

GEOLOGY AND COAL RESOURCES OF THE CANTARALO
SPRING 7½' QUADRANGLE, CIBOLA COUNTY, NEW MEXICO

NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES
OPEN-FILE REPORT 142

by
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- Contents:
- (1) Geologic map with cross sections and references
 - (2) Stratigraphic column
 - (3) Discussion of coal resources, 3 pages with measured sections at 8 localities
 - (4) Table of surface and mineral ownership

Coal Resources - Cantaralo Spring 7½'

Coal beds may be seen in outcrop in two formations within the Cantaralo Spring quadrangle - The Dakota Sandstone and the Moreno Hill Formation. The Dakota Sandstone exposures are in the W½ section 30, T 5N, R 20W, (Duran Canyon) and in the SE¼, SE¼ section 25, T 5N, R 21W, and reveal thin lignitic and/or coaly beds generally less than 8" thick in paludal shale sequences. In Duran Canyon only one coaly zone, about 25' below the top of the formation, may be seen; in the section 25 exposure 2 carbonaceous zones may be seen, one in each of two paludal shale units separated by a 6-8 ft. sandstone bed. The Dakota Sandstone coals are of no economic importance.

The Moreno Hill Formation exposures are limited to the perimeter of the Zuni Plateau in the southeast quadrant of the quadrangle. The basal part of the formation does crop out in the east-west trending ridge in sections 16, 17, and 18 T 5N, R 20W, but no coal is present or exposed. The Moreno Hill has been removed by Tertiary erosion in the western one half of the quadrangle and there would be essentially no coal west of Cullen Tank. The accompanying measured sections, the localities of which are marked by an ⊗ on the geologic map, show coal seams or coaly beds up to 3.5 ft. thick. The "main coal bed", or the thickest, is within 10 to 20 ft. of the top of the Atarque Sandstone, and is characterized by a medial 2 inch thick white to light bluish gray hard clay (altered ash bed), the exception being in the SW¼ section 30, T 5N, R 19W where the clay is not present or not easily recognized.

Two test holes drilled on the Zuni Plateau in 1981 provide reserve data. One in the SE $\frac{1}{4}$ section 19, T 5N, R 19W was spudded at an elevation of 7190 and drilled to a T.D. of 500 ft. The other was in the SW $\frac{1}{4}$ section 13, T 5N, R 20W and was spudded at an elevation of 7140 and drilled to a T.D. of 380 ft.; both holes bottomed in the Rio Salado Shale. The logs indicate about 2 ft. of coal at a depth of 163 ft. in section 19. In section 13 no coal was intersected but a carbonaceous zone is present at 110 ft.; drill cuttings show additional carbonaceous zones between 130 and 165 ft.

These two drill holes plus coal sections measured in outcrop at the 8 localities indicated on the map provide the basis for the resource estimates shown in the table below. Only the "main" coal zone was used in the calculations because the lower one is not traceable to any extent in outcrop and generally does not meet the cut off thickness of 14 inches. The factor used is 1750 tons/acre foot (or 1.12 million tons/section foot). The area factor shown in the table is that portion of a square mile that is considered to be underlain by coal of the indicated thickness.

Analysis of grab samples of weathered coal yielded BTU values ranging from about 5000 up to 9350 and ash contents of about 14% up to 44%. BTU values of fresh samples could be expected to run up to 30% higher.

Cantaralo Spring Quadrangle Coal Resources By Section

Section	Township	Range	Seam Thickness (in ft.)	Area Factor	Coal Resource Estimate In Short Tons
6 (partial)*	5N	19W	- - - -	(.00)	0
1	5N	20W	3.0 m	(.33)	1,120,000
2	5N	20W	2.3 m	(.10)	258,000
3	5N	20W	2.2 m	(.30)	739,000
10	5N	20W	2.3 i	(.75)	1,930,000
11	5N	20W	2.4 i	(.80)	2,150,000
12	5N	20W	3.0 i	(.85)	2,856,000
7 (partial)*	5N	19W	1.5 m	(.10)	168,000
18 (partial)*	5N	19W	2.0 i	(.45)	1,008,000
13	5N	20W	0.0 †	()	0
14	5N	20W	1.5 i	(1.00)	1,680,000
15	5N	20W	1.5 m	(.55)	924,000
22	5N	20W	1.4 i	(.20)	313,000
23	5N	20W	1.4 m	(.80)	1,254,000
24	5N	20W	2.0 i	(.95)	2,128,000
19 (partial)*	5N	19W	2.0 †	(.60)	1,344,000
30 (partial)*	5N	19W	3.5 m	(.35)	1,364,000
25	5N	20W	3.2 i	(.75)	2,688,000
26	5N	20W	- - - -	(.00)	0
TOTAL					21,924,000

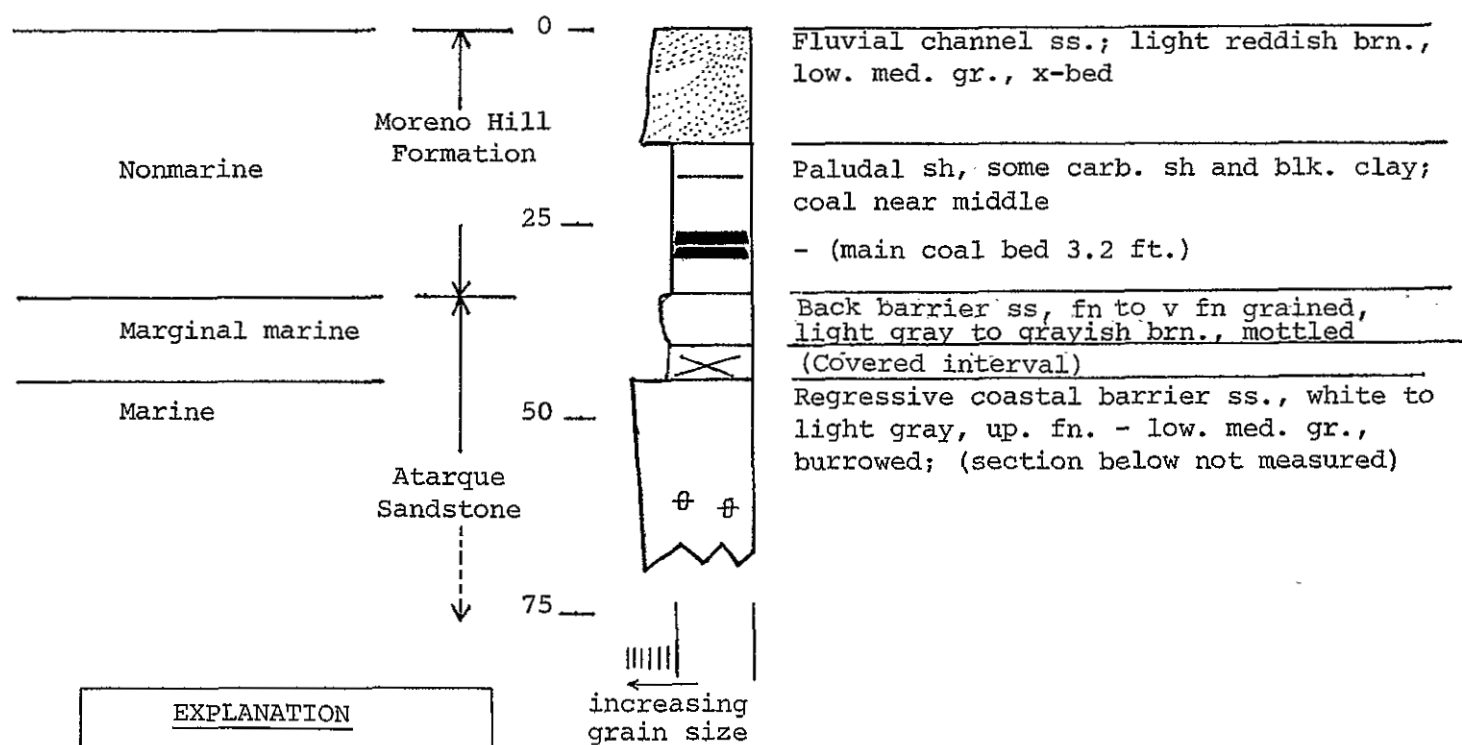
* additional resources in this section will be shown in report on adjacent quadrangle.

† drill hole in section






m = measured

i = inferred

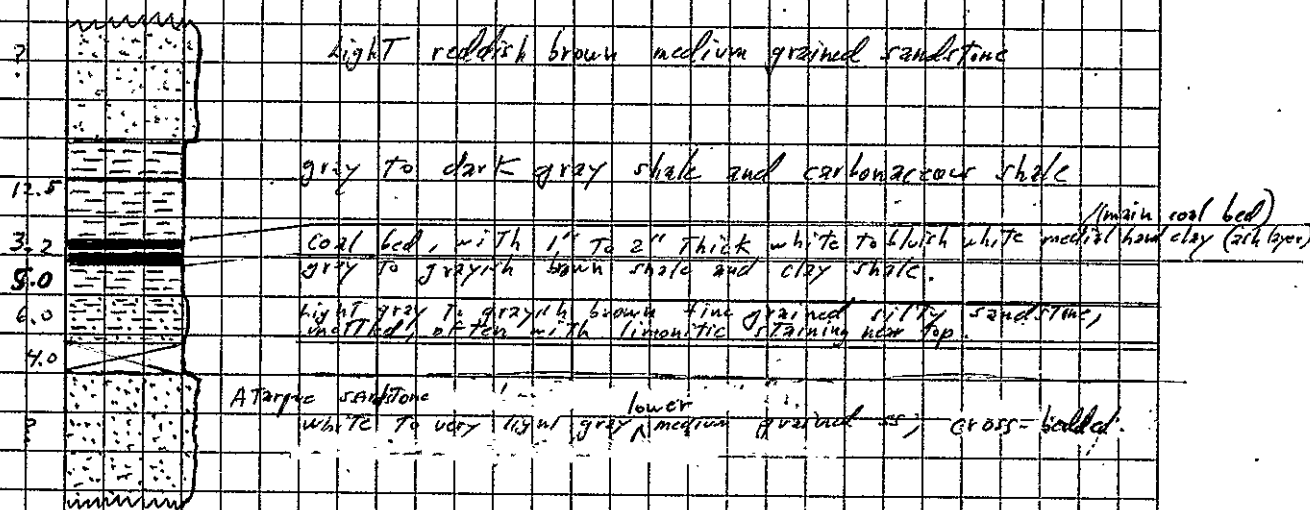
Measured coal bearing section in
the NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 1, T 5N R 20W



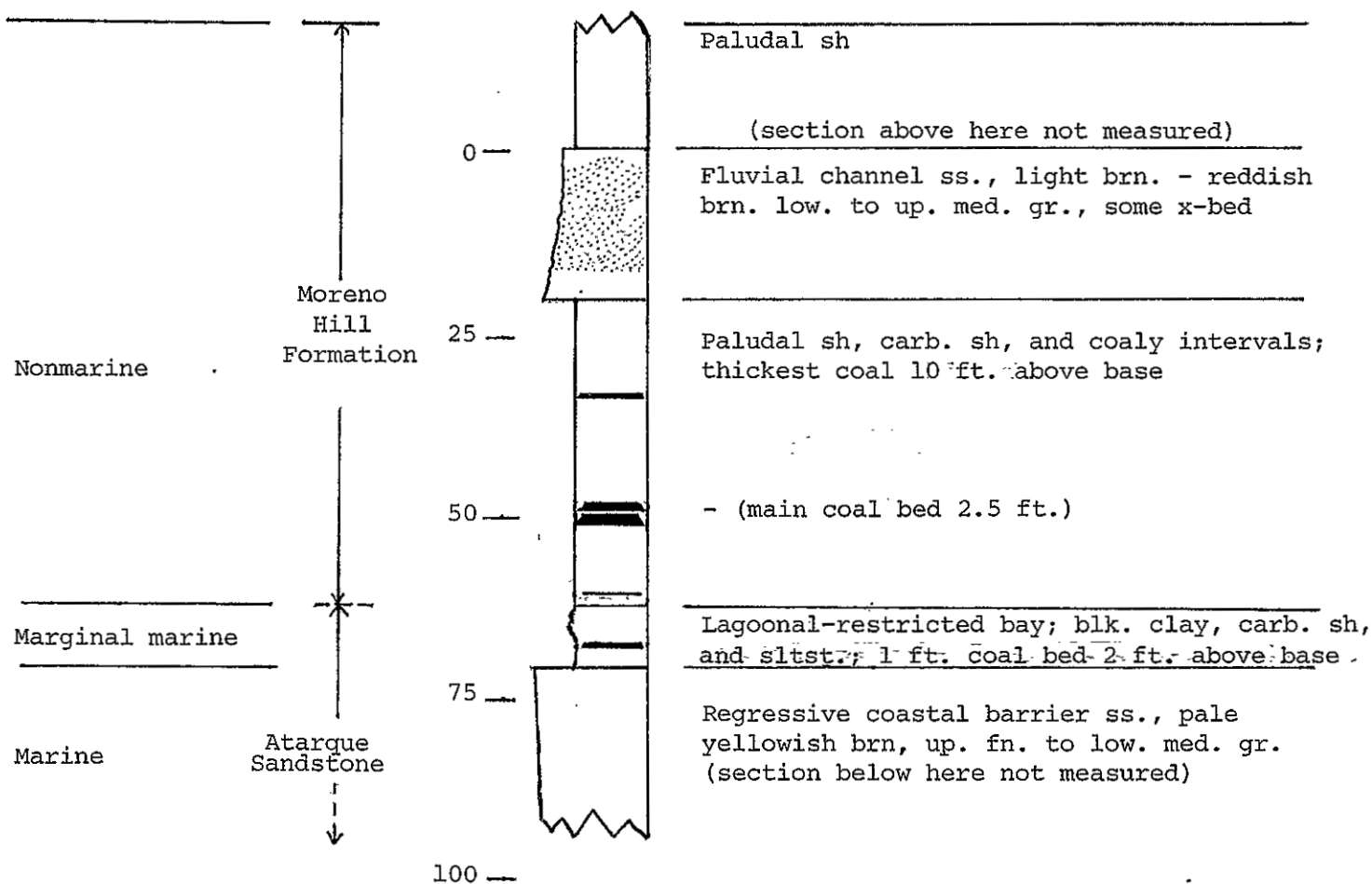
EXPLANATION

-  Burrowed
-  Root tubes
-  Calc. concretions
-  Carbonaceous
-  Coal bed

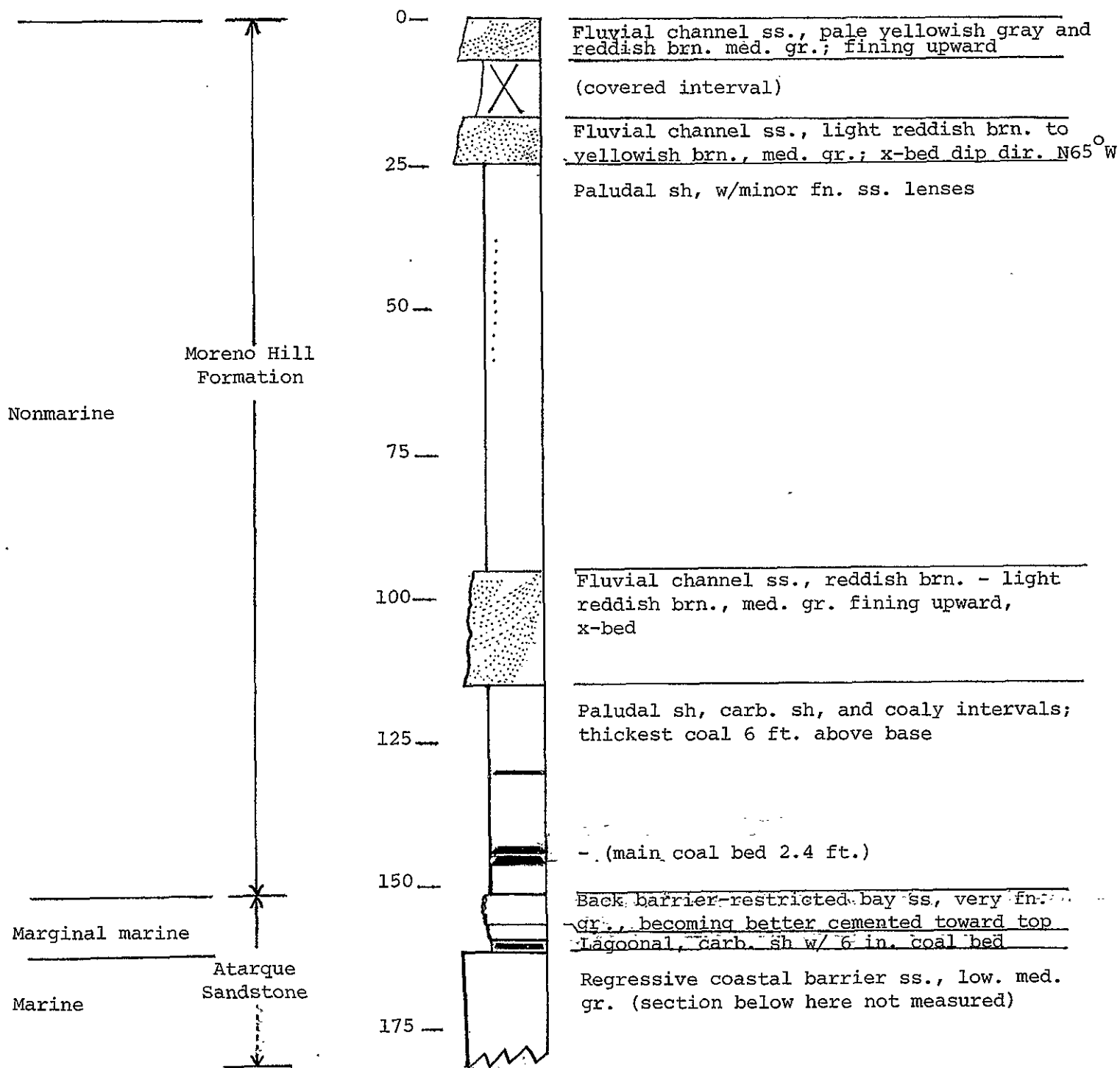
Locality P

NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec 1, 5N 20W

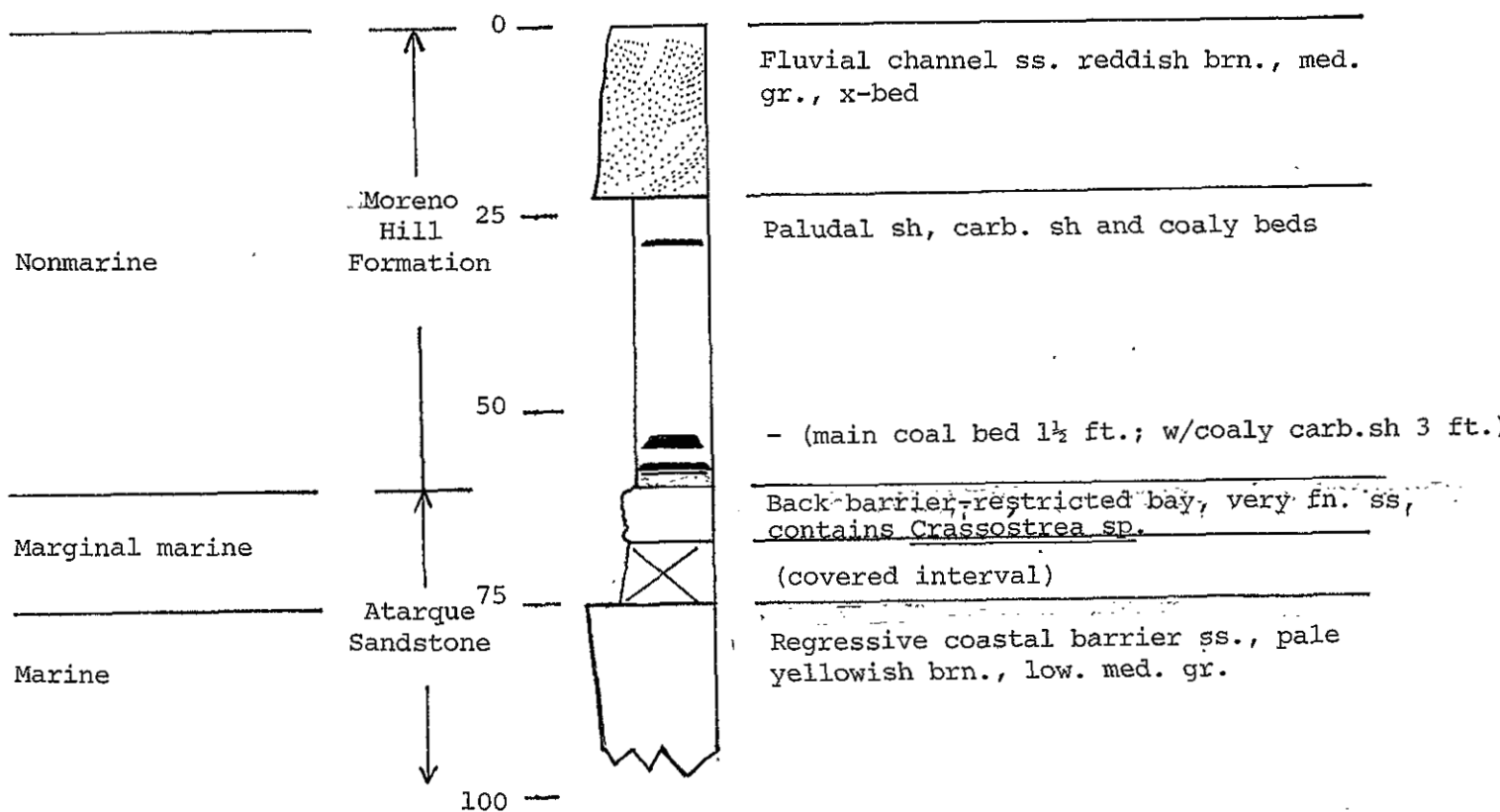
Measured coal bearing section in
the SW $\frac{1}{4}$ sec. 2, T 5N R 20W



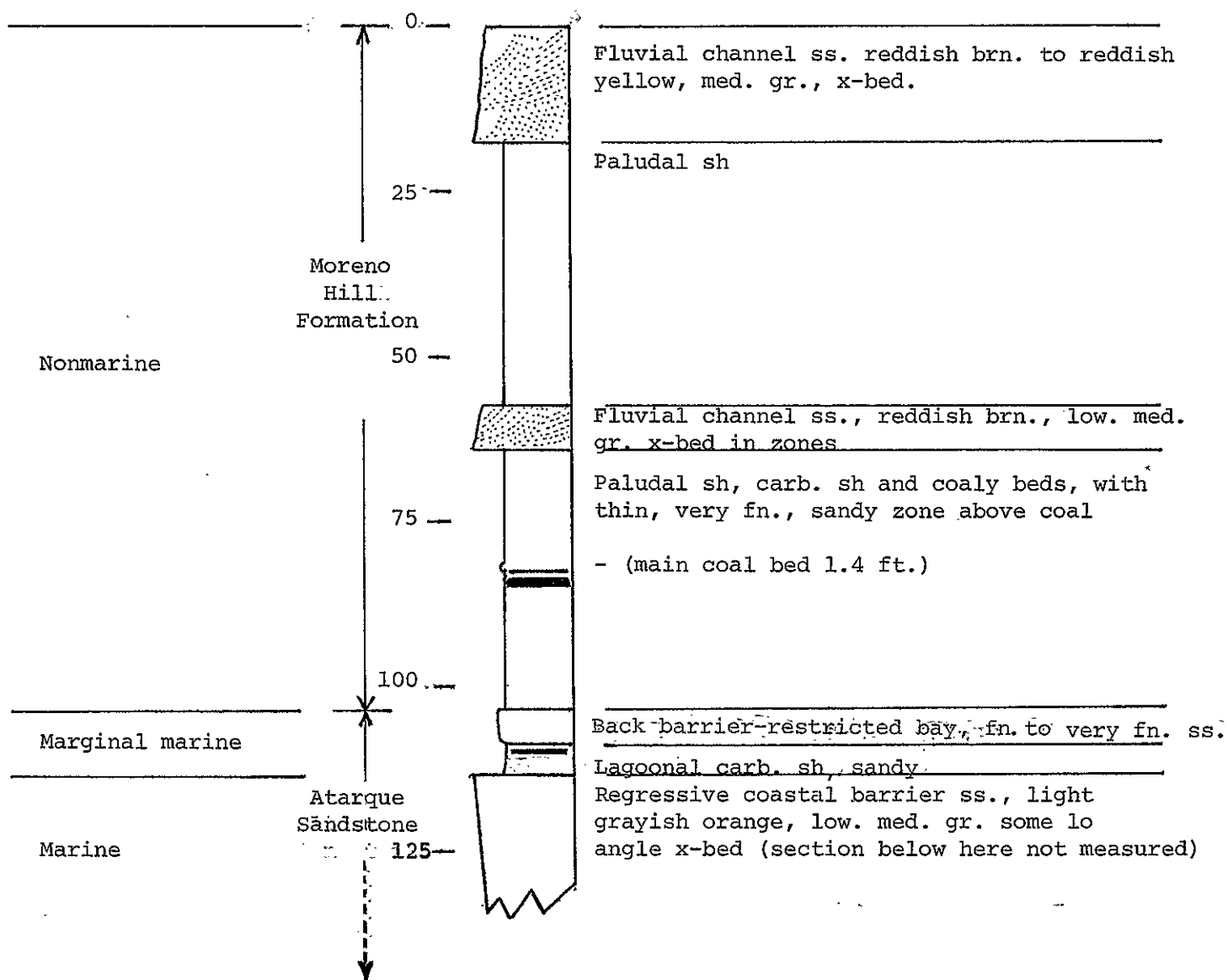
Measured coal bearing section in
the SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 3, T 5N R 20W



Measured coal bearing section in
the SE $\frac{1}{4}$ sec. 7, T 5N R 19W

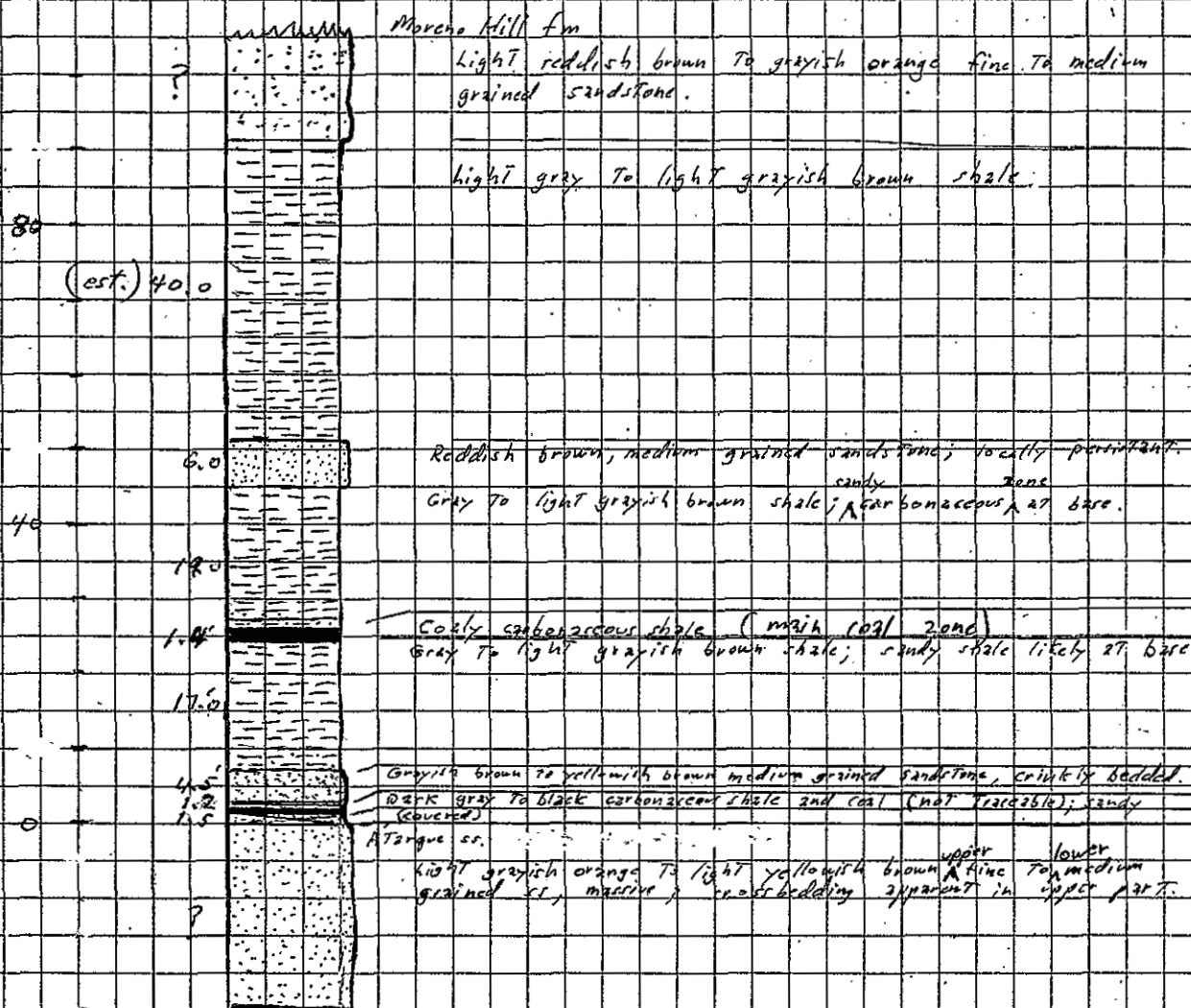


Measured coal bearing section in
the SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 23, T 5N R 20W

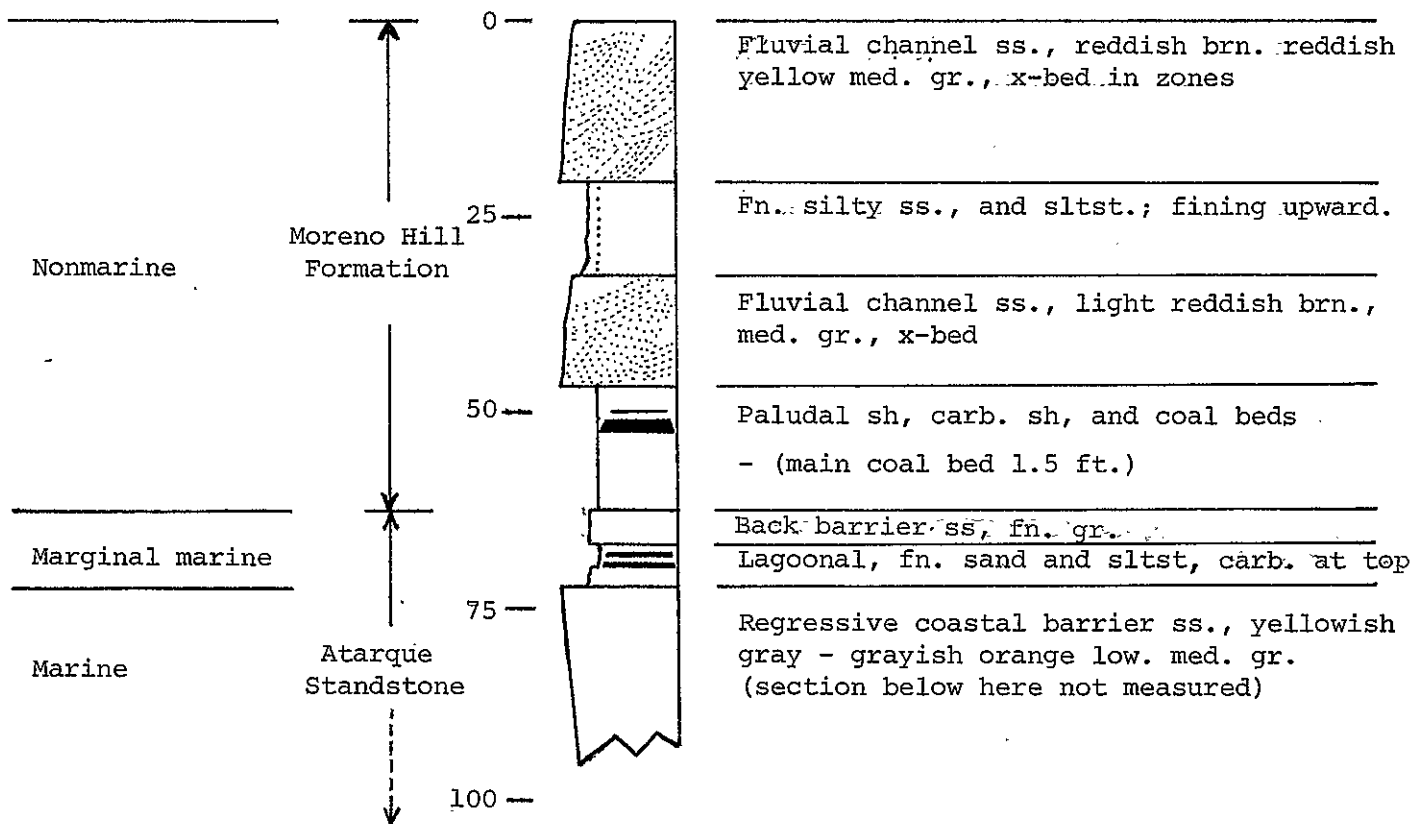


Locality Y

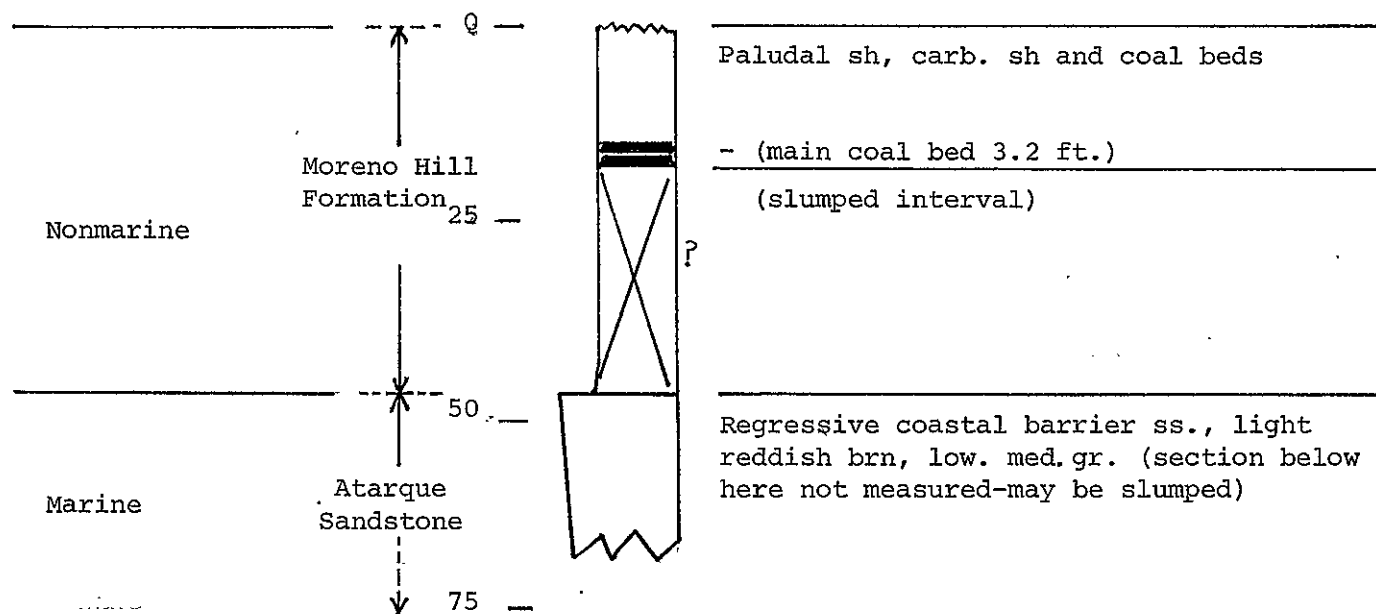
SW 1/4 SW 1/4 sec 23 5N 20W



Measured coal bearing section in
the SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 15, T.5N R 20W

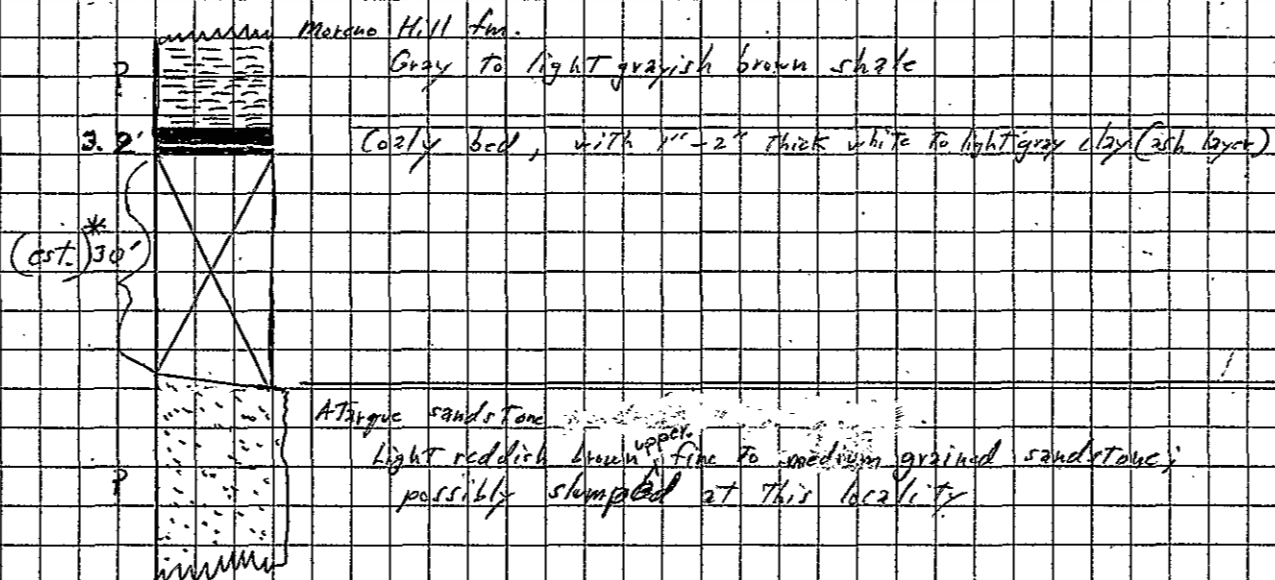


Measured coal bearing section in
the SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 30, T.5N R 19W



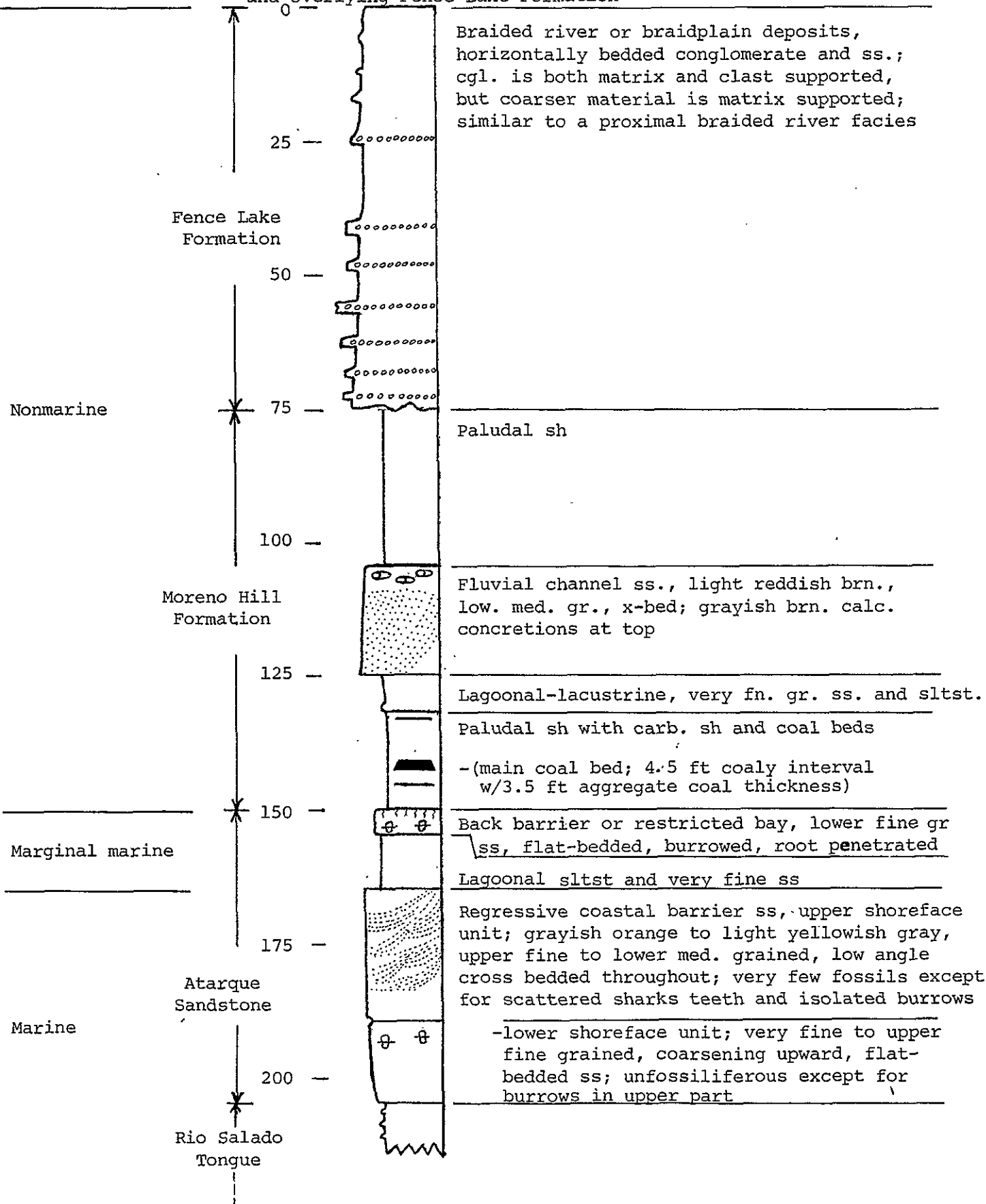
Locality W

SW 1/4 SE 1/4 sec 30 5N 19W



* Lagoon - back barrier marginal marine facies not exposed here; allowing for that the interval between Ka and "main coal" is normal.

Measured coal bearing section in
SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 30, T 5N R 19W
showing underlying Atarque Sandstone
and overlying Fence Lake Formation



CANTARALO SPRING QUADRANGLE, LAND AND MINERAL OWNERSHIP

<u>Township and Range</u>	<u>Section</u>	<u>Parcel</u>	<u>patent or action number</u>	<u>Railroad Grant</u>	<u>Homestead or other private</u>	<u>State of New Mexico</u>	<u>Rights reserved to U.S. Government</u>
6N	19W	18	all 1078497	X			ditches and canals
		19	all 670394	X			ditches and canals
		30	all 1067470	X			ditches and canals
		31	all 670394	X			ditches and canals
6N	20W	13	all 611945	X			-none-
		14	E $\frac{1}{2}$ E $\frac{1}{2}$ 995042		X		coal, ditches and canals
			W $\frac{1}{2}$ E $\frac{1}{2}$; NW $\frac{1}{4}$ 1089020		X		all minerals, ditches and canals
			SW $\frac{1}{4}$ 1121757		X		coal, ditches and canals
		15	all 611945	X			-none-
		16	all 1223973			X	ditches and canals
		17	all 611945	X			-none-
		18	all 30-63-0045			X	all minerals, ditches and canals
		19	all 611945	X			-none-
		20	all 30-63-0045			X	all minerals, ditches and canals
		21	all 611945	X			-none-
		22	all 1121757		X		coal, ditches and canals
		23	all 670394	X			ditches and canals
		24	all 1121757		X		coal, ditches and canals
		25	all 670394	X			ditches and canals
		26	all 1121757		X		coal, ditches and canals
		27	all 670394	X			ditches and canals
		28	all 1117038		X		-none-
		29	all 611945	X			-none-
		30	all 30-63-0045			X	all minerals, ditches and canals
		31	all 611945	X			-none-
		32	all 1223974			X	ditches and canals
		33	all 611945	X			-none-
		34	all 1117038		X		coal, ditches and canals
		35	all 670394	X			ditches and canals
		36	all 1223973			X	ditches and canals
6N	21W	13	all 790935	X			-none-
		24	all 1117039		X		-none-
		25	all 790935	X			-none-
		36	all 1223976			X	ditches and canals
5N	19W	6	W $\frac{1}{2}$ NE $\frac{1}{4}$; E $\frac{1}{2}$ NW $\frac{1}{4}$ 1078908	X			ditches and canals
			S $\frac{1}{2}$; W $\frac{1}{2}$ NW $\frac{1}{4}$ 30680100		X		all minerals, ditches and canals
		7	all 670394	X			ditches and canals
		18	all 38680100		X		all minerals, ditches and canals
5N	20W	19	all 670394	X			ditches and canals
		30	all 1078908	X			ditches and canals
		1	all 670394	X			ditches and canals
		2	all 1222551			X	ditches and canals
		3	all 670394	X			ditches and canals
		4	all 1121757		X		coal, ditches and canals
		5	all 670394	X			ditches and canals
		6	all 1121757		X		coal, ditches and canals
		7	all 670394	X			ditches and canals
		8	N $\frac{1}{2}$ IL-288			X	coal, ditches and canals
			S $\frac{1}{2}$ 1078908	X			ditches and canals
		9	all 670394	X			ditches and canals
		10	W $\frac{1}{2}$ IL-288			X	coal, ditches and canals
			E $\frac{1}{2}$ 1117038		X		coal, ditches and canals
		11	all 670394	X			ditches and canals
		12	all 1117038		X		coal, ditches and canals
		13	all 670394	X			ditches and canals
		14	N $\frac{1}{2}$ 30680100		X		all minerals, ditches and canals
			S $\frac{1}{2}$ IL-288			X	coal, ditches and canals
		15	all 670394	X			ditches and canals
		16	all 1222515			X	ditches and canals
		17	all 670394	X			ditches and canals
		18	N $\frac{1}{2}$ 1078908	X			ditches and canals
			S $\frac{1}{2}$ 1117038		X		coal, ditches and canals
		19	all 670394	X			ditches and canals
		20	all 1078908	X			ditches and canals
		21	all 670394	X			ditches and canals
		22	E $\frac{1}{2}$; SW $\frac{1}{4}$ 1117038		X		coal, ditches and canals
			NW $\frac{1}{4}$ 1078908	X			ditches and canals
		23	all 670394	X			ditches and canals
		24	all 1078908	X			ditches and canals
		25	all 670394	X			ditches and canals
		26	E $\frac{1}{2}$ 117038		X		coal, ditches and canals
			N $\frac{1}{2}$ NW $\frac{1}{4}$ 117038		X		coal, ditches and canals
			S $\frac{1}{2}$ SW $\frac{1}{4}$ 117038		X		coal, ditches and canals
			S $\frac{1}{2}$ NW $\frac{1}{4}$ 1078908		X		coal, ditches and canals
			N $\frac{1}{2}$ SW $\frac{1}{4}$ 1078908	X			ditches and canals
		27	all 670394	X			ditches and canals
		28	all 1078908	X			ditches and canals
		29	all 570394	X			ditches and canals
		30	all 1078908	X			ditches and canals
5N	21W	1	all 903628	X			ditches and canals
		12	all 1078908	X			ditches and canals
		13	all 903678	X			ditches and canals
		24	all IL-274			X	ditches and canals
		25	all 903628	X			ditches and canals

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Description of Map Units

- Qal Alluvial deposits undifferentiated, clay, silt, sand, and gravel in arroyos, through flowing streams, and on floodplains and narrow interstream divides. More than 25 ft exposed in recent alluvies.
- Qs Sheetwash alluvium, fine sand, silt, and clay on broader interstream divides, mostly in southern portion of the quadrangle.
- Qae Alluvial and eolian deposits; silt and sand on intermediate level surfaces, broad valleys, gentle to moderate slopes mostly in the western half of the quadrangle; is found for the most part on the Bidahocho Formation.
- Qcl Colluvium and landslide masses; very coarse wastage, rockfalls and talus block slides on or at the base of the steeper slopes; includes moderate to large (up to 1000) in length blocks of Cretaceous sandstone and/or Bidahocho Formation that have slid on the Rio Salado shale.
- Qoa Older alluvium; mostly silt, sand and some gravels on slightly elevated surfaces not graded to present drainage system; may represent "topographic reversals."
- Ob Basalt flows; originating from centers to east in North Plains Lava Beds; olivine tholeiite in composition, with a K-Ar age of 1.41 m.y. (Laughlin, Brooking, Damon, and Shatigullah, 1979)
- Tb Bidahocho Formation; isolated deposits of uncertain age; some consist of stratified volcanic rich coarse sandstone and conglomerate, friable to well indurated, and some are debris flows consisting of undifferentiated coarse material derived from the Fence Lake Member of the Bidahocho Formation.
- Tbu Upper member of the Bidahocho Formation (Pliocene), light gray and light yellowish gray lithic sandstone, poorly sorted but generally lower medium to coarse grained, with a calcareous cement that varies from very poor to firm, and brown unconsolidated fine to medium grained sand occurring in pockets a few inches thick and in lenses up to several tens of feet thick; base not exposed but thickness may range up to 200 ft in the west-central part of the quadrangle.
- Tbfl Fence Lake Member of Bidahocho Formation (Miocene?), coarse sandstones and pebbles, cobbles, and boulder conglomerates, generally stratified but poorly cemented; overall color varies from light gray to pinkish or purplish gray; white calcareous zones, or calcite lenses, occur throughout and also as isolated patches on the surface. Sandstones are lithic containing black, red, and gray volcanic clasts and multi-colored quartz grains. The conglomerates are composed of basalt, some rhyolites and other volcanic rocks, and minor quartzite, jasper, and agate. The unit is restricted to the higher levels which are areas underlain by the Moreno Hill Formation or the Atarque Sandstone; it is the oldest of the Tertiary sedimentary units in the area. Provenance is likely the volcanic field southeast of Quemado; thickness varies greatly due to deposition, but at places exceeds 125 ft. Best exposures in SW sec. 30, T.5N., R.19W.
- Kmh Moreno Hill Formation (Upper Cretaceous); fluvial channel sandstones, pale to grayish silty sandstone, sandstone and coal, and minor siltstone. Sandstones are pale yellowish brown to light brown and reddish brown, predominantly upper fine to lower medium grained, but may locally become coarse grained especially near base of a channel complex, generally a fining upward trend can be determined within a channel system, which may range up to 40 ft thick. Fluvial sedimentary structures, including both tabular and festoon cross bedding, and current ripple marks are common. In SW NW sec. 24, T.5N., R.20W., current ripples indicate a flow direction of S.80W., in other localities such as SW sec. 22, T.5N., R.20W., current direction not as clear. The shales are gray, olive gray, and brownish gray, with dark gray to black carbonaceous zones that contain coaly beds. The lower most carbonaceous zone, 2 to 4 ft thick, rests directly on the Atarque sandstone, but is neither well exposed nor everywhere present, and is overlain by the 8 to 12 ft thick very fine-grained silty sandstone that locally contains thin, fine-grained silty sandstone. Above this is the first major paludal shale member which ranges up to 45 ft thick and contains a 1 to 3 ft thick coal and coaly carbonaceous shale bed 10 to 15 ft above the base; this is the "main coal bed" and is characterized in most outcrops by a medial 2 inch thick hard clay (filled with beds) locally a 1 to 2 ft thick carbonaceous zone can be found 10 to 15 ft above the "main coal bed." A fluvial channel sandstone overlies the shale member and is in turn overlain by a paludal shale that may attain a thickness of 75 ft. Thickness of formation ranges up to 240 ft.
- Ka Atarque Sandstone (Upper Cretaceous), yellowish gray to grayish orange and light reddish brown very fine to lower medium grained sandstone, generally a well cemented, massive cliff former, however, in many places a medial silty zone up to 7 ft thick is present and forms a slope between the upper and lower cliff forming sandstones. In a few places this silty zone gives way to a dark gray silty shale containing reworked carbonaceous material, such as just southwest of the Cantaralo windmill in sec. 2, T.5N., R.20W. The medial silty zone is best developed and recognized along the north side of the Zuni fluvial where it commonly separates a lower flat bedded from an upper cross-bedded sandstone. These may correspond to the lower and upper shoreface sequence characteristic of regressive coastal barrier sandstones. Burrows, including *Schismopoda*, are present throughout, but are more common in lower part; sharks teeth found locally in middle and upper part. In some places the uppermost part of the Atarque consists of a 2 to 4 ft thick carbonaceous shale interval, generally covered, overlain by an 8 to 12 ft thick very fine-grained silty sandstone that locally contains the brachiopod *Craspedota* sp. in abundance. *Craspedota* localities are the SW SW sec. 2, T.5N., R.20W. and the NW sec. 7, T.5N., R.19W. Thickness of the unit ranges from 25 to 55 ft.
- Kmr Rio Salado Tongue of Mancos Shale (Upper Cretaceous); medium to dark gray, and light brownish gray to grayish brown marine shales, silty shales, and calcareous shales, weathers to moderately steep soft slopes which are generally covered by colluvium, talus, and landslide debris derived from the overlying sandstones. In many places the white to orange weathering calcareous shale and calcarenite zone that is equivalent to the lower part of the Bridge Creek Limestone Member of the Greenhorn Formation may be seen approximately 25 ft above the base of the Rio Salado Tongue; it may be identified by numerous thin bentonite beds, and the presence of the oyster *Pygostrea murchisoni* (Stanton), the uppermost bed of the member is a calcarenite composed largely of *P. murchisoni* debris. *Pygostrea* sp. was found in calcarenite float from the member in the NW sec. 25, 6N., 20W. Approximately 100 to 120 ft above the top of the Bridge Creek equivalent the shale becomes interbedded with thin beds of very fine-grained calcareous sandstone and fossiliferous limestone concretions in excess of 2 ft in diameter. Fossils associated with the concretions are *Hemiteles nodosus*, *Hemiteles depressus*, and *Montychites conchalis*. Collections made at U.S.G.S. Mesozoic locality no. 01282 in sec. 2, T.5N., R.20W. The contact between the Rio Salado shale and the overlying Atarque Sandstone is interbedded and transitional, the uppermost part of the Rio Salado containing thin beds of yellowish gray, very fine-grained silty sandstone, thickness ranges from 210 to 250 ft.
- Kdt Twoells Tongue of Dakota Sandstone (Upper Cretaceous), pale yellow and yellowish gray to gray, fine and medium grained, shallow water marine sandstone. In the northern half of the quadrangle total thickness is 25 ft.; the lower 16 ft is a gray, fine-grained, poorly cemented sandstone the upper 9 ft is an upper fine to lower medium grained quartzose sandstone, generally well sorted, with very minor black accessory minerals, and more firmly cemented than the lower portion; good exposures in the SW sec. 15, T.6N., R.20W. In the southern half of the quadrangle thickness ranges up to 27 ft with the lower and lower middle part consisting of very fine-grained gray silty sandstone that contain bioturbated zones. The middle portion is characterized by alternating beds, 4 to 8 inches thick, of gray fine-grained sandstone and light gray very fine silty sandstone, burrowed and bioturbated in places. The uppermost 8 to 10 ft consist of medium scale sets of tabular cross beds inclined 22° to 25° in a south in southwesterly direction.
- Kmw Whitewater Arroyo Tongue of Mancos Shale (Upper Cretaceous), medium to dark gray shale, soft slope former. About 6 ft above the base in Seep Canyon *Calymene* and *Cantharus* was found in the Mesozoic locality 01280. 25 ft above the base is a persistent 18 to 20 inch thick orange to white weathering bentonite bed. The 12 ft interval overlying the bentonite commonly contains *Encrinurus* *Triseri*. Total thickness of unit, 50 to 60 ft.
- Kdp Pagute Tongue of Dakota Sandstone (Upper Cretaceous); yellowish gray to grayish green, massive, well cemented, marine sandstone, with a gray to light gray finer grained base that is 2 to 4 ft thick and transitional with the underlying lower part of the Mancos Shale. The upper half contains large brown limy concretions up to 3 ft in diameter, and a 1 to 1½ ft thick coquina bed at the top that is comprised largely of *Encrinurus* *levis* and *Pygostrea* cf. *P. sellum*. In the southern one half of the quadrangle the unit is 16-18 ft thick and commonly forms a small cliff below the Whitewater Arroyo. In the northeastern part the ammonite *Pleurostrophia* *wyomingtonensis* was found near the top of the massive, concretion bearing sandstone and also in the transitional zone at the base (U.S.G.S. Mesozoic localities 01242 and 01246), in the SW SW sec. 13, T.6N., R.20W. the transitional zone is here thickened and the underlying Mancos Shale has become much more sandy and thus the base of the Pagute is not as well defined as it is further south.
- Knl Lower Part of the Mancos Shale (Upper Cretaceous); light to medium gray and light brownish gray siltstone and very fine silty sandstone, with 3 to 4 ft of gray micaceous bentonitic clay at the top in the southern half of the quadrangle; thickness ranges from 15 to 18 ft. In the northeast corner along the north side of Jarolona Draw in sec. 13 up to 50 ft of thinly bedded sandy siltstone and very fine silty sandstone is exposed. This sandy interval may belong more properly in the main body of the Dakota Sandstone, but neither the thin pebbly conglomerate nor the underlying Mancos shales characteristic of the top or upper part of the Dakota are present here.
- Kd Dakota Sandstone, main body (Upper Cretaceous), the marine, marginal marine, and non-marine rocks that make up the lowest part of the Cretaceous sequence in west-central New Mexico (Hook, Cobban and Landis, 1980). In the NW NW sec. 24, T.5N., R.20W., current ripples indicate a flow direction of S.80W., in other localities such as SW sec. 22, T.5N., R.20W., current direction not as clear. The shales are gray, olive gray, and brownish gray, with dark gray to black carbonaceous zones that contain coaly beds. The lower most carbonaceous zone, 2 to 4 ft thick, rests directly on the Atarque sandstone, but is neither well exposed nor everywhere present, and is overlain by the 8 to 12 ft thick very fine-grained silty sandstone that locally contains thin, fine-grained silty sandstone. Above this is the first major paludal shale member which ranges up to 45 ft thick and contains a 1 to 3 ft thick coal and coaly carbonaceous shale bed 10 to 15 ft above the base; this is the "main coal bed" and is characterized in most outcrops by a medial 2 inch thick hard clay (filled with beds) locally a 1 to 2 ft thick carbonaceous zone can be found 10 to 15 ft above the "main coal bed." A fluvial channel sandstone overlies the shale member and is in turn overlain by a paludal shale that may attain a thickness of 75 ft. Thickness of formation ranges up to 240 ft.

Map Symbols

Contact, dashed where approximate or inferred

Fault, dashed where concealed, U, upthrown side; D, downthrown side

Dip of beds

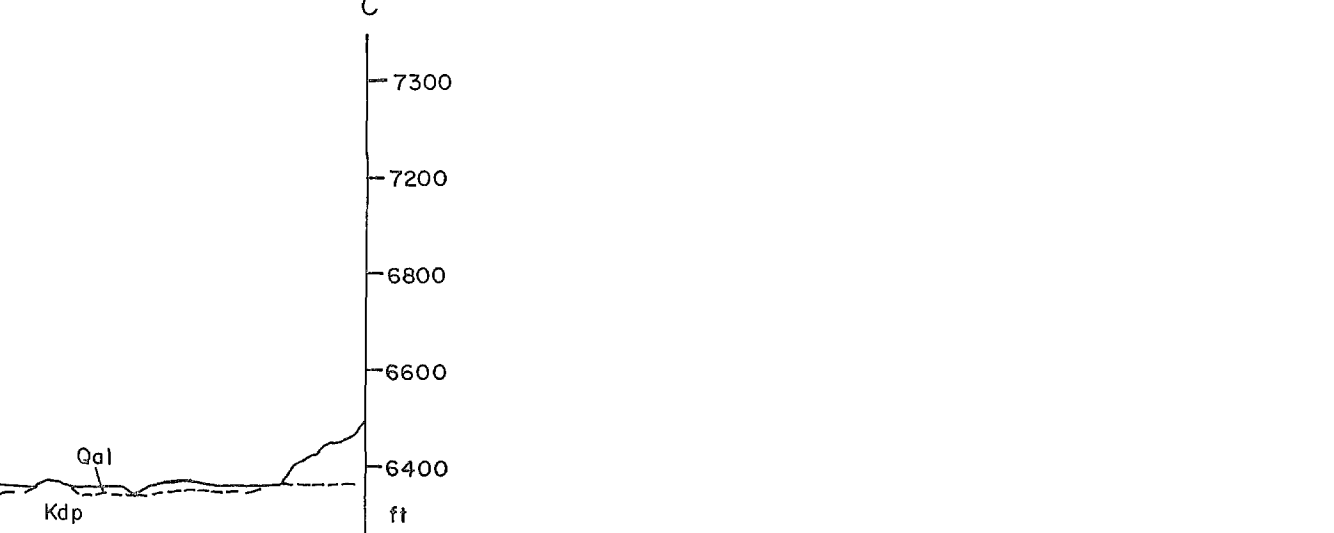
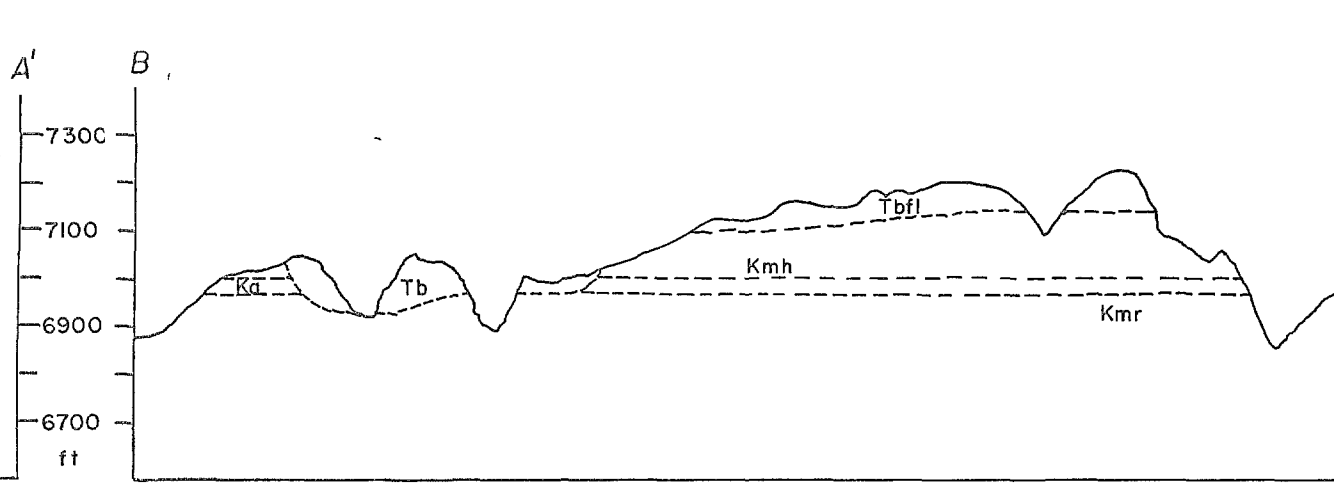
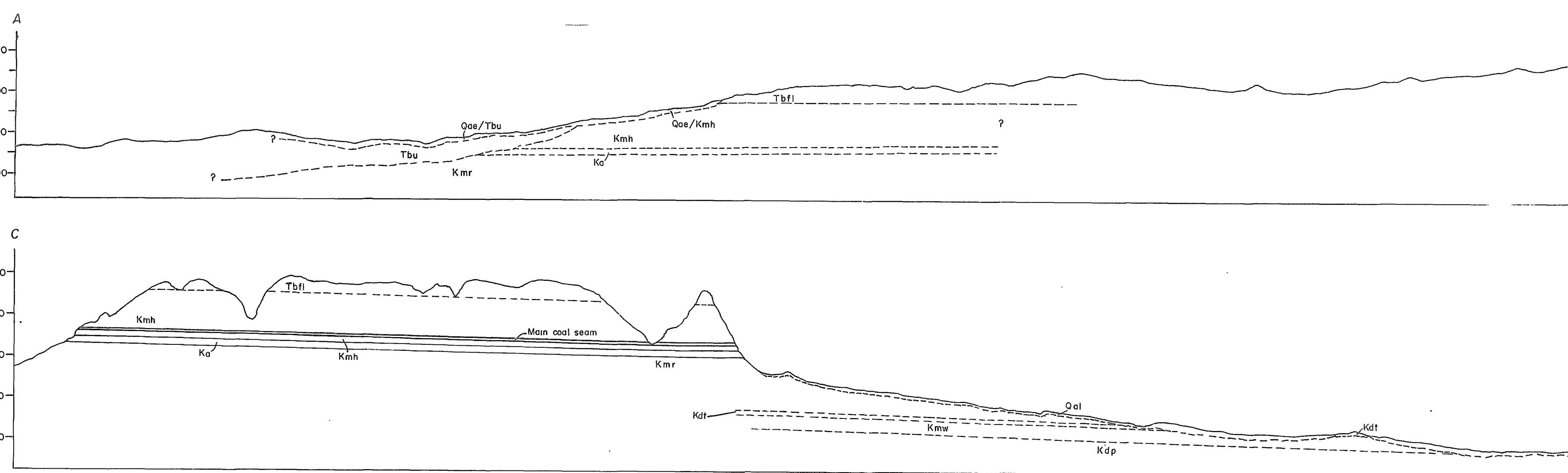
Apparent dip of beds

Measured section locality number

Measured coal section

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GEOLOGIC MAP OF THE CANTARALO SPRING QUADRANGLE, CIBOLA COUNTY, NEW MEXICO

By

Orin J. Anderson

1981

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