New Mexico Bureau of Mines & Mineral Resources

Open-File Report 105

MAPS SHOWING THE REGIONAL EXTENT OF SANDSTONE BODIES WITHIN THE GALLUP SANDSTONE COMPILED FOR THE SAN JUAN BASIN HYDROGEOLOGIC STUDY

Nancy H. Mizell, Geologist

and William J. Stone, Hydrogeologist

August, 1979

CONTENTS

Introduction 1

Purpose 1

Previous work 1

Data Sources 2

Acknowledgements 3

Map Construction Methods 3

Molenaar (1973 and 1974) 4

Mercer and Cooper (1970) 4

Stone and Mizell (1978) 11

Final Compilation 11

Errors Involved in Compilation 11

Results and Conclusions 12

Selected References 17

ILLUSTRATIONS

Figure 1 - - Sample induction-electric logs showing sandstone bodies in Gallup Sandstone 10

Table 1 - - Location of control points used for maps and cross sections 5

Table 2 - - Distribution, top elevation, and thickness of sandstone bodies within Gallup Sandstone 7

Plate 1 - - Cross sections showing stratigraphic relationship of sandstone bodies within Gallup Sandstone pocket

Plate 2 - - Map showing regional extent of Torrivo sandstone body, Gallup Sandstone pocket

Plate 3 - - Map showing regional extent of sandstone bodies A, B, and C, Gallup Sandstone pocket

Plate 4 - - Map showing regional extent of sandstone bodies D, E, and F, Gallup Sandstone pocket

Plate 5 - - Map showing thickness of sandstone bodies within Gallup Sandstone pocket

INTRODUCTION

Purpose

This study was designed to interpret the regional extent of the seven sandstone facies of Gallup Sandstone described by Molenaar (1973). He identified six marine facies, designated A, B, C, D, E, and F sandstones, and a single nonmarine facies which he named the Torrivio Sandstone Member. In this report Molenaar's facies will be called sandstone bodies. Delineation of the vertical and horizontal limits of the sandstone bodies will aid future studies such as refining a model of the ground-water system in the San Juan Basin.

Previous Work

Numerous publications in the geologic literature describe the Gallup Sandstone, and many more deal with the stratigraphy of the San Juan Basin. Only those investigations that are singularly significant are cited here. A broader bibliography may be obtained by close study of the specific papers cited.

Sears (1925) named the Gallup Sandstone for outcrops near the city of Gallup, establishing the type area there. Beaumont (1957) described the Gallup Sandstone along the western margin of the San Juan Basin and Dane and others (1957) described the age and stratigraphy of the Gallup Sandstone south and east of the type area. Using electric-log data Stone and Mizell (1978) traced the Gallup Sandstone through the subsurface in the San Juan Basin.

Other sources of subsurface data are ground-water and drilling reports. In a ground-water study, Mercer and Cooper (1970) provided data pertaining to the Gallup Sandstone aquifer system in the Gallup-Tohatchi area. More recent ground-water studies of the Gallup Sandstone, by Mercer and Lapalla (1972) and Hiss and Marshall (1975) include results of pumping tests as well as core and electric-log data.

Detailed stratigraphic studies of the Gallup Sandstone since its definition have resulted in a better understanding of the depositional environments responsible for the unit. Budd (1957) suggested four facies trends developed within the Gallup Sandstone. Campbell (1971 and 1979), from a study of the Gallup Sandstone in the northwestern San Juan Basin, suggested the Gallup as a depositional model of a beach shoreline. Campbell (1972) also discussed offshore age equivalents of the Gallup in northwestern New Mexico. In other studies of northwestern New Mexico, Molenaar (1973, 1974) discussed the sandstone facies in the Gallup.

Data Sources

The data used in preparation of this study are published outcrop data, published subsurface data, and published facies interpretations. Outcrop data consist of measured sections, which are shown on Plate 1 in cross section form, modified from Molenaar (1973, 1974).

The principal source of subsurface or well data is Molenaar (1973, 1974) with supplementary data from Mercer

and Cooper (1970) and Stone and Mizell (1978). Cross sections on Plate 1 present well data from Molenaar (1973, 1974). Sample logs, electric logs, top elevations and thicknesses of units were drawn from Mercer and Cooper (1970). Well data from Stone and Mizell (1978) consist of nine electric logs. Figure 1 shows representative samples of the log characteristics of each of Molenaar's (1973) sandstone bodies.

Data from Molenaar's (1973, 1974) cross sections are the basis for the maps of the A, B, C, D, E, F, and Torrivio sandstone bodies of the Gallup Sandstone. The sources of surface elevations, used to compute top elevations and thickness of each body, are O'Sullivan and Beikman (1963), Hackman and Olson (1977), and Wyant and Olson (1978).

ACKNOWLEDGEMENTS

We wish to thank C.M. Molenaar for reviewing original drafts of Plates 1-4. His comments and suggestions have been helpful but any errors thereon are ours alone.

MAP CONSTRUCTION METHODS

The approach used in this study includes four steps: 1) a comprehensive review of the literature pertaining to the Gallup Sandstone; 2) extensive study of significant papers to determine methods of extracting useable information; 3) computation of top elevation and thickness of each sandstone body; and 4) final compilation of data from selected

papers needed to produce maps showing the regional extent of the sandstone bodies. Unique problems with each data source necessitate separate discussion of the major sources.

Molenaar (1973 and 1974)

Three types of data utilized from Molenaar (1973, 1974) include: 1) location of well control points (Table 1); 2) location of outcrop control points (Table 1); and 3) cross sections of the San Juan Basin. Elevations for the top of the Gallup Sandstone were determined from geologic maps (O'Sullivan and Beikman, 1963; Hackman and Olson, 1977; Wyant and Olson, 1978) and using control-point locations (Table 1). Elevations for the top and thicknesses of each sandstone body (Table 2) were determined from cross sections (Plate 1) and previously calculated top elevations for the Gallup Sandstone.

Mercer and Cooper (1970)

Selected data from Mercer and Cooper (1970) were chosen because: 1) their wells penetrate Gallup Sandstone in the area east and north of the city of Gallup; 2) their location is not already covered by Molenaar's data, but is close enough to other data to allow cross checking; 3) sample or electric logs are available. Four wells (Table 1) meet these criteria and were used in calculating top elevations.

TABLE 1

Location of control points used for maps and cross sections; M = Molenaar (1973, 1974), MC = Mercer and Cooper (1970), and SM = Stone and Mizell (1978). See plates 1, 2, 3 and 4.

Part I - Surface control

Control Point	Location		Reference	Cross Section
4	NE¼	30-31N-19W	M	A-A'
5	N½	5-30N-19W	M	A-A'
6	N½	20-30N-19W	M	A-A'
7	SE¼	12-29N-20W	M	A-A'
8	SE¼	26-29N-20W	M	A-A'
9	SW¼	7-28N-19W	M	A-A'
10	S½	25-28N-19W	M	A-A'
11		17-27N-19W	M	A-A'
12		33-27N-19W	M	A-A'
13	SE¼SE¼	18-26N-19W	M	A-A'
14	SW¼SW¼	31-26N-19W	M	A-A'
15	NW¼NW¼	30-25N-19W	M	A-A'
16	SW¼SW¼	12-24N-20W	M	A-A'
17	SE¼	31-24N-19W	M	A-A'
18	NW¼	16-23N-19W	M	A-A'
19	SW¼	27-23N-19W	M	A-A'
20	W½	19-20N-19W	M	A-A'
21	NE¼	17-18N-20W	M	A-A'
22	NE¼	12-17N-21W	M	A-A'
23	NW¼	36-17N-21W	M	A-A'
27	S½	31-15N-20W	M	C-C'
28	NE¼	29-15N-19W	M	C-C'
29	SE¼NE¼	13-15N-18W	M	C-C'
38	NW¼	15-16N-17W	M	C-C'
39	SW¼NE¼	7-16N-16W	M	C-C'
40	NW¼	11-16N-16W	M	C-C'
41		22-16N-15W	M	C-C'
42		3-16N-15W	M	C-C'
43		15-16N-14W	M	B-B', C-C'
44		4-15N-13W	M	C-C'
45	SW¼	9-15N-12W	M	C-C'
46		7-15N-11W	M	C-C'
47		36-15N-11W	M	C-C'
48		4-14N-10W	M	C-C'
49		1-14N-10W	M	C-C'
50		22-14N-9W	M	C-C'
51		6-13N-8W	M	C-C'
52	E½SW¼	28-12N-8W	M	C-C'
53	N½NE¼	2-10N-8W	M	D-D'
62	E½	19-11N-6W	M	D-D'
63	E½	4-11N-5W	M	D-D'
64		30-13N-4W	M	D-D'

65	SE¼	4-13N-4W	M	D-D'
66	SW¼SW¼	7-14N-3W	M	D-D'
67	NE¼SW¼	27-15N-3W	M	D-D'
68	E½	10-15N-3W	M	D-D'
69	NW¼NW¼	36-16N-2W	M	D-D'

Part II-Subsurface Control

Control Point	Well Location	Well Name	Ref.	Cross Section
101	20-15N-18W	H.P. Doty Water Well	M	C-C'
102	28-15N-18W	V.F. Maddox	M	B-B'
103	8-18N-12W	Jones and Peachee	M	B-B'
104	26-20N-13W	Sinclair No.1	M	B-B'
105	18-21N-12W	Sinclair No 1	M	B-B'
106	23-23N-12W	Humble Oil No.	M	B-B'
107	29-24N-11W	Magnolia Pet. No. 1	M	B-B'
108	17-25N-11W	Shell Oil No. 113-17	M	B-B'
109	9-26N-11W	Pan American Pet. No. 1	M	B-B'
110	10-27N-11W	Sinclair No. 7	M	B-B'
117	33-15N-8W	R.A. Crane, Jr. No.1	M	
118	9-15N-7W	Crown Cent. Pet. No. 6	M	
120	25-16N-5W	Hughes and Hughes No. 1	M	
121	29-17N-4W	Refiners Pet. No. 1	M	
93	8-15N-18W	Gallup 15	MC	
94	3-15N-19W	Miller-Gamerco 1	MC	
95	17-16N-18W	Munoz 1-A	MC	
96	27-19N-18W	Bureau Indian Affairs 14T-514	MC	
292	22-21N-11W	Tesoro Pet. 1 Boundary	SM	
302	19-20N-11W	Davis Oil 1 Wild Card	SM	
311	32-19N-12W	Hughes & Hughes 1 State Tract 18	SM	
312	14-19N-11W	Sinclair 1 Santa Fe 74 N. Ranch	SM	
334	8-17N-7W	Davis Oil 1 El Tigre	SM	
343	5-15N-6W	Shar-Alan 2 Fernandez	SM	
347	29-19N-17W	Pure Oil 1 Coyote Canyon	SM	
366	33-16N-8W	Shar-Alan 3 Fernandez	SM	
371	32-18N-16W	Superior Oil K-1 Navajo	SM	

TABLE 2

Distribution, top elevation, and thickness of sandstone bodies within the Gallup Sandstone (top elevation, ft/thickness, ft). See Plate 1, 2, 3 and 4

Control Point	Torrivio Member	A	B	C	D	E	F
4			5000/10				
5			5000/20				
6			5250/40				
7			5600/40				
8			5578/50				
9			5571/54				
10			5570/57				
11		Missing	? /50				
12	Missing	? /55	? /46				
13	6750/59	Missing	6691/60				
14	6200/65		6135/80				
15	6200/39		6128/57				
16	6800/46		6680/29		Missing		
17	7000/20		6911/30	Missing	6881/10		
18	6400/115		Missing	6282/49	6233/30		
19	7000/80			6917/55	6862/37		
20	7718/66			7586/21	7550/20	Missing	
21	? /70			Missing	? /30	? /88	
22	? /44				? /25	? /120	
23	5755/27				5662/36	5581/105	
27	? /90				? /25	? /48	? /46
28	6378/100				6219/58	6122/15	6043/46
29	6279/60			Missing	6550/45	6460/64	6340/54
38	7140/75			7050/56	6994/84	6867/19	6748/8
39	Present			Present	Missing	Present	?
40	6900/40			6850/47		?	?
41	? /30			? /40		?	?
42	7234/49			7171/32		?	6963/50
43	7200/31			7140/42		?	?
44	Missing			8020/57		7180/30	Missing
45	7385/24			7320/62		7130/19	

TABLE 2, continued

Control Point	Torrivio Member	A	B	C	D	E	F
46	Missing			7470/80		7300/66	
47				7280/61		7129/32	
48				7420/81		7215/26	
49				? /150		? /15	
50				7440/126		7195/34	
51				7260/101		7037/19	Missing
52				Present		Present	?
53				?/75		? /33	?/ 54
62				7680/75			
63				6080/75			
64			?	6770/110			
65			7000/85	?			
66		?	600/85				
67		6000/98	?				
68		6000/60					
69		Missing					
101	? /83			Missing	? /50	?/ 60	? /60
102				? /110			
103				? /45			
104			Missing	? /56			
105		Missing	? /30	? /105			
106		? /88	Missing				
107		Missing					
108							
109							
110							
117				6730/100			
118				5500/90			
120		6055/30	6025/100				
121		Missing					
93	5398/?				5290/?	5190/?	5100/?
94	5740/?				Missing	5610/?	5538/?

TABLE 2, continued

Control Point	Torrivio Member	A	B	C	D	E	F
95	5102/?			4992/?	4872/?	4730/?	Missing
96	5300/?				5275/?	5070/?	4960/?
292		3405/140					
302			3972/130				
311	4928/40			4743/130		4533/45	
312			4289/120	4289/120			
334		4822/10	4812/43	4761/24			
343			5711/100	5556/30			
347	4972/33			4929/31	4858/40	4738/60	
366				5252/20		5132/42	
371				5545/15	5505/33	5460/35	5395/30

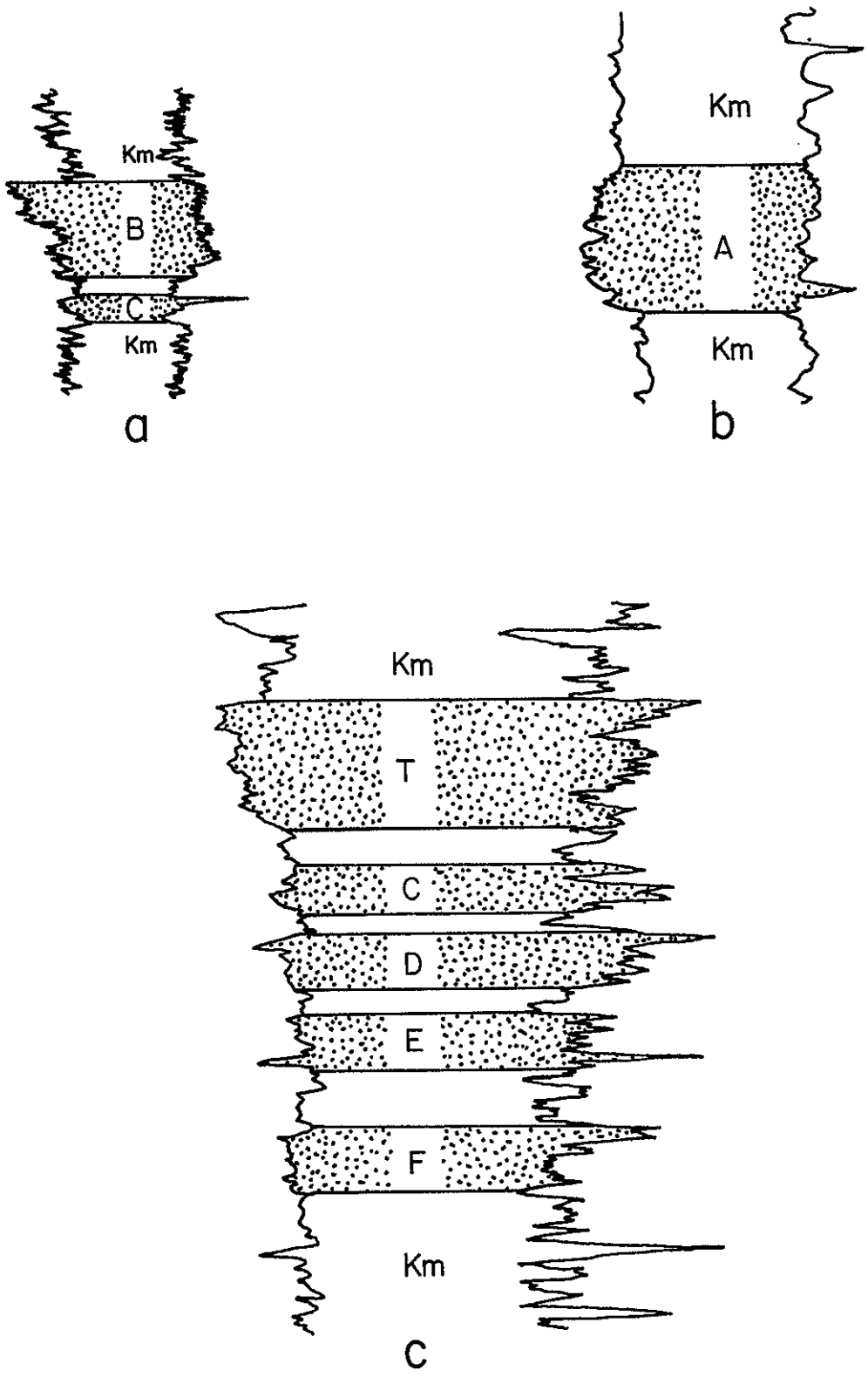


Fig. 1 Sample induction-electric logs showing sandstone bodies (stippled) in Gallup Sandstone; **a** from well 312, **b** from well 106, **c** from well 371 (Table1). Km = Mancos Shale.

Stone and Mizell (1978)

Data from Stone and Mizell (1978) were selected to fill in gaps from other sources and especially the central and eastern edge of the study area. Top and bottom elevations are based on electric-log "picks" for each sandstone body; examples are shown in figure 1. The thickness of sandstone bodies is then determined.

Final Compilation

Steps involved in final compilation include: 1) comparison of all elevation values (Table 2) to determine the correct vertical position of the sandstone bodies, i.e. the C sandstone is plotted on the C sandstone body map and not the D or E sandstones; 2) use of cross sections A-A', B-B', C-C', and D-D' on Plate 1 to delineate horizontal boundaries of each sandstone body; 3) data projection and interpretation for areas where data are scarce or lacking. The final results are a map of the Torrivio Sandstone body (Plate 2), a map of the A, B and C sandstone bodies (Plate 3), a map of the D, E and F sandstone bodies (Plate 4), and isopach maps of each sandstone body (Plate 5).

Errors Involved in Compilation

The accuracy of the top elevation and thickness values (Table 2) used to make regional extent and isopach maps for sandstone bodies within the Gallup Sandstone is estimated

to be between 80 and 90 percent for thickness and ± 150 ft for top elevations. This top elevation error factor combines errors from: 1) measured sections (Molenaar, 1973, p. 86); 2) calculating surface elevations; 3) determining tops and bottoms from Molenaar's (1973, 1974) cross sections; and 4) choosing tops and bottoms from electric and sample logs. These errors should not detract from the usefulness of the maps of the sandstone bodies.

RESULTS AND CONCLUSIONS

1. The Torrivio Sandstone body (Plate 2) extends eastward from measured section 13 (north of Sanostee) to well 105 (west of Chaco Canyon), then south to measured section 45 (southeast of Crownpoint). In this area the Torrivio Sandstone is the highest sandstone body in the Gallup. Cross sections A-A' and B-B' (Plate 1) suggest the Torrivio may merge with the A and B sandstones (Molenaar, 1979, written communication), and never overlie the A. The Torrivio Sandstone ranges in thickness (Plate 5) from 100 ft at measured section 28 (west of Gallup) to 20 ft at measured section 17 (south of Sanostee).

2. Cropping out northward from measured section 12 (north of Sanostee), the A sandstone (Plate 3) extends farthest toward the center of the basin. The A sandstone extends eastward in a narrow belt from northwest of Bisti to measured section 68 (24 miles west of San Ysidro). At the surface, the A sandstone is only seen to overlie the

B at measured section 12, however, in the subsurface the A overlies the B, and the C (Plate 1). Cross section B-B' (Plate 1) shows the A sandstone to be higher than the B, but in D-D', the A does not appear higher. Molenaar (1979, written communication) suggested the absence of abrupt stratigraphic rises in the southeast part of the basin, where sandstone bodies A, B, and C, may all merge together. Plate 5 shows the A sandstone body thickening toward the center of the basin. From 55 ft at measured section 12 (north of Sanostee) on the west, and 98 ft at measured section 67 (southwest of San Ysidro) on the east, sandstone body A thickens to 140 ft at well 292 (west of Chaco Canyon).

3. The B sandstone extends north from measured section 16 (south of Sanostee) to measured section 6 (south of Biklabito), and eastward in a belt which thins near wells 104 and 292 (southwest of Chaco Canyon) to well 343 (west of San Ysidro) where it merges with sandstones A and C. Molenaar (1973) suggested the B and C sandstones are separate facies based on sudden thickness changes in overlying nonmarine deposits between measured sections 15 and 16 (Plate 1, cross section A-A') and wells 104 and 106 (Plate 1, cross section B-B'). Sandstone body B varies very abruptly in thickness in the center and eastern margin of the basin (Plate 5). In the western outcrop the B increases from 29 ft at measured section 30 (southwest of Sanostee) to a maximum thickness of 80 ft at measured section 14 (west of Sanostee), and

then decreases to 20 ft toward the north at measured section 4 (east of Bikalbito).

4. The most extensive marine sandstone body is the C (Plate 3). It extends west from the outcrop, measured sections 62 thru 64 (north of Laguna), to well 95 (north of Gallup) and measured sections 20 thru 13 (north of Sanostee). The C sandstone body overlies the D, E, and F (Plates 1, 2, 3, and 4). Sandstone body C appears to have no definite thickness pattern (Plate 5). Thickness of the C ranges from 15 ft at well 371 (west of Crownpoint) to 150 ft at measured section 49 (northwest of Ambrosia Lake).

5. Sandstone body D (Plate 3) crops out in an oblong area between measured sections 23 (18 miles northwest of Gallup) and 17 (south of Sanostee) on the west, well 371 on the east, and between measured sections 27 (2 miles west of Gallup) and 39 (18 miles northeast of Gallup) on the south (Plate 1, cross sections A-A', C-C'). The D sandstone body principally overlies the E but also the F in small areas in the south and east (Plate 4). Plate 5 shows sandstone body D to range in thickness from 10 ft at measured section 17 (south of Sanostee) in the north, to 84 ft at measured section 38 (northwest of Gallup) in the south. The D appears to be more evenly distributed that the other sandstone bodies.

6. Sandstone body E is developed in two pocket-like areas (Plate 4). In the west the E extends west to the outcrop from well 371 to measured section 20 (southwest of

Sheep Springs) and south from well 371 to measured section 38 (12 miles east of Gallup). The eastern area extends southwest from well 366 (south of Star Lake) to the outcrop at measured section 44 (southeast of Crownpoint), and southeast to the outcrop at measured section 62 (northwest of Laguna). The E is missing toward the center of the basin and appears to be discontinuous at the surface (Plate 1, cross section C-C'). The E sandstone body overlies the F between measured sections 27 (west of Gallup) and 29 (in Gallup), 38 and 39 (east of Gallup), and 52 and 53 (south of San Mateo). Thickness of sandstone body E in the western area ranges from 120 ft at measured section 22 (northeast of Gallup) to 15 ft at measured section 28 (west of Gallup) (Plate 5). In the eastern area the thickness is not so great and ranges from 66 ft at measured section 46 (southeast of Crownpoint) to 15 ft at measured section 49 (northeast of Ambrosia Lake).

7. Sandstone body F is developed in small pockets along the southern Gallup Sandstone outcrop belt (Plate 4). In the east the F is found in measured sections 52 and 53 (south of San Mateo), with a thickness of 54 ft at measured section 53 (Plate 5). In the west in two areas, between measured sections 38 (east of Gallup) and 42 (west of Crownpoint) and well 371 (north of Gallup), and measured sections 27 (west of Gallup) and 29 (in Gallup). Thickness of sandstone body F ranges from 60 ft at well 101 (in Gallup) to 8 ft at measured section 39 (east of Gallup).

SELECTED REFERENCES

Beaumont, E. C., 1957, The Gallup Sandstone as exposed in the western part of the San Juan Basin: Four Corners Geological Society, Guidebook 2nd field conference, p. 114-120

Budd, Harrell, 1957, Facies development of the Gallup Formation: Four Corners Geological Society, Guidebook 2nd field conference, p. 121-127

Campbell, C. V., 1971, Depositional model--Upper Cretaceous Gallup beach shoreline, Shiprock area, northwestern New Mexico: Journal of Sedimentary Petrology, v. 41, no. 2, p. 393-409

Campbell, C. V., 1973, Offshore equivalents of upper Cretaceous Gallup beach sandstone, northwestern New Mexico: Four Corners Geological Society, Guidebook 18th field conference, p. 78-84

Campbell, C. V., 1979, Model for beach shoreline in Gallup Sandstone (Upper Cretaceous) of northwestern New Mexico: New Mexico Bureau of Mines and Mineral Resources, Circ. 164, 32p.

Dane, C. H., Bachman, G. O., and Reeside, Jr., J. B., 1957, The Gallup Sandstone, it's age and stratigraphic relationships south and east of the type locality: Four Corners Geological Society, Guidebook 2nd field conference, p. 99-113

Hackman, R. J., and Olson, A. B., 1977, Geology, structure, and uranium deposits of the Gallup 2° sheet, New Mexico and Arizona: U.S. Geological Survey, Misc. Geol. Inv. Map I-981

Hiss, W. L., and Marshall, J. G., 1975, Interpretation of geologic and hydrologic data from the Ray-1 well, city of Gallup, McKinley County, New Mexico: U.S. Geological Survey, Open-File Rept. 75-573, 58p.

Kirk, A. R., and Sullivan, M. W., 1976, Preliminary geologic map of the Dalton Pass quadrangle, McKinley County, New Mexico: U.S. Geological Survey, Open-File Rept. 76-184, map

Kirk, A. R., and Zech, R. S., 1976, Preliminary geologic and structure contour maps of the Oak Spring quandrangle, McKinley County, New Mexico: U.S. Geological Survey, Open-File Rept. 76-347, map

Mercer, J. W., and Cooper, J. B., 1970, Availability of groundwater in the Gallup-Tohatchi area, McKinley County, New Mexico: U.S. Geological Survey, Open-File Rept. MK-31, 194p.

Mercer, J. W., and Lappala, E. G., 1972, Erwin--1 production well, city of Gallup, McKinley County, New Mexico: U.S. Geological Survey, Open-File Rept., 53p.

Molenaar, C. M., 1973, Sedimentary facies and correlations of the Gallup Sandstone and associated formations, northwestern New Mexico: Four Corners Geological Society, Guidebook 18th field conference, p. 85-110

Molenaar, C. M., 1974, Correlation of the Gallup Sandstone and associated formations, Upper Cretaceous, eastern San Juan and Acoma basins, New Mexico: New Mexico Geological Society, Guidebook 25th field conference, p. 251-258

O'Sullivan, R. B., and Beikman, H. M., 1963, Geology, structure, and uranium deposits of the Shiprock 2° sheet, New Mexico: U.S. Geological Survey, Misc. Inv. Map I-345

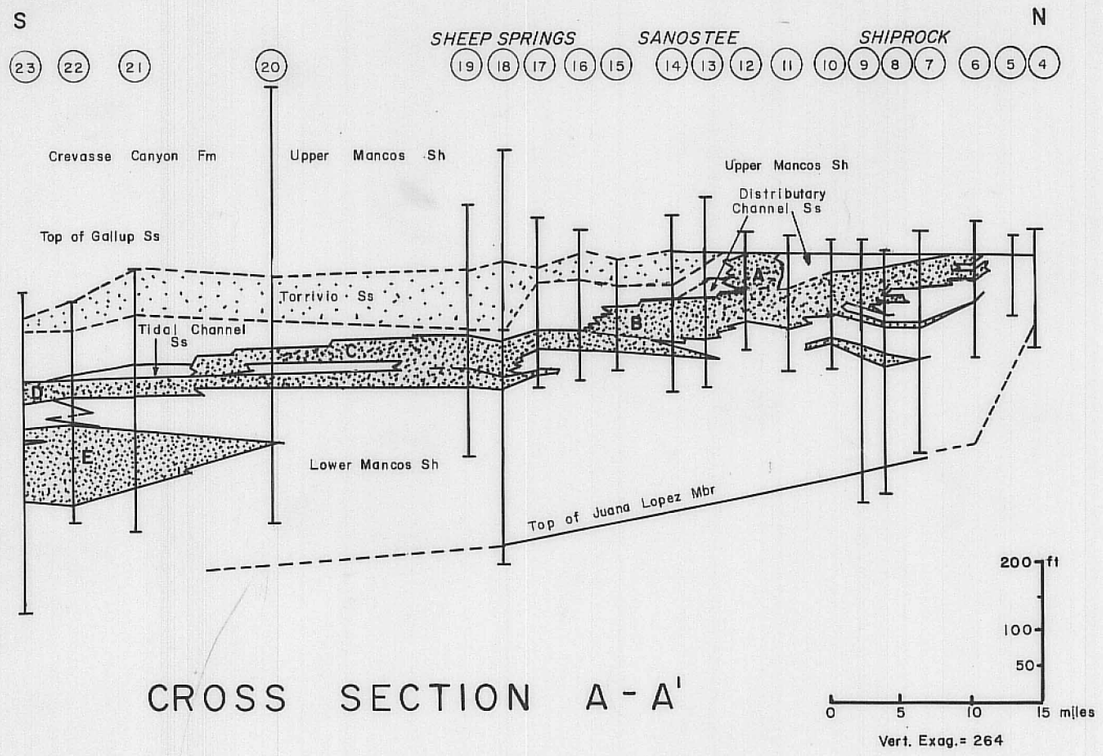
Robertson, J. F., 1976, Preliminary geologic map of the Casamero Lake quadrangle, McKinley County, New Mexico: U.S. Geological Survey, Open-File Rept. 76-681, map

Robertson, J. F., and Jackson, T. J., 1975, Geologic and structure contour maps of the Hosta Butte quadrangle, McKinley County, New Mexico: U.S. Geological Survey, Open-File Rept. 75-302, map

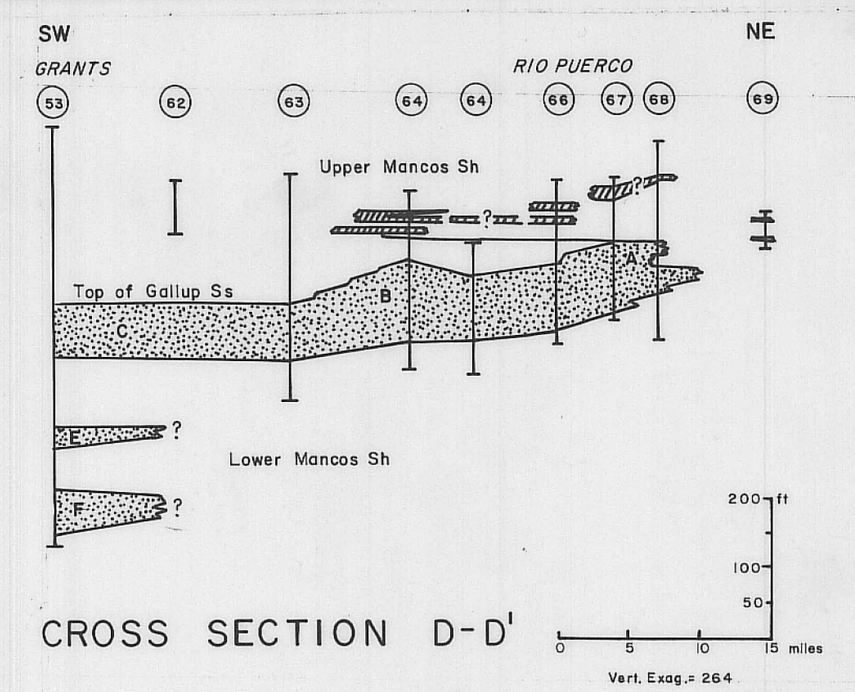
Sabins, F. F., 1963, Anatomy of stratigraphic trap, Bisti field, New Mexico: Amer. Association Petroleum Geologists, v. 47, no. 2, p. 193-228

Stone, W. J., and Mizell, N. H., Basic subsurface data compiled for hydrogeologic study of the San Juan Basin, northwest New Mexico: New Mexico Bureau of Mines and Mineral Resources, Open-File Rept. 89, 41p.

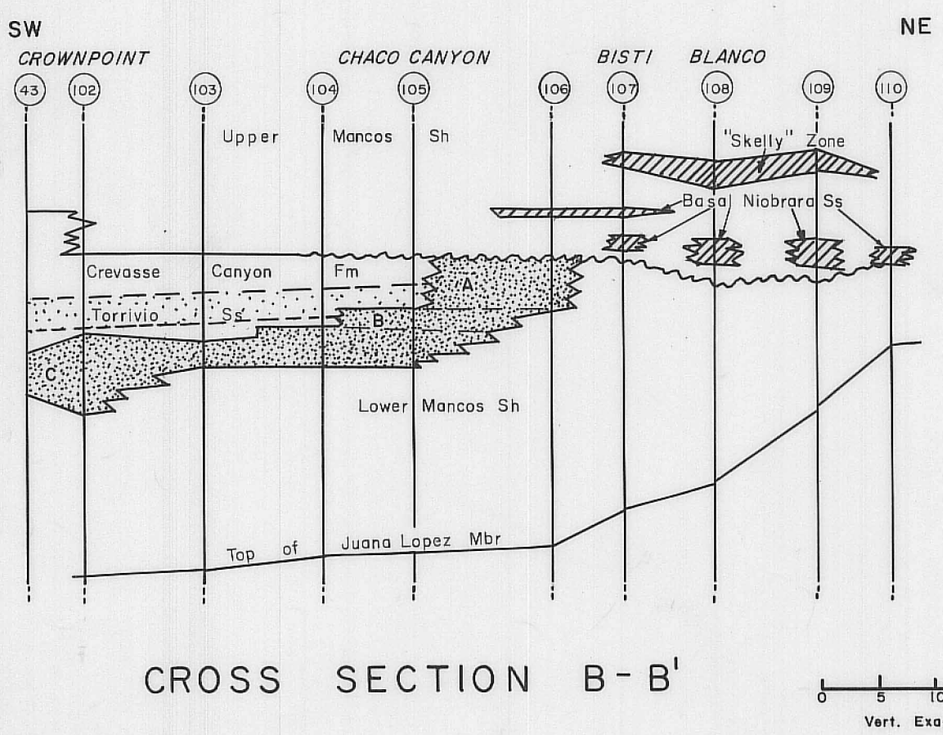
Wyant, D. J., and Olson, Annabelle, 1978, Geologic map of the Albuquerque 2° sheet, northwestern New Mexico: U.S. Geological Survey, Open-File Rept. 78-476, map



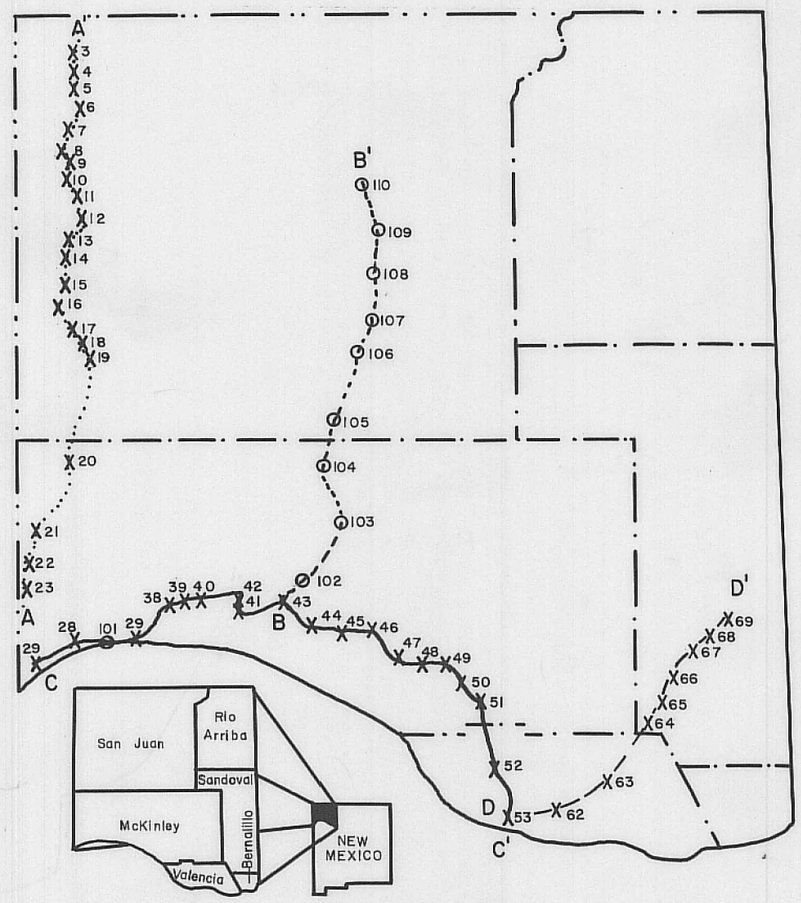
CROSS SECTION A-A'



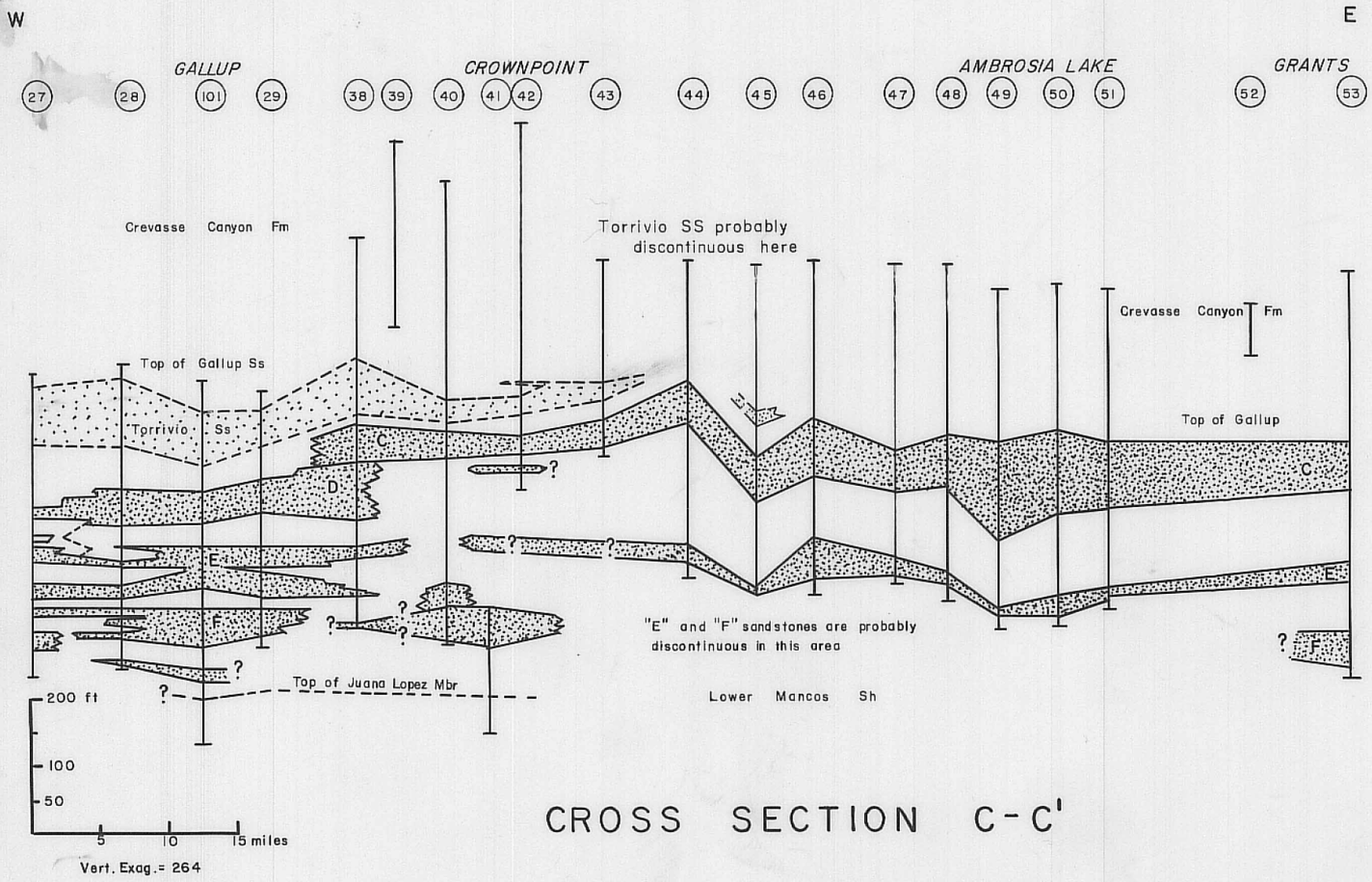
CROSS SECTION D-D'



CROSS SECTION B-B'



Map showing location of cross sections A-A', B-B', and C-C', D-D'; x = measured section control point, o = well control point. (See table I for further information)



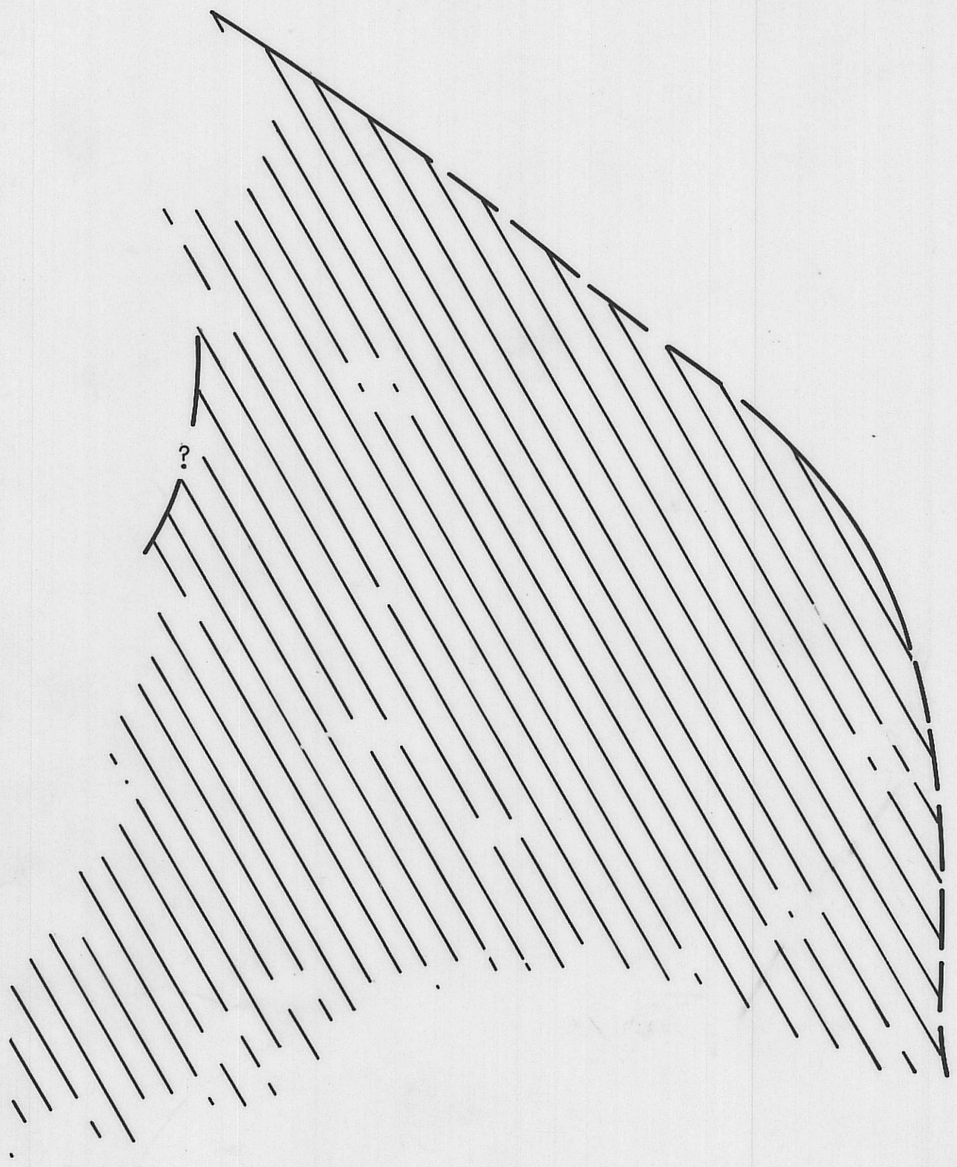
CROSS SECTION C-C'

EXPLANATION

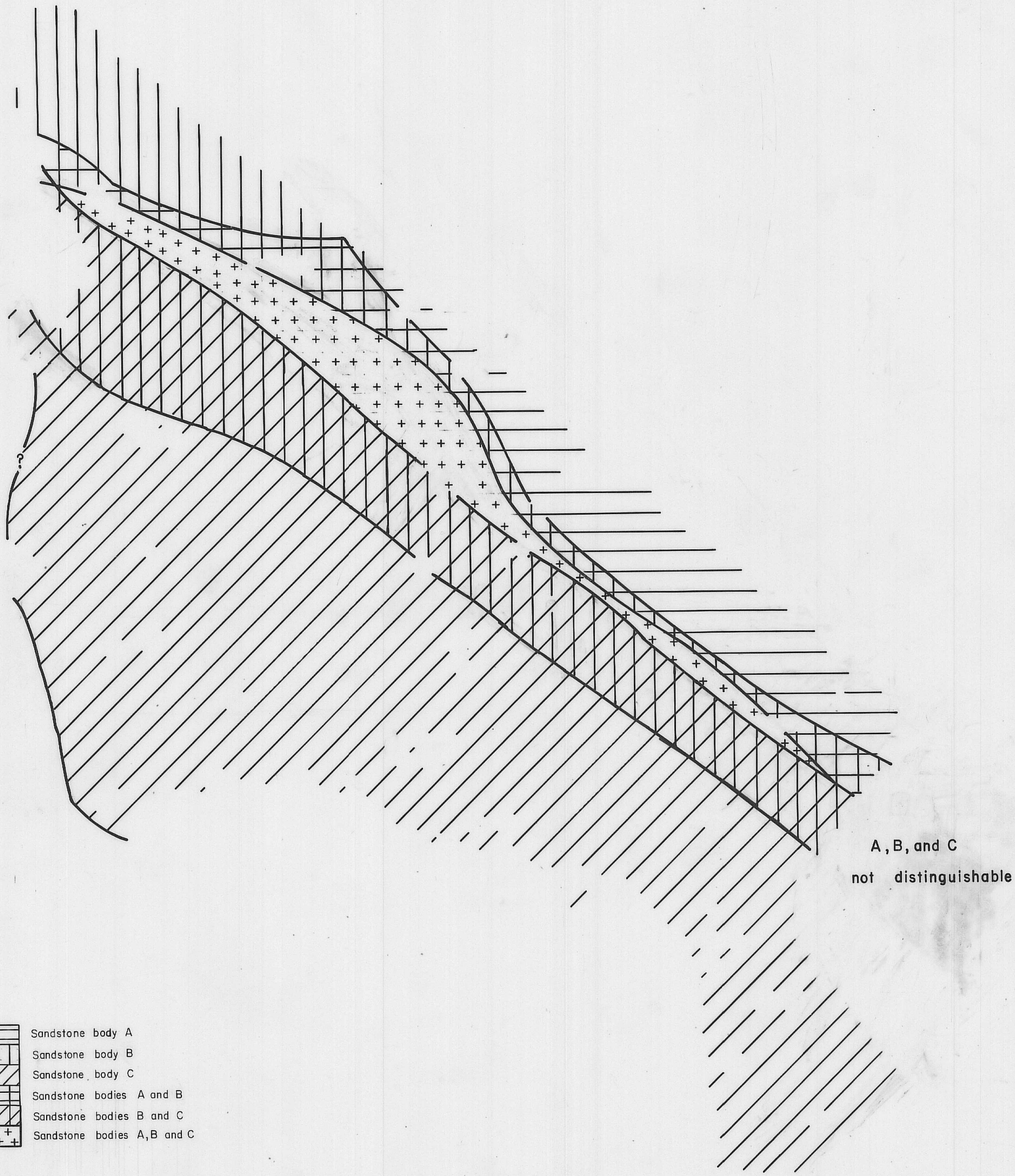
- Line of measured section
- Portion of well trace; dashes indicate well continues
- Fluvial channel sandstone
- Marine and coastal barrier sandstone
- Offshore bar sandstone
- Other marine and non marine deposits

CROSS SECTIONS SHOWING STRATIGRAPHIC RELATIONSHIP OF SANDSTONE BODIES (STIPPLED) WITHIN GALLUP SANDSTONE, SAN JUAN BASIN

(modified from Molenaar, 1973 and 1974)



Torrivio Sandstone body



Sandstone body A

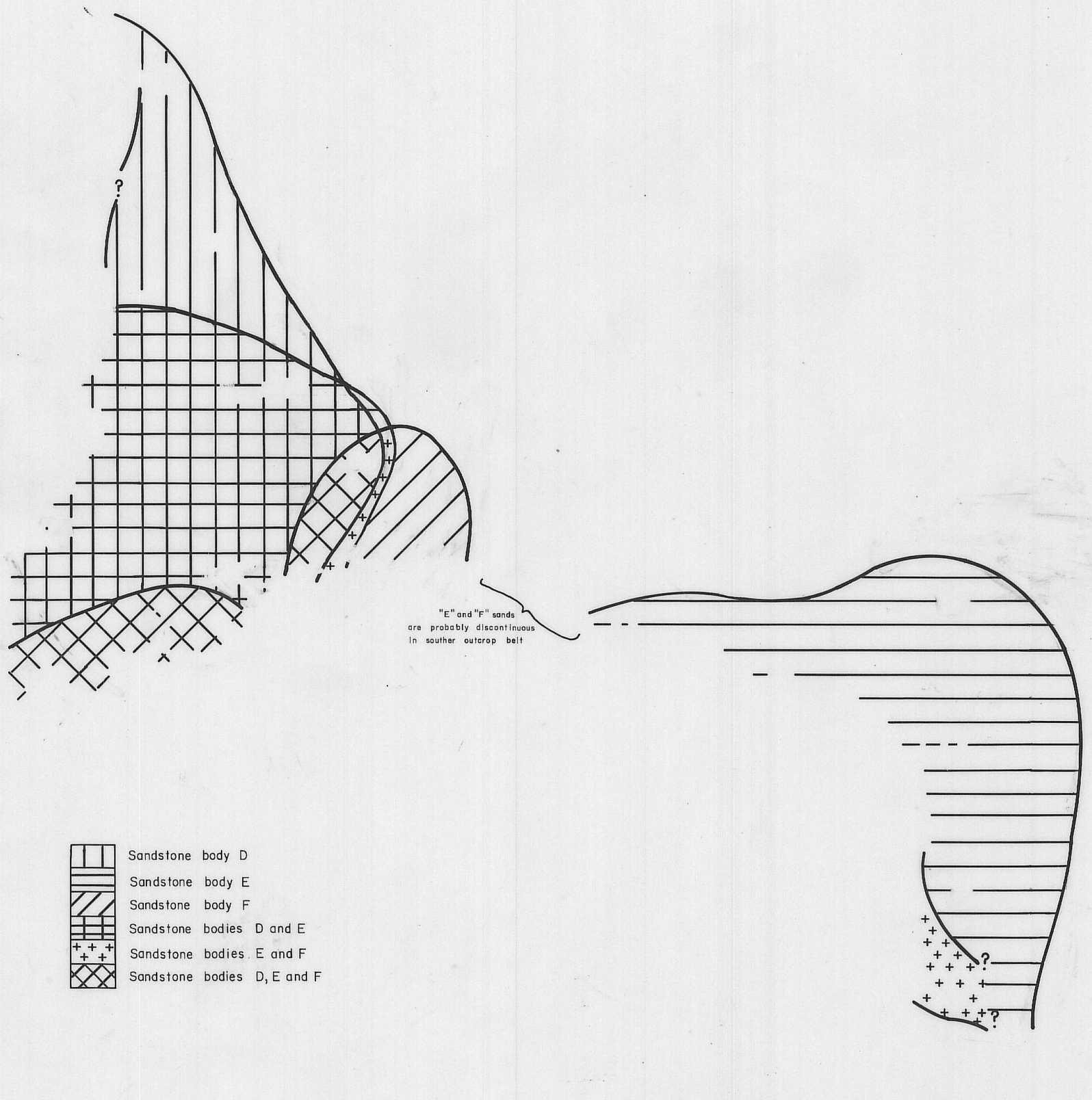
Sandstone body B

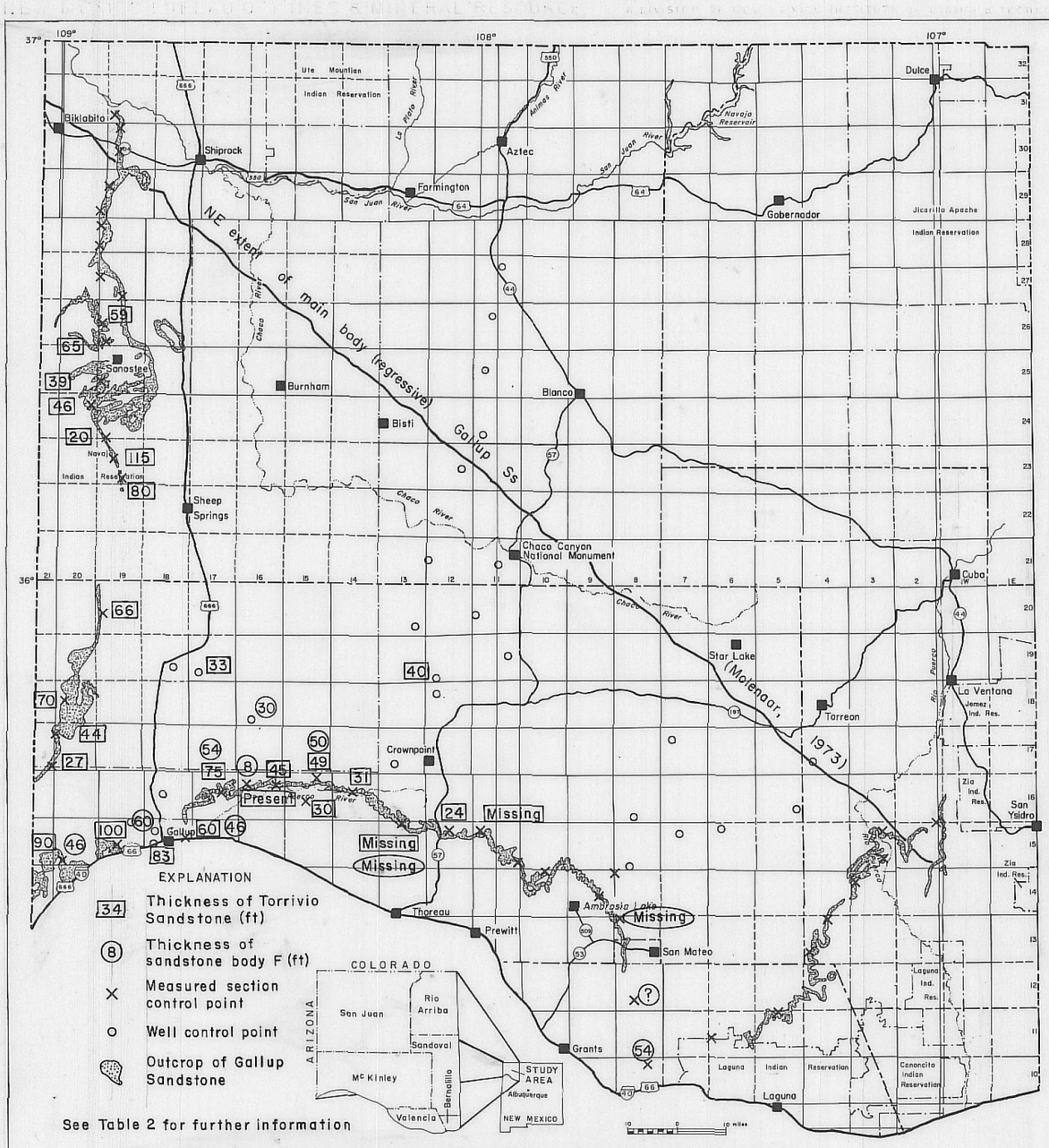
Sandstone body C

Sandstone bodies A and B

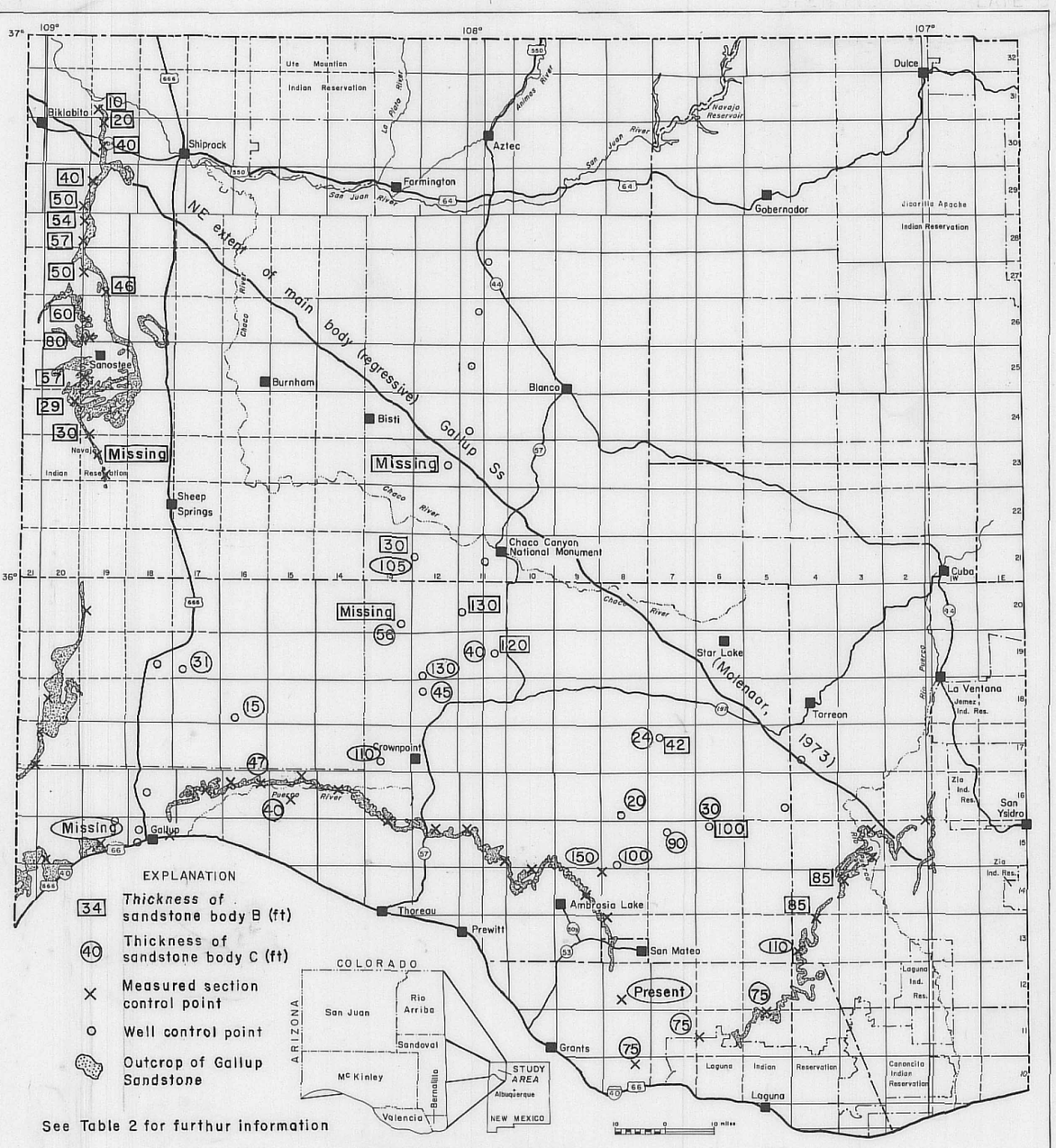
Sandstone bodies B and C

Sandstone bodies A, B and C

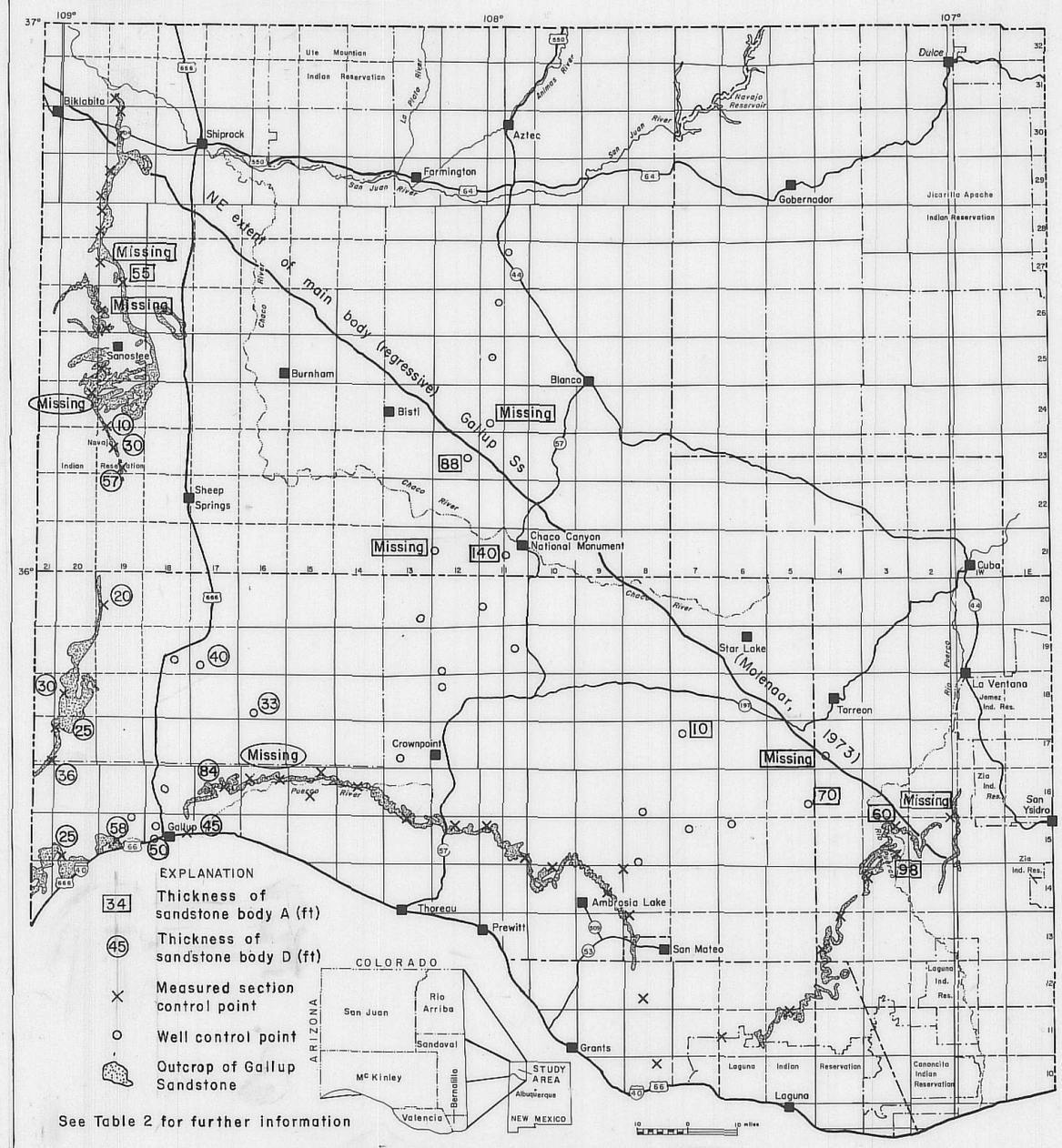

?
"E" and "F" sands
are probably discontinuous
in souther outcrop belt
?
?
Sandstone body D
Sandstone body E
Sandstone body F
Sandstone bodies D and E
Sandstone bodies E and F
Sandstone bodies D, E and F



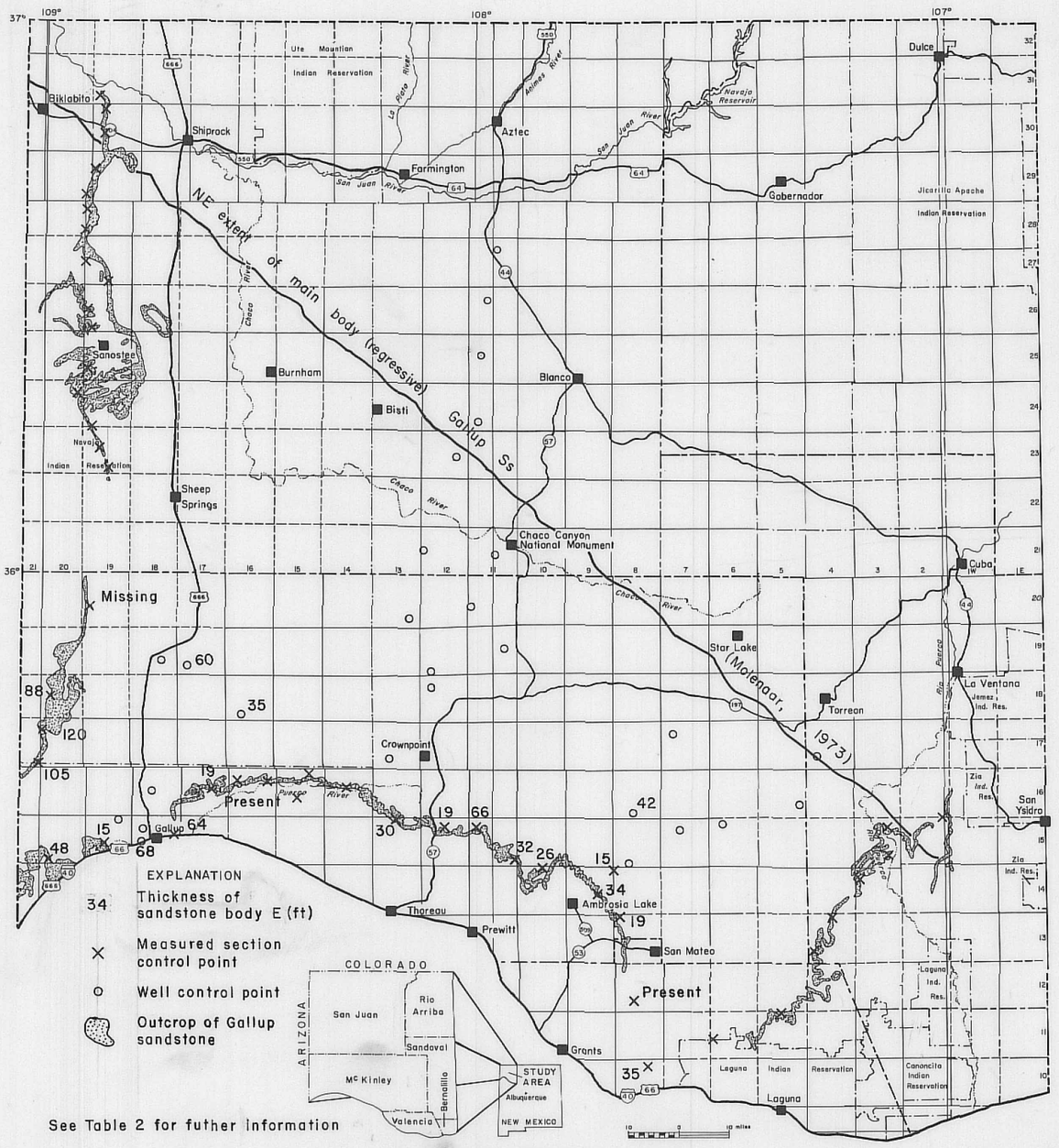
Torrivio Sandstone and sandstone body F



Sandstone bodies B and C



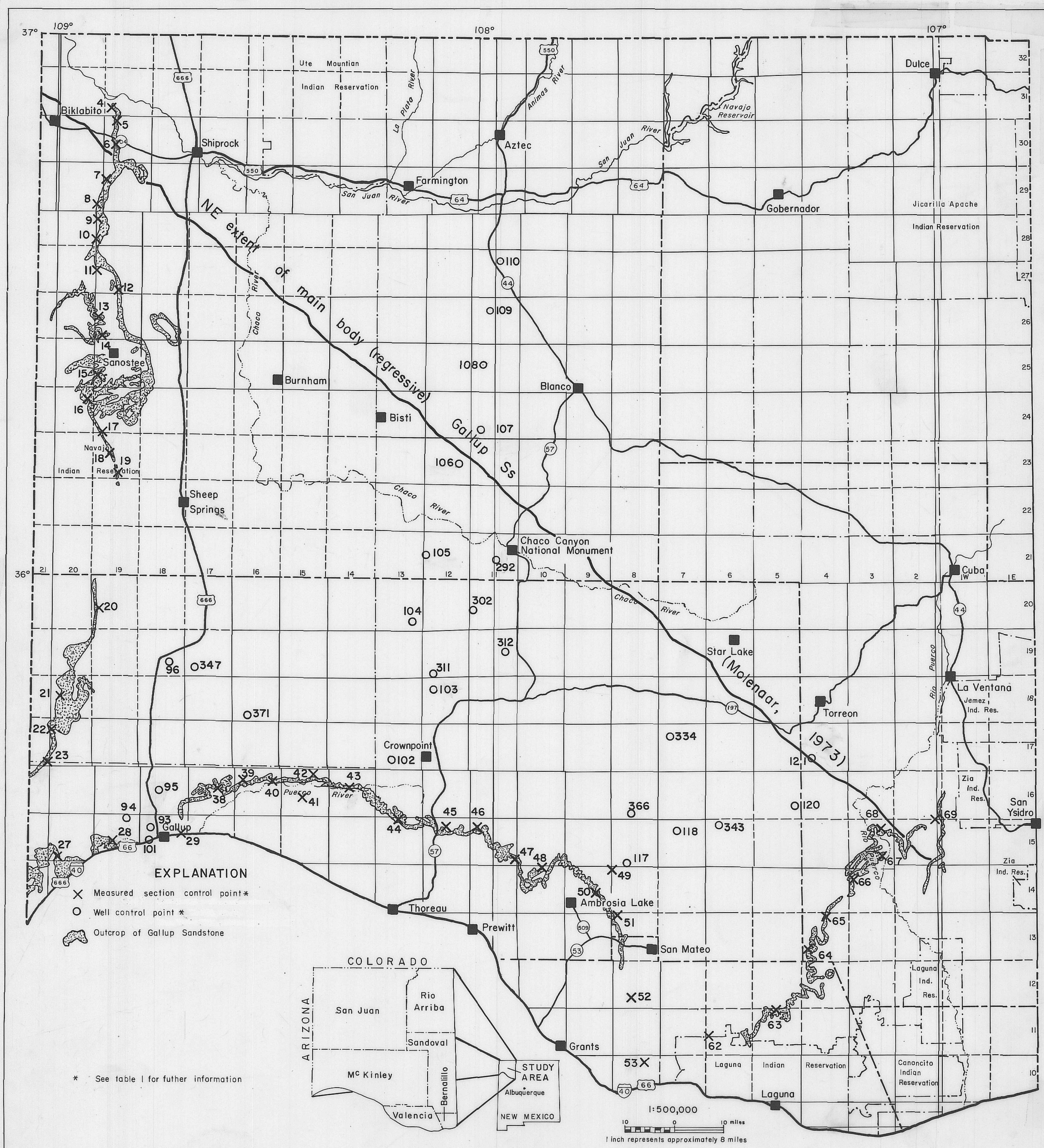
Sandstone bodies A and D



Sandstone body E

MAP SHOWING THICKNESS OF SANDSTONE BODIES WITHIN GALLUP SANDSTONE, SAN JUAN BASIN

OF 105


37°
109°
108°
107°
Ute Mountian Indian Reservation
Biklabito
Shiprock
La Plata River
Animas River
Aztec
Navajo Reservoir
San Juan River
Farmington
Dulce
Gobernador
Jicarilla Apache Indian Reservation
NE extent of main body (regressive) Gallup Ss
Chaco River
Burnham
Bisti
Blanco
Sanostee
Navajo Indian Reservation
Sheep Springs
Chaco Canyon National Monument
Cuba
Star Lake
(Molenaar, 1973)
Torreon
La Ventana
Jemez Ind. Res.
Rio Puerco
Crownpoint
Puerco River
Gallup
Zia Ind. Res.
San Ysidro
Thoreau
Prewitt
Ambrosia Lake
San Mateo
Grants
Laguna Ind. Res.
Laguna Indian Reservation
Canoncito Indian Reservation
Laguna
36°
EXPLANATION
Measured section control point*
Well control point *
Outcrop of Gallup Sandstone
* See table I for futher information
COLORADO
ARIZONA
NEW MEXICO
San Juan
Rio Arriba
Sandoval
Mc Kinley
Bernalillo
Valencia
STUDY AREA
Albuquerque
1:500,000
10 0 10 miles
1 inch represents approximately 8 miles