UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Lithologic descriptions of selected intervals of Jurassic rocks in southeastern Utah, northeastern Arizona, and northwestern New Mexico

by

Steven M. Condon[1]

Open-File Report 85-223

This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

[1]USGS Denver, Colorado

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CONTENTS

LIST OF ILLUSTRATIONS

LITHOLOGIC DESCRIPTIONS OF SELECTED INTERVALS OF JURASSIC ROCKS IN SOUTHEASTERN UTAH, NORTHEASTERN ARIZONA, AND NORTHWESTERN NEW MEXICO

By Steven M. Condon

INTRODUCTION

This report contains descriptions of 18 measured sections of selected Jurassic rocks in the Four Corners area (fig. 1). Most of the sections were measured from the upper part of the Entrada Sandstone to the base of either the Salt Wash or Recapture Members of the Morrison Formation. In some sections, in the southern part of the area, all of the Morrison was measured and described up to the contact with the overlying Cretaceous Dakota Sandstone. Figure 2 shows the formations and members within this stratigraphic interval. The sections presented in this report are intended to aid other ongoing stratigraphic studies, and hopefully will have use in subsurface correlations of Jurassic units in the Four Corners area.

STRATIGRAPHY

The Carmel Formation is the oldest rock unit in southeastern Utah and northeastern Arizona that is considered to be entirely Jurassic in age. In the Four Corners area it forms ledges of resistant sandstone separated by siltstone slopes. The Carmel averages about 120 ft thick in southeastern Utah (O'Sullivan, 1965) and thins to the south and east of there. It isn't recognized in northwestern New Mexico (fig. 2). None of the Carmel is described in the measured sections included in this report.

The Entrada Sandstone overlies the Carmel in southeastern Utah and northeastern Arizona and is the lowermost Jurassic unit in northwestern New Mexico. In southeastern Utah and northeastern Arizona, the Entrada consists of a lower sandy, middle silty, and upper sandy lithofacies. In northwestern New Mexico, in most of the area of this report, the Entrada has been divided into a lower silty and upper sandy lithofacies. These lithofacies have been assigned various member names in different geographical areas. In the Carrizo Mountains area (fig. 1) the Entrada thins to as little as 40 ft (Strobell, 1956); however, it thickens to about 360 ft in the Lupton area (Harshbarger and others, 1957). A maximum of about 80 ft at the top of the Entrada was measured in the present study; most sections include just a few feet of the upper Entrada.

In the area of this report, the Wanakah Formation overlies the Entrada Sandstone. The Wanakah consists of three members, from oldest to youngest, the Todilto Limestone Member, the Beclabito Member, and the Horse Mesa Member (Condon and Huffman, in press).

The Todilto Limestone Member consists of gray, thinly bedded limestone and siltstone, and ranges from 0 to 20 ft thick in this area. It thins, as a result of nondeposition, onto the edges of the ancestral San Juan Basin. In this report, the Todilto is present in sections 7-12, Beclabito Dome to Navajo.

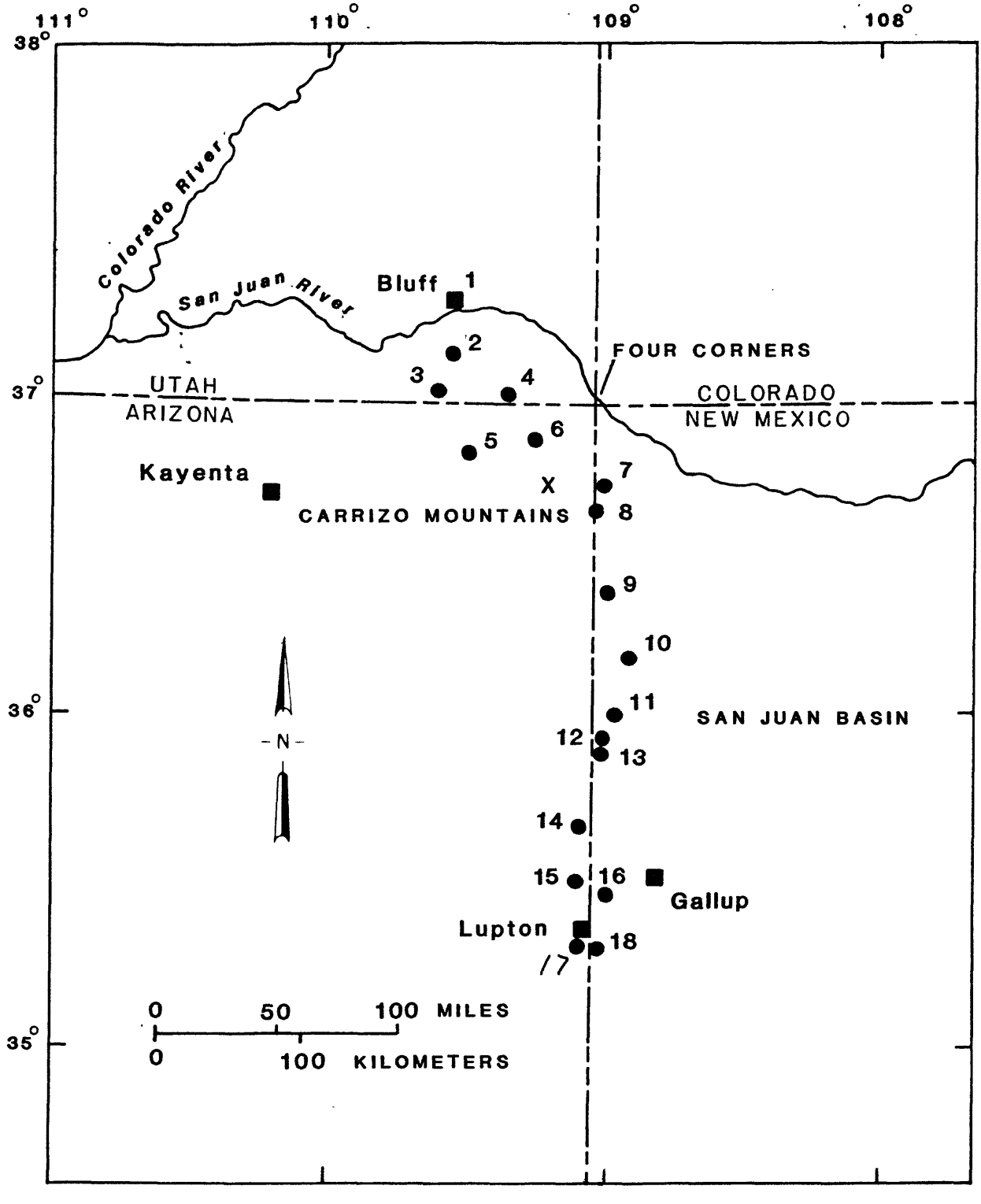

Figure 1. Index map of measured sections.

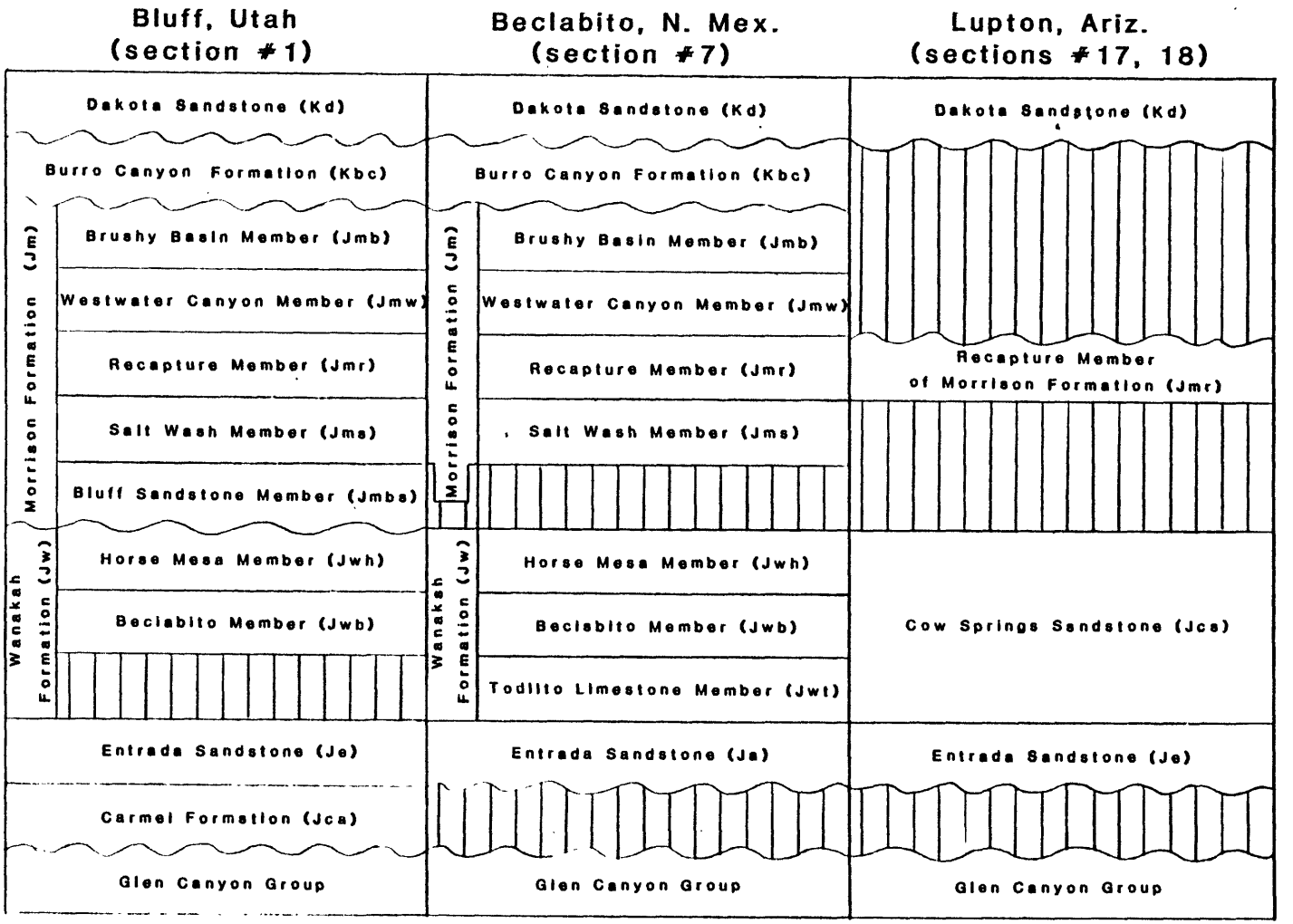

Figure 2. Correlation chart showing nomenclature of this report.

The Beclabito Member typically consists of a series of thin sandstone and sandy siltstone ledges separated by very thin siltstone and mudstone beds. A prominent sandy zone within the unit is the bed at Butler Wash (O'Sullivan, 1980). This bed is actually an interval of rock, consisting of a lower white sandstone, a middle part that is made up of thinly interbedded siltstone and sandstone, and an upper white sandstone. In the present report, the bed at Butler Wash has been correlated from southeastern Utah to northeastern Arizona and northwestern New Mexico. In southeastern Utah, the Beclabito ranges from about 170 to 200 ft in thickness. In northeastern Arizona and northwestern New Mexico, it is from 0 to about 175 ft thick. The Beclabito isn't recognized south of section no. 13 (Twin Buttes Wash).

The Horse Mesa Member is dominantly medium to coarse grained sandstone, and contains a few siltstone beds in its lower part. It was previously correlated with the Bluff Sandstone at Bluff, Utah (Strobell, 1956), but in the present report is considered to underlie the Bluff Sandstone Member of that area. The Bluff has now been reassigned as a member of the Morrison Formation (O'Sullivan, 1980). The Horse Mesa Member ranges in thickness from about 10 to 60 ft in northeastern Arizona and northwestern New Mexico, and 20-30 ft in southeastern Utah.

The Cow Springs Sandstone intertongues with and replaces the Beclabito and Horse Mesa Members of the Wanakah in a north-south direction along the Arizona-New Mexico state line. The Cow Springs consists of fine grained, well sorted sandstone, which is both crossbedded and flatbedded. It is present as thin tongues of light-colored, crossbedded sandstone within the Wanakah in the Todilto Park (no. 11), Navajo (no. 12), and Twin Buttes Wash (no. 13) sections and thickens southward. The thickness of the Cow Springs in the study area ranges from 0-283 ft.

The Morrison Formation overlies the Wanakah Formation in southeastern Utah, and overlies either the Wanakah or the Cow Springs Sandstone in northwestern New Mexico and northeastern Arizona. In southeastern Utah and northeastern Arizona the Morrison comprises five members: in ascending order, the Bluff Sandstone Member, the Salt Wash Member, the Recapture Member, the Westwater Canyon Member, and the Brushy Basin Member. In northwestern New Mexico, all of the members are present except the Bluff Sandstone Member.

The Bluff Sandstone Member consists of medium to coarse grained, crossbedded, and flatbedded sandstone. It ranges in thickness from 0 to nearly 350 ft (O'Sullivan, 1978). The Bluff thins northward, westward, and southward from Bluff, Utah; in the present report, thicknesses of 24-54 ft were measured.

The Salt Wash Member overlies either the Bluff Sandstone Member of the Morrison or the Wanakah Formation in the northern part of the study area (sections 1-9). The basal unit of the Salt Wash commonly consists of thin, tabular sandstone beds separated by siltstone or mudstone slopes. This unit is overlain by a coarsening-upward sequence of medium to thick tabular sandstones, and thin mudstone beds. No complete thicknesses of Salt Wash were measured in the present study.

In sections 10-18, the Recapture is the basal member of the Morrison. The Recapture is made up of sandstone, siltstone, and mudstone, with local limestone beds. Full thicknesses of the Recapture were measured in sections 14, 16, 17, and 18, and range from about 200 to 330 ft.

The Westwater Canyon Member overlies the Recapture and consists of medium to coarse grained sandstone and minor siltstone or mudstone beds. The Westwater Canyon was only measured at the Pipeline Road section (no. 14), where it is about 100 ft thick. It was removed by erosion prior to deposition of the Dakota Sandstone south of the Pipeline Road section.

The Brushy Basin Member overlies the Westwater Canyon Member. It consists of variegated claystone and mudstone with minor lenticular sandstone and limestone beds. None of the Brushy Basin was measured or described in the present study.

In southeastern Utah and part of northwestern New Mexico, the Cretaceous Burro Canyon Formation overlies the Morrison Formation. The Burro Canyon is not recognized in Arizona or in much of northwestern New Mexico. In areas where it is absent, the Cretaceous Dakota Sandstone overlies the Morrison Formation. Neither the Burro Canyon or Dakota Sandstone were measured or described as part of the present study.

LOCATION

The sections were measured from Bluff, in southeastern Utah, southward to Lupton, Arizona (fig. 1). Outcrops of Jurassic rocks are somewhat scattered in southeastern Utah and northeastern Arizona; however, exposures there are generally good, and units could be traced from one section to another with confidence. Sections 7-11 in New Mexico are well-exposed but separated by cover, particularly between sections 10 and 11. Sections 12-18 are along a line of nearly continuous cliffs that define the western edge of the San Juan Basin.

METHODS

Field data were recorded on forms intended for outcrop or core studies that are described in detail by Reynolds and others (1975). Appendix A explains symbols and abbreviations used on the forms. Note that there are continuous lines that indicate the visual porosity estimate and dominant grain size on the forms. These lines approximate the spontaneous-potential and resistivity curves on a standard geophysical log. The forms were designed this way to ease comparison between outcrop and subsurface data.

Wherever possible, measurements were made with a 5 ft Jacob staff and Abney level. A tape measure was used in areas where cliffs made use of the Jacob staff impractical. Two sections (Gothic Wash, no. 2, and Twin Buttes Wash, no. 13) were measured, in part, over long, gentle dipslopes. Thicknesses measured in those areas are possibly subject to error. The strata at the Toadlena section, no. 10, dip eastward at approximately 75°, and there may be some tectonic thinning of the units in that section.

Many thanks go to John McDonnell, Paul Hildebrandt, and Carl Harris, who assisted in measuring these sections. The discerning reader will note small stylistic differences between sections. These are due, in large part, to differences between field assistants.

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APPENDIX A

Explanation of section forms

The section forms in this report are divided into vertical columns that each contain different types of information. Each column will be discussed briefly below.

Depth / alt. and formation tops. In this report this column is used to indicate thicknesses of the units in feet.

Shows. Because these forms are designed for subsurface, as well as surface sections, a column for oil shows is included. This column was not used in this report.

Fractures. The fractures column was also included on these forms for use in core studies. In this report this column is used to indicate stratigraphic units. (See figure 2 for the symbols used for formations and members.)

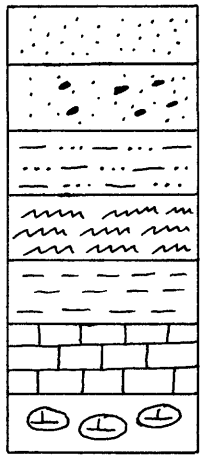
C.P.S. C.P.S. refers to counts-per-second of a hand-held scintillometer. Readings of relative radioactivity were taken for some of the sections. The abbreviation "Bk" on some of the forms refers to the background readings.

Visual porosity estimate. This column is a continuous line graph representing an estimate of the porosity of the unit measured. Estimates were obtained by placing a few drops of water or dilute HCl on the rock.

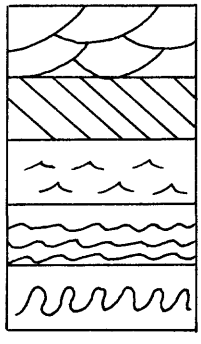
Core. This indicates the number of the core run for subsurface studies. It was not used in the present report.

Rock type. The rock type column contains a weathering profile of the outcrop, a lithologic symbol for rock type, drawings of sedimentary structures within the units, and arrows and numbers that designate the position of samples taken. Small strike and dip symbols next to some intervals indicate the presence of calcareous zones.

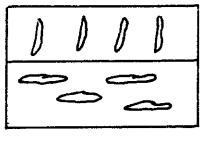
Lithology	Symbol
Sandstone	
Conglomeratic sandstone	
Siltstone	
Mudstone	
Claystone	
Limestone	
Limestone clasts or nodules	



Sedimentary structures	Symbol
Trough crossbeds	
Tabular-planar crossbeds	
Ripples (current or oscillation)	
Adhesion ripples	
Contorted bedding	



Miscellaneous	Symbol
Burrows	
Vertical	
Horizontal	



Footnotes. Used to indicate location of samples collected.

Color. Colors were estimated by a comparison with the GSA Rock-color chart (Goddard and others, 1948). Where possible, colors were estimated from fresh, dry outcrops.

Dominant grain size. The dominant grain size of rock units was estimated by comparing them to standard grain size charts. Class divisions correspond to the phi scale. Dots to the left or right of the solid line indicate variations from the norm.

Bedding. Bedding refers to set thickness of sedimentary units. Abbreviations are as follows: VTK - very thick; TK - thick; M, MED, or AV - medium; TN - thin; VTN - very thin; LAM - laminated; MASS - massive. Combinations of terms indicates a range of bedding thicknesses.

Sedimentary structures. This column indicates the type of sedimentary structure that is shown graphically in the rock type column. Abbreviations of sedimentary structures are as follows: CLL - trough crossbeds (curved, parallel laminations); SM, LO ⋋ TR. - small scale, low angle trough crossbeds (there are several variations of this notation, depending on the scale and angle of crossbedding); TAB. PLANAR - tabular-planar crossbeds; DWLL - current or oscillation ripples (discontinuous, wavy, nonparallel laminations); WLL - adhesion ripples (wavy, nonparallel laminations); ELL - horizontal laminations (even, parallel laminations); STRLESS - structureless.

Biologic constituents. This column indicates the presence of organic material, burrowing, and bioturbation.

Sorting and roundness. Commonly used abbreviations for sorting are as follows: VWS - very well sorted; WS - well sorted; MWS - moderately well sorted; M or MOD - moderately sorted; FS - fair sorting; PS - poorly sorted. Abbreviations for roundness include: A - angular; SA - subangular; SR - subrounded; R - rounded.

Cement. This column was used to indicate the presence of calcite cement. Abbreviations used include: V. CAL - very calcareous; M. CAL or MOD. CAL - moderately calcareous; SL. CAL - slightly calcareous; NON CAL or N. CAL - non-calcareous.

Percent feldspar. Estimated percent feldspar, usually potassium feldspar, in the unit.

Accessory minerals or fragments. Colors of unidentified accessory minerals are in this column. Abbreviations for colors are: BK or BLK - black; R or RD - red; OR - orange; GRN - green; GY - gray; WT - white. In some sections an attempt was made to estimate the percentage of accessory minerals.

Description. This is essentially a "comments" section. It contains information not covered on the rest of the form.

Inferred environment of deposition. Possible environments of deposition are noted in this section. These interpretations are preliminary, and two or more possibilities are often listed.

Transport direction. Where possible, estimates of the direction of sediment transport were made. Most of these estimates were taken from axes of trough crossbeds.

APPENDIX B
Measured sections

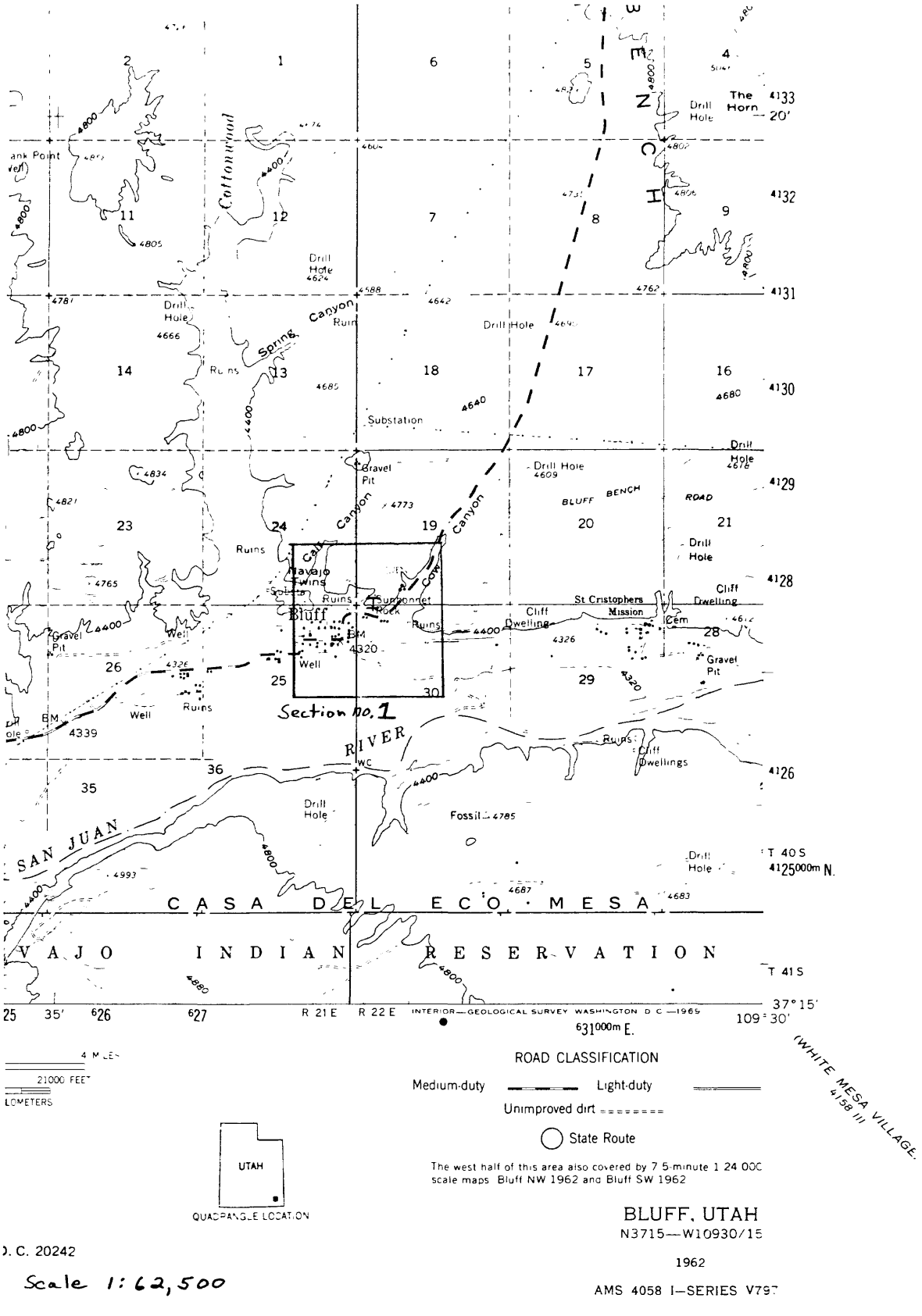
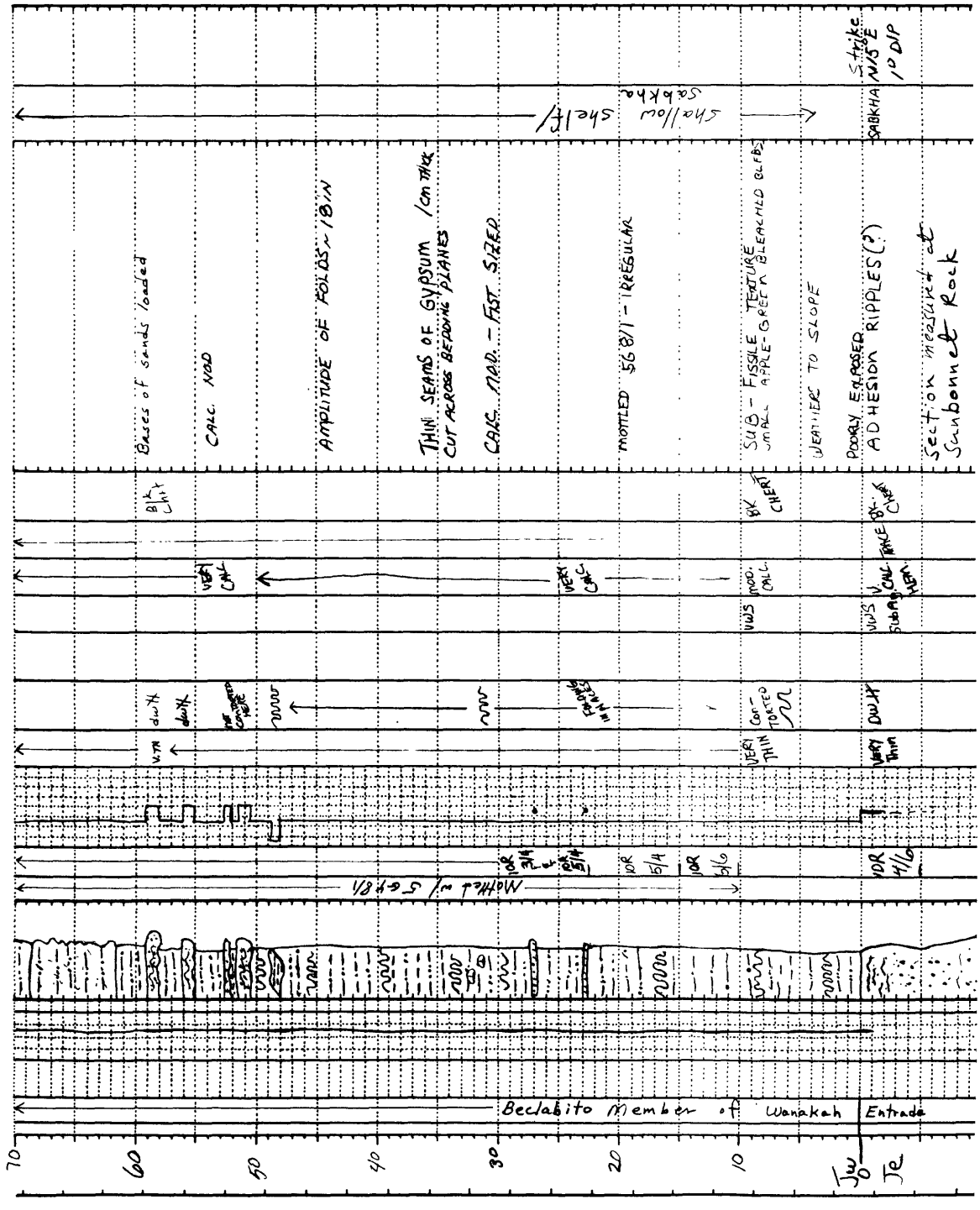


Figure 3. Location of measured section no. 1.

① LOCATION 1. BLUFF NW 1/4, NW 1/4 Sec. 30, SW 1/4, SW 1/4 Sec. 19, Sec. NW 1/4, SE 1/4 19 T. 40 S. R. 22 E.

STATE UTAH COUNTY San Juan

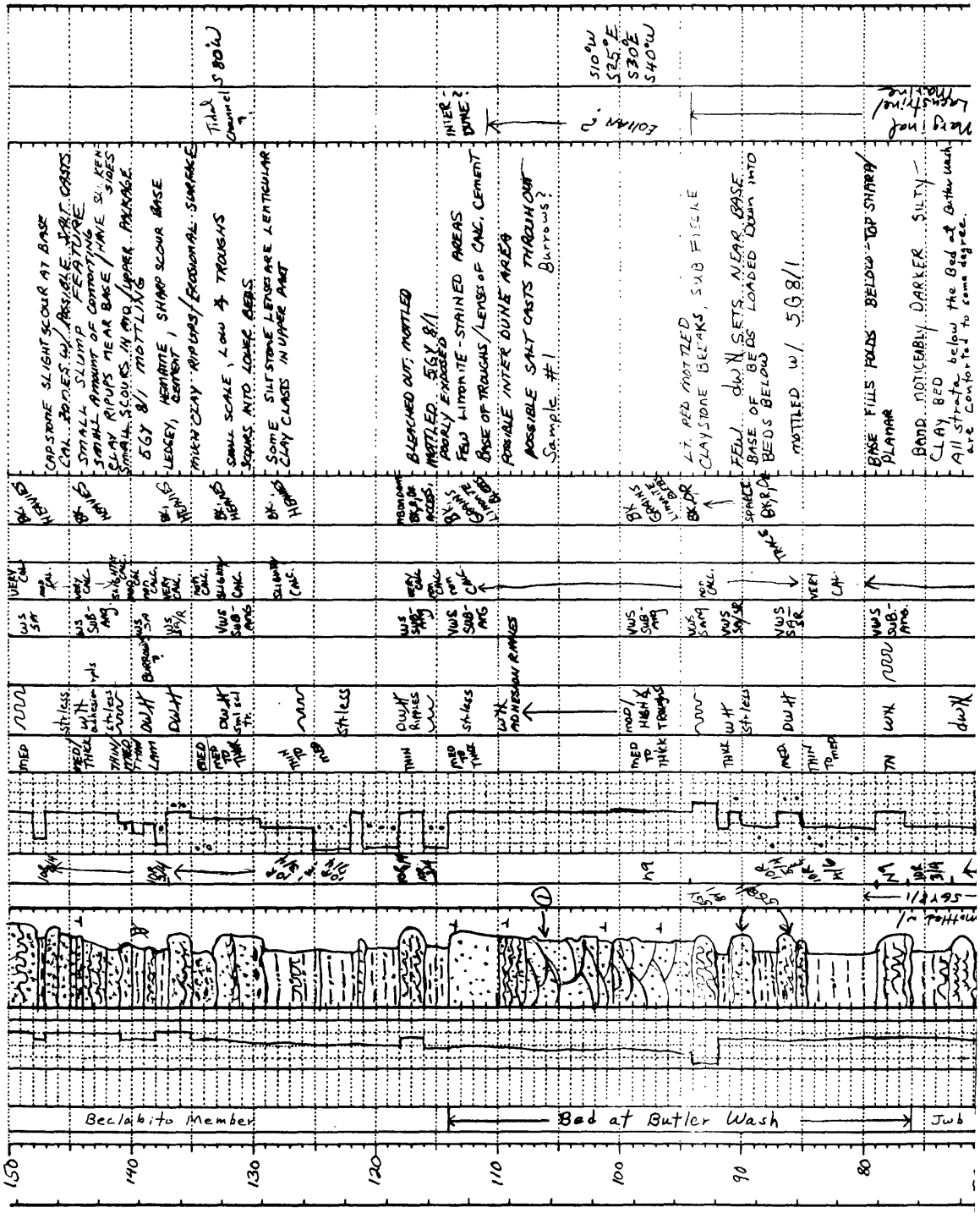
U.S.G.S. CORE LIBRARY NUMBER 7183 API WELL NUMBER Condon / Harris



LOCATION BLUFF Sec. 19, 30 T. 40 S. R. 22 E

STATE UTAH COUNTY San Juan

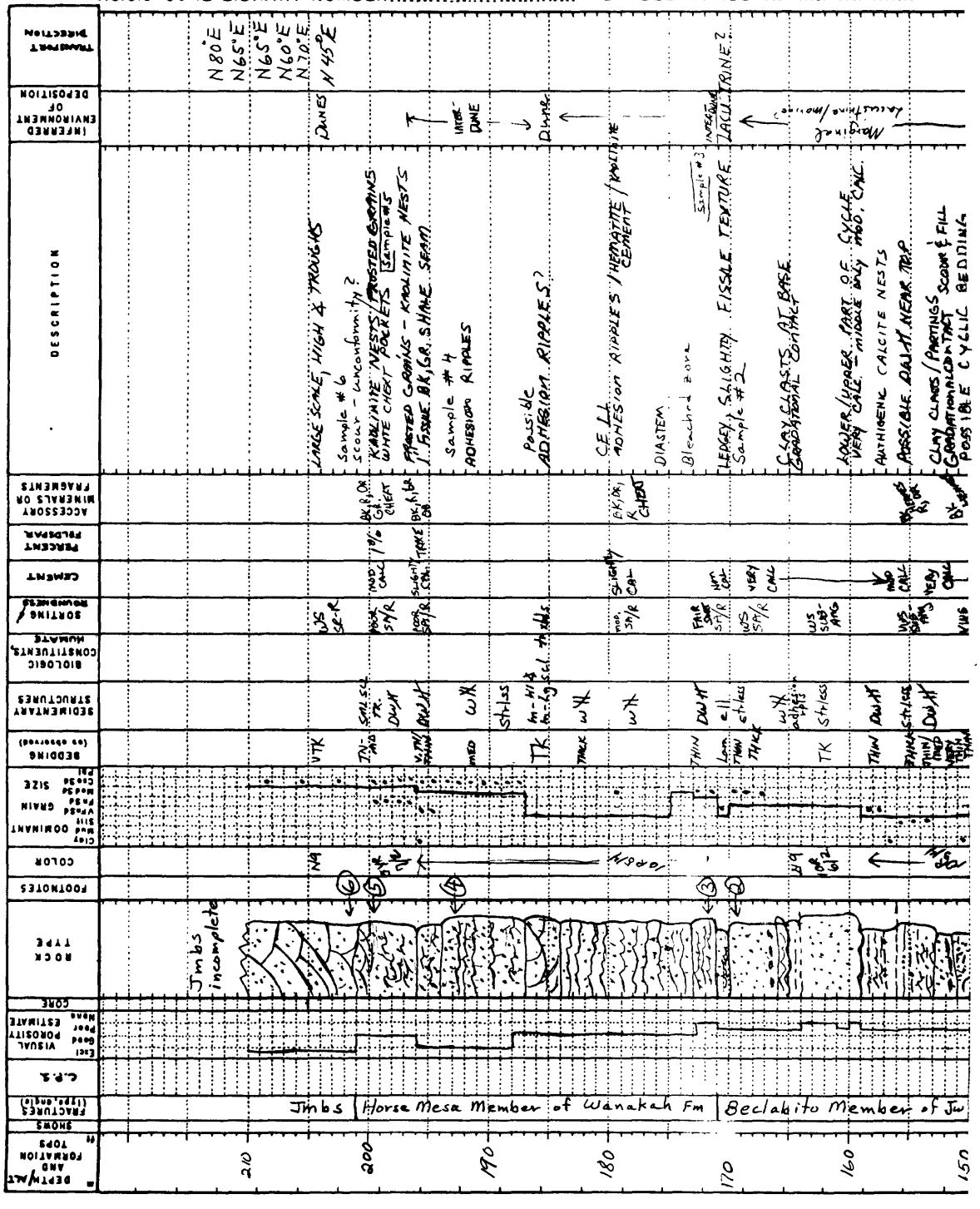
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



(3) LOCATION BLUFF Sec. 19, 30 T. 40 S. R. 22E

STATE UTAH COUNTY San Juan

U.S.G.S. CORE LIBRARY NUMBER ..... API WELL NUMBER .....



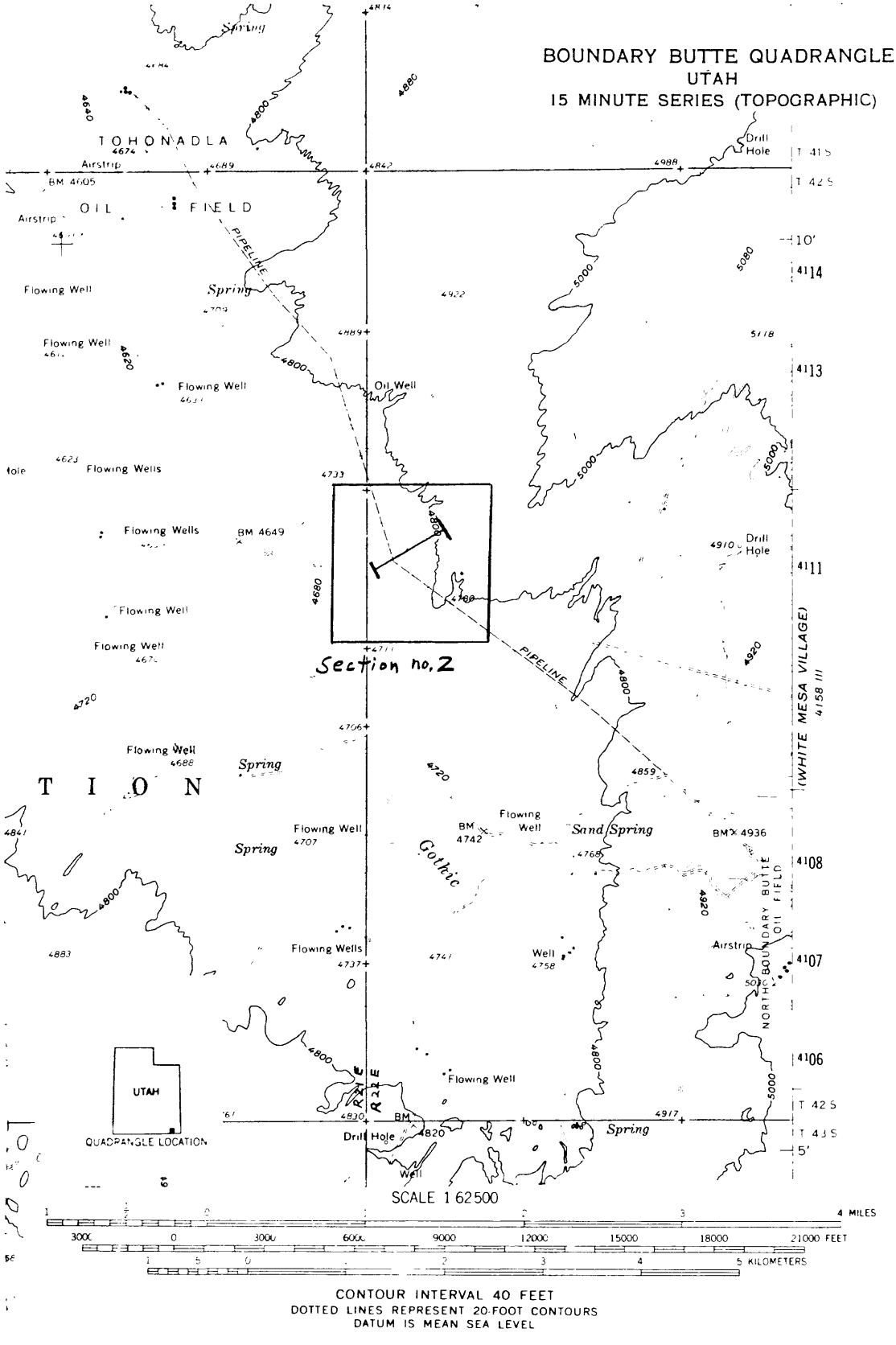
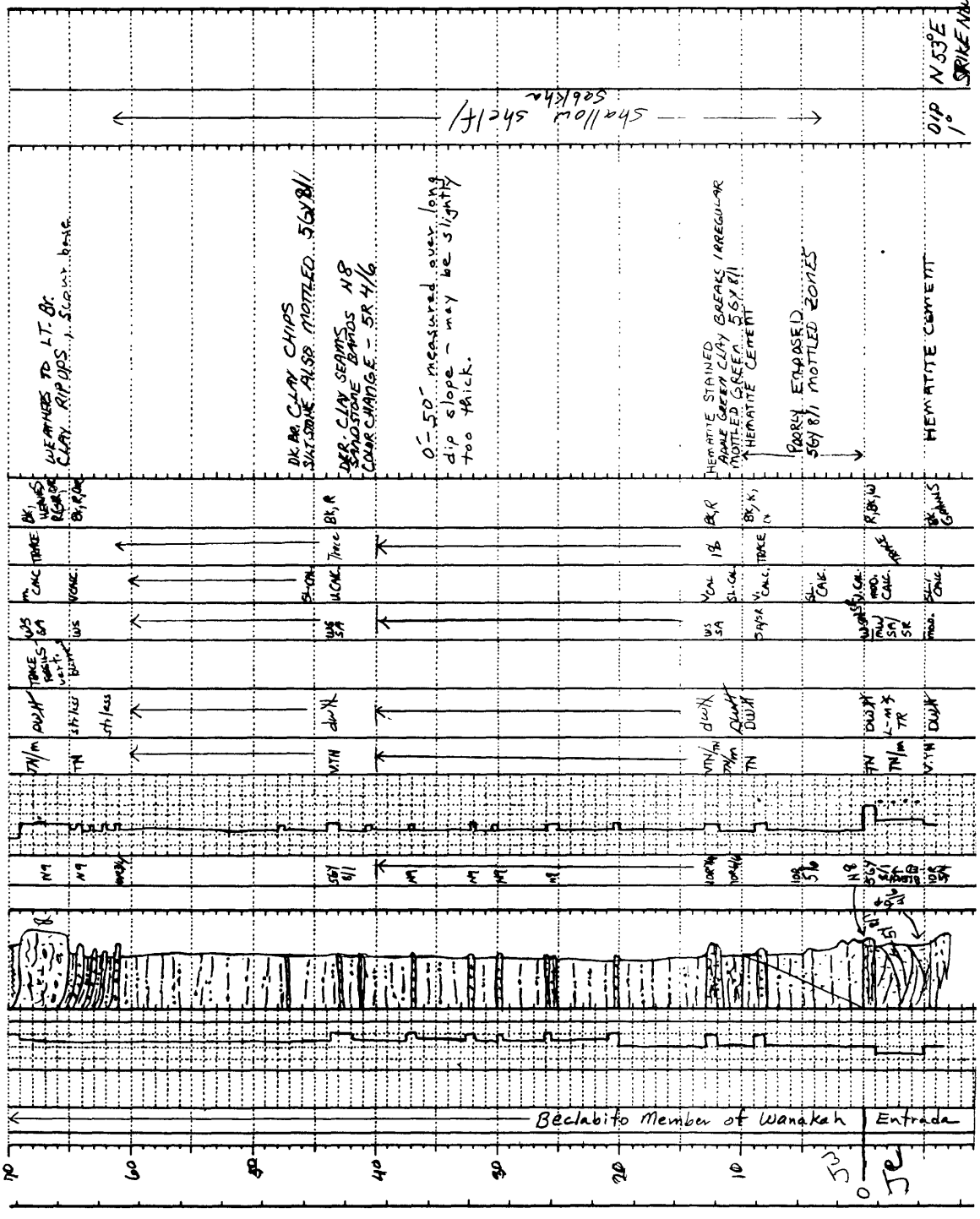


Figure 4. Location of measured section no. 2.

LOCATION 2 GOTHIC WASH Sec. 18 S½, NW¼ T. 42 S. R. 22 E. (estimated)

① STATE UTAH COUNTY San Juan

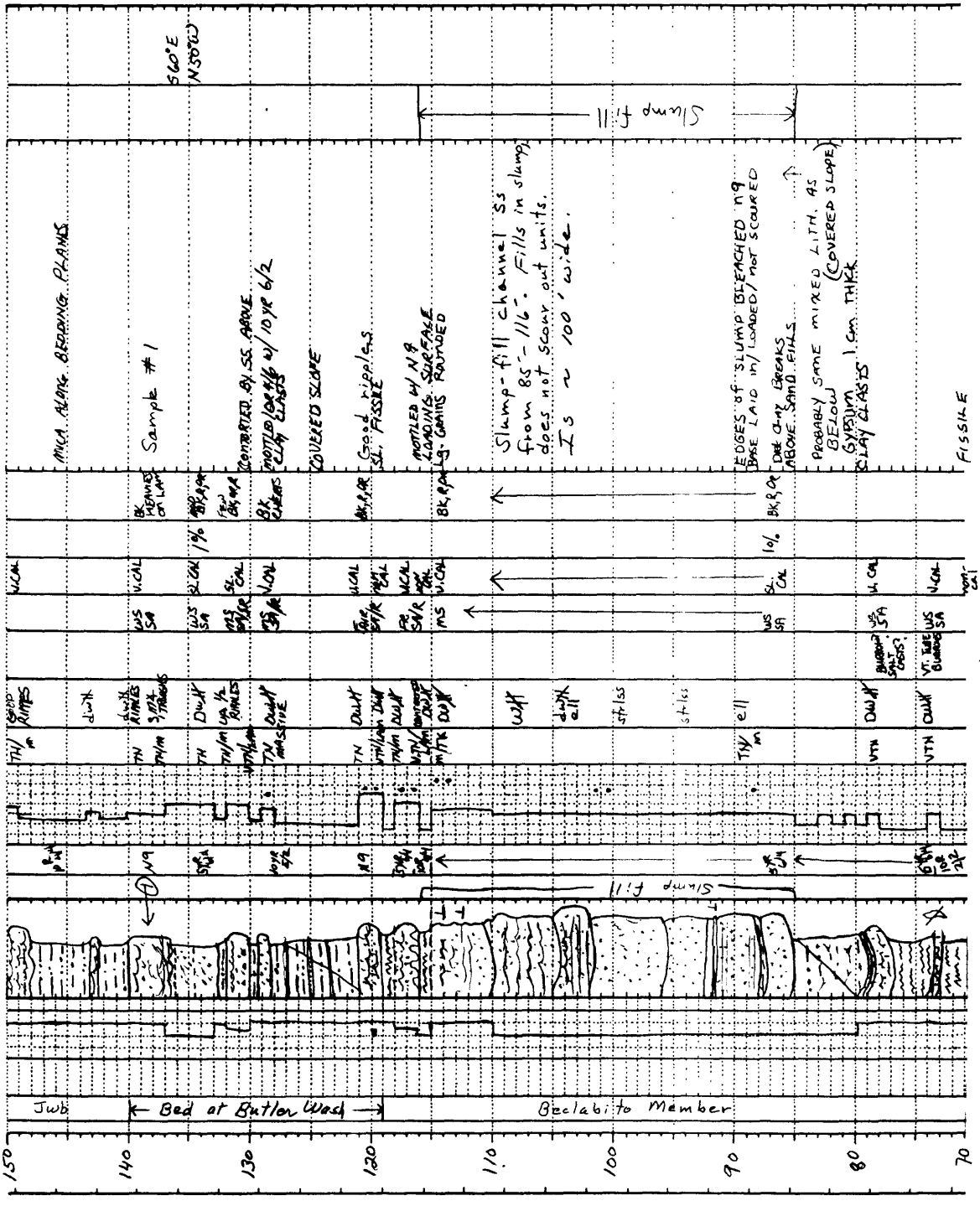
U.S.G.S. CORE LIBRARY NUMBER 7183 API WELL NUMBER Condon, Harris



LOCATION Gothic Wash Sec. 18 T. 42 S. R. 22 E.

(2) STATE Utah COUNTY

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



③ LOCATION GOTHIC WASH Sec. 18 S½, NW¼ T. 42 S. R. 22E.

STATE UTAH COUNTY

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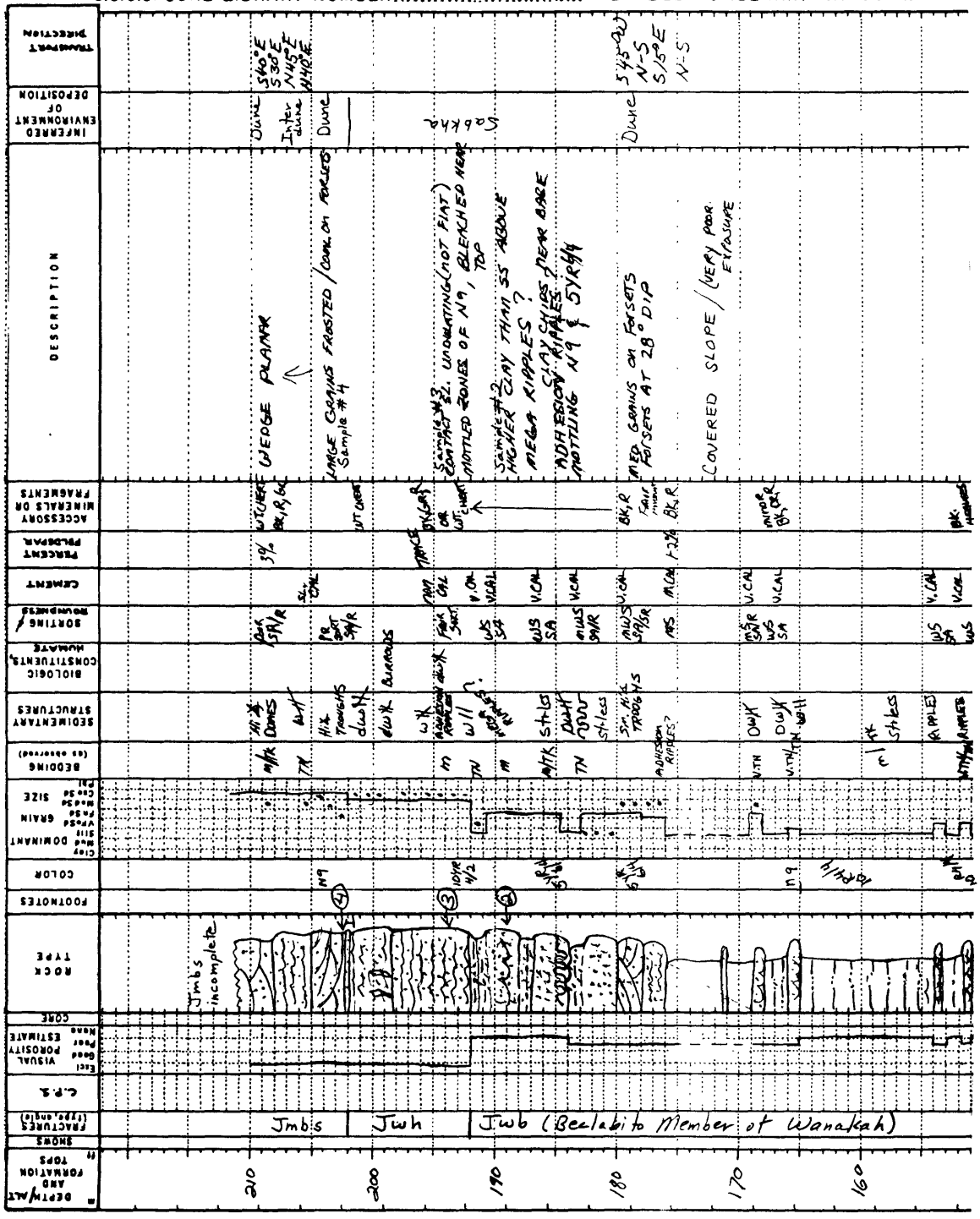

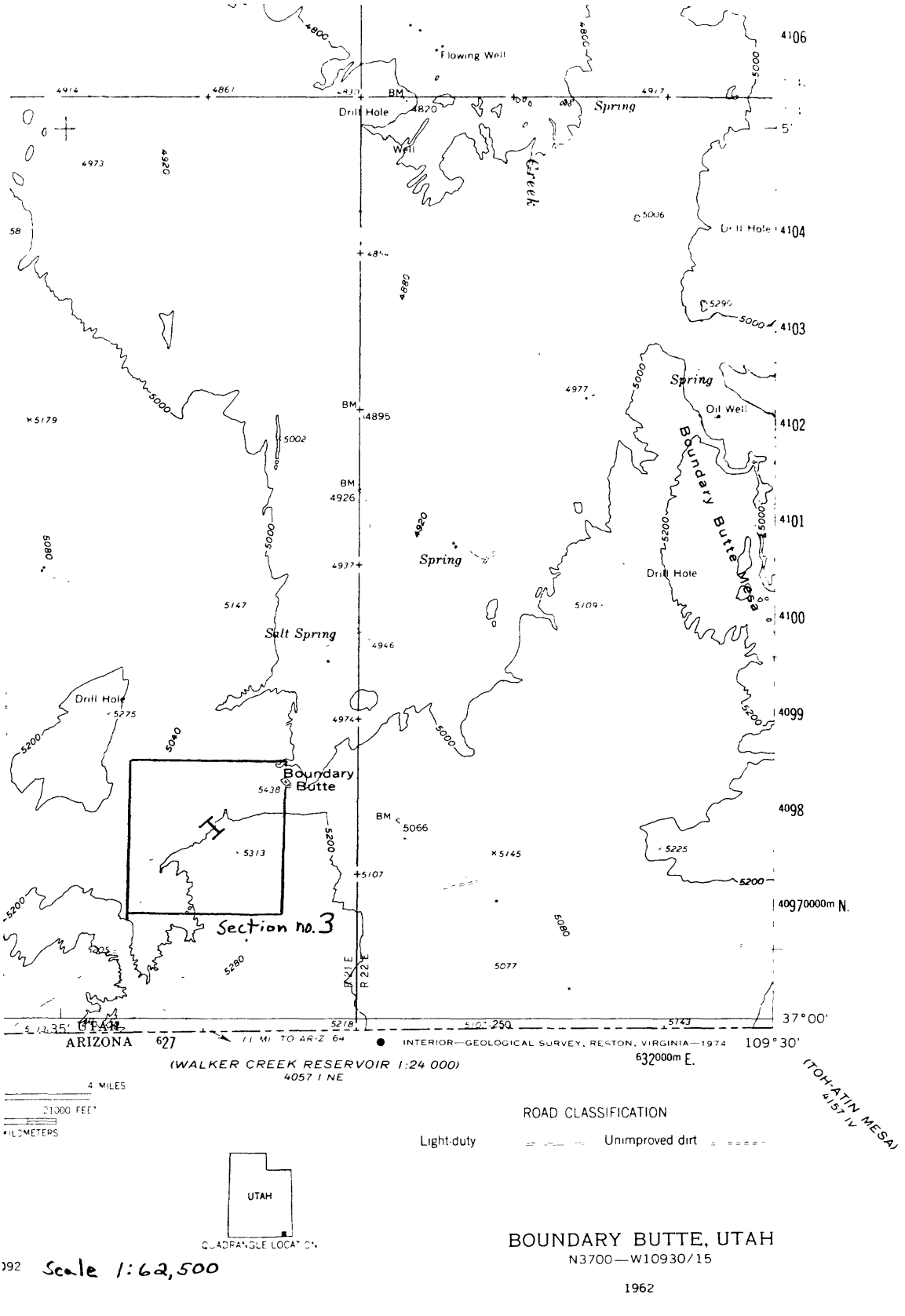

Figure 5. Location of measured section no. 3.

LOCATION 3. Boundary Butte NW 1/4, SW 1/4 Sec. 25 T. 43 S. R. 21 E.

STATE UTAH COUNTY San Juan

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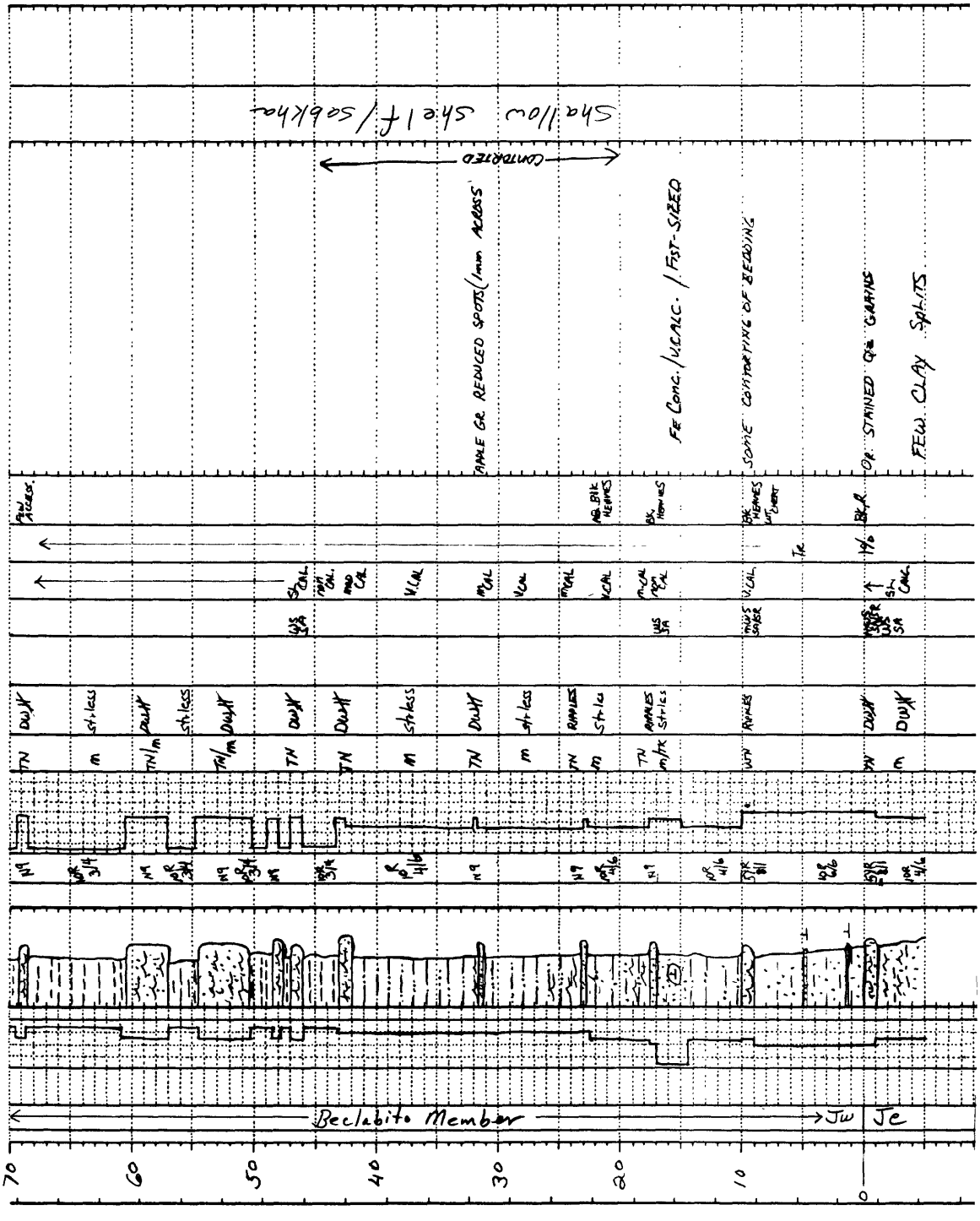
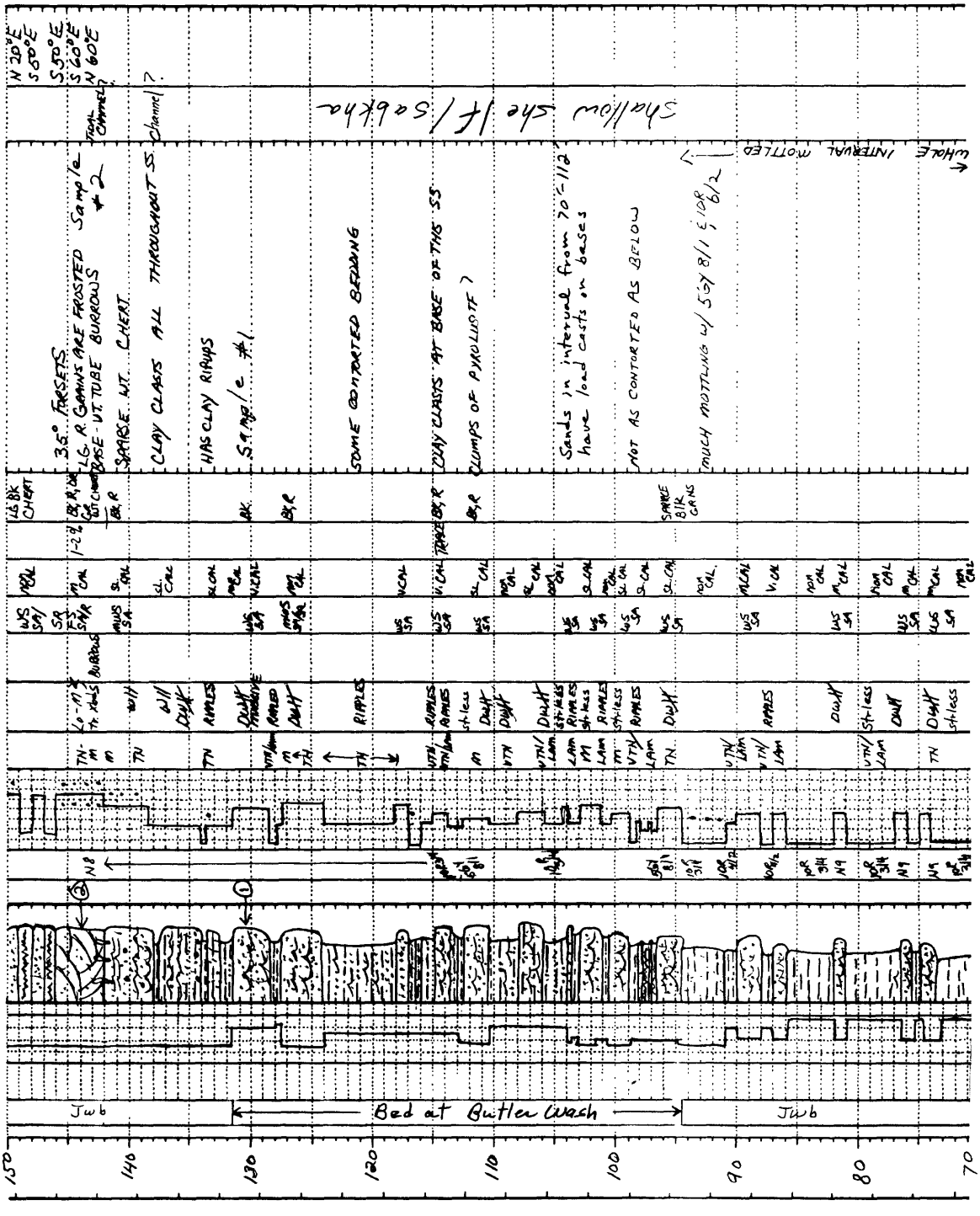


(8) LOCATION Boundary Butte Sec. 25 T. 43 S. R. 21 E

STATE UTAH COUNTY San Juan

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION Boundary Butte Sec. 25 T. 43 S. R. 21 E

(3) STATE UTAH COUNTY San Juan

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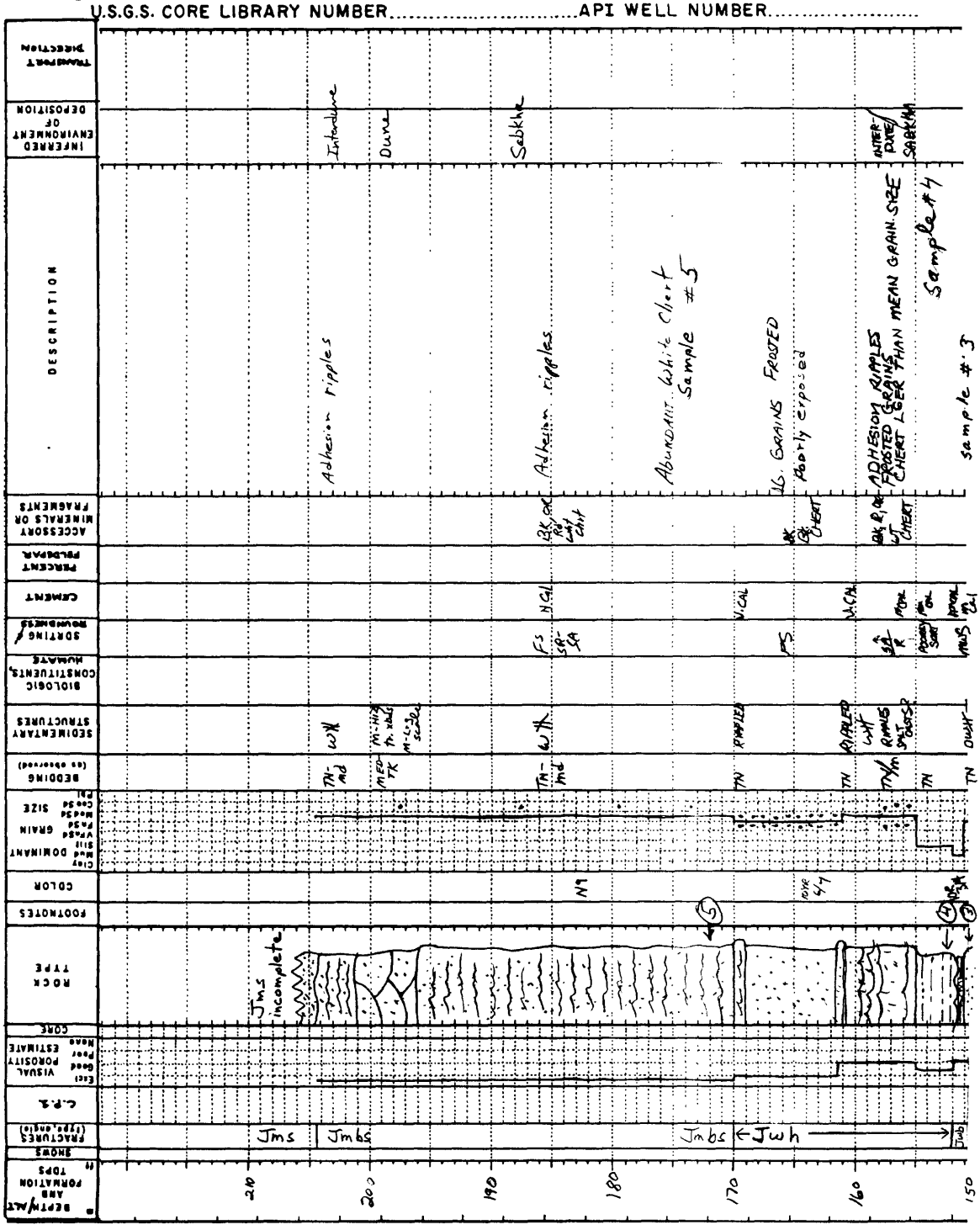


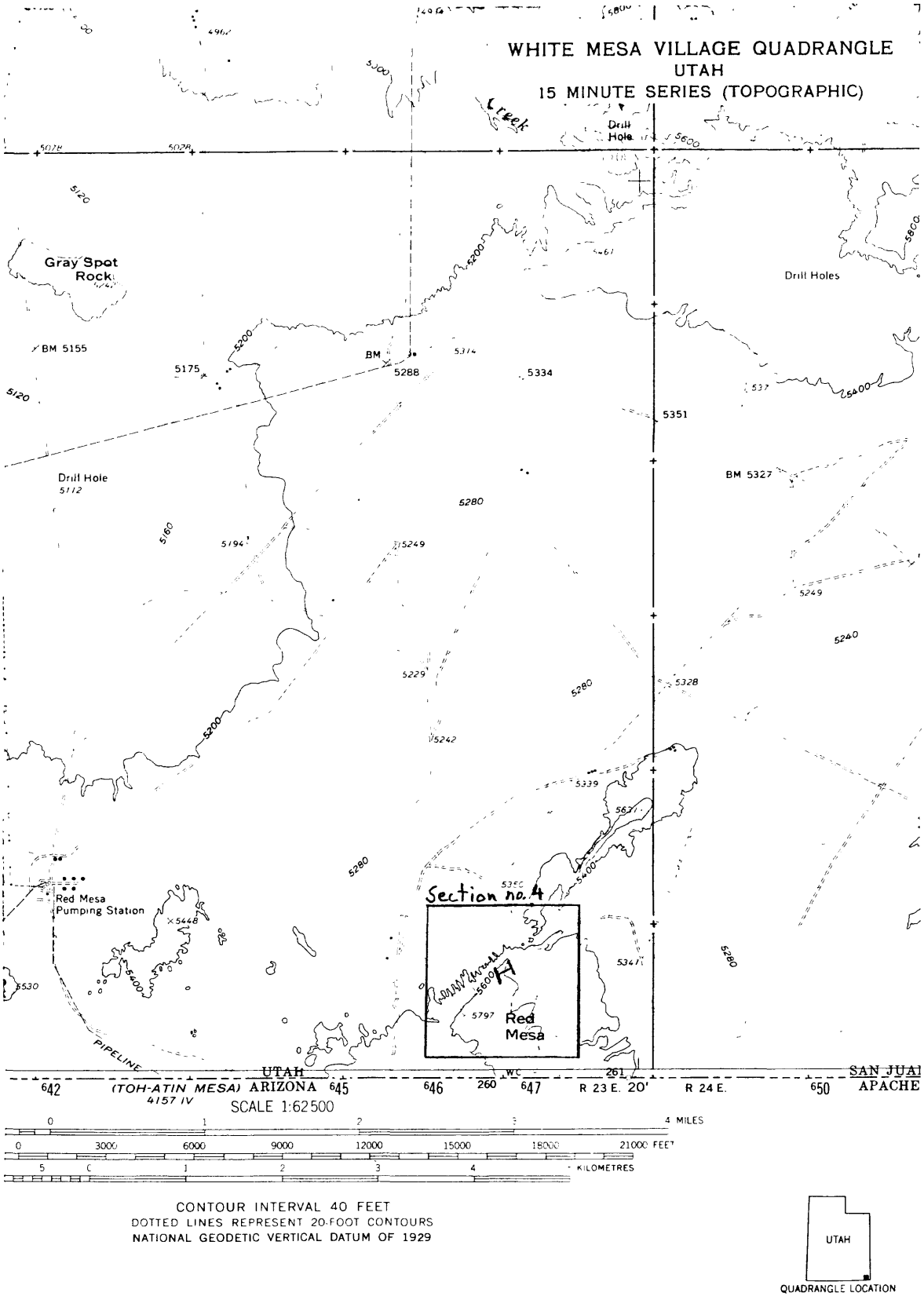
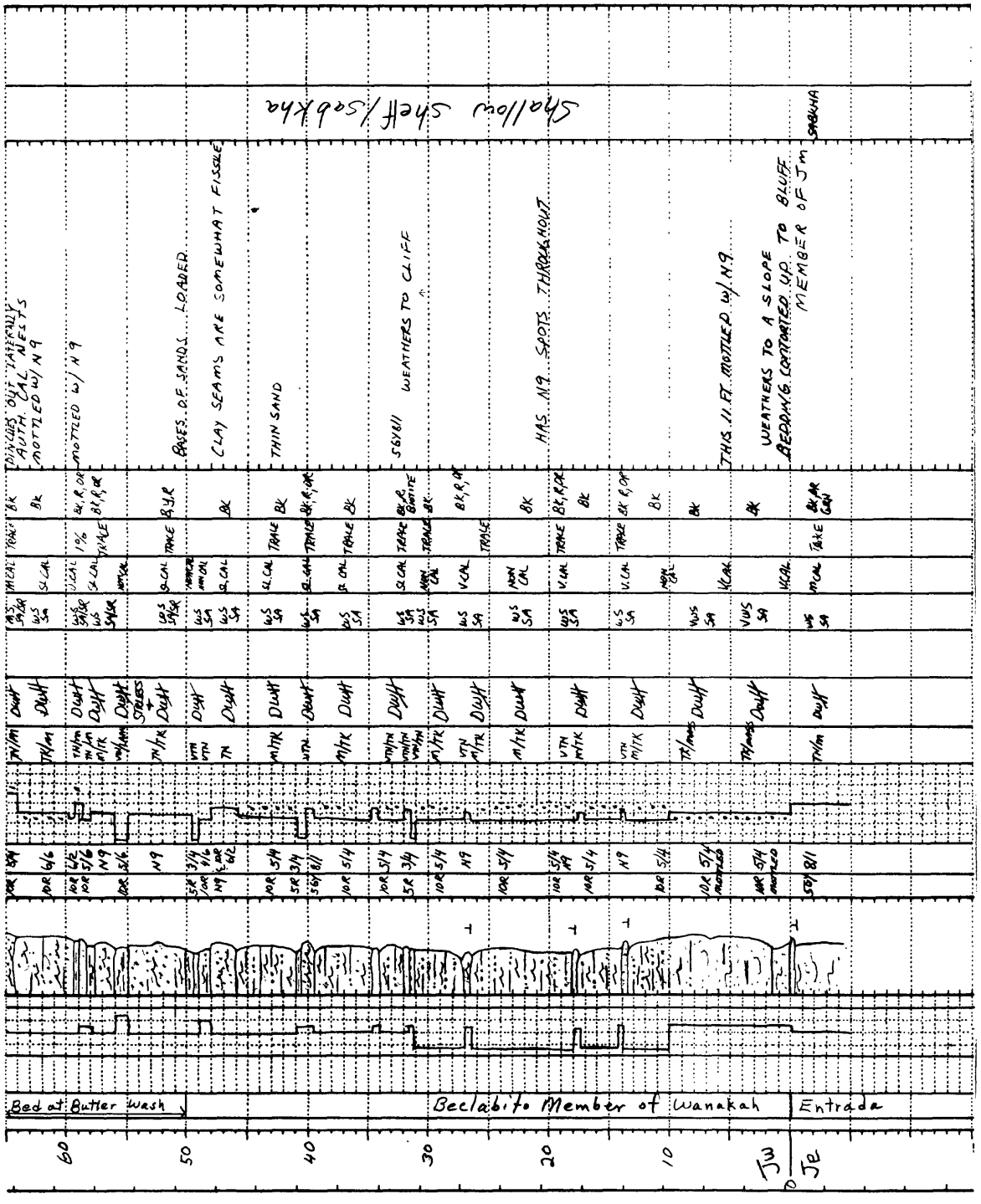


Figure 6. Location of measured section no. 4.

LOCATION 4 RED MESA Sec. 36 W1/2, NW 1/4 T. 43S R. 23E

(1) STATE UTAH COUNTY San Juan

U.S.G.S. CORE LIBRARY NUMBER 8183 API WELL NUMBER Gordon Harris



LOCATION RED MESA Sec. 36 T. 43S R. 23E

(2) STATE Utah COUNTY San Juan

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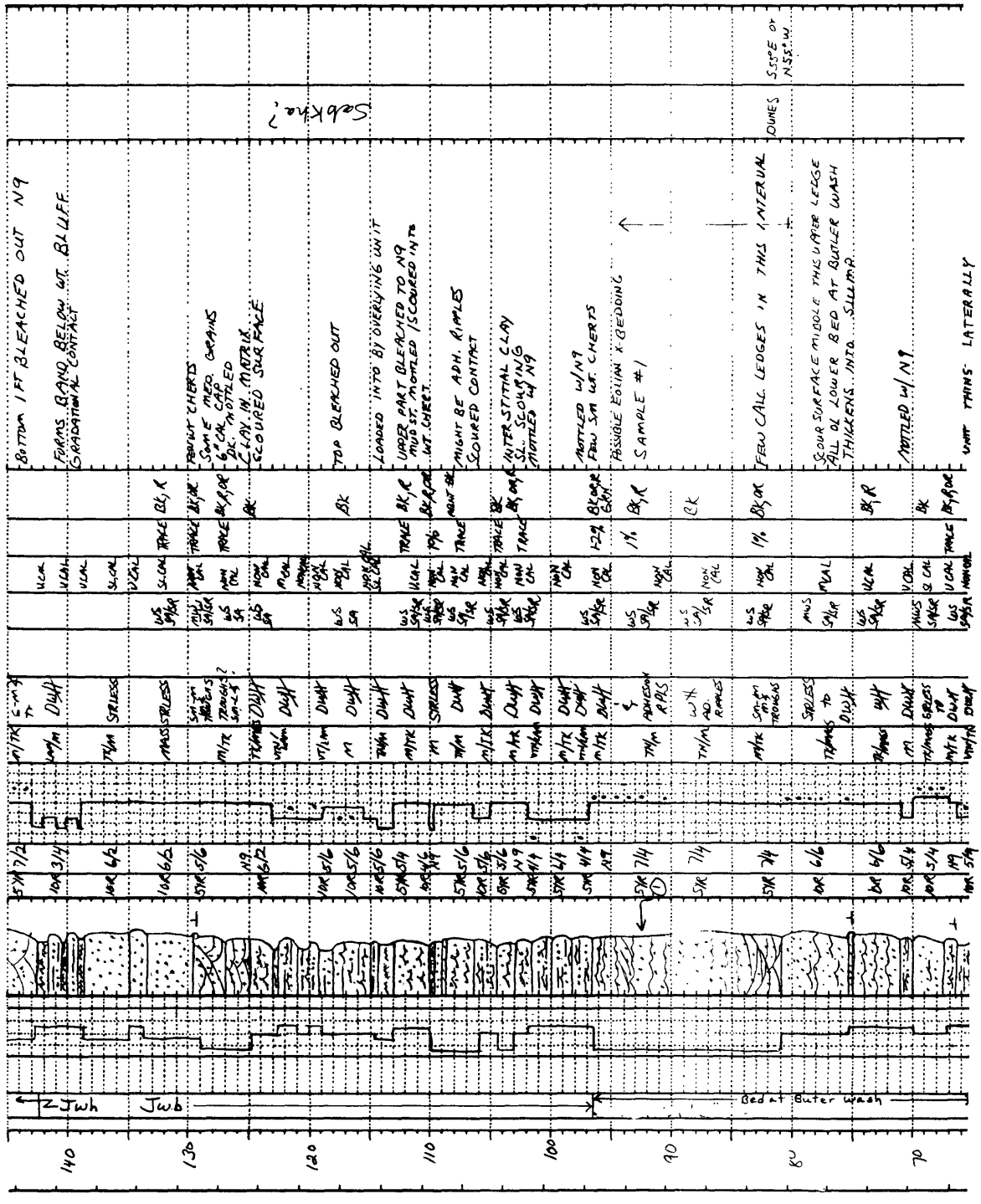
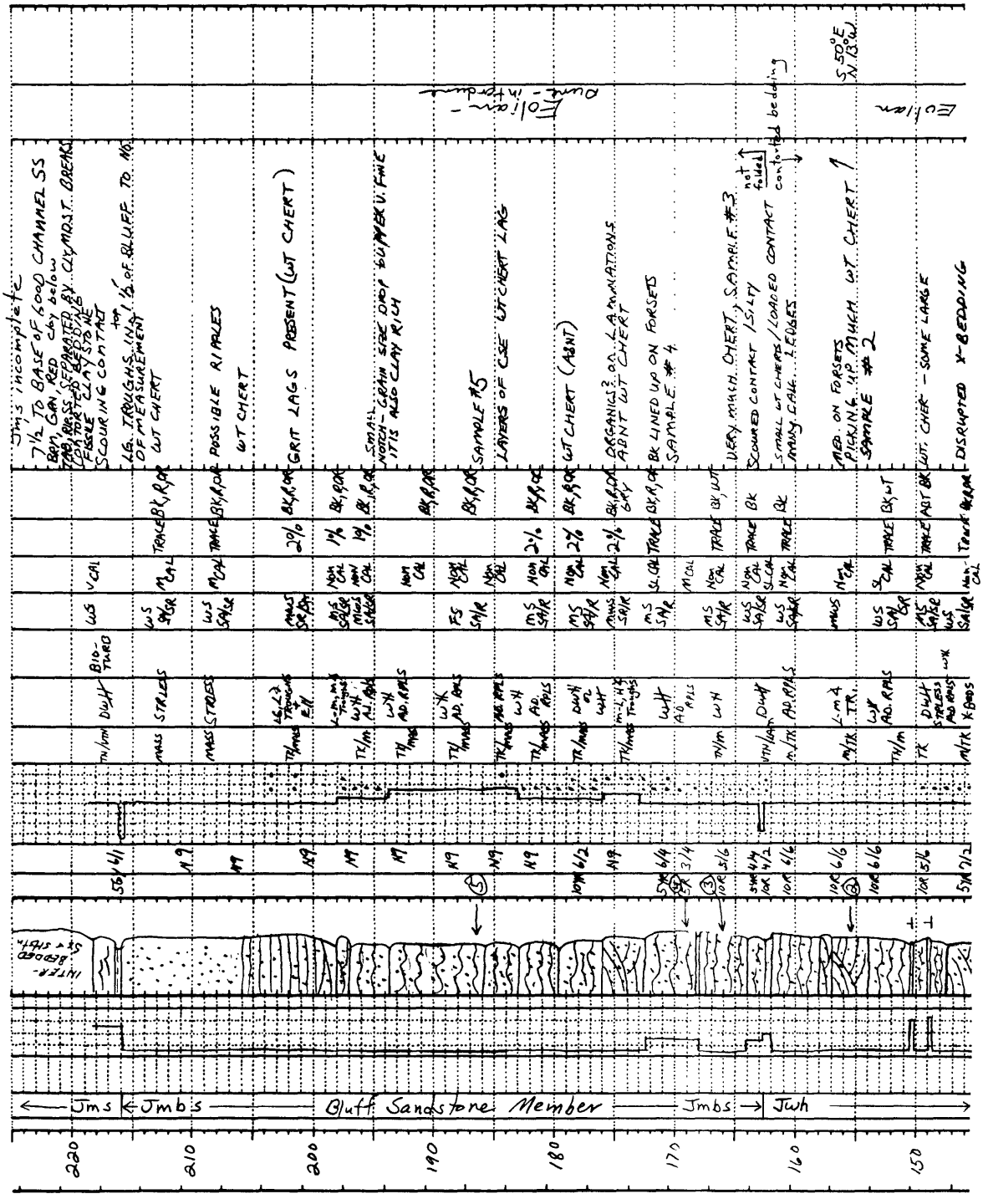


LOCATION Red Mesa Sec. 36 T. 43 S R. 23 E

(3) STATE Utah COUNTY San Juan

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



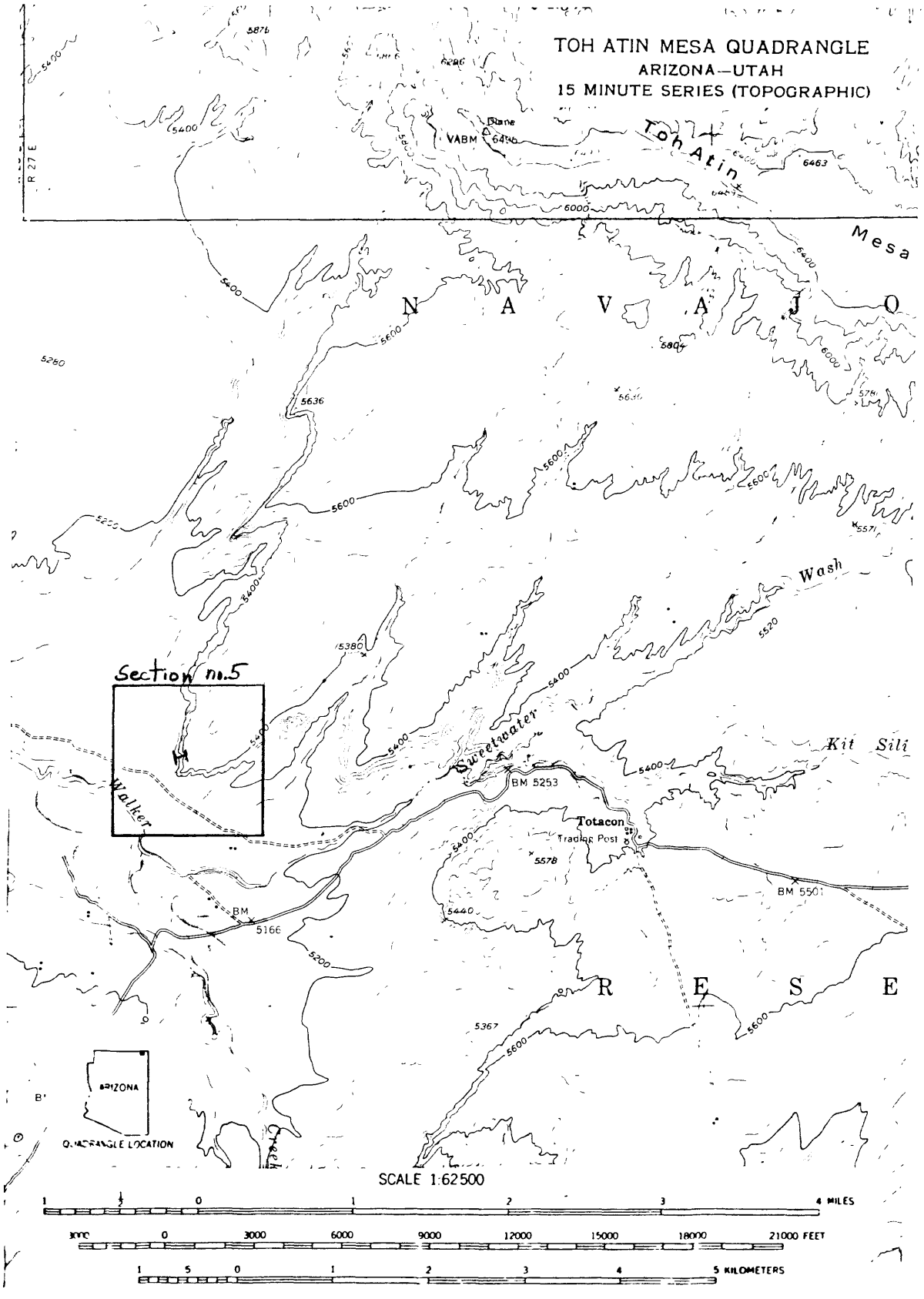
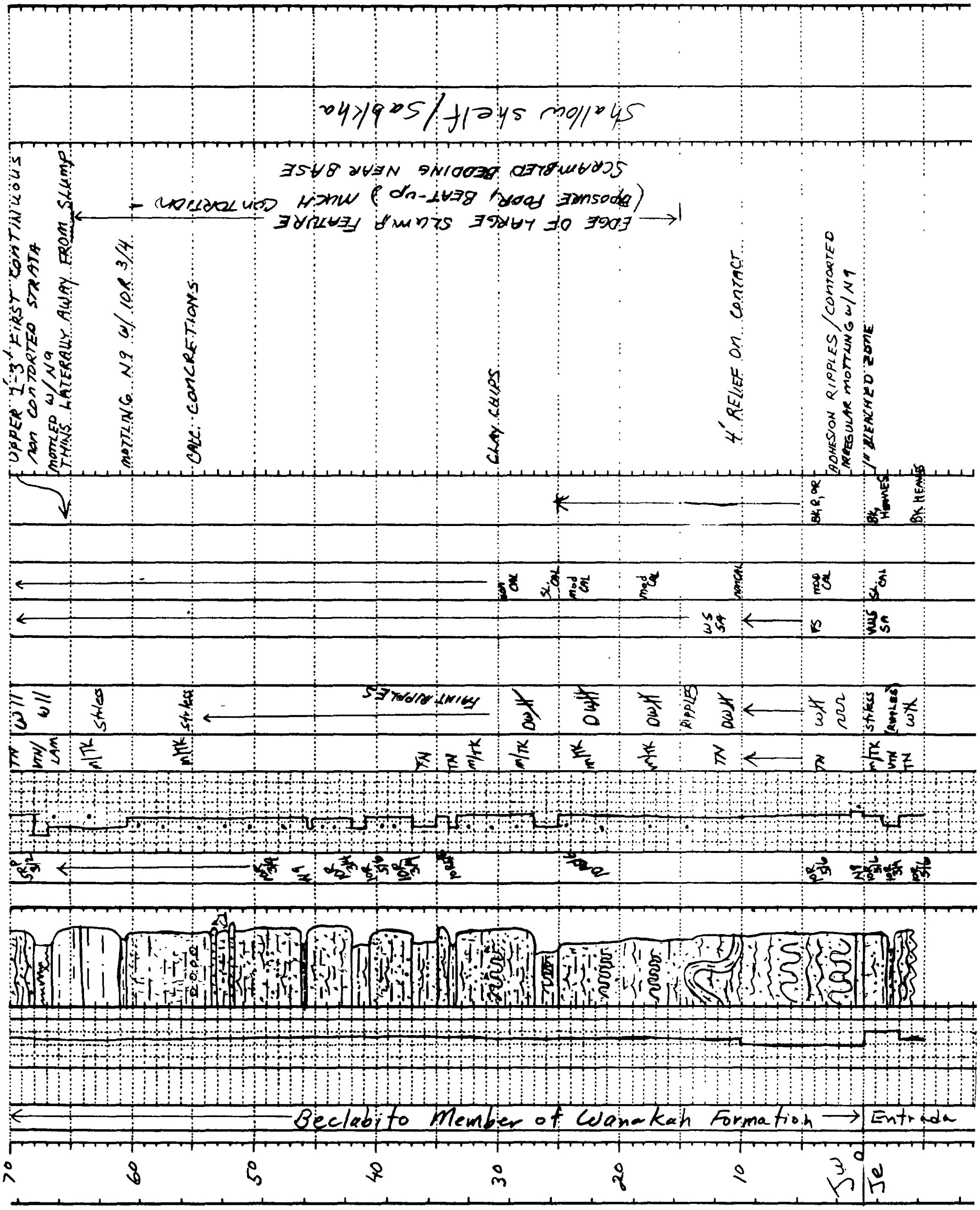


Figure 7. Location of measured section no. 5.

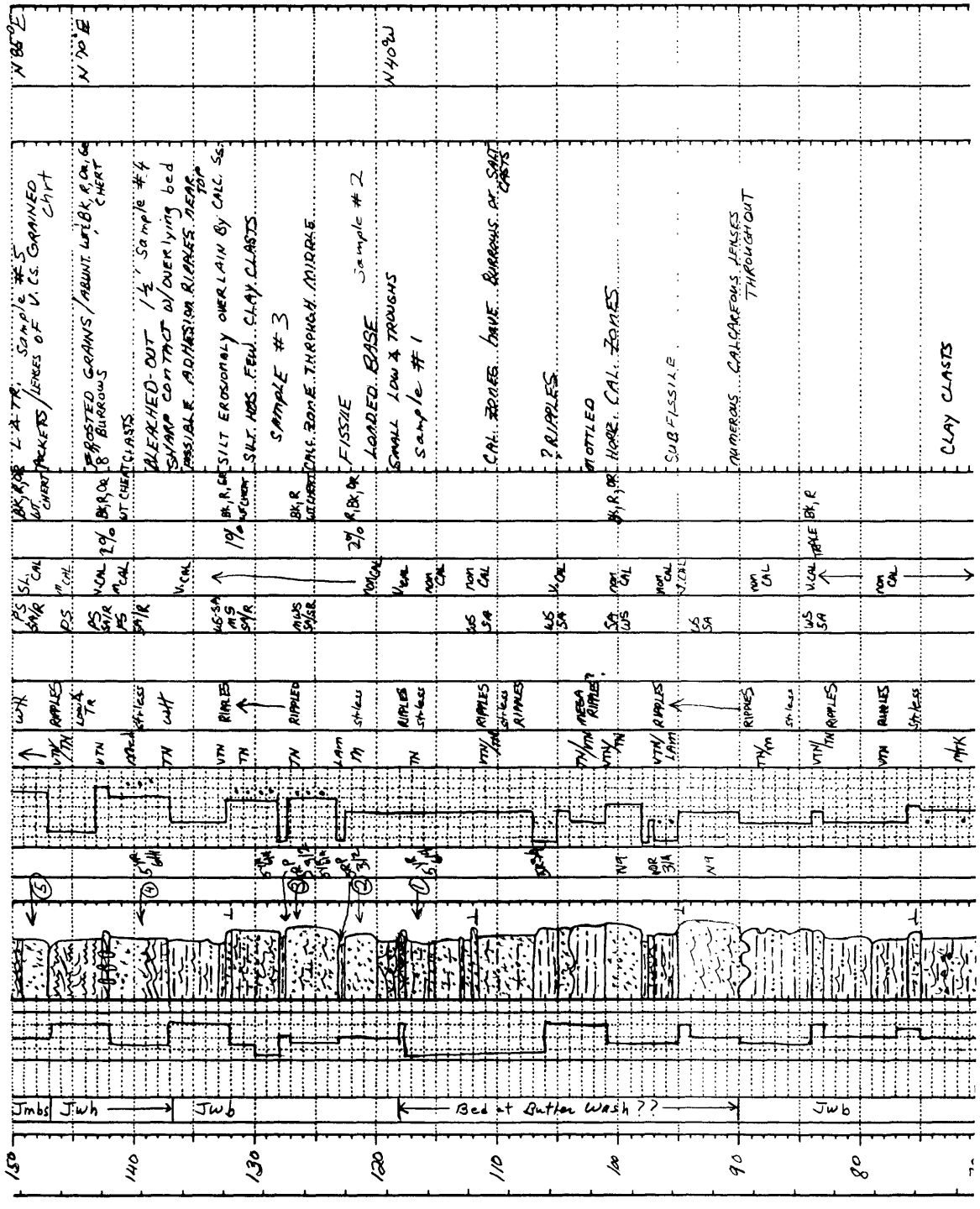
LOCATION 5. Toh Atin Mesa Sec. 20 (SW 1/4, NW 1/4) T. 40 N R. 27 E (Estimated)

① STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER 8/83 API WELL NUMBER Condon, Harris



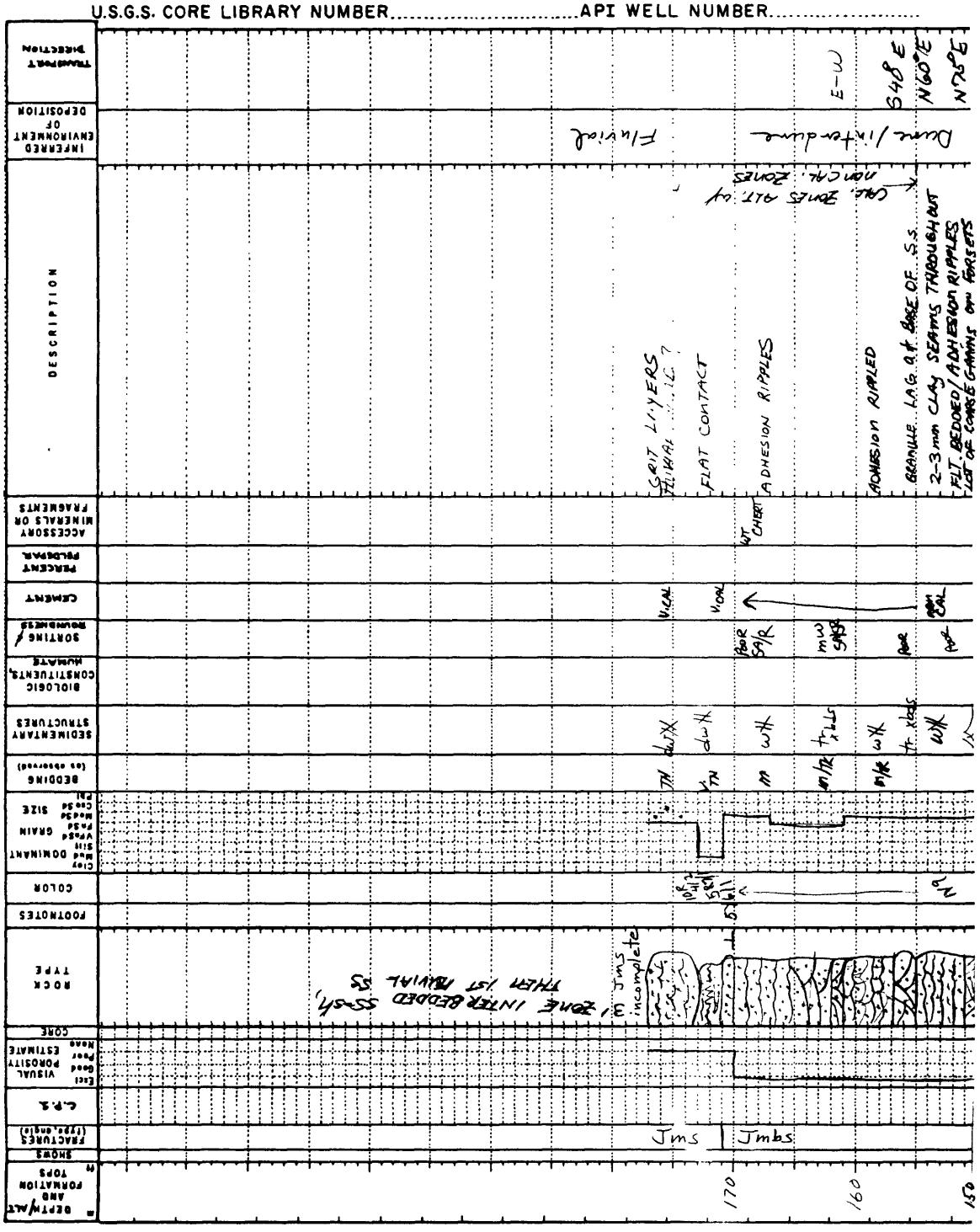
(2) LOCATION Tohatin Mesa Sec. 28 T. 40 N R. 27 E (est.)
STATE Arizona COUNTY Apache
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



(3) LOCATION Tom ATIN MESA Sec. 20 T. 40 N R. 27 E (est.)

STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



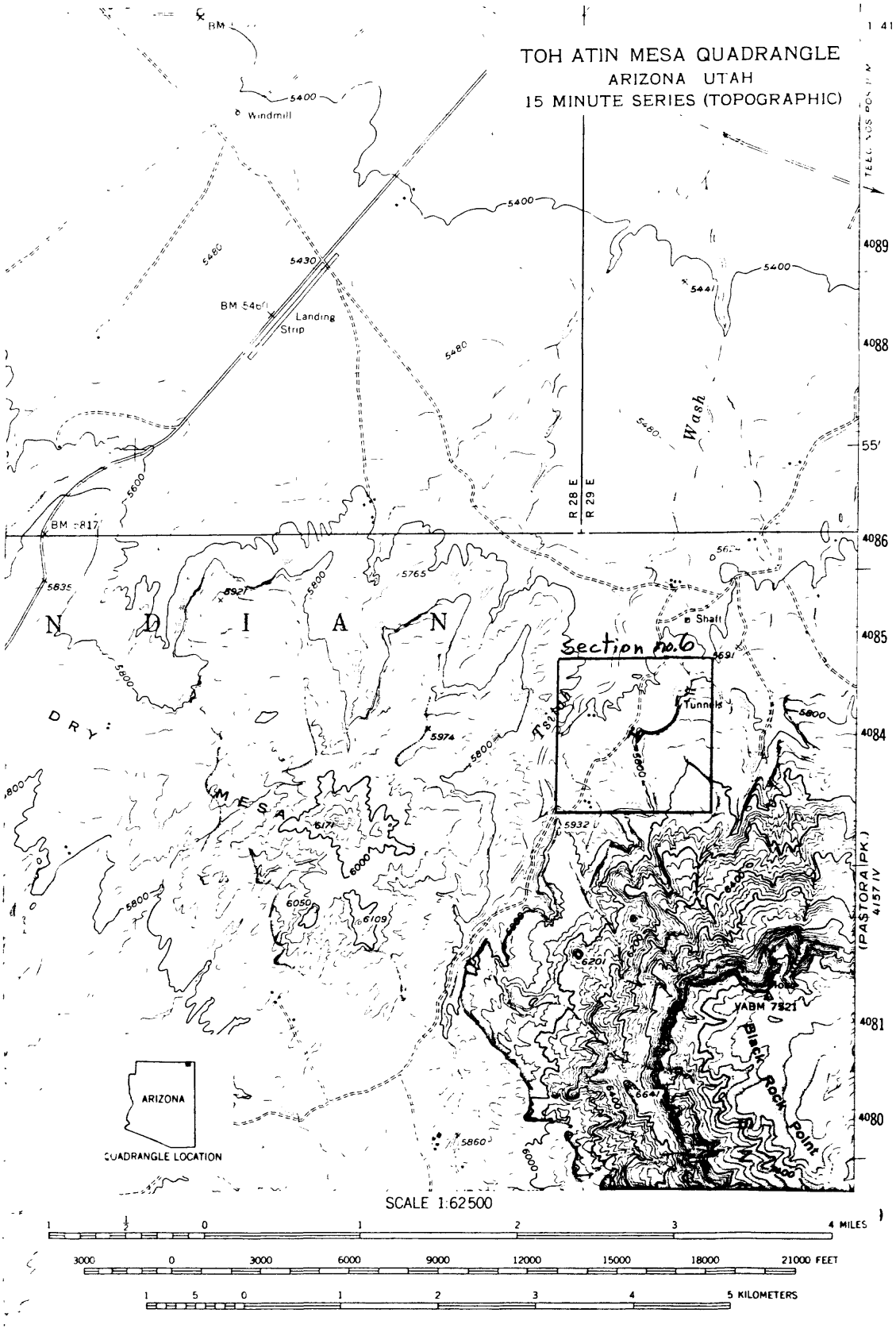
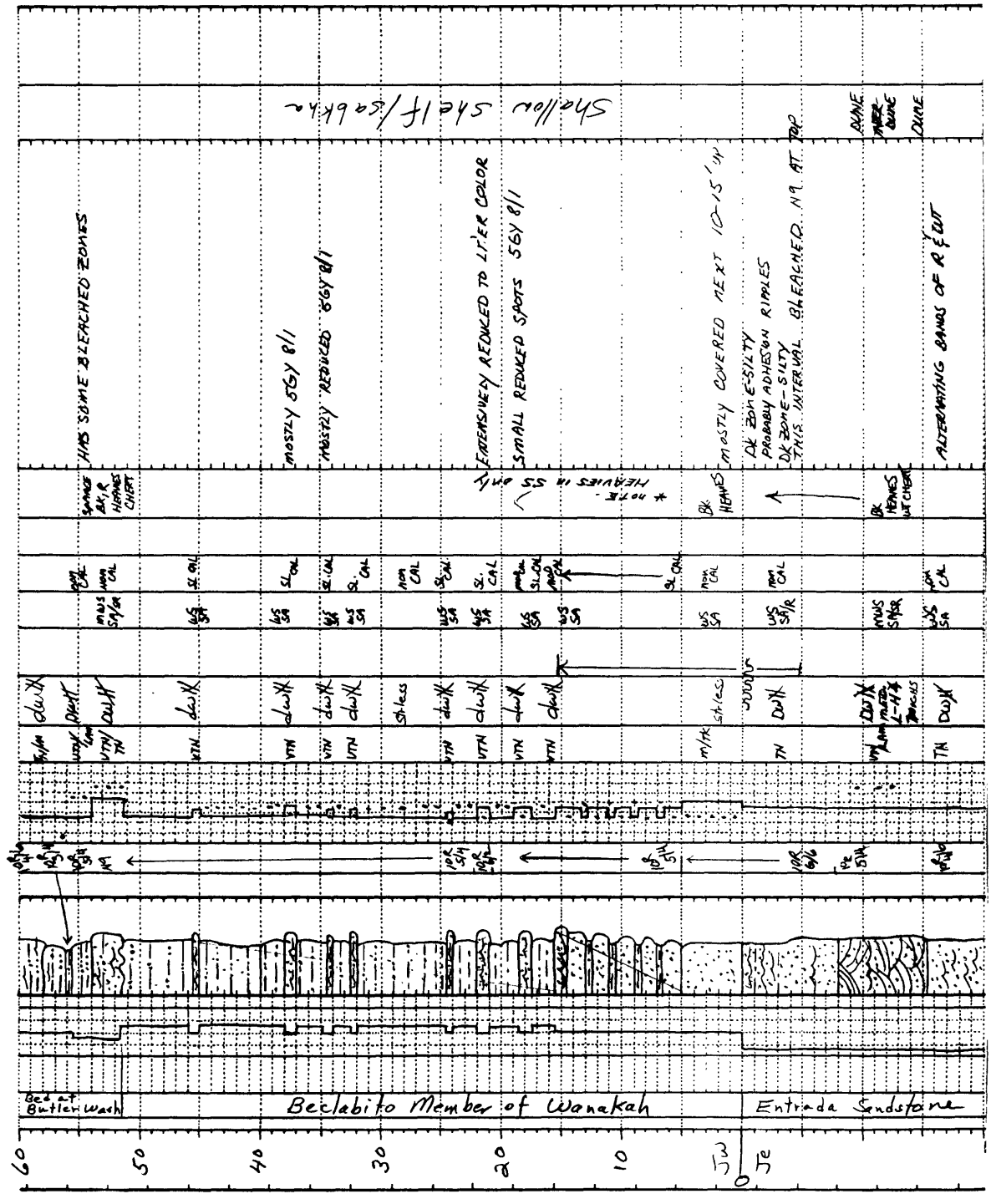


Figure 8. Location of measured section no. 6.

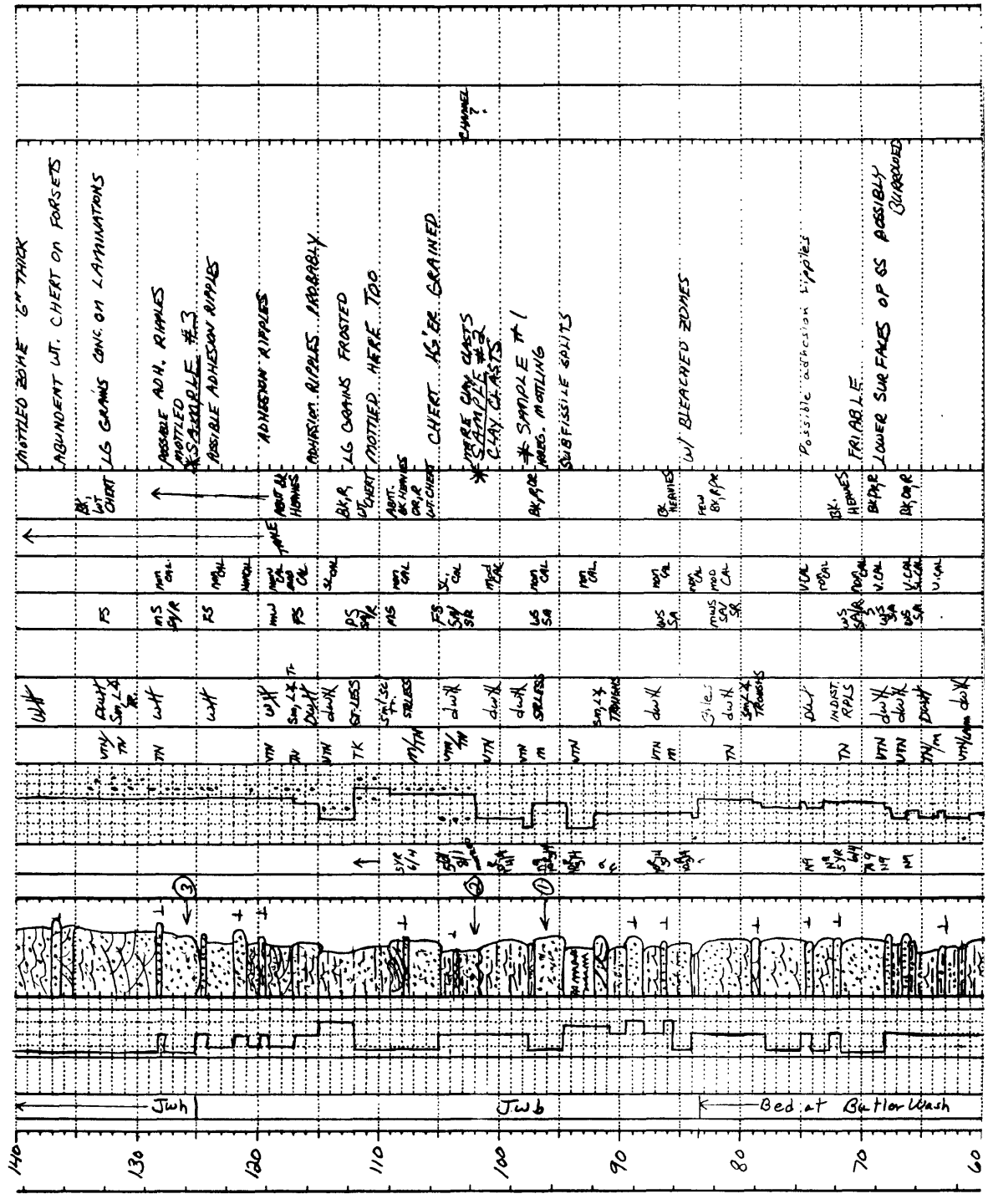
6. SE¼, NW¼
LOCATION Tsitah Wash Sec. 7 T. 40 N. R. 29E. (estimated)
① STATE Arizona COUNTY Apache
U.S.G.S. CORE LIBRARY NUMBER 8183 API WELL NUMBER Conoco, Harris



LOCATION TSEGI WASH Sec. 7 T. 40N. R. 29E (est.)

(2) STATE Arizona COUNTY Apache

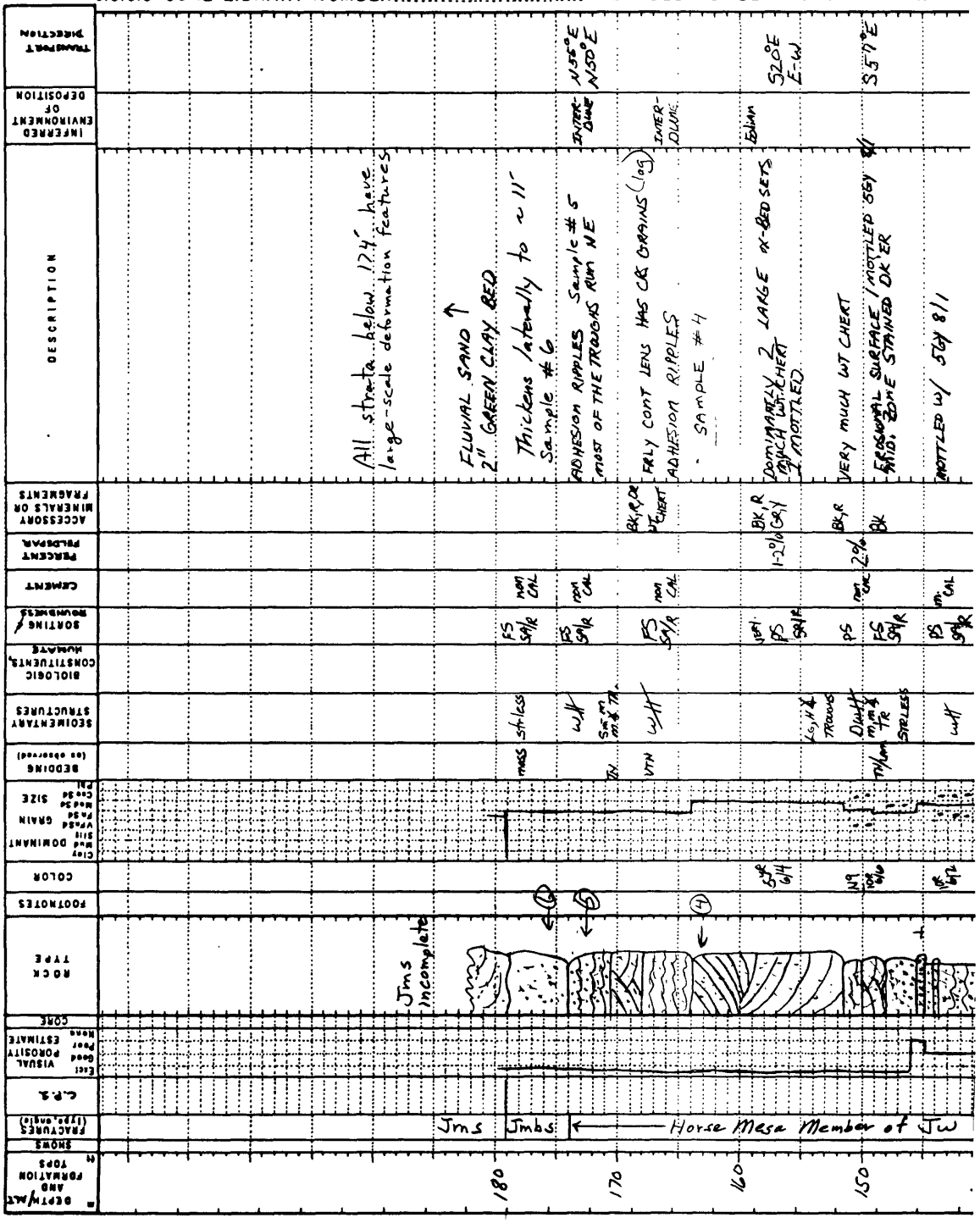
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION TSITAH WASH Sec. 7 T. 40 N R. 29E (est.)

(3) STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



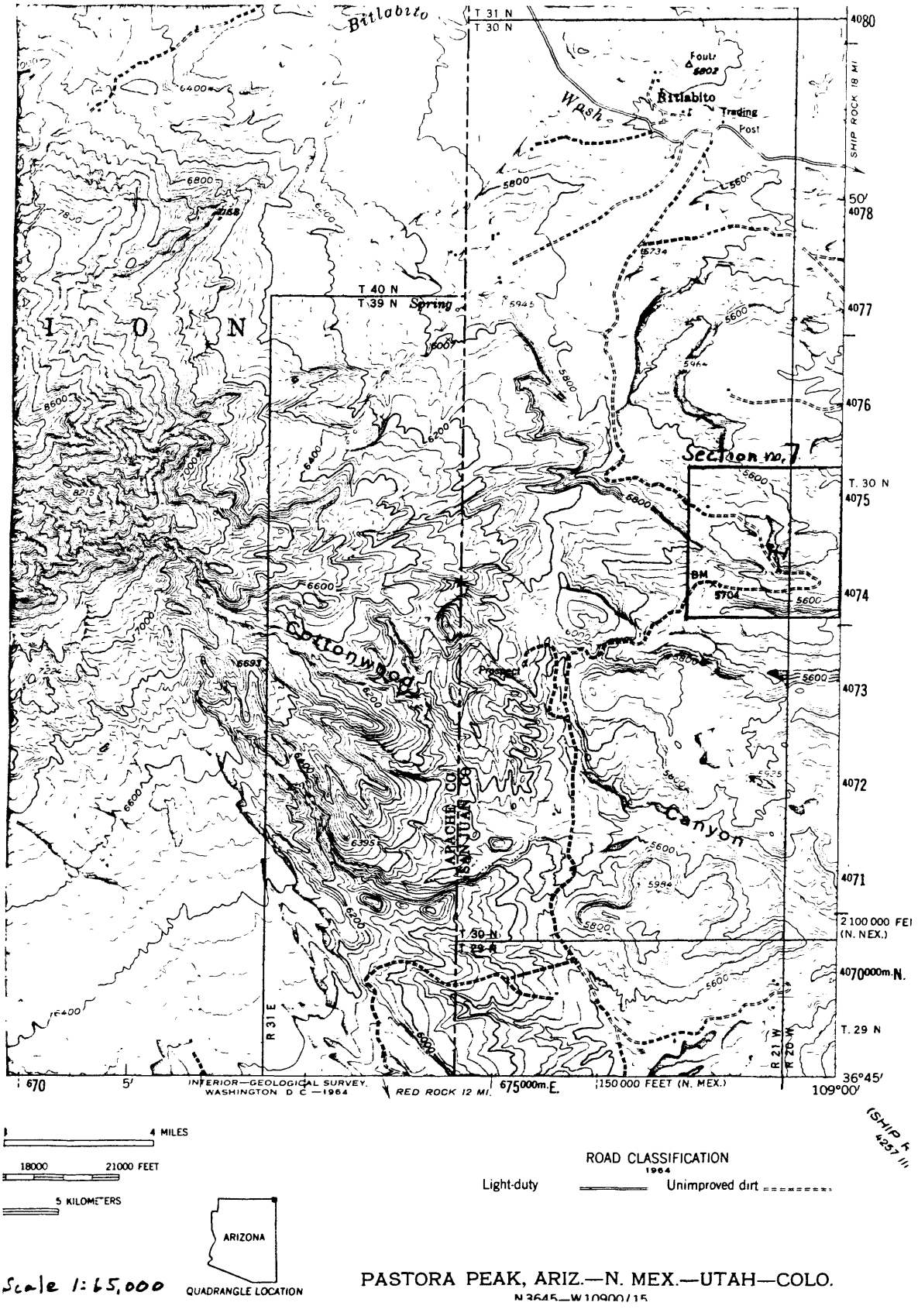
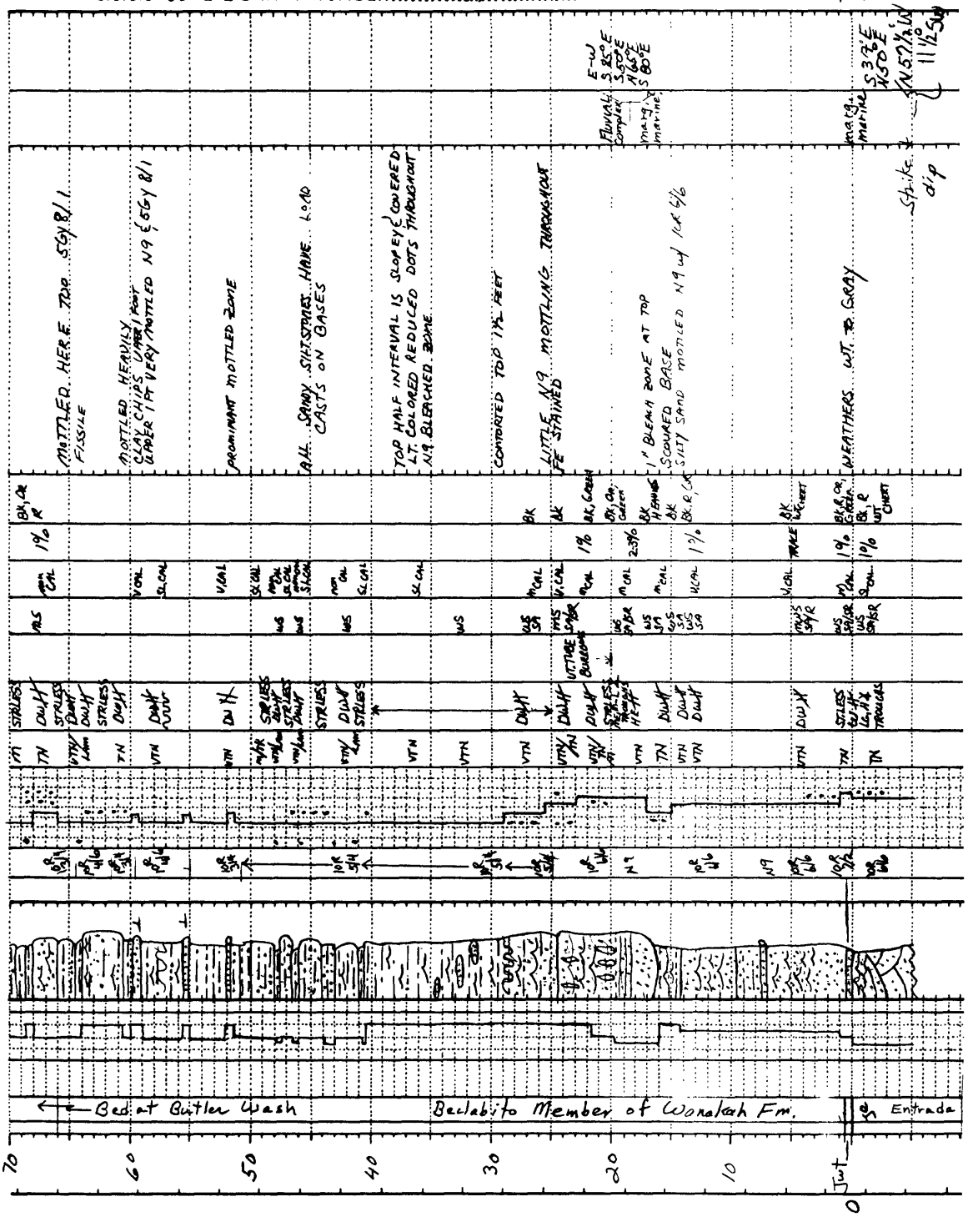


Figure 9. Location of measured section no. 7.

LOCATION Beclabito Dome Sec. 24 SE1/4, NE1/4 T. 30N R. 21W.

STATE New Mexico COUNTY San Juan

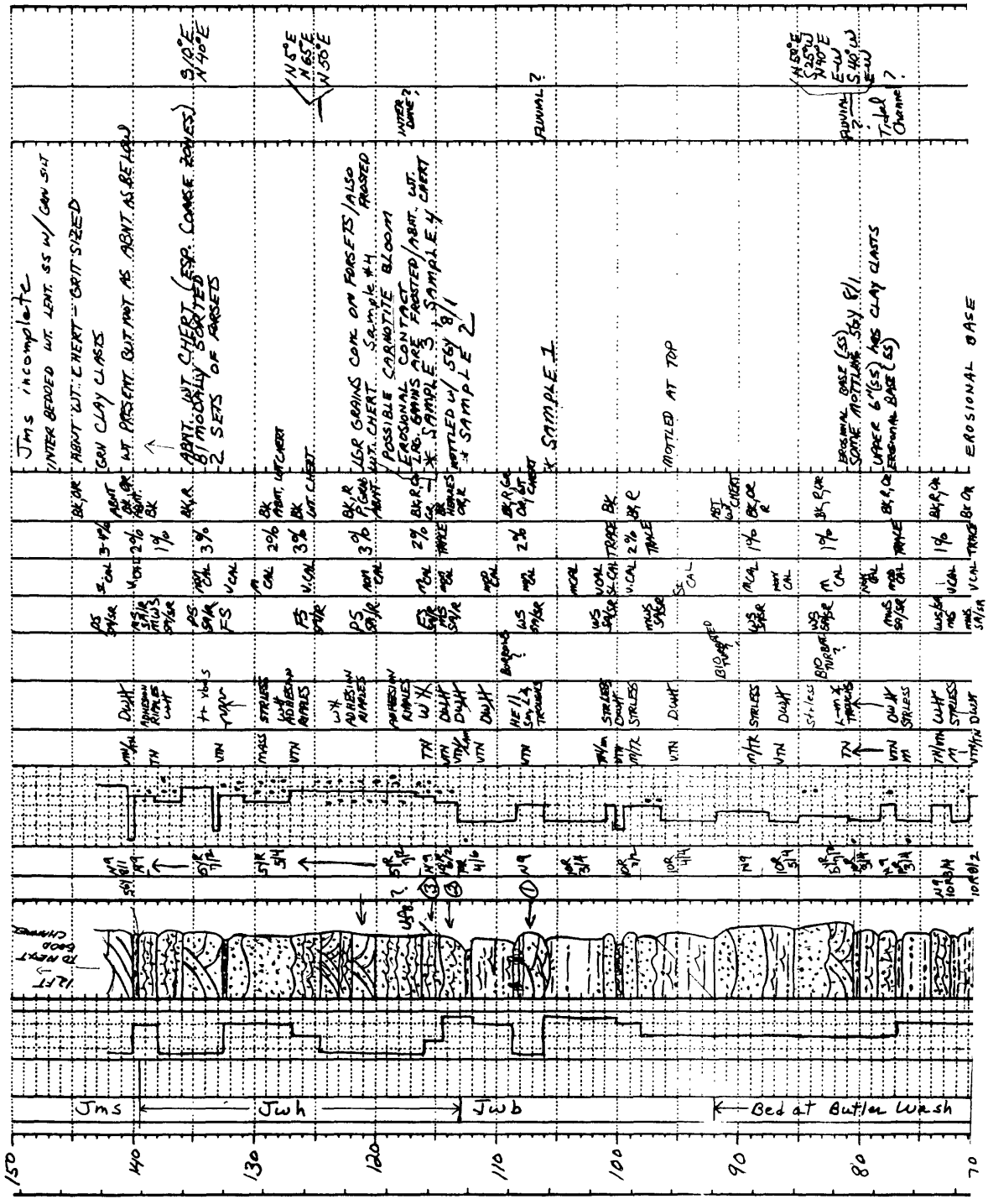
U.S.G.S. CORE LIBRARY NUMBER 8183 API WELL NUMBER Conron, Harris



LOCATION Bec Lab ito Dome Sec. 24 T. 30N R. 21W

STATE New Mexico COUNTY San Juan

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



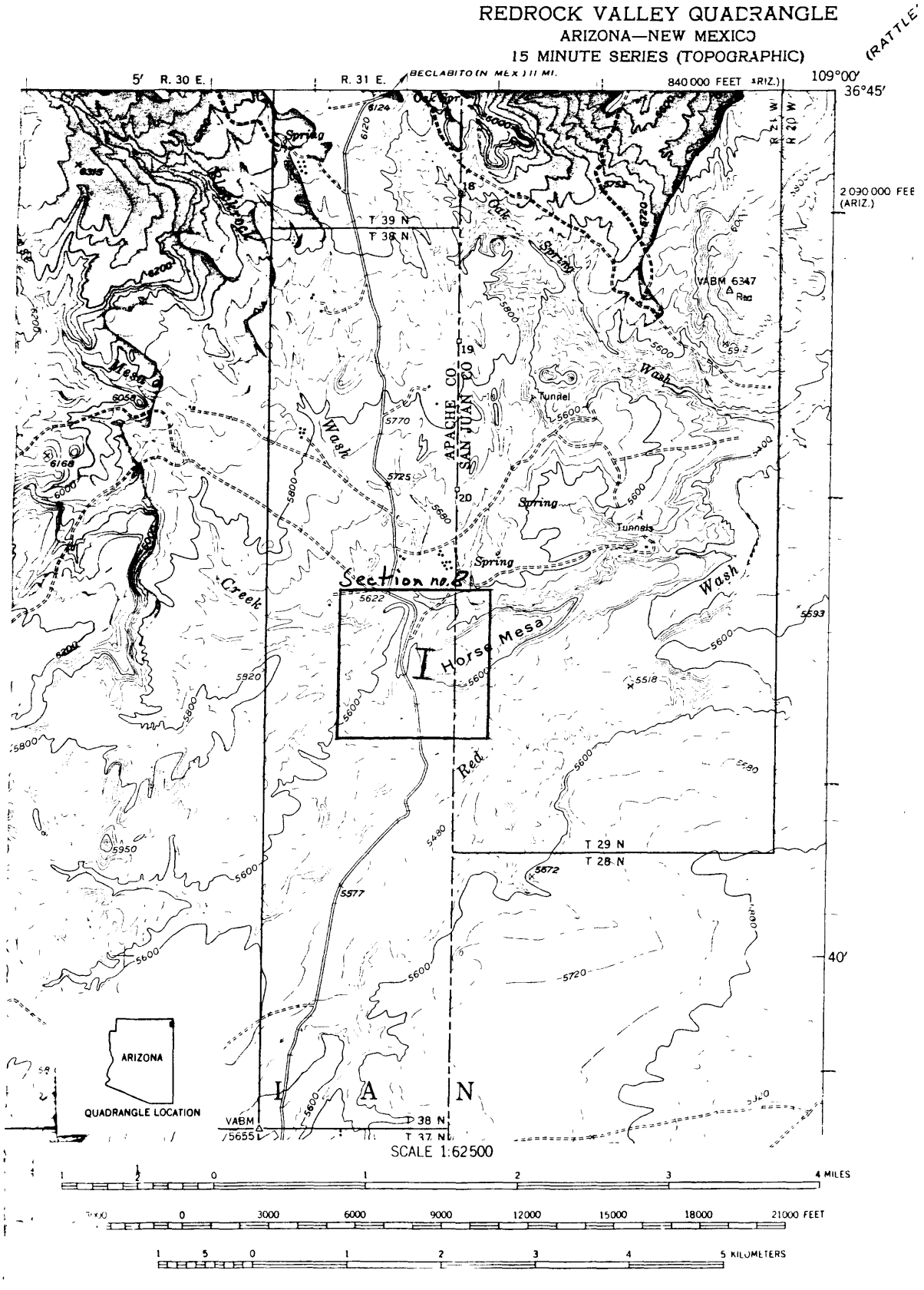
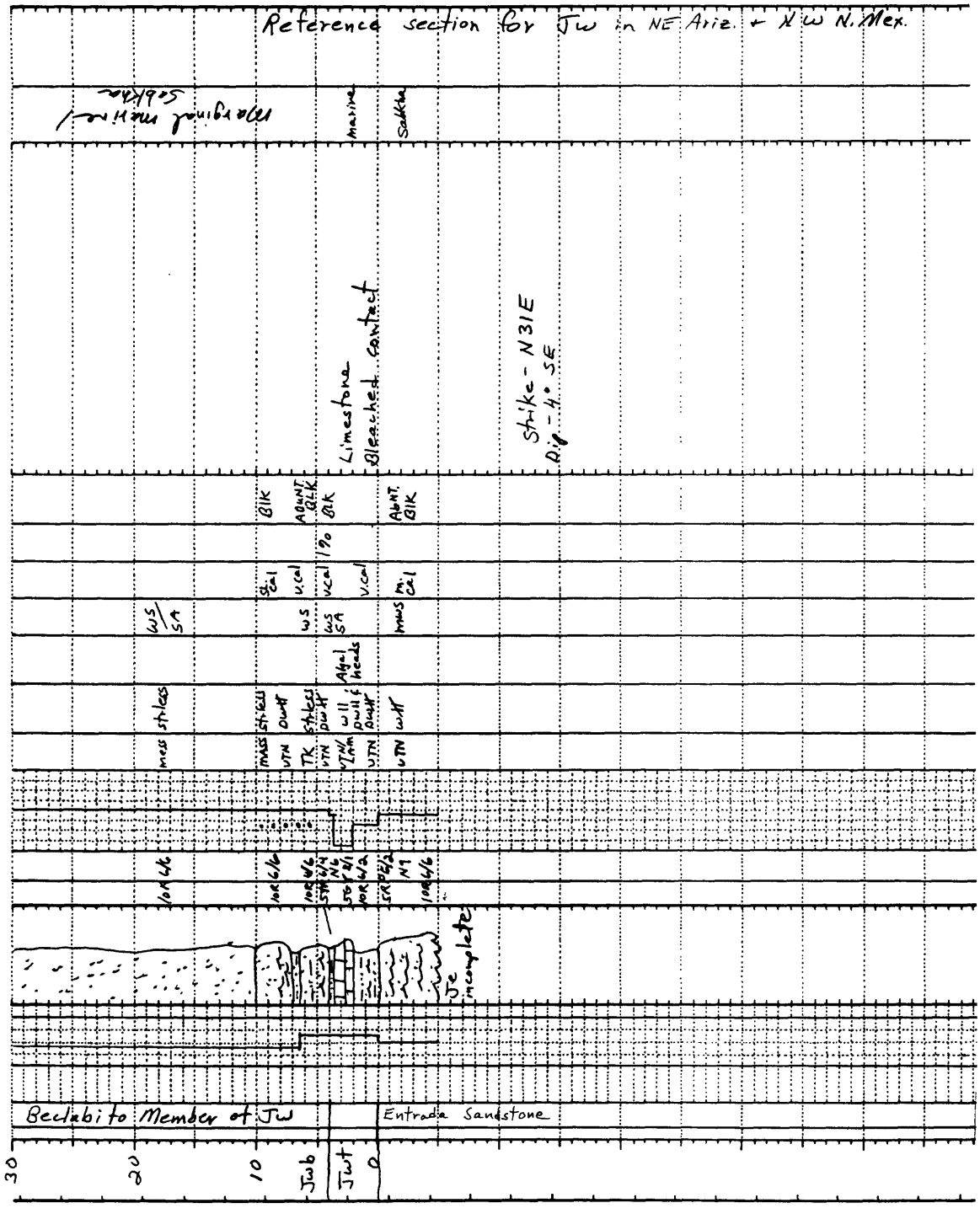


Figure 10. Location of measured section no. 8.

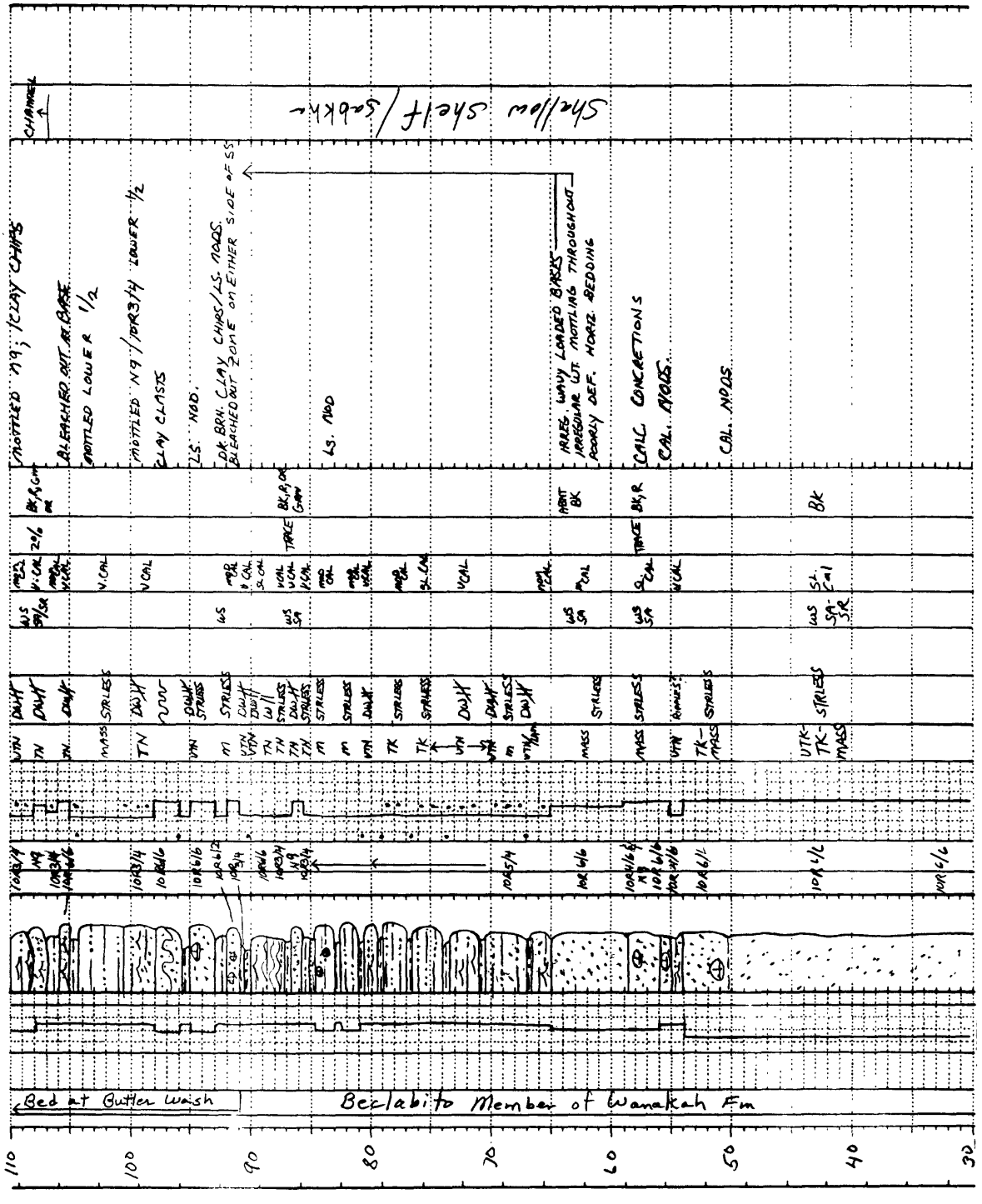
LOCATION 8. Horse Mesa Sec. 17 SW1/4, SW1/4 T. 38 N. R. 31E.

STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER 8183 API WELL NUMBER Condon / Harris



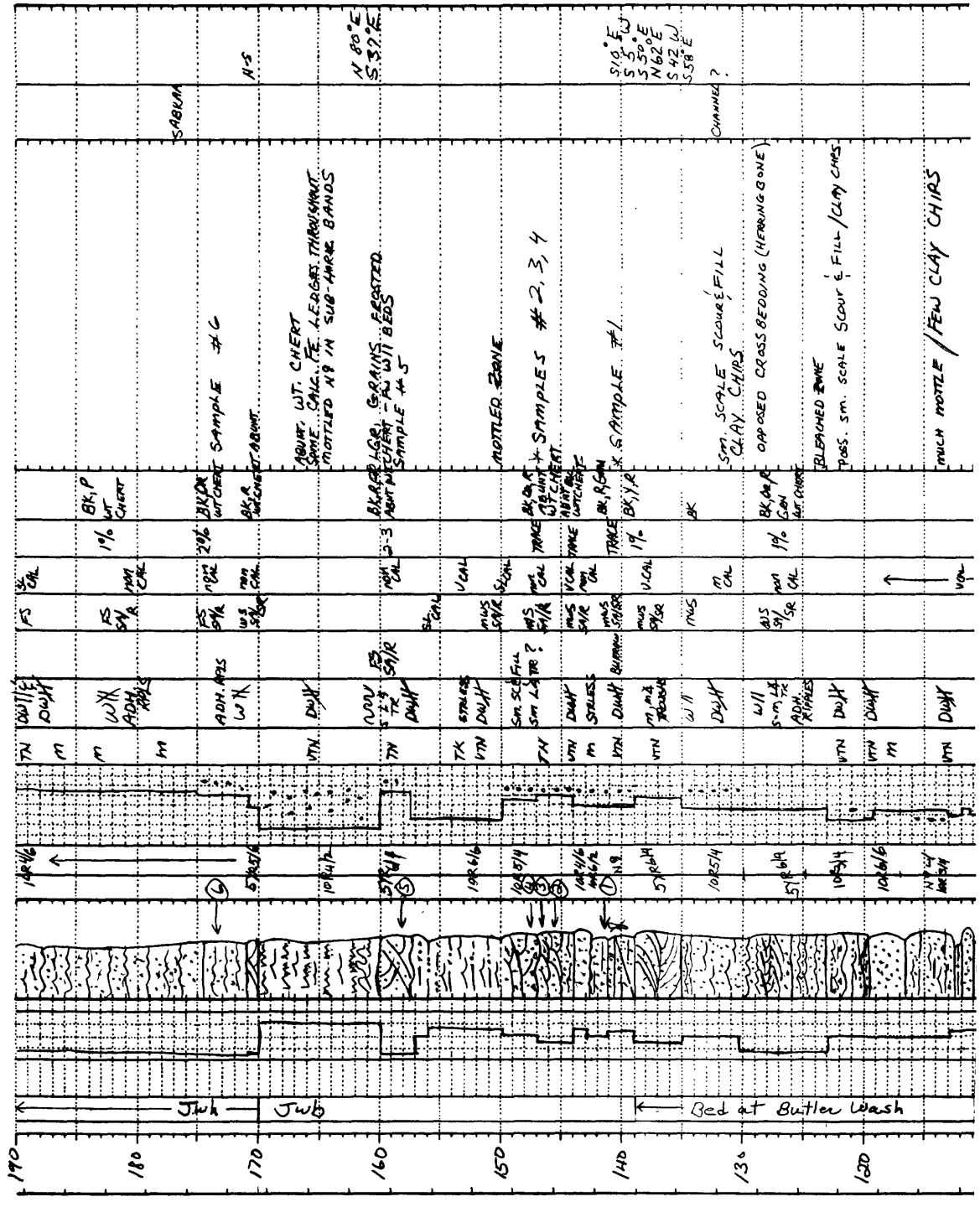
LOCATION HORSE MESA Sec. 17 SW¼, SW¼ T. 38 N. R. 31 E.
STATE Arizona COUNTY Apache
U.S.G.S. CORE LIBRARY NUMBER 8182 API WELL NUMBER CONDON + HARRIS



(3) LOCATION Horse Mesa Sec. 17 T. 38 N R. 31E

STATE Arizona COUNTY Apache

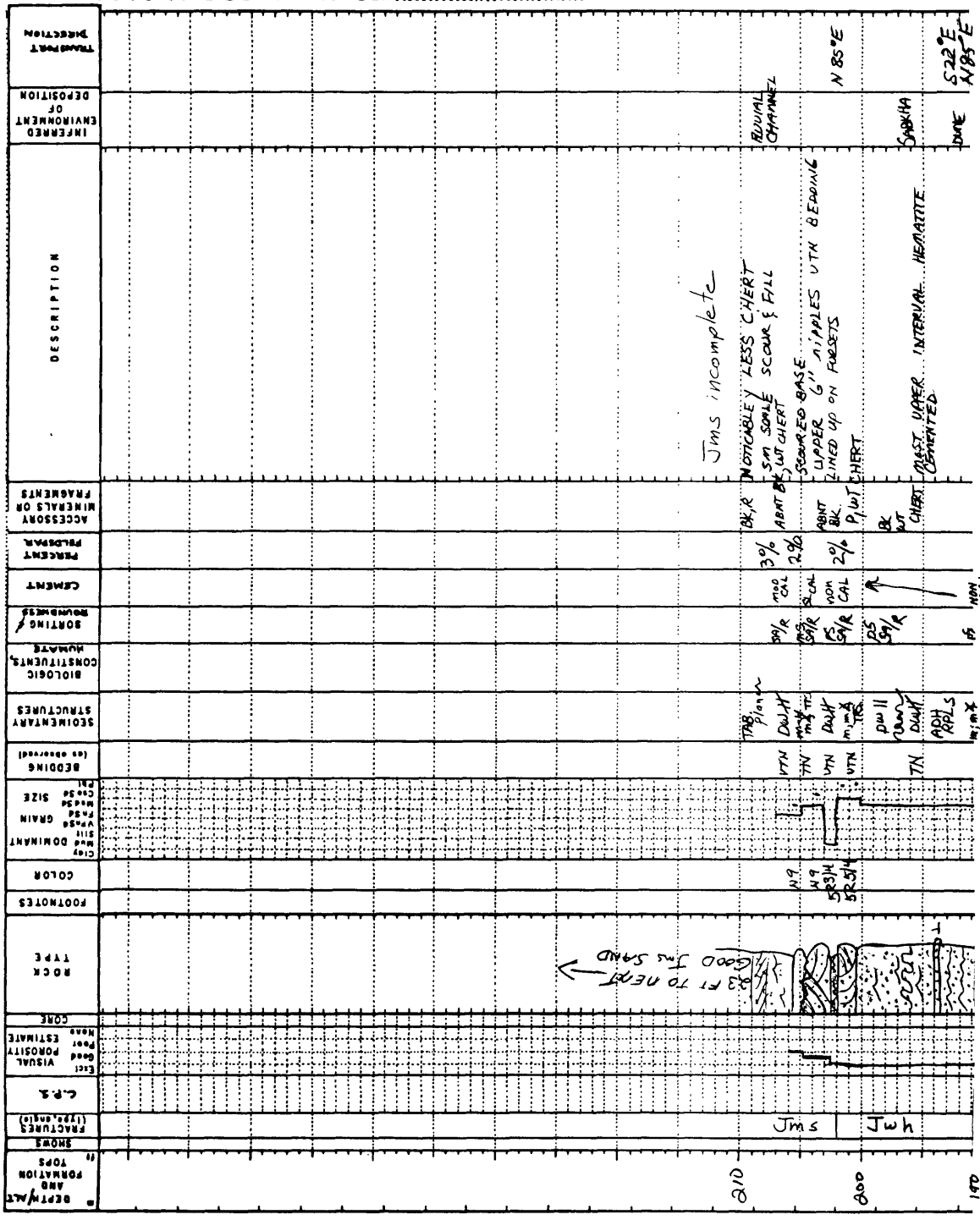
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



(4) LOCATION Horse Mesa Sec. 17 T. 38N R. 31E

STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



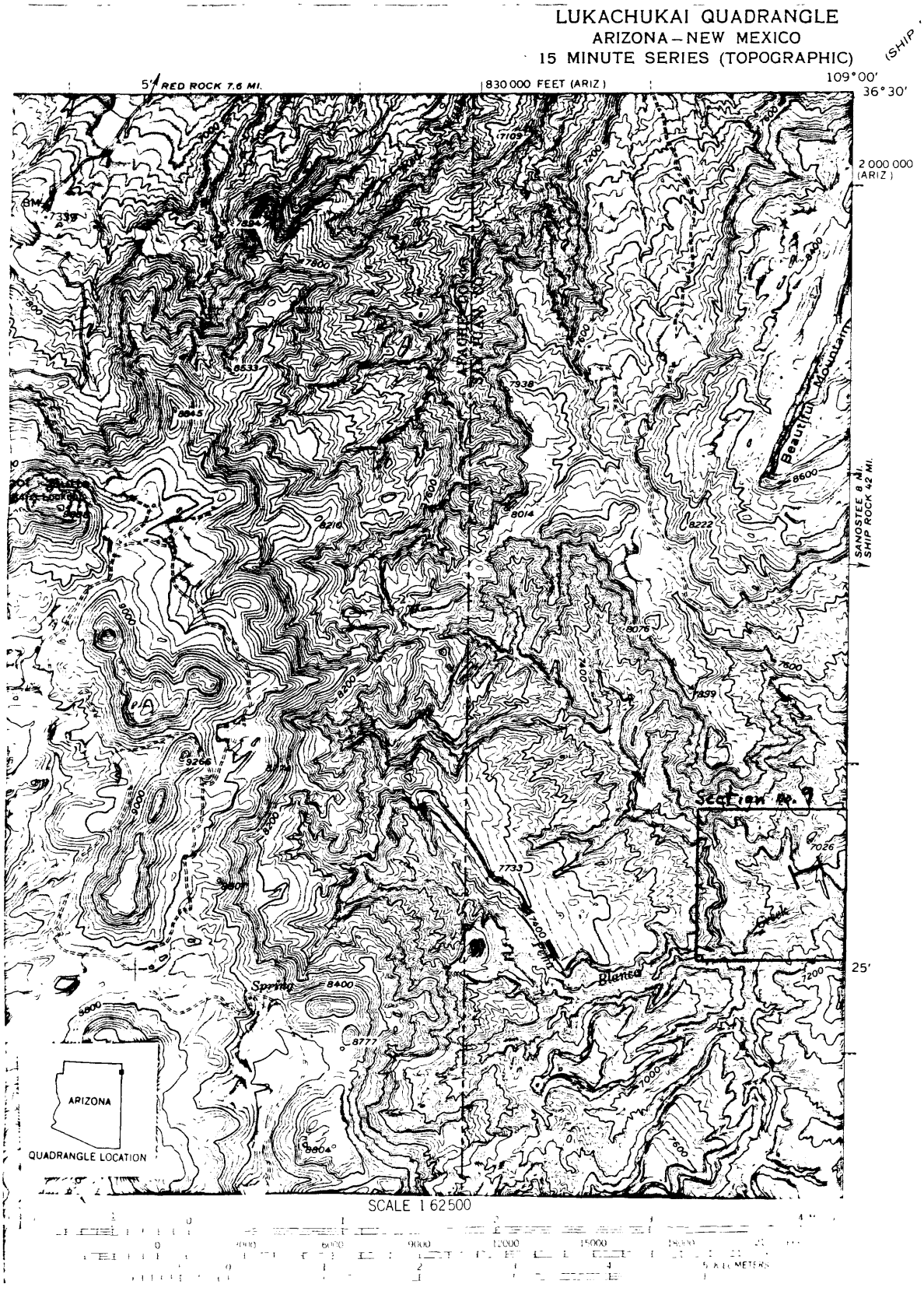
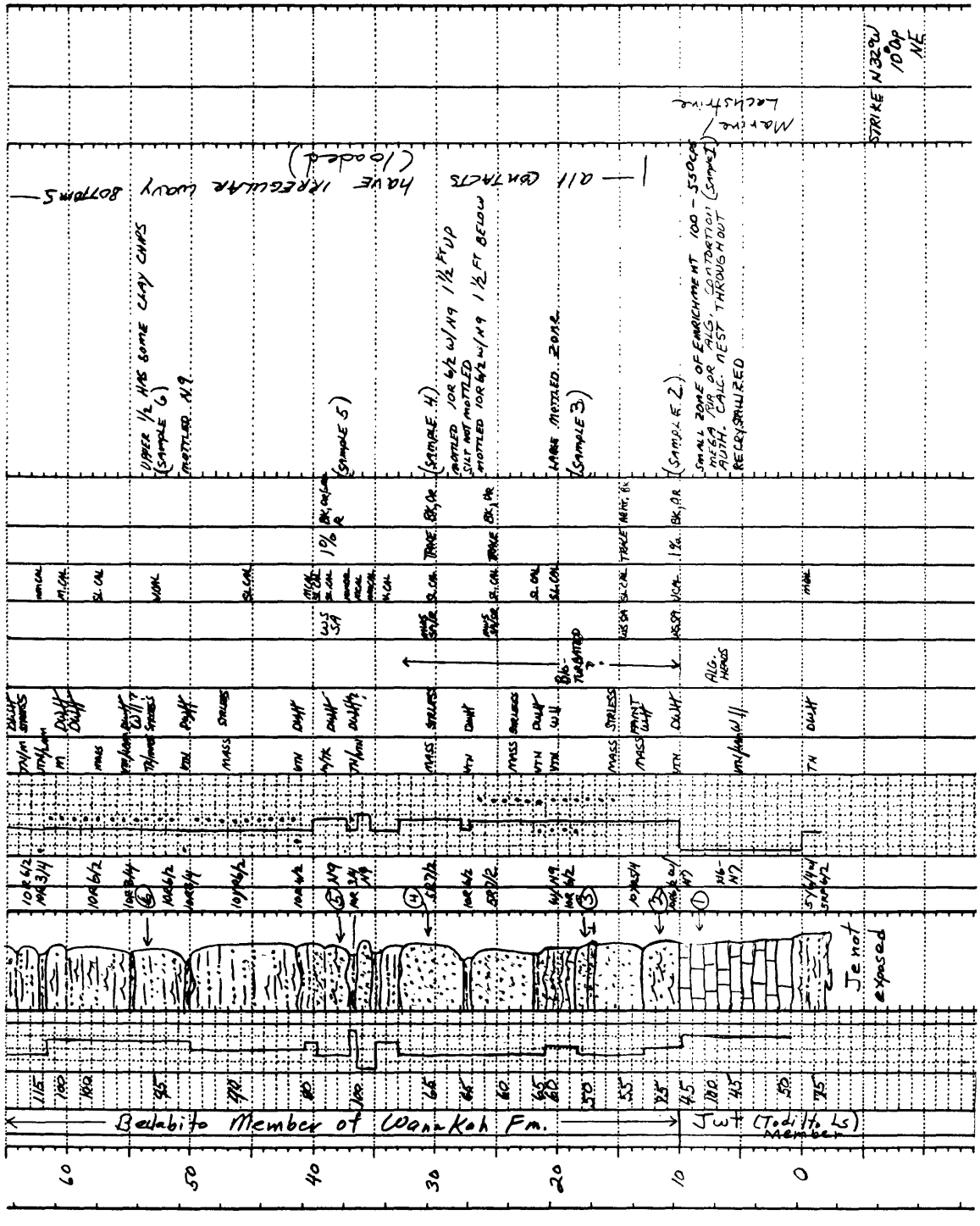


Figure 11. Location of measured section no. 9.

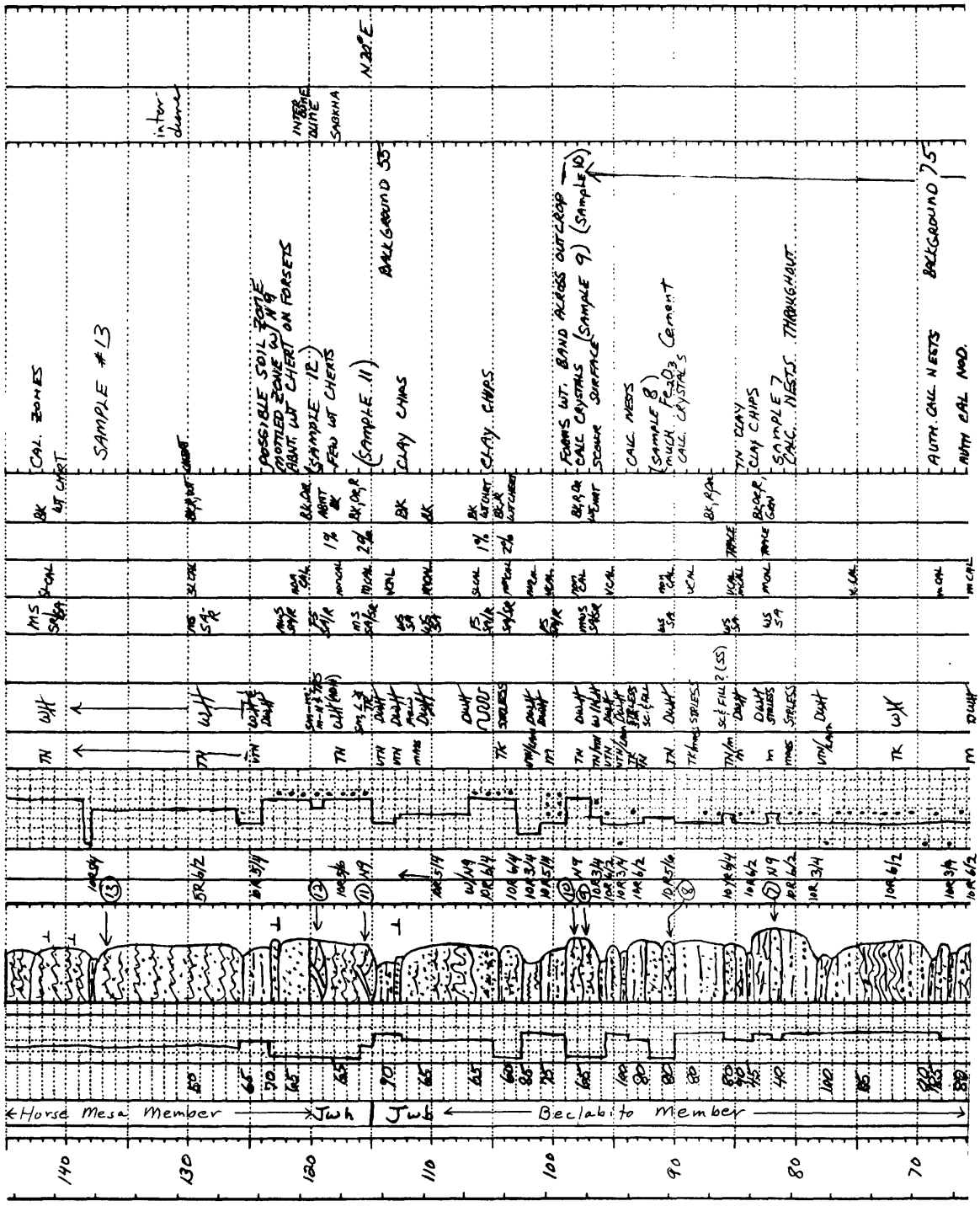
LOCATION 9 SANOSTEE WASH Sec. 5 NE1/4, SE1/4 T. 25 N. R. 20W (estimated)

STATE New Mexico COUNTY San Juan

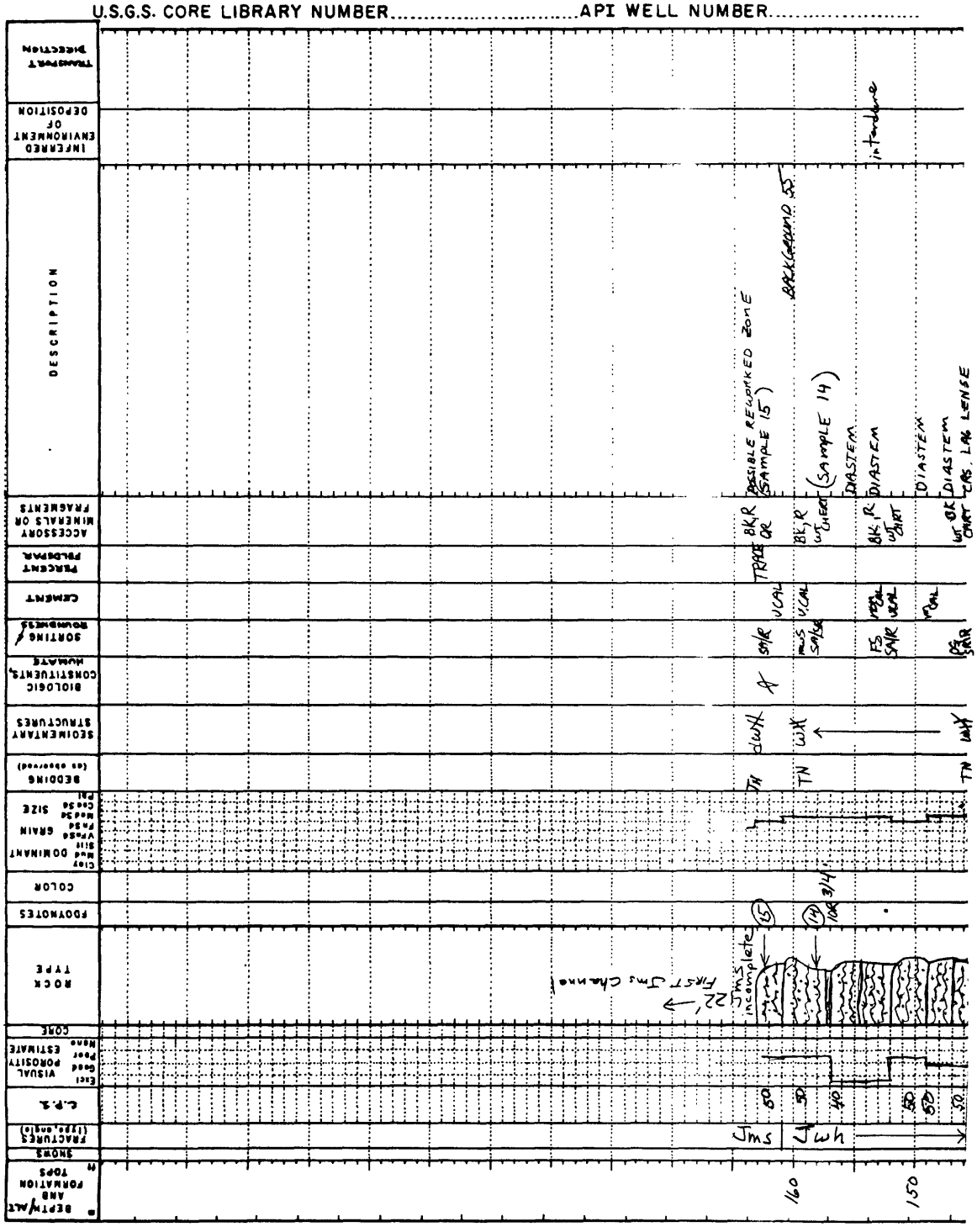
U.S.G.S. CORE LIBRARY NUMBER 8183 API WELL NUMBER CONDON, HARRIS



(2) LOCATION Sanostee Wash Sec. 5 T. 25N R. 20 W. (estimated)
STATE New Mexico COUNTY San Juan
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



(3) LOCATION Smastee Wash Sec. 5 T. 25N R. 20W. (estimated)
STATE New Mexico COUNTY San Juan
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



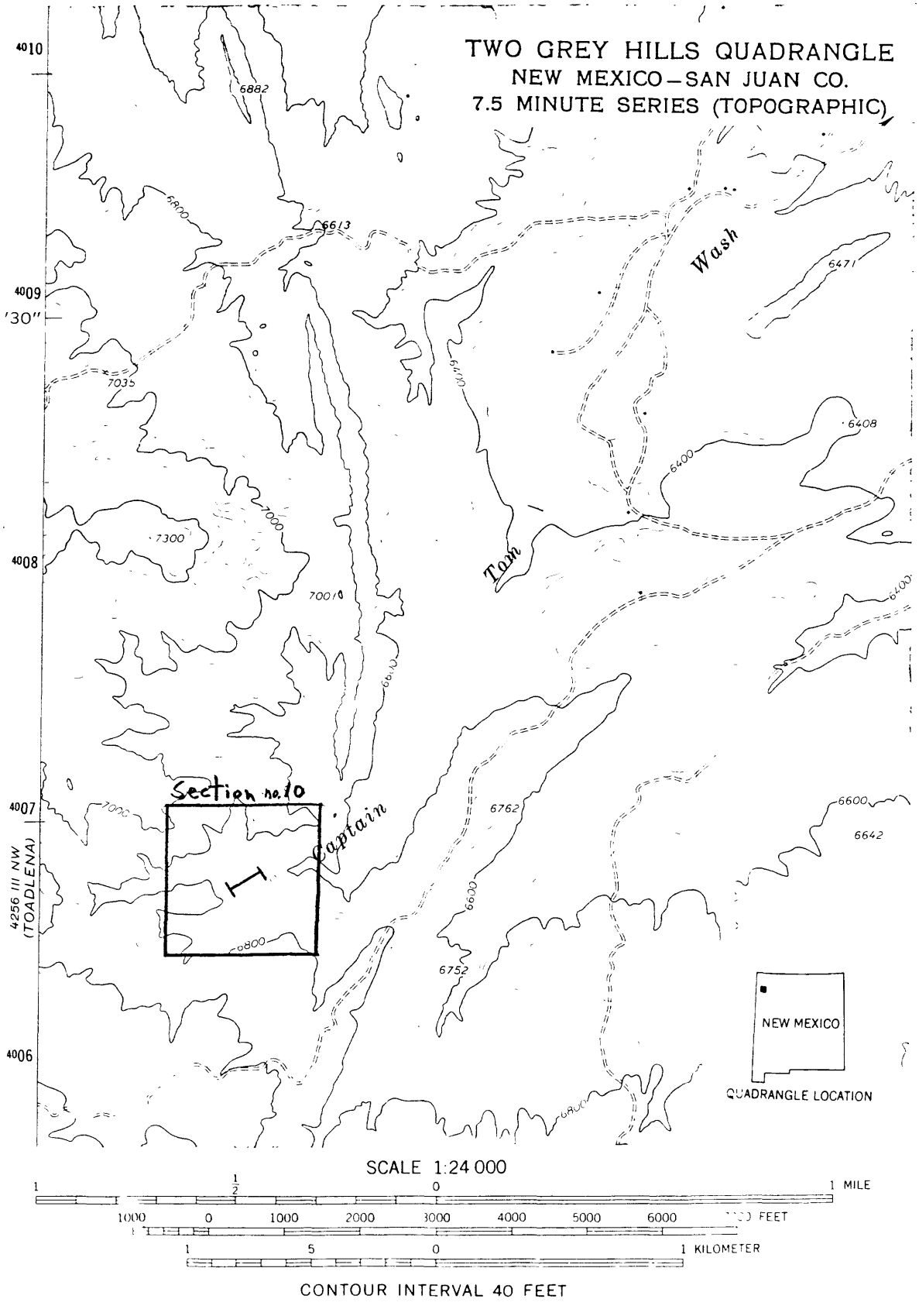


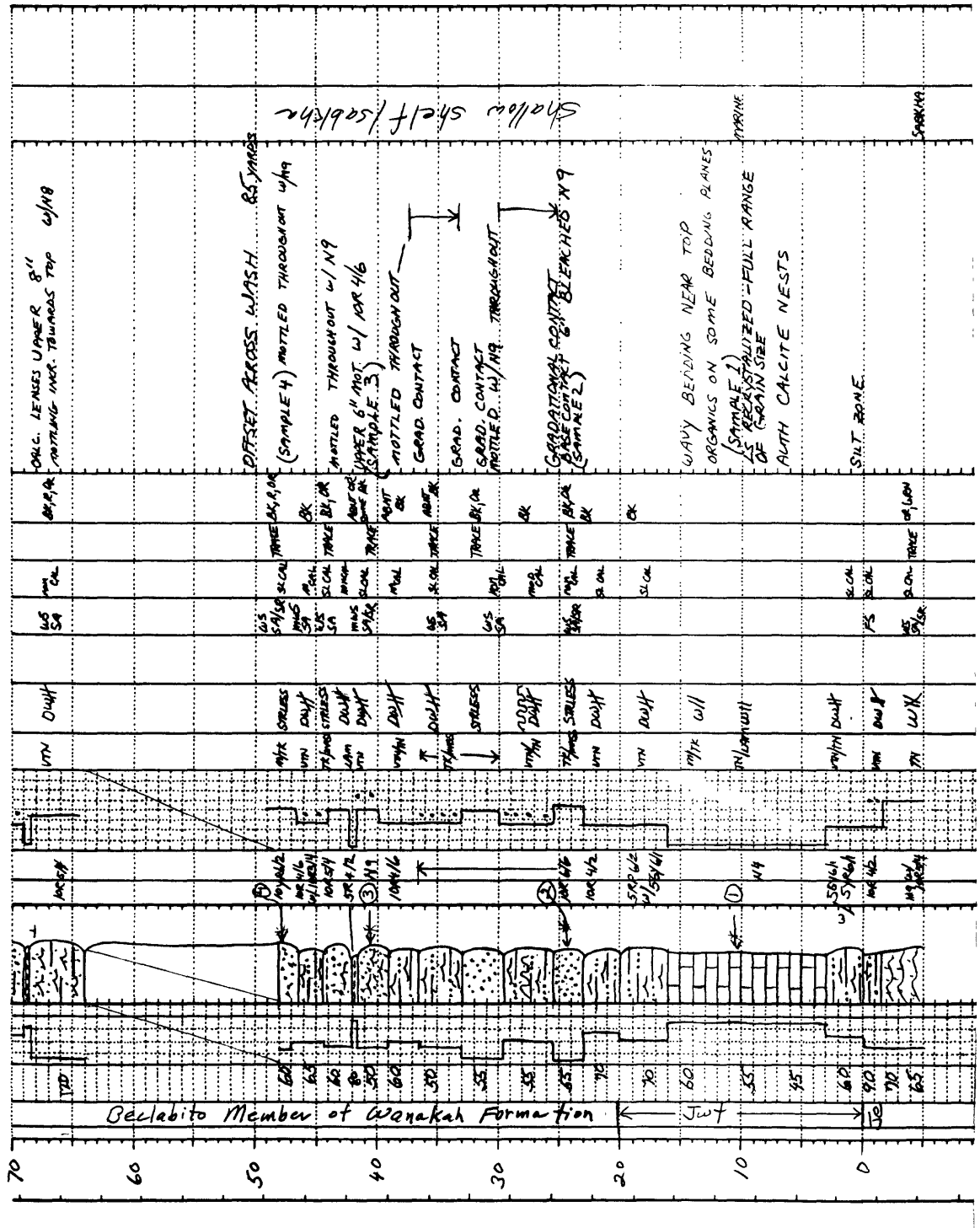
Figure 12. Location of measured section no. 10.

10.

LOCATION Tadlena Sec. 23 T. 23N. R. 19W. (estimated) NE1/4, NW1/4

STATE New Mexico COUNTY San Juan

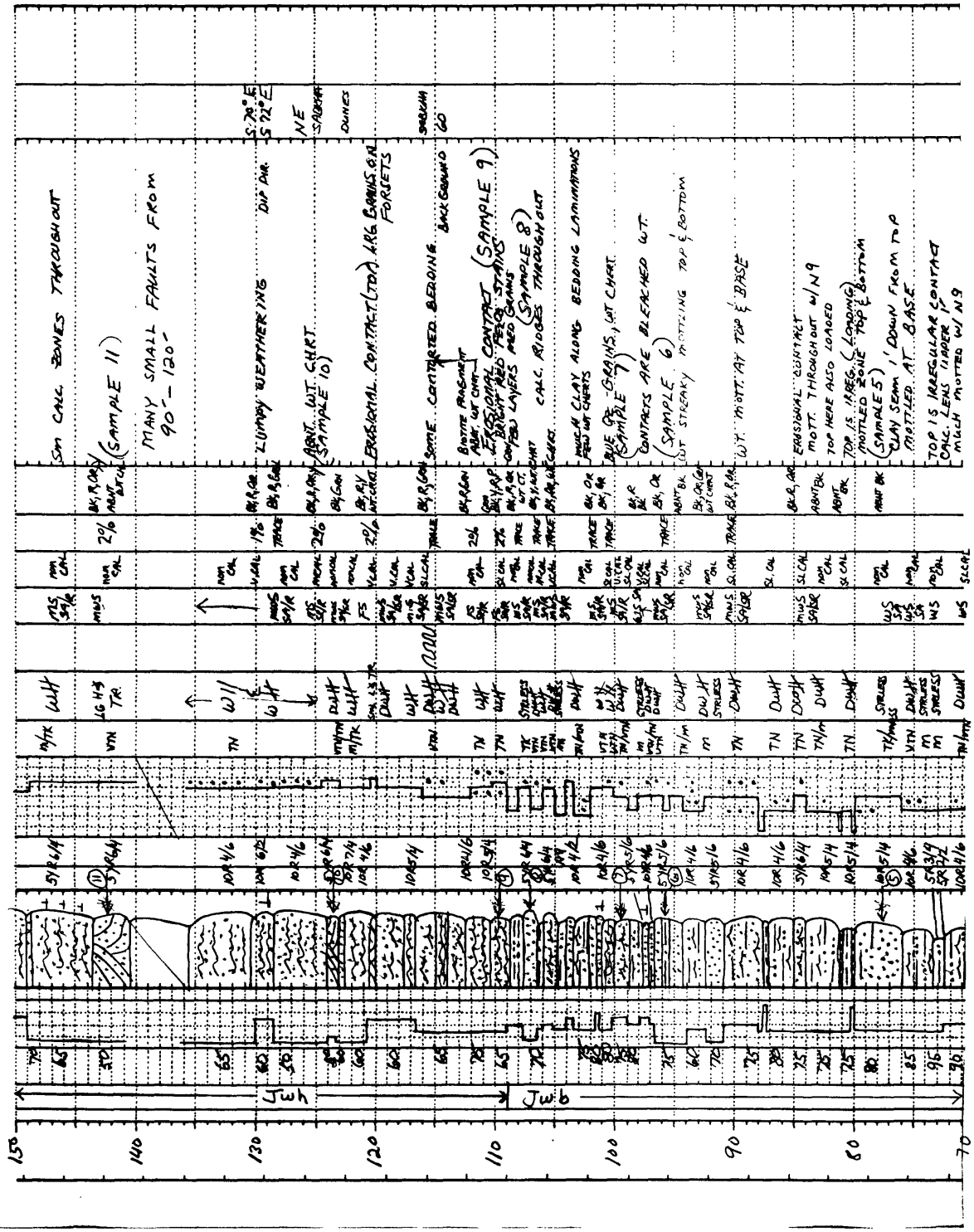
U.S.G.S. CORE LIBRARY NUMBER 8183 API WELL NUMBER Conoco, Harris



LOCATION TOADLENA Sec. 33 T. 23N. R. 19W (estimated)

STATE New Mexico COUNTY San Juan

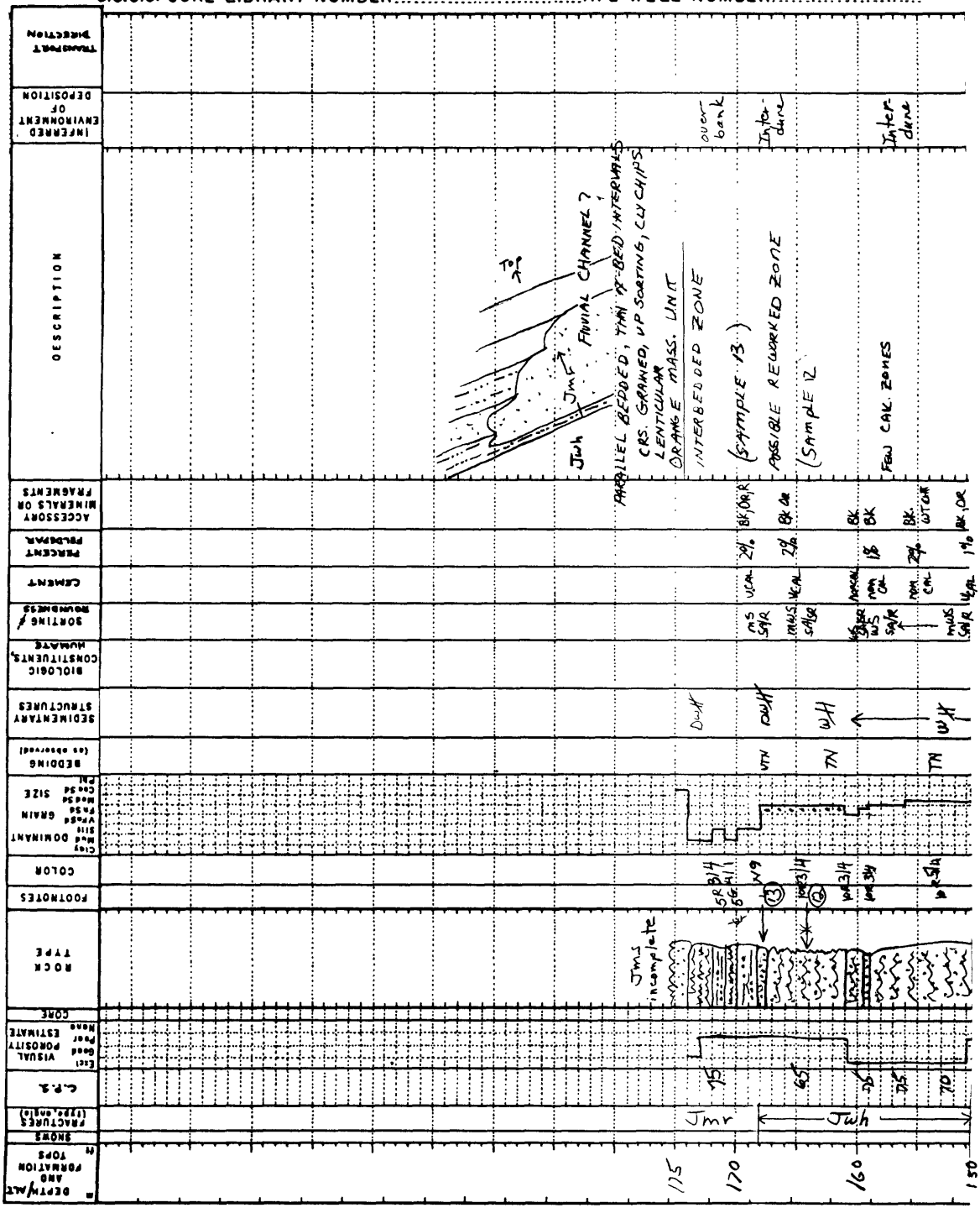
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION Toadlena Sec. 33 T. 23N. R. 19W (estimated)

STATE New Mexico COUNTY San Juan

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



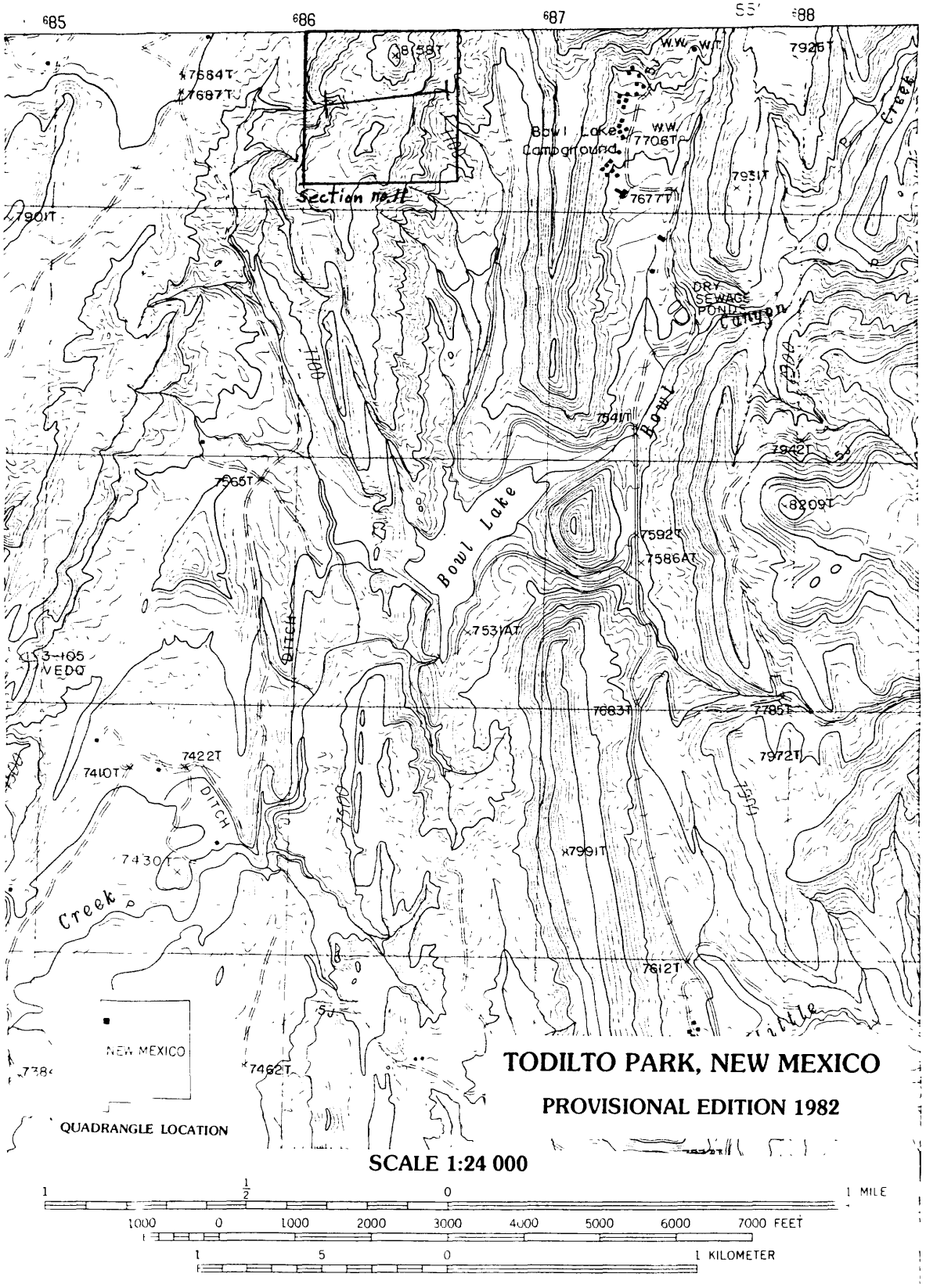
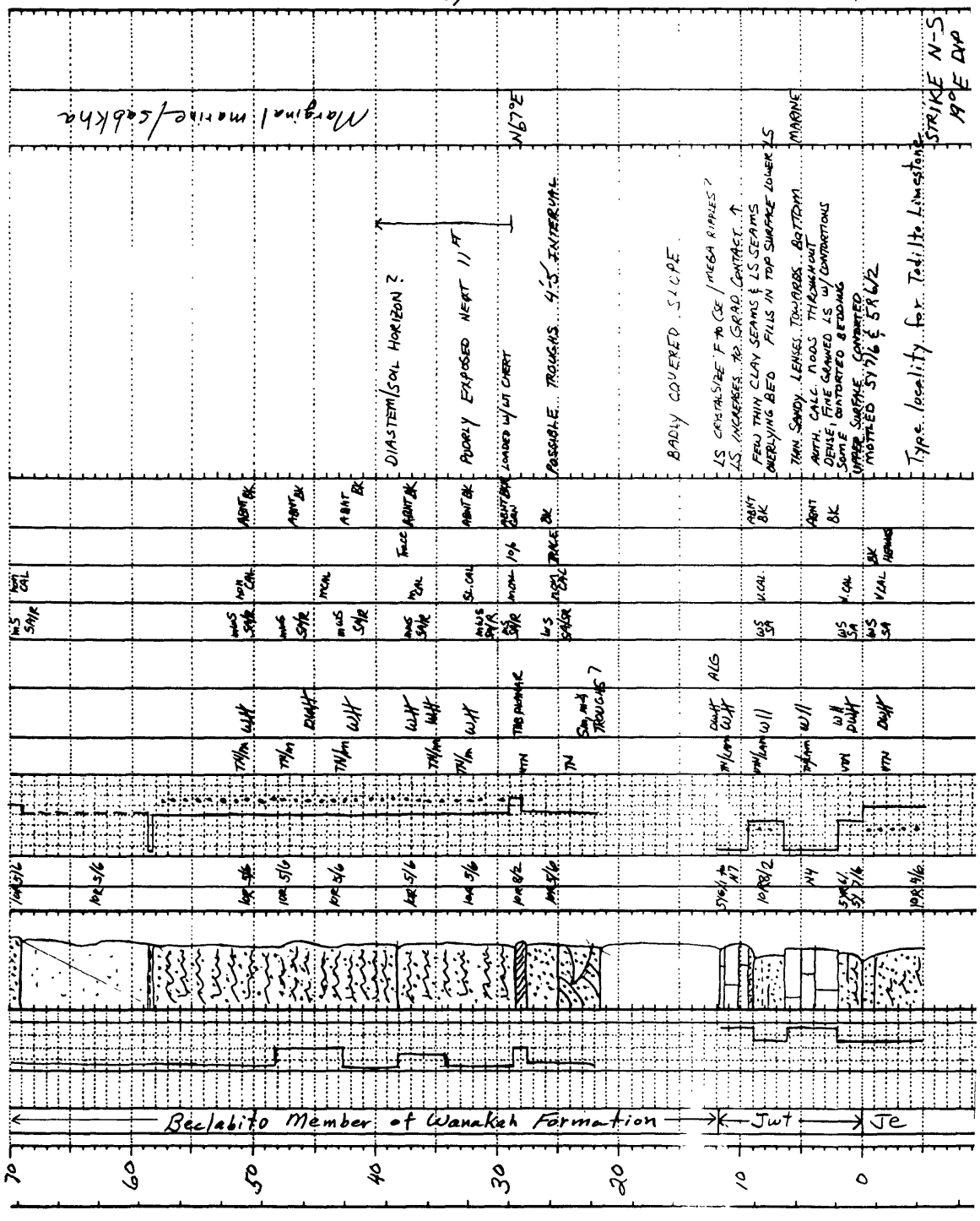


Figure 13. Location of measured section no. 11.

LOCATION 11. Todilto Park Sec. 13 N½ NW¼ T. 20N. R. 20W. (estimated)

STATE New Mexico COUNTY McKinley

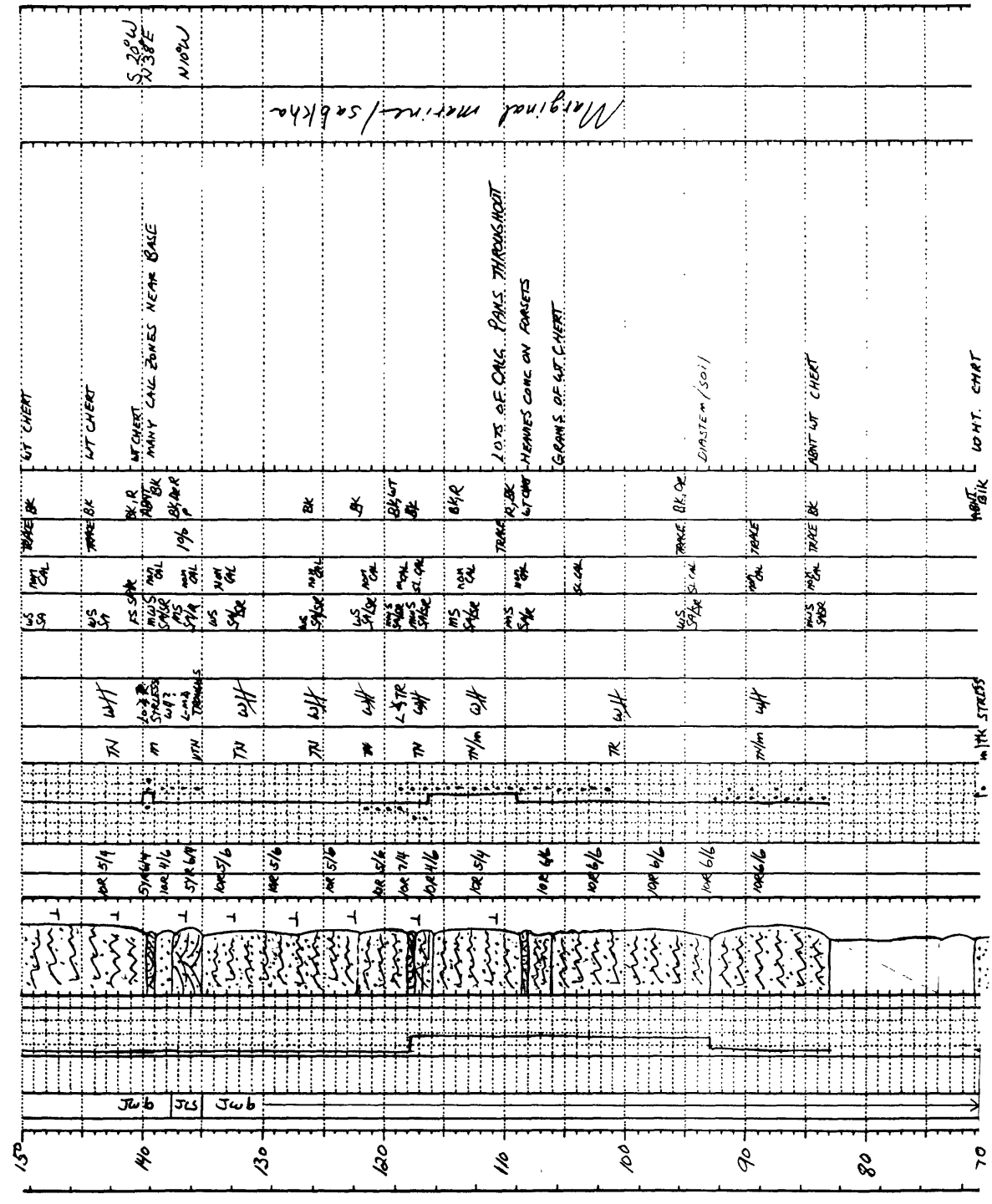
U.S.G.S. CORE LIBRARY NUMBER 8183 API WELL NUMBER Condon, Harris



LOCATION Todilto Park Sec. 13 T. 20 N R. 20 W. (estimated)

(8) STATE New Mexico COUNTY McKinley

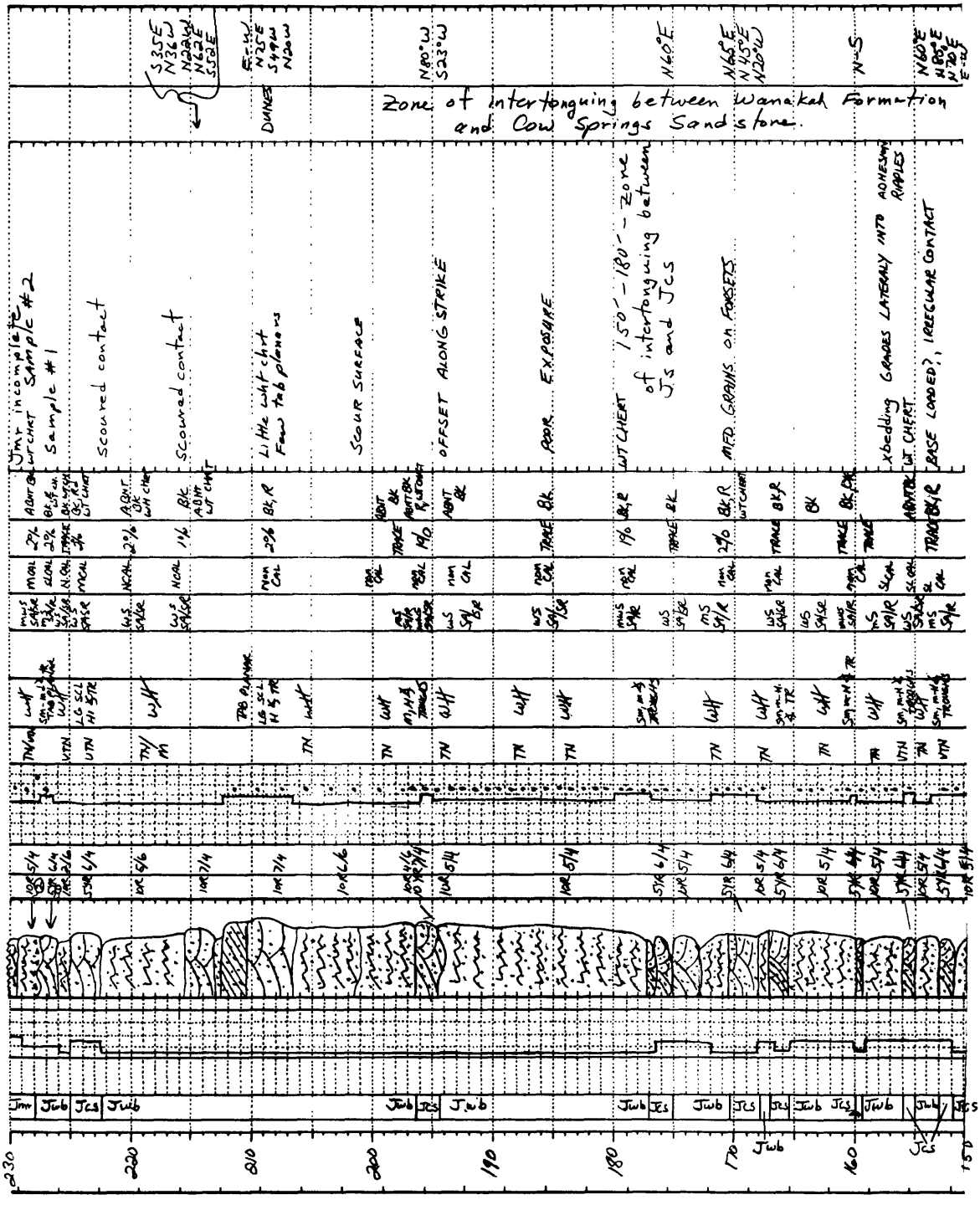
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION Toditto Park Sec. 13 T. 20N R. 20W (estimated)

(3) STATE New Mexico COUNTY McKinley

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



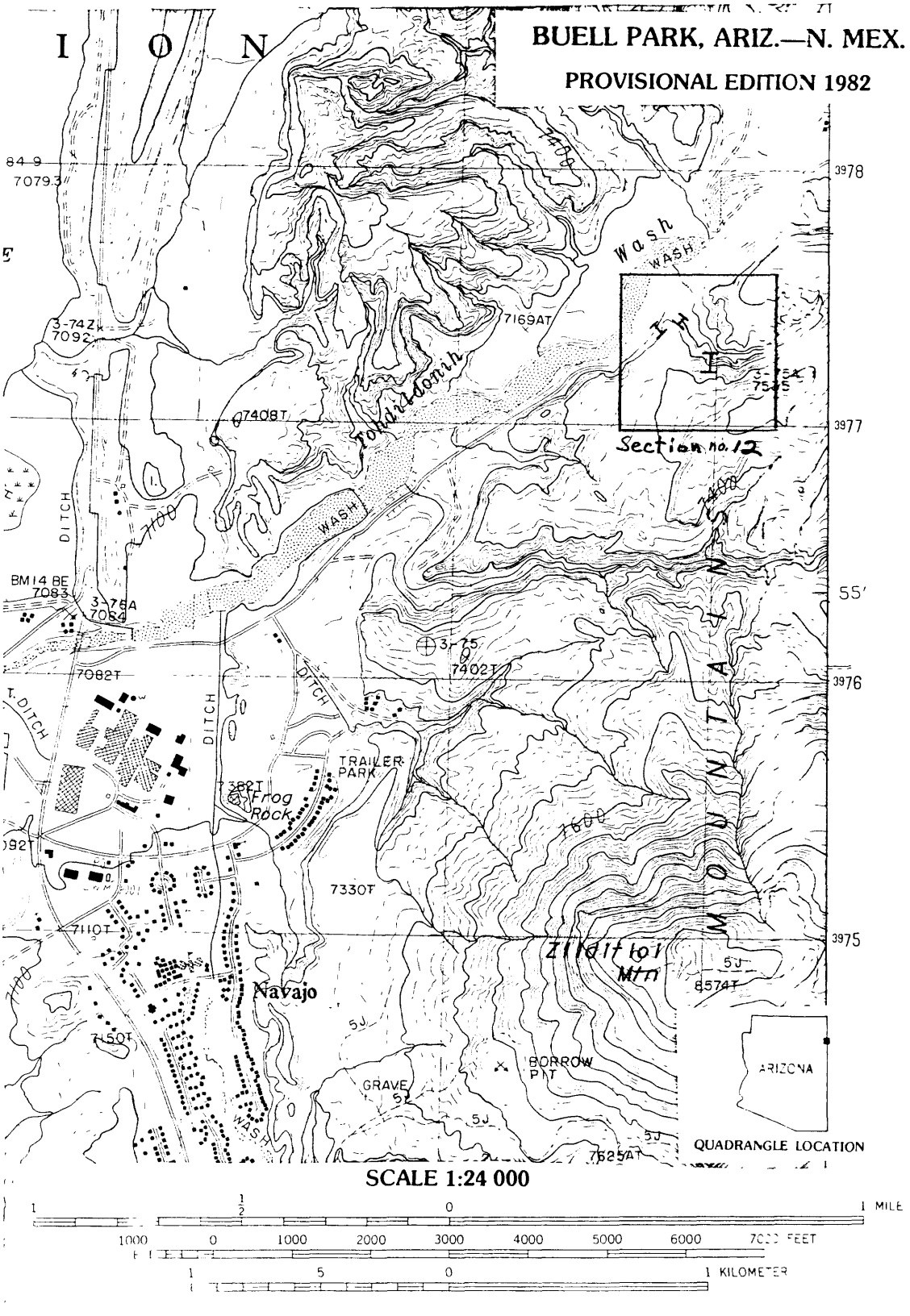
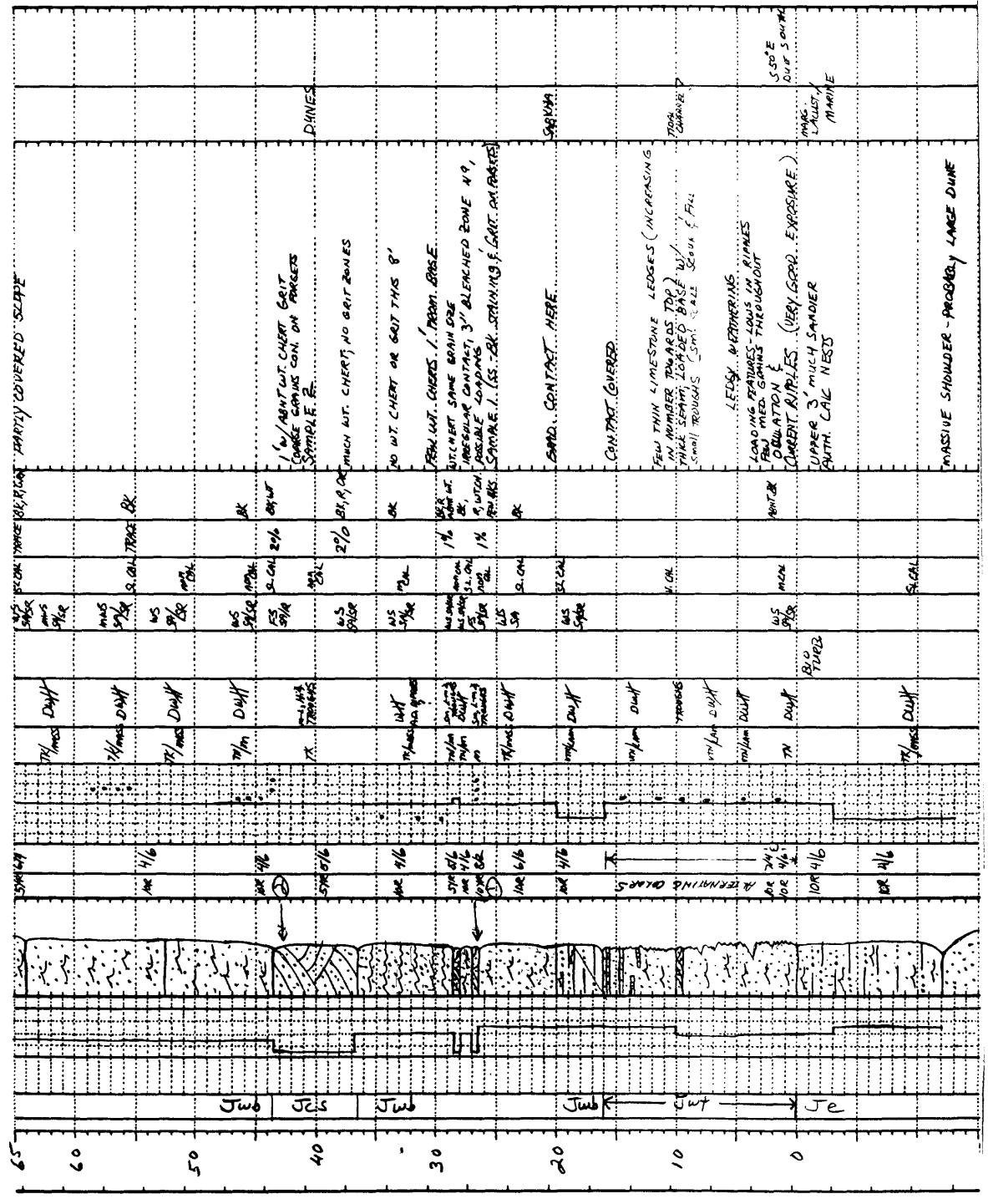


Figure 14. Location of measured section no. 12.

LOCATION 12. Navajo Sec. 31 E1/2, NE1/4 T. 20N. R. 20W. (estimated)

STATE New Mexico COUNTY McKinley

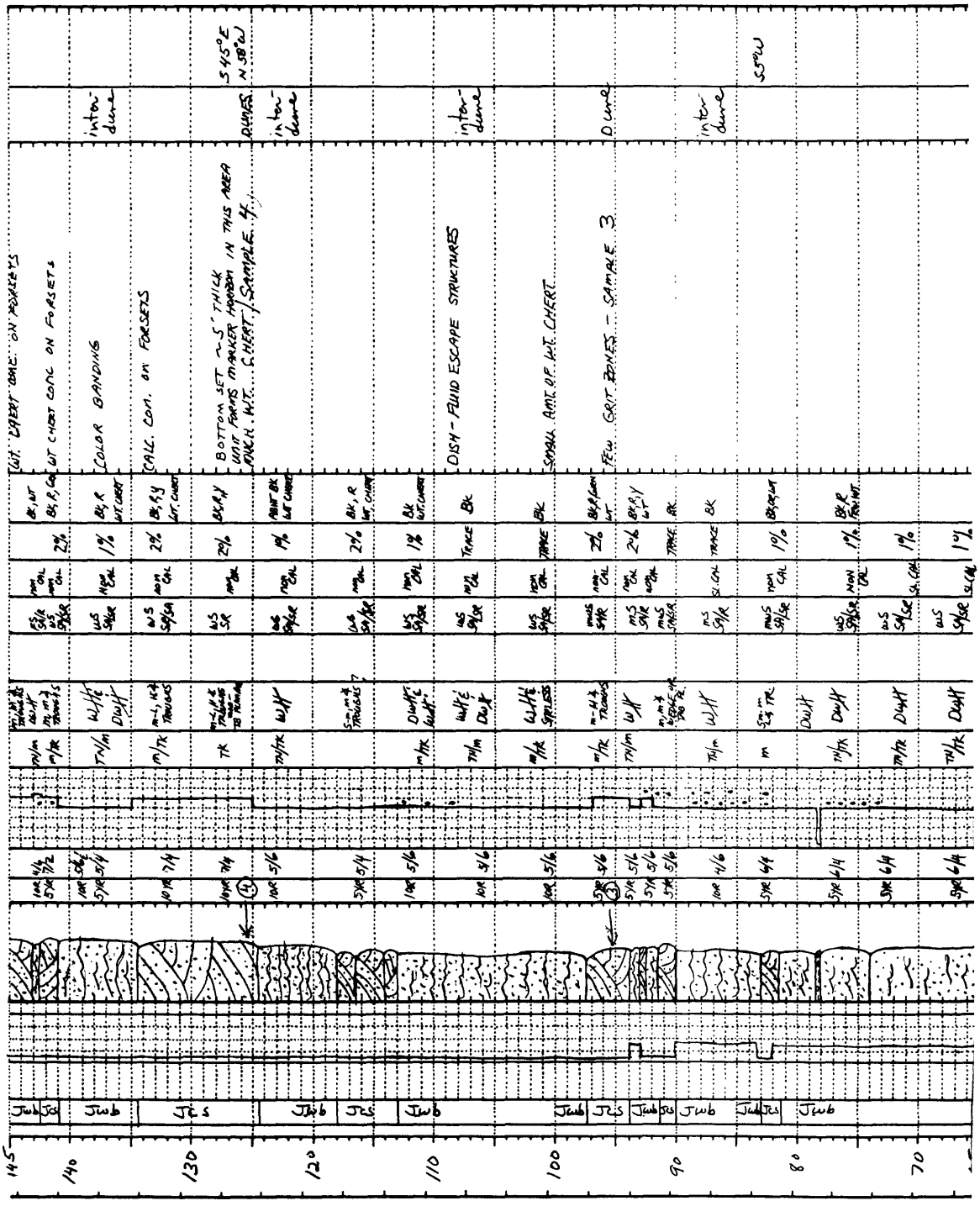
U.S.G.S. CORE LIBRARY NUMBER 8183 API WELL NUMBER Condon, Harris



LOCATION Navajo Sec. 31 T. 20 N. R. 20 W. (estimated)

② STATE New Mexico COUNTY McKinley

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION Navajo Sec. 31 T. 20N R. 20W (estimated)

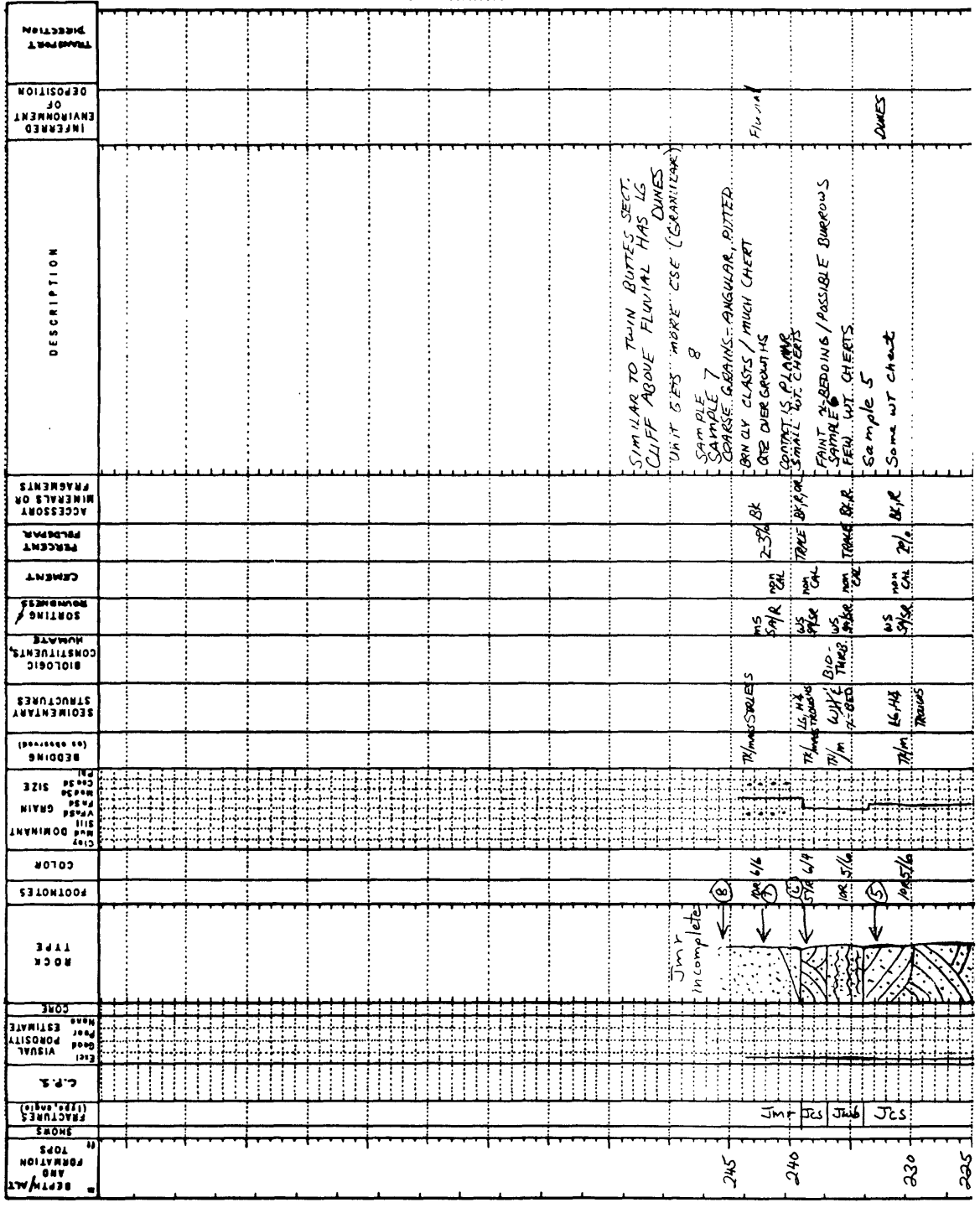
③ STATE New Mexico COUNTY McKinley

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER

LOCATION Navajo Sec. 31 T. 20 N. R. 20 W (estimated)

STATE New Mexico COUNTY McKinley

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



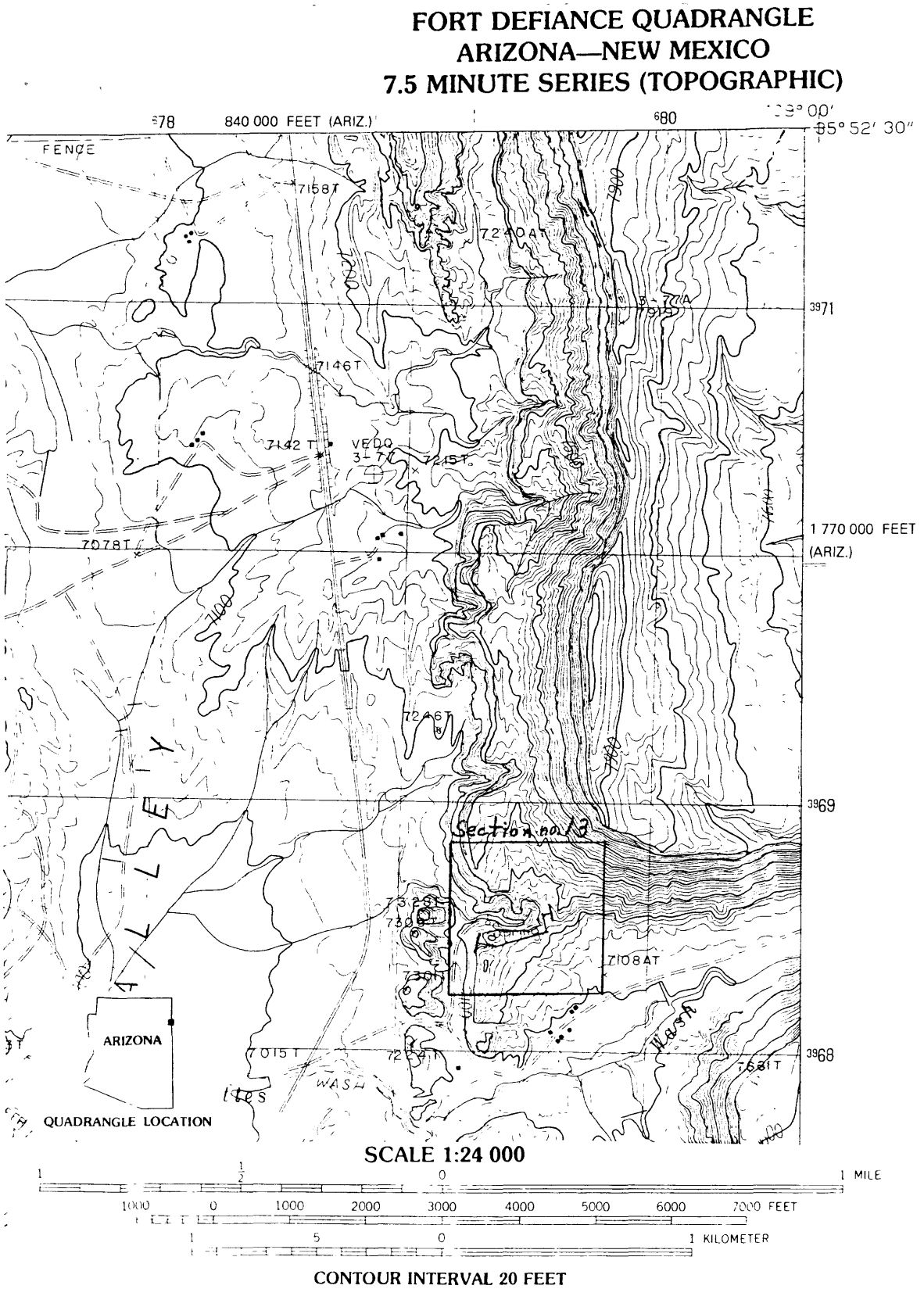
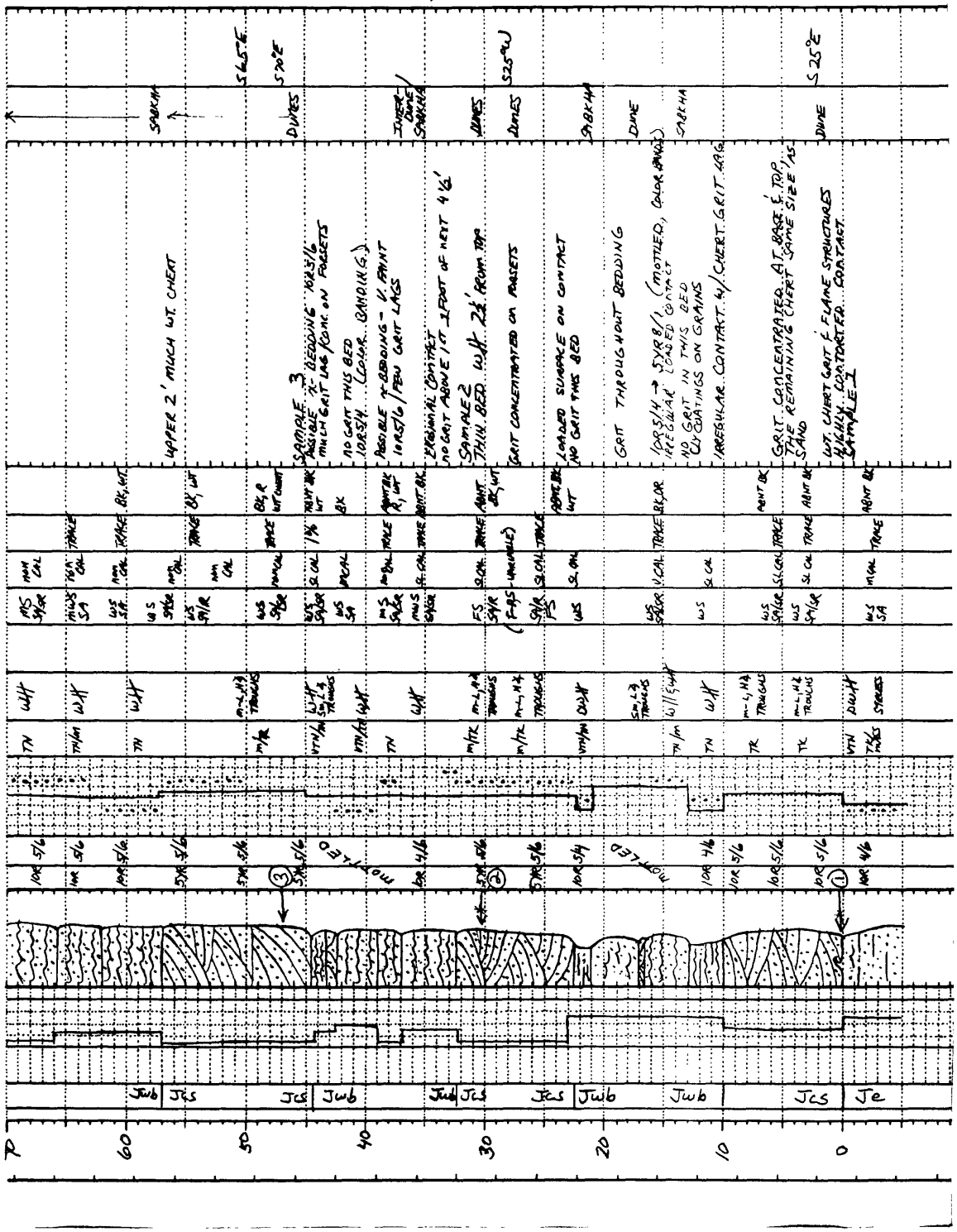


Figure 15. Location of measured section no. 13.

LOCATION 13 TWIN BUTTES WASH Sec. 30 T. 19N. R. 20W. (estimated) E½, NW¼

STATE New Mexico COUNTY McKinley

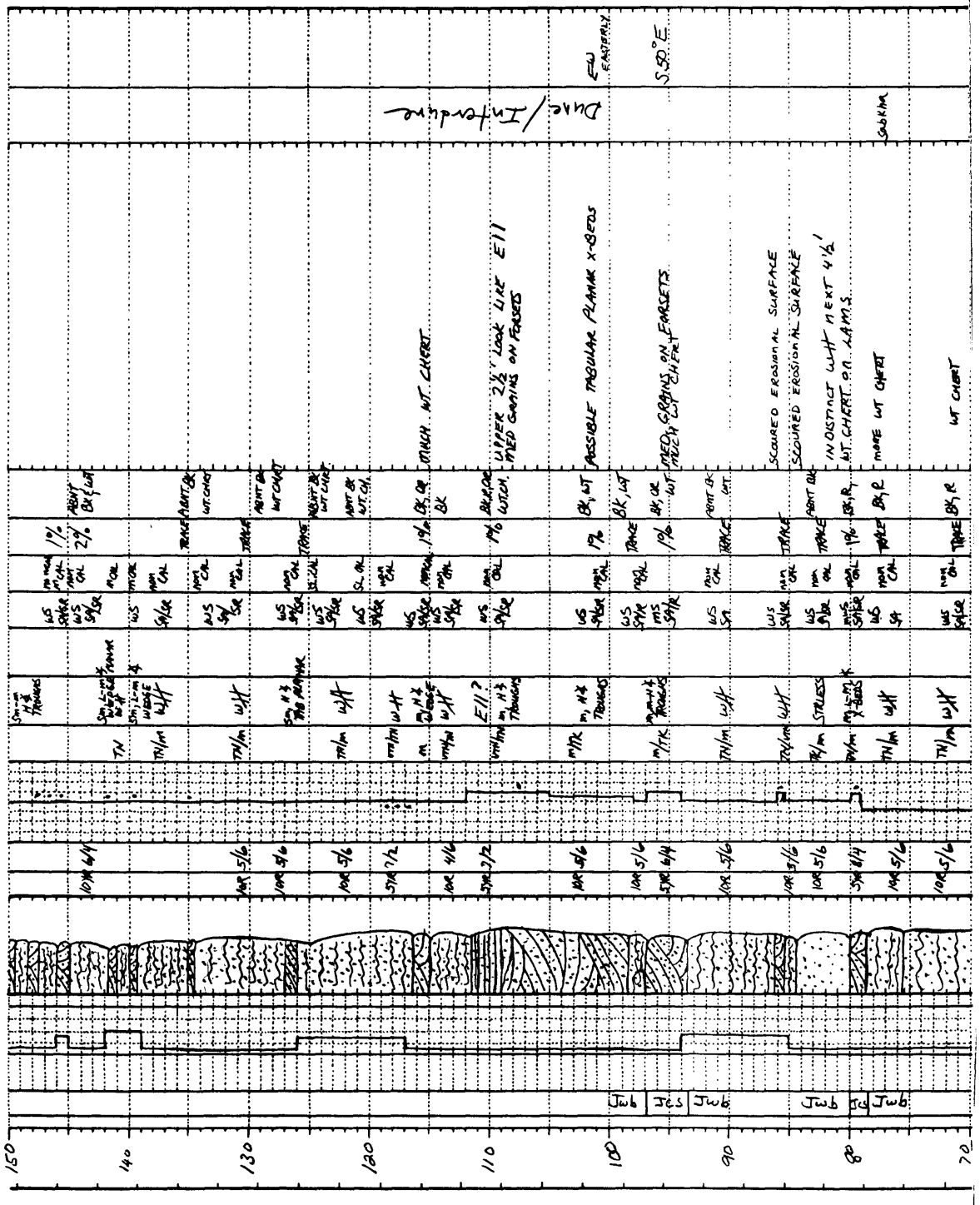
U.S.G.S. CORE LIBRARY NUMBER 8/83 API WELL NUMBER CONDON, HARRIS



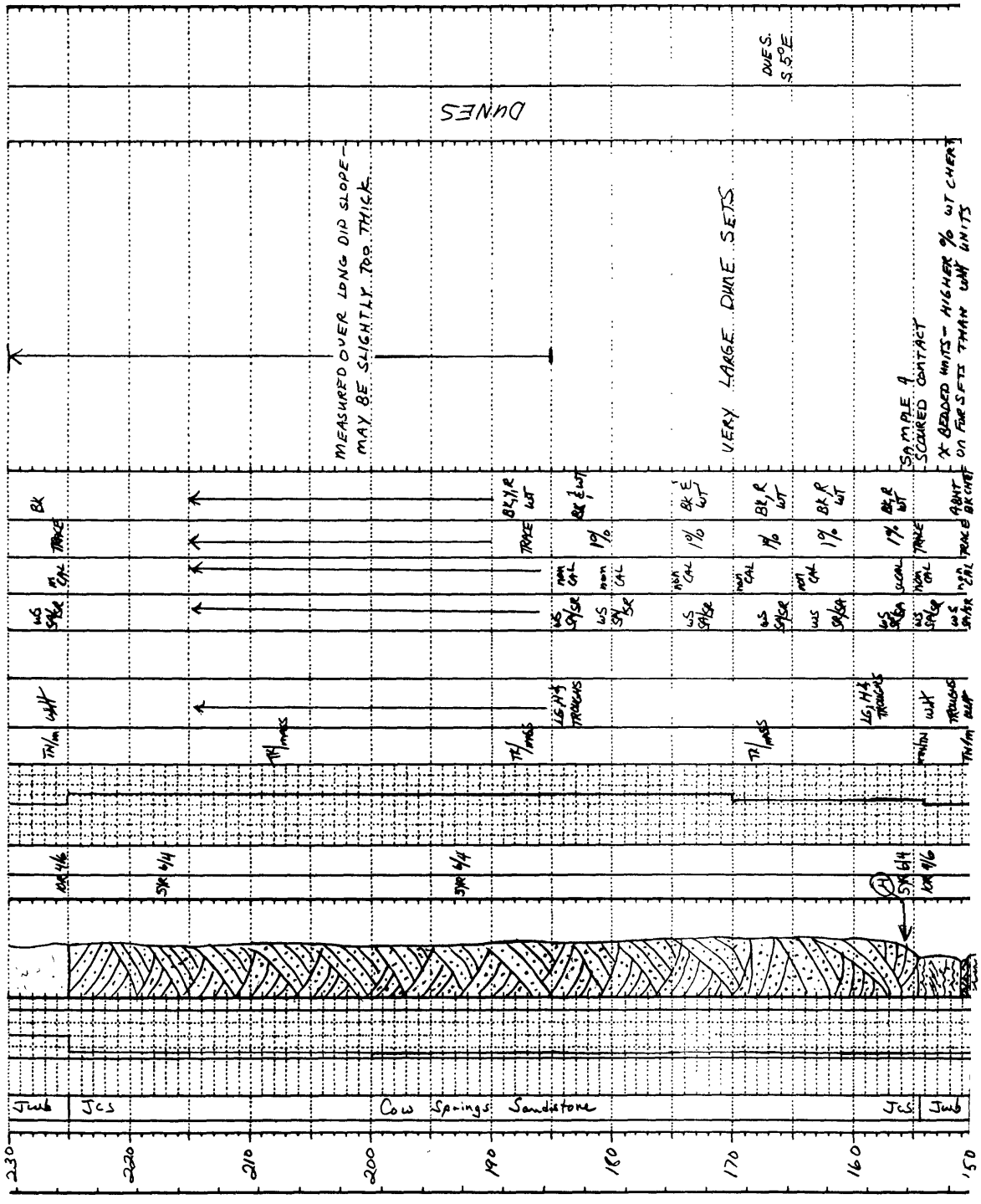
LOCATION Twin Buttes Wash Sec. 30 T. 19N. R. 20W (estimated)

STATE New Mexico COUNTY McKinley

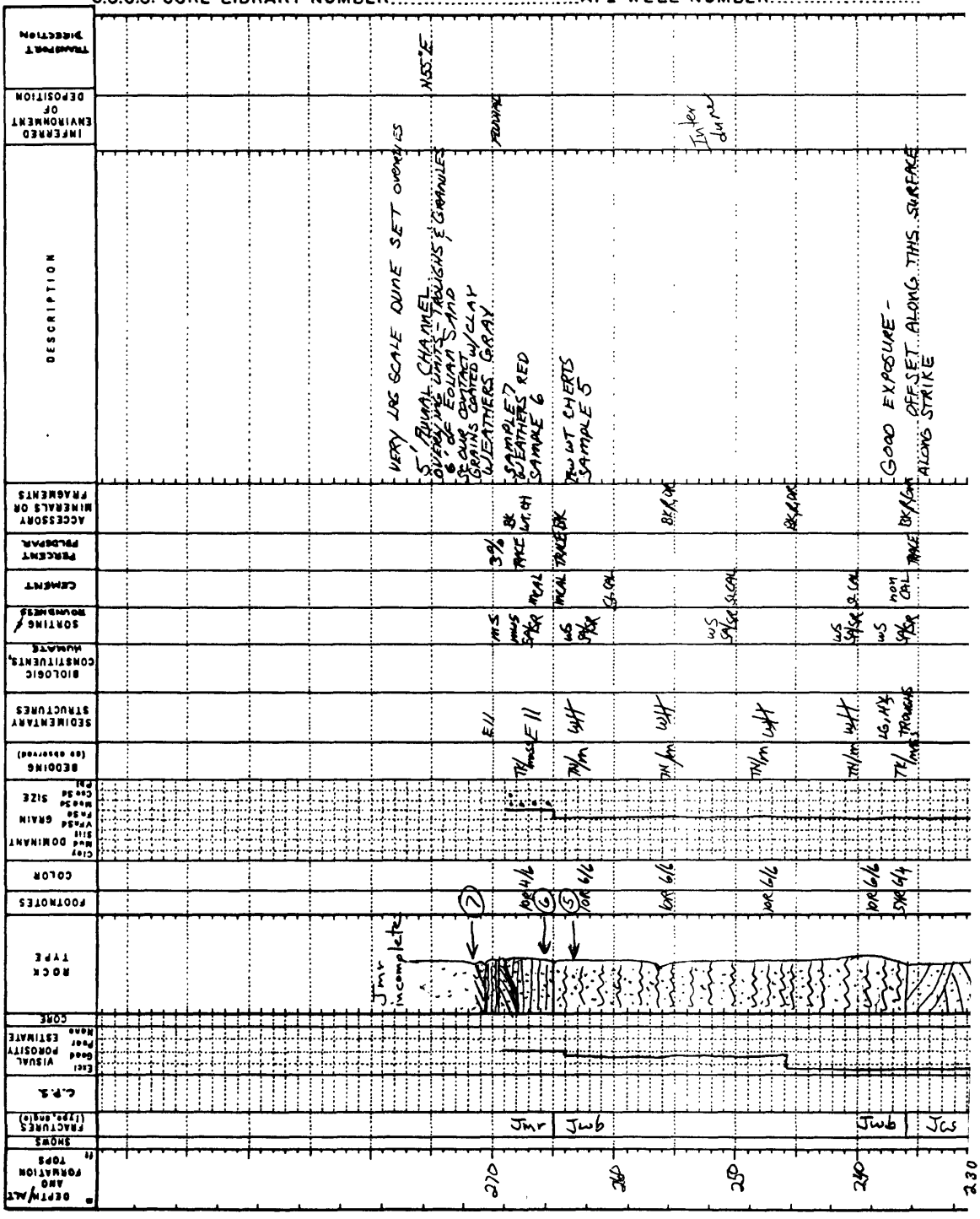
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



(3) LOCATION Twin Buttes Wash Sec. 30 T. 19N. R. 20W (estimated)
STATE New Mexico COUNTY Mckinley
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



(4) LOCATION Twin Buttes Sec. 30 T. 19N R. 20W (estimated)
STATE New Mexico COUNTY Mckinley
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



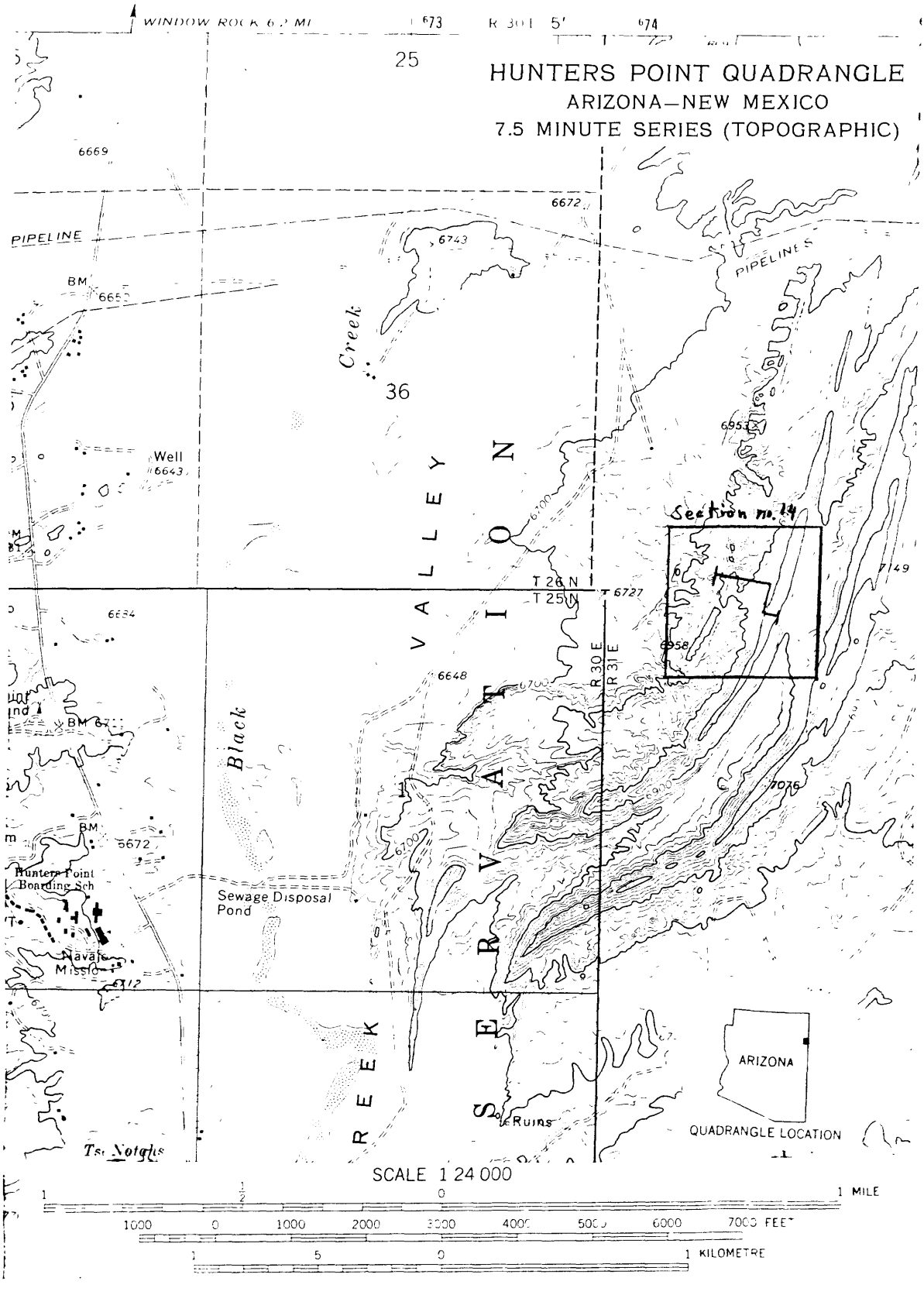
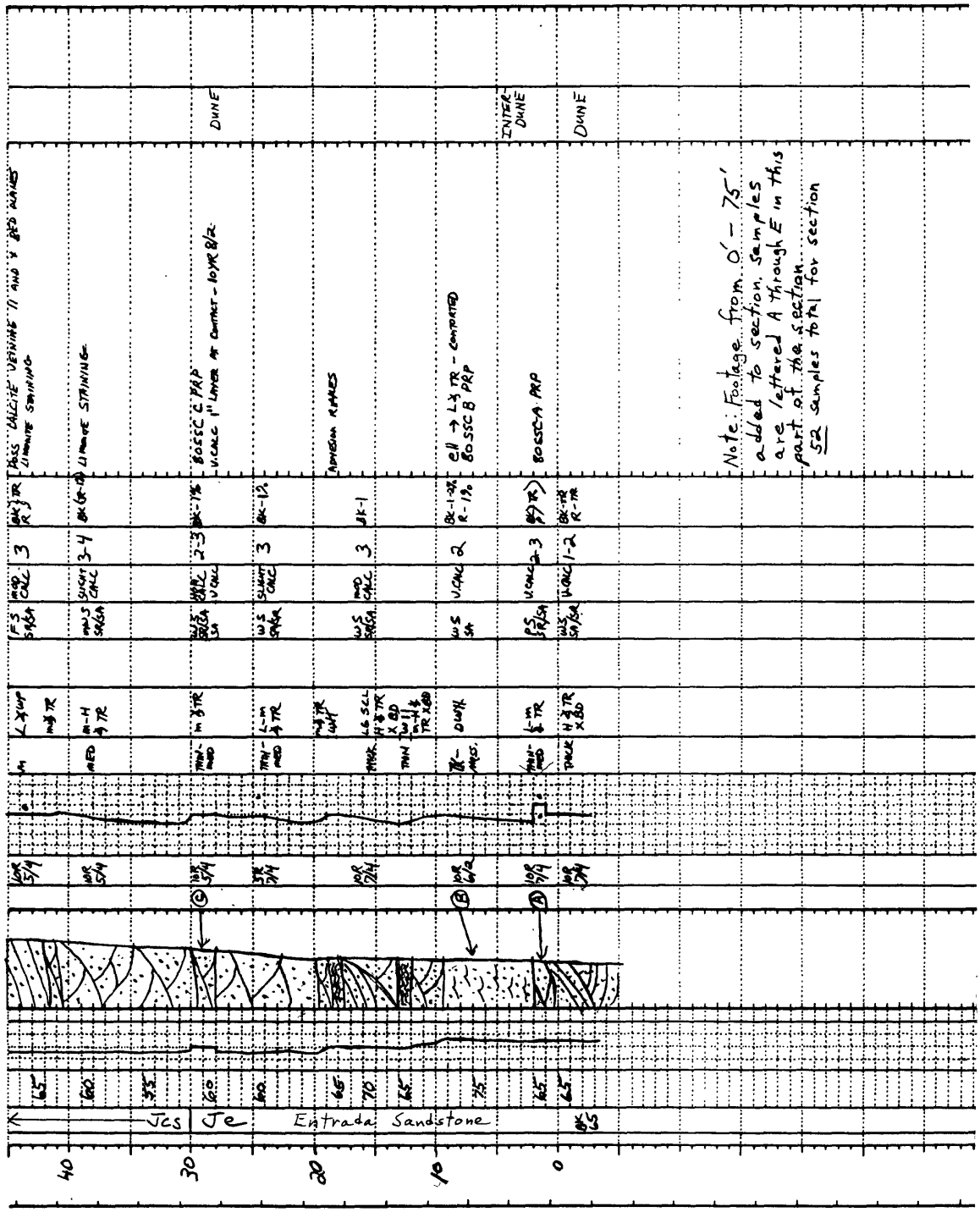


Figure 16. Location of measured section no. 14.

LOCATION 14. Pipeline Road Sec. 30 SE1/4, SW1/4 T. 26 N. R. 31E. (estimated)

① STATE Arizona COUNTY Apache

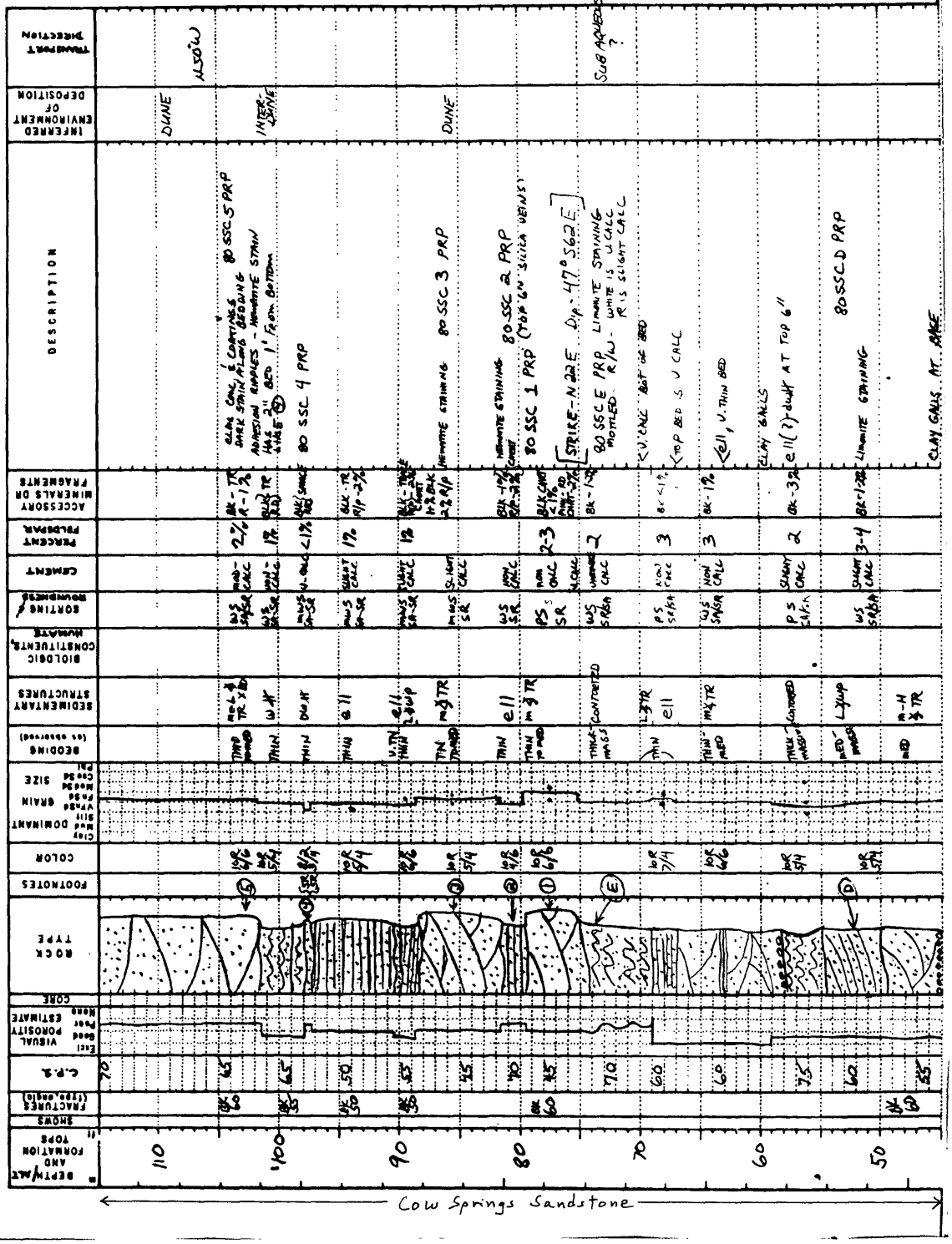
U.S.G.S. CORE LIBRARY NUMBER 6180 API WELL NUMBER Cenoco/McDonnell



LOCATION Pipeline Road Sec. 30 T. 26 N. R. 31E (est.)

STATE Arizona COUNTY Apache

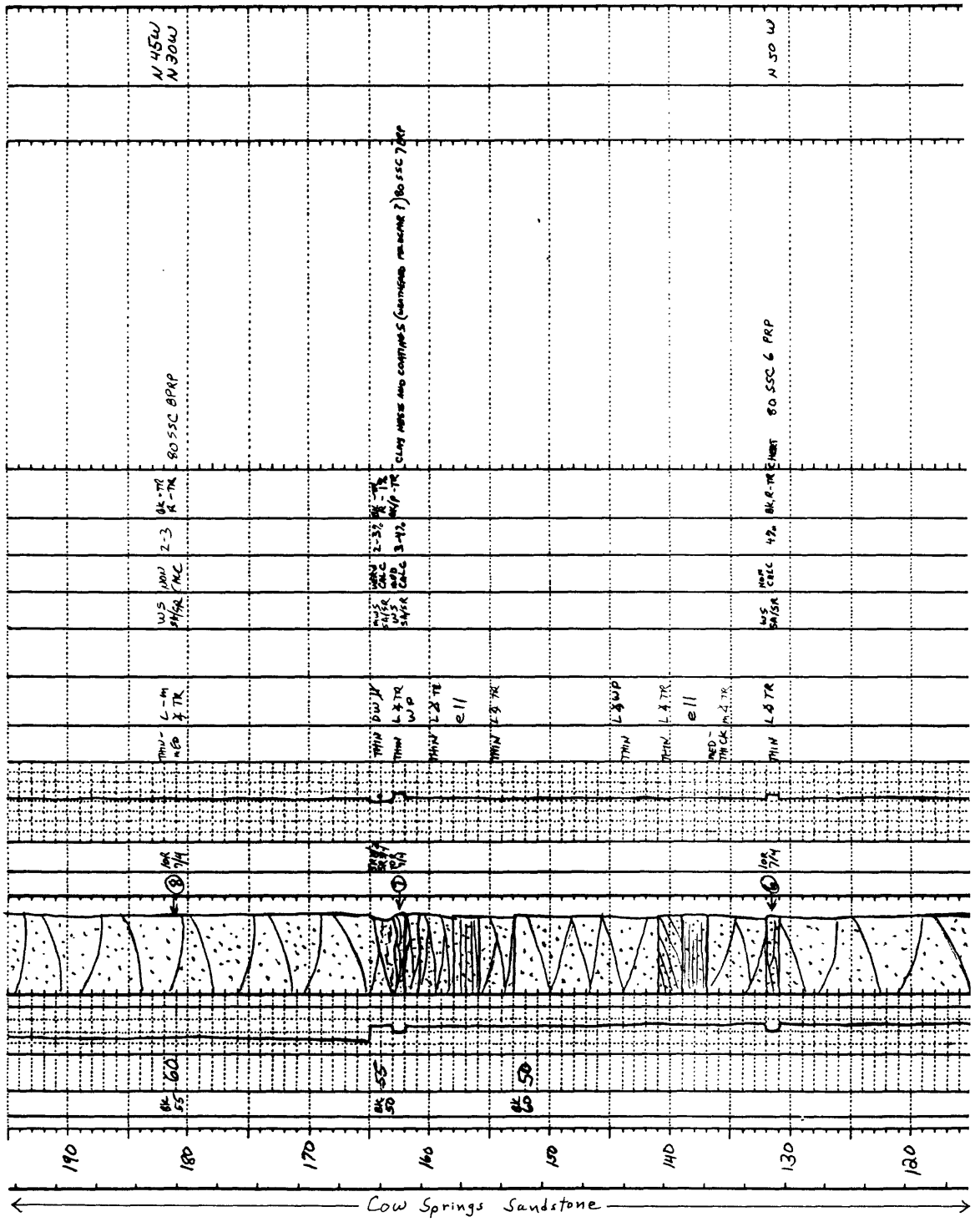
LATITUDE AND LONGITUDE



LOCATION Pipeline Rd Sec. 30 T. 26N R. 31E (est.)

(3) STATE Arizona COUNTY Apache

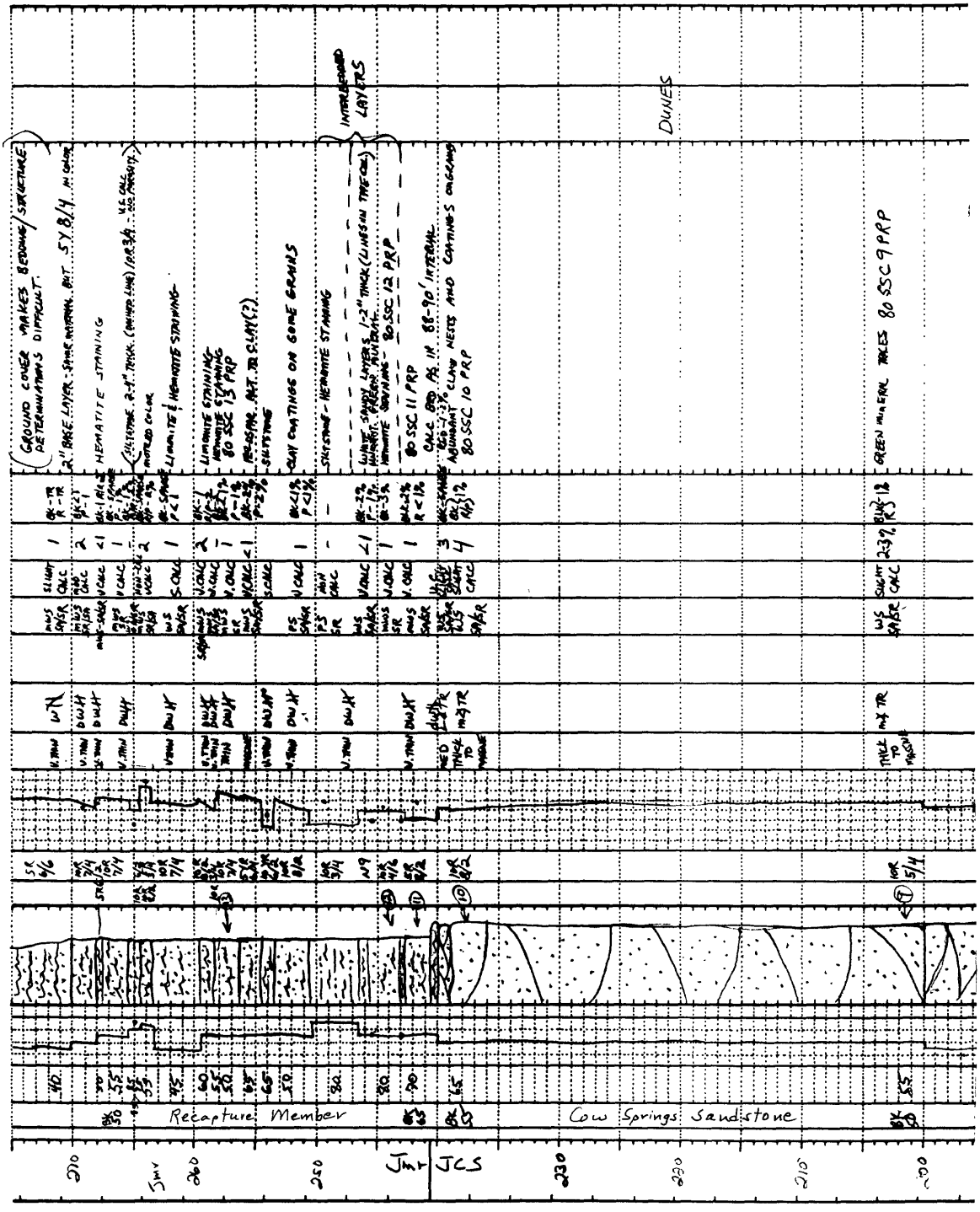
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



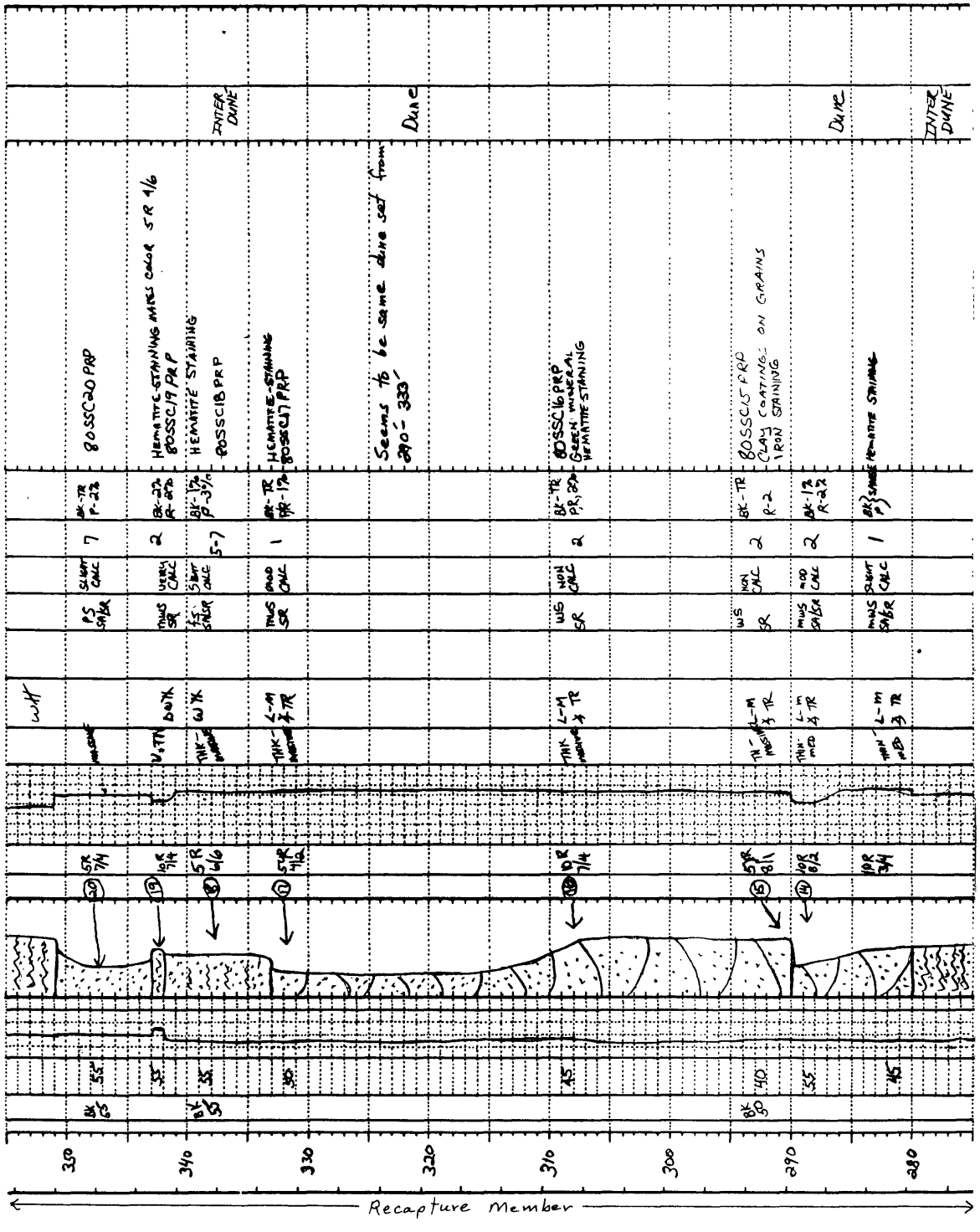
LOCATION Pipeline Road Sec. 30 T. 24N. R. 31E (est.)

④ STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



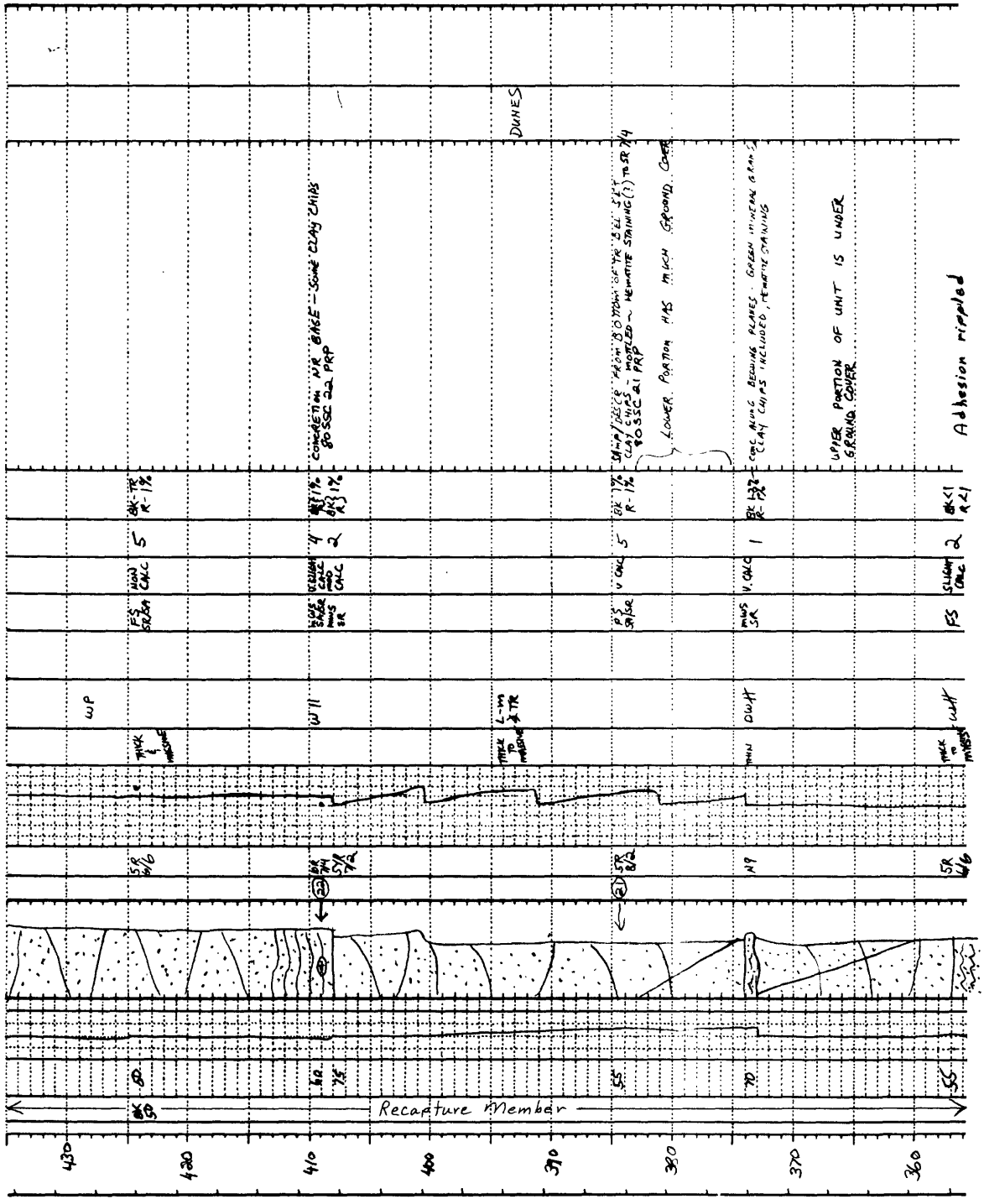
(5) LOCATION Pipeline Road Sec. 30 T. 26N R. 31E (est.)
STATE Arizona COUNTY Apache
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION PIPELINE ROAD Sec. 30 T. 26N R. 31E (est.)

② STATE Arizona COUNTY Apache

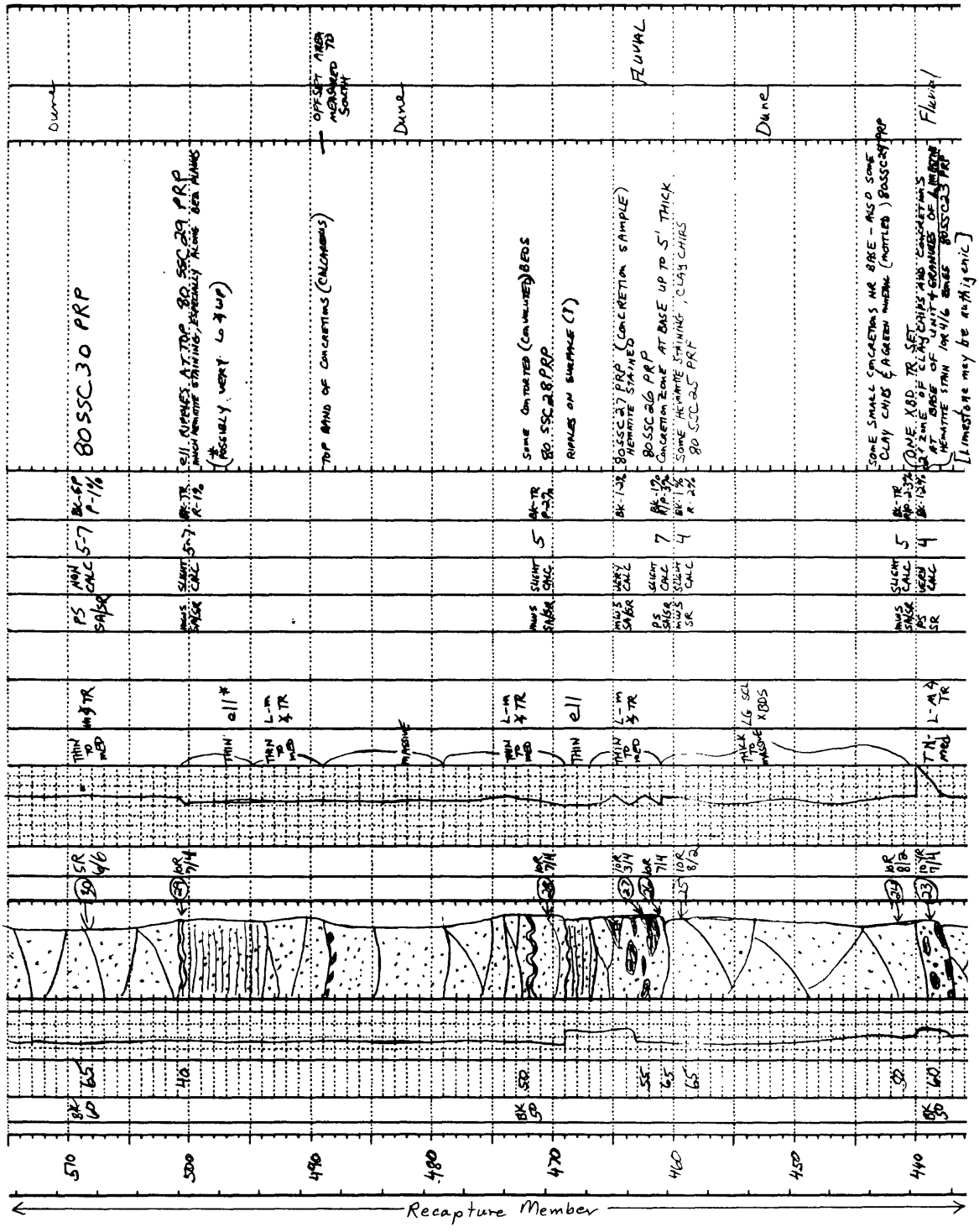
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION PIPELINE ROAD Sec. 30 T. 26N. R. 31E (est.)

(7) STATE Arizona COUNTY Apache

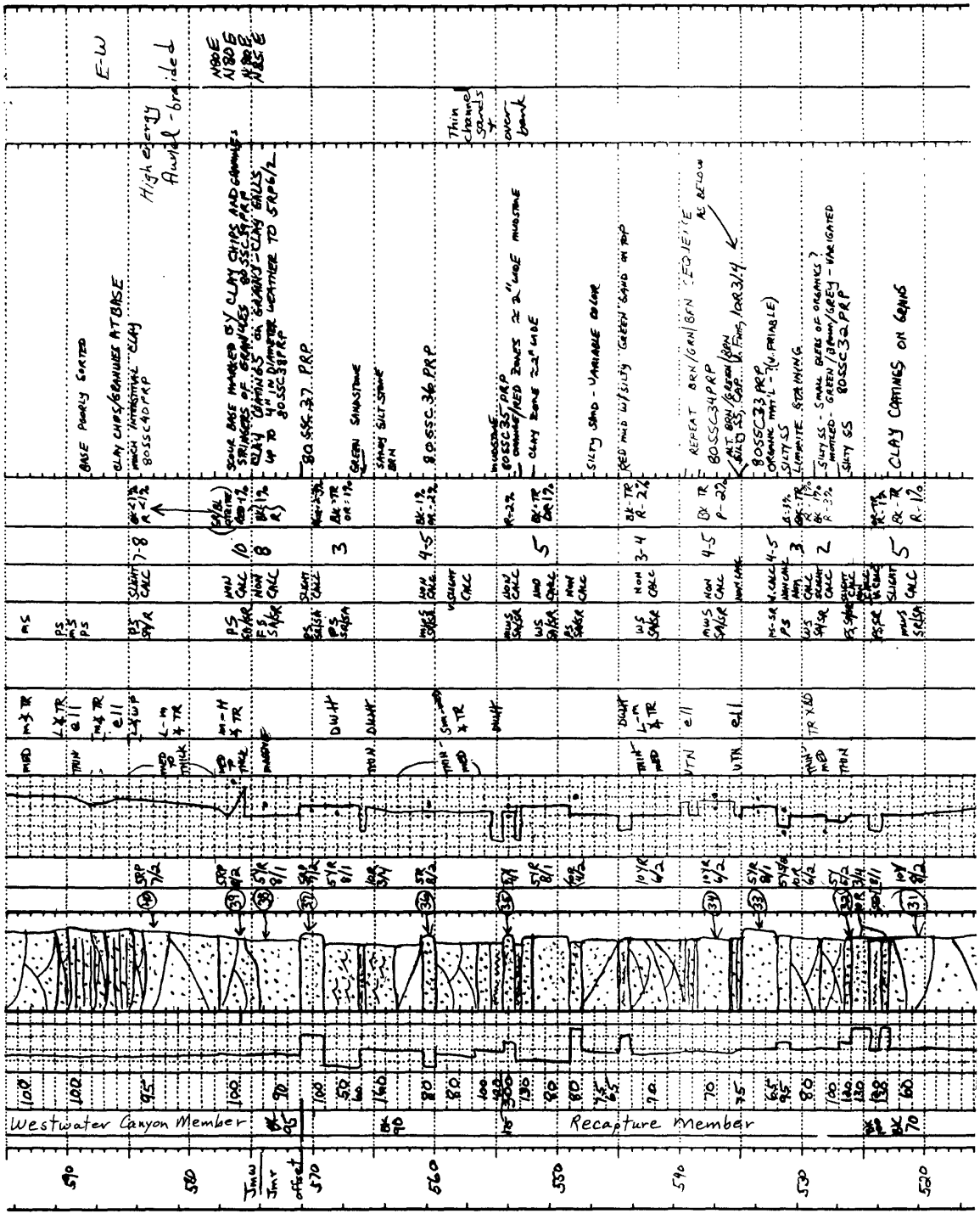
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



(8) LOCATION Pipeline Road Sec. 30 T. 24N R. 31E (est.)

STATE Arizona COUNTY Apache

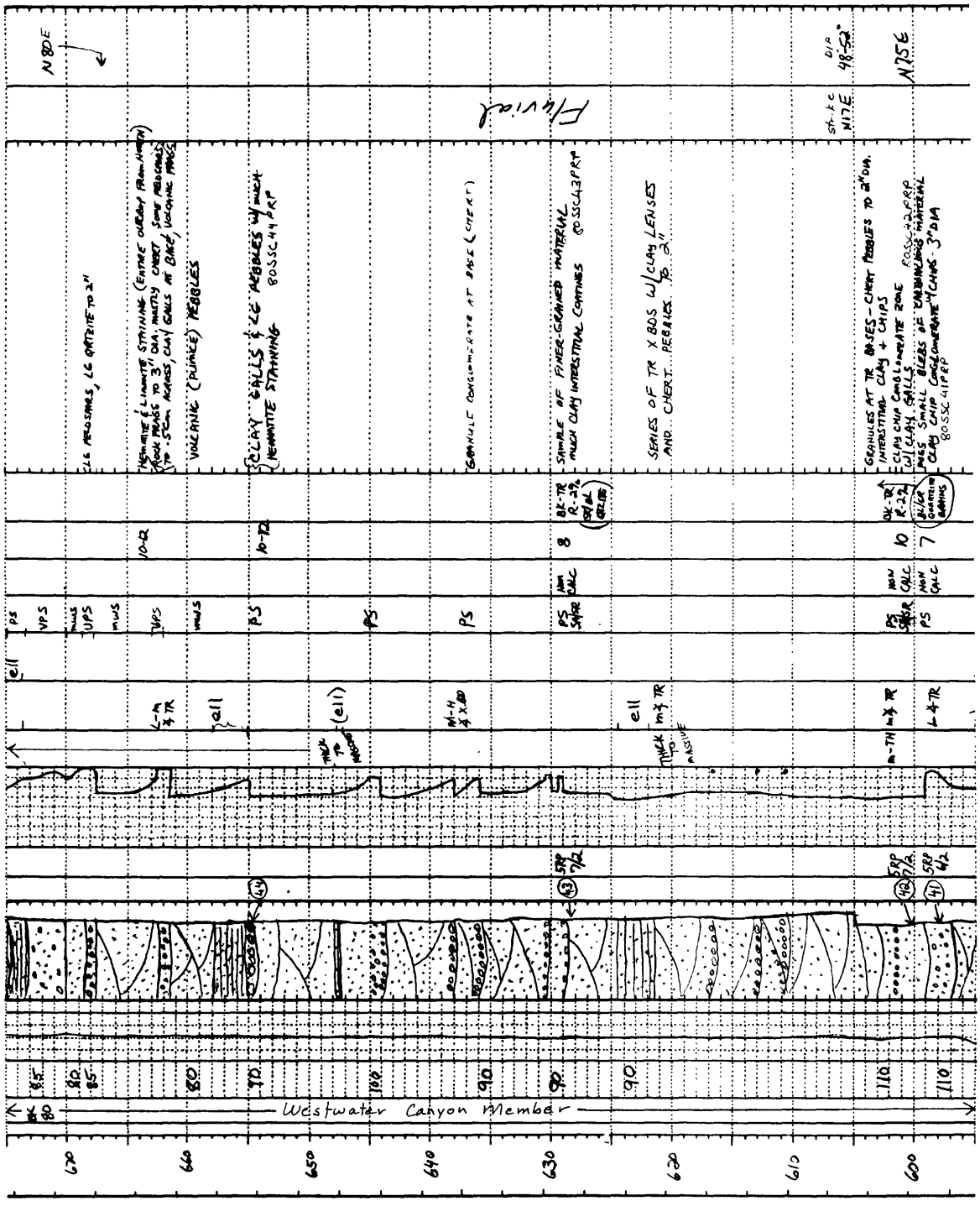
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION Pueblo Pass Sec. 30 T. 24N. R. 31E (est.)

⑨ STATE Arizona COUNTY Apache

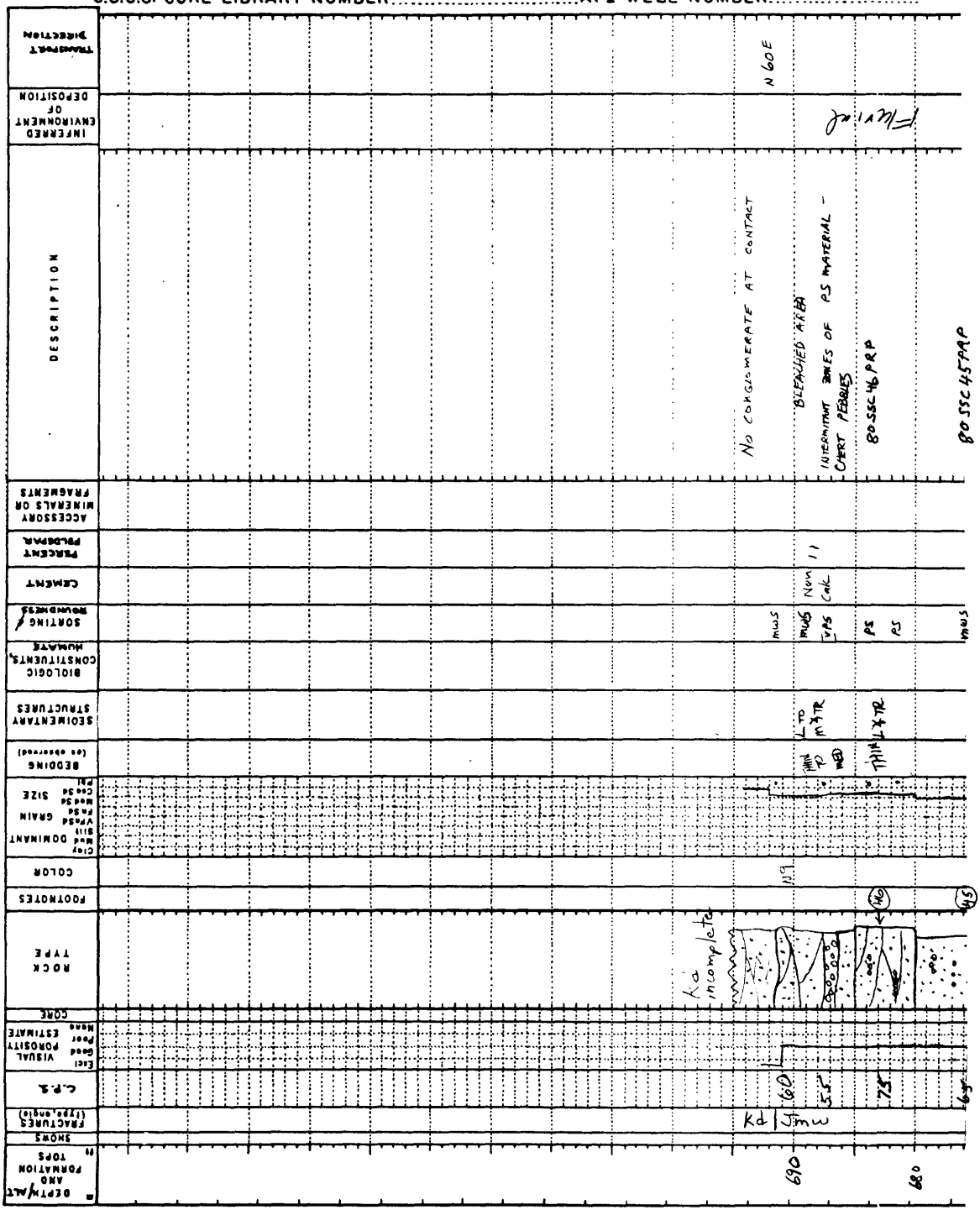
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION Pipeline Road Sec. 30 T. 26N R. 31E (est.)

STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



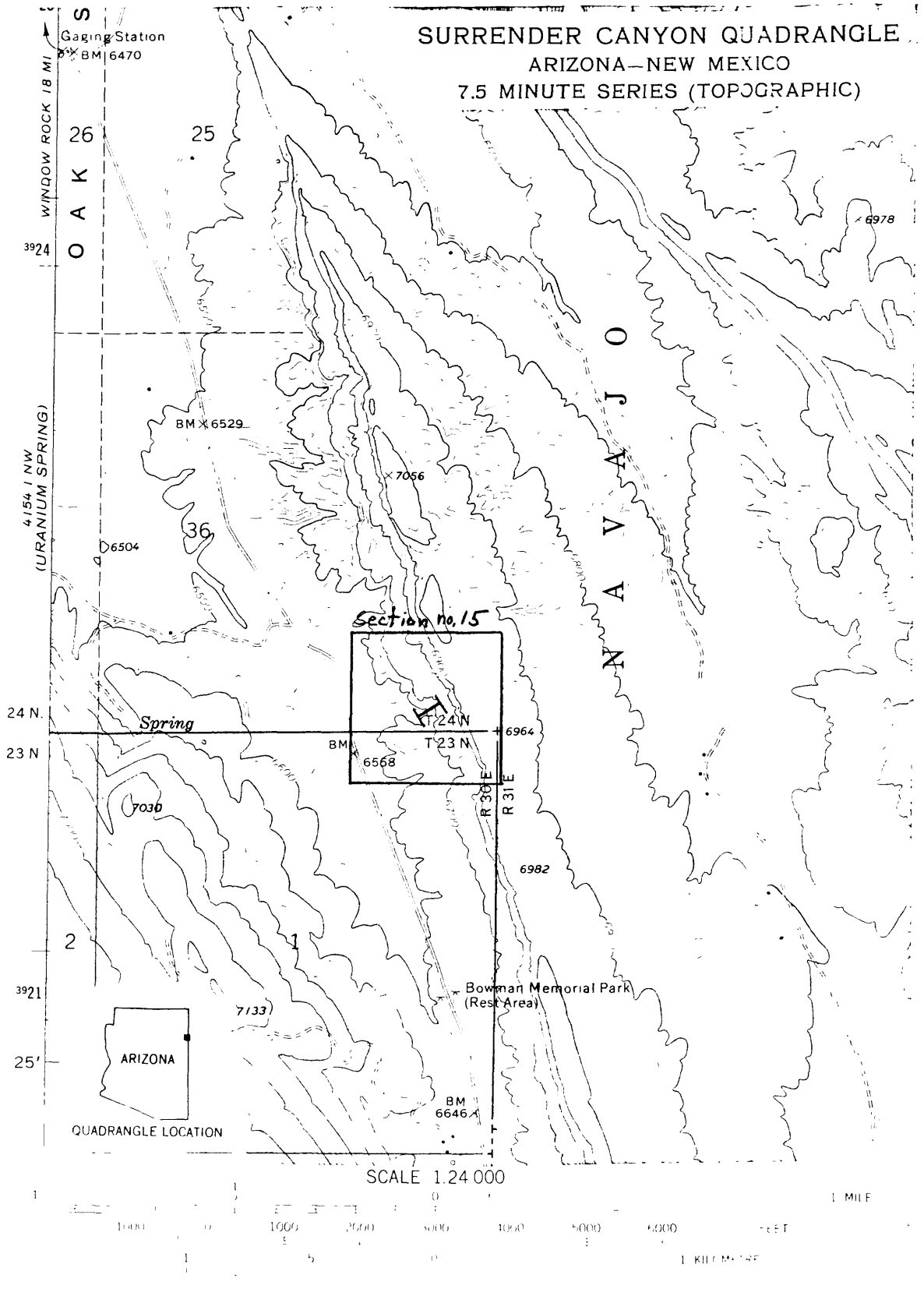
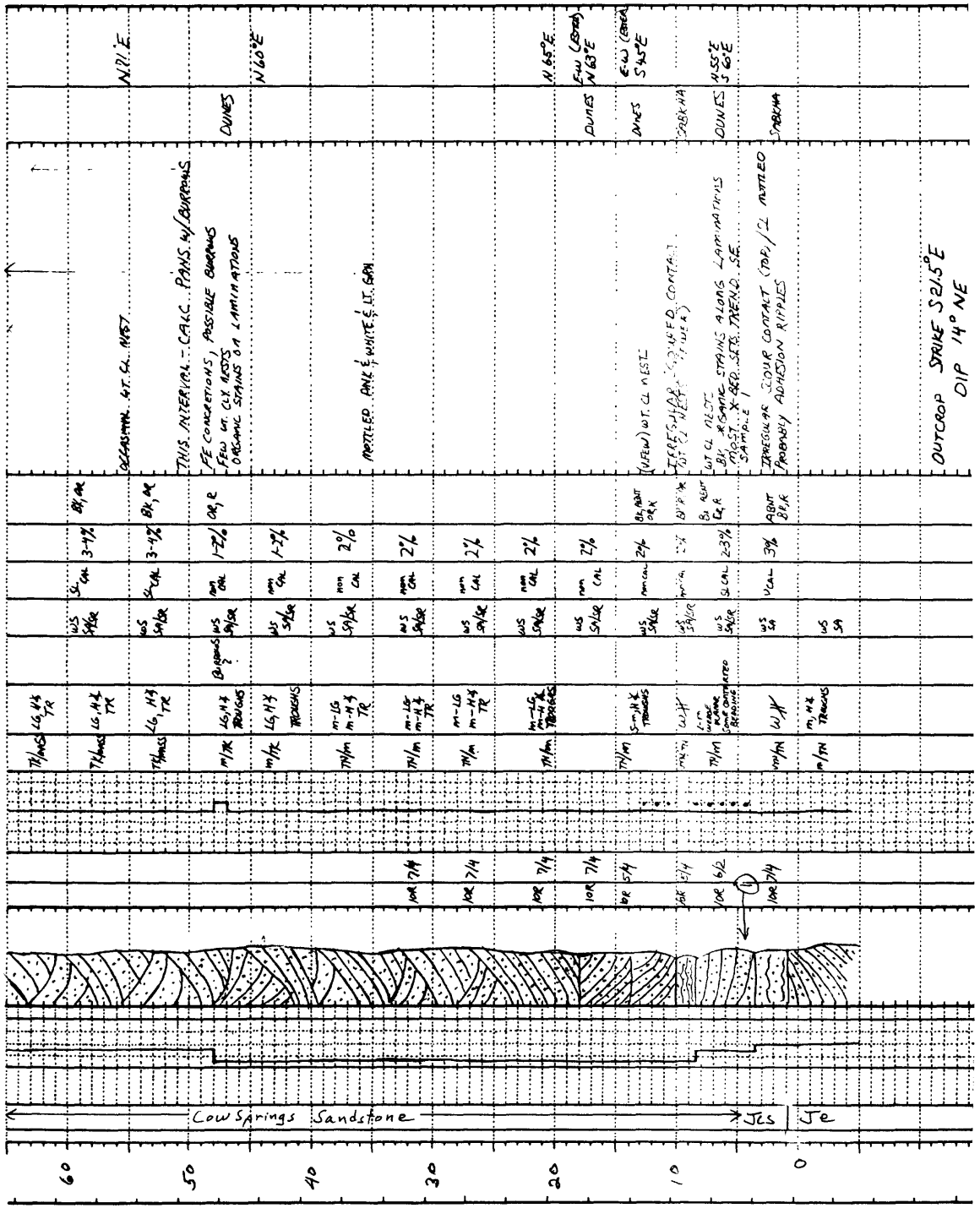


Figure 17. Location of measured section no. 15.

LOCATION 15 Bowman Park SW 1/4, NE 1/4 Sec. 36 T. 24 N. R. 30 E.

STATE Arizona COUNTY Apache

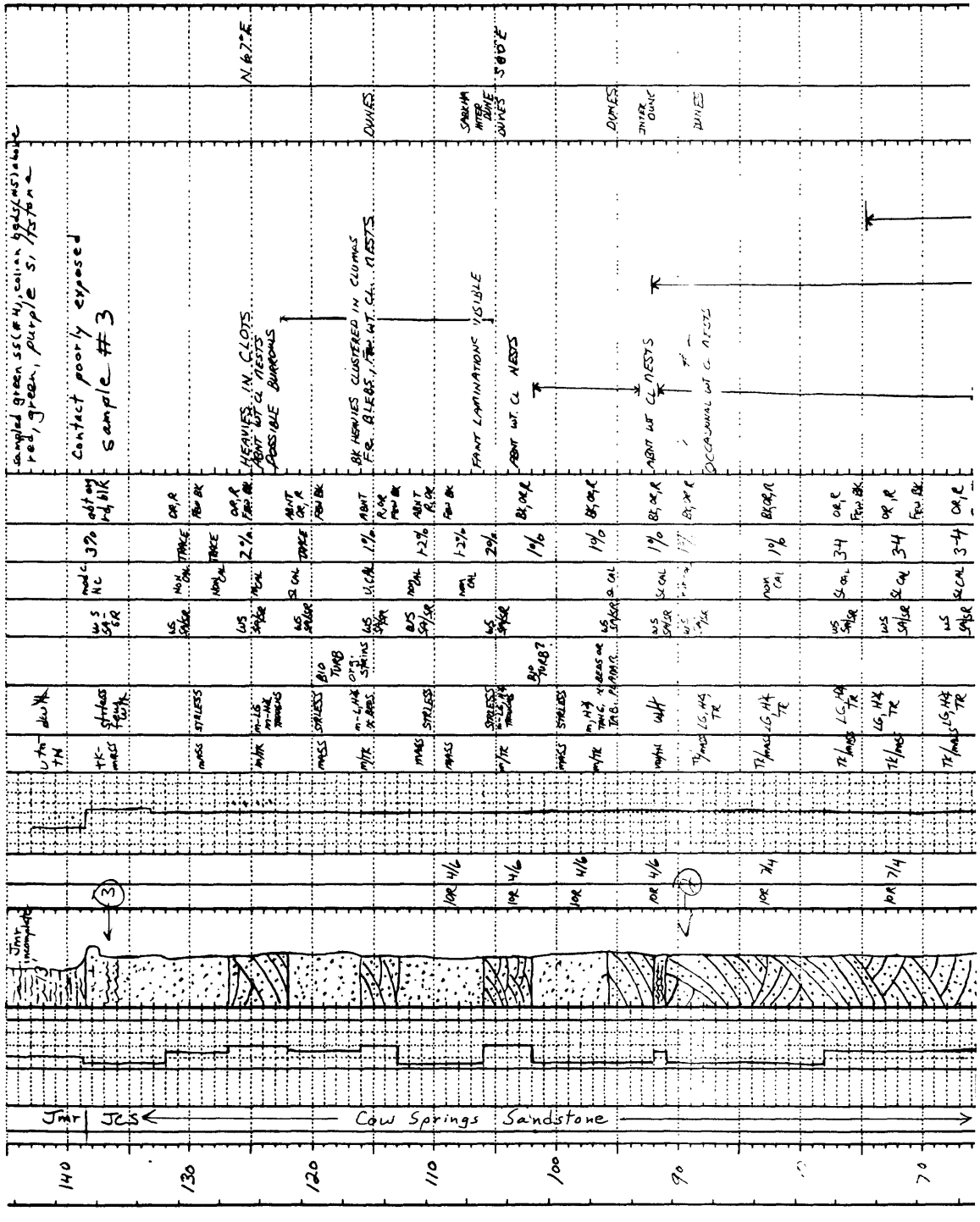
U.S.G.S. CORE LIBRARY NUMBER 8183 API WELL NUMBER Condon, Harris



LOCATION Bowman Park Sec. 36 T. 24N. R. 30E.

(2) STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



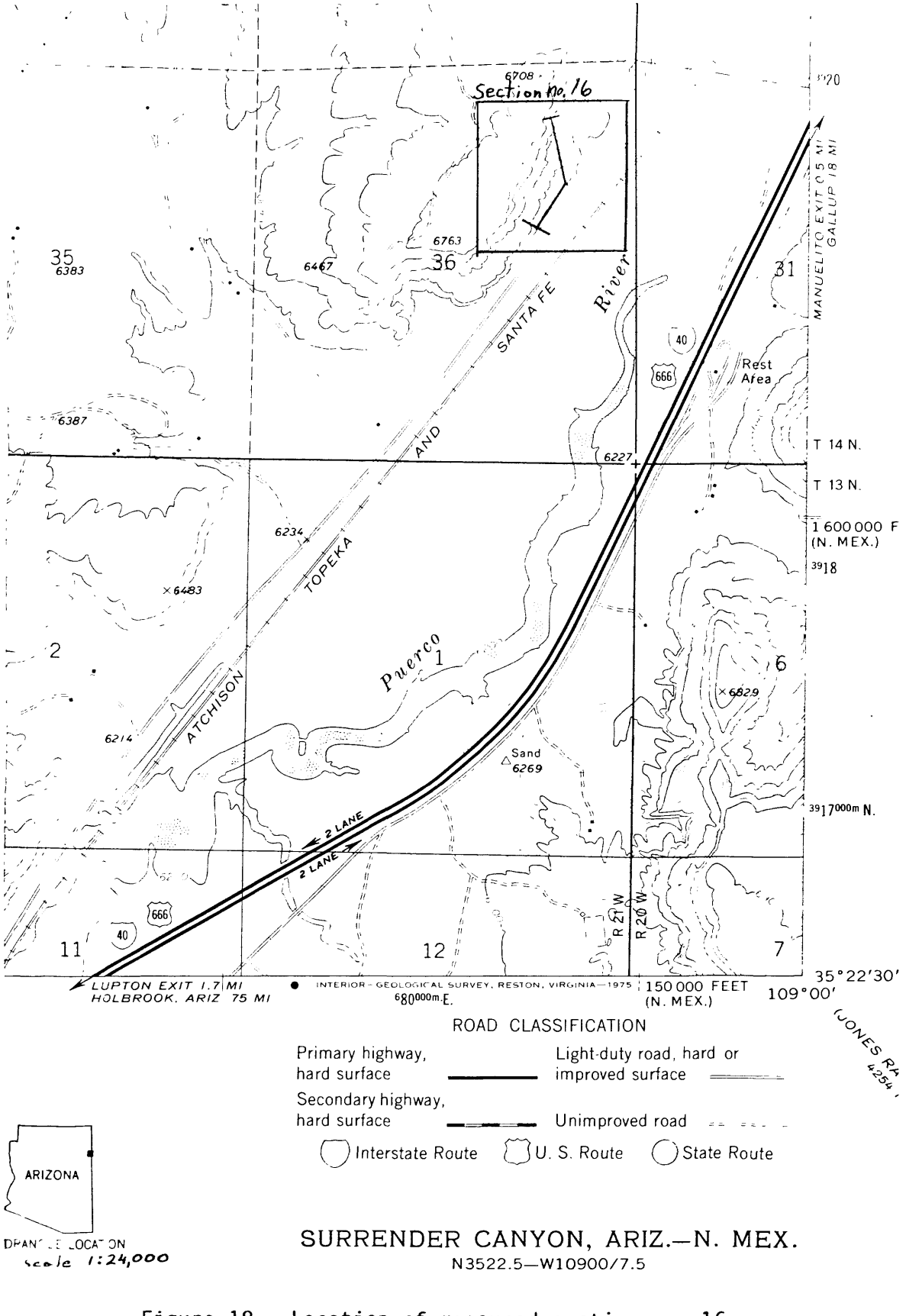
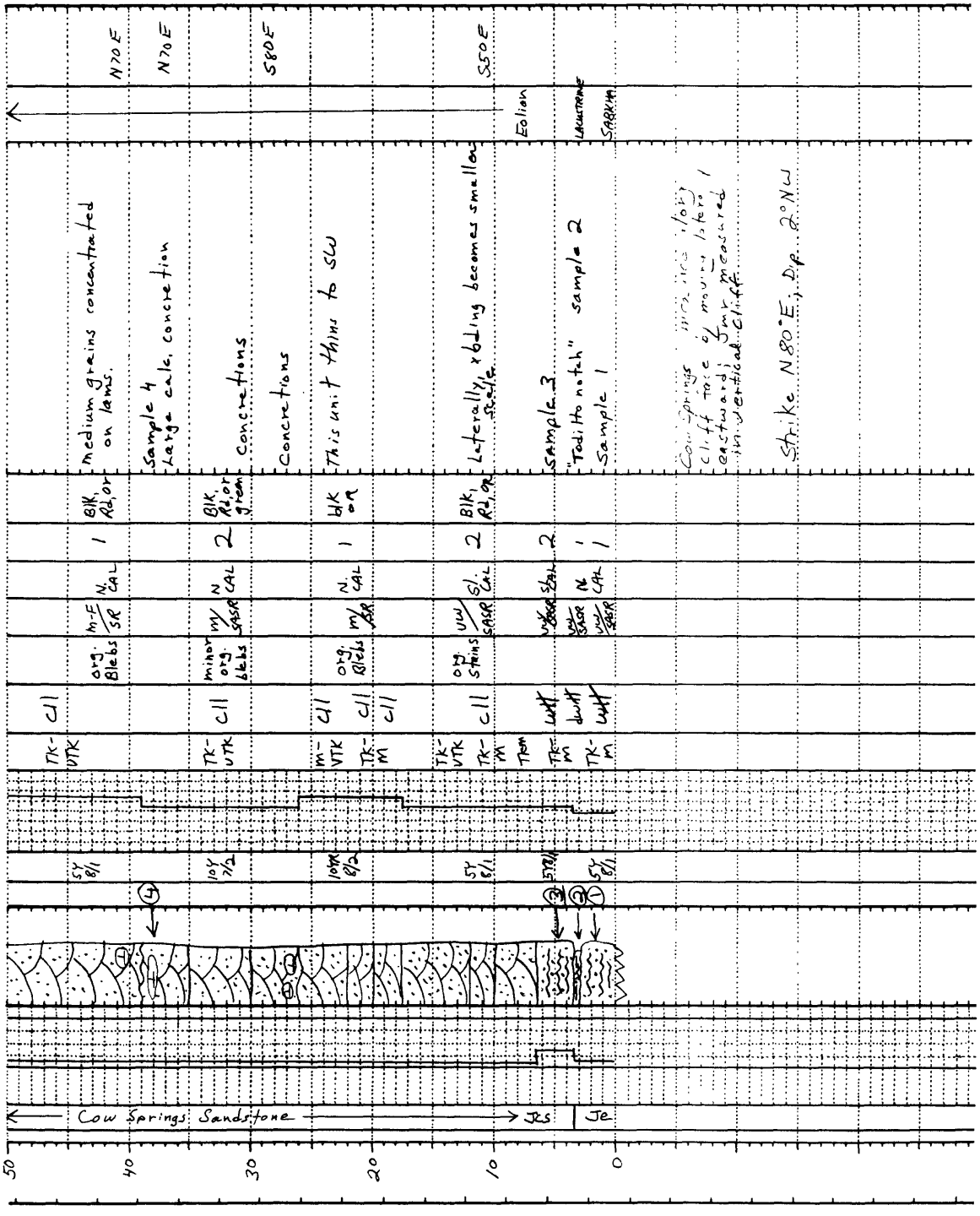


Figure 18. Location of measured section no. 16.

LOCATION 16 Manuelito Sec. E½NE¼, 36 T. 14N. R. 21W.

STATE New Mexico COUNTY McKinley

U.S.G.S. CORE LIBRARY NUMBER 8182 API WELL NUMBER Condon, Hildebrandt



(2)

LOCATION 16 Manuelito Sec. 36 T. 14N. R. 21W

STATE New Mexico COUNTY Mckinley

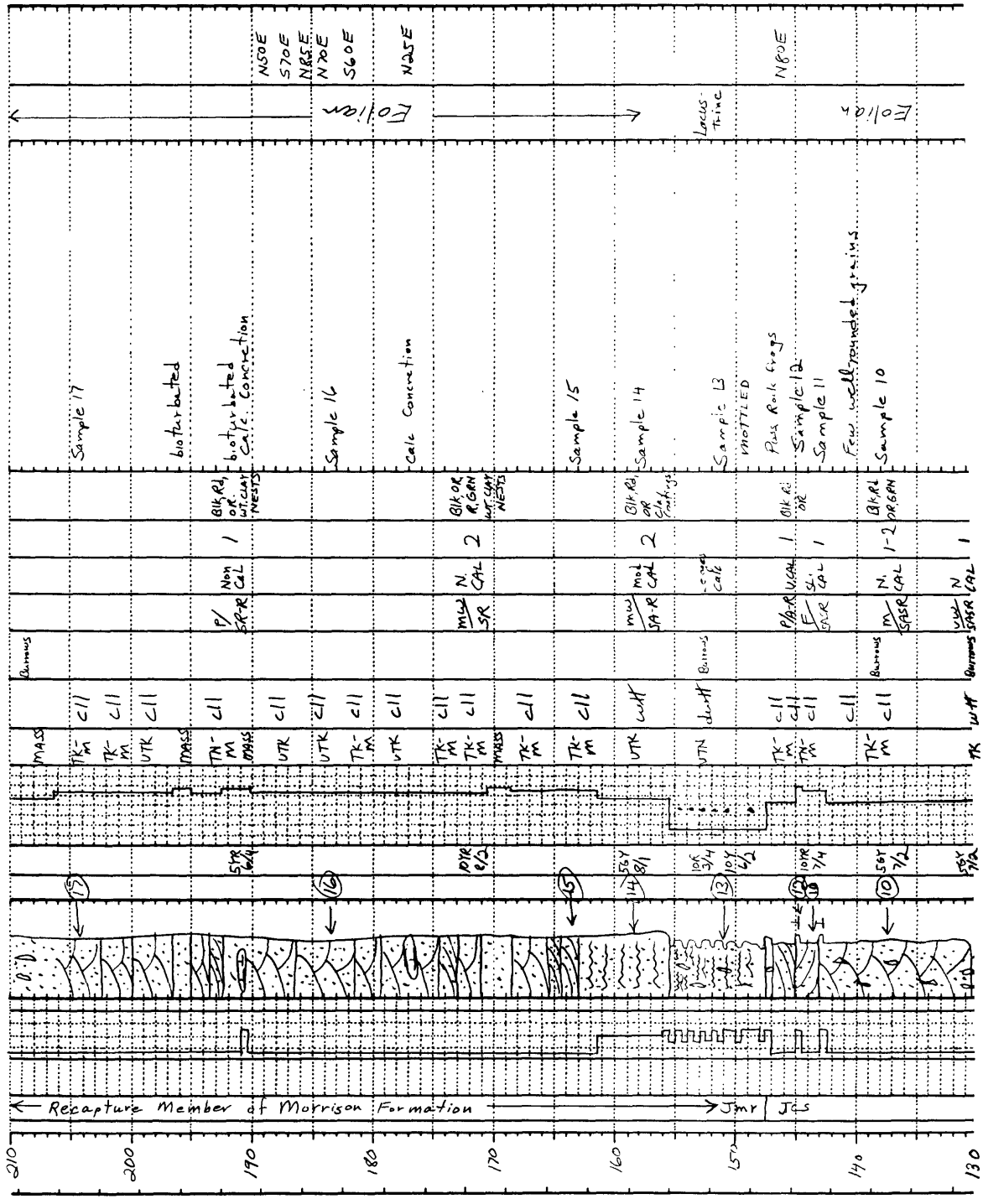
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER

(3)

LOCATION Manuelito Sec. 36 T. 14N R. 21W

STATE New Mexico COUNTY McKinley

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER

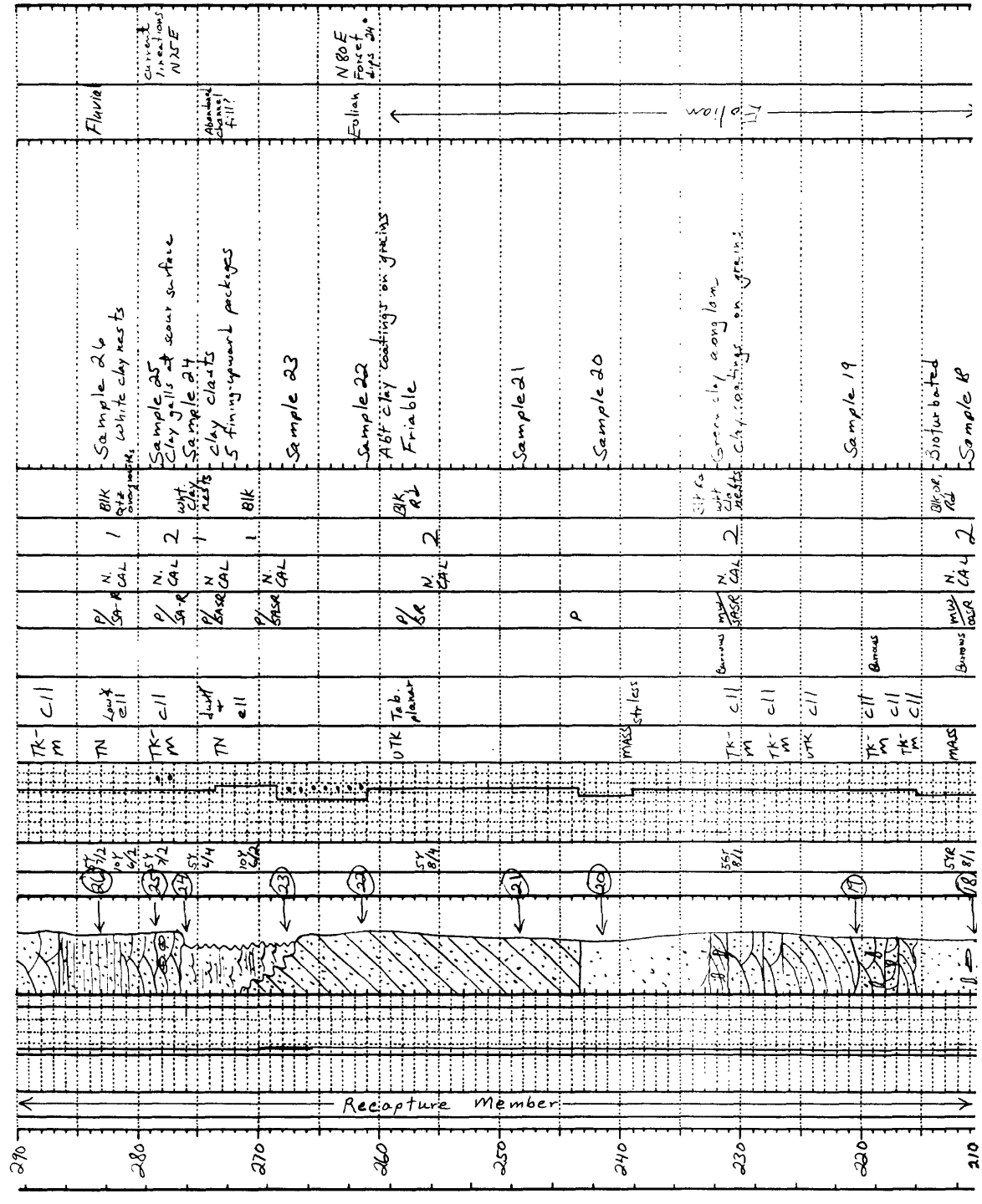


(4)

LOCATION Manuelito Sec. 36 T. 14N R. 21W

STATE New Mexico COUNTY McKinley

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER

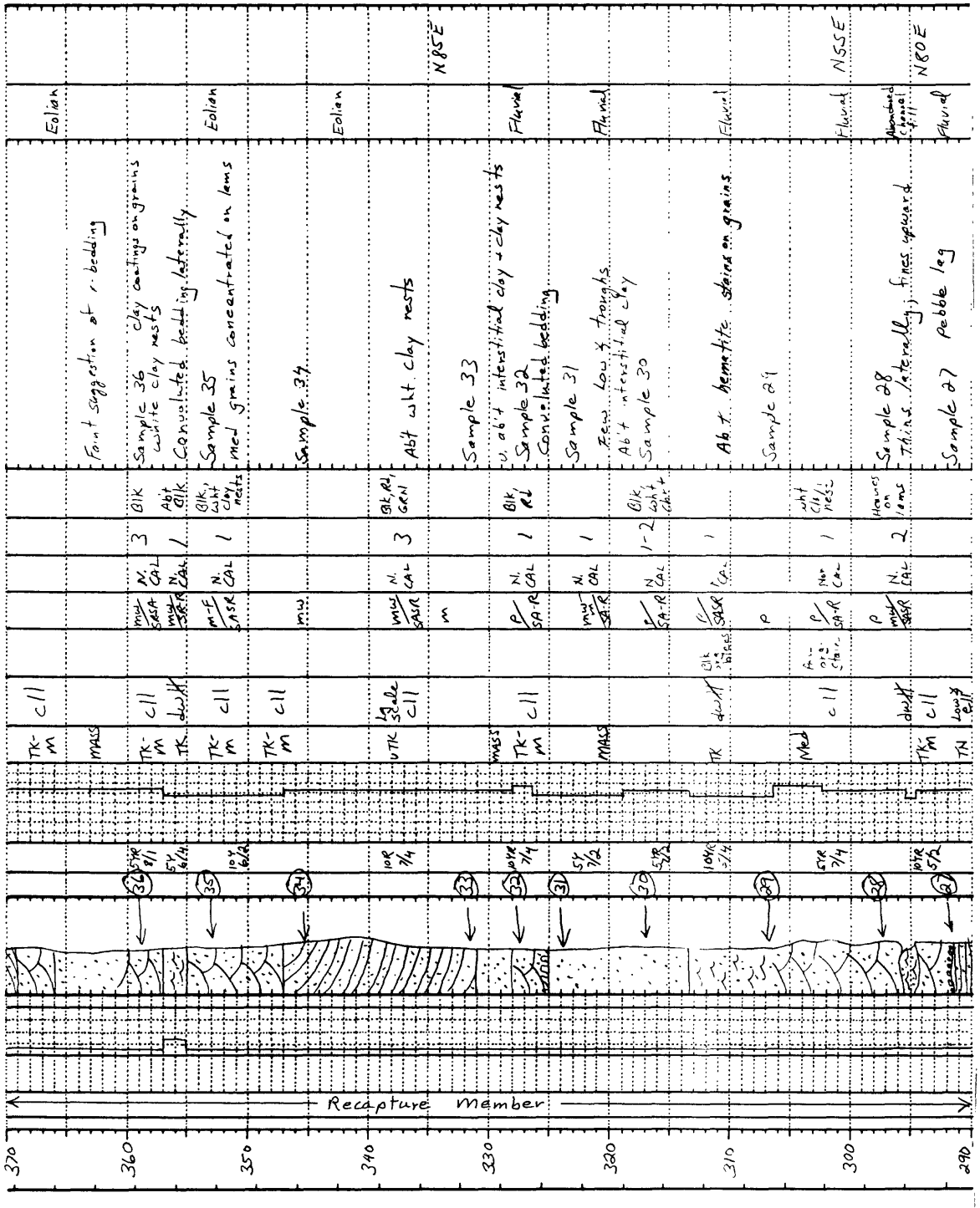


(5)

LOCATION Manuelito Sec. 36 T. 14N. R. 21W

STATE New Mexico COUNTY McKinley

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER

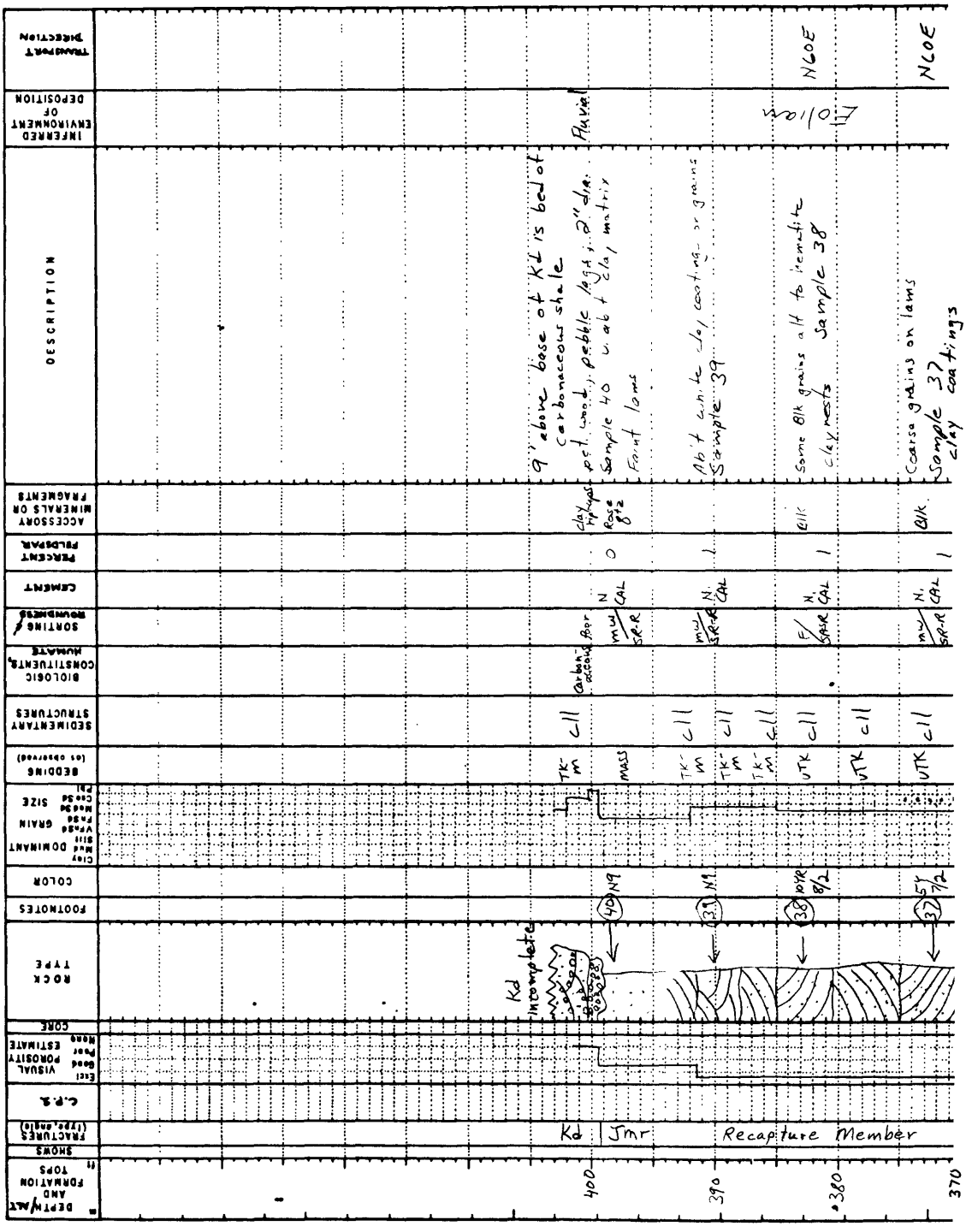


(6)

LOCATION Manuelito Sec. 36 T. 14N R. 21W

STATE New Mexico COUNTY Mckinley

LATITUDE AND LONGITUDE



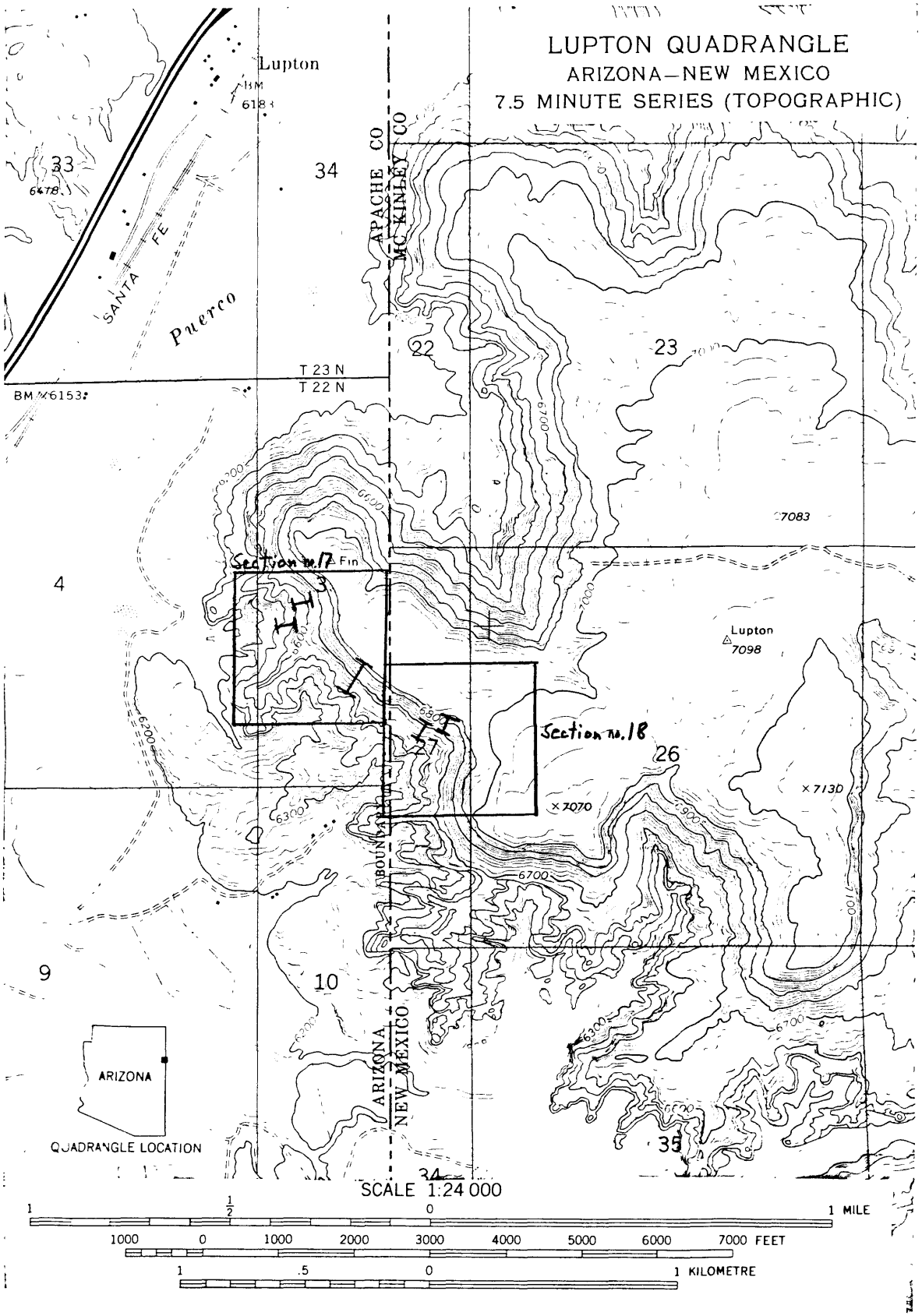
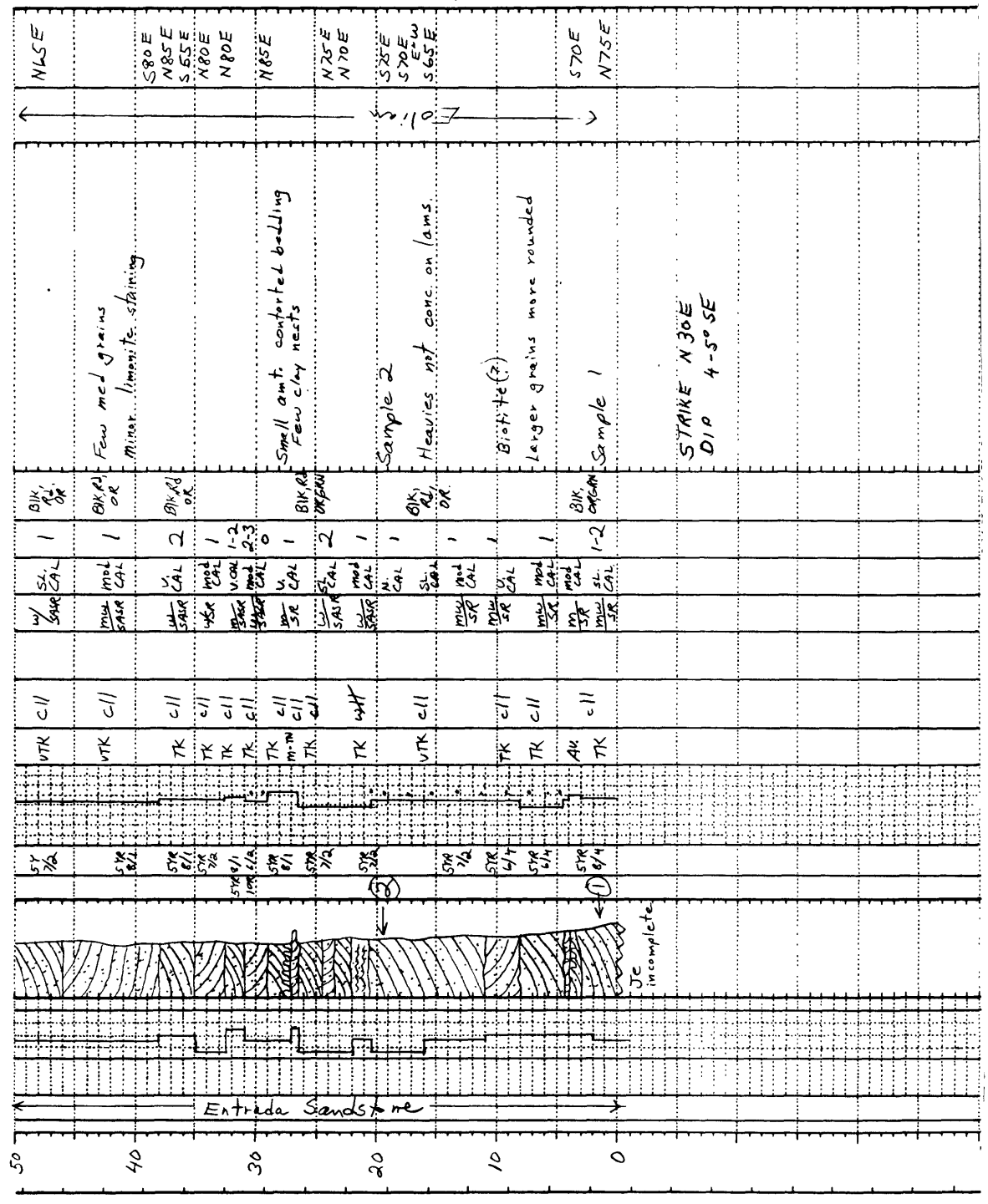


Figure 19. Location of measured section no. 17.

LOCATION 17. Lupton West Sec. N½, SW¼ 3 T. 22N R. 31E.

STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER 8182 API WELL NUMBER ~~Conoco Hildebrandt~~

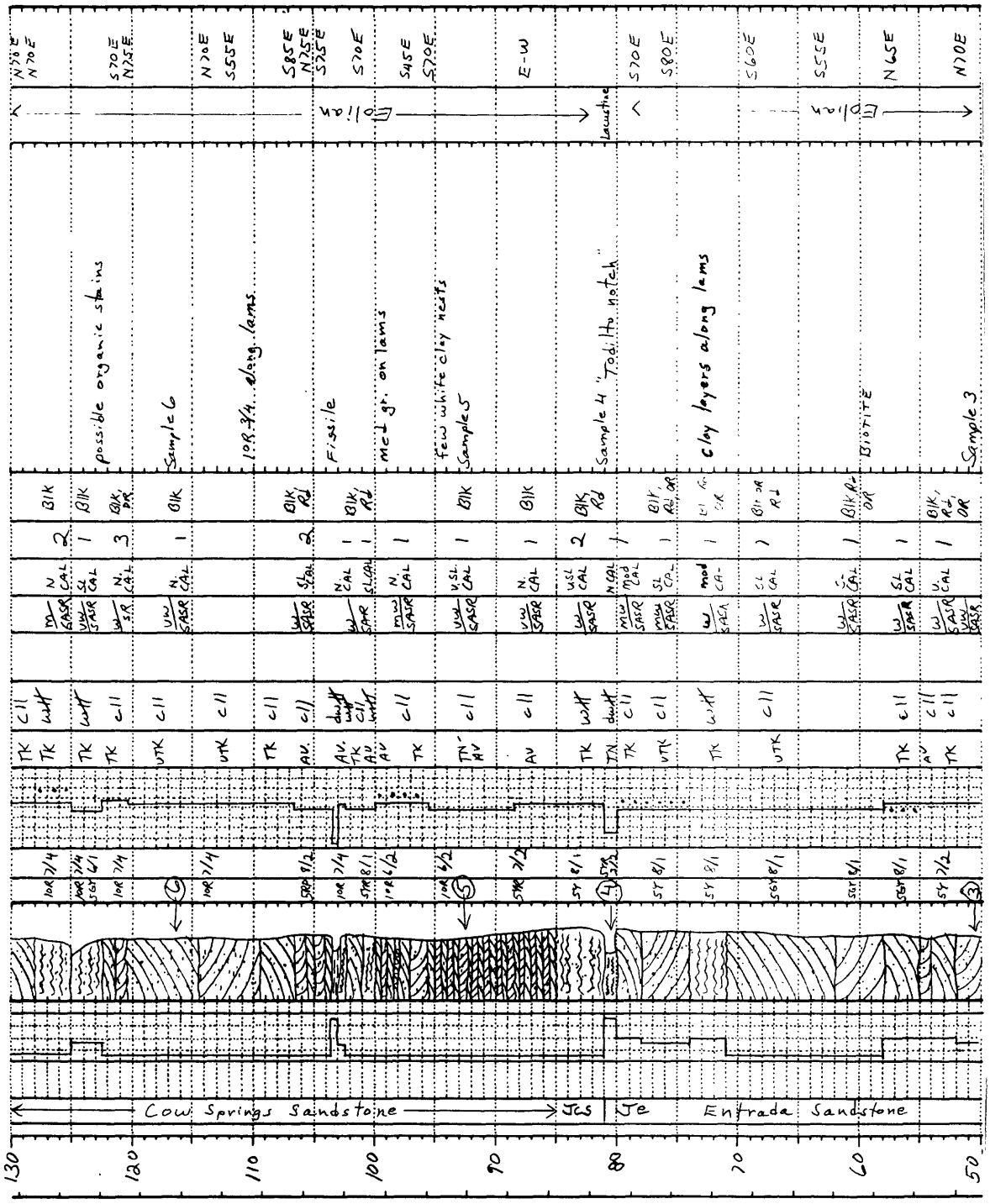


(2)

LOCATION Lupton West Sec. 3 T. 22 N. R. 31 E.

STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER ..... API WELL NUMBER .....



LOCATION Lupton West Sec. 3 T. 22N R. 31E

STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER

(4)

LOCATION Lupton West Sec. 3 T. 22N R. 31E

STATE Arizona COUNTY Apache

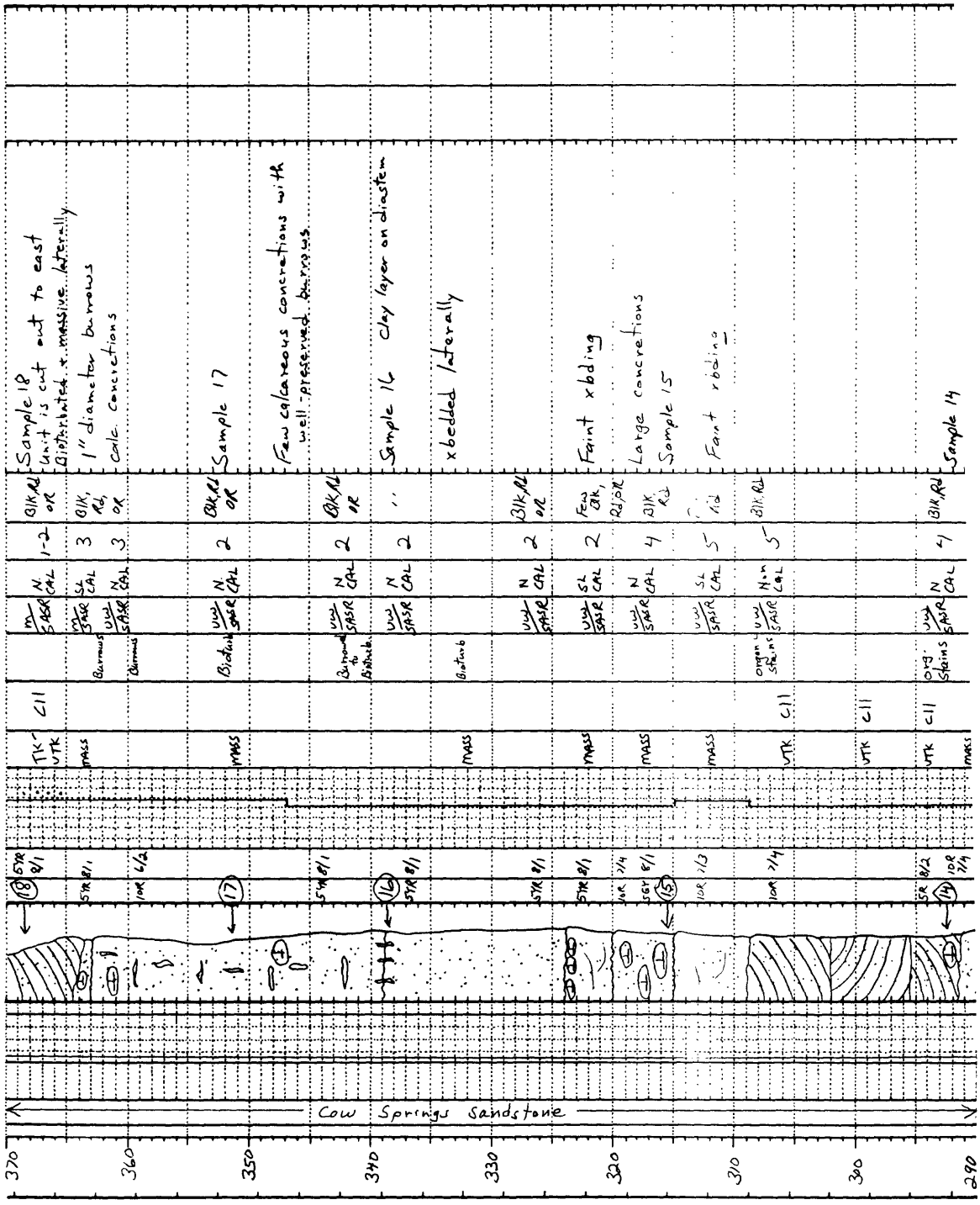
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER

(5)

LOCATION Lupton West Sec. 3 T. 22N R. 31E

STATE Arizona COUNTY Apache

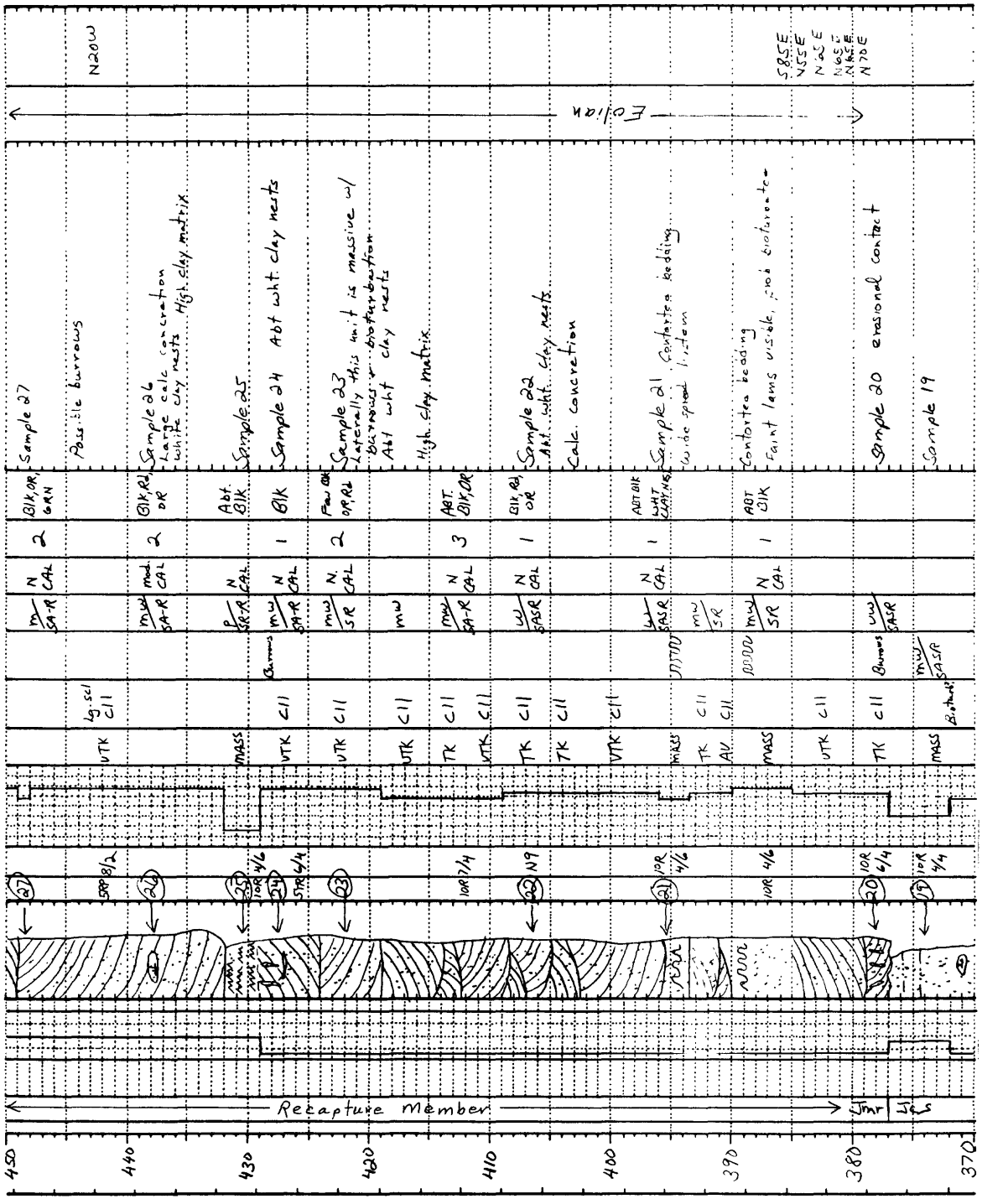
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION Lupton West Sec. 3 T. 22N R. 31E

STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



(7)

LOCATION Lupton West Sec. 3 T. 22 N R. 31E

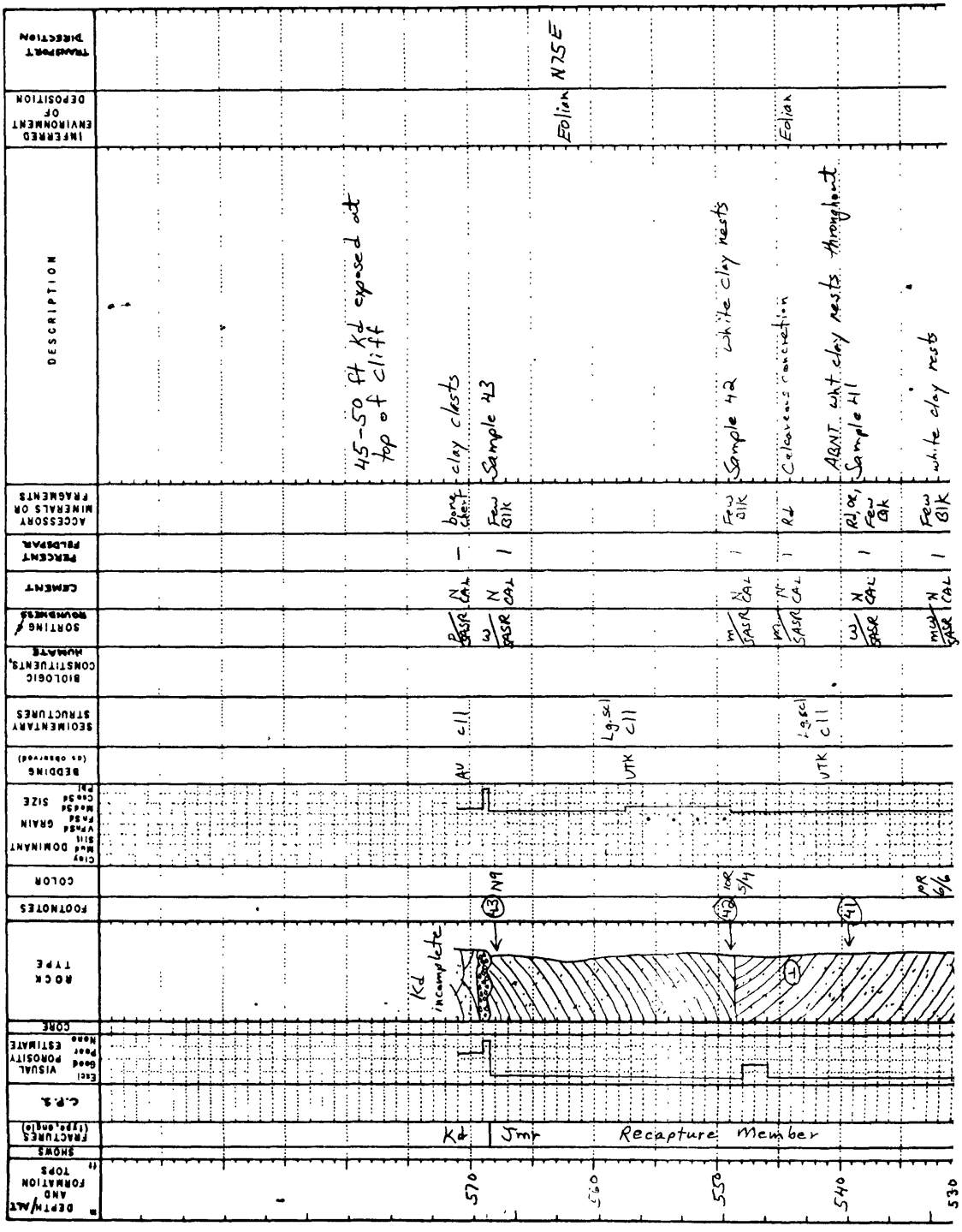
STATE Arizona COUNTY Apache

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER

LOCATION Lupton West Sec. 3 T. 22N R. 31E

(18) STATE Arizona COUNTY Apache

LATITUDE AND LONGITUDE



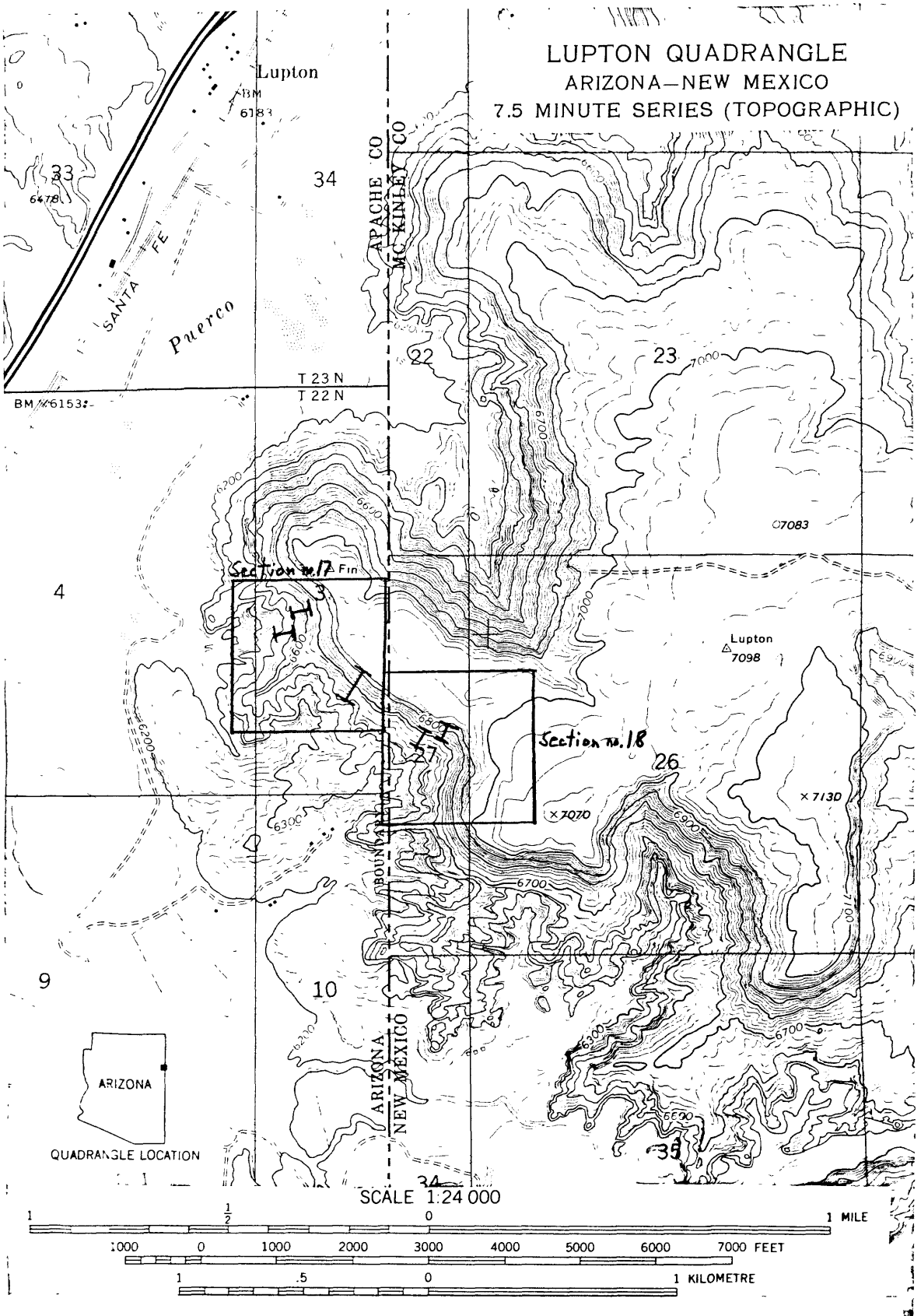


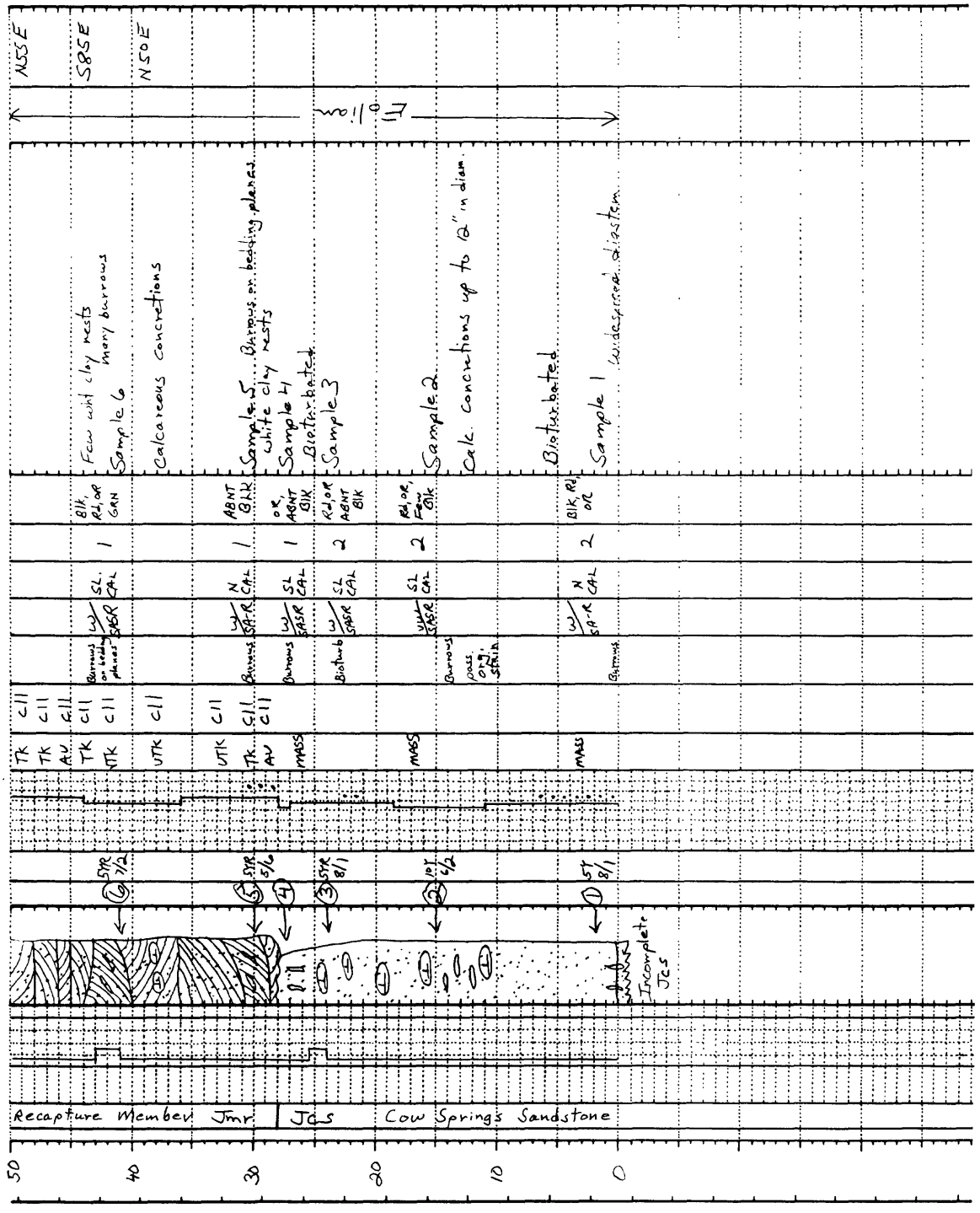
Figure 20. Location of measured section no. 18.

18.

LOCATION Lupton East Sec. SE¼NE¼, 27 T. 13N. R. 21W

STATE New Mexico COUNTY McKinley

U.S.G.S. CORE LIBRARY NUMBER 8182 API WELL NUMBER Conoco, Hilcorp Sandy



(2)

LOCATION Lupton East Sec. 27 T. 13N R. 21W

STATE New Mexico COUNTY McKinley

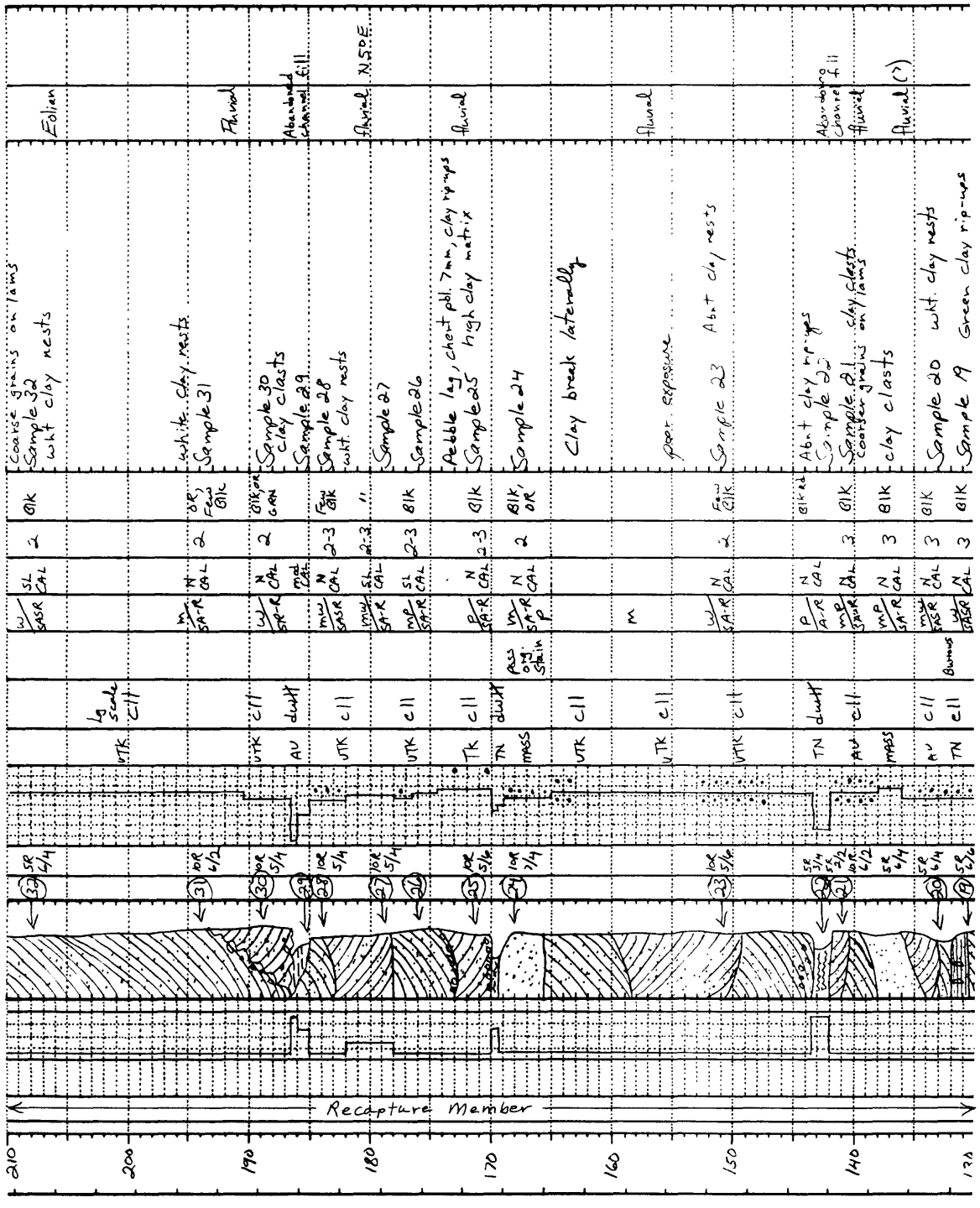
U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER

(3)

LOCATION Lupton East Sec. 27 T. 13N R. 21W

STATE New Mexico COUNTY McKinley

U.S.G.S. CORE LIBRARY NUMBER API WELL NUMBER



LOCATION Lupton East Sec. 27 T. 13N R. 21W

④ STATE New Mexico COUNTY McKinley

LATITUDE AND LONGITUDE