GEOLOGY AND COAL RESOURCES OF THE TWENTYTWO SPRING 7½' QUADRANGLE, CATRON AND CIBOLA COUNTIES, NEW MEXICO

OF 143

ORIN J. ANDERSON

GEOLOGY AND COAL RESOURCES OF THE TWENTYTWO SPRING 7½' QUADRANGLE, CATRON AND CIBOLA COUNTIES, NEW MEXICO

NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES
OPEN-FILE REPORT 143 (1981 VERSION by STEPHEN J. FROST, REVISED 1982) by ORIN J. ANDERSON

January 12, 1982

Contents:

Coal Resources - Twentytwo Spring 7½' Quadrangle

Non-marine shales containing thin coal beds are present in two formations within the quadrangle - the Dakota Sandstone (main body) and the Moreno Hill Formation. The Dakota Sandstone coals are exposed in the NE¼ of sec. 19 along the south wall of Perry Canyon, and in the NW¼ NW¼ of adjacent sec. 20, in T 4N, R 20W. Lenticular coaly zones up to 18 inches thick, but with numerous carbonaceous shale partings, occur in the upper part of the middle palludal shale unit and in the lower part of the upper, thin-bedded sandstone unit (see description of map units). Based upon these outcrops as well as others in sec. 36 of T 5N R 21W, it would appear that the Dakota coals are of no economic importance in this area.

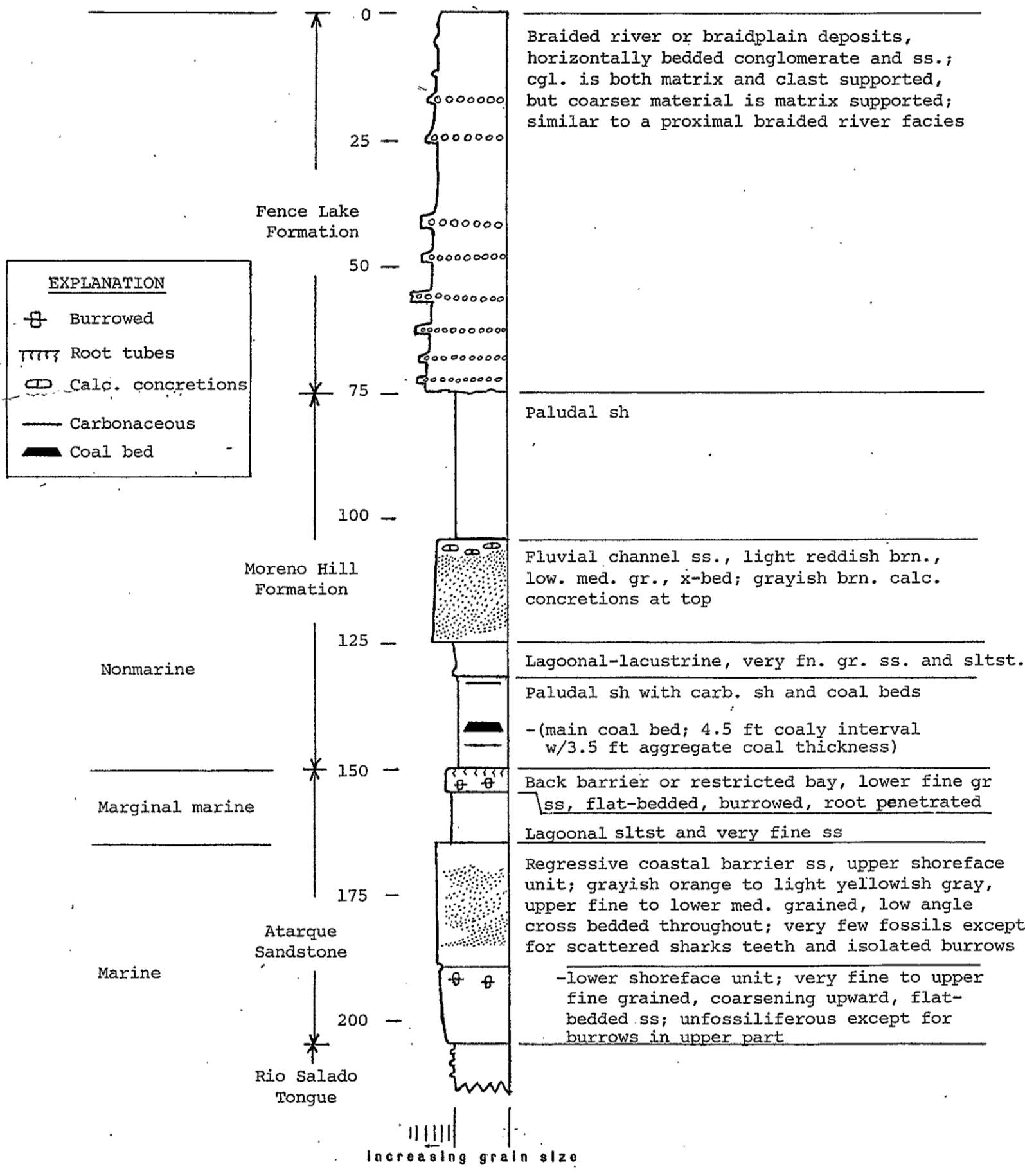
The Moreno Hill Formation exposures are limited to sections 35, 36, and 31 along the southern rim of the Zuni Plateau in the northeastern corner of the quadrangle. As is shown on the measured section in Fig. 1, the coal lies about 8 ft above a fine-grained back barrier or restricted bay sandstone that is taken as the top of the Atarque locally. Here a 4.5 ft coaly interval is well exposed along an unstable southeastward facing slope. Two carbonaceous shale partings and a thin hard gray clay (altered ash bed) near the base of the interval reduce the aggregate coal thickness to 3.5 ft. Essentially the coal is restricted to the N½ N½ sec. 36 T 5N R 20W, a total area of 125-140 acres, and is overlain by an erosional wedge of palludal shales and fluvial channel sandstones, thickening from 30 ft on the south to approximately 100 ft on the north at the north section line. The overburden

continues to thicken northward for one mile onto the adjacent quadrangle where the Tertiary Fence Lake Formation is somewhat thicker.

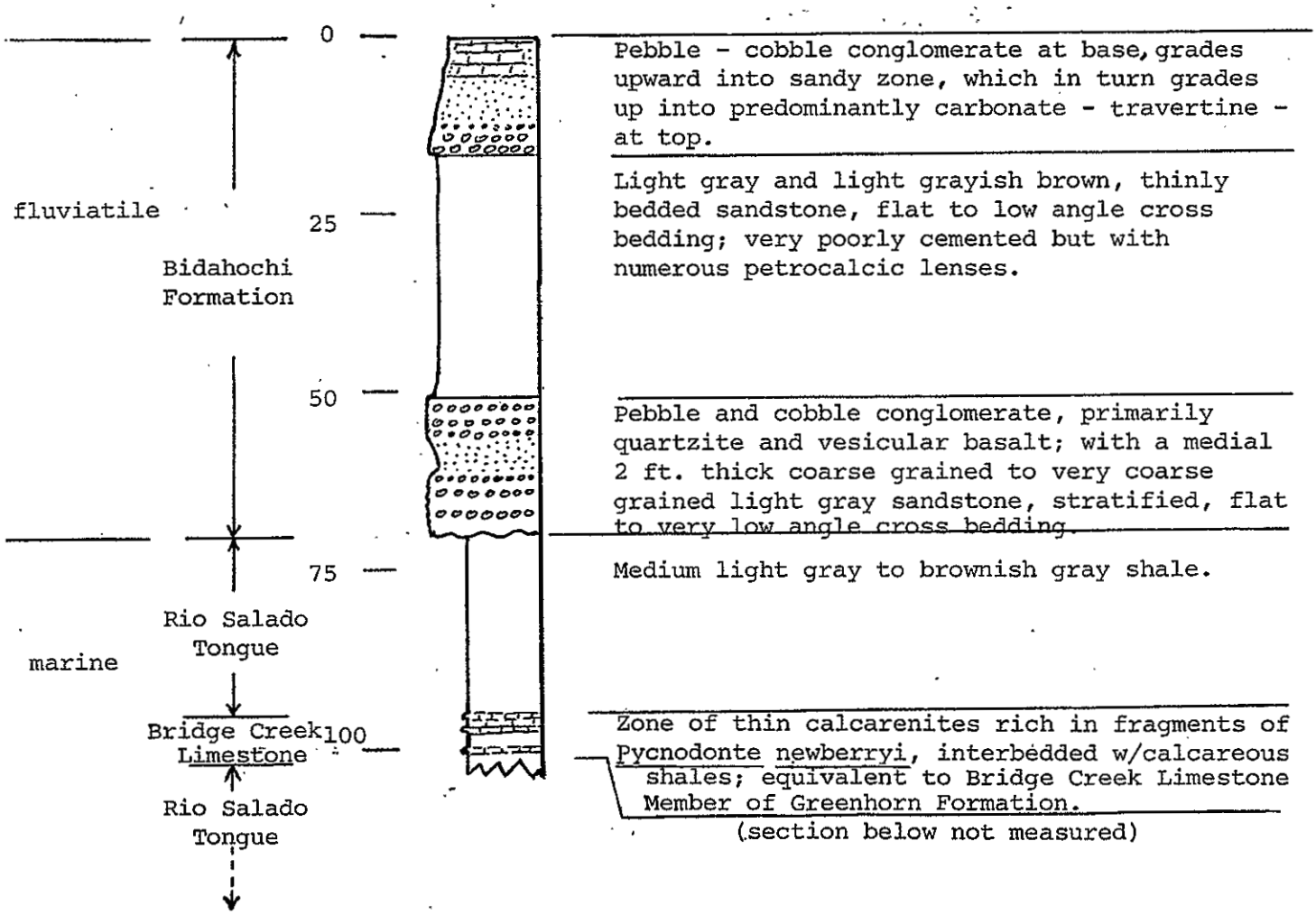
Using a factor of 1750 tons/acre foot of coal the section 36 coal resources (and hence the total quadrangle) would total approximately 857,500 short tons.

Analyses of grab samples of weathered coal from this coal zone yielded BTU values ranging up to 9350 and ash contents of about 17% (New Mexico Bureau of Mines and Mineral Resources Coal Analysis Laboratory). BTU values of fresh samples could be expected to run somewhat higher.

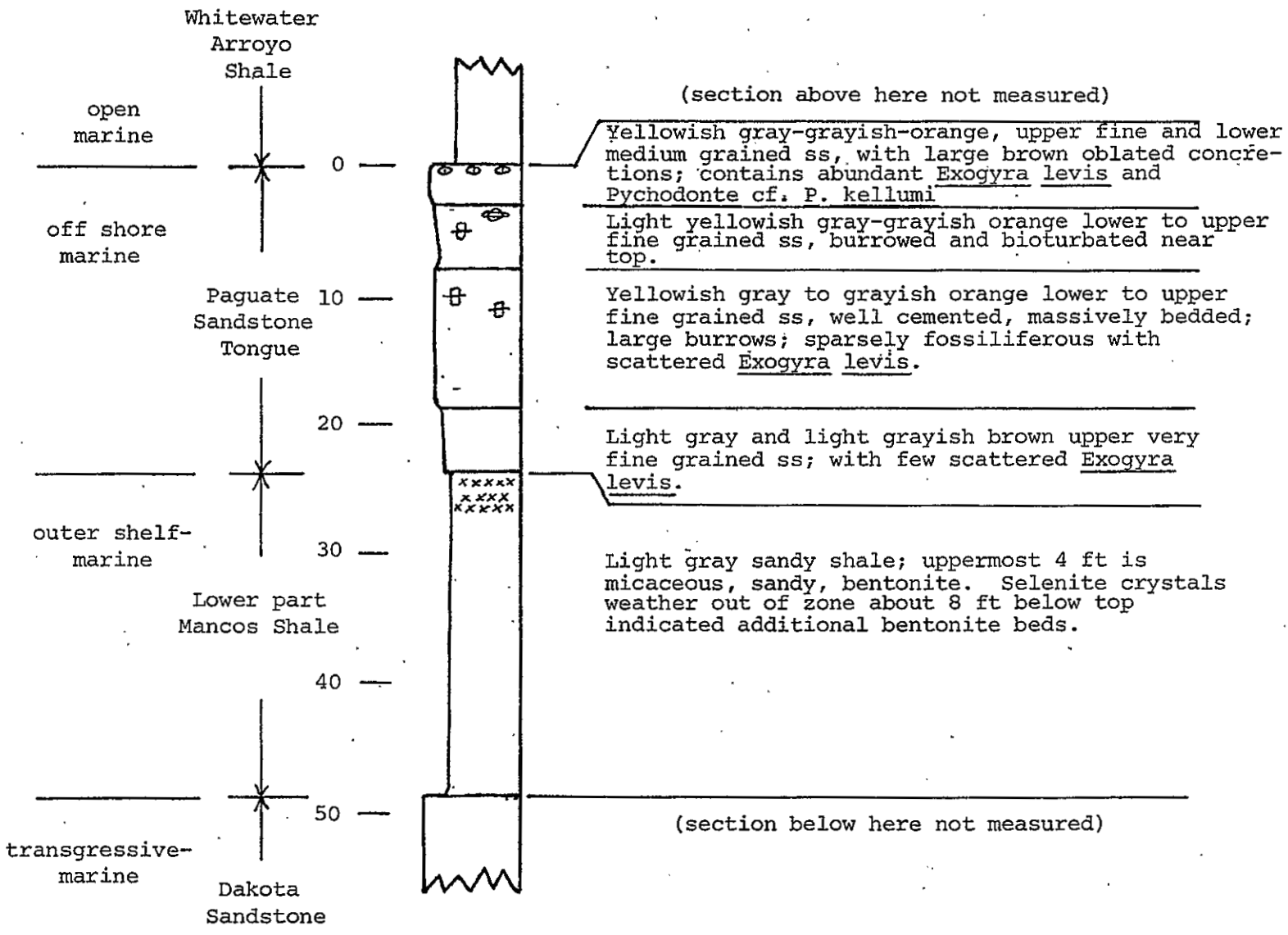
Fig. 1 Measured coal bearing section in SW¼ SW¼ sec. 30, and NW¼ NW¼ sec. 31, T 5N R 19W showing underlying Atarque Sandstone and overlying Fence Lake Formation



Measured section of Bidahochi Formation and portion of the underlying Rio Salado Tongue of Mancos Shale, SW¼ SW¼ sec 21, T 4N R 20W Cibola Co., New Mexico



Measured section of Paguate Tongue (Kdp)
of Dakota Sandstone (Kd) and the lower part
of the Mancos Shale (Kml), in NE¼ NE¼
Sec. 2 T 4N R 20W,
Cibola Co., New Mexico



UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TWENTYTWO SPRING QUADRANGLE
NEW MEXICO
7.5 MINUTE SERIES (TOPOGRAPHIC)

COMPOSITE SECTION

SYSTEM	SERIES	FORMATION	MEMBER OR UNIT	THICKNESS	LITHOLOGY
TERTIARY	Pliocene	Bidahochi Formation		0'-324'	
	Miocene	Fence Lake Formation		100'-350'	
		Moreno Hill Formation	Upper Sandstone	25'	
			Middle Shale	30'	
			Lower Sandstone	45'	
CRETACEOUS	Upper Cretaceous	Dakota Sandstone	Main Body	100'-120'	
			Paguate Tongue	2'-5'	
		Mancos Shale	Whitewater Arroyo Tongue	6'	
			Lower part	25'	
			Rio Salado Tongue	200'	
TRIASSIC	Upper Triassic	Chinle Formation	Upper Petrified Forest Member	240'+	

Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1971. Field checked 1972

Projection and 10,000-foot grid ticks: New Mexico coordinate system, west zone (transverse Mercator)
1000-metre Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Fine red dashed lines indicate selected fence lines

SCALE 1:24 000

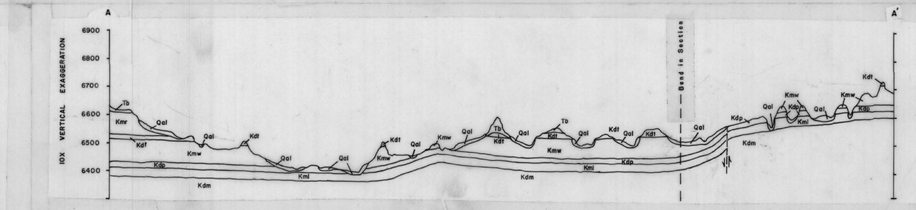
CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

ROAD CLASSIFICATION

Primary highway, hard surface — Light-duty road, hard or improved surface
Secondary highway, hard surface — Unimproved road
Interstate Route — U. S. Route — State Route

TWENTYTWO SPRING, N. MEX.
N3430—W10852.5/7.5
1972

A — A'



CORRELATION OF MAP UNITS

Qal	Qae	Holocene and Pleistocene	QUATERNARY
Qcl	Qoa		
Tb		Pliocene and Miocene(?)	TERTIARY
Unconformity			
Tfl			
Unconformity			
Kmh		Upper Cretaceous	CRETACEOUS
Ka			
Kmr			
Kdt			
Kmw			
Kdp			
Kml			
Kdm			
Unconformity			
Trc		Upper Triassic	TRIASSIC

MAP SYMBOLS

- Contact—dashed where approximate or inferred
- Fault—dashed where approximately located; U, upthrown side; D, downthrown side; (?), indicates uncertain existence
- Syncline—trace of axial plane showing direction of plunge; dotted where projected beneath mapped units
- 45° Strike and dip of beds
- Bentonite bed (diagrams only)

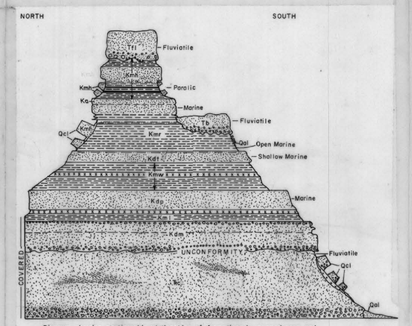


Diagram showing stratigraphic relationships of formations in mapped area and environments of deposition.

DESCRIPTION OF MAP UNITS

Qal Holocene alluvium. Mainly clay, silt, and sand, with local accumulations of gravel in arroyos through flowing streams, on floodplains, and on narrow interstream divides; includes colluvium at places.

Qae Alluvial and eolian deposits. Sand and silt on moderate, mostly west-facing slopes in northern half of quadrangle.

Qcl Colluvial and landslide deposits. Coarse wastage on steeper slopes surrounding the prominent mesas or plateaus; includes minor slides, slump blocks, torevs blocks, and talus and colluvium.

Qoa Older alluvium. Silt, sand, and gravel perched on slightly elevated benches or ridges, not graded to present drainages; in many places it is unclear whether the gravels represent coarse alluvium in ancient channels now represented as a topographic reversal, or whether they are a lag derived from the "Zanjonmesa" of the Bidahochi Formation.

Tb Bidahochi Formation (Pliocene). Highly variable light brown sands, light gray sandstones, and pebbly conglomerates, generally poor to fair cementation, but with numerous petrocalcic lenses in the sandy zones, and with travertine capping the unit in at least one locality - SW¼ sec. 21 T 4N, R 20W (see measured stratigraphic section of Tb). Elsewhere exposures are poor except for basal conglomerates exposed in the W½ SE¼ sec 8, and in the center W½ NE¼ sec 15 T 4N R 20W. Conglomerates are composed mainly of vesicular basalt and quartzite derived from the Fence Lake Formation which caps the Zuni Plateau lying immediately to north; Bidahochi here is apparently part of a "fanglomerate" deposited at mouth of Perry Canyon; probably exceeds 100 ft (30 m) in thickness at places.

Tfl Fence Lake Formation (Miocene?). Coarse sandstones and pebble, cobble and boulder conglomerates, generally stratified with some low angle cross bedding, poorly cemented. Overall color varies from light gray to pinkish or purplish gray. White petrocalcic lenses occur throughout and also as isolated patches on the surface. Sandstones are poorly sorted and rich in lithic fragments including black, red, and gray volcanic clasts and multi-colored quartz grains. The conglomerates are generally matrix supported and consist of basalts, rhyolites and other volcanic rocks, and minor quartzite, jasper, and agate; provenance is likely the volcanic field northeast of Quemado. The unit is restricted to the higher levels (sec. 35 and 36 T 5N R 20W) which are underlain by the Moreno Hill Formation and Atarque Sandstone, and is the oldest of the Tertiary sediments in the area. Thickness varies due in part to the irregular surface upon which it was deposited, but at places exceeds 125 ft. (38 m).

Kmh Moreno Hill Formation (Upper Cretaceous). Fluvial channel sandstones, paludal shales, mudstones, carbonaceous shale, and minor coal. Sandstones are pale yellowish brown to reddish brown, fining upward lenticular units that range up to 40 ft thick; both tabular and festoon cross bedding common. The shales range from gray through brownish gray and olive gray with carbonaceous zones that contain thin coal beds; the thickest coal bed is 2 to 3 ft and lies 8 to 10 ft above the top of the Atarque Sandstone. Exposures are limited to edge of Zuni Plateau in the extreme northeastern corner of quadrangle, where thickness exceeds 100 ft (30 m).

Ka Atarque Sandstone (Upper Cretaceous). Yellowish gray to grayish orange, lower very fine to upper fine grained sandstone; generally well cemented with subrounded to rounded grains, and poor to fair sorting; thin to massively bedded with thin interbedded shales at base. Exposures, limited to the northeastermost corner of quadrangle, show the Atarque to be composed of a lower, flat bedded, very fine to fine grained sandstone overlain by a coarser, more massive low-angle cross-bedded sandstone about 25 ft. thick; these two units may correspond to the lower and upper shoreface sequence characteristic of regressive coastal barrier sandstones such as this. The upper cross-bedded unit is overlain by an 8-10 ft. thick sandy shale which is in turn overlain by a 3 ft thick burrowed (including Ophiomorpha) root penetrated, very fine grained sandstone. This latter sequence is interpreted to be lagoonal deposits overlain by a back barrier sandstone (after Molenaar, 1973). Sharks teeth were collected from upper shoreface facies in the NW¼ sec. 31 T 5N R 19W. Thickness, including marginal marine sequence at top, about 55 ft. (17 m).

Kmr Rio Salado Tongue of Mancos Shale (Upper Cretaceous). Medium to dark gray and light grayish brown marine shale, silty shale, and calcareous shale; good exposures are limited to upper slopes of sandstone capped mesas or plateaus and even here are commonly masked by colluvium and landslide debris. In places the white or orange weathering calcareous shale and calcarenite zone that is equivalent to the Bridge Creek Limestone Member of the Greenhorn Formation may be seen approximately 25 to 35 ft above the base; it is identified by numerous thin bentonite beds, by the presence of a Pycnodonte newberryi (Stanton) zone, and by the platy calcarenite beds ¼ to 3/4 inch thick containing fragments of P. newberryi and other shell fragments. The P. newberryi zone may best be seen in NW¼NW¼ sec. 1 and in the SE¼SW¼ T 4N R 20W. The calcarenite may be seen along road in the SW¼ sec. 34 T 5N R 20W, and in the SE¼SW¼ sec. 22 and NW¼ SW¼ sec. 8 of T 4N R 20W. Approximately 100 feet above the top of the Bridge Creek Member equivalent a few thin, fine grained, laminated sandstones appear along with large (in excess of 2 ft in diameter) limestone concretions; associated with the concretions are the ammonites Mammites depressus, Mammites nodosoides, and Neoptychites cephalotus. Upper part grades into overlying Atarque Sandstone through a sequence of interbedded shale and sandstone. Thickness of unit approximately 200 ft (61 m).

Kdt Twowells Tongue of Dakota Sandstone (Upper Cretaceous). Light gray to yellowish gray and dusky yellow upper very fine to medium grained sandstone. It is a coarsening upward sequence with a lower flat-bedded light gray very fine sandstone interbedded with arenaceous shale; a middle part commonly yellowish gray - dusky yellow, fine grained, burrowed and bioturbated, overlain by a coarser grained planar cross bedded zone; dip direction of cross beds variable, but generally south to southeastward. The unit is not everywhere preserved due to varying degree of induration and the incompetent nature of underlying shale, but good exposures may be found in sections 9, 15, 21, and 22 of T 4N R 20W. Near the center of the latter section thickness reaches 27 ft (8.3 m).

Kmw Whitewater Arroyo tongue of Mancos Shale (Upper Cretaceous). Medium to dark gray shale, soft slope former. Locally there are large brown calcareous concretions near base of unit, such as in the S½ SE¼ sec 16 and the W½ NW¼ sec 15 of T 4N R 20W; in and immediately below concretion zone Pilcatula cf. P. ferryi were collected. Twenty-five ft above base is an 18 inch thick white to orange weathering bentonite bed with several more 1 inch to 2 inch thick just above it; good exposures of bentonite beds are found in the S½ SE¼ sec 15, T 4N R 20W and in the S½ SE¼ sec 1 T 4N R 20W, but it may be seen at other localities as well. The relatively large oyster Exogyra trigeri is particularly abundant near the bentonite beds. Thickness of unit about 60 ft (18.5 m).

Kdp Paguate Tongue of Dakota Sandstone (Upper Cretaceous). Yellowish gray to light grayish orange lower fine to lower medium grained sandstone with a light gray finer grained base that is 5 ft thick and gradational into the underlying Mancos Shale Tongue; overlying the basal fine grained unit is 11' of massively bedded, well cemented, sandstone commonly with large burrows but only sparsely fossiliferous with scattered Exogyra levis. A bioturbated zone commonly overlies and is in turn overlain by a 3 ft thick coquinoid zone with Pycnodonte cf P. kellumi and Exogyra levis almost exclusively. Thickness at measured section is NE¼ NE¼ sec 2 T 4N, R 20W, about 24 ft. (see stratigraphic column of Kdp and Kml).

Kml Lower part of Mancos Shale (Upper Cretaceous). Gray to medium dark gray arenaceous shale and siltstone; base almost everywhere concealed, but upper portion exposed locally, the best exposure being in the NE¼ sec. 2 along the walls of Perry Canyon. Selenite weathers out of zone 6 to 8 ft below top; upper 4 ft composed of micaceous, arenaceous bentonite. Thickness difficult to establish, but very small exposure of Dakota Sandstone (?) in stream bed in center of NE¼ NE¼ sec. 2, T 4N R 20W provides a local datum for a thickness estimate of 25 ft (7.5 m).

Kdm 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). Exposures in northwest corner of quadrangle and in the adjacent Cantaralo Spring quadrangle indicate a thickness in excess of 100 ft. A three part division may be recognized as follows: (1) a lower fluvial and marginal marine, flat bedded and cross-bedded quartzose sandstone, upper fine to medium grained, locally up to 25 ft exposed; (2) a middle paludal shale, 50 to 60 ft thick, containing carbonaceous shale with very thin coal beds, and thin-bedded fine grained lenticular sandstones that range from several inches to 5 ft in thickness; and (3) an upper part consisting of cross-bedded shallow marine sandstones massive at base, overlain by a sequence of interbedded fine grained sandstones and sandy carbonaceous shales; the top of the massive sandstone is marked by a pebble conglomerate; the interbedded fine grained zone contains burrows and trails, and a fossiliferous bed containing Turritella sp., Pycnodonte sp. and small bivalves was found in the NW¼ NW¼ section 1, T 3N R 20W; also Pycnodonte cf. P. kellumi appear locally at the surface in abundance, as in the SW¼ NW¼ section 36, T 4N R 20W. The middle shale part, discussed under (2), may contain more sandstone in southwest corner of quadrangle.

Trc Chinle Formation, undivided (Upper Triassic). Grayish red to reddish brown and purple mudstone, siltstone, and claystone with scattered lenticular beds of light gray sandstone and conglomerate; individual lenses display sharp color contrasts; mudstones commonly mottled; many of the claystone units contain bentonite. The nearly 240 ft of section exposed in southwest corner of quadrangle is all assigned to the Petrified Forest Member.

REFERENCES

Akers, J.P., 1964, Geology and groundwater in the central part of Apache County, Arizona: U.S. Geological Survey Water-supply paper 1771

Anderson, Orin J., 1981, Geology and coal resources of the Cantaralo Spring quadrangle, Cibola County, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Open-file Report 142

Cooley, M.E., 1956, Chinle Formation of Apache County, Arizona: Ph.D. Dissertation, University of Arizona, 317 p., 2 pls.

Dane, D.H., Landis, E.R., and Cobban, W.A., 1971, The Twowells Sandstone tongue of the Dakota Sandstone and the Tres Hermanos Sandstone as used by Herrick (1900), Western New Mexico: U.S. Geological Survey, Prof. Paper 750-B, p. 1317-1322

Darton, N.H., et al. 1915, Guidebook of western United States, part C, the Santa Fe Route: U.S. Geological Survey, col. 613, 200 p.

_____, 1926, "Redbeds" and associated formations in New Mexico: U.S. Geological Survey, Bull. 794, 326 p.

Foster, R.W., 1964, Stratigraphy and petroleum possibilities of Catron County, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bull. 85, 55 p., 2 pls., 11 figs., 1 table

Herrick, C.L., 1900, Report on a geological reconnaissance in Western Socorro and Valencia Counties, New Mexico: American Geologist, vol. 25, pp. 331-346

Hook, S.C. and Cobban, W.A., 1977, Pycnodonte newberryi (Stanton) Common guide fossil in Upper Cretaceous of New Mexico: New Mexico Bureau of Mines and Mineral Resources, Annual Report 1976-1977, p. 48-54, 5 figs.

Hook, S.C., Cobban, W.A., and Landis, E.R., 1980, Extension of the intertongued Dakota Sandstone-Mancos Shale terminology into the southern Zuni Basin: New Mexico Geology, v. 2, no. 3

Hook, S.C., Molenaar, C.M., and Cobban, W.A., 1982 (in preparation), Redefinition of the Cretaceous Tres Hermanos Sandstone of Herrick (1900), west-central New Mexico: New Mexico Bureau of Mines and Mineral Resources Circular no. 185.

Landis, E.R., Dane, C.H., and Cobban, W.A., 1973, Stratigraphic terminology of Dakota Sandstone and Mancos Shale, west-central New Mexico: U.S. Geological Survey, Bull. 1372-J, 44 p., 4 figs.

Molenaar, C.M., 1973, Sedimentary facies and correlation of the Gallup Sandstone and associated formations, northwestern New Mexico: in Four Corners Geological Society Memoir: Book, 1973.

_____, 1977, Stratigraphy and depositional history of Upper Cretaceous rocks of the San Juan Basin area, New Mexico and Colorado, with a note on economic resources: New Mexico Geological Society, Guidebook 28th field conference, p. 159-166, 1 fig.

Owen, D.E., 1966, Nomenclature of Dakota Sandstone (Cretaceous) in San Juan Basin, New Mexico and Colorado: American Association of Petroleum Geologists, Bull., v. 50, no. 5, p. 1023-1028, 3 figs.

Pike, W.S., Jr., 1947, Intertonguing marine and nonmarine Upper Cretaceous deposits of New Mexico, Arizona and southwestern Colorado: Geological Society of America, Mem. 24, 103 p., 12 pls., 7 figs.

Reagan, A.B., 1924, Stratigraphy of the Hope Buttes Volcanic Field, Arizona: Pan American Geologist, vol. 41, p. 355.

Repenning, C.A., and Irvin, J.H., 1954, Bidahochi Formation of Arizona and New Mexico: Am. Assoc. Petroleum Geologists Bull., v. 38, p. 1821-1826.

Stewart, J.H., Poole, F.G., and Wilson, R.F., 1972, Stratigraphy and origin of the Chinle Formation and related Upper Triassic strata in the Colorado Plateau Region: U.S.G.S. Prof. Paper 690.

GEOLOGIC MAP OF THE TWENTYTWO SPRING QUADRANGLE, CATRON AND CIBOLA COUNTIES, NEW MEXICO

NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES

OPEN-FILE REPORT 143 (1981 VERSION BY STEPHEN J. FROST, REVISED 1982) BY ORIN J. ANDERSON