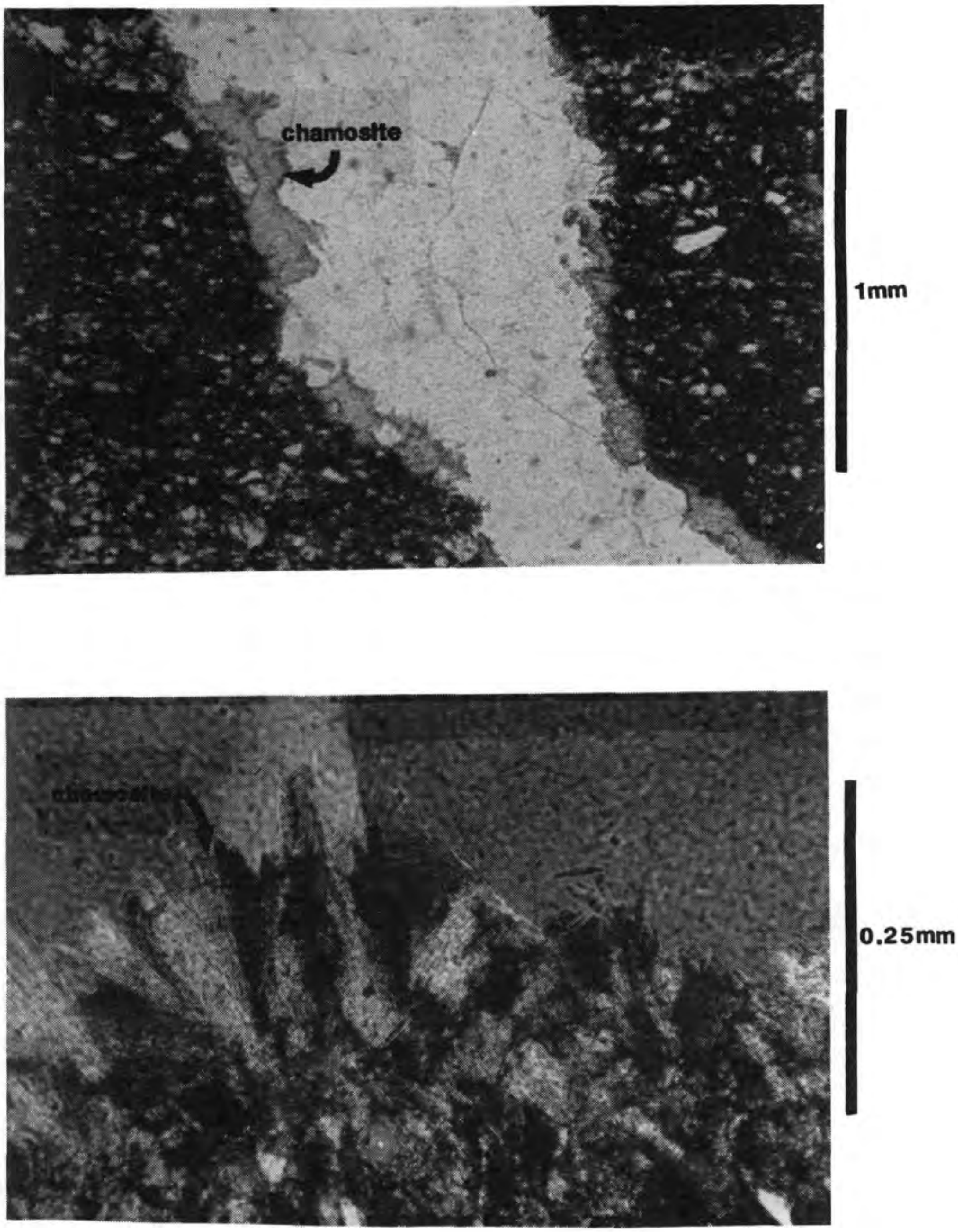


Figure 18. Photomicrographs of Chamosite Lining Fracture Walls at 8123.3 ft in MWX-2; (a) Plane Light; (b) Polarized Light

Barite is much less commonly observed than calcite, quartz, or dickite. It has only been identified in two Type 1 fractures and only in very minimal amounts in any one fracture. Due to its paucity in fractures where it has been identified and typically microscopic crystalline habitat, the identification of barite requires x-ray diffraction, petrographic analysis, or scanning electron microscope work (Figure 19). These analyses were not conducted on every fracture or along the entire length of any one fracture, so the presence of barite may have frequently been overlooked. To date, the age relationship between barite and other mineralization is unclear.

Measured fracture width of these largely vertical and mostly calcite-filled extension fractures ranges from roughly a centimeter to a small fraction of a millimeter. Figure 20 shows the distribution of maximum fracture width with respect to depth. A few of the fractures were split open in the core barrel and occasionally only half of the fracture was retrieved. In most such cases, the fracture mineralization appears subhedral with well formed crystal faces that must have formed in an at least partially unconfined environment. If immeasurable, the width of fractures with subhedral mineralization was arbitrarily listed as 1 cm, which is 1 mm less than the maximum fracture width measured in the core. As shown in Figure 20 the wider Type 1 extension fractures are concentrated between 6000 and 6100 ft, although they also occur sporadically throughout the Mesaverde section. A listing of wider Type 1 extension fractures with subhedral mineralization is given in Table 2. These fractures are most likely open to some extent in the subsurface.

Over 95% of these Type 1 and S extension fractures are found in sandstone and siltstone lithologies in the core (Figure 21). Fracture terminations observed in core are often at lithologic (mostly mudstone) contacts, but also occur within the fractured lithology. Due to the en echelon morphology of these fractures, it's often difficult, and occasionally impossible, to determine if absolute fracture terminations are

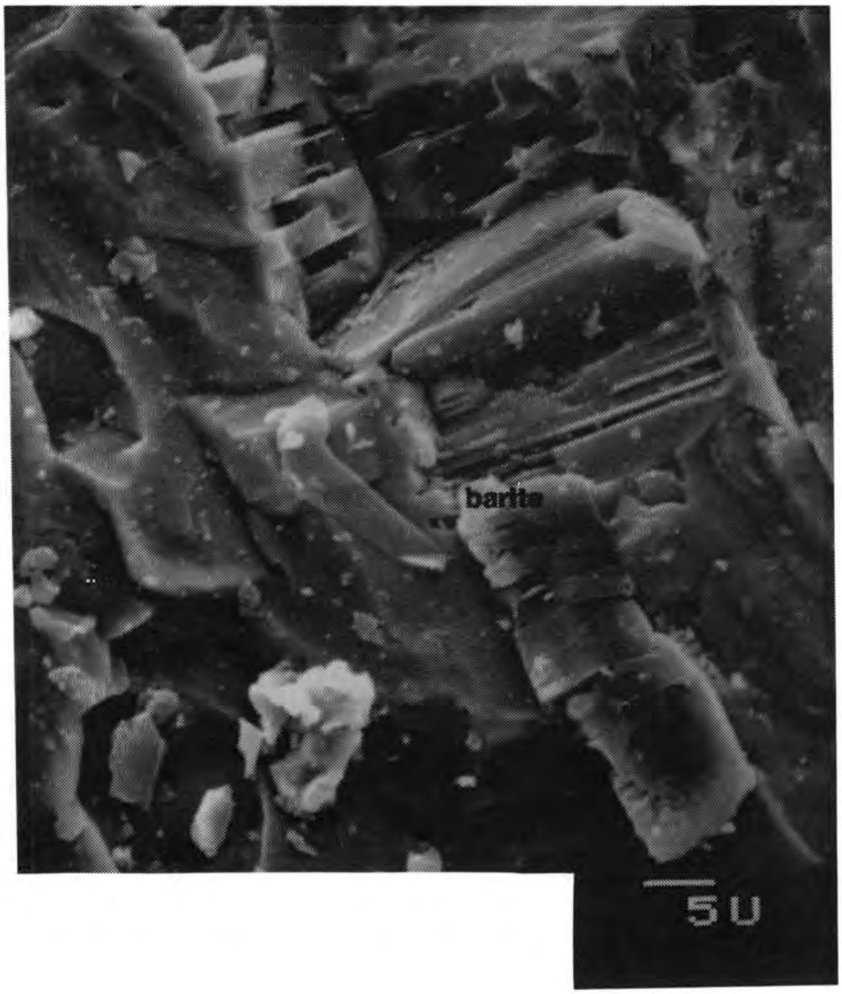


Figure 19. Scanning Electron Micrograph of Barite in Type 1 Fracture at 6047.5 ft in MWX-1

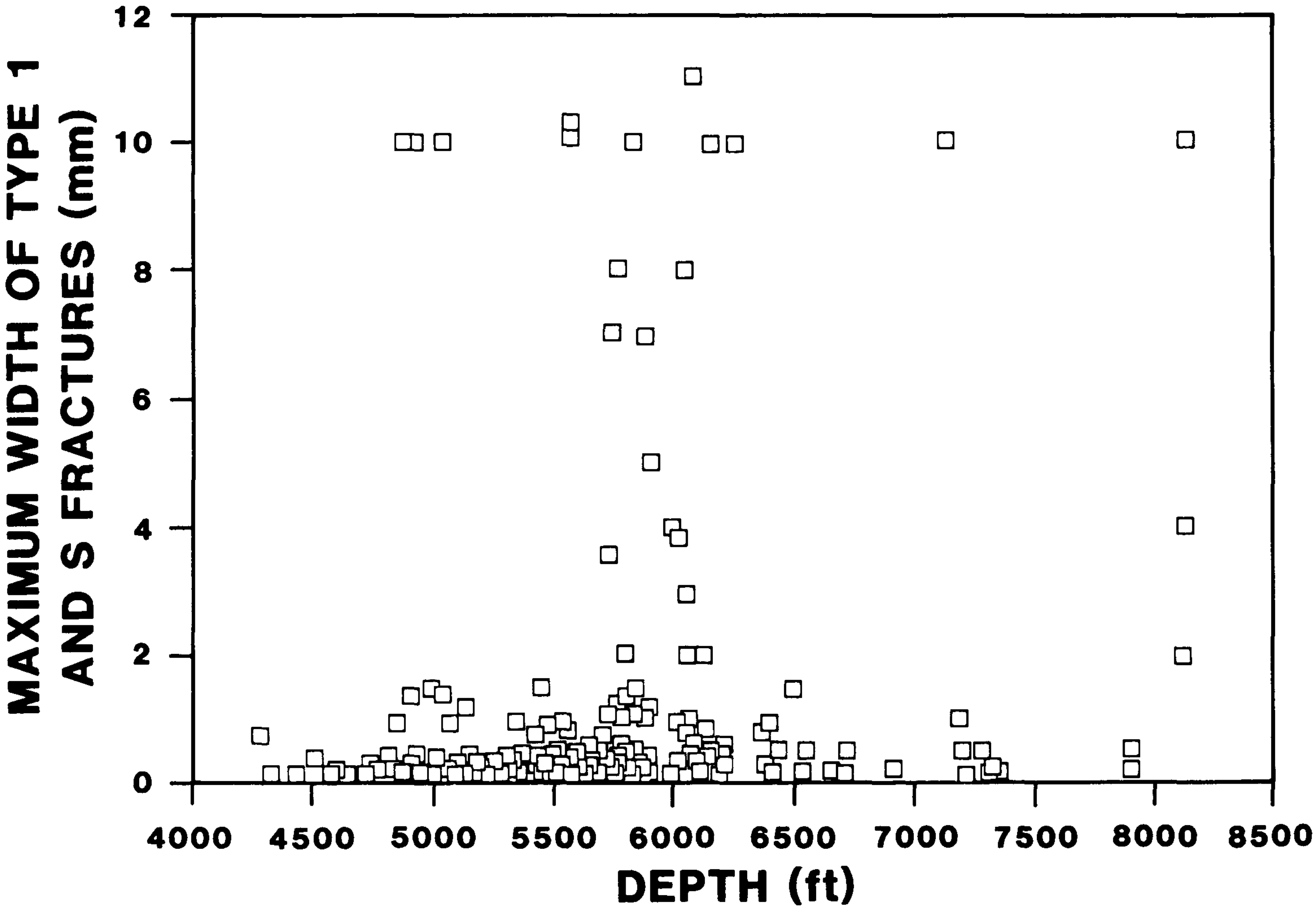


Figure 20. Distribution of Type 1 and S Fracture Widths With Respect to Depth; Core Data From all Three MWX Wells

Table 2

Type 1 and S Fractures With Subhedral Mineralization

Well	Depth of Top of Fracture (ft)	Fracture Height in Core (ft)	Maximum Fracture Width in Core (mm)
MWX-1	4877.3	1.0	10.0*
	4904.6	1.6	1.4
	4908.0	1.0	10.0
	5016.4	3.5	10.0*
	5730.4	6.0	3.6
	5863.9	1.8	7.0
	5866.6	4.2	7.0
	5890.4	1.0	4.0
	6007.7	2.8	3.8
	6033.0	1.1	3.0
	6075.7	1.4	11.0
	6249.2	1.3	10.0*
MWX-2	5567.0	0.6	10.0*
	5568.0	4.0	10.0*
	5743.3	3.5	7.0
	5750.4	1.8	1.2
	5761.5	3.5	8.0
	5779.6	2.7	2.0
	5793.6	2.1	1.2
	5826.2	2.7	1.5
	7122.2	4.0	10.0*
	7181.1	1.7	1.0
	8123.3	0.2	4.0
	8124.2	0.5	10.0*
MWX-3	5809.5	0.3	10.0*

*Separated fracture, width estimated at 10.0 mm.

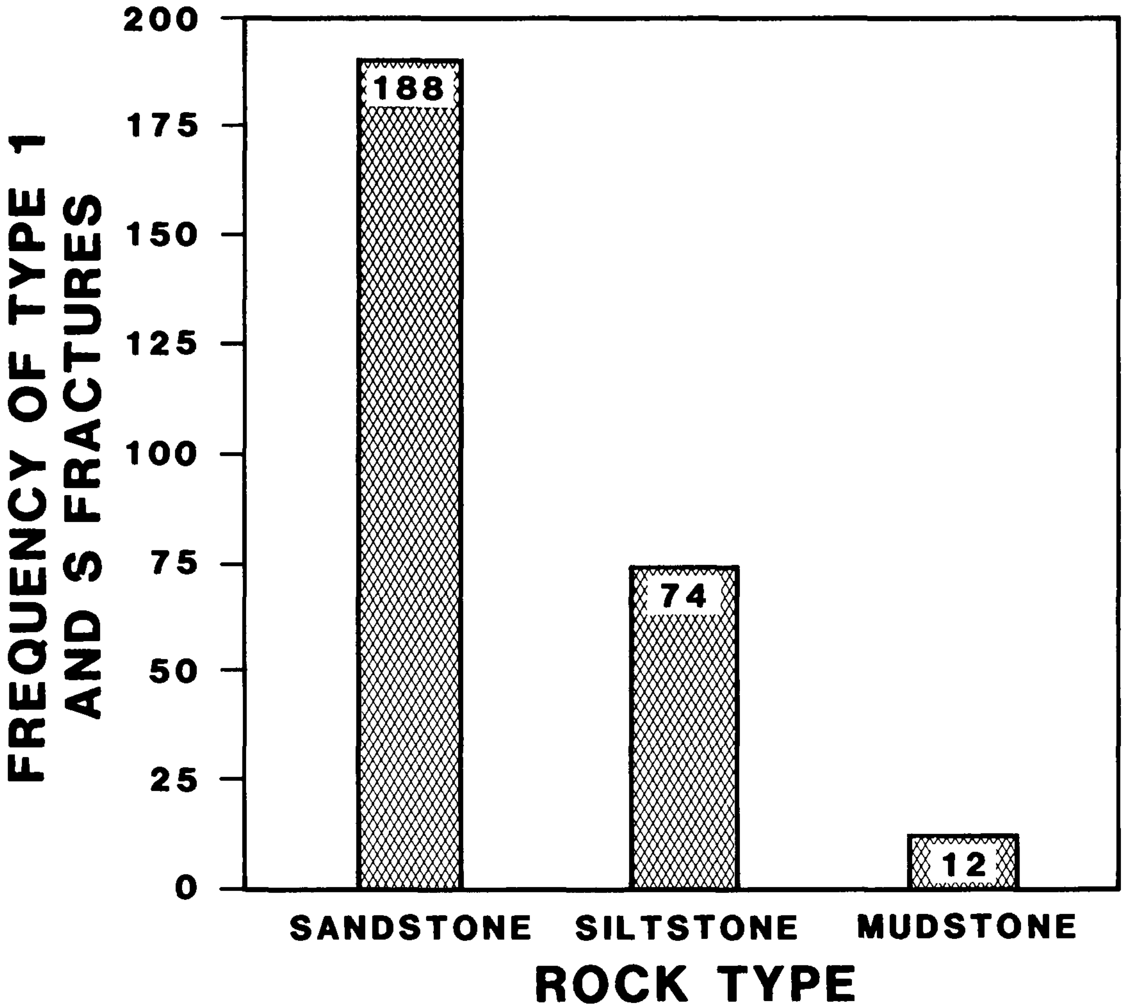


Figure 21. Frequency of Type 1 and Type S Fractures in Three Different Rock Types; Core Data From all Three MWX Wells

observed in the 4-in.-diameter core or if terminations of only a segment of a much larger fracture are observed in the core. Abrupt terminations of these Type 1 extension fractures at mudstone contacts (as shown in Figure 22), coupled with the very rare occurrence of these fractures in mudstone lithologies, suggest that the terminations at mudstone contacts are absolute fracture terminations.

b. "Frac Blast" Fractures (Type 8)

Type 8 or "frac blast" fractures are the second most common subgroup of extension fractures detected in MWX core. Figures 23 and 24 show photographs of typical "frac blast" or Type 8 extension fractures. They appear to have imparted an exploded rock texture to the core, hence the informal name "frac blast." The fracture planes range from undulatory to planar and frequently are coincident with syndepositional sedimentary structures or bedding planes. Measured fracture dips range from horizontal to vertical, and fracture mineralization always includes dickite. In some intervals the Type 8 fractures are parallel to each other, and in other intervals, they are mutually perpendicular to each other. There are no oriented core data available for the interval of core where these "frac blast" fractures were detected.

About 61 "frac blast" fractures were detected; all between 6080 ft and 6315 ft in MWX-1. Figure 25 shows the distribution of these Type 8 extension fractures with depth. The upper coastal interval where Type 8 fractures were detected in MWX-1 was not cored in either of the other two MWX wells. The "frac blast" fractures are highly concentrated between approximately 6129 and 6200 ft, and they generally occur in clusters within core intervals 1 to 2 ft in length. It is impossible to determine the relationship of numerous, often undulatory fracture strands, varying widely in length, width, strike, and dip within these clusters. Consequently, an arbitrary maximum fracture number of 6 was assigned when six or more fractures or fracture strands were counted. Forty-eight or 80 percent of the "frac blast" fractures occur in these high-density clusters.

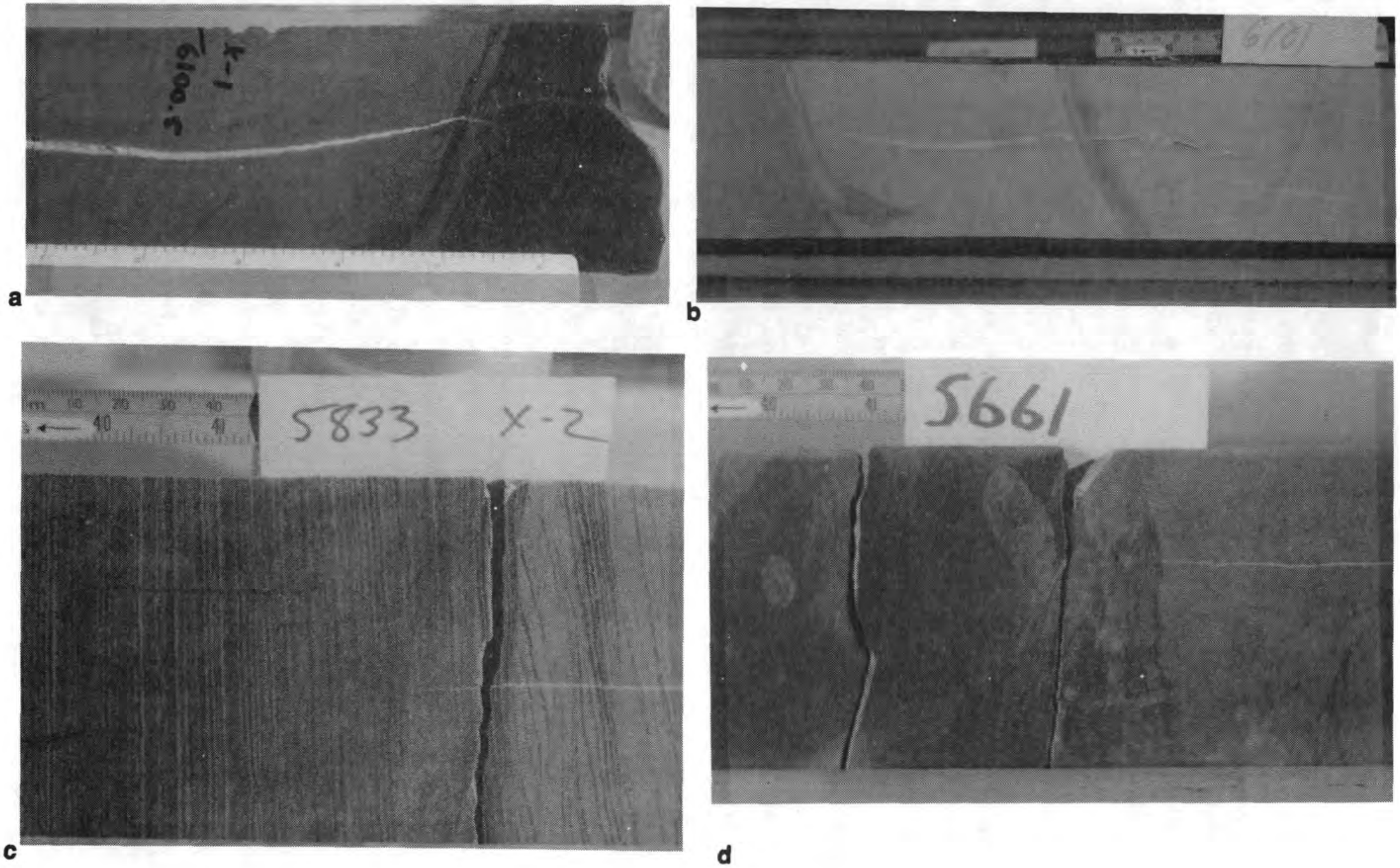


Figure 22. Photographs of Type 1 Fracture Terminations at Mudstone Contacts; (a) ~6100.5 ft in MWX-1; (b) ~6101 ft in MWX-1; (c) ~5833 ft in MWX-2; (d) ~5661 ft in MWX-1

Figure 23. Examples of Type 8 "Frac Blast" Fractures in Core; Both Photos From ~6135 ft in MWX-1

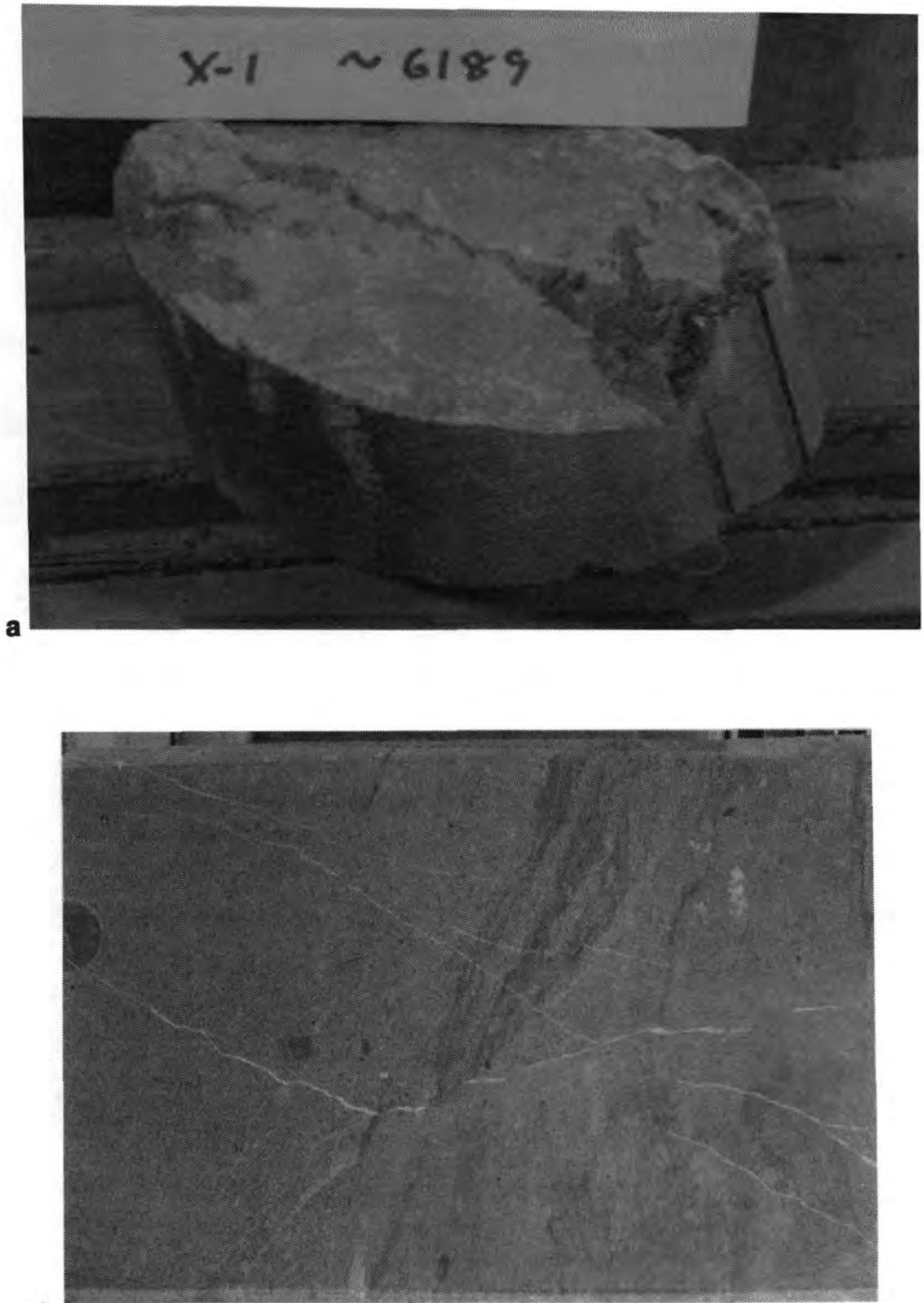


Figure 24. Examples of Type 8 "Frac Blast" Fractures in Core; (a) ~6189 ft in MWX-1; (b) ~6198 ft in MWX-1

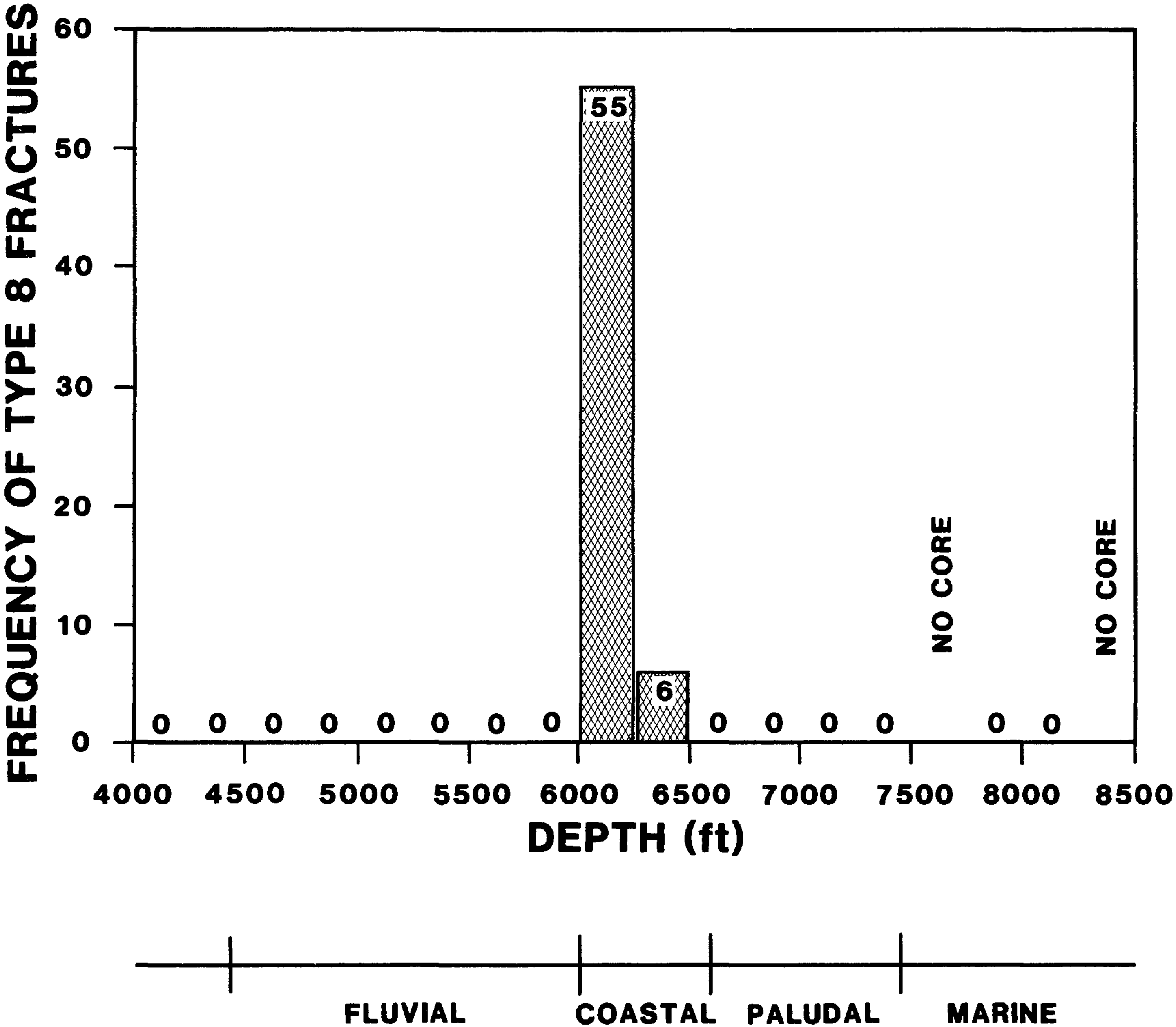


Figure 25. Frequency Distribution of Type 8 Fractures With Respect to Depth; Core Data From MWX-1 and MWX-2

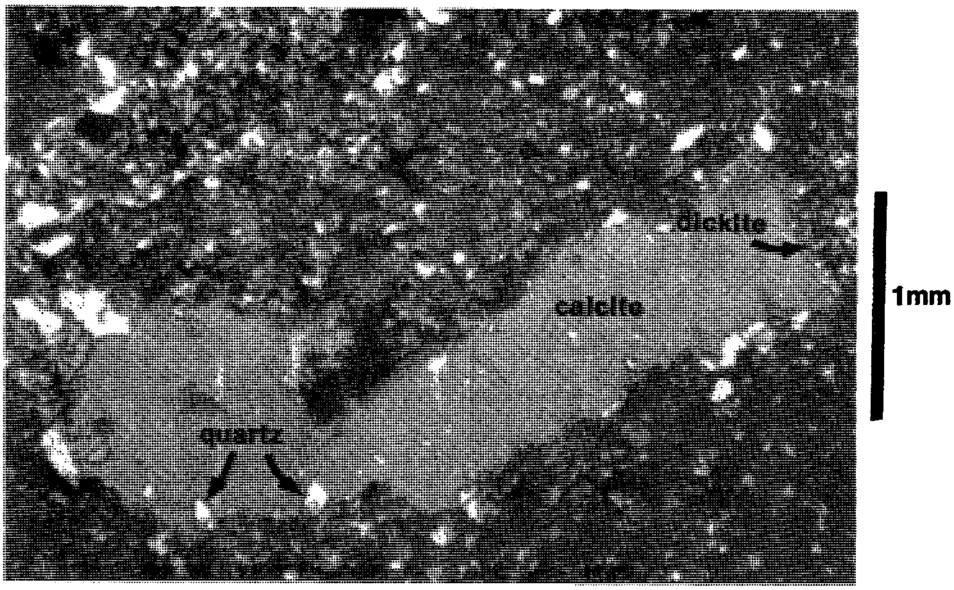
Dickite is the predominant mineralization of the "frac blast" fractures. Dickite has also been detected in other types of fractures within the "frac blast" interval and slightly beyond it. Calcite is also commonly present in Type 8 fractures, and lesser amounts of quartz and barite have been identified microscopically or in x-ray. Figure 26 shows photomicrographs of a Type 8 fracture with quartz and calcite mineralization as well as dickite.

The maximum fracture widths of individual "frac blast" fractures are plotted with respect to depth in Figure 27. For "frac blast" clusters, only the maximum width of the widest fracture within the cluster is plotted in Figure 27. The measured fracture width ranges from a small fraction of a millimeter to 6 millimeters in the core. Blue epoxy impregnation of thin sections and SEM analysis reveal the presence of microporosity within dickite mineralization (Figure 28).

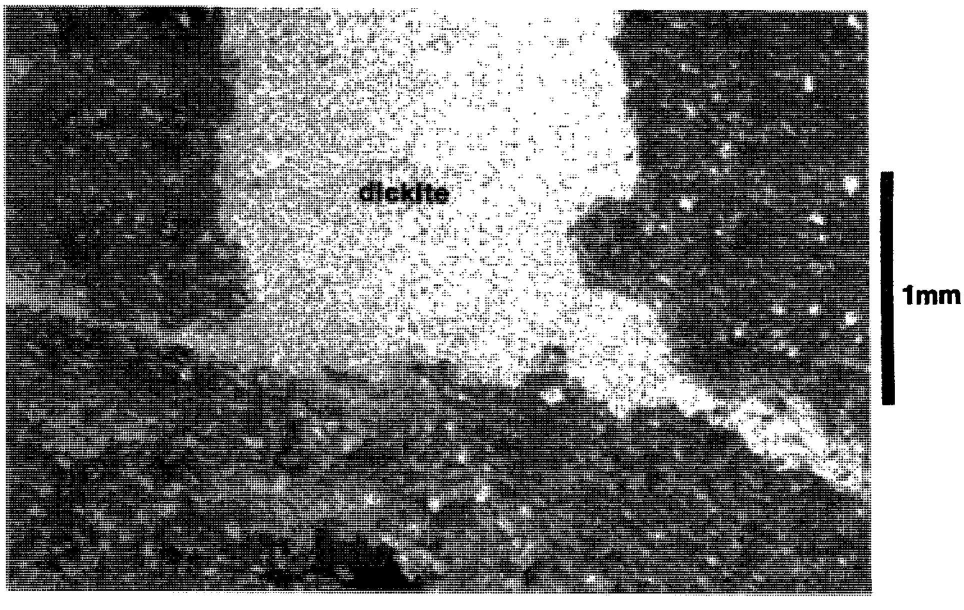
Type 8 fractures occur most commonly in muddy siltstone or interlaminated and mixed mudstone, siltstone, and sandstone. In contrast to Type 1 extension fractures, they are infrequently observed in clean sandstones and siltstones. However, clean sandstones and siltstones are less common in the "frac blast" interval than in some other intervals of the core. (Note the gamma log response in the "frac blast" interval marked in Figure 29.) The "frac blast" clusters and individual fractures terminate within the fractured lithology and at mudstone contacts in the core. Since these fractures occur frequently in mudstone lithologies, the occasional termination at a mudstone contact may be coincidental, or represent only an interruption in the fracturing that continues beyond the core diameter.

c. Horizontal Fractures (Type 7)

This subgroup of extension fractures at MWX is comprised of 27 horizontal to subhorizontal, generally planar, mostly calcite-mineralized fractures. Fractures in this subgroup of extension fractures are indistinguishable from horizontal to subhorizontal "frac blast" fractures



a



b

Figure 26. Photomicrographs of Type 8 Fracture Mineralization; (a) Calcite and Quartz in Fracture at 6147.5 ft in MWX-1 (Polarized Light); (b) Dickite in Fracture at 6147.5 ft in MWX-1 (Plane Light);

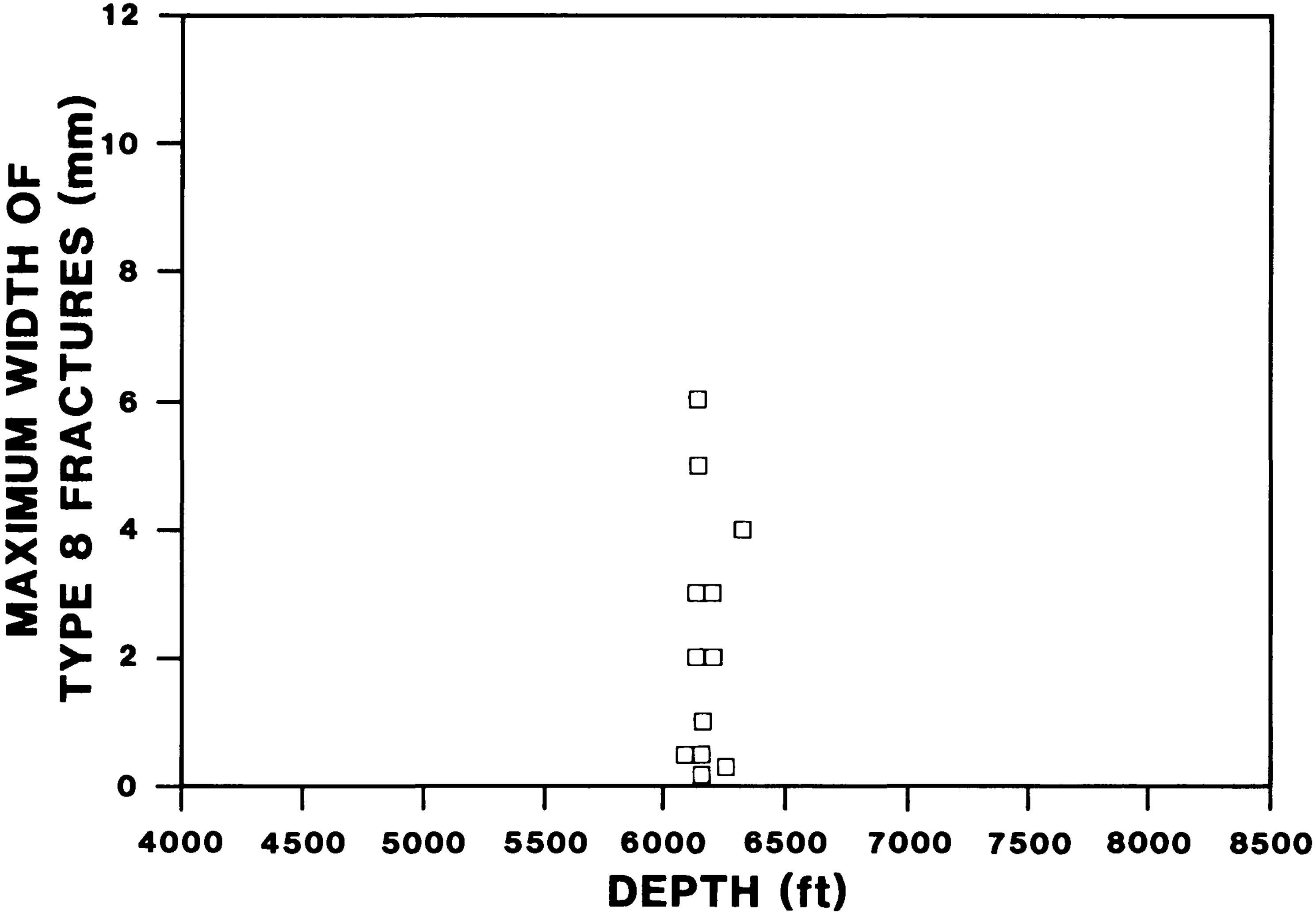


Figure 27. Distribution of Type 8 Fracture Widths With Respect to Depth; Core Data From MWX-1 and MWX-2

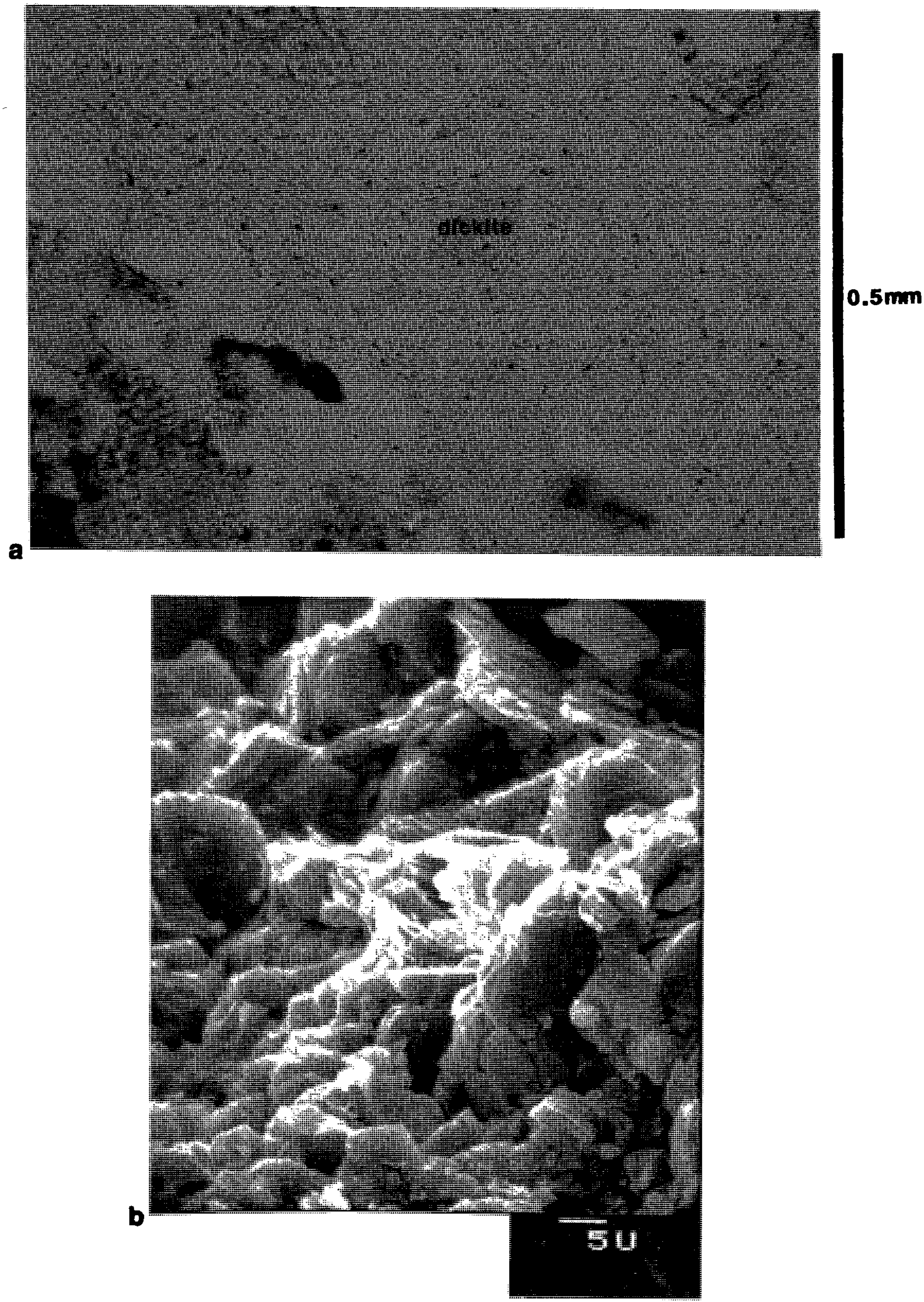


Figure 28. Photomicrographs of Dickite Mineralization (~6047 ft, MWX-1); (a) Thinsection of Dickite, Micro-Porosity is Darker in Color; (b) SEM Photo of Dickite

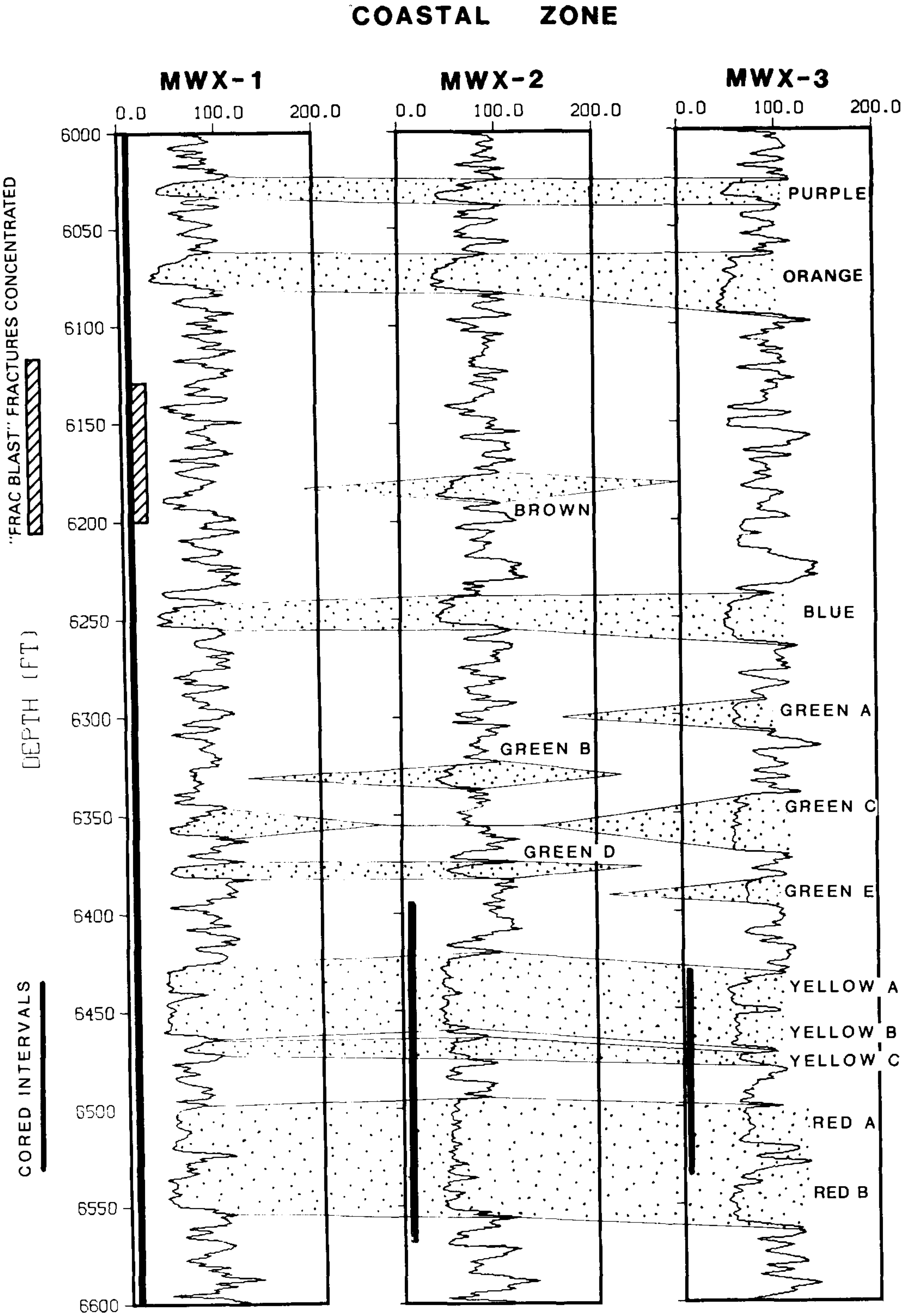


Figure 29. Gamma Log Correlations Through the Coastal Zone at the MWX Site

based on fracture morphology alone. Therefore, the presence or absence of dickite mineralization was used as a criterion to distinguish between the two groups of fractures. There were no horizontal to subhorizontal extension fractures in the "frac blast" interval (~6080 to 6315 ft) without dickite mineralization; therefore, none of the horizontal fractures in this interval were included in the Type 7 subgroup. The frequency distribution of the Type 7 subgroup (shown in Figure 30) appears to show concentrations in the lower fluvial interval and in the lower coastal/upper paludal interval.

The Type 7 subgroup is comprised of fractures that range from horizontal to 40° in dip (Figure 31). Fracture planes vary from planar to irregular and frequently are coincident with bedding planes and more horizontal reservoir heterogeneities. Although Type 7 fractures occur in all lithologies, 85 percent of those detected are in the MWX sandstones and siltstones.

Like all extension fractures previously discussed, Type 7 fractures often appear stranded or branched (Figure 32). As is the case with any stranded fracture, the relationship between individual fracture strands is often not verifiable in core. If the individual fracture strands were spaced <0.1 ft apart or within 0.2 ft of a main fracture strand, they were arbitrarily all considered part of the same fracture. Most often one strand appears to be the main fracture strand as it is wider and more continuous through the core. There are no orientation data available for any Type 7 fractures. They either did not occur in oriented core, or were too close to horizontal, or too irregular to make reasonably accurate strike and dip measurements.

As stated earlier, by definition none of the Type 7 fractures were mineralized with dickite. Fracture mineralization includes calcite, quartz, and barite. The most common mineralization is calcite or a combination of calcite and quartz. Quartz alone was detected in one Type 7 fracture in the vicinity of 5567 ft in MWX-2. Only two Type 7 fractures

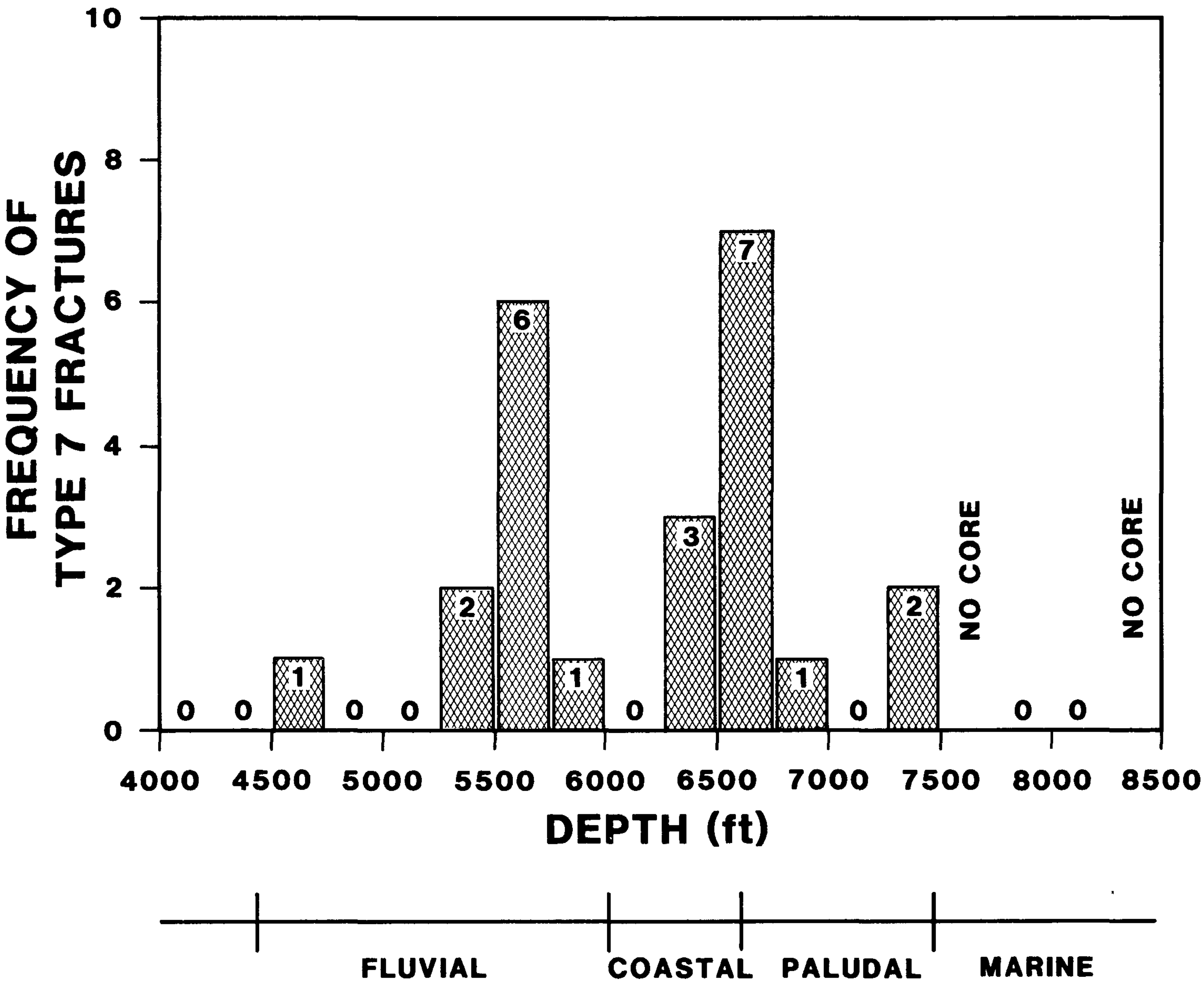


Figure 30. Frequency Distribution of Type 7 Fractures With Respect to Depth; Core Data From MWX-1 and MWX-2

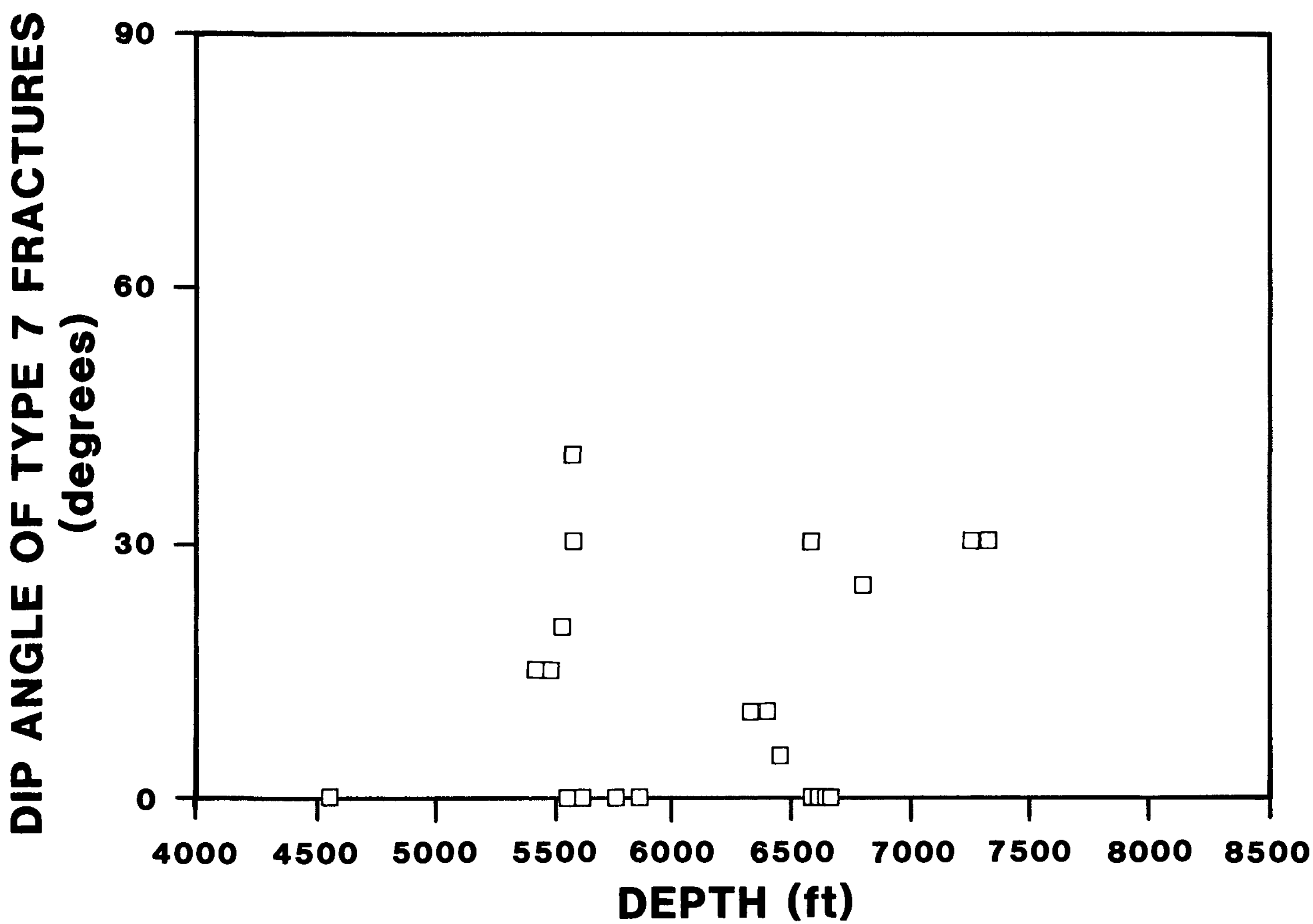
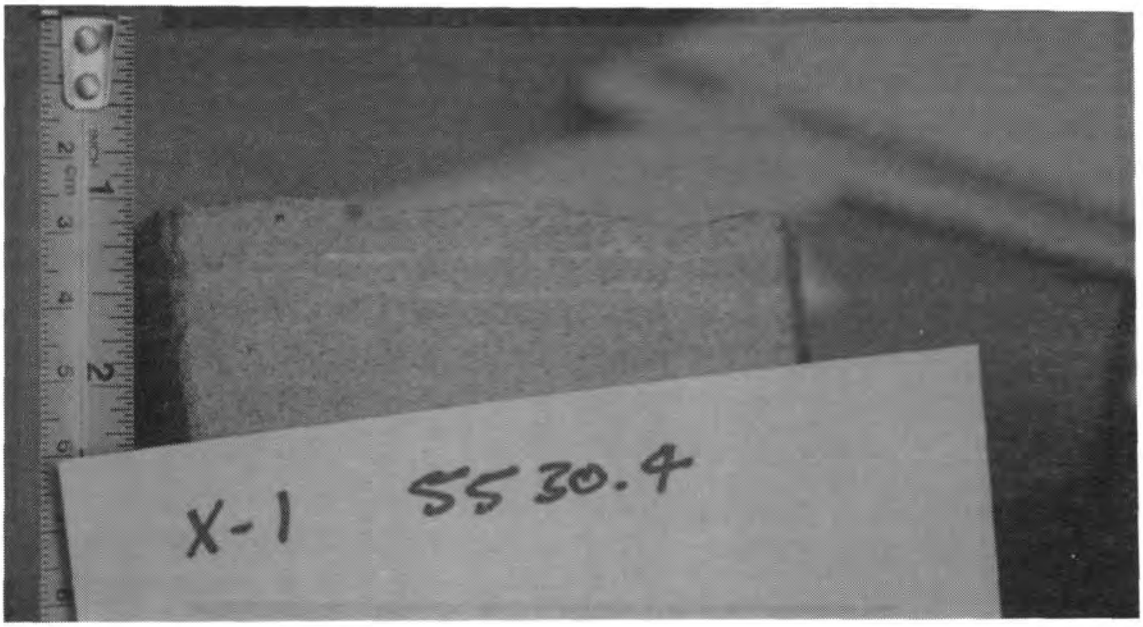


Figure 31. Distribution of Type 7 Fracture Dip Angles With Respect to Depth; Core Data From all Three MWX Wells



a

b

Figure 32. Stranded Type 7 Fractures; (a) 5530.4 ft, MWX-1; (b) 6661.9 ft, MWX-1

with barite mineralization were identified; they are both in the coastal interval around 6396 ft in MWX-1. Occasionally mineralization appears subhedral suggesting the fractures are partially open in situ. Measurable fracture width varies from a fraction of a millimeter to 5 millimeters (Figure 33).

d. Other Extension Fractures (Type C and Type N)

In addition to the three main subgroups of extension fractures, there are two types that occur rarely and may or may not be related to the other subgroups. Type C extension fractures are mineralized coal cleats. There are roughly four small ($\leq$0.2 ft in length), vertical, calcite-mineralized coal cleats at 6897.4 ft in MWX-3. They all strike N85W, parallel to most of the oriented Type 1 extension fractures.

Type N or "contained fractures" are defined as extension fractures contained in a sandstone or siltstone clast encased in mudstone. In the MWX core there are two occurrences of these Type N fractures. The clasts are small enough to be recognized as clasts in the 4-in. core. At 5388.9 ft in MWX-1, there are roughly 20 horizontal to subhorizontal fractures in a sandstone clast (approximately 0.3 ft by 0.5 ft in core). In thin section, these calcite-mineralized fractures appear to extend slightly into the encasing mudstone lithology (Figure 34). This suggests that the fracturing occurred after the sandstone clast was in place and probably after the mudstone was lithified. What appears to be a smaller sandstone clast (approximately 0.1 ft by 0.2 ft in core) with four horizontal calcite-filled fractures was intersected at 5693.8 ft in MWX-1 (Figure 35).

2. SHEAR FRACTURES

Shear fractures involve movement parallel to the fracture plane, and the fracture walls generally exhibit detectable displacement. At MWX this displacement is in the form of slickensides (friction grooves). The shear fractures in the MWX core have been divided up into five different types.

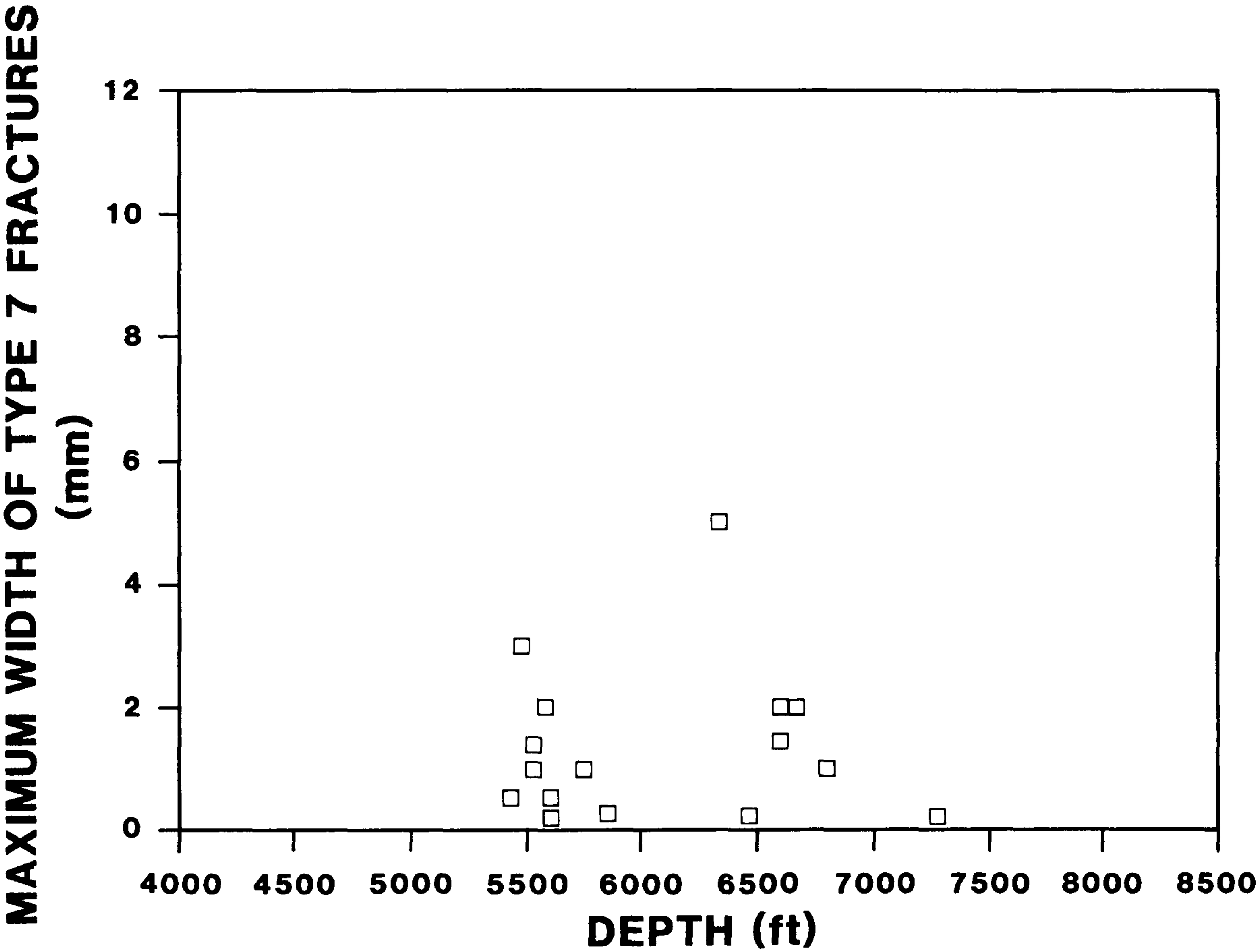


Figure 33. Distribution of Type 7 Fracture Widths With Respect to Depth; Core Data From all Three MWX Wells

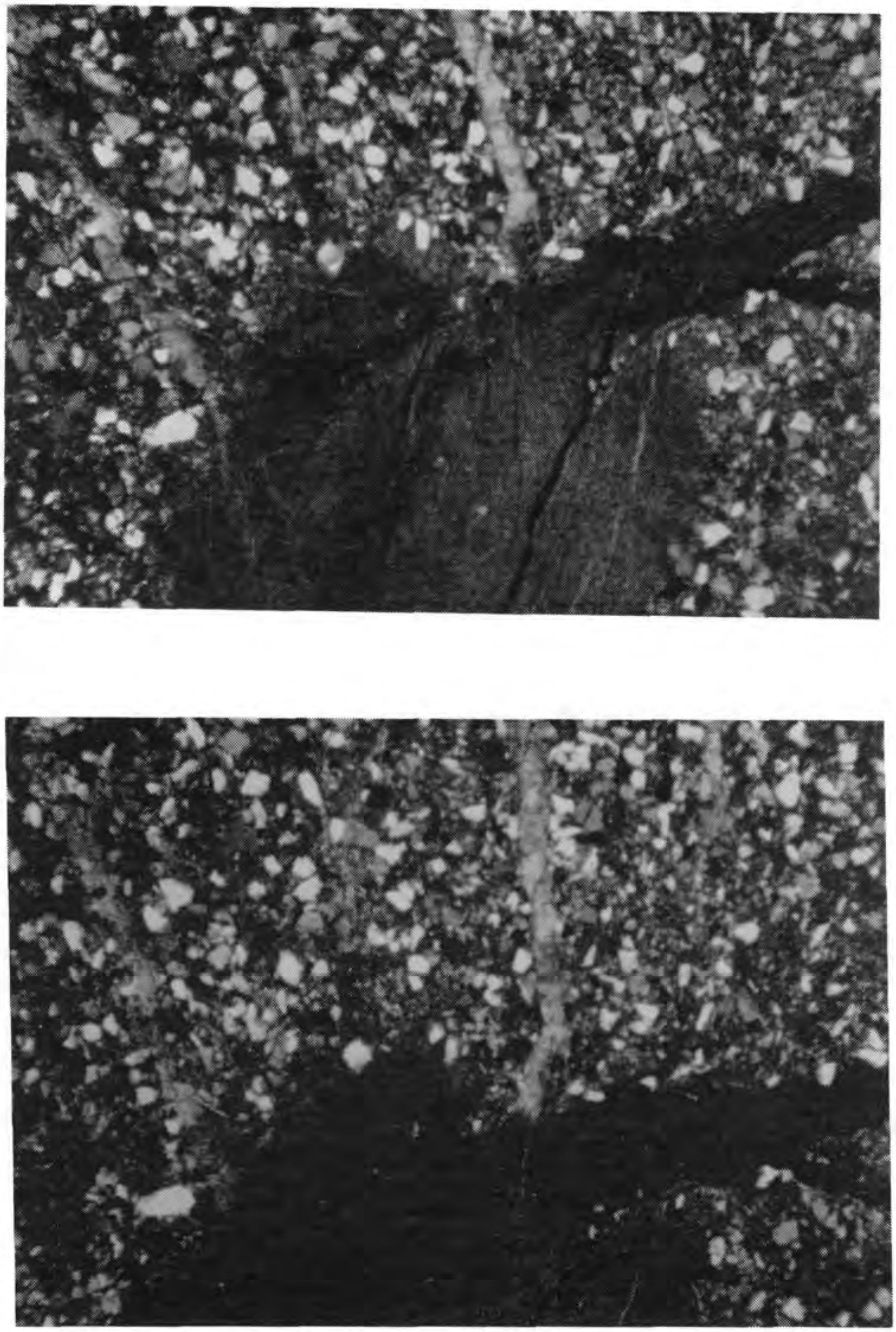


Figure 34. Photomicrographs of Calcite Fractures in a Sandstone Clast Extending into the Encasing Mudstone (5389 ft, MWX-1, polarized light)

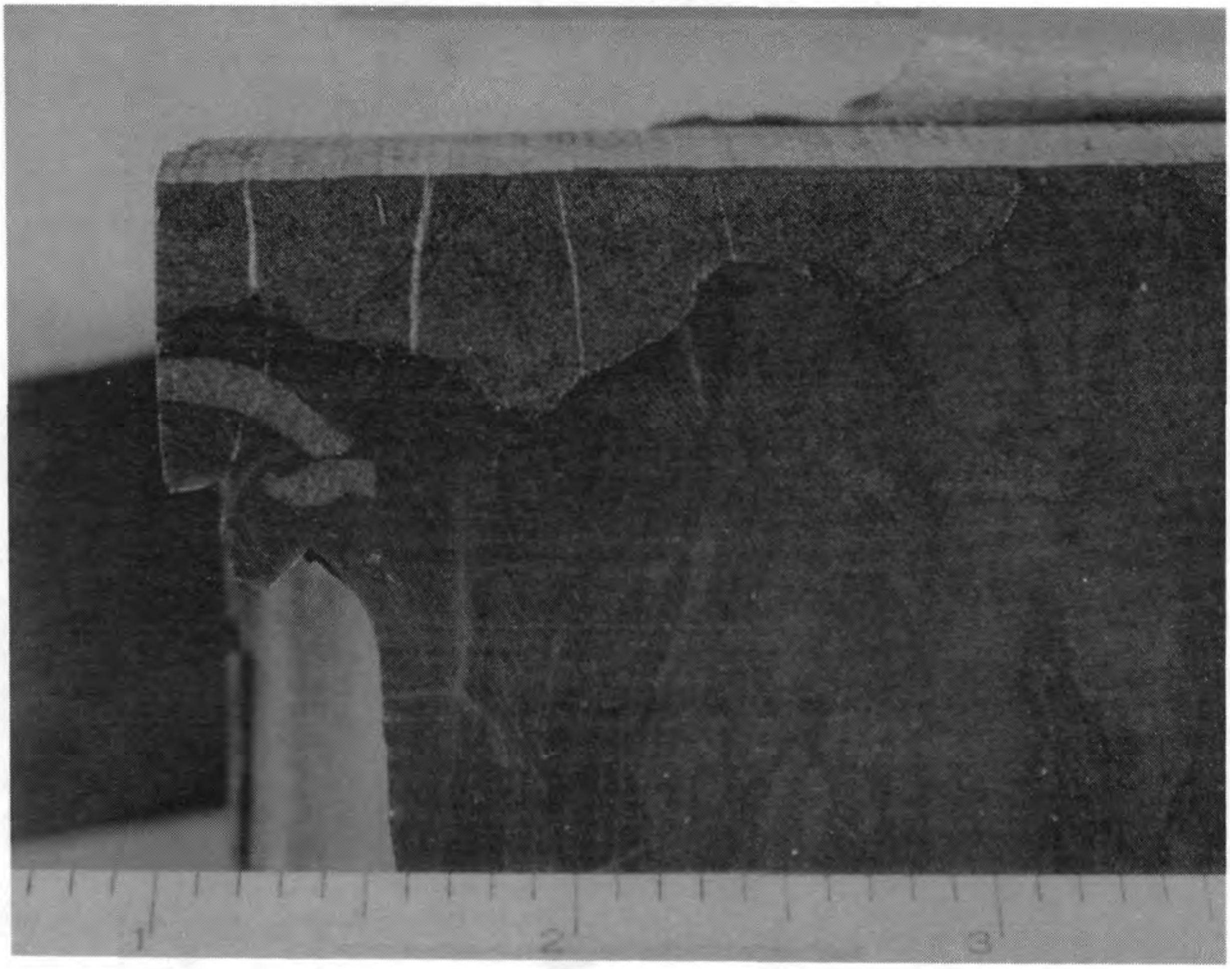


Figure 35. A Fractured Sandstone Clast Encased in Mudstone, Type N; (5693.8 ft, MWX-1)

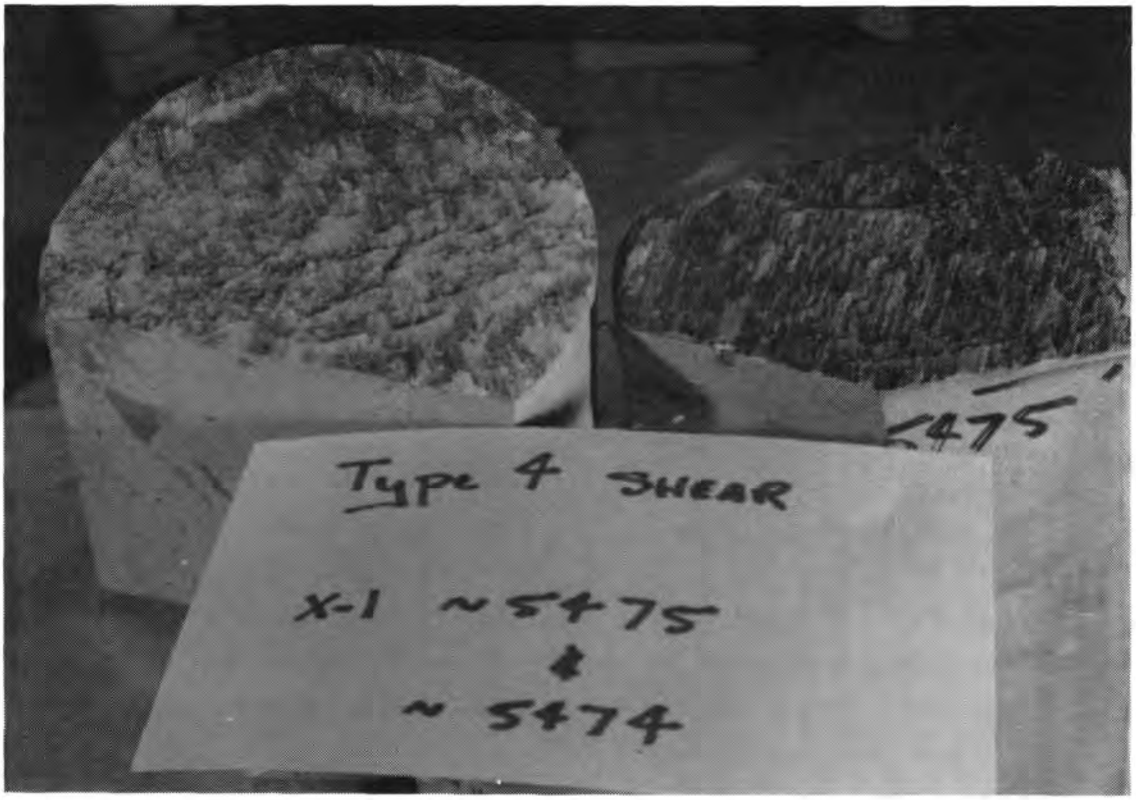
Some of these fracture types are distinguished by their host lithology. The shear fractures associated with sandstone and siltstone lithologies include Types 4 and 5. Type 2 fractures are shear fractures confined to carbonaceous mudstone laminations in sandstones and siltstones. Types 3 and 6 fractures are found only in mudstone.

a. Low-Angle Shear Fractures in Sandstone or Siltstone (Type 4)

All low-angle (<50°), slickensided fractures in MWX sandstones and siltstones are included in the Type 4 subgroup. Figure 36 shows photographs of Type 4 fractures detected at MWX. All four of the Type 4 fractures were identified at depths in MWX-1 that were not cored in either of the other two MWX wells. Their distribution with depth is shown in Figure 37. Fracture planes range from irregular to planar and from horizontal to 40° in dip.

The fractures included in this group are mineralized with calcite, quartz, and/or dickite, and mineralization is commonly subhedral in the form of slickencrysts. (Slickencrysts are defined by P. L. Hancock (1985) as mineral fibers or crystals aligned at some small angle to the fracture wall (Figure 38).) Calcite is the predominant mineralization. Quartz and dickite were only detected on one of the four Type 4 fracture planes, where a trace of quartz and an appreciable quantity of dickite showed up in an x-ray of the fracture mineralization at 6712.4 ft in MWX-1. Measured fracture width data is not available for these fractures, as all Type 4 fractures separated in the core barrel. Mineralization is a couple of millimeters thick in places, and the presence of subhedral mineralization suggests that in places the fractures may be open at depth.

Slickensides extend across the entire exposed Type 4 fracture plane, and except in one location, the fracture planes extend across the entire core break. At 6712.4 ft the fracture appears to terminate abruptly in one area within the core (Figure 39).



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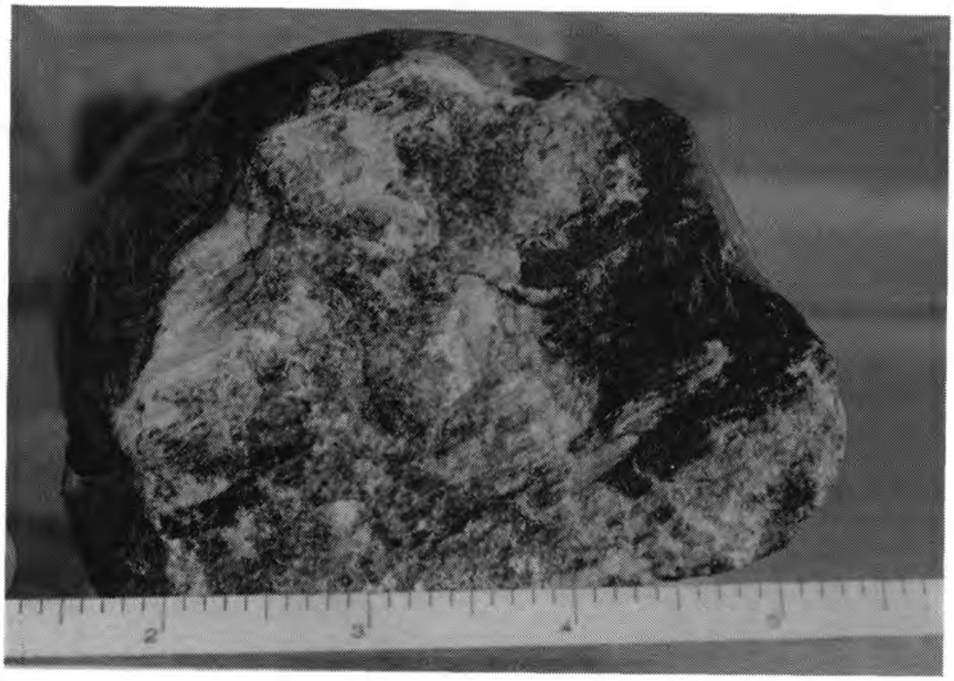


b

Figure 36. Type 4 Fractures in Core; (a) 5474 ft and 5475 ft, MWX-1; (b) 6662.8 ft, MWX-1

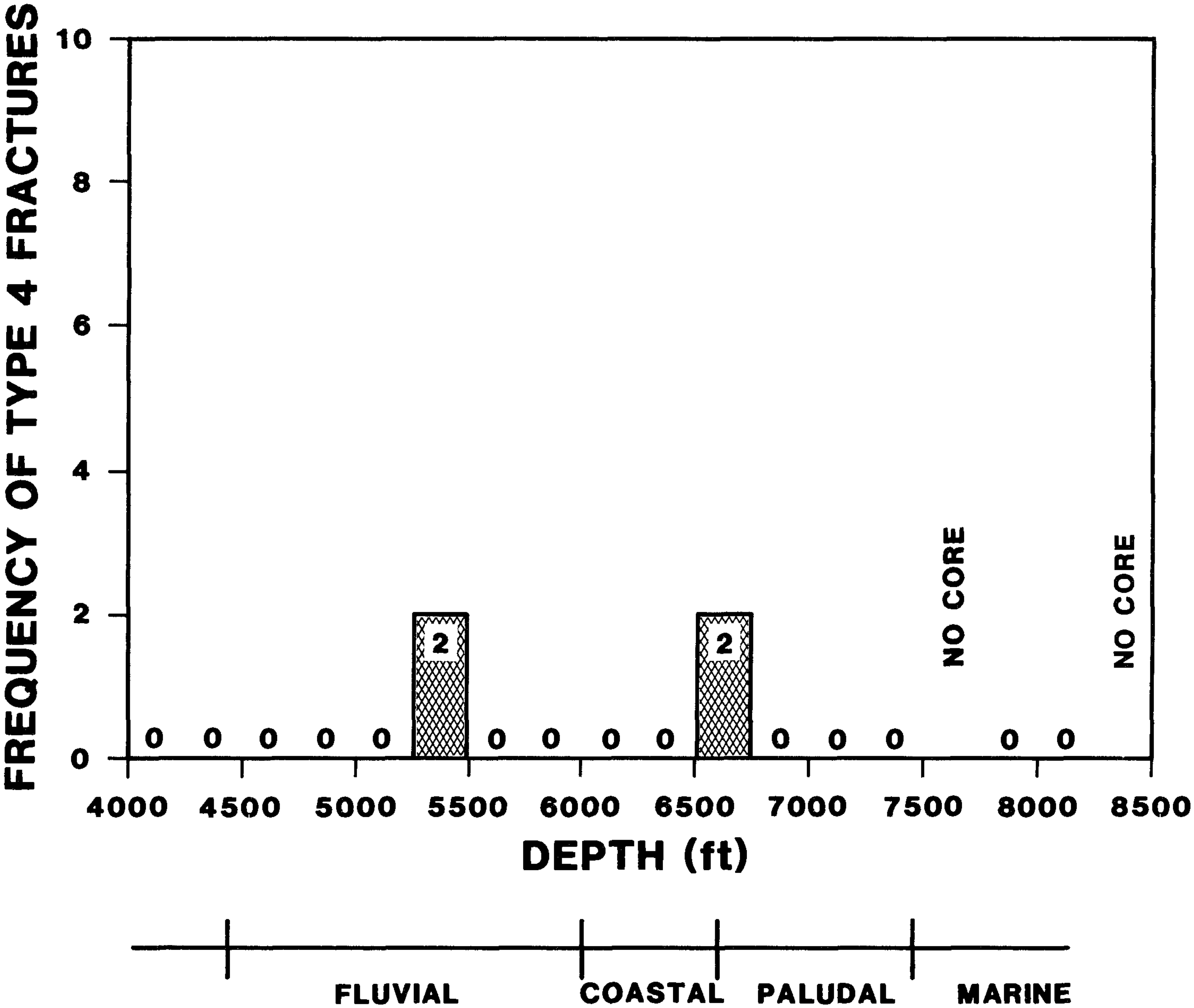


Figure 37. Frequency Distribution of Type 4 Fractures With Respect to Depth; Core Data From MWX-1 and MWX-2

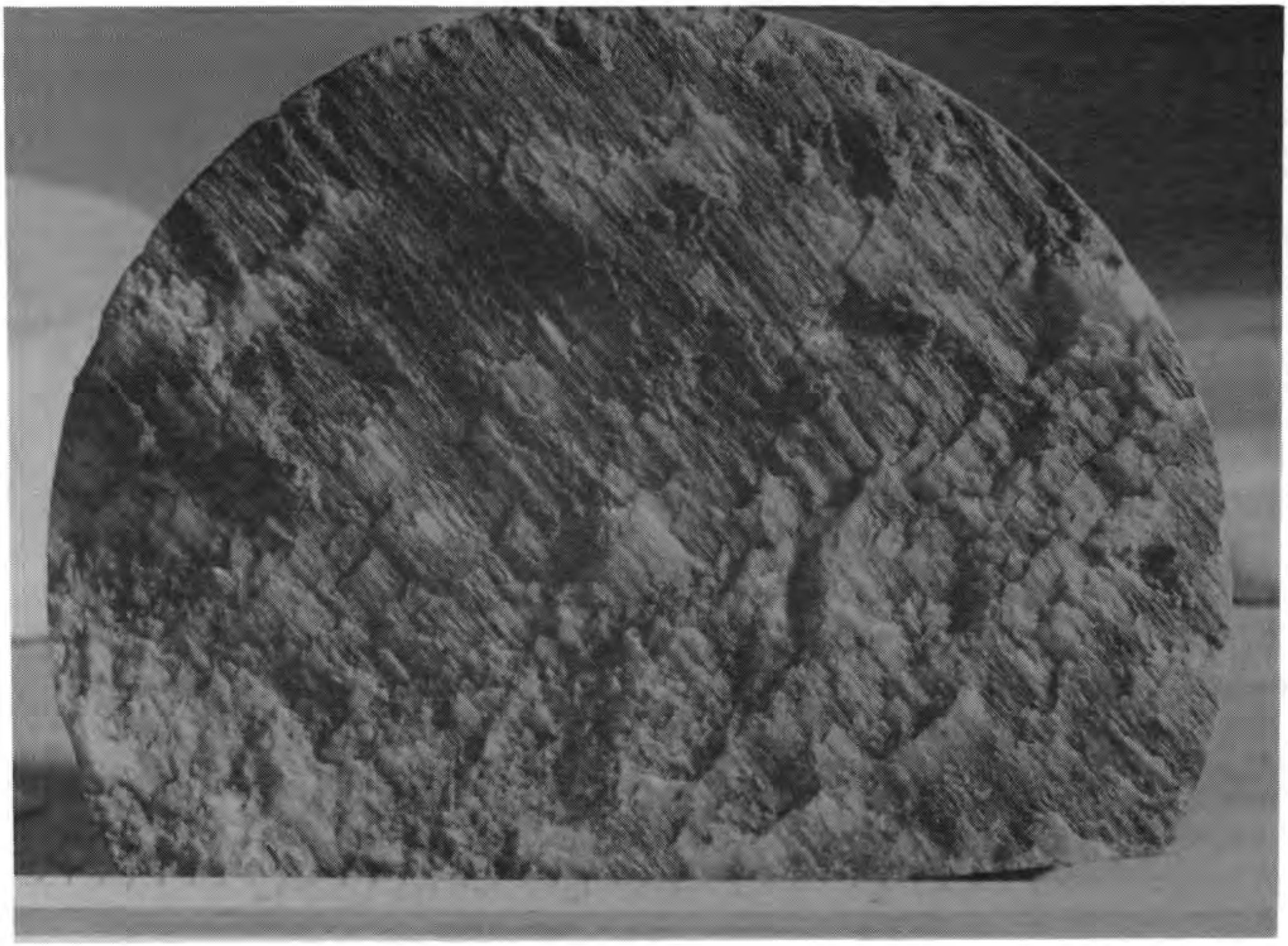


Figure 38. Calcite Slickencrysts on a Type 4 Fracture, 5474 ft, MWX-1

Figure 39. Type 4 Fracture Terminating Within Core Diameter, 6712.4 ft, MWX-1

With the exception of a fracture at 6662.7 ft, these fractures occur in predominantly fine-grained sandstone. At 6662.7 ft, the host rock is mixed siltstone, fine sandstone, and mudstone, and in the immediate vicinity of the fracture, the rock is predominantly muddy siltstone.

Orientation data is available for three of the four Type 4 fractures. The two Type 4 shear fractures in the fluvial interval look like low-angle thrust faults. Both fractures dip roughly 15° and are relatively planar. Slickensides and slickencrysts suggest that the upper plate at 5474.0 ft and at 5475.0 ft was moved up in the direction of S50W and N60E, respectively, as shown in Figure 40. Paleomagnetic data was used to orient the fracture at 6712.4 ft. The motion on this fracture appears to be strike-slip, and the slickenside azimuth is roughly N70W. There are no orientation data for the fracture at 6662.7 ft; however, the relative motion on this fracture also appears to be strike-slip.

b. High-Angle to Near-Vertical Shear Fractures in Sandstone or Siltstone (Type 5)

Only one fracture in the MWX core fits this category of shear fractures. This unique Type 5 fracture dips roughly 80°. Its undulating fracture walls are lined with carbonaceous mudstone as well as patches of subhedral quartz and calcite. Slickensides also occur in patches and indicate strike-slip motion.

This fracture occurs at 4909.1 ft in MWX-1. It probably intersects or may be part of the Type 1 extension fracture at 4908.0 ft. The 0.1 ft of core that contains both the top of the Type 5 fracture and the bottom of the Type 1 fracture has been removed for analysis and is not available for inspection. Both the presence of carbonaceous mudstone and the undulatory nature of this Type 5 fracture suggest this fracture is coincident with a sedimentary feature.

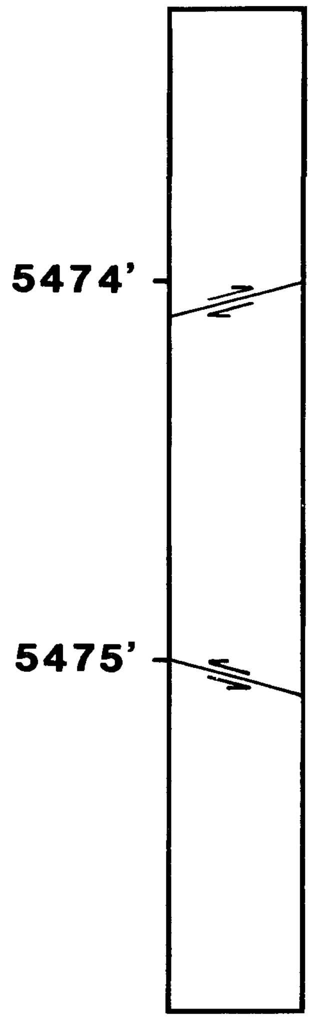


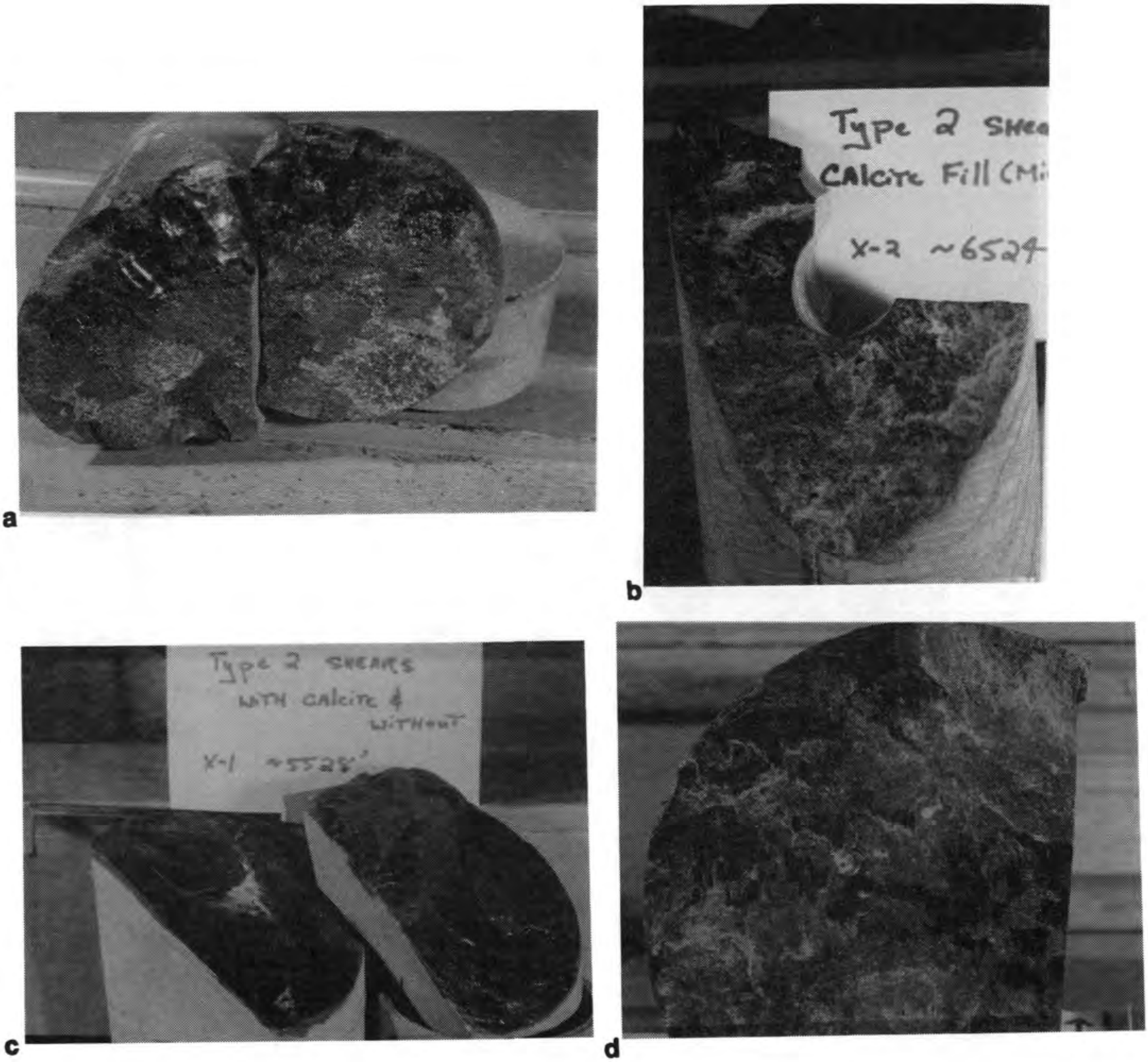
Figure 40. Sketch Showing Configuration of Type 4 Fractures Intersecting MWX-1 in the Fluvial Section

c. Shear Fractures Within Carbonaceous Mudstone Laminations in Sandstone or Siltstone (Type 2)

Type 2 fractures are defined as shear fractures that are confined to carbonaceous mudstone laminations in sandstones and siltstones. The strike and dip of these fracture planes is probably controlled by bedding. Figure 41 shows photographs of typical Type 2 fractures in MWX core. The thickness of the host mudstone laminations varies from approximately 1 mm to 2 cm. Slickensides commonly occur in patches, locally interspersed with patches of mineralization. Figure 42 shows the frequency distribution of these shear fractures with depth. All of these fractures separated in the core barrel, so no fracture width data is available. A total of 77 Type 2 fractures were identified in the MWX core from all three wells. Fracture planes range from very planar to very irregular and from horizontal to 50° in dip (Figure 43).

Mineralization was detected on 22 (30%) of the Type 2 fractures. The distribution of these mineralized fractures with depth is shown in Figure 44. Since mineralization is patchy and erratically distributed on the fracture planes, many of the apparently unmineralized Type 2 fractures may be partially mineralized beyond the core diameter. Mineralization is also occasionally microscopic. For example, calcite mineralization was only detected on the fracture at 6523.5 ft in MWX-2 when a microscopic patch of calcite was fortuitously included in a thin section across the fracture plane.

All ten of the mineralized Type 2 fractures in the fluvial interval are partially mineralized with macroscopic calcite that is often subhedral. At 5530.9 ft in MWX-1, sample preparation for fluid inclusion analyses revealed the presence of microscopic quartz crystals, interspersed with the calcite. In the coastal and paludal intervals, calcite is the most commonly observed mineralization on the ten mineralized Type 2 fractures; however, dickite and barite have also been detected. The dickite and



a b c d

Figure 41. Type 2 Fractures in Core; (a) 7843.9 ft, MWX-2; (b) 6523.5 ft, MWX-2; (c) 5528 ft, MWX-1; (d) 7838.6 ft, MWX-2

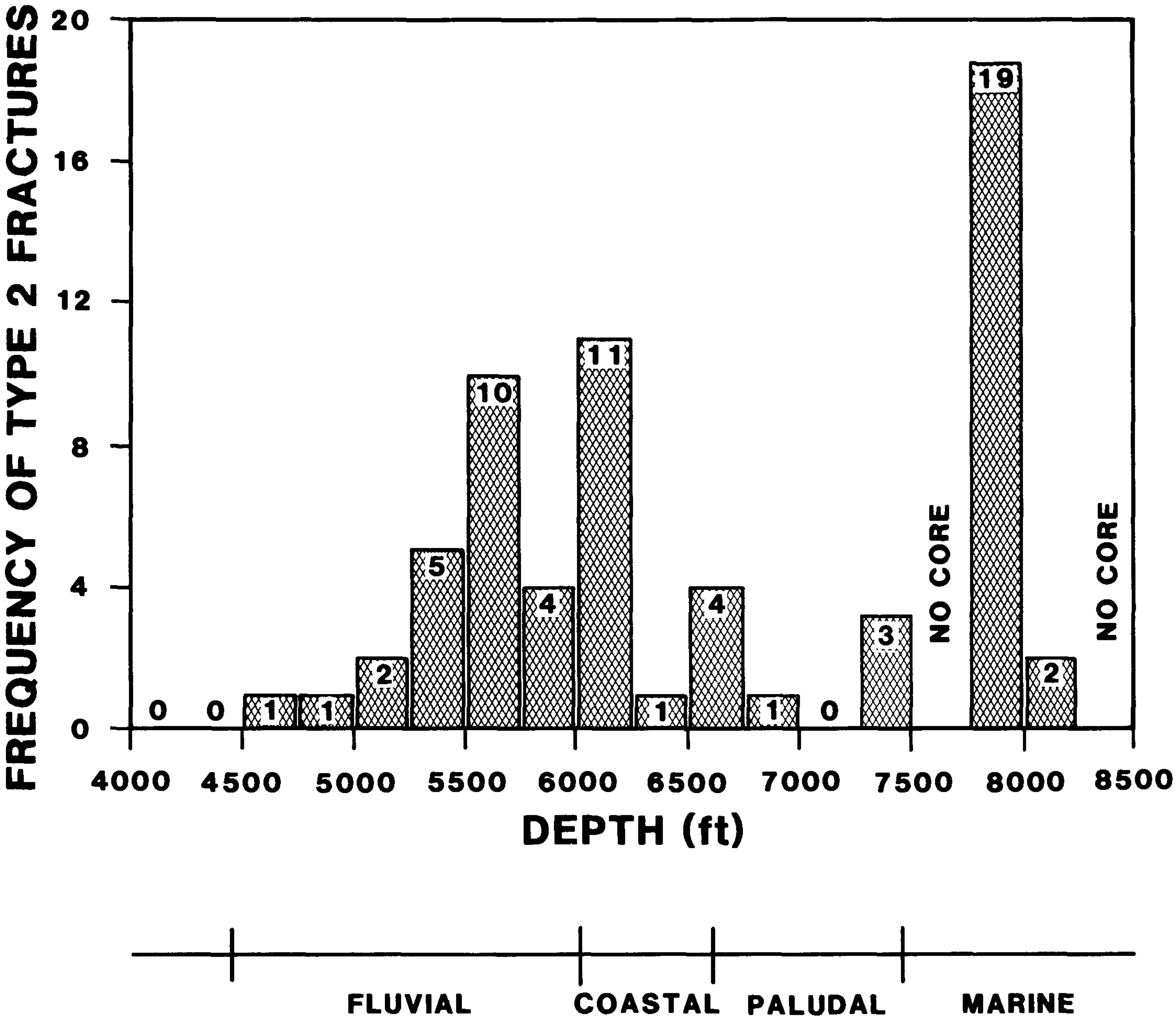


Figure 42. Frequency Distribution of Type 2 Fractures With Respect to Depth; Core Data From MWX-1 and MWX-2

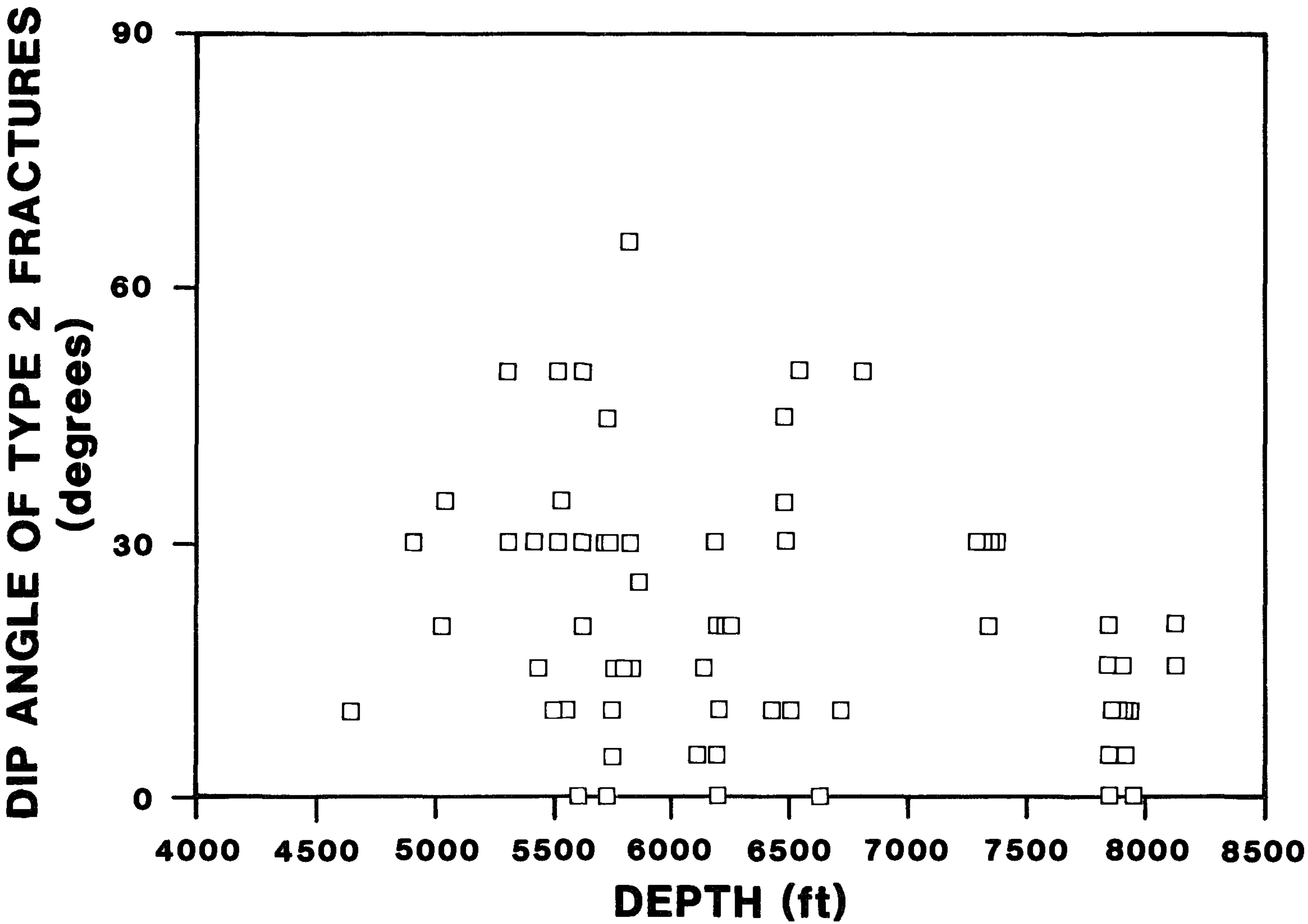


Figure 43. Distribution of Type 2 Fracture Dip Angle With Respect to Depth; Core Data From all Three MWX Wells

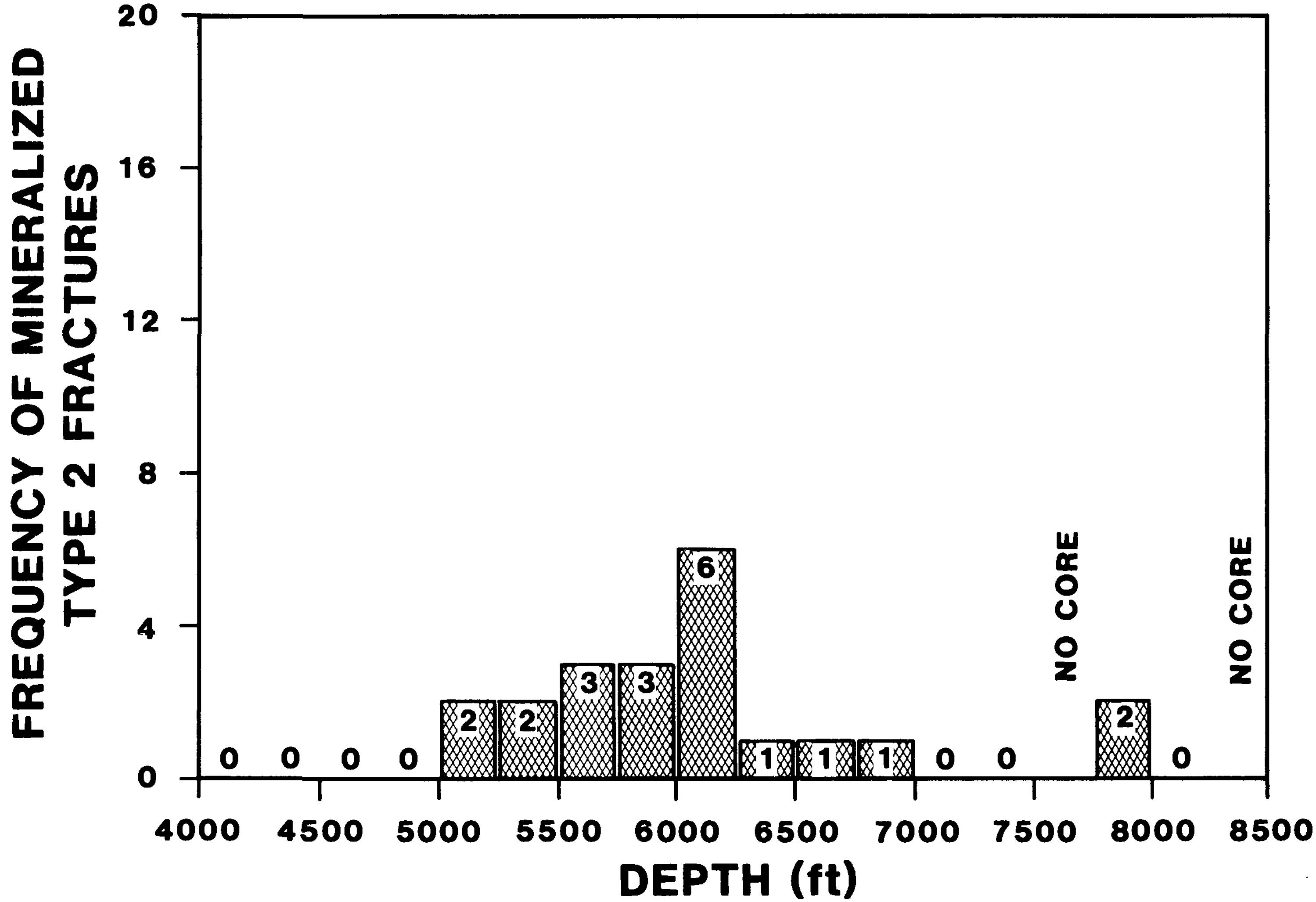


Figure 44. Frequency Distribution of Mineralized Type 2 Fractures With Respect to Depth; Core Data From MWX-1 and MWX-2

barite are confined to fractures from 6189 to 6197 ft in MWX-1. Patches of subhedral quartz crystals were identified on both of the mineralized Type 2 fractures occurring in marine core.

Occasionally mineral crystals on the Type 2 fractures are aligned as slickencrysts; however, more often the crystals are not aligned and occur in depressions on the fracture walls that are devoid of slickensides. Slickensides on these Type 2 fractures commonly occur in small ($\leq$3 cm in diameter) patches, but occasionally cover the entire fracture plane exposed in the core. Rarely, slickensides with two distinctly different bearings have been observed on the same fracture plane.

A total of 36 of these fractures have been oriented with respect to true north. Figures 45, 46, and 47 show the distribution of the fracture strikes, dip azimuths, and slickenside bearings with respect to depth. Since we've assumed that strike and dip azimuth are controlled by bedding, only slickenside bearing would be indicative of stress directions. (The angle between slickenside bearing and dip direction ranges from 0° to 80°.) The slickenside bearings are plotted in a rosette diagram in Figure 48 and show a possible preferred orientation. Relative motion along these fractures is indeterminate for all but two of them: at 5527.8 and 5530.9 ft in MWX-1, slickencrysts imply thrust motion.

One possible explanation for the Type 2 fractures is that they formed along pre-existing bedding planes as minor lateral adjustments within the sandstones, during the different uplift and subsidence stages that the formation was subjected to. This would explain the apparently random dip/azimuths and the nominally aligned slickensides.

d. Dewatering Fractures in Mudstone (Type 3)

Type 3 fractures in mudstones are randomly oriented, undulating, polished planes with curvilinear slickensides. Opposing fracture walls fit together so tightly that most of these fractures were undetectable until after the core had dried. Others were opened during the coring and handling process. Figures 49 and 50 show photographs of typical Type 3

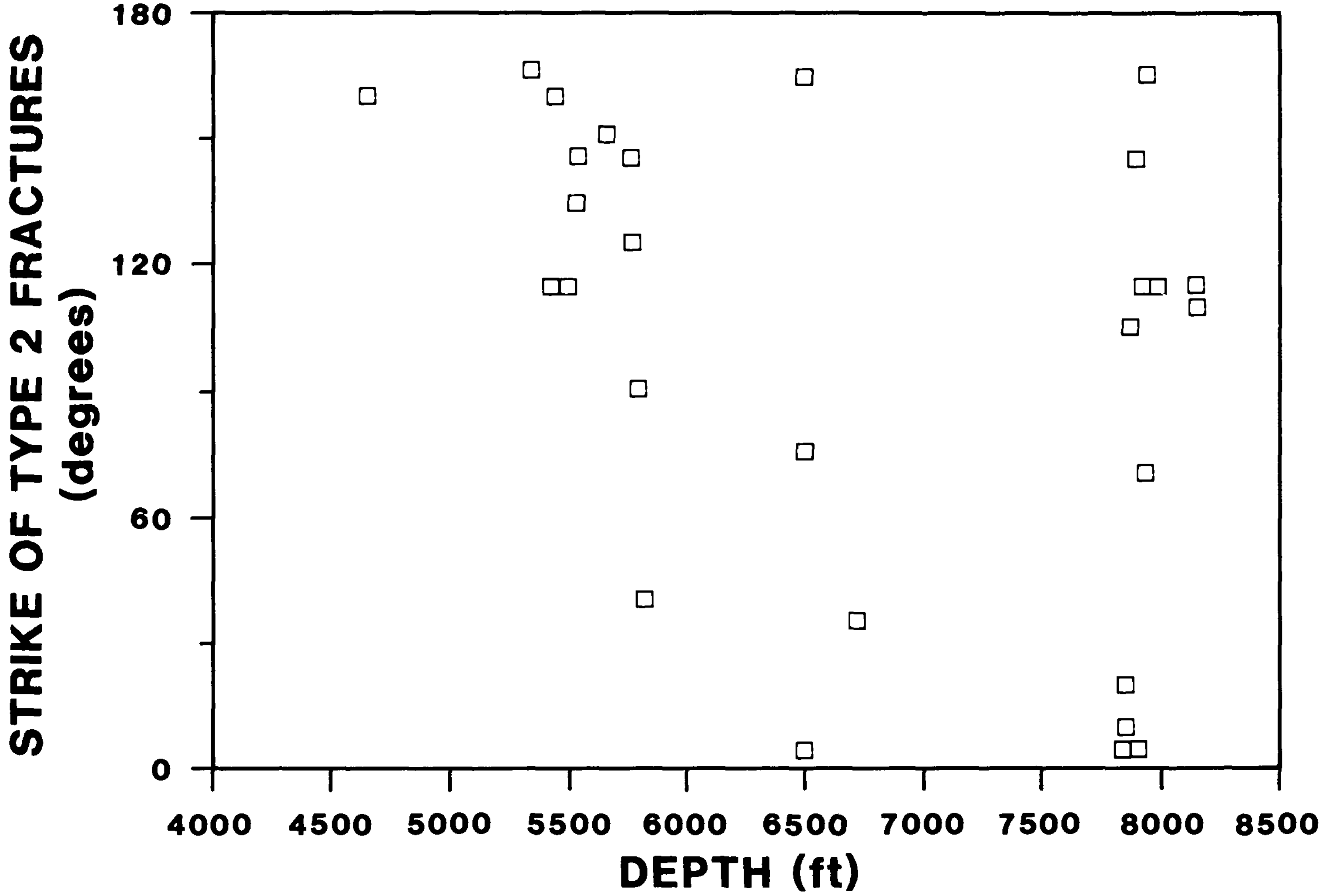


Figure 45. Distribution of Type 2 Fracture Strikes With Respect to Depth; Oriented Core Data From all Three MWX Wells

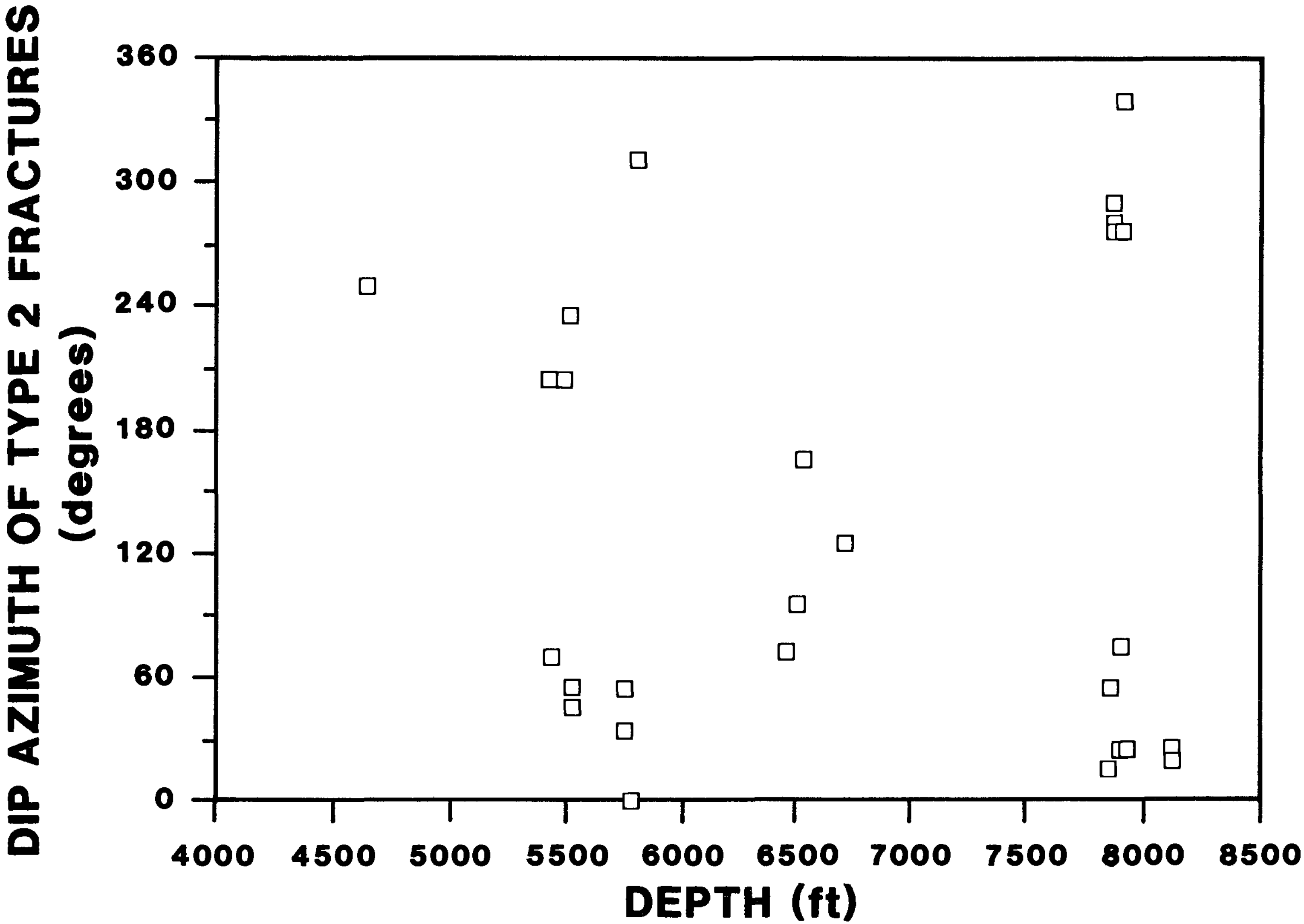


Figure 46. Distribution of Type 2 Dip Azimuths With Respect to Depth; Oriented Core Data From all Three MWX Wells

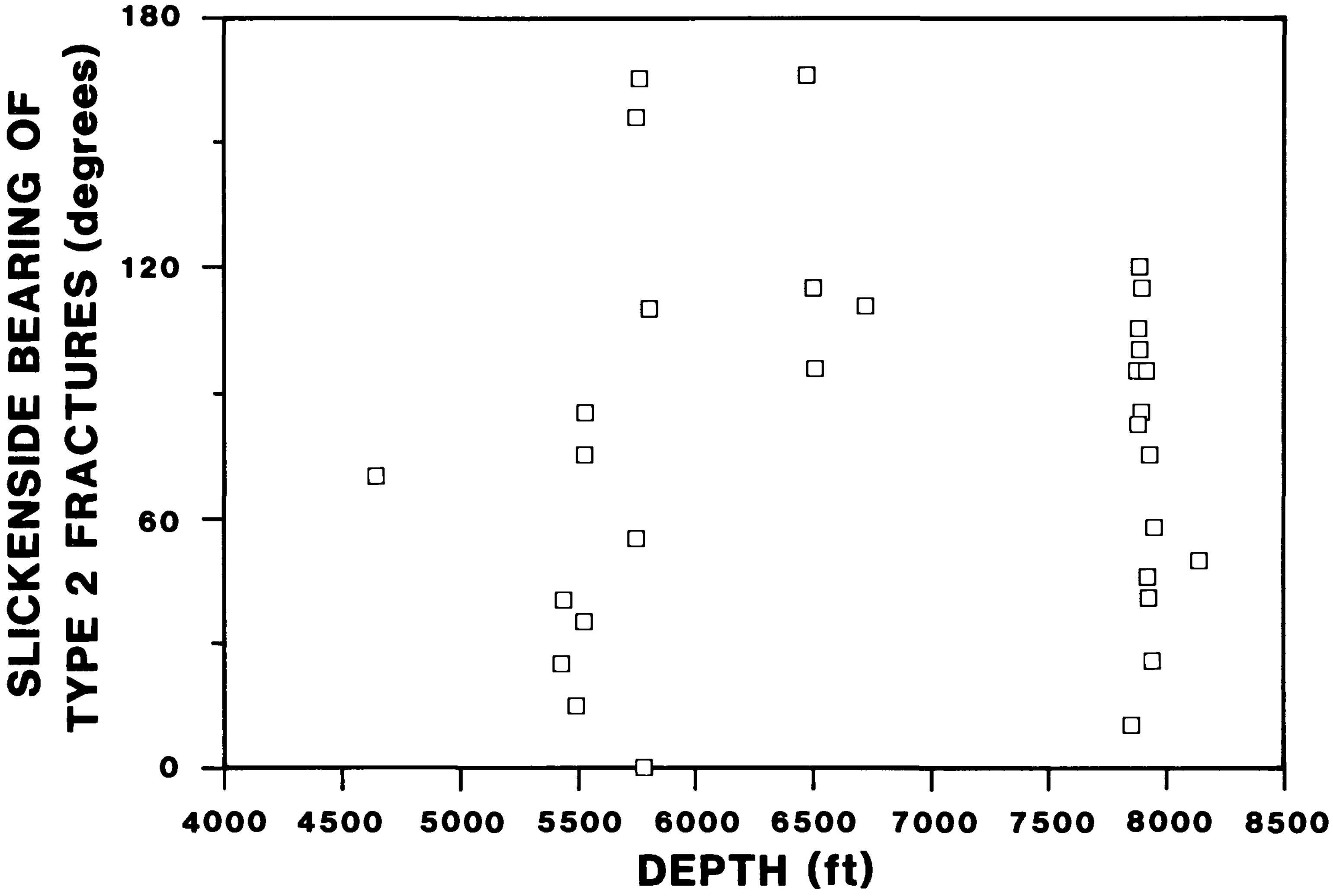


Figure 47. Distribution of Type 2 Slickenside Bearings With Respect to Depth; Oriented Core Data From all Three MWX Wells

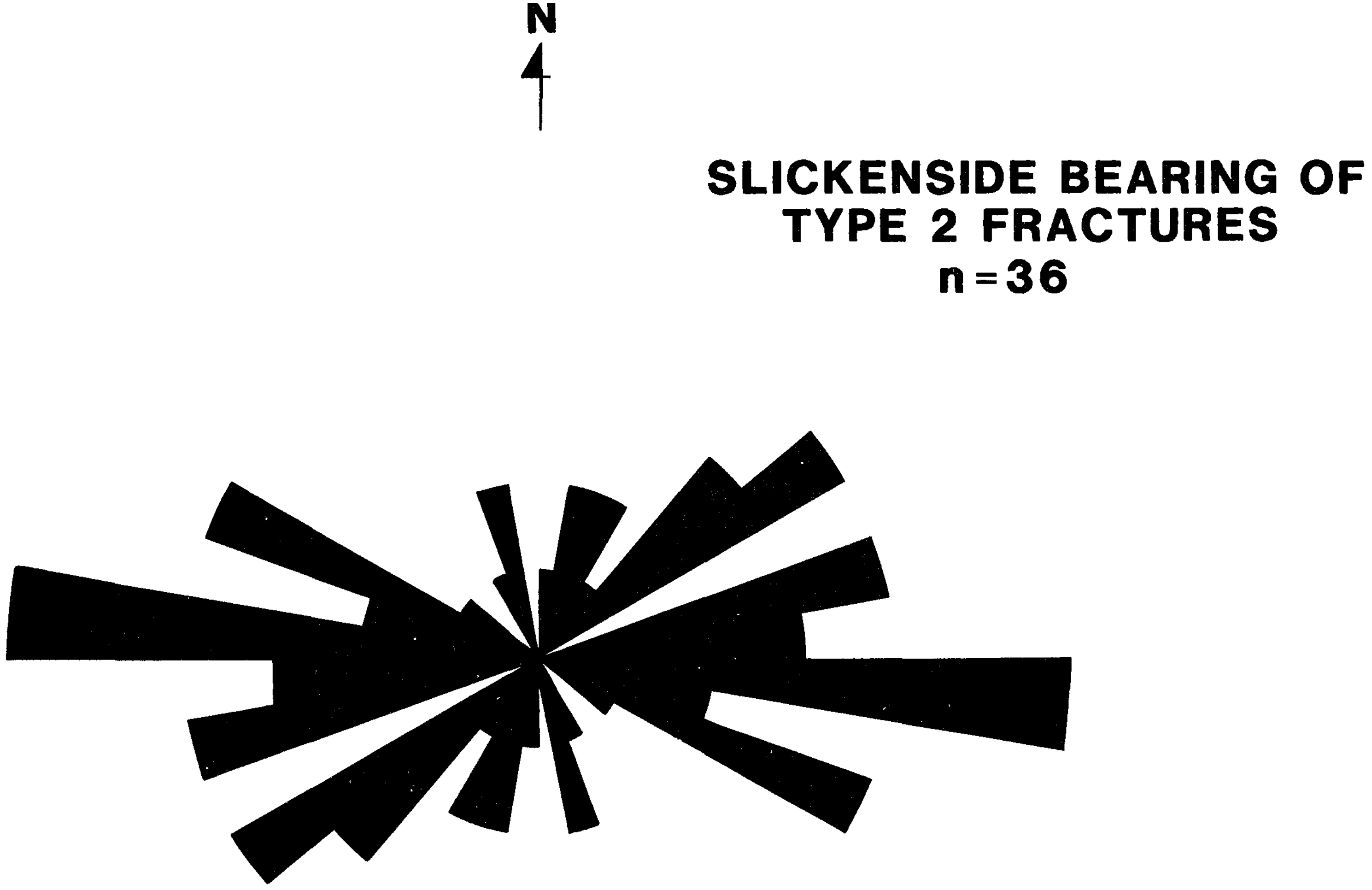
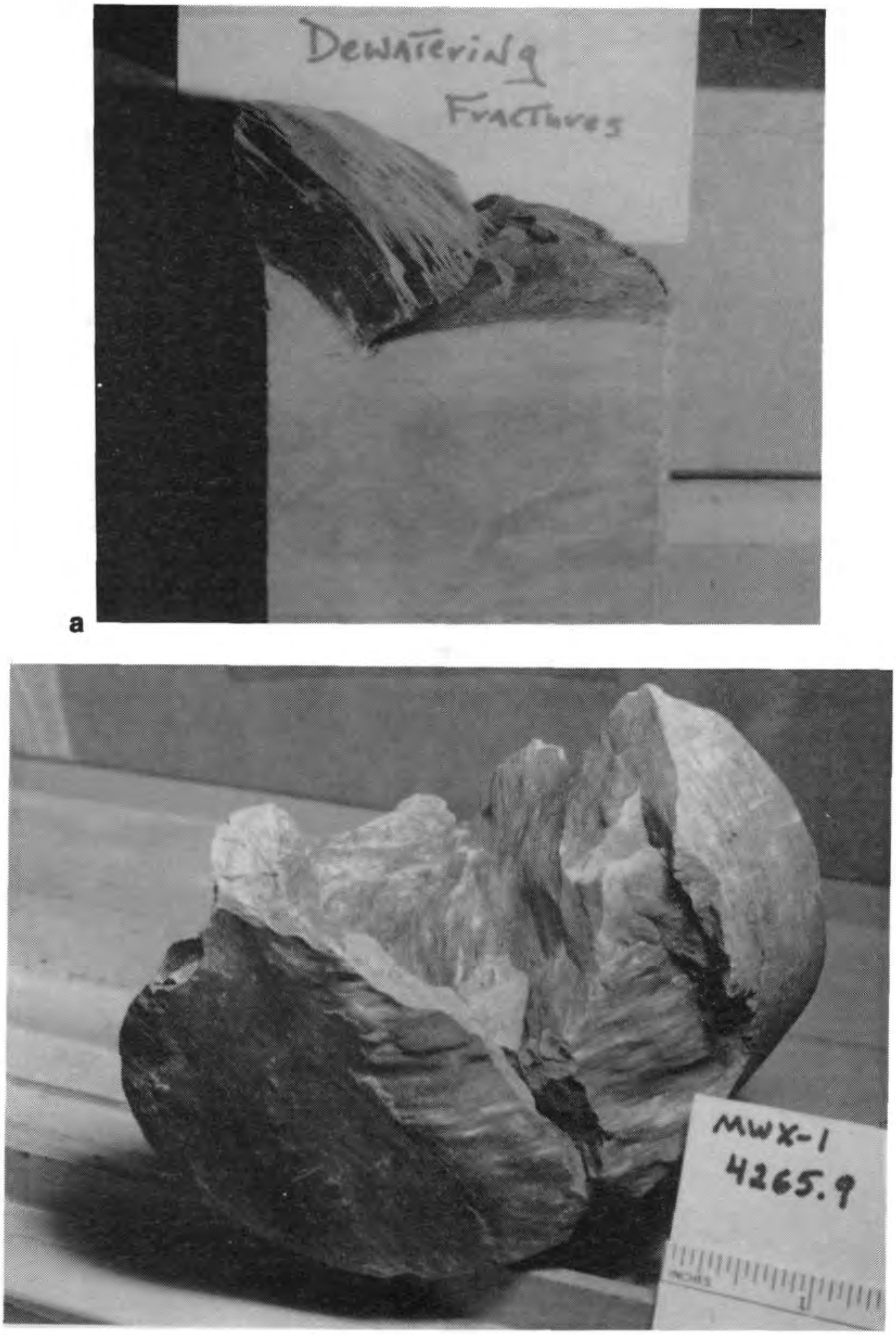


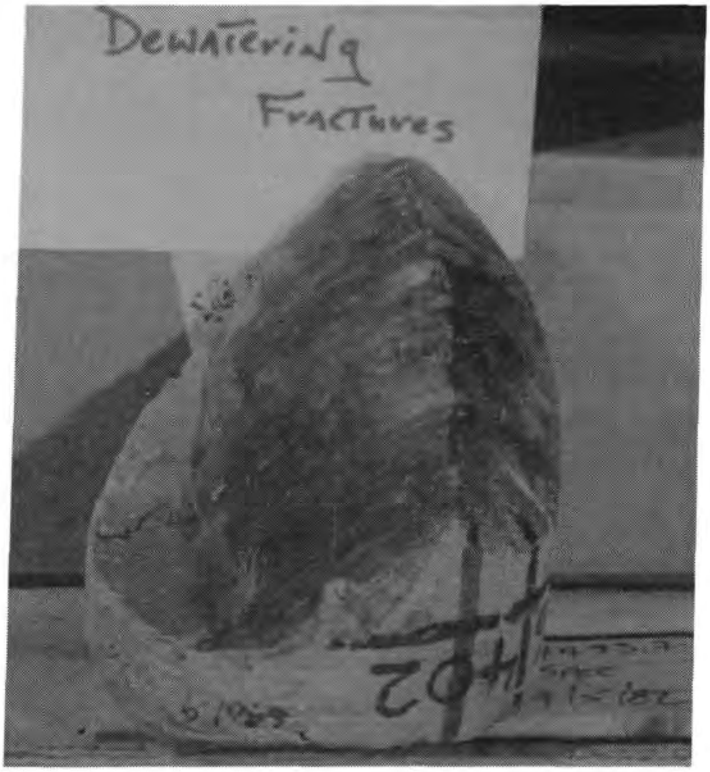
Figure 48. Slickenside Bearings of Type 2 Fractures Plotted in a Rosette Diagram; Oriented Core Data From all Three MWX Wells



a

b

Figure 49. Type 3 Dewatering Fractures; (a) 5737.5 ft MWX-1; (b) 4265.9 ft, MWX-1



a

b

Figure 50. Type 3 Dewatering Fractures; (a) 6402 ft, MWX-3;
(b) Mineralized Type 3, 6127 ft, MWX-1

fractures. Approximately 1425 Type 3 fractures were identified in the core from the three MWX wells.

The dried MWX mudstone core is incompetent and broken in the intervals where these Type 3 fractures are abundant, making counting and/or describing individual fractures difficult. Except where oriented and where they occurred separately, these fractures were described in groups in Appendix A. A reasonable estimate of the number of fracture planes present was determined by reconstruction of the core from available fragments. Descriptions given for the fracture groups are general descriptions of the entire group. Figure 51 shows the frequency distribution of the Type 3 fractures with depth. Roughly 97 percent of these fractures occur in mudstones in the fluvial and coastal intervals.

Only nine of these fractures are mineralized. Figure 52 shows the distribution of the mineralized Type 3 fractures with respect to depth. Patches of subhedral quartz crystals were detected on one Type 3 fracture at 7913.0 ft in MWX-1, and calcite lines slickenside grooves on a fracture at 5795.5 ft in MWX-3. The seven other mineralized Type 3 fractures all occur roughly between 6125 and 6245 ft in MWX-1. Mineralization on these fractures includes calcite, dickite, and barite. Calcite slickencrysts occur in patches on 2 of these fractures at roughly 6127 ft in MWX-1.

Due to the incompetent condition of the core where these fractures occur, fracture orientations were difficult to measure. In general, Type 3 fractures range from 0° to 70° in dip, but most dip between 20° and 50°. Slickenside bearings are generally parallel to dip direction, and due to the undulating and sometimes conical curvature of the fracture planes, slickensides frequently converge and/or diverge on individual planes. Strike, dip azimuth, and slickenside bearings all appear to be randomly oriented with respect to true north.

Seventy individual Type 3 fractures were oriented with respect to true north between 5690 and 5820 ft in MWX-3. Figures 53, 54, 55, and 56 show the distribution of dip angle, dip direction, strike, and slickenside

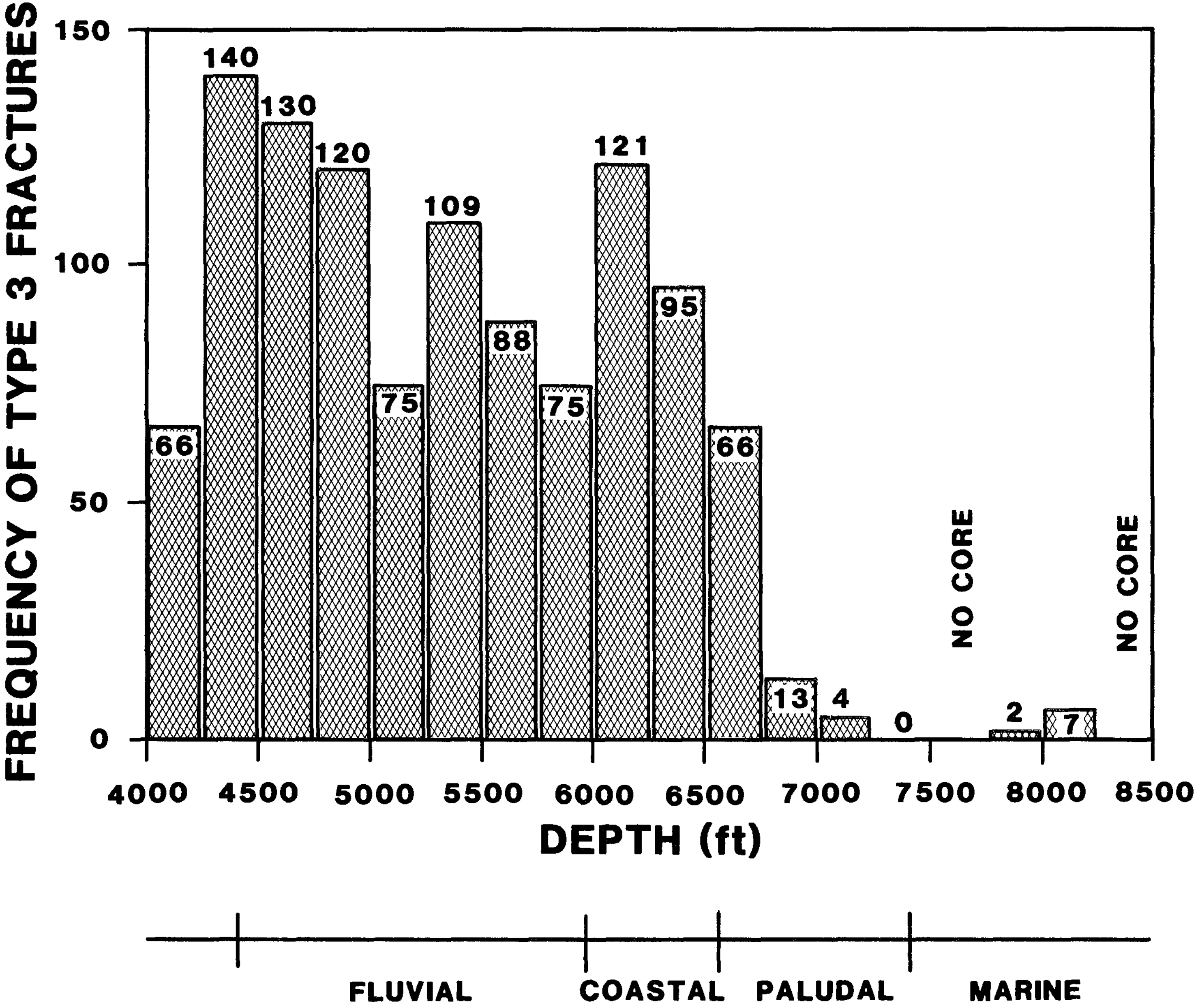


Figure 51. Frequency Distribution of Type 3 Fractures With Respect to Depth; Core Data From MWX-1 and MWX-2

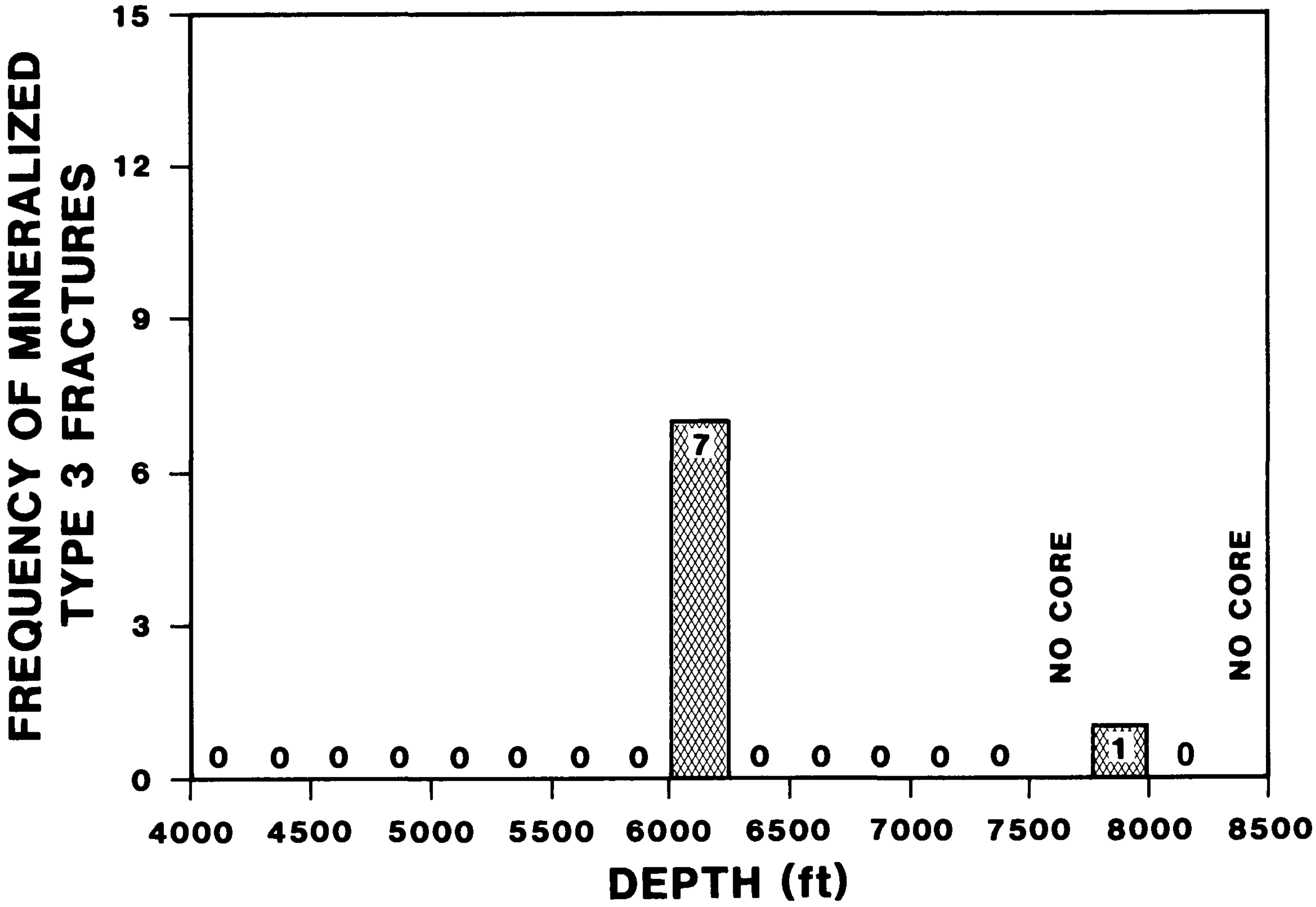


Figure 52. Frequency Distribution of Mineralized Type 3 Fractures
With Respect to Depth; Core Data From MWX-1 and MWX-2

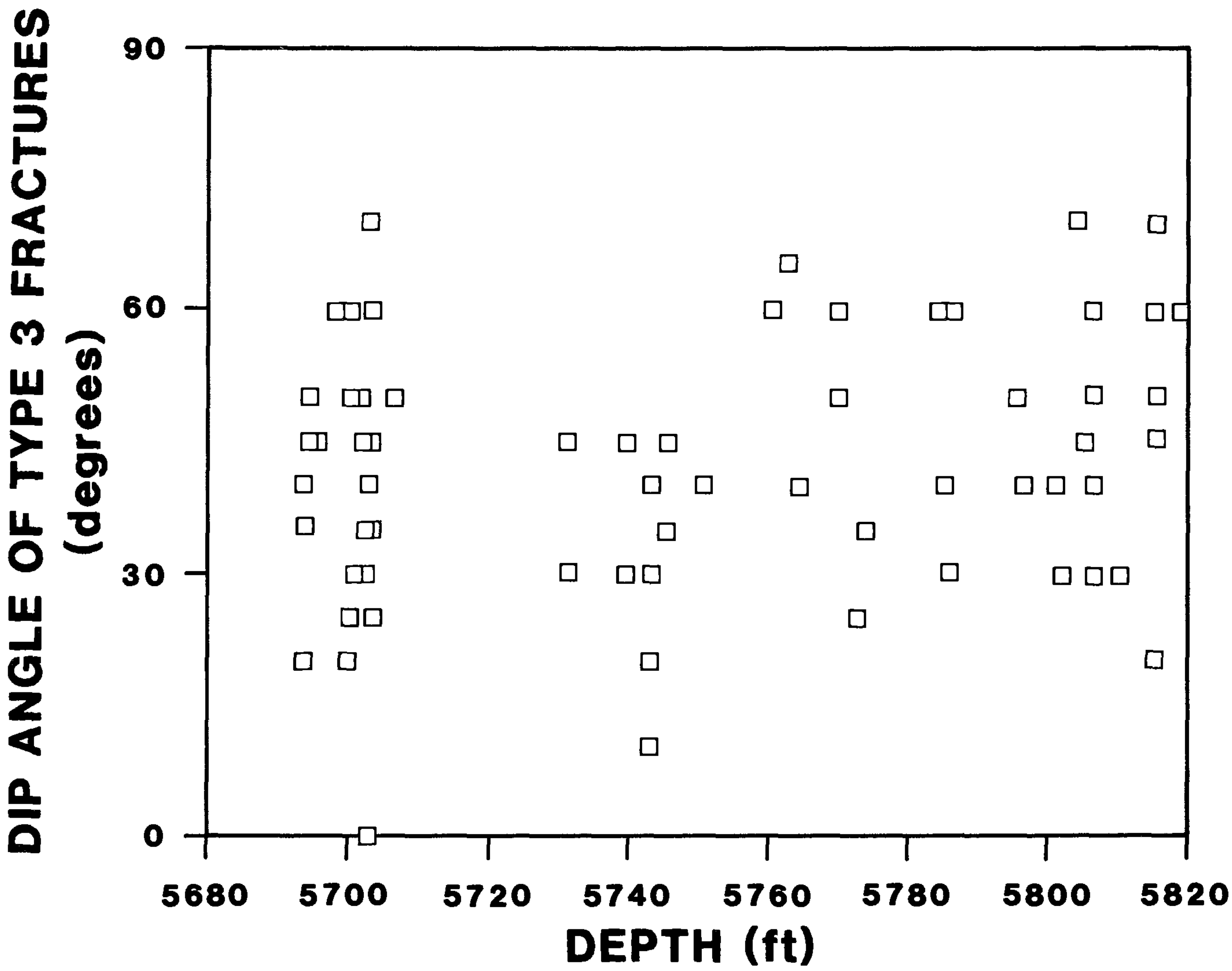


Figure 53. Distribution of Type 3 Fracture Dip Angles With Respect to Depth; Core Data From MWX-3

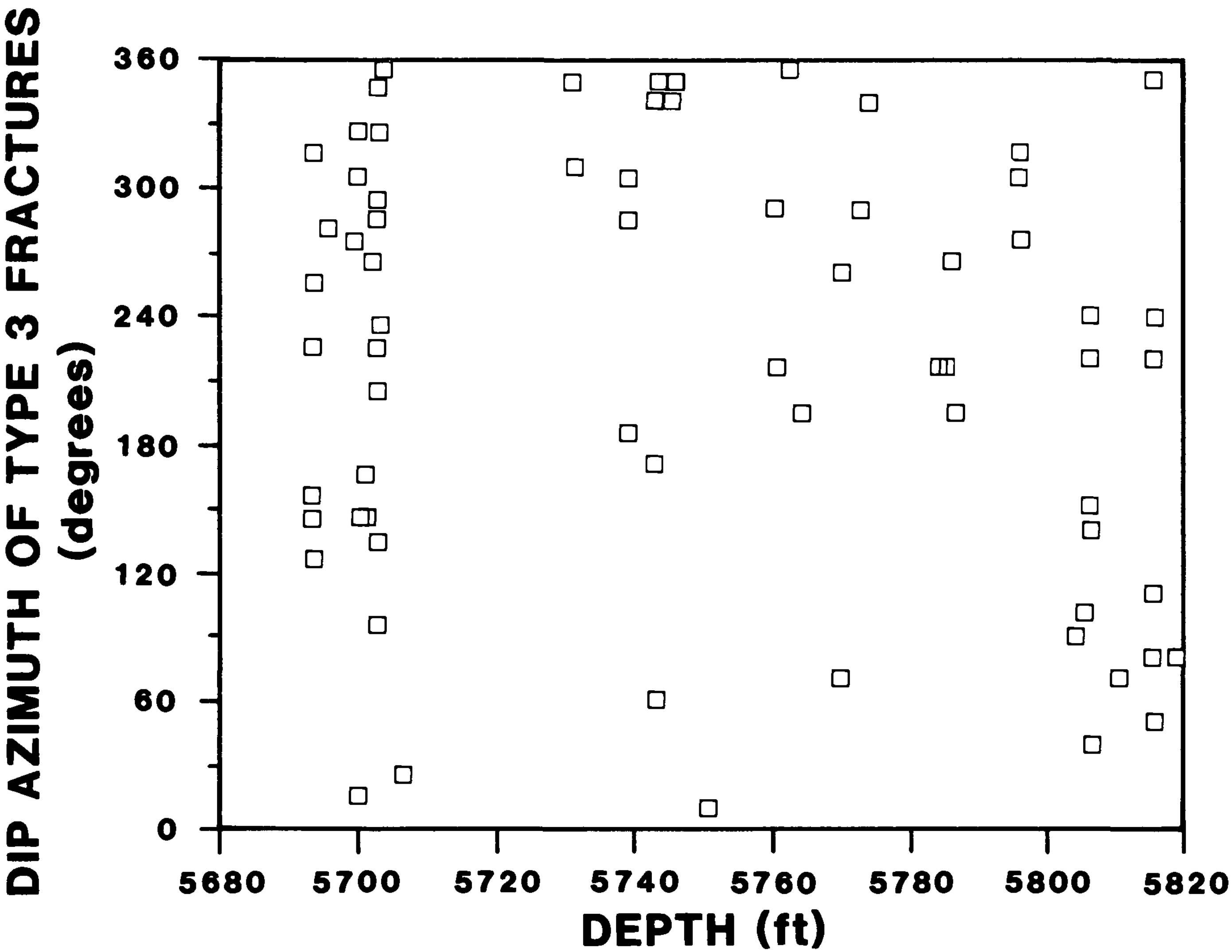


Figure 54. Distribution of Type 3 Fracture Dip Azimuths With Respect to Depth; Oriented Core Data From MWX-3

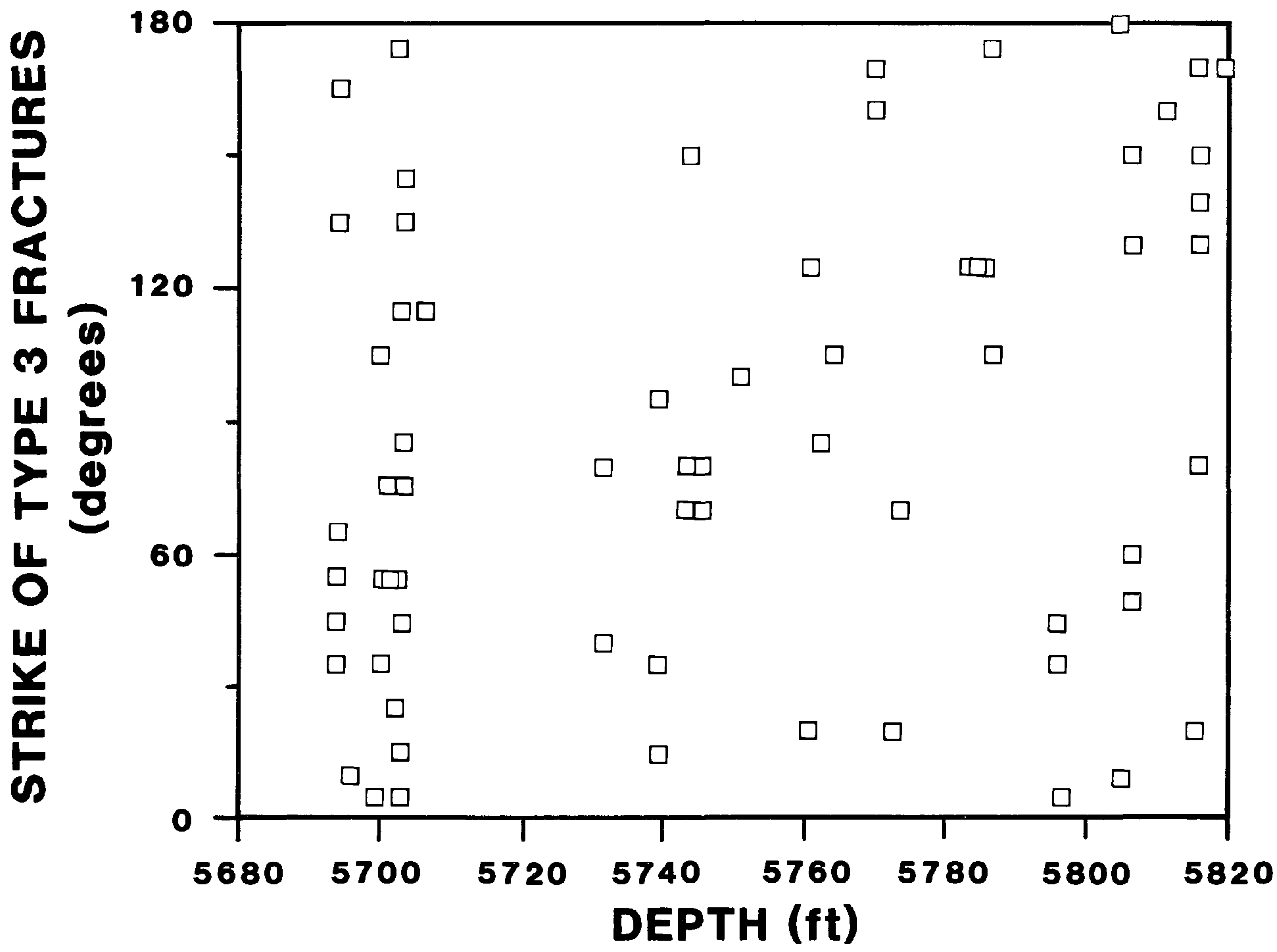


Figure 55. Distribution of Type 3 Fracture Strikes With Respect to Depth; Oriented Core Data From MWX-3

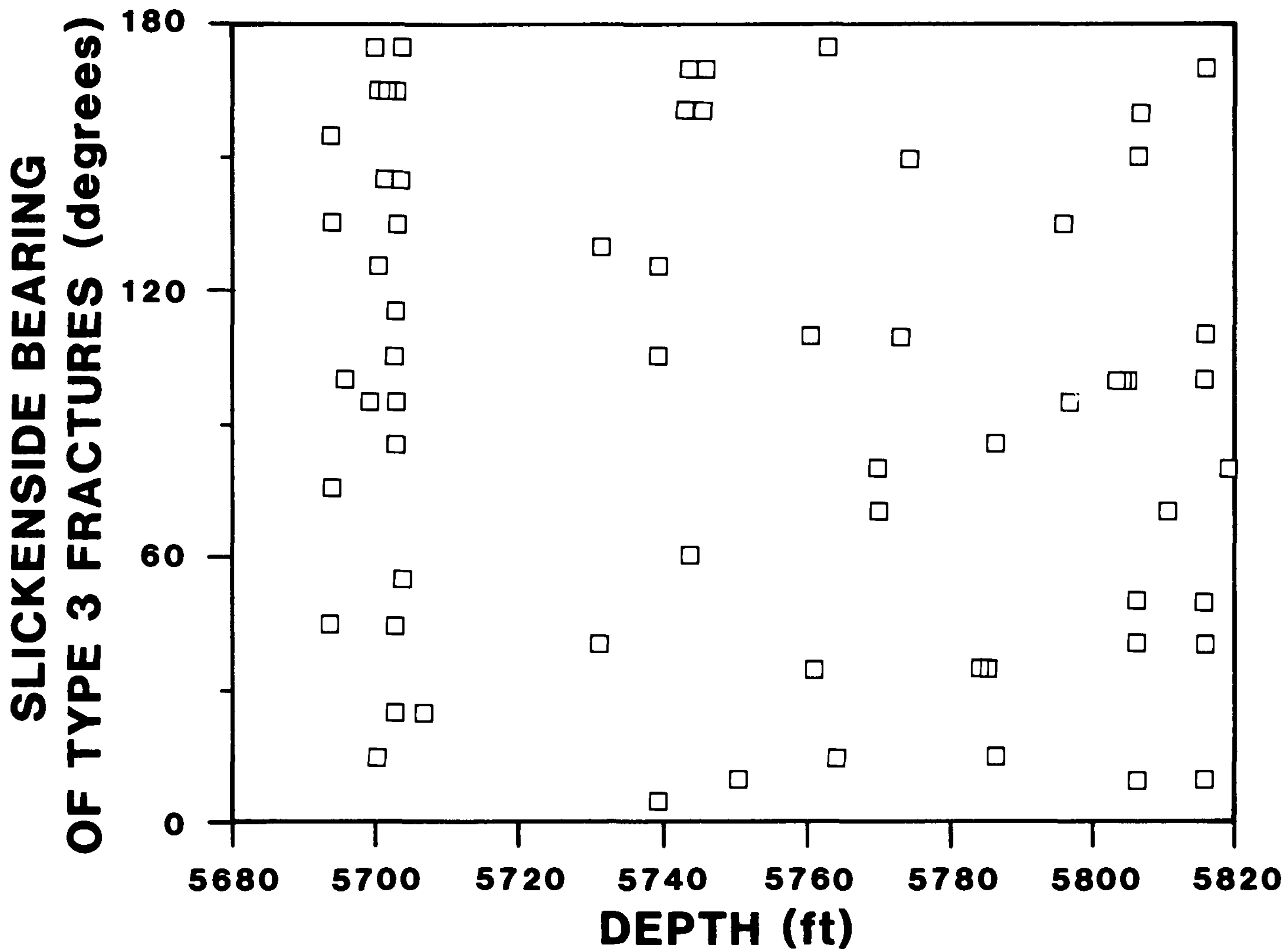


Figure 56. Distribution of Type 3 Fracture Slickenside Bearings With Respect to Depth; Oriented Core Data From MWX-3

bearing with respect to depth. The distributions shown in Figures 53 through 56 are believed to be typical of all Type 3 fractures in MWX core. Every Type 3 fracture identified in this 130-ft core interval was carefully oriented in an effort to avoid bias. Other strike, dip, and slickenside bearing measurements made on some of the more competent Type 3 fracture planes throughout the oriented core intervals also suggest these planes are randomly oriented.

Verbeek and Grout (1984) hypothesized that these Type 3 fractures are compaction and dewatering planes with minor slippage (1 to 2 cm), that formed early in the depositional history of the rocks while mudstones were still plastic. The undulating to conical surfaces and random orientation support this hypothesis. In outcrop, Verbeek and Grout (1984) recognized that this type of fracturing in mudstone is associated with discrete dewatering conduits in overlying sandstones. Three such dewatering pipes were identified in the core (e.g. Figure 57) and are included in the fracture database as Type D. These dewatering fractures or planes in mudstones probably act as planes of weakness, but only rarely as planes of permeability at depth as evidenced by the scarcity of mineralization.

The higher frequency of dewatering fractures in the core above 6750 ft (Figure 51) may be due to increased rates of deposition of these strata. More rapid deposition would encourage the entrapment of water in undercompacted sediments, and thus the formation of dewatering structures as the dewatering took place at greater than usual depths.

e. Shears in Mudstones (Type 6)

It is difficult to distinguish Type 6 from Type 3 shear fractures in mudstones. However, it is important to do so since Type 3 fractures have a distinct prelithification origin, whereas Type 6 fractures were most likely formed after lithification of the mudstones. Shear fractures in sandstones and siltstones were distinguished by dip angle, and in the case of Type 2 by host lithology, whereas Type 3 and Type 6 fractures occur in the same lithologies and have comparable dip angles. Type 6 shear fractures, by

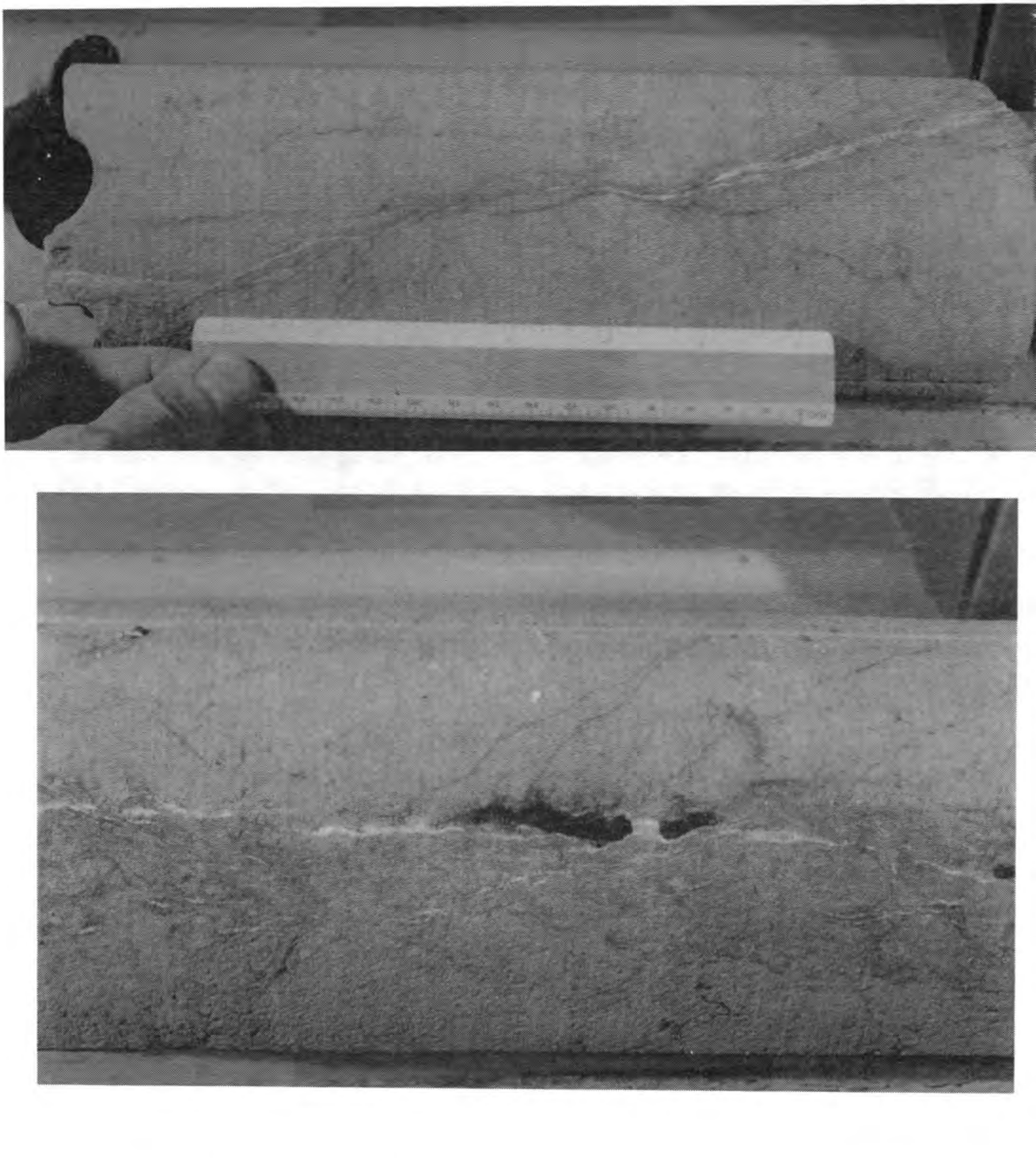


Figure 57. Dewatering Pipe in Sandstone at 5798 ft in MWX-1

definition, occur in predominantly mudstone lithology, are relatively planar, and are covered with linear slickensides that are continuous across the entire fracture plane exposed in the core. Eight Type 6 fractures have been identified in MWX core and are described in Appendix A. These fractures range from horizontal to 50° in dip, and most of the fracture planes appear to be polished. Figure 58 shows the distribution of these Type 6 fractures with depth, and Figure 59 is comprised of photographs of Type 6 fractures.

All of these Type 6 fractures have a slickenside bearing that is within 10° of the dip azimuth except the fracture at 6060.0 ft in MWX-1. The angle between the dip direction and the slickenside bearing is closer to 50° at this location. Only three of these fractures occur in oriented core. At 8123.9 ft in MWX-2, the dip azimuth is N68E and the slickenside bearing is N58E, whereas at 6884.9 ft in MWX-3, both the dip direction and slickenside bearing are N65E. At 8101.4 ft in MWX-2, the slickenside bearing is N10E on this horizontal Type 6 fracture.

All of these fractures separated along the fracture plane in the core barrel, so no fracture width data is available. Three of the fractures are partially mineralized. Calcite was identified on two Type 6 fractures and dickite was detected on one fracture. The calcite is subhedral at 6060.0 ft in MWX-1, but not at 6884.9 ft in MWX-3. "Frac blast" fractures are associated with the dickite-mineralized Type 6 fracture at 6151.1 ft in MWX-1 (Figure 60).

With the exception of the Type 6 at 8123.9 ft in MWX-2, all of these fractures occur in fairly homogeneous mudstone lithologies. At 8123.9 ft, the host rock is finely interlaminated siltstone and mudstone, and this Type 6 fracture crosscuts bedding.

D. SUMMARY AND CONCLUSIONS

A comprehensive natural fracture database for the Department of

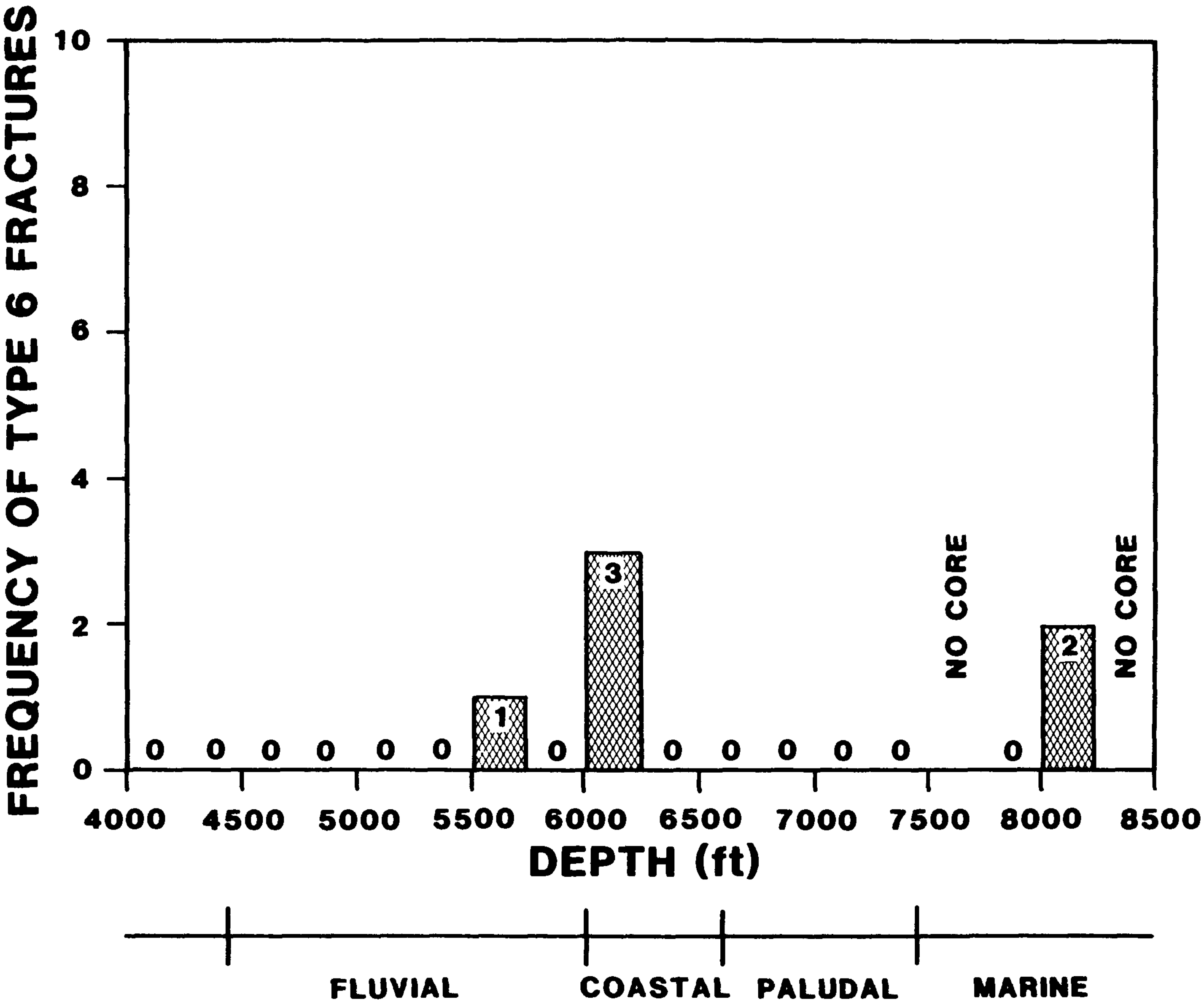


Figure 58. Frequency Distribution of Type 6 Fractures With Respect to Depth; Core Data From MWX-1 and MWX-2

a

b

Figure 59. Type 6 Fractures in Core; (a) 5848.5 ft, MWX-2; (b) 8123.9 ft, MWX-2

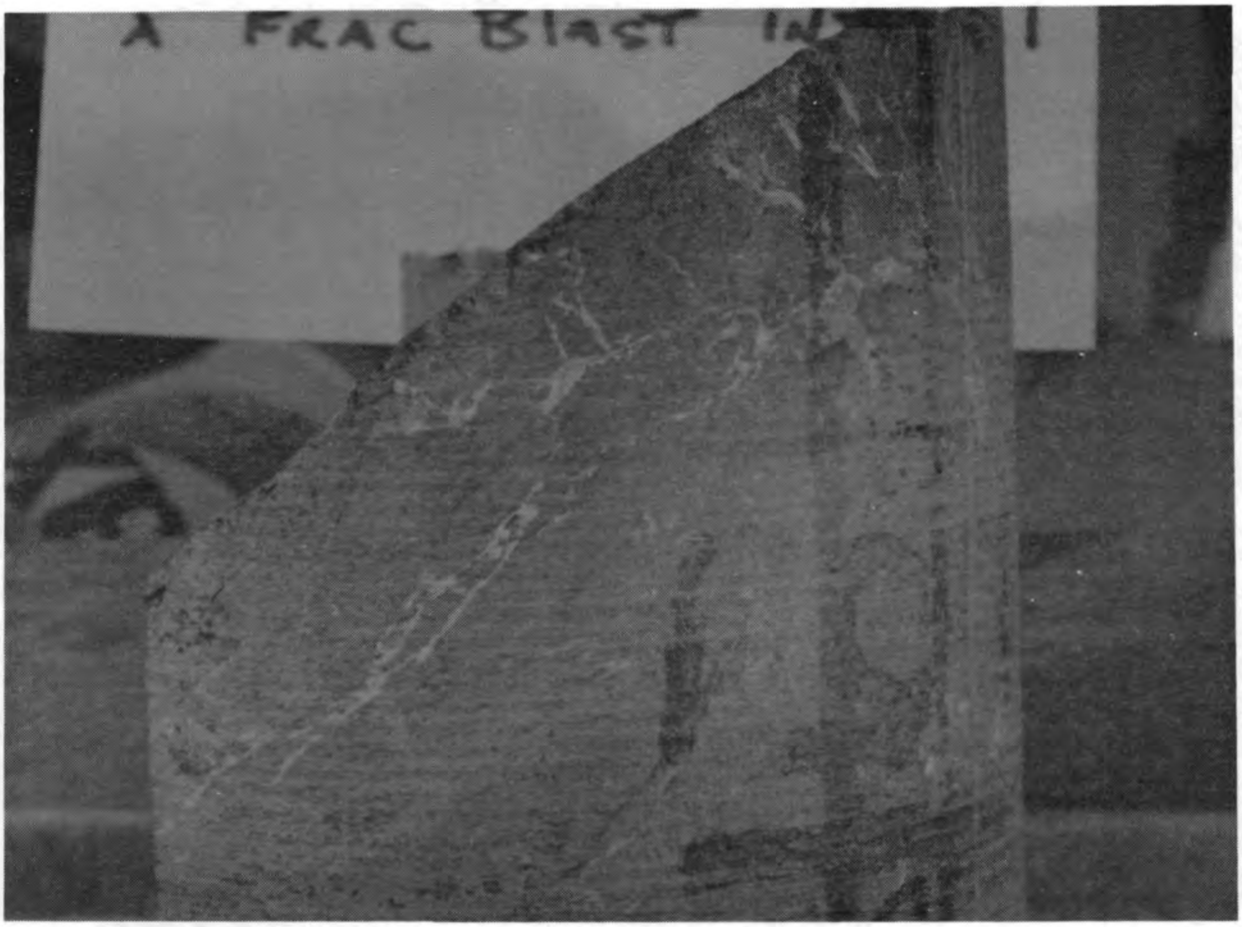


Figure 60. Type 6 Fracture With Associated "Frac Blast" Fractures, 6151.1 ft, MWX-1

Energy's 4200 ft of MWX core is presented and described in this report. Approximately 1880 natural fractures and 117 mechanically induced fractures are included. This database is presented in Appendix A. (It is also available on floppy disc upon request; see page iii for details.)

Approximately 1425 or 75 percent of the MWX fractures are interpreted as early-formed dewatering and compaction planes. They are randomly oriented, undulating, polished planes generally inclined from 20° to 50°. Type 3 fractures are rarely mineralized, and slickensides on these fracture planes are curvilinear.

Extension fractures (Types 1, S, 7 and 8) make up 20 percent of the MWX natural fracture database. These include approximately 275 vertical to subvertical, planar, mostly calcite-mineralized Type 1 and S fractures, as well as 27 horizontal to subhorizontal, planar, mostly calcite-mineralized Type 7 fractures. Types 1, S and 7 are frequently stranded or branched. Approximately 25 percent of the Type and S fractures have been oriented with respect to true north. The orientation data indicate that the predominant fracture strike is west-northwest parallel to the present-day maximum compressive stress direction, independently measured at the MWX site. A few Type 1 and S fractures with strike azimuths north-northwest and northeast were also identified in some core intervals.

In addition, there are roughly 61 "frac blast" type extension fractures, densely concentrated between 6100 and 6200 ft in MWX-1. The "frac blast" or Type 8 fractures have imparted an exploded rock texture to the host rock and are frequently coincident with sedimentary structures and bedding planes. These Type 8 fractures range from undulatory to planar and from horizontal to vertical. Dickite is the predominant fracture mineralization.

The remaining 5 percent of the natural fractures in MWX core are shear fractures that are probably not related to mudstone dewatering. These are the Type 4, 5, 2, and 6 fractures discussed in this paper. There were four low-angle, slickensided Type 4 fractures identified in MWX sandstones and siltstones. Type 4 fracture planes range from horizontal to 40° in dip and calcite is the predominant mineralization. With the exception of Type 4 and 5 shears, the relative motion along the MWX shear fractures is generally indeterminate. Two Type 4 fractures are thrust faults and two are strike-slip faults. The database includes only one vertical to subvertical, slickensided, calcite-mineralized Type 5 fracture in a sandstone lithology. Relative motion on this fracture also is apparently strike-slip.

A total of 77 slickensided Type 2 fractures, confined to carbonaceous mudstone laminations in sandstone and siltstone, have been identified in MWX core. Type 2 fractures range from horizontal to 50° in dip, and one-third of these fractures are mineralized, predominantly with calcite.

There are eight Type 6 fractures described in the MWX fracture database. The Type 6 fractures in mudstone are planar, occasionally mineralized fractures with continuous linear slickensides.

Changes in fracturing characteristics at MWX are in places coincident with changes in depositional environment and in other places with lithologic boundaries. For example, Type 1 and S fractures are confined to sandstone and siltstone lithologies and are densely concentrated in the lower fluvial and upper coastal environments. Present-day stress changes are also coincident with lithologic boundaries (Warpinski et al., 1985; Warpinski and Teufel, 1987) and possibly coincident with depositional boundaries (Warpinski, 1988).

Branagan et al. (1984) established that natural fractures make a substantial contribution to reservoir production at the MWX site. Results of laboratory permeability tests of matrix rock indicate permeabilities that are one to three orders of magnitude lower than those calculated from well test results at MWX. Lorenz and Finley (1987) discussed fracture characteristics and related production for Mesaverde intervals tested at

MWX, but additional work needs to be done. Although the majority of fractures are Type 3 dewatering fractures that are probably unimportant to reservoir productivity, there are more than 400 fractures whose significance to reservoir productivity needs to be completely evaluated.

It is reasonable to assume that all mineralized fractures, both shear and extension fractures, were open to the movement of fluids at some time in the depositional and burial history of the rocks, and they are most likely still open at depth. Figure 61 shows the distribution of these potentially permeable paths with respect to depth at MWX. Patchy and incomplete mineralization may act as a natural proppant, and laboratory tests suggest that even the most completely calcite-mineralized fractures enhance permeability of sandstone cores one to two orders of magnitude (Lorenz et al., 1986). Moreover, subhedral mineralization on some of the fracture walls is direct evidence for an opening along the fracture at depth. Apparently unmineralized shear fractures may also be propped and permeable as shearing may create asperities on fracture walls.

Natural fractures are the dominant control on in situ reservoir permeability at the MWX site (Lorenz and Finley, 1987; Lorenz et al., 1986). This report is a detailed catalog of the natural fractures encountered in core from the MWX wells. Its purpose has been to present a quantitative fracture database to be used for future studies in fracture distribution and its effect on reservoir production.

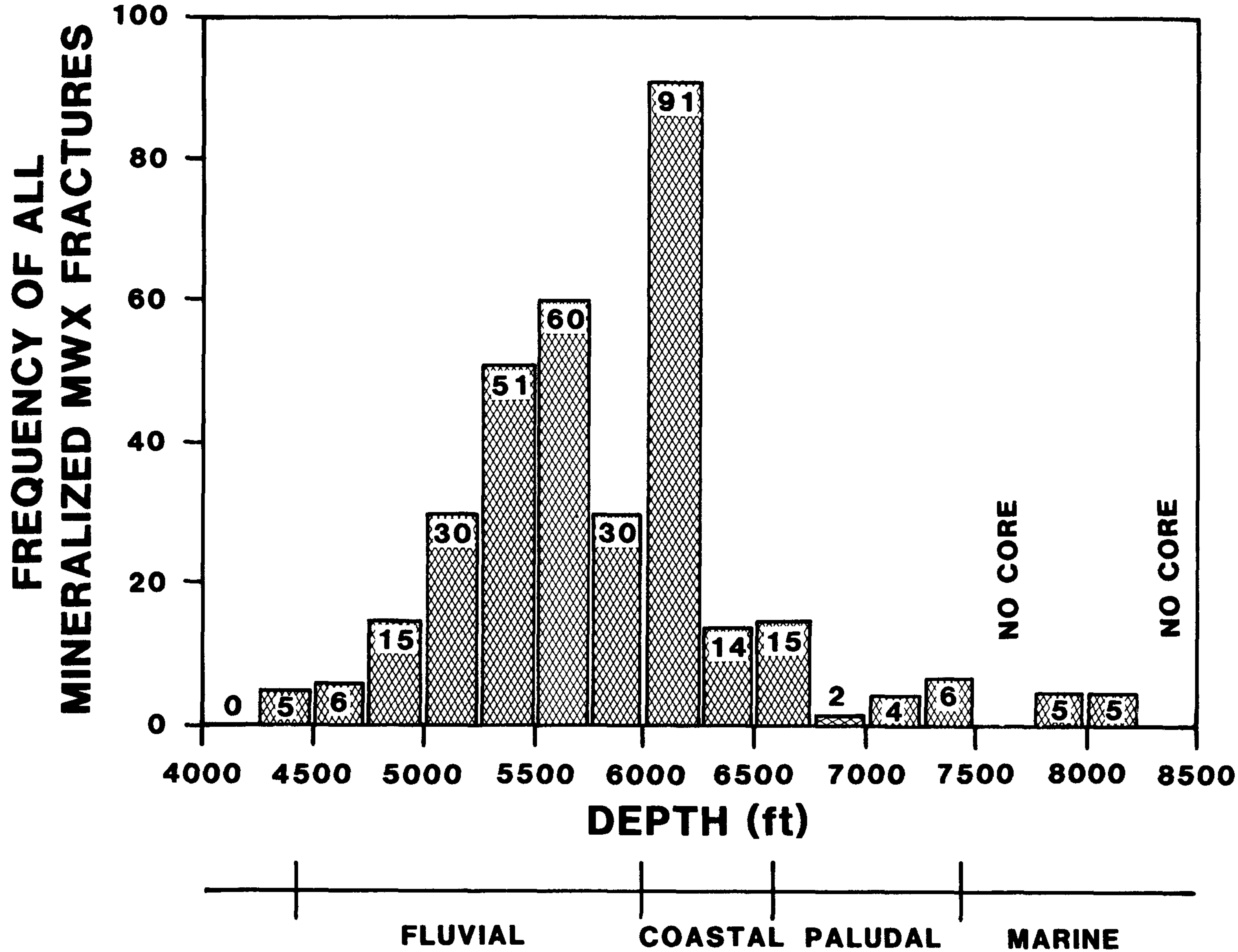


Figure 61. Frequency Distribution of all Mineralized Fractures With Respect to Depth; Core Data From MWX-1 and MWX-2

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LEGEND FOR APPENDIX A

Well Number: MWX-1, MWX-2, or MWX-3

Core Depth and Log Depth: Depth of the top of the fracture or fracture group in feet.

Frac Type: Fracture type as defined in text.

1 - vertical to subvertical extension fracture
2 - shear fracture confined to carbonaceous lamination in sandstone or siltstone
3 - dewatering fracture
4 - low angle shear fracture in sandstone or siltstone
5 - high angle shear fracture in sandstone or siltstone
6 - shear fracture in mudstone
7 - horizontal to subhorizontal extension fracture
8 - "frac blast" fracture
S - fracture swarm of type 1 extension fractures; fracture number is denoted as 03
C - mineralized coal cleat
N - fractured sandstone clast encased in mudstone
D - dewatering pipe or conduit
P - drilling-induced petal fracture
B - coring-induced scribe-line fracture

# of Fracs: Number of fractures that fit the description.

Frac Height: Core height of a fracture or fracture group in feet. 9999--information not available.

Frac Width: Maximum fracture width in mm; this width is always the maximum width of a single strand of the fracture or fracture group. 9999--information not available.

Frac Strike*: True strike. 999--information not available.

Dip Angle: Dip inclination in degrees; angle measured relative to horizontal. 99--information not available.

Dip Azimuth*: True direction of down dip. 999--information not available.

Slick Bearing*: True bearing of the slickensides. 999--information is not available.

* The true orientations have been determined using multishot oriented core data unless they are followed by a P. True orientations followed by a (P) were determined using paleomagnetic techniques.

Type Motion: Type of motion with reference to shear fractures

R - reverse
N - normal
S - strike slip
9 - information not available

Slick Extent: Extent of slickensides

+ - slickensides across core break
- - slickensides in patches
9 - information not available

Fill Type: Type of mineralization

C - calcite
Q - quartz
D - dickite
B - barite
H - chamosite
999 - no mineralization detected

Fill Amount: Amount of mineralization

P - partial fill
C - complete fill
9 - no mineralization

Crystal Type:

S - macroscopic subhedral crystals present
9 - no mineralization
blank - no macroscopic subhedral crystals detected.

Top Term: Upper termination of fracture or fracture group

1 - at mudstone contact
2 - out of core
3 - within lithology
4 - at gradational mudstone contact
5 - at mudstone lamination in sandstone or siltstone
6 - at grainsize change other than mudstone
7 - termination sampled (information unavailable)
8 - at rubble zone
9 - information not available

Bot Term: Bottom termination of fracture or fracture group. Same legend as Top Term above

Lith: Predominant lithology

0 - finely interlaminated mudstone and siltstone
1 - coarse sandstone
2 - medium-grained sandstone
3 - fine grained sandstone
4 - fine grained sandstone with mudstone laminations
5 - sandstone, siltstone, and mudstone intermixed with soft sediment swirls
6 - siltstone
7 - mudstone
8 - coal
9 - information not available

Lab Analyses: Laboratory analyses completed

T - petrographic analysis
S - SEM analysis
X - x-ray diffraction analysis
F - fluid inclusion analysis
blank - no lab analysis conducted

Second Line: Additional comments

APPENDIX A

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	4170.0	4160.0	3	8	3.7	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4179.3	4169.5	3	6	1.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4181.5	4171.5	3	4	.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4182.8	4173.0	3	8	3.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4197.8	4190.0	3	15	2.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4202.0	4194.0	3	6	1.9	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4207.6	4198.5	3	1	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4211.7	4202.0	3	12	4.8	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4248.6	4238.5	3	6	.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4265.7	4256.0	3	12	.7	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4271.0	4261.0	1	1	2.6	0.8	999	90	999	999	9	9	C	C		1	1	3	FT
	ENECHELON																		
1	4273.7	4264.0	3	7	1.8	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4279.5	4269.5	3	11	4.1	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4288.0	4278.0	3	3	.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4333.7	4323.5	1	1	1.5	0.2	999	90	999	999	9	9	C	C		3	3	2	
1	4337.6	4327.5	3	1	.2	9999	999	50	999	999	9	9	999	9	9	2	2	7	
	MORE PLANAR TYPE 3, SLICKS DOWNDIP																		
1	4341.9	4332.0	1	1	1.1	0.2	999	90	999	999	9	9	C	C		3	3	1	
1	4361.5	4351.5	3	7	1.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4376.5	4368.5	3	9	3.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4385.0	4377.0	3	4	.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4397.1	4389.0	3	11	6.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4406.3	4398.5	3	7	3.7	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4427.0	4419.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4430.0	4422.0	3	2	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4432.1	4424.0	3	3	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4434.6	4426.5	3	2	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4437.5	4428.5	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4442.5	4431.5	3	2	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	4444.5	4434.5	1	1	.9	0.1	999	90	999	999	9	9	C	C		1	2	3	
	MULTIPLE SMALL ENECHELON FRACS, ORGANICS WITH CALCITE																		
1	4452.0	4442.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4454.4	4444.5	3	7	2.1	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4460.9	4451.0	3	6	1.9	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4465.0	4455.0	3	10	3.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4474.0	4464.0	3	10	4.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4481.2	4471.0	3	5	1.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4491.9	4480.0	1	1	1.7	0.4	999	90	999	999	9	9	C	C		3	1	3	
1	4493.6	4482.5	3	16	5.9	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4505.7	4493.5	3	4	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4509.9	4498.0	3	7	6.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4529.1	4517.0	P	1	.2	9999	999	70	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 40 DEG.,CONCAVE UP																		
1	4543.6	4531.5	7	1	.0	9999	999	0	999	999	9	9	999	9	9	9	9	9	
	SAMPLED BY PITTMAN AND SPRUNT,FILL?,NO DATA AVAILABLE																		
1	4571.4	4561.5	1	1	2.6	0.2	999	90	999	999	9	9	C	C		3	3	3	
	ENECHELON MOSTLY 2 STRANDS,TERMS W/LITH BUT CLOSE TO MUDST LAM OR WHERE LAMS MORE DENSE																		
1	4581.7	4573.5	1	1	.4	0.1	999	90	999	999	9	9	C	C		3	3	3	
	ENECHELON FRAC ORGANICS WITH CALCITE																		
1	4585.5	4576.5	3	6	1.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4589.5	4580.5	3	18	7.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4600.5	4588.5	3	3	.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4611.5	4599.5	3	11	3.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4622.0	4611.0	3	7	.8	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4625.0	4614.0	3	6	2.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4630.3	4619.5	1	1	.5	0.2	999	90	999	999	9	9	C	C		5	5	3	
	FRAC ONLY SEEN ON ONE SIDE OF CORE, ROCK VERY CALCAREOUS																		
1	4645.3	4634.4	2	1	.0	9999	340	10	250	250	9	-	999	9	9	2	2	4	
	BUMPY IRREGULAR PLANE WITH PATCHES OF SLICKS																		
1	4656.4	4645.5	P	3	1.2	9999	120	99	999	999	9	9	999	9	9	9	9	3	
	PETAL FRACS, EACH ÁBOUT 0.1' IN LENGTH,INIATION ANGLES 30 DEG.,CONCAVE UP																		
1	4657.7	4646.5	P	1	.2	9999	999	99	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 35 DEG.-CONCAVE UP																		
1	4658.5	4647.5	3	16	4.9	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4664.0	4651.5	3	6	3.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4705.6	4692.5	1	1	.2	0.2	279	90	999	999	9	9	C	C		2	2	3	
	FRAC JUST BARELY SKIMMED CORE,FILL LOOKS PATCHY ON EXPOSED PLANE																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	4707.0	4694.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4708.0	4695.0	3	7	2.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4712.0	4699.0	3	15	7.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4721.0	4708.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4721.9	4709.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4732.0	4719.0	3	7	2.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4734.8	4722.0	1	1	1.0	0.3	999	90	999	999	9	9	C	C		1	5	6	
	ENECHELON STRANDS, PARALLEL TO PETAL FRACS @4735.2,NO USABLE MULTISHOT DATA																		
1	4735.2	4722.5	P	5	.7	9999	999	40	999	999	9	9	999	9	9	9	9	6	
	APPROX 0.1' IN LENGTH,INIATION ANGLE 50 DEG.,CONCAVE UP																		
1	4736.3	4723.5	P	2	.3	9999	999	99	999	999	9	9	999	9	9	9	9	6	
	APPROX 0.1'IN LENGTH INIATION ANGLE 33 DEG.,CONCAVE UP																		
1	4736.6	4724.0	1	1	.5	0.1	999	90	999	999	9	9	C	C		3	4	6	
	NO USABLE MULTISHOT DATA																		
1	4737.3	4725.5	P	1	.1	9999	999	99	999	999	9	9	999	9	9	9	9	6	
	INIATION ANGLE 45 DEG.																		
1	4739.6	4727.5	3	1	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	LARGER 3 TYPE, ALL THE WAY ACROSS CORE																		
1	4747.0	4735.0	3	11	2.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4750.8	4738.5	P	7	3.5	9999	999	99	999	999	9	9	999	9	9	9	9	6	
	SHORT (0.1'),LOW ANGL,TWO-OPPOSITE SIDES OF CORE-INIATION ANGLES 45&65DEG-CONCAVEUP																		
1	4758.0	4746.0	3	4	.8	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4759.1	4757.0	1	1	.4	0.1	999	90	999	999	9	9	C	C		3	3	6	
	MUDDY SILTST,ONLY SEEN ON ONE SIDE OF CORE,NO USABLE MULTISHOT DATA																		
1	4796.0	4786.0	1	1	.6	0.5	278	90	999	999	9	9	C	C		6	1	3	
	STRANDED,TOPTERM @ INTERLAMINATED MUDST AND SS																		
1	4799.0	4789.0	3	12	3.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4803.0	4793.0	3	4	3.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4812.0	4802.0	3	4	2.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4814.5	4804.5	P	3	1.9	9999	295	99	999	999	9	9	999	9	9	9	9	3	
	POORLY DEFINED PETALS 0.1-0.2' IN LENGTH,TWO 45 &60 DEG.-CONCAVE UP																		
1	4817.5	4807.5	3	1	.0	9999	100	99	190	190	9	9	999	9	9	9	9	7	
1	4817.5	4807.5	3	1	.0	9999	20	99	290	310	9	9	999	9	9	9	9	7	
1	4817.5	4807.5	3	13	6.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4819.2	4809.0	3	1	.0	9999	345	99	255	255	9	9	999	9	9	9	9	7	
1	4819.2	4809.0	3	1	.0	9999	245	99	155	155	9	9	999	9	9	9	9	7	
1	4822.0	4812.0	3	2	.0	9999	240	99	150	150	9	9	999	9	9	9	9	7	
1	4822.0	4812.0	3	1	.0	9999	315	99	45	90	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	4823.0	4813.0	3	1	.0	9999	240	99	150	150	9	9	999	9	9	9	9	7	
1	4839.3	4829.5	3	17	3.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4843.8	4834.0	1	1	.9	0.2	999	90	999	999	9	9	C	C		3	7	2	
1	4846.4	4837.0	1	1	1.2	1.0	999	90	999	999	9	9	QC	C		3	6	2	FT
	LOOKS LIKE ALL CALCITE IN THINSECTION																		
1	4853.6	4843.5	1	1	1.0	0.3	999	90	999	999	9	9	C	C		3	1	2	
1	4858.5	4848.5	3	1	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4864.5	4854.5	3	13	11.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4877.3	4867.5	1	1	1.0	10.0	999	90	999	999	9	9	C	P	S	1	3	3	
	OPEN FRAC,CORE BROKEN HERE,WIDTH IS ESTIMATED																		
1	4881.2	4871.0	1	1	.6	0.2	999	90	999	999	9	9	C	C		8	3	3	
1	4889.7	4879.5	3	4	2.6	9999	999	60	999	999	9	9	999	9	9	9	9	7	
	ALL PARALLEL, POLISHED SURFACES THROUGH CORE																		
1	4901.6	4891.5	1	1	1.0	0.4	999	90	999	999	9	9	C	C		7	6	2	
	MOSTLY COMPLETE BUT SOME GAPS IN FILL,POSSIBLY SOME QTZ TOO																		
1	4904.6	4894.5	1	1	1.6	1.4	999	90	999	999	9	9	QC	P	S	5	2	2	T
	FINE QTZ, CL TS SAMPLE MAY SHOW CALC UNDER QTZ,OPEN FRAC-WIDTH FR MAD																		
1	4908.0	4898.0	1	1	1.0	10.0	999	90	999	999	9	9	Q	P	S	5	7	2	
	FINE QTZ, MAY BE CONTINUOUS WITH FRAC BELOW AT 4909.1,OPEN FRAC-WIDTH ESTIMATED																		
1	4909.1	4899.0	5	1	.9	9999	999	80	999	999	S	-	QC	P	S	7	5	2	
	OPEN FRAC,MAY BE CONT.W/FRAC ABOVE,UNDULATING PLANE WITH ORGANICS ,CROSSCUTS SOME LAMS																		
1	4910.0	4900.0	2	1	.1	9999	999	30	999	999	9	-	999	9	9	2	2	2	
	FRAC ABOVE TERMS HERE																		
1	4919.7	4909.5	1	1	.5	0.2	999	90	999	999	9	9	C	C		5	7	6	
	FILL LOOKS PARTIAL ON EXPOSED PLANE																		
1	4922.0	4912.0	3	14	5.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4952.7	4950.5	3	1	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	LARGER 3 TYPE																		
1	4959.0	4947.0	3	5	1.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4964.4	4952.5	3	4	2.9	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	LARGER 3 TYPES																		
1	4978.0	4966.0	3	11	3.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4983.2	4967.0	1	1	.4	0.1	999	85	999	999	9	9	C	C		3	3	3	
	THREE ENECHELON STRANDS																		
1	4985.2	4969.0	1	1	5.7	1.5	999	90	999	999	9	9	C	C		1	1	3	T
	STRANDED,SEVERAL MISSING CORE INTERVALS IN THE MIDDLE																		
1	4997.0	4971.5	3	5	.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	4999.1	4973.5	1	1	.1	0.1	999	90	999	999	9	9	C	C		3	3	4	
1	5001.4	4975.5	1	1	.4	0.4	999	90	999	999	9	9	C	C		5	7	3	
	0.1'SAMPLE OUT @ BOTTOM,STRANDED,LOOKS PARTIAL ON EXPOSED PLANE																		
1	5014.4	5003.0	1	2	1.0	0.3	999	90	999	999	9	9	C	C		3	6	3	
	PARALLEL FRACS SEPARATED BY 0.2'																		
1	5016.4	5005.0	1	1	3.5	10.0	999	85	999	999	9	9	QC	P	S	2	1	3	FTS
	LARGE SUBHEDRAL CRYSTALS,FRAC OPEN-WIDTH FROM MADSEN,QTZ NOT SEEN IN THINSECTION																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	5034.0	5023.0	1	1	3.1	1.4	999	90	999	999	9	9	C	C		5	6	2	
	@TOP FRAC IS TIGHT, WIDENS @MUDST PART.SPLITS-8 STRANDS-SINGLE STRAND AFTER PARTING																		
1	5035.6	5024.5	2	1	.2	9999	999	35	999	999	9	-	C	P		2	2	4	
	DOWN DIP SLKS PARALLEL TO FRAC STRIKE @5034.0-CM GAP IN EXT FRAC-?OFFSET																		
1	5036.2	5025.0	2	1	.0	9999	999	20	999	999	9	-	C	P		2	2	4	
	POLISHED,SLKS NORMAL TO FRAC STRIKE @5034.0,OCCURS@GAP IN FRAC@5034.0,IRREG PL																		
1	5041.2	5030.0	1	1	.2	0.1	999	90	999	999	9	9	C	C		5	3	2	
	SINGLE STRAND																		
1	5066.0	5055.0	3	10	3.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5067.1	5055.5	1	1	.3	0.3	999	50	999	999	9	9	C	C		2	2	7	
	IN W/TYPE 3 FRACS																		
1	5072.5	5060.5	D	1	1.3	0.5	999	90	999	999	9	9	C	P		1	1	6	
	MULTIPLE STRANDS PLUME OF MUDST,TWO DIFF STRIKES-30 DEGREES DIFF																		
1	5074.9	5063.0	1	1	.2	0.2	999	90	999	999	9	9	C	C		5	4	2	
	MOSTLY COMPLETE FILL-SOME GAPS																		
1	5078.5	5067.5	1	1	.4	1.0	999	80	999	999	9	9	C	C		3	1	2	
	WAVY PLANE																		
1	5080.8	5069.5	1	1	1.0	0.1	999	90	999	999	9	9	C	C		1	1	2	
	ENECHELON STRANDS																		
1	5081.9	5070.5	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5083.3	5071.0	1	1	.3	0.3	999	90	999	999	9	9	C	C		2	4	2	
1	5094.2	5083.0	1	1	.3	0.2	999	90	999	999	9	9	C	C		3	1	2	
1	5113.1	5102.0	3	7	2.9	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5122.0	5111.0	3	3	.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5124.8	5113.0	1	1	4.2	1.2	999	85	999	999	9	9	C	C		6	2	2	
	SOME GAPS IN FILL, STRIKE OF THIS FRAC 25 DEG. DIFF THAN STRIKE OF FRAC BELOW																		
1	5124.8	5114.0	1	1	1.6	0.3	999	90	999	999	9	9	C	C		6	3	2	
	STRIKE OF THIS FRAC 25 DEG. DIFF THAN STRIKE OF FRAC ABOVE IN SAME PIECE OF CORE																		
1	5131.9	5121.0	1	1	2.1	1.2	999	85	999	999	9	9	C	C		2	6	2	
1	5139.3	5128.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5140.0	5128.5	1	1	1.0	0.4	999	90	999	999	9	9	C	C		2	2	3	
1	5143.7	5131.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5144.4	5131.5	1	1	2.0	0.2	999	90	999	999	9	9	C	C		1	3	2	
1	5152.1	5139.0	1	1	2.7	0.5	999	85	999	999	9	9	C	C		2	2	1	
	STRANDED WITH 0.4' GAP IN FRAC(53.7-54.1),BOTTERM ENECHELON OUT OF CORE @MUDST CONT.																		
1	5157.3	5144.5	3	4	.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5157.9	5145.0	1	1	.5	0.3	999	90	999	999	9	9	C	C		1	5	6	
1	5163.0	5150.0	3	5	2.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5177.0	5162.5	3	6	2.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5183.0	5168.0	3	8	1.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	5191.3	5175.0	3	1	.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	LARGER 3 TYPE, STRIKE PARALLEL TO FRAC BELOW BUT OPPOSITE DIP																		
1	5192.4	5176.0	3	1	.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	LARGER 3 TYPE, STRIKE PARALLEL TO FRAC ABOVE BUT OPPOSITE DIP																		
1	5199.2	5185.5	1	1	.5	0.2	999	85	999	999	9	9	C	C		2	1	6	
	SOME GAPS IN FILL																		
1	5199.7	5186.0	3	11	9.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5213.0	5197.5	3	4	4.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5221.0	5206.0	3	5	2.8	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5223.8	5209.5	1	1	1.0	0.2	999	90	999	999	9	9	C	C		1	6	3	
1	5225.8	5211.5	3	3	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5227.2	5212.5	1	1	.3	0.2	999	90	999	999	9	9	C	C		1	3	6	
1	5232.0	5217.5	1	2	.6	0.3	999	90	999	999	9	9	C	C		5	1	3	
	TWO PARALLEL FRACS 1.5 IN APART, FILL HAS SOME GAPS																		
1	5233.4	5219.0	3	1	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	LARGER 3 TYPE																		
1	5235.1	5221.0	1	1	.4	0.2	999	90	999	999	9	9	C	C		1	1	6	
	DESCRIPTION FROM MADSEN'S NOTES																		
1	5239.7	5225.5	1	1	1.2	0.2	999	90	999	999	9	9	C	C		5	5	3	
	TERMS @MINOR MUDST PARTINGS																		
1	5249.1	5234.5	1	2	.5	0.2	999	85	999	999	9	9	C	C		1	1	3	
	SOME GAPS IN FILL, TWO PARALLEL FRACS GREATER THAN 0.1' APART																		
1	5251.4	5236.5	1	1	.4	0.4	999	85	999	999	9	9	C	C		1	1	2	
1	5255.8	5241.5	1	1	.4	0.4	999	65	999	999	9	9	C	C		6	2	7	
	TOP TERM @ SANDST CONTACT																		
1	5255.8	5241.5	3	12	3.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5264.0	5250.5	3	10	2.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5268.3	5255.0	1	1	.7	0.2	999	90	999	999	9	9	C	C		6	3	3	
	TOP TERM @MUDDY SS																		
1	5269.6	5256.0	1	1	3.0	0.4	999	90	999	999	9	9	C	C		3	1	3	S
	INCORPORATED MADSEN'S NOTES																		
1	5274.3	5260.0	1	1	.4	0.2	999	90	999	999	9	9	C	C		1	1	5	
	TERMS AT MUD SWIRLS																		
1	5277.4	5263.0	3	5	2.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5283.1	5268.5	P	2	.3	9999	999	60	999	999	9	9	999	9	9	9	9	3	
	TWO PETALS (0.1-.2') INIATION ANGLES 50 & 55 DEG.-CONCAVE UP,BOTH STRANDED																		
1	5284.4	5270.0	3	7	2.1	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5302.8	5288.5	1	1	1.4	0.2	999	90	999	999	9	9	C	C		1	2	3	
	JUST SKIMS EDGE OF CORE																		
1	5304.8	5291.5	2	1	.1	9999	999	30	999	999	9	-	C	P		2	2	4	
	SLK BEARING 50DEG. OFF OF STRIKE OF FRAC@5302.8,DOWNDIP 30DEG.OFF OF SLK BEAR.																		
1	5305.4	5292.0	2	1	.3	9999	999	50	999	999	9	-	999	9	9	2	2	4	
	SLKS OFF OF DOWN DIP APPROX. 30DEG.																		
1	5319.6	5306.0	1	1	1.8	0.5	999	90	999	999	9	9	C	C		1	4	3	
	BOT. TERM. @CONTACT WITH INTERBEDDED SS/MUDST																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	5321.3	5308.0	P	1	.1	9999	999	99	999	999	9	9	999	9	9	9	9	9	
	PETAL FRAC STRIKE 10DEG. OFF OF FRAC STRIKE @5319.6-INIATION ANGLE 65 DEG.-CONVEX UP																		
1	5321.8	5308.5	1	1	.4	0.5	999	90	999	999	9	9	C	C		3	1	4	
	ROCK TYPE-INTERBED MUDST & SANDST																		
1	5322.5	5309.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5324.6	5311.0	1	1	.3	0.1	999	90	999	999	9	9	C	C		4	4	4	
	ROCK TYPE-INTERBEDED MUDST & SANDST																		
1	5332.6	5319.0	3	1	.2	9999	999	60	999	999	9	9	999	9	9	2	2	7	
	PARALLEL TO FRAC@ 5333.6,SLKS 20DEG.OFF OF DOWNDIP,OPEN FRAC																		
1	5333.6	5320.0	3	1	.2	9999	999	60	999	999	9	9	999	9	9	2	2	7	
	PARALLEL TO FRAC ABOVE DOWNDIP SLKS,OPEN FRAC																		
1	5334.1	5320.5	1	1	1.1	0.4	999	90	999	999	9	9	C	C		1	1	3	
	FILL LOOKS PARTIAL ON EXPOSED PLANE																		
1	5341.4	5325.0	1	1	1.6	1.0	999	90	999	999	9	9	C	C		1	2	3	
	BOTTERM-1 STRAND OUT OF CORE & 1 STRAND @MUDST CONTACT CLOSE TO EDGE,																		
1	5343.7	5326.5	3	7	2.8	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5347.4	5330.5	1	1	.3	0.1	999	90	999	999	9	9	C	C		3	3	2	
1	5358.6	5343.0	1	1	1.4	0.5	999	90	999	999	9	9	C	C		2	1	2	
	ENECHELON STRANDS, WAVY & CLOSE TO EDGE OF CORE																		
1	5360.9	5345.5	1	1	.8	0.4	999	90	999	999	9	9	C	C		3	3	4	
	THREE ENECHELON STRANDS																		
1	5366.7	5351.0	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5368.1	5352.5	1	1	1.3	0.3	999	90	999	999	9	9	C	C		6	1	2	
	GAPS IN FILL,TOP TERM AT FINE SS CONTACT, STRANDED																		
1	5373.0	5358.5	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5373.4	5359.0	1	1	.7	0.2	999	90	999	999	9	9	C	C		1	1	2	
	FOUR ENECHELON STRANDS-0.2'EACH																		
1	5375.3	5361.0	1	1	.7	0.4	999	85	999	999	9	9	C	C		2	1	4	
	FILL PATCHY ON EXPOSED PLANE																		
1	5377.0	5362.0	3	20	9.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5388.3	5377.5	1	1	.1	9999	999	90	999	999	9	9	C	C		3	3	3	
1	5388.8	5378.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5388.9	5378.0	N	20	.5	0.3	999	20	999	999	9	9	C	C		1	1	5	T
	(APPROX 20 STRANDS) FRACS EXTEND 1MM INTO MUDST,0-20DEG.																		
1	5389.6	5378.5	1	1	.4	0.1	999	90	999	999	9	9	C	C		5	5	6	
1	5393.5	5379.0	3	5	1.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5398.6	5383.5	1	1	.5	0.1	999	90	999	999	9	9	C	C		3	5	2	
1	5399.3	5384.5	1	1	.4	0.2	999	90	999	999	9	9	C	C		5	5	2	
	FRAC MAY BE RELATED TO FRAC @5398.6-GAP @ 2"MUDST PARTING																		
1	5406.0	5391.0	1	1	1.0	0.8	999	90	999	999	9	9	C	C		3	5	2	
	BOT TERM @MUDST SHARD,STRANDED, FRAC NEAR EDGE OF CORE																		
1	5407.8	5393.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5409.2	5394.0	1	1	1.1	0.8	999	90	999	999	9	9	C	C		4	2	3	
	STRANDED, WIDER AT BOTTOM																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	5410.1	5394.5	P	2	.3	9999	999	99	999	999	9	9	999	9	9	9	9	3	
	PARALLEL TO FRAC @5409.2 ABOVE,ONE INIATION ANGLE 55 DEG.-CONCAVE UP																		
1	5428.6	5411.5	3	7	1.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5431.6	5415.5	1	1	2.2	0.3	999	90	999	999	9	9	C	C		1	3	3	
	WHOLE CORE, STRANDED																		
1	5438.4	5422.5	1	1	.2	1.5	999	70	999	999	9	9	C	C		3	3	6	
	THREE PARALLEL STRANDS APPROX. 1" APART,60-70 DEG. DIP																		
1	5439.5	5423.5	1	1	.1	0.2	999	90	999	999	9	9	C	C		6	6	6	
	TERMS WHERE MUDST LAMS MORE NUMEROUS,STRAPPING CORRECTION-LOG DEPTHS CORRECT																		
1	5427.6	5429.5	7	1	.0	0.5	999	15	999	999	9	9	C	C		2	3	4	
	FRAC ONLY PART WAY THRU CORE, FRAC APPEARS TO BE WITHIN ORGA MUDST LAM.																		
1	5429.9	5432.0	2	1	.0	9999	295	30	205	205	9	-	999	9	9	2	2	4	
	BUMPY PLANE																		
1	5431.1	5433.0	1	2	.3	0.2	273	90	999	999	9	9	C	C		1	1	6	
	TWO PARALLEL FRACS GREATER THAN 0.1' APART																		
1	5433.9	5436.0	S	3	1.2	0.5	285	90	999	999	9	9	C	C		1	3	3	
	FILL LOOKS PATCHY ON EXPOSED PLANE,FRAC SWARM,FRACS 0.2-1.2'LONG,0.1-0.5MM																		
1	5437.5	5443.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5438.5	5444.5	2	1	.0	9999	340	15	70	220	9	-	C	P	S	2	2	4	
	PATCHES OF CALCITE OPEN FRAC,BUMPY IRREG BREAK,FLAT XSTALS,FAINT SLKS																		
1	5440.6	5446.5	1	1	.6	0.3	270	90	999	999	9	9	C	C		3	1	3	
	FRAC IS CLOSE TO EDGE OF CORE,OPEN FRAC,FILL PATCHY ON EXPOSED PLANE																		
1	5442.2	5447.0	1	1	1.0	0.3	330	90	999	999	9	9	C	C		1	5	6	
	MUDDY SILTST,FILL PATCHY, MOSTLY TWO PARALLEL STRANDS,BOTTERM @2 TYPE BELOW																		
1	5445.0	5447.5	3	3	2.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	APPROX. FOOTAGE																		
1	5447.3	5449.0	1	1	.5	0.5	310	90	999	999	9	9	C	C		4	3	5	
	TERMS WITHIN CORE HORIZONTALLY @MUDST CONTACT,STRANDED-ONE STRAND(0.2')																		
1	5447.3	5449.0	1	1	.3	0.5	310	90	999	999	9	9	C	C		4	2	5	
1	5448.0	5450.0	3	6	4.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	APPROX. FOOTAGE																		
1	5455.0	5457.0	1	1	1.1	1.0	280	90	999	999	9	9	C	C		1	1	3	T
	TWO PARALLEL FRACS SEPARATED BY LESS THAN 0.1'																		
1	5461.5	5463.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	F
1	5474.0	5475.0	4	1	.0	9999	290	15	20	230	R	+	C	P	S	2	2	3	
	SLICKENCRYSTS ON THRUST FAULT,OPEN FRAC,SLK BEARING-UP MOVEMENT																		
1	5474.0	5475.0	1	1	.1	0.2	280	90	999	999	9	9	C	C		3	1	3	
	TOP TERM @THRUST FAULT ABOVE,BOT TERM CLOSE TO MUDST CONTACT																		
1	5475.0	5476.0	4	1	.0	9999	320	15	230	60	R	+	C	P	S	2	2	3	
	SLICKENCRYSTS ON THRUST FAULT,OPEN FRAC,SLK BEARING-UP MOVEMENT																		
1	5475.3	5475.5	7	1	.0	3.0	999	15	999	999	9	9	C	C		2	3	3	T
	OUT OF CORE ON ONE SIDE,0-15DEG.,LOOKS LIKE THERE MAY BE SLKS IN PHOTO-SAMPLED																		
1	5488.0	5490.0	1	1	.1	0.5	999	90	999	999	9	9	C	C		5	5	3	
	ONLY SEEN ON ONE SIDE OF CORE																		
1	5491.2	5493.0	2	1	.0	9999	295	10	205	15	9	-	999	9	9	2	2	4	
1	5491.5	5493.5	3	6	2.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5493.9	5496.0	S	3	1.4	1.0	280	90	10	999	9	9	C	C		1	5	6	
	FRACS 70-75DEG.&90DEG 0.2-1.0'IN LENGTH,FILL PATCHY,0.1-1.0MM,BOTTERM 0.1'MUDST PART																		
1	5495.4	5497.5	S	3	.9	1.0	280	90	10	999	9	9	QC	C		5	1	6	T
	ALL DETAILS AS ABOVE EXCEPT TOPTERM @0.1'MUDST PARTING,SOME STRANDS AREN'T FILLED W/QTZ																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	5496.8	5499.0	3	4	1.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5498.4	5500.5	1	1	.5	0.5	290	70	20	999	9	9	C	C		1	3	6	
1	5499.6	5501.5	3	3	.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5503.7	5505.5	S	3	.9	1.0	45	90	999	999	9	9	QC	C		1	1	3	T
		FILL PATCHY,FRACS 0.3-.9'IN LENGTH,NO QTZ IN SOME STRANDS,MICROPROBE ANALYSIS																	
1	5506.0	5508.0	1	1	1.0	0.5	45	80	999	999	9	9	C	C		1	2	3	
		FILL PATCHY,FRAC SKIMS CORE CLOSE TO EDGE																	
1	5509.0	5510.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5509.8	5511.5	3	5	2.9	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5513.7	5515.0	3	3	.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5520.6	5522.0	1	1	1.7	0.5	295	85	999	999	9	9	C	C		3	1	3	
1	5523.0	5525.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5523.4	5525.5	3	1	.1	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5527.8	5529.5	2	1	.1	9999	315	30	45	255	R	-	C	P	S	2	2	4	
		SLK BEARING-UP DIR. CARB. MAT'L CONCENTRATED ON THRUST FAULT PLANE,SUBTLE SLICKS																	
1	5528.0	5529.7	2	1	.2	9999	325	35	55	255	9	-	999	9	9	2	2	4	
		SLKS IN PATCHES ASSOC W/ORGA MAT'L																	
1	5528.2	5530.0	2	1	.3	9999	325	50	235	215	9	-	999	9	9	2	2	4	
		ONLY ONE SMALL PATCH OF LINEATIONS,ASSOCIATED WITH SFT SED. DEFORM.																	
1	5529.8	5531.5	7	1	.1	1.4	999	20	999	999	9	9	C	P	S	2	3	3	
		ONE END OF FRAC IN LITH,0-20DEG.DIP																	
1	5530.4	5532.5	7	1	.1	1.0	230	20	999	999	9	9	QC	P	S	2	2	3	T
		TWO PARALLEL FRACS 1" APART OR LESS																	
1	5530.9	5533.0	2	1	.0	9999	999	10	999	265	R	-	QC	P	S	2	2	4	F
		PLANE BROKEN UP SUBTLE SLICKENCRYSTS,FI ANAL.-QTZ ONLY,SLICK BEARING-UP,5-10DEG.																	
1	5531.2	5533.2	3	3	.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
		CALCITE FILLED VEINS ASSUMED TO BE SEDIMENTARY FEATURES IN THIS LOCATION																	
1	5531.8	5533.5	S	3	.5	0.2	285	80	999	999	9	9	QC	C		1	1	6	T
		FRACS 0.2-0.5																	
1	5532.1	5533.7	1	1	.2	0.2	325	80	999	999	9	9	C	C		2	1	6	T
		THIS FRAC WITHIN FRAC SWARM ABOVE,POSSIBLY SOME QUARTZ																	
1	5536.9	5538.5	P	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	9	
		INIATION ANGLE 35 DEG.-CONCAVE UP																	
1	5541.4	5543.0	1	1	2.2	0.2	999	90	999	999	9	9	C	C		3	3	3	
		OFFSET @ TYPE 2 5543.2,PARALLEL TO PETAL ABOVE																	
1	5543.2	5544.5	2	1	.0	9999	999	10	999	999	9	-	999	9	9	2	2	4	
		SLK BEARING PARALLEL TO PETAL @5536.9,NOT EXACTLY DOWN DIP																	
1	5555.5	5558.5	1	1	.7	0.8	999	90	999	999	9	9	C	C		3	3	3	
		ALL DATA FROM MADSEN'S NOTES,STRANDED																	
1	5557.9	5561.0	1	1	4.0	1.0	999	90	999	999	9	9	C	C		3	3	3	
		SOME CORE MISSING HERE																	
1	5562.6	5565.5	7	1	.0	9999	999	0	999	999	9	9	C	P		2	2	4	
		OCCURS IN ORGA LAM IN SS,SUBHEDRAL?,OPEN FRAC																	
1	5567.1	5570.0	1	1	.4	0.2	999	90	999	999	9	9	C	C		7	7	6	
		MUDDY SILTST, FRAC MAY BE AS MUCH 1'LONGER																	
1	5578.8	5580.0	1	1	1.9	0.2	999	90	999	999	9	9	C	C		1	3	3	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	5583.6	5584.5	3	10	6.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5587.0	5590.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5596.9	5599.0	S	3	3.6	0.5	999	75	999	999	9	9	C	C		1	1	6	
	INDIVIDUAL FRACS TERM WITHIN LITH AND OUT OF CORE ALSO,0.1-0.5MM																		
1	5602.0	5601.0	6	1	.0	9999	999	45	999	999	9	+	999	9	9	2	2	7	
	POLISHED DOWNDIP SLKS,SLIGHTLY POLISHED,NOT REAL SMOOTH																		
1	5606.2	5605.0	S	3	.3	0.4	999	90	999	999	9	9	C	C		6	6	3	
	SWARM IN GREEN SS,TERMS AT GRAY SS CONTACTS																		
1	5607.9	5607.0	1	1	.9	0.4	999	90	999	999	9	9	C	C		1	1	3	
	CROSSES HORIZ. FRAC BELOW, HORIZ FRAC APPEARS OLDER																		
1	5608.6	5607.5	7	1	.0	0.2	999	0	999	999	9	9	C	P		2	2	3	
	IN PLACES WIDTH IS NEGLIGIBLE AND NO FILL IS VISIBLE																		
1	5609.7	5608.5	1	1	.4	0.2	999	90	999	999	9	9	C	C		1	1	3	
	75-90DEG.DIP, THIS FRAC OFFSET @HORIZ FRAC BELOW																		
1	5610.0	5609.0	7	1	.0	0.5	999	0	999	999	9	9	C	P		2	2	4	
	FRAC FOLLOWS MUDST LAM,FRAC IS VERY TIGHT AND FILL IS INVISIBLE IN PLACES																		
1	5611.0	5610.0	2	1	.0	9999	999	0	999	999	9	-	C	P	S	2	2	4	
	PATCHY FILL, XSTALS ARE VERY FINE, VERY BUMPY PLANE,SLKS ACROSS MOST OF PLANE																		
1	5611.2	5610.2	1	1	.4	0.3	999	90	999	999	9	9	C	C		1	1	3	
	THIS FRAC OFFSET AT A MUDST LAM																		
1	5611.7	5610.5	7	1	.0	0.2	999	0	999	999	9	9	C	P		2	2	3	
	FOLLOWS IRREG. BEDDING PLANE,IN PLACES FILL IS INVISIBLE																		
1	5615.5	5615.5	1	1	.9	0.5	999	90	999	999	9	9	C	C		3	2	4	
	FRAC GOES THRU TYPE 2 BELOW,FRAC STRIKE PARALLEL TO SLK BEARING																		
1	5616.2	5616.0	2	1	.0	9999	999	30	999	999	9	+	999	9	9	2	3	4	
	FRAC TERMS WITHIN LITH @ TERM OF ORGA LAM,SUBTLE SLKS,NO OFFSET OF TYPE 1@5615.5																		
1	5617.8	5618.0	1	1	.7	0.5	999	90	999	999	9	9	C	C		2	2	3	
	FRAC JUST BARELY SKIMS CORE-QUESTIONABLE WIDTH																		
1	5621.8	5622.0	3	4	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5623.7	5623.5	2	1	.0	9999	999	20	999	999	9	-	999	9	9	2	2	4	
	SUBTLE SLKS																		
1	5624.7	5627.0	2	1	.0	9999	999	50	999	999	9	-	999	9	9	2	2	4	
	DOWNDIP SLKS, SUBTLE SLKS																		
1	5628.3	5630.5	1	1	1.2	0.6	999	90	999	999	9	9	C	C		5	3	3	
	TOP TERM @ PARTLY POLISHED MUDST PARTING																		
1	5633.0	5635.0	1	1	1.4	0.6	999	90	999	999	9	9	C	C		7	3	3	
	PROBABLY ONLY A FEW TENTHS LONGER,SEPARATED FROM FRAC BELOW BY SED. SWIRL																		
1	5634.8	5637.0	1	1	1.2	0.2	999	90	999	999	9	9	C	C		3	1	3	
	MAY BE RELATED TO FRAC ABOVE																		
1	5636.0	5638.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	2	2	7	
	VERY IRREG. PLANE SLKS PARALLEL TO FRAC STRIKE @5633.0 AND 5634.8,@ SS/MUDST CONTACT																		
1	5638.6	5640.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5639.3	5641.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5644.8	5646.5	S	3	.5	0.1	999	80	999	999	9	9	C	C		1	1	6	
1	5646.5	5647.0	3	6	1.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5647.9	5648.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5648.3	5648.5	1	1	.9	0.2	999	90	999	999	9	9	C	C		3	3	6	
	ALL FROM MADSEN'S NOTES																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	5650.0	5650.0	S	3	.4	0.1	999	90	999	999	9	9	C	C		1	1	6	
1	5650.7	5650.5	3	4	1.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5652.1	5652.0	S	3	.6	0.1	999	90	999	999	9	9	C	C		1	1	6	
1	5653.5	5653.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5655.8	5657.0	1	1	.1	0.1	999	90	999	999	9	9	C	C		3	3	4	
1	5658.5	5659.5	3	4	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5661.0	5662.0	1	1	.6	0.4	999	90	999	999	9	9	C	C		1	1	6	
	ALL FROM MADSEN'S NOTES																		
1	5670.5	5671.5	3	6	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5677.2	5677.5	S	3	1.5	0.2	999	90	999	999	9	9	C	C		1	1	6	
1	5692.0	5697.0	1	1	1.6	0.6	999	90	999	999	9	9	C	C		3	5	4	
	CLOSE TO EDGE OF CORE																		
1	5693.8	5698.0	N	4	.2	0.3	999	0	999	999	9	9	C	C		1	1	3	
	MAX. WIDTH OF SS CHUNK IS 0.1'																		
1	5694.2	5698.5	3	20	9.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5704.0	5707.0	1	1	1.6	0.4	999	90	999	999	9	9	C	C		3	3	3	
	STRANDED																		
1	5707.0	5710.0	1	1	.1	0.1	999	90	999	999	9	9	C	C		3	3	3	
	ONLY SEEN IN SLAB FACE																		
1	5710.4	5713.5	1	1	.8	0.8	999	90	999	999	9	9	C	C		3	1	3	
	DATA FROM MADSEN'S NOTES,ALL RUBBLE NOW																		
1	5712.0	5715.0	1	1	.1	0.1	999	90	999	999	9	9	C	C		1	1	3	
	ONLY SEEN ON ONE SIDE OF CORE																		
1	5730.4	5733.0	1	1	6.0	3.6	999	90	999	999	9	9	C	P	S	3	1	3	T
	FRACTURE DATA(WIDTH) PRIMARILY FROM MADSEN'S NOTES,STRANDED,OPEN IN PLACES,VUGGY FILL																		
1	5736.9	5739.5	3	13	5.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5739.7	5742.5	1	2	1.2	0.4	999	90	999	999	9	9	C	C		3	1	6	
	FROM MADSEN'S NOTES																		
1	5745.8	5749.0	2	1	.0	9999	999	5	999	999	9	-	999	9	9	2	2	6	
	@CARB LAM IN SILTST																		
1	5750.2	5753.0	3	1	.0	9999	999	20	999	999	9	9	999	9	9	2	2	7	
1	5750.6	5753.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5752.3	5755.5	2	1	.1	9999	999	15	999	999	9	-	C	P	S	2	2	4	
	SLIDE AND DUMP FILL, OPEN FRAC,BUMPY PLANE BUT REGULAR RIDGES,STYLOLITE??FRAC TYPE?																		
1	5754.1	5757.0	7	1	.0	1.0	999	0	999	999	9	9	C	C		2	2	3	
	VERY IRREGULAR PLANE FOLLOWS CONTACT BETWEEN SS & SILTST,WIDE VARIATIONS IN WIDTH																		
1	5754.8	5758.0	3	3	.8	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5757.0	5760.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5767.8	5771.0	3	3	.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5772.9	5775.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	5774.3	5776.5	1	1	.7	0.1	999	90	999	999	9	9	C	C		1	1	6	
	MOSTLY 2 PARALLEL STRANDS APPROX. ONE HALF INCH APART,PARALLEL TO PETAL BELOW																		
1	5774.7	5777.0	P	1	.1	9999	999	99	999	999	9	9	999	9	9	9	9	6	
	INIATION ANGLE 45 DEG.-CONCAVE UP																		
1	5775.4	5777.5	3	1	.3	9999	999	45	999	999	9	9	999	9	9	2	2	7	
	LARGER 3 TYPE																		
1	5777.0	5779.0	1	1	.8	0.2	999	90	999	999	9	9	C	C		4	5	3	
1	5785.5	5786.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5789.1	5790.0	3	11	4.9	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5794.0	5793.0	1	1	.2	0.1	999	90	999	999	9	9	C	C		1	1	6	
	MOSTLY 2 PARALLEL STRANDS																		
1	5795.0	5794.0	3	11	3.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5798.0	5797.0	D	1	2.9	9999	999	90	999	999	9	9	CB	C		7	7	3	T
	ORGA. AND CAL. FILL MOSTLY COMPLETE SOME GAPS,MULTISTRANDED,STRIKE W/10DEG FRAC @5811.4																		
1	5802.6	5804.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	SLKS 20DEG TO DOWNDIP																		
1	5810.4	5812.5	2	1	.0	9999	999	30	999	999	9	-	C	P		2	2	4	
	SLKS 40DEG. TO DOWNDIP,SMALL PATCHES OF CALCITE																		
1	5811.4	5813.0	1	1	1.5	0.2	999	90	999	999	9	9	C	C		5	3	4	
1	5811.7	5813.5	2	1	.0	9999	999	99	999	999	9	-	C	P	S	2	2	5	
	SLIDE & DUMP FILL, 45DEG BETWEEN EXT FRAC STRIKE AND THIS SLK BEAR,VERY IRREG PLANE																		
1	5815.8	5817.0	3	3	.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5817.2	5818.0	1	2	1.0	0.1	999	90	999	999	9	9	C	C		1	1	3	
	TWO PARALLEL FRACS APPROX. 2"APART,STRIKES PARALLEL TO PETALS BELOW																		
1	5818.1	5819.0	P	2	.2	9999	999	99	999	999	9	9	999	9	9	9	9	9	
	INIATION ANGLES 50 DEG.-CONVEX UP																		
1	5823.5	5825.5	P	1	.1	9999	999	99	999	999	9	9	999	9	9	9	9	9	
	INIATION ANGLE 60 DEG.-CONSTANT DIP																		
1	5826.2	5828.0	2	1	.0	9999	999	30	999	999	9	-	999	9	9	2	2	4	
	FRAC FOLLOW SFT SED. SWIRL,SLKS DOWNDIP																		
1	5841.7	5841.5	1	1	.8	0.5	999	80	999	999	9	9	C	C		3	3	3	T
	THINSECTION IS MARKED INCORRECTLY SHOULD BE 5841.8 NOT 5841.5																		
1	5845.0	5845.0	1	1	.1	0.1	999	90	999	999	9	9	C	C		3	3	7	
	SILTY MUDST,APPROX DEPTH DIFFICULT TO FIND																		
1	5845.5	5845.5	3	4	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5848.7	5848.5	3	3	.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5850.6	5850.5	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5852.0	5852.0	3	4	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5862.5	5861.5	3	4	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5863.9	5863.0	1	1	1.8	7.0	999	90	999	999	9	9	C	P	S	1	2	3	
	OPEN FRAC,STRANDED POSSIBLY TWO EPISODES OF CALCITE,WIDTH FROM MADSEN																		
1	5866.6	5865.5	1	1	4.2	7.0	999	90	999	999	9	9	C	P	S	7	1	3	S
	OPEN-WIDTH FR MADSEN SAMPLE OUT ONLY .4'LONG,FILL AS ABOVE,MAY BE RELATED TO FRAC ABOVE?																		
1	5871.7	5870.5	S	3	.2	0.2	999	90	999	999	9	9	C	C		1	1	3	
	FRACS PARALLEL TO FRAC@5866.6																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	5872.7	5871.5	1	1	.6	1.0	999	85	999	999	9	9	C	C		1	1	3	
	STRANDED																		
1	5875.0	5875.5	1	1	.9	0.2	999	90	999	999	9	9	C	C		3	3	3	
	WELL STRANDED PARALLEL TO FRACS ABOVE UP TO 5866.6																		
1	5886.6	5887.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5887.3	5887.5	1	1	.4	0.5	999	90	999	999	9	9	C	C		2	1	4	
	FRAC JUST SKIMS CORE,MAY BE END OF LARGER CALCITE FILLED FRAC																		
1	5888.6	5889.0	1	1	1.0	0.1	999	90	999	999	9	9	C	C		3	3	5	
	MULTI-STRANDED SOME VERT CARB MAT'L																		
1	5890.4	5890.5	1	1	1.0	5.0	999	85	999	999	9	9	C	P	S	3	2	5	
	STRANDED,OPEN FRAC VUGGY FILL-WIDTH FROM MADSEN																		
1	5892.4	5892.5	1	1	1.4	0.2	999	90	999	999	9	9	C	C		3	1	5	
	ROCKTYPE AS ABOVE STRANDED,PARALLEL TO FRAC ABOVE-5890.4																		
1	5896.9	5897.0	1	1	.5	1.2	999	75	999	999	9	9	C	P	S	2	6	3	
	PARALLEL TO FRACS ABOVE UP TO 5890.4,VUGGY FILL-WIDTH FROM MADSEN																		
1	5900.3	5900.5	1	1	.7	0.2	999	90	999	999	9	9	C	C		3	5	4	
	INTERLAMINATED MUD AND SILT,BOTTERM AT 0.2"CLAY PARTING,OPEN,FILL PATCHY ON EXPOSED PL																		
1	5904.4	5905.5	1	1	.3	0.1	999	90	999	999	9	9	C	C		5	3	2	
1	5916.0	5917.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5917.0	5918.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5921.1	5921.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5926.4	5925.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5937.6	5936.5	1	1	.4	0.2	999	90	999	999	9	9	C	C		5	5	2	
1	5973.6	5970.5	3	7	2.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5978.0	7976.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5986.4	5979.5	3	2	.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5988.3	5987.5	1	1	.2	0.1	999	85	999	999	9	9	D	C		3	3	5	
	SILT & MUD MIX, ONLY SEEN ON ONE SIDE OF CORE																		
1	5990.4	5988.5	3	2	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	5991.4	5989.5	1	1	1.9	4.0	999	90	999	999	9	9	C	P	S	1	3	1	
	OPEN FRAC-WIDTH FROM MADSEN																		
1	5996.0	5994.0	1	1	1.5	0.4	999	90	999	999	9	9	D	C		1	1	3	X
	MOSTLY 2 PARALLEL STRANDS																		
1	6002.1	5998.0	1	1	.7	1.0	999	80	999	999	9	9	C	C		2	1	3	
	MOSTLY 2 PARALLEL STRANDS																		
1	6003.0	5999.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6007.7	6003.5	1	1	2.8	3.8	999	85	999	999	9	9	QC	P	S	1	1	3	FT
	OPEN FRAC-WIDTH FROM MADSEN																		
1	6011.5	6007.5	3	4	.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6016.0	6012.0	3	5	1.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6021.5	6017.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	6022.4	6018.5	3	7	2.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6033.0	6029.0	1	1	1.1	3.0	999	80	999	999	9	9	QD	P	S	9	1	3	XS
	OPEN FRAC-WIDTH FROM MADSEN																		
1	6034.3	6030.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	SLICK BEARING ROUGHLY PARALLEL TO FRAC STRIKES @6033.0 AND 6035.7																		
1	6035.7	6031.5	1	1	1.0	8.0	999	90	999	999	9	9	QCD	P	S	1	5	3	
	CURVED PLANE,TOPTERM @SFT SED DEFOR FEA W/SLKS IN DIFF DIRECTIONS,OPEN-WIDTH FR MAD																		
1	6039.1	6035.0	3	6	1.1	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6047.2	6043.0	1	1	.4	0.8	999	90	999	999	9	9	DCB	P		1	1	3	TS
	VUGS IN FILL,CALC AND BARITE SEEN WITH SEM																		
1	6048.4	6044.5	1	1	.9	1.0	999	80	999	999	9	9	DC	P		1	1	4	
	SOME VUGS BUT MOSTLY COMPLETE FILL																		
1	6050.7	6046.5	1	1	.3	2.0	999	90	999	999	9	9	CD	P		1	1	3	
	VUGGY FILL																		
1	6054.9	6051.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6056.3	6052.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6060.0	6056.0	6	1	.1	9999	999	30	999	999	9	+	C	P	S	2	2	7	
	POLISHED,DIP AZIMUTH AND SLK AZIMUTH AT AN ANGLE OF APPROX. 50DEG.,MUDST-COALY																		
1	6075.7	6071.5	1	1	1.4	11.0	999	80	999	999	9	9	C	P	S	2	2	2	
	OPEN FRAC-WIDTH FROM MADSEN																		
1	6081.5	6077.5	1	1	1.1	0.6	999	90	999	999	9	9	D	C		1	1	5	
	MIXED MUDST & SILTST																		
1	6082.5	6078.5	8	2	.1	0.5	999	10	999	999	9	9	BD	C		2	3	5	
	FILL PARTIAL ON EXPOSED PLANE,PLANES NOT THRU CORE																		
1	6083.0	6079.0	3	3	.9	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	DEWATERING PIPE ABOVE																		
1	6084.4	6081.0	1	1	.1	0.1	999	90	999	999	9	9	C	C		1	1	5	
1	6086.1	6082.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6088.7	6085.0	1	1	.4	0.2	999	90	999	999	9	9	C	C		1	3	3	
1	6100.2	6096.0	1	1	.9	2.0	999	90	999	999	9	9	C	P		1	1	6	F
	VUGGY FILL																		
1	6106.9	6103.0	1	1	1.1	0.4	999	90	999	999	9	9	C	C		1	1	6	
1	6111.5	6107.5	3	7	1.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	DEWATERING PIPE ABOVE																		
1	6116.1	6112.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6117.9	6114.0	1	1	.6	0.4	999	90	999	999	9	9	C	C		1	1	5	
	MUDDY SS																		
1	6119.1	6115.0	2	1	.0	9999	999	5	999	999	9	-	C	P	S	2	2	6	
	OCCURS AT MUDST LAM																		
1	6123.3	6119.0	3	2	.1	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6124.3	6120.0	1	1	.4	0.8	999	90	999	999	9	9	D	P		1	1	3	
	VUGGY FILL, ONLY SEEN ON ONE SIDE OF CORE																		
1	6124.4	6120.5	1	1	.1	0.3	999	99	999	999	9	9	C	C		2	2	3	
	JUST BARELY SKIMMED CORE																		
1	6125.3	6121.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	6126.5	6122.5	3	14	2.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6127.1	6123.0	3	2	.1	9999	999	30	999	999	9	9	C	P	S	9	9	7	
	TYPE 3 WITH SUBHEDRAL CALCITE AND SLICKENCRYSTS, ALL PATCHY,PLANES ARE BROKEN UP																		
1	6129.0	6125.0	8	6	1.5	6.0	999	90	999	999	9	9	DC	P		1	1	5	
	BREC SS,SS & MUD MIX 0.1-6MM,SED FEATURES W/CAL&DIC, HORI TO VERTI,PART-COMP																		
1	6131.1	6127.0	8	6	1.7	3.0	999	90	999	999	9	9	DC	P		1	2	0	X
	DIP 0-90,PART- COMP FILL,0.1-3MM,MOTION ON ONE FRAC @BOTT CONTEMP W/LITHIFICATION																		
1	6131.9	6128.0	2	1	.0	9999	999	15	999	999	9	-	999	9	9	2	2	0	
	DOWNDIP SLKS,PLANAR, POLISHED																		
1	6133.2	6129.0	6	1	.0	9999	999	10	999	999	9	+	999	9	9	2	2	7	
	DOWNDIP SLKS,POLISHED VERY PLANAR																		
1	6134.4	6130.5	3	5	.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6134.9	6131.0	8	6	.9	5.0	999	90	999	999	9	9	DC	C		1	1	6	
	MIXED SILT/MUD, 0.1-5MM,DIP 40-90																		
1	6137.0	6133.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6143.6	6140.5	8	1	.0	2.0	999	10	999	999	9	9	DC	C		2	2	3	
	BEDDING CONTACT (SCOUR CONTACT)WITHIN SS																		
1	6146.0	6143.0	3	3	.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6146.6	6143.5	8	6	2.0	0.5	999	80	999	999	9	9	DCQ	C		1	3	6	XTS
	MUDDY SILTST,DIP 0-80 SOME FRACS FOLLOW BEDDING PLANES,0.1-0.5MM,INTERSECTING STRIKES																		
1	6149.3	6146.0	8	6	2.0	2.0	999	90	999	999	9	9	DC	C		3	1	6	
	MUDDY SILTST, DIP 0-90,0.2-2MM,BOT TERM @TYPE 6 (6151.1)																		
1	6149.6	6146.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6151.1	6148.0	6	1	.2	9999	999	35	999	999	9	+	D	P		2	2	7	
	WEB TYPE FRACS CONC 1"ABOVE THIS FRAC,OPEN FRAC,DOWNDIP SLKS,POLISHED																		
1	6151.2	6148.5	3	3	.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6151.8	6149.0	8	4	1.1	0.2	999	90	999	999	9	9	D	C		1	1	0	
	OCCASIONAL WEB TYPE FRACS,0-90,SOME FOLLOW BEDDING																		
1	6153.5	6150.5	8	1	.1	0.2	999	40	999	999	9	9	D	C		3	3	0	
1	6154.2	6151.0	8	1	.0	1.0	999	10	999	999	9	9	D	C		2	2	6	
	MUDDY SILTST																		
1	6158.5	6155.5	3	1	.5	9999	999	70	999	999	9	9	999	9	9	2	2	7	
1	6159.0	6156.0	3	10	3.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6164.8	6162.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6165.1	6162.0	3	1	.1	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6173.2	6170.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6174.5	6171.5	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6178.9	6176.0	2	1	.0	9999	999	30	999	999	9	-	999	9	9	2	2	4	
1	6187.0	6184.0	3	4	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6188.3	6185.5	8	6	1.6	2.0	999	50	999	999	9	9	BD	P		3	3	4	X
	(1)OPEN FRAC,0.1-2MM, DIP 0-50,SFT SED DEFORMATION PRESENT,BARITE XRAYED																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	6189.9	6187.0	2	1	.0	9999	999	20	999	999	9	-	CD	P	S	2	2	4	
	OPEN FRAC																		
1	6190.2	6187.5	8	1	.3	3.0	999	60	999	999	9	9	DC	P		2	2	3	X
	DICKITE IMPLIES STRIKE-SLIP MOTION-? OPEN FRAC																		
1	6190.5	6188.0	8	1	.3	3.0	999	60	999	999	9	9	DC	P		2	2	3	
	OPEN FRAC																		
1	6190.8	6188.5	2	1	.0	9999	999	0	999	999	9	-	D	P		2	2	4	
	LOOKS A LITTLE LIKE A TYPE 3 FRAC,HIGHLY POLISHED																		
1	6192.6	6189.5	1	1	.9	0.6	999	80	999	999	9	9	D	C		3	5	3	
1	6193.0	6190.0	2	1	.0	9999	999	0	999	999	9	-	BD	P		2	2	4	X
	INTERSECTS FRAC @6192.6,FILL CONTINUOUS BETW FRACS,SLKS IN 2 DIRECT,?DEPTH,BA-XRAYED																		
1	6193.9	6191.0	1	1	.8	0.2	999	90	999	999	9	9	C	C		5	3	4	
	MOSTLY COMP FILL, MAYBE SOME DICKITE TOO																		
1	6195.2	6192.0	1	1	.8	0.4	999	80	999	999	9	9	D	C		2	2	0	
	DIP 60-80,OFFSET @TYPE 2 BELOW,INTERSECTS FRAC TYPE 1@6195.4																		
1	6195.4	6192.5	2	1	.0	9999	999	0	999	999	9	-	999	9	9	2	2	0	
	NO FILL,FRAC ABOVE MAY BE OFFSET-NOT CERTAIN																		
1	6195.4	6192.5	1	1	1.5	0.3	999	80	999	999	9	9	C	C		5	5	3	
	STRANDED,STRIKE 50D OFF STR OF FRAC@6195.2,MAYBE SOME DICKITE,POSS OFFSET@6195.2FRAC																		
1	6197.1	6194.0	2	1	.0	9999	999	5	999	999	9	-	D	P		2	2	4	
	OPEN FRAC																		
1	6197.7	6194.5	2	1	.0	9999	999	10	999	999	9	-	999	9	9	2	2	4	
	SLKS ACROSS MOST OF THIS BUMPY PLANE																		
1	6197.7	6194.5	8	6	.9	2.0	999	75	999	999	9	9	DC	C		5	3	6	
	TOP @6197.7 SHEAR,DIP 50-75,0.1-2MM																		
1	6201.5	6198.5	3	6	1.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6203.5	6200.5	2	1	.1	9999	999	20	999	999	9	+	C	P		2	2	4	
	VERY PLANAR,OPEN FRAC,SLKS IN 2 DIFFERENT DIRECTIONS																		
1	6206.9	6204.0	3	1	.0	9999	999	30	999	999	9	9	CD	P		9	9	7	
1	6210.0	6207.0	3	2	.2	9999	999	10	999	999	9	9	D	P		9	9	7	
	NO POSITIVE ID ON THE DICKITE																		
1	6217.5	6214.5	3	2	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6219.8	6217.0	3	1	.0	9999	999	5	999	999	9	9	CD	P		2	3	7	
1	6225.0	6221.5	3	4	.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6233.8	6230.0	3	6	.7	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6242.0	6238.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6242.9	6239.0	8	2	.2	0.3	999	30	999	999	9	9	D	C		3	3	6	
	SILTST WITH MUD LAMS INDIVID FRACS TERM WITHIN LITH AND OUT CORE-ZONE CONFINED TO LITH																		
1	6243.2	6239.5	3	3	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6243.2	6239.5	3	1	.0	9999	999	0	999	999	9	9	B	P		9	9	7	
	FILL OCCURS AS PATCH ON ONE PLANE,NO POSITIVE ID ON BARITE																		
1	6248.5	6244.5	2	1	.0	9999	999	20	999	999	9	-	999	9	9	2	3	4	
	AT ONE EDGE LAM ENDS IN SS AND SLKS TERM																		
1	6249.2	6245.0	1	1	1.3	10.0	999	90	999	999	9	9	QBC	P	S	5	2	3	X
	OPEN FRAC,BARITE(XRAY) AND POSS. DICKITE, FINE QTZ CRYSTALS MOSTLY,MINOR CALC,WIDTH EST.																		
1	6259.0	6254.0	3	11	6.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	6269.2	6264.0	3	14	2.8	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6274.7	6269.5	3	4	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6275.5	6270.5	3	4	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6278.0	6273.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6279.4	6274.5	3	3	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6289.0	6284.0	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6300.7	6296.0	3	7	3.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6311.0	6307.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6312.4	6310.5	8	6	.3	4.0	999	90	999	999	9	9	DC	C		3	3	7	
	CALCAREOUS SILTY MUDST, DIP 70-90,0.1-4MM,TWO DISTINCT PHASES OF MINERALIZATION																		
1	6325.5	6322.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6328.0	6325.0	3	7	1.1	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6328.5	6325.5	7	1	.0	5.0	999	10	999	999	9	9	C	C		2	2	7	
	DEPTH IS APPROX., ASSOCIATED WITH COALY MATERIAL																		
1	6358.7	6353.5	1	1	.3	0.8	999	85	999	999	9	9	C	C		5	2	3	
	FRAC JUST BARELY SKIMS CORE																		
1	6365.7	6360.5	1	1	1.1	0.3	999	90	999	999	9	9	C	C		1	1	3	
1	6367.5	6362.5	3	4	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6373.0	6368.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6376.6	6370.5	3	8	2.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6392.3	6387.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6395.3	6389.5	3	4	.1	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6396.5	6390.5	7	1	.0	9999	999	10	999	999	9	9	B	P		2	2	3	
	OPEN FRAC,FILL TYPE NOT CONFIRMED,PARALLEL TO FRAC @6396.7																		
1	6396.6	6390.5	1	1	.2	1.0	999	90	999	999	9	9	D	C		3	3	3	
	BOTTOM TERM @ FRAC AT 6396.8 BELOW																		
1	6396.8	6391.0	7	1	.0	9999	999	10	999	999	9	9	B	P		2	2	3	
	OPEN FRAC,FILL TYPE NOT CONFIRMED,PARALLEL TO FRAC @6396.4																		
1	6397.4	6391.5	3	4	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6399.0	6394.0	1	1	2.9	0.2	999	90	999	999	9	9	C	C		1	1	2	
1	6406.6	6403.0	3	5	1.8	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6410.7	6406.5	3	3	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6414.1	6410.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6418.0	6414.0	3	5	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	6430.4	6429.0	2	1	.0	9999	999	10	999	999	9	-	C	P	S	2	2	6	
	MUDDY SILTST SLKS ACROSS MOST OF PLANE																		
1	6465.0	6462.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6490.6	6487.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6501.4	6499.5	2	1	.0	9999	5	10	95	95	9	-	999	9	9	2	2	4	
	OPEN FRAC, ROUGH PLANE																		
1	6525.1	6523.0	1	1	.7	0.2	290	90	999	999	9	9	C	C		2	2	3	
	FRAC JUST BARELY SKIMS CORE,WIDTH QUESTIONABLE																		
1	6556.0	6554.0	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6557.5	6556.0	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6561.0	6561.0	3	6	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6584.3	6588.0	7	1	.0	9999	999	0	999	999	9	9	C	P		2	2	4	
	OPEN FRAC,PARTIALLY FOLLOWS MUDST LAM,FILL PATCHY																		
1	6584.7	6588.5	7	1	.2	1.4	999	30	999	999	9	9	C	P		2	3	4	
	MULTIPLE STRANDS FOLLOWING MUDST LAMINATIONS,0.1-1.4MM,FILL VUGGY																		
1	6584.9	6589.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6588.5	6592.5	3	5	.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6593.0	6597.0	3	4	.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6594.0	6598.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6595.6	6499.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6597.5	6600.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6603.4	6606.0	7	1	.0	2.0	999	0	999	999	9	9	C	C		2	2	8	
	VERY DISCONTINUOUS ROUGHLY 4 STRANDS,0.1-2.0																		
1	6604.0	6606.5	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6606.5	6608.5	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6609.0	6611.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6613.7	6614.5	3	2	.1	2.0	999	0	999	999	9	9	999	9	9	9	9	7	
	VERY PLANAR,POLISHED																		
1	6613.7	6614.5	7	1	.1	2.0	999	0	999	999	9	9	C	C		3	3	7	
	COALY MUDST,FRAC ZONE IS CONFINED TO LITH,(3)STRANDS DISCONTINUOUS,ONE END-OUTCORE?																		
1	6623.7	6620.5	3	2	.0	9999	999	99	999	999	9	9	999	9	9	2	2	7	
1	6630.2	6627.0	2	1	.0	9999	999	0	999	999	9	-	999	9	9	2	2	4	
	SLKS COVER MOST OF PLANE																		
1	6630.7	6627.5	2	1	.0	9999	999	0	999	999	9	+	999	9	9	2	2	4	
1	6633.9	6631.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6634.5	6631.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6634.6	6631.6	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	6637.4	6634.5	3	3	.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6661.5	6658.5	7	3	.6	2.0	999	0	999	999	9	9	CQ	P	S	2	2	5	
	PARALLEL TO BEDDING COMP-PART OPEN ,ZONE CONFINED TO LITH,STRANDED,0.1-2.0+,SOME DISCONT.																		
1	6662.5	6659.5	1	2	.4	0.1	999	90	999	999	9	9	C	C		3	3	3	
	TWO PARALLEL FRACS SANDSTONE IS PREDOMINANT LITHOLOGY																		
1	6662.7	6659.7	4	1	.0	9999	999	20	999	999	S	+	C	P	S	2	2	5	F
	SLICKENCRYSTS,IRREGULAR PLANE,FRAC @6662.5 INTERSECTS THIS FRAC W/NO APPARENT OFFSET																		
1	6663.0	6660.0	P	3	.4	9999	999	35	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLES 35DEG CONSTANT DIP,,PARALLEL FRAC @6662.5 & 60 DEG. OFF SLK BEARING @6662.7																		
1	6665.0	6662.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6680.4	6677.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6684.0	6681.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6688.0	6685.0	P	1	.1	9999	999	99	999	999	9	9	999	9	9	9	9	6	
	INIATION ANGLE 50 DEG.-CONSTANT DIP																		
1	6695.9	6693.0	3	4	.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6710.9	6709.0	1	1	2.7	0.5	330P	90	999P	999P	9	9	C	C		7	1	3	
	FRAC CROSSES THE TWO SHEAR FRACS DESCRIBED BELOW,ORIENTATION FROM PALEOMAG																		
1	6712.4	6710.5	4	1	.2	9999	290P	40	20P	110P	S	+	DQ	P		3	2	3	XS
	NIETHER STRIKE OR SLKS ARE PARAL.TO FRAC@6710.9-NO APP OFFSET,TR QTZ SEEN IN XRAY,ORIEN-PALEO																		
1	6712.8	6711.0	2	1	.0	9999	35	10	125	110	9	-	C	P	S	2	2	4	
	VERY PLANAR,SLICKS CURVED,SLICKENCRYSTS,ORIENT FROM PALEOMAG,NO APP. OFFSET OF TYPE 1																		
1	6715.0	6713.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6715.5	6713.5	1	1	1.2	0.2	999	90	999	999	9	9	C	C		2	2	4	S
	FRAC IS OFFSET AT COALY SHARD,FILL LOOKS PATCHY ON EXPOSED PLANE																		
1	6718.1	6716.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6718.3	6716.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6719.0	6717.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6743.0	6741.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6748.0	6746.0	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6749.3	6747.5	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6759.7	6757.5	D	1	2.0	9999	999	99	999	999	S	-	999	9	9	9	9	9	
	SOME APPARENT STRIKE/SLIP MOTION																		
1	6762.7	6760.5	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6764.2	6762.0	3	5	.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6776.7	6774.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6789.5	6787.5	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6790.2	6788.0	3	2	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
1	6797.7	6795.5	7	1	.1	1.0	999	25	999	999	9	9	C	C		2	3	6	
	MUDDY SILTST, DIP 0-25																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
1	6798.2	6796.0	2	1	.2	4.0	999	50	999	999	9	-	C	P	S	2	2	6	
	MUDDY SILTST, SLICKENCRYSTS,SLKS ROUGHLY DOWNDIP																		
1	7881.0	7879.0	P	1	.2	9999	272	40	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 30 DEG.-CONVEX UP																		
1	7881.6	7879.5	P	1	.1	9999	999	99	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 50 DEG.-CONVEX UP																		
1	7881.7	7879.7	P	1	.1	9999	267	50	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE ??																		
1	7882.8	7880.5	P	1	.1	9999	274	50	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 45 DEG.-CONVEX UP																		
1	7884.0	7882.0	P	1	.1	9999	274	40	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 25 DEG.-CONVEX UP																		
1	7884.1	7882.1	P	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 40 DEG.-CONCAVE UP																		
1	7884.9	7883.0	P	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 15 DEG.-CONVEX UP																		
1	7886.0	7884.0	P	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 20 DEG.-CONVEX UP																		
1	7886.3	7884.5	P	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 40 DEG.-CONVEX UP																		
1	7886.6	7884.6	P	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 35 DEG.-IRREGULAR																		
1	7892.1	7890.0	P	1	.1	9999	271	80	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 65 DEG.-??																		
1	7896.9	7895.0	P	1	.1	9999	281	80	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 45 DEG.-CONVEX UP																		
1	7903.7	7902.0	1	1	.9	0.5	280	90	999	999	9	9	Q	C		2	1	3	T
1	7903.7	7902.0	1	1	.9	0.2	295	90	999	999	9	9	Q	C		1	1	3	T
	LISTED SEPARATELY FROM FRAC ABOVE BECAUSE OF CHANGE IN STRIKE,FILL PATCHY ON EXPOSED PL.																		
1	7904.1	7902.0	P	5	.5	9999	311	60	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 50 DEG.-CONSTANT DIP																		
1	7913.0	7910.0	3	1	.0	9999	999	0	999	35	9	9	Q	P	S	2	2	7	S
	SUBHEDRAL QTZ IN PATCHES ON VERY IRREGULAR PLANE,OPEN FRAC																		
1	7916.1	7913.0	P	1	.1	9999	288	30	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 40 DEG.-CONCAVE UP																		
1	7916.5	7913.5	P	1	.1	9999	288	30	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 35 DEG.-CONCAVE UP																		
1	7916.8	7914.0	P	1	.1	9999	288	30	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 40 DEG.-CONVEX UP																		
1	7920.8	7918.0	2	1	.0	9999	250	5	340	45	9	-	999	9	9	2	2	4	
	SLKS COVER MOST OF PLANE																		
1	7921.9	7919.0	2	1	.0	9999	250	10	340	40	9	-	999	9	9	2	2	4	
1	7942.1	7939.0	2	1	.0	9999	295	10	25	25	9	-	999	9	9	2	2	4	
1	7948.3	7945.5	2	1	.0	9999	999	0	999	57	9	-	999	9	9	2	2	4	
1	7949.7	7946.5	3	1	.0	9999	58	5	310	50	9	9	999	9	9	2	2	7	
	REALLY AT CONTACT BETWEEN SS AND MUDST																		
2	4873.0	4863.0	3	6	4.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	4877.0	4867.0	3	6	2.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	4917.4	4906.5	1	1	.3	0.5	999	80	999	999	9	9	C	C		2	5	3	
	BOTTERM AT SED FEAT WITH BLK ORGA MAT'L AND PATCHES OF CALC.(FRAC?)NO USABLE MULTISHOT DATA																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
2	4922.0	4911.0	3	3	2.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	4925.0	4914.0	3	3	1.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	4948.5	4935.0	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5566.6	5568.0	7	1	.2	2.0	999	40	999	999	9	9	C	C		2	2	2	
2	5567.0	5568.5	1	1	.6	10.2	999	85	999	999	9	9	QC	P	S	2	3	2	TF
	BOTTERM AGAINST FRAC @5567.6 BELOW,OPEN FRAC,WIDTH ESTIMATED																		
2	5567.6	5569.0	7	1	.1	9999	999	30	999	999	9	9	Q	P	S	2	2	2	
	TYPE FRAC?,OPEN FRAC																		
2	5568.0	5569.5	1	1	4.0	10.0	999	90	999	999	9	9	QC	P	S	7	7	2	TS
	OPEN FRAC,SECTION OF CORE IS BROKEN-A NUMBER OF MISSING PIECES,WIDTH ESTIMATED																		
2	5701.0	5791.0	2	1	.3	9999	999	45	999	999	9	-	999	9	9	2	2	4	
2	5705.0	5795.0	3	1	.0	9999	999	10	999	999	9	9	999	9	9	9	9	7	
	SLICK BEARING PARALLEL TO FRAC STRIKE AT 5705.4																		
2	5705.3	5795.5	2	1	.1	9999	999	30	999	999	9	-	999	9	9	2	2	4	
	SLICK BEARING PARALLEL TO FRAC STRIKE AT 5705.4																		
2	5705.4	5795.6	1	1	.3	0.4	999	80	999	999	9	9	C	C		1	2	3	
	STRIKE PARALLEL TO SLICK BEARING ABOVE																		
2	5708.0	5798.0	3	8	4.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5717.0	5708.0	3	6	1.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5718.2	5709.0	1	3	1.4	0.6	999	90	999	999	9	9	C	C		1	1	3	
2	5721.2	5712.0	1	1	.3	0.6	999	80	999	999	9	9	C	C		3	2	3	
2	5741.5	5732.5	1	1	.5	1.0	999	90	999	999	9	9	C	P		3	4	4	
	VUGGY FILL																		
2	5743.3	5734.5	1	1	3.5	7.0	999	90	999	999	9	9	QC	P	S	5	2	3	FT
	STRIKE CHANGES 40 DEG @ SOFT SEDI DEFORM FEAT AND DIP IS IRRATIC HERE, OPEN-WIDTH FR MADSEN																		
2	5748.4	5739.5	3	4	.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5748.5	5739.6	6	1	.3	9999	999	50	999	999	9	+	999	9	9	2	2	7	
	POLISHED,DOWNDIP SLKS, VERY PLANAR																		
2	5750.4	5741.5	1	1	1.8	1.2	999	90	999	999	9	9	C	P	S	1	1	3	
	MULTISTRANDED, SOME OUT OF CORE,PART-COMP FILL-SOME SUBHEDRAL FILL IN VUGS																		
2	5756.0	5747.0	3	8	1.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5761.5	5752.5	1	1	3.5	8.0	300P	90	999P	999P	9	9	QC	P	S	1	1	3	FT
	STRIKE FROM PALEOMAG WIDTH FROM MADSEN																		
2	5765.6	5756.5	3	9	11.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5775.9	5767.0	1	1	.8	1.0	999	90	999	999	9	9	C	C		1	1	3	
2	5777.3	5768.5	3	8	2.2	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5779.6	5770.5	1	1	2.7	2.0	999	90	999	999	9	9	C	P	S	1	1	3	
	VUGGY FILL WIDTH FROM MADSEN																		
2	5793.6	5784.5	1	1	2.1	1.4	999	85	999	999	9	9	C	P	S	2	4	3	
	MULTI-STRANDED, OFFSET ACROSS MUDST PARTINGS,VUGGY FILL-WIDTH FROM MADSEN,MINOR SUBHEDRAL																		
2	5798.2	5799.0	3	15	7.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
2	5806.4	5796.5	1	1	.8	0.2	999	90	999	999	9	9	C	C		1	1	6	
2	5807.7	5797.5	3	10	6.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5814.1	5803.0	1	1	.5	0.4	999	90	999	999	9	9	C	P		1	1	3	
VUGGY FILL,?SUBHEDRAL																			
2	5817.8	5807.0	1	1	.4	0.2	999	90	999	999	9	9	C	C		3	3	3	
ONLY SEEN ON ONE SIDE OF WHOLE CORE																			
2	5825.0	5814.0	3	5	.4	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5826.2	5815.0	1	1	2.7	1.5	999	85	999	999	9	9	C	P	S	1	6	3	
MULTI-STRANDED,TOP TERM @ SILTST CONTACT,VUGGY FILL																			
2	5832.9	5823.0	1	1	.4	0.3	999	90	999	999	9	9	C	C		6	1	3	
WORM BURROW AT TERM OF FRAC,FRAC THINS & TERMS AS MUDST LAMS MORE NUMEROUS																			
2	5849.6	5839.5	2	1	.0	9999	999	25	999	999	9	-	999	9	9	2	2	4	
45 DEGREES BETWEEN DOWNDIP AND SLICK BEARING																			
2	5850.3	5840.5	2	1	.0	9999	999	15	999	999	9	-	999	9	9	2	2	4	
VERY SUBTLE SLKS																			
2	5850.8	5841.0	3	2	.0	9999	999	15	999	999	9	9	999	9	9	2	2	7	
VERY IRREG PLANE @MUDST-SS CONTACT																			
2	5852.5	5842.5	1	1	.4	0.2	999	90	999	999	9	9	C	C		3	1	0	
ONLY SEEN ON ONE SIDE OF CORE																			
2	5853.0	5843.0	3	6	3.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5858.4	5848.5	3	4	.1	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	5858.8	5849.0	1	1	.8	0.2	999	90	999	999	9	9	C	C		3	3	0	
2	5864.8	5855.0	3	8	.7	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	6401.9	6398.0	3	13	6.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	6427.3	6423.5	1	1	.7	0.5	999	90	999	999	9	9	C	C		3	3	3	
TWO STRANDS OFFSET AT CARB. LAM																			
2	6439.8	6436.0	7	1	.0	0.2	999	5	999	999	9	9	C	C		2	2	3	
2	6461.6	6457.5	2	1	.0	9999	999	30	999	999	9	-	999	9	9	2	2	4	
SLKS DOWNDIP																			
2	6465.2	6461.0	2	1	.0	9999	999	45	999	999	9	-	999	9	9	2	2	4	
SLKS DOWNDIP- COVER MOST OF PLANE																			
2	6496.3	6490.0	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	6496.4	6490.5	3	1	.0	9999	348	40	258	258	9	9	999	9	9	9	9	7	
IRREGULAR PLANE																			
2	6496.5	6490.6	3	1	.0	9999	358	40	88	88	9	9	999	9	9	9	9	7	
IRREGULAR PLANE																			
2	6523.5	6516.0	2	1	.3	9999	75	50	165	165	9	+	C	P		2	2	4	T
OPEN FRAC, FILL SEEN ONLY IN THINSECTION																			
2	6541.2	6535.0	1	1	.9	0.5	275	90	999	999	9	9	C	C		5	3	3	
BOT TERM WITHIN SS WITH ABUND ORGA LAMS																			
2	6559.5	6553.5	3	1	.0	9999	290	20	200	220	9	9	999	9	9	2	2	7	
ORIENTATION DATA QUESTIONABLE BECAUSE OF UNSPECIFIED BREAK																			
2	6560.0	6564.0	3	1	.0	9999	360	30	90	90	9	9	999	9	9	2	2	7	
ORIENTATION DATA QUESTIONABLE BECAUSE OF UNSPECIFIED BREAK																			
2	7081.0	7069.0	3	1	.8	9999	999	70	999	999	9	9	999	9	9	2	2	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
2	7122.2	7114.0	1	1	4.0	10.0	270P	80	999P	999P	9	9	Q	P	S	2	3	3	FTS
	MICROSCOPIC QTZ NUCLEATED ON SS GRAINS,OPEN-WIDTH EST., RUBBLIZED CORE,WEAK PALEOMAG																		
2	7170.4	7162.0	3	1	.2	9999	999	99	999	999	9	9	999	9	9	2	2	7	
	MORE PLANAR FRAC																		
2	7181.1	7173.0	1	1	1.7	1.0	290P	90	999P	999P	9	9	QC	P	S	3	5	3	TF
	STRANDED,VUGGY FILL SOME ORGANIC MATERIAL IN FRAC ALSO																		
2	7182.8	7175.0	B	1	.2	9999	999	90	999	999	9	9	999	9	9	9	9	6	
2	7188.5	7180.5	3	5	1.8	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	7193.0	7185.0	3	4	.3	9999	999	99	999	999	9	9	999	9	9	9	9	7	
2	7217.3	7208.5	1	1	.4	0.1	999	90	999	999	9	9	C	C		5	5	3	T
	TERMS @ IRREGULAR MUDST LAMS,MICROPROBE ANALYSIS																		
2	7218.6	7209.5	1	1	.7	0.5	999	90	999	999	9	9	C	C		2	5	3	T
	STRANDED																		
2	7243.7	7233.5	B	1	.2	9999	999	90	999	999	9	9	999	9	9	9	9	7	
2	7256.2	7246.0	P	2	.2	9999	999	99	999	999	9	9	999	9	9	9	9	3	
	EACH 0.1'LONG INIATION ANGLES 55 DEG.-CONCAVE UP																		
2	7256.3	7246.5	7	1	.1	0.1	999	30	999	999	9	9	C	C		3	3	3	
	TWO FRACS SEEN ON ONE SIDE OF WHOLE CORE																		
2	7257.0	7247.0	B	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	4	
	APPROX. DEPTH																		
2	7279.0	7269.0	1	1	.5	0.5	999	90	999	999	9	9	C	C		2	3	4	
	@BOTTERM MUDST LAMS WIDER AND MORE FREQUENT																		
2	7279.5	7269.5	B	1	.1	9999	999	90	999	999	9	9	999	9	9	9	9	0	
2	7293.8	7284.0	B	1	1.0	9999	999	90	999	999	9	9	999	9	9	9	9	7	
	FRAC MAY BE LONGER																		
2	7315.2	7305.0	1	1	.4	0.1	999	90	999	999	9	9	C	C		1	1	3	
	FILL LOOKS PARTIAL ON EXPOSED PLANE																		
2	7316.0	7306.0	B	1	.4	9999	999	90	999	999	9	9	999	9	9	9	9	6	
	APPROX. DEPTH, SANDY MUDST																		
2	7316.6	7306.5	7	1	.1	9999	999	30	999	999	9	9	QC	P	S	2	2	0	
	IRREGULAR PLANE 5-30DEG,PATCHY FILL,OPEN FRAC																		
2	7327.1	7317.0	2	1	.0	9999	999	30	999	999	9	-	999	9	9	2	2	4	
2	7327.7	7317.5	2	1	.0	9999	999	20	999	999	9	-	999	9	9	9	9	4	
	SLKS COVER MOST OF PLANE																		
2	7330.7	7320.5	B	1	.3	9999	999	90	999	999	9	9	999	9	9	9	9	3	
2	7332.8	7323.0	B	1	.2	9999	999	90	999	999	9	9	999	9	9	9	9	3	
2	7339.6	7329.5	B	1	.1	9999	999	99	999	999	9	9	999	9	9	9	9	3	
	APPROX. DEPTH																		
2	7348.5	7338.5	1	1	.5	0.2	999	90	999	999	9	9	C	C		1	1	3	T
	SEEN ONLY IN SLAB FACE																		
2	7355.3	7345.5	2	1	.1	9999	999	30	999	999	9	-	999	9	9	2	2	4	
2	7368.4	7358.5	1	1	.7	0.1	999	90	999	999	9	9	C	C		6	3	3	
	TOPTERM AT CONTACT WITH SS W/MUDST SHARDS																		
2	7838.6	7831.5	2	1	.0	9999	20	5	290	300	9	-	999	9	9	2	2	4	
2	7838.9	7832.0	2	1	.0	9999	20	5	290	285	9	-	999	9	9	2	2	4	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
2	7841.2	7834.0	2	1	.0	9999	999	5	999	10	9	-	Q	P	S	2	2	4	
	OPEN FRAC,PATCHY FILL GENERALLY ROUGH PLANE																		
2	7841.8	7835.0	2	1	.0	9999	999	0	999	82	9	-	999	9	9	2	2	4	
2	7842.8	7836.0	2	1	.0	9999	999	0	999	275	9	-	999	9	9	2	2	4	
2	7843.2	7836.5	B	1	.5	9999	262	90	999	999	9	9	999	9	9	3	3	4	
2	7843.9	7837.0	2	1	.1	9999	185	20	275	275	9	-	Q	P	S	2	2	4	FS
	OPEN FRAC,PATCHY FILL																		
2	7845.1	7838.0	2	1	.0	9999	10	10	280	280	9	-	999	9	9	2	2	4	
2	7850.7	7844.0	2	1	.0	9999	325	5	55	275	9	-	999	9	9	2	2	4	
2	7852.2	7845.0	2	1	.0	9999	999	0	999	85	9	-	999	9	9	2	2	4	
2	7852.4	7845.5	2	1	.0	9999	285	15	15	295	9	-	999	9	9	2	2	4	
2	7869.8	7863.0	P	1	6.8	9999	325	90	999	999	9	9	999	9	9	9	9	3	
	SMALLER (0.2')PETALS ARE PARALLEL TO AND ASSOC W/FRAC,INIATION ANGLES 60-85DEG.,CONVEX UP																		
2	7877.2	7870.0	P	2	.4	9999	323	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLES 80 DEG.-CONVEX UP,FRACS ON OPPOSITE SIDES																		
2	7879.5	7872.5	P	1	.1	9999	318	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 80DEG CONSTANT DIP																		
2	7880.1	7873.0	P	1	.1	9999	323	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE ?																		
2	7880.5	7873.5	P	1	.7	9999	322	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 80 DEG -CONSTANT IRREG.																		
2	7882.2	7875.0	P	1	1.6	9999	327	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE ?																		
2	7884.0	7877.0	P	1	.3	9999	147	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 80DEG																		
2	7885.3	7878.0	P	1	.2	9999	321	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 80DEG																		
2	7885.7	7878.5	P	1	.2	9999	321	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 80DEG																		
2	7886.6	7879.5	P	1	.1	9999	326	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 80DEG																		
2	7888.6	7881.5	P	1	.2	9999	325	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 80DEG																		
2	7889.0	7882.0	P	1	.1	9999	320	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 80DEG																		
2	7889.3	7882.5	P	1	.1	9999	335	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 80DEG																		
2	7891.2	7884.0	P	1	2.3	9999	325	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 80DEG																		
2	7891.2	7884.0	B	1	.2	9999	264	90	999	999	9	9	999	9	9	9	9	3	
2	7891.2	7884.0	B	1	.4	9999	274	90	999	999	9	9	999	9	9	9	9	3	
2	7893.8	7887.0	B	1	.3	9999	253	90	999	999	9	9	999	9	9	9	9	3	
2	7895.1	7888.0	B	1	.3	9999	283	90	999	999	9	9	999	9	9	9	9	3	
2	7895.5	7888.5	P	1	.2	9999	328	90	999	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 55DEG- CONVEX UP																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
2	7895.8	7889.0	P	1	.1	9999	333	90	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 55DEG- CONVEX UP																			
2	7896.2	7889.2	2	1	.0	9999	5	10	275	275	9	-	999	9	9	2	2	4	
2	7896.4	7889.5	2	1	.0	9999	295	10	25	275	9	-	999	9	9	2	2	4	
2	7897.9	7891.0	2	1	.0	9999	999	5	999	999	9	-	999	9	9	2	2	4	
2	7898.1	7891.2	2	1	.0	9999	999	15	999	999	9	-	999	9	9	2	2	4	
2	7903.2	7896.0	2	1	.0	9999	345	10	75	75	9	-	999	9	9	2	2	4	
2	7903.4	7896.5	P	1	.9	9999	343	90	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 65DEG CONSTANT DIP																			
2	7903.7	7896.7	P	1	.1	9999	358	90	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 65DEG CONSTANT DIP																			
2	7903.9	7897.0	P	1	.1	9999	3	90	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 65DEG CONSTANT DIP																			
2	7904.2	7897.2	P	1	.1	9999	3	90	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 65DEG CONSTANT DIP																			
2	8101.4	8094.5	6	1	.0	9999	999	0	999	10	9	+	999	9	9	2	2	7	
ORIENTATION DATA VARIES 20-25 DEG. ON A STRAIGHT SCRIBE,POLISHED																			
2	8112.6	8104.5	1	1	2.7	2.0	85	90	999	999	9	9	QC	C		3	7	3	TF
2	8118.6	8110.5	2	1	.0	9999	295	20	25	50	9	-	999	9	9	2	2	4	
2	8121.6	8113.5	2	1	.0	9999	290	15	20	50	9	-	999	9	9	2	2	4	
VERY FAINT SLKS																			
2	8122.8	8114.5	3	1	.0	9999	270	30	360	360	9	9	999	9	9	2	2	7	
2	8122.9	8115.0	3	1	.0	9999	999	0	999	60	9	9	999	9	9	2	2	7	
2	8123.1	8115.5	3	1	.0	9999	80	15	350	55	9	9	999	9	9	2	2	7	
2	8123.2	8115.6	3	1	.0	9999	10	10	280	60	9	9	999	9	9	2	2	7	
2	8123.3	8115.7	3	1	.0	9999	80	5	350	360	9	9	999	9	9	9	9	7	
2	8123.3	8115.7	3	1	.0	9999	310	30	40	70	9	9	999	9	9	9	9	7	
2	8123.3	8115.8	S	3	.2	4.0	330	90	999	999	9	9	HQC	P	S	3	3	7	TFS
SILTY MUDST,70-90DEG SOME FRAC STRANDS COMPLETELY FILLED,VUGGY FILL																			
2	8123.9	8116.0	6	1	.3	9999	340	50	70	60	9	+	999	9	9	2	2	0	
VERY PLANAR, CROSSCUTS BEDDING,TYPE QUESTIONABLE,PLANE IS POLISHED AND BLACK																			
2	8124.2	8116.5	1	1	.5	10.0	345	90	999	999	9	9	HQC	P	S	2	3	0	TXS
SKIMS EDGE OF CORE, OPEN FRAC-WIDTH ESTIMATED																			
2	8124.9	8117.0	3	1	.0	9999	90	12	360	60	9	9	999	9	9	2	2	7	
THIS FRAC ALSO HAS SLICKS ORIENTED 358																			
3	4887.1	4887.0	P	2	.3	9999	277	90	999	999	9	9	999	9	9	9	9	9	
INIATION ANGLE 65DEG CONCAVE UP																			
3	4903.7	4903.5	1	1	.4	0.2	140	90	999	999	9	9	C	C		5	3	0	
FRAC IS ONLY VISIBLE ON ONE SIDE OF CORE -ONLY .5"INTO CORE-STRIKE QUESTIONABLE																			
3	4904.0	4904.0	B	1	.0	9999	140	99	999	999	9	9	999	9	9	9	9	0	
SCRIBELINE FRAC PARALLEL TO EXT. FRAC ABOVE																			
3	4923.0	4923.0	3	6	5.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
3	5690.8	5697.0	P	1	.1	9999	105	99	15	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 50DEG CONSTANT DIP																		
3	5692.1	5698.0	P	1	.1	9999	95	99	5	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 60DEG CONSTANT DIP																		
3	5692.3	5698.5	P	1	.3	9999	85	99	175	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 70DEG CONSTANT																		
3	5692.6	5699.0	P	1	.2	9999	105	99	195	999	9	9	999	9	9	9	9	3	
	INIATION ANGLE 70DEG CONSTANT DIP																		
3	5693.4	5699.5	3	1	.2	9999	65	35	155	155	9	9	999	9	9	9	9	7	
3	5693.4	5699.5	3	1	.2	9999	315	40	225	225	9	9	999	9	9	9	9	7	
3	5693.7	5700.0	3	1	.2	9999	35	45	125	135	9	9	999	9	9	9	9	7	
3	5693.7	5700.0	3	1	.2	9999	45	50	315	315	9	9	999	9	9	9	9	7	
3	5693.9	5700.5	3	1	.0	9999	55	50	145	135	9	9	999	9	9	9	9	7	
3	5693.9	5700.5	3	1	.0	9999	345	20	255	255	9	9	999	9	9	9	9	7	
3	5693.9	5700.5	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5694.7	5701.0	3	1	.0	9999	10	45	280	280	9	9	999	9	9	9	9	7	
3	5695.0	5701.5	3	6	2.6	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5698.0	5704.0	3	1	.0	9999	999	60	999	999	9	9	999	9	9	9	9	7	
	DOWNDIP SLKS																		
3	5699.0	5705.0	3	6	.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5699.5	5705.5	3	1	.0	9999	5	20	275	275	9	9	999	9	9	9	9	7	
3	5699.7	5705.7	3	1	.0	9999	285	25	15	15	9	9	999	9	9	9	9	7	
3	5699.9	5706.0	3	1	.0	9999	55	25	145	175	9	9	999	9	9	9	9	7	
3	5700.1	5706.0	3	1	.0	9999	35	30	305	305	9	9	999	9	9	9	9	7	
3	5700.1	5706.0	3	1	.0	9999	285	50	15	15	9	9	999	9	9	9	9	7	
3	5700.1	5706.0	3	1	.0	9999	55	60	325	345	9	9	999	9	9	9	9	7	
3	5700.1	5706.0	3	3	.9	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5701.3	5707.5	3	1	.0	9999	75	45	165	165	9	9	999	9	9	9	9	7	
3	5701.4	5707.6	3	1	.0	9999	55	50	145	145	9	9	999	9	9	9	9	7	
3	5702.5	5708.5	3	1	.0	9999	25	30	295	295	9	9	999	9	9	9	9	7	
3	5702.5	5708.5	3	1	.0	9999	355	45	265	265	9	9	999	9	9	9	9	7	
3	5702.8	5709.0	3	1	.0	9999	75	60	345	345	9	9	999	9	9	9	9	7	
3	5702.8	5709.0	3	1	.0	9999	999	0	999	999	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
3	5702.8	5709.0	3	1	.0	9999	45	70	135	135	9	9	999	9	9	9	9	7	
3	5702.8	5709.0	3	1	.0	9999	295	40	205	205	9	9	999	9	9	9	9	7	
3	5702.8	5709.0	3	1	.0	9999	15	45	285	285	9	9	999	9	9	9	9	7	
3	5702.8	5709.0	3	1	.0	9999	5	45	95	95	9	9	999	9	9	9	9	7	
3	5702.9	5709.1	3	1	.0	9999	315	40	225	225	9	9	999	9	9	9	9	7	
3	5702.9	5709.1	3	1	.0	9999	55	30	325	325	9	9	999	9	9	9	9	7	
3	5703.1	5709.2	3	1	.0	9999	45	35	135	135	9	9	999	9	9	9	9	7	
3	5703.4	5709.5	3	1	.0	9999	325	25	235	235	9	9	999	9	9	9	9	7	
3	5703.7	5710.0	3	1	.0	9999	85	35	355	355	9	9	999	9	9	9	9	7	
3	5706.5	5712.5	3	1	.0	9999	295	50	25	25	9	9	999	9	9	9	9	7	
3	5707.3	5713.5	1	2	3.0	1.0	80	90	999	999	9	9	C	C		4	1	4	TS
	TWO PARALLEL FRACS 0.1'+ APART,STRANDED																		
3	5712.6	5718.5	1	1	.4	1.0	275	90	999	999	9	9	C	C		3	2	4	
	FRAC JUST SKIMMED CORE																		
3	5713.4	5719.5	1	1	.6	0.5	290	90	999	999	9	9	C	C		3	3	4	
	TOP AND BOT CLOSE TO IRREGULAR MUDST LAMS,TWO MAIN STRANDS																		
3	5714.7	5721.0	P	1	.1	9999	230	99	999	999	9	9	999	9	9	9	9	6	
	QUESTIONABLE ORIENT BECAUSE OF TIMING OF CONNECTION,INIATION ANGLE OBSCURE																		
3	5714.9	5721.5	P	1	.1	9999	230	99	999	999	9	9	999	9	9	9	9	6	
	QUESTIONABLE ORIENT BECAUSE OF TIMING OF CONNECTION, INIATION ANGLE OBSCURE																		
3	5714.9	5721.5	1	1	.1	0.2	999	90	999	999	9	9	C	C		7	3	6	
	ONLY SEEN ON ONE SIDE OF CORE-CAN'T TRACE IN CROSS-SECTION,TOPTERM IN 0.2'SAMPLE OUT																		
3	5728.5	5734.5	2	1	.0	9999	999	0	999	156	9	–	999	9	9	2	2	4	
	VERY COARSE SS																		
3	5731.5	5738.0	3	1	.0	9999	80	30	350	40	9	9	999	9	9	9	9	7	
3	5731.5	5738.0	3	1	.0	9999	40	45	310	310	9	9	999	9	9	9	9	7	
3	5732.5	5739.0	2	1	.0	9999	999	30	999	999	9	–	999	9	9	2	2	4	
3	5739.3	5745.5	3	1	.0	9999	15	45	285	285	9	9	999	9	9	9	9	7	
3	5739.3	5745.5	3	1	.0	9999	95	30	185	185	9	9	999	9	9	9	9	7	
3	5739.4	5745.6	3	1	.0	9999	35	30	305	305	9	9	999	9	9	9	9	7	
3	5740.4	5747.0	2	1	.0	9999	325	10	55	55	9	–	999	9	9	2	2	4	
3	5740.6	5747.2	P	1	.1	9999	105	60	999	999	9	9	999	9	9	9	9	4	
	SILTY SS W/ABUND MUDST LAMS, INIATION ANGLE 60 DEG-CONSTANT DIP																		
3	5740.9	5747.5	2	1	.0	9999	305	10	35	345	9	–	999	9	9	2	2	4	
	MUDST PARTING BETWEEN FINE SS & SILTST																		
3	5743.1	5749.0	3	1	.0	9999	80	10	170	170	9	9	999	9	9	9	9	7	
3	5743.1	5749.0	3	1	.0	9999	70	20	340	340	9	9	999	9	9	9	9	7	

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
3	5743.4	5749.5	3	1	.0	9999	80	40	350	350	9	9	999	9	9	9	9	7	
3	5743.4	5749.5	3	1	.0	9999	330	30	60	60	9	9	999	9	9	9	9	7	
3	5745.5	5751.5	3	1	.0	9999	70	35	340	340	9	9	999	9	9	9	9	7	
3	5745.9	5752.0	3	1	.0	9999	80	45	350	350	9	9	999	9	9	9	9	7	
3	5747.0	5753.0	3	6	1.7	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5749.4	5755.5	1	1	.8	0.5	280	90	999	999	9	9	C	C		1	3	4	
ROCK TYPE AS ABOVE																			
3	5750.6	5756.5	3	1	.0	9999	100	40	10	10	9	9	999	9	9	9	9	7	
3	5752.9	5759.0	P	1	.1	9999	120	60	999	999	9	9	999	9	9	9	9	4	
INIATION ANGLE 60DEG.- CONSTANT DIP																			
3	5758.0	5764.0	P	1	.1	9999	300	65	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 65DEG.- CONSTANT DIP																			
3	5760.3	5766.5	1	1	.5	0.5	80	90	999	999	9	9	C	C		1	3	6	
3	5760.5	5766.5	3	1	.0	9999	20	60	290	290	9	9	999	9	9	9	9	7	
3	5760.8	5767.0	3	1	.0	9999	125	60	215	215	9	9	999	9	9	9	9	7	
3	5762.6	5768.5	3	1	.0	9999	85	65	355	355	9	9	999	9	9	9	9	7	
3	5764.2	5770.0	3	1	.0	9999	105	40	195	195	9	9	999	9	9	9	9	7	
3	5766.6	5774.5	P	1	.0	9999	999	45	215	999	9	9	999	9	9	9	9	6	
MUDDY SILTST INIATION ANGLE 45 DEG.-IRREGULAR																			
3	5766.7	5774.6	P	1	.0	9999	999	50	195	999	9	9	999	9	9	9	9	6	
MUDDY SILTST INIATION ANGLE 50DEG.-IRREGULAR																			
3	5767.2	5773.0	1	2	.4	0.2	90	90	999	999	9	9	C	C		3	2	6	
MUDDY SILTST,TWO PARALLEL FRACS 2"APART-ONE IN LITH & ONE OUT OF CORE @BOTTOM																			
3	5769.5	5775.5	1	1	.4	0.3	280	90	999	999	9	9	C	C		1	1	3	T
GAPS IN FILL																			
3	5770.0	5776.0	3	1	.0	9999	350	50	260	260	9	9	999	9	9	9	9	7	
3	5770.0	5776.0	3	1	.0	9999	340	60	70	70	9	9	999	9	9	9	9	7	
3	5770.0	5776.0	3	7	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5773.0	5779.0	3	1	.0	9999	20	25	290	290	9	9	999	9	9	9	9	7	
3	5773.0	5779.0	3	3	1.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5774.0	5780.0	3	1	.0	9999	70	35	340	330	9	9	999	9	9	9	9	7	
3	5778.2	5782.5	2	1	.0	9999	270	15	0	0	9	-	999	9	9	2	2	4	
SUBTLE SLKS																			
3	5780.0	5784.0	1	1	.8	1.0	295	90	999	999	9	9	C	C		7	2	3	T
CORE MISSING IN BOX,MICROPROBE ANALYSIS																			
3	5783.1	5787.0	P	2	.2	9999	110	90	999	999	9	9	999	9	9	9	9	4	
EXACT CORE DEPTH UNKNOWN, INIATION ANGLES 80 AND 85DEG.-CONVEX UP																			
3	5783.3	5787.5	1	1	.3	0.2	290	90	999	999	9	9	C	C		7	1	4	
@TOPTERM 0.7' SAMPLE OUT,FRAC SPLIT-THIN FILM OF CALCITE ON EXPOSED PLANE																			

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
3	5784.2	5788.0	3	1	.0	9999	305	60	215	215	9	9	999	9	9	9	9	7	
3	5785.0	5789.0	3	1	.0	9999	305	40	215	215	9	9	999	9	9	9	9	7	
3	5785.0	5789.0	3	4	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5786.2	5790.0	3	1	.0	9999	355	30	265	265	9	9	999	9	9	9	9	7	
3	5786.7	5790.5	3	1	.0	9999	105	60	195	195	9	9	999	9	9	9	9	7	
3	5788.5	5792.5	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5788.8	5793.0	S	3	.2	0.2	280	90	999	999	9	9	C	C		7	3	6	
	MUDDY SILTST, TOPTERM MISSING,FILL PARTIAL ON EXPOSED PLANE																		
3	5789.7	5793.5	1	1	.4	0.2	90	90	999	999	9	9	C	C		7	7	6	
	MUDDY SILTST, FILL PARTIAL ON EXPOSED PLANE,EXACT WIDTH UNKNOWN,TERMS MISSING																		
3	5791.0	5795.0	3	15	4.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5795.5	5799.5	3	1	.0	9999	45	50	315	315	9	9	C	P		9	9	7	
	CALCITE FILL IN TROUGHS																		
3	5795.5	5799.5	3	3	.5	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5796.0	5800.0	3	1	.0	9999	35	50	305	315	9	9	999	9	9	9	9	7	
3	5796.5	5800.5	3	1	.0	9999	5	40	275	275	9	9	999	9	9	9	9	7	
3	5800.1	5804.0	1	1	.5	0.2	999	90	999	999	9	9	C	C		5	5	0	
	INTERLAMINATED SS/ MUDST/SILT,MULTISTRANDED,NO ORIENT DATA,5800.3-NORMAL INDUCED FRAC?!																		
3	5800.8	5804.5	3	1	.0	9999	999	40	999	999	9	9	999	9	9	9	9	7	
3	5802.0	5806.0	3	1	.0	9999	999	30	999	999	9	9	999	9	9	9	9	7	
3	5803.7	5807.5	1	1	.7	0.3	999	90	999	999	9	9	C	C		3	3	5	
	FILL PARTIAL ON EXPOSED PLANE,MULTISTRANDED,ONE STRAND OUT OF CORE @TOP																		
3	5804.4	5808.5	3	1	.0	9999	360	70	90	100	9	9	999	9	9	9	9	7	
3	5805.0	5809.0	2	1	.0	9999	40	65	310	290	9	-	999	9	9	2	2	4	
	SFT SED MUDST SWIRL IN FINE SS																		
3	5805.3	5809.5	3	1	.0	9999	10	45	100	100	9	9	999	9	9	9	9	7	
3	5805.8	5810.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5806.3	5810.5	3	1	.0	9999	310	50	40	40	9	9	999	9	9	9	9	7	
3	5806.3	5810.5	3	1	.0	9999	60	30	150	150	9	9	999	9	9	9	9	7	
3	5806.3	5810.5	3	1	.0	9999	330	40	240	230	9	9	999	9	9	9	9	7	
3	5806.6	5810.6	3	1	.0	9999	310	30	220	190	9	9	999	9	9	9	9	7	
3	5806.6	5810.6	3	1	.0	9999	50	60	140	160	9	9	999	9	9	9	9	7	
3	5807.3	5811.5	1	1	2.5	0.5	305	90	999	999	9	9	C	C		4	1	3	
	STRANDED																		
3	5809.5	5813.5	1	1	.3	10.0	310	90	999	999	9	9	QC	P	S	2	2	3	
	FRAC JUST SKIMS CORE ENECHELON AT MUDST CONTACT,OPEN FRAC-WIDTH ESTIMATED																		

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
3	5810.7	5814.5	3	1	.0	9999	340	30	70	70	9	9	999	9	9	9	9	7	
3	5812.1	5816.0	P	1	.0	9999	120	55	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 55DEG.- IRREGULAR																			
3	5812.8	5817.0	P	1	.0	9999	120	60	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 60DEG.- CONSTANT DIP																			
3	5813.8	5818.0	P	1	.0	9999	130	60	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 60DEG.- CONCAVE UP																			
3	5814.2	5818.2	P	1	.0	9999	110	70	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 70DEG.- CONCAVE UP																			
3	5814.6	5818.5	P	1	.1	9999	120	70	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 70DEG.- CONCAVE UP																			
3	5815.1	5819.0	P	1	.0	9999	110	50	999	999	9	9	999	9	9	9	9	3	
INIATION ANGLE 50DEG.- CONCAVE UP																			
3	5815.7	5819.5	3	1	.0	9999	80	20	350	350	9	9	999	9	9	9	9	7	
3	5815.7	5819.5	3	1	.0	9999	320	60	50	50	9	9	999	9	9	9	9	7	
3	5815.7	5819.5	3	1	.0	9999	310	60	220	220	9	9	999	9	9	9	9	7	
3	5815.7	5819.5	3	1	.0	9999	350	70	80	100	9	9	999	9	9	9	9	7	
3	5815.7	5819.5	3	1	.0	9999	20	50	110	110	9	9	999	9	9	9	9	7	
3	5815.7	5819.5	3	1	.0	9999	330	45	240	190	9	9	999	9	9	9	9	7	
3	5819.3	5823.5	3	1	.0	9999	350	60	80	80	9	9	999	9	9	9	9	7	
3	5819.3	5823.5	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5820.9	5825.0	1	1	.8	1.0	290	90	999	999	9	9	C	C		1	4	3	T
3	5821.7	5825.5	P	1	.0	9999	120	99	999	999	9	9	999	9	9	9	9	6	
OBSCURE INIATION																			
3	5823.5	5827.5	P	1	.0	9999	120	65	999	999	9	9	999	9	9	9	9	6	
INIATION ANGLE 55DEG.- CONVEX UP																			
3	5825.0	5829.0	P	3	.5	9999	124	90	999	999	9	9	999	9	9	2	3	3	
PETALS 0.2-.3'LONG, 80-90DEG MAX DIP,(2)BOTTERMS AT MUDST PTGS,INIAT.ANGLES 80DEG-CONVEX UP																			
3	5845.2	5849.0	1	1	.2	0.1	999	90	999	999	9	9	C	C		7	1	2	
TOPTERM IN 0.2' SAMPLE OUT																			
3	5847.2	5851.0	3	1	.0	9999	999	45	999	999	9	9	999	9	9	9	9	7	
3	5850.1	5853.0	1	1	.3	0.2	999	90	999	999	9	9	C	C		1	1	6	
MULTISTRANDED, (1)BOTTERM OUT OF CORE																			
3	5850.7	5853.5	1	1	.8	1.0	999	90	999	999	9	9	C	C		1	1	5	
MULTISTRANDED																			
3	5851.8	5855.0	1	2	.1	0.5	999	90	999	999	9	9	C	C		1	1	6	
GREATER THAN 0.1' APART																			
3	5854.6	5856.5	1	1	.4	0.3	999	80	999	999	9	9	C	C		1	1	6	T
STRANDED,FILL LOOKS PARTIAL ON EXPOSED PLANE																			
3	5855.6	5857.5	7	1	.0	0.3	999	0	999	999	9	9	C	C		3	3	6	
HORIZ FRAC,UNABLE TO TRACE THRU CORE																			
3	5861.0	5861.0	3	4	1.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	5865.3	5865.5	P	4	1.0	9999	999	90	999	999	9	9	999	9	9	9	9	3	
ALL PETALS PARALLEL INIATION ANGLES 35DEG.-CONVEX UP																			

WELL NO	CORE DEPTH	LOG DEPTH	FRAC TYPE	# OF FRACS	FRAC HEIGHT	FRAC WIDTH	FRAC STRIKE	DIP ANGLE	DIP AZIMUTH	SLICK BEARING	TYPE MOTION	SLICK EXTENT	FILL TYPE	FILL AMOUNT	CRYSTAL TYPE	TOP TERM	BOT TERM	LITH	LAB ANALYSES
3	6449.3	6449.5	3	1	.0	9999	999	0	999	250	9	9	999	9	9	2	2	7	
	QUESTIONABLE ORIENT																		
3	6457.9	6459.0	1	1	2.3	1.5	280	90	999	999	9	9	QC	C		3	5	4	TF
	TOP TERM WHERE ORGA LAMS BECOME MORE FREQ., VERY STRANDED,NO QTZ IN THINSECT.ONLY FI																		
3	6469.6	6470.5	3	1	.0	9999	320	20	50	50	9	9	999	9	9	3	3	7	
3	6469.7	6470.6	3	3	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
3	6475.0	6476.5	2	1	.0	9999	345	35	75	115	9	-	999	9	9	2	2	4	
3	6499.1	6502.0	3	1	.0	9999	295	30	25	25	9	9	999	9	9	3	3	7	
3	6499.8	6503.0	3	1	.0	9999	25	25	115	115	9	9	999	9	9	9	9	7	
	IRREGULAR PLANE																		
3	6500.6	6503.5	3	1	.0	9999	315	15	45	45	9	9	999	9	9	9	9	7	
	QUESTIONABLE ORIENT																		
3	6879.9	6877.0	3	1	.0	9999	60	20	330	330	9	9	999	9	9	9	9	7	
3	6880.0	6877.1	3	1	.0	9999	999	45	999	999	9	9	999	9	9	9	9	7	
	NO SCRIBE																		
3	6881.9	6879.0	3	1	.0	9999	999	45	999	999	9	9	999	9	9	9	9	7	
	NO SCRIBE																		
3	6881.9	6879.0	3	1	.0	9999	999	20	999	999	9	9	999	9	9	9	9	7	
	@ RIGHT ANGLE TO FRAC ABOVE																		
3	6882.4	6879.5	3	1	.0	9999	999	20	999	999	9	9	999	9	9	9	9	7	
	NO SCRIBE																		
3	6884.5	6881.5	3	2	.0	9999	15	99	105	105	9	9	999	9	9	9	9	7	
3	6884.5	6881.5	3	1	.0	9999	15	99	285	285	9	9	999	9	9	9	9	7	
3	6884.9	6882.0	6	1	.0	9999	335	30	65	65	9	+	C	P		2	2	7	
	SCRIBE ROTATING, POLISHED																		
3	6886.0	6883.0	3	7	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	NO SCRIBE																		
3	6887.1	6884.0	1	1	.2	0.2	275	90	999	999	9	9	C	C		5	5	3	
	TERMS AT IRREGULAR MUDST LAMS																		
3	6895.6	6892.5	B	1	.0	9999	999	90	999	999	9	9	999	9	9	9	9	9	
3	6897.4	6894.5	C	4	.2	0.5	265	90	999	999	9	9	C	C	9	3	3	8	
	THESE ARE COAL CLEATS WITH FILL- 4 SMALL CLEATS																		
3	6897.5	6894.6	3	1	.0	9999	335	30	245	245	9	9	999	9	9	9	9	7	
3	6908.0	6905.0	3	1	.0	9999	95	50	185	235	9	9	999	9	9	9	9	7	
3	7155.9	7154.0	3	1	.0	9999	15	30	285	275	9	9	999	9	9	9	9	7	
3	7155.9	7154.0	3	1	.0	9999	999	99	999	999	9	9	999	9	9	9	9	7	
	INTERSECTING FRAC ABOVE																		
3	7157.5	7155.5	3	1	.0	9999	35	15	125	125	9	9	999	9	9	9	9	7	
	QUESTIONABLE SCRIBE																		
3	7157.5	7155.5	3	1	.0	9999	55	40	145	145	9	9	999	9	9	9	9	7	
	QUESTIONABLE SCRIBE																		
3	7157.5	7155.5	3	1	.0	9999	295	20	25	25	9	9	999	9	9	9	9	7	
	QUESTIONABLE SCRIBE																		