U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
SOUTHERN UTE TRIBE AND
U.S. BUREAU OF INDIAN AFFAIRS

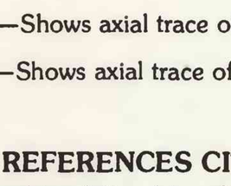
PROFESSIONAL PAPER 1505-A
PLATE 1

Base from U.S. Geological Survey
Cortez, 1982; Durango, 1983;
Farmington, 1980; Navajo Reservoir, 1980

APPROXIMATE MEAN DECLINATION, 1992

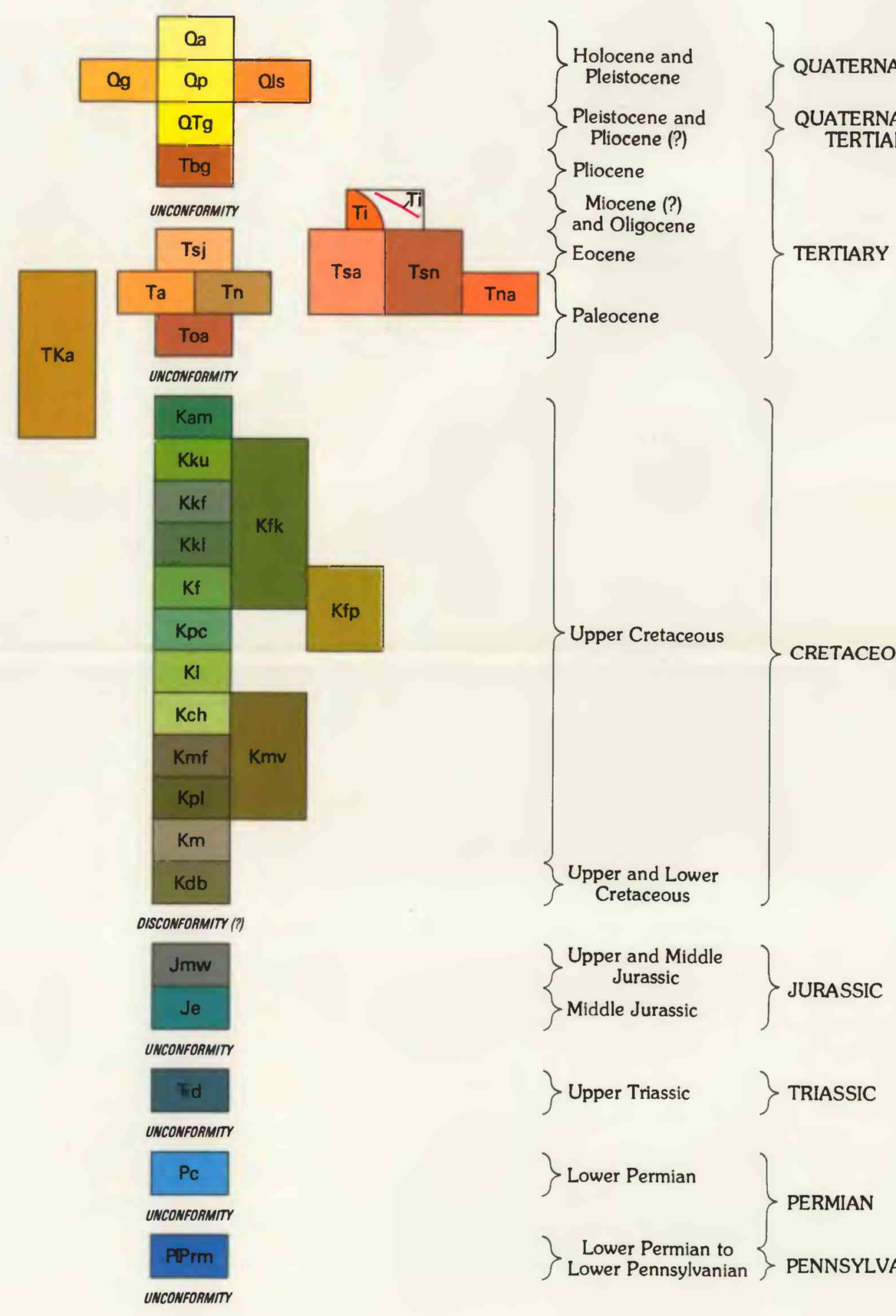
SCALE 1:100 000

CONTOUR INTERVALS 50 AND 20 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929



Geology and structure contours compiled in 1986
Structure contours modified from Haynes and others (1972), O'Sullivan and Beikman (1963), and Steven and others (1974)
This plate was published previously as U.S. Geological Survey Miscellaneous Investigations Map I–1958 (Condon, 1990).

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

[Descriptions modified from Barnes (1953), Barnes and others (1954), Fassett (1985), Fassett and Hinds (1971), Hayes and Zapp (1955), Manley and others (1987), Wood and others (1948), and Zapp (1949).]

Qa **Alluvium (Holocene and Pleistocene)**—Unconsolidated silt, sand, and gravel deposited mainly in stream beds and on floodplains

Qg **Terrace gravel (Holocene and Pleistocene)**—Pebbles, cobbles, and gravel deposited on benches bordering streams. Small deposits found in eastern part of map area, larger deposits found along main streams in central and western areas

Qp **Pediment deposits (Holocene and Pleistocene)**—Thin deposits of gravel that cap gently sloping pediments; only mapped along Hogback monocline in southwest part of map area

Qls **Landslide deposits (Holocene and Pleistocene)**— Unconsolidated deposits of rock debris that obscure underlying bedrock in southeastern part of map area

QTg **High level terrace and pediment gravel (Pleistocene and Pliocene?)**—Gravel deposits located on upland drainage divide on west side of map area. Lithology of gravels indicates that their source may have been La Plata Mountains to northeast

Tbg **Bridgetimber Gravel (Pliocene)**—Boulder and gravel deposits composed of a heterogeneous mixture of igneous, metamorphic, and sedimentary rock fragments. Now thought to be Pliocene in age for the following reasons: (1) The great height of the deposit above the Animas and La Plata rivers. (Bridge Timber Mountain is over 1600 ft (485 m) above the Animas and La Plata rivers.) (2) The unit has reversed magnetism at outcrops in New Mexico. (3) Rock fragments of the Bridgetimber Gravel are extremely weathered compared to clasts in Pleistocene fluvial deposits (Manley and others, 1987). The Bridgetimber may be as young as early Pleistocene. As much as 100 ft (30 m) thick on Bridge Timber Mountain, southwest of Durango (sec. 25, T. 34 N., R. 11 W.)

Ti **Intrusive igneous rocks (Miocene(?) and Oligocene)**—Mainly gray to black, vertical dikes composed of basalt, diabase, and andesite. Archuleta Mesa, in southeast part of map, capped by augite andesite sill 300 ft (91 m) thick (Wood and others, 1948)

Tsj **San Jose Formation (Eocene)**—Brown, gray, and grayish-yellow, lenticular, medium- to thick-bedded, crossbedded, locally arkosic, conglomeratic to fine-grained sandstone. Red, gray, and brown sandy shale; and gray to white tuff beds. Fluvial and lacustrine origin. Conformably overlies Nacimiento and Animas Formations except in area of overstep at Bridge Timber Mountain. (See diagrammatic cross-section of Tertiary units). Approximately 1,100–2,500 ft (335–760 m) thick; top eroded

Tn **Nacimiento Formation (Paleocene)**—Gray, brown, green, and red shale and mudstone, and tan, yellowish-gray, and greenish-gray, friable, fine- to medium-grained, conglomeratic sandstone. Minor lignite beds (Baltz, 1953, p. 44). Fluvial and lacustrine origin. Conformably overlies Animas Formation and Ojo Alamo Sandstone; grades northward into upper part of Animas Formation. About 350–1100 ft (107–335 m) thick

Tsn **San Jose and Nacimiento Formations, undivided**

TKa **Animas Formation (Paleocene and Upper Cretaceous)**

Ta **Upper part (Paleocene)**—Olive, brown, gray, red, green, and purple conglomerate, tuffaceous sandstone, lithic tuff, and shale. Local carbonaceous to coaly mudstone beds. Volcanogenic and fluvial origin. Baltz (1953, p. 33) noted that contact with underlying McDermott Member is erosional in southwest part of map area; Fassett (1985, p. 319) showed an unconformity between the two units; Barnes and others (1954) considered the contact to be gradational. Zapp (1949) mapped an area of intertonguing between the upper part of the Animas and the McDermott Member in a small area east of Durango (Secs. 19, 20, T. 35 N., R. 8 W.). To the south the Animas conformably overlies Ojo Alamo Sandstone and grades laterally into Nacimiento Formation. Thickness 1,300–2,600 ft (400–800 m)

Tna **Nacimiento Formation and upper part of Animas Formation, undivided**

Toa **Ojo Alamo Sandstone (Paleocene)**—Tan, fine- to coarse-grained, conglomeratic sandstone interbedded with minor greenish-gray siltstone and mudstone. Small outcrop in southwest part of map area is northwesternmost outcrop of formation; unit thickens southeastward from wedge edge at outcrop; thins erosionally northward and is not present along outcrop at north edge of map area. Fluvial origin. Unconformably overlies Kirtland Shale and McDermott Member of Animas Formation (Fassett, 1985, p. 319)

Animas Formation

Kam **McDermott Member (Upper Cretaceous)**—Reddish-brown to purple; very coarse breccia, volcanic conglomerate, tuffaceous sandstone, shale, mudstone, and tuff. Most clasts consist of andesite debris (Baltz, 1953, p. 32); grain size decreases southward. Deposited in fluvial system that was greatly influenced by nearby volcanic eruptions. Conformably overlies Kirtland Shale (Fassett, 1985, p. 319); grades laterally eastward into upper part of Animas Formation (Zapp, 1949). Thickness along Animas River 300 ft (100 m); thins southward

Tsa **San Jose and Animas Formations, undivided**

Kirtland Shale (Upper Cretaceous)

Kku **Upper member**—Greenish-gray, purple, and dark-gray mudstone and yellowish-gray to yellowish-orange, fine- to medium-grained sandstone. Thickness 185–455 ft (56–140 m)

Kkf **Farmington Sandstone Member**—Yellowish-gray to yellowish-orange, fine- to medium-grained, locally conglomeratic, lenticular sandstone beds and greenish- gray to yellowish-gray mudstone. Thickness 350 ft (107 m)

Kkl **Lower member**—Olive-gray to greenish-gray mudstone and thin interbeds of light-gray, very fine to fine-grained sandstone. Formation deposited in fluvial channels and overbank areas on well-drained coastal plain. Conformably overlies Fruitland Formation. Thickness 195–325 ft (60–100 m)

Kf **Fruitland Formation (Upper Cretaceous)**—Light-gray, olive, and brown, very fine to medium-grained, lenticular sandstone beds; yellowish-brown, olive, and greenish-gray siltstone and mudstone; and brown, gray, and black carbonaceous shale and coal. Thin limestone coquina beds in lower part. Deposited in brackish-water lagoonal and swampy coastal plain environments in lower part; grades upward into well-drained coastal plain environments. Conformably overlies and intertongues with Pictured Cliffs Sandstone. Coal most abundant in lower one-third of formation in beds as much as 40 ft (12 m) thick. Siltstone and mudstone most abundant in upper part. Total thickness 300–500 ft (91–152 m). Kirtland and Fruitland Formations mapped together from Yellowjacket Creek (Sec. 4, T. 34 N., R. 5 W.) to Montezuma Mesa (Sec. 33, T. 32 N., R. 2 W.); only Fruitland believed to extend southeastward from that locality (Fassett and Hinds, 1971, p. 20). Combined unit of Kirtland and Fruitland Formations 800 ft (245 m) thick near Piedra River; thins southward and eastward

Kfk **Fruitland Formation and Kirtland Shale, undivided**

Kpc **Pictured Cliffs Sandstone (Upper Cretaceous)**

Upper part—Yellowish-orange to gray, fine- to medium-grained sandstone and minor thin shale beds. Thickness 100–130 ft (30–40 m)

Lower part—Interbedded thin beds of grayish-orange, brown, and olive-gray, very fine to fine-grained sandstone and light- to dark-gray shale and siltstone. Sandstone beds of lower part increase upward in number and abundance. Deposited as regressive marine sandstone. Conformably overlies and intertongues with Lewis Shale. Both upper and lower contacts with adjacent formations rise stratigraphically northeastward. Thickness 85–200 ft (26–61 m). Formation thins to about 140 ft (43 m) at Piedra River and is very thin to absent northeast of Pagosa Springs (Wood and others, 1948)

Kfp **Fruitland Formation and Pictured Cliffs Sandstone, undivided**

Kl **Lewis Shale (Upper Cretaceous)**—Dark-gray to greenish-gray shale that contains minor thin beds of fine-grained sandstone, concretionary argillaceous limestone, and bentonite. Marine shale. Conformably overlies, intertongues with, and grades laterally into Cliff House Sandstone. Thickens northeastward from about 500 ft (150 m) in Barker dome area (Sec. 16, T. 32 N., R. 14 W., New Mexico) (Hayes and Zapp, 1955) to 1,800 ft (550 m) in Durango area (Zapp, 1949), and to 2,400 ft (730 m) on eastern side of map area (Barnes, 1953; Wood and others, 1948)

Kmv **Mesaverde Formation (Upper Cretaceous)**—Light-brown to light-gray, fine- to medium-grained sandstone, dark-gray shale, and minor coal beds. Transgressive and regressive marine sandstone. Mesaverde Group (west of Los Pinos River) consists of Point Lookout Sandstone at base, overlain by Menefee Formation and Cliff House Sandstone. Mesaverde Formation believed to be equivalent mainly to Menefee Formation (Barnes, 1953). Thickness 325–365 ft (100–110 m); pinches out northeastward (Wood and others, 1948).

Kch **Cliff House Sandstone (Upper Cretaceous)**—White to yellowish-orange, fine- to medium-grained sandstone interbedded with minor siltstone. Base of unit rises stratigraphically to southwest (Wanek, 1959, p. 696). Transgressive marine sandstone. Disconformably overlies Menefee Formation in most areas; intertongues extensively with Menefee in Barker dome area and northwestward from there at surface. Thickness 350 ft (107 m) thick in Barker dome area; 325 ft (100 m) thick in Durango area; thins eastward

Kmf **Menefee Formation (Upper Cretaceous)**—Informally divided into upper coal-bearing member, middle barren member, and lower coal-bearing member in southwest part of map (Hayes and Zapp, 1955). Divisions not recognizable in all areas. Whole formation thins northward and eastward from 630 ft (192 m) in Barker dome area to about 125 ft (38 m) northeast of Durango

Upper coal member—Carbonaceous shale and lenticular coal beds interbedded with thin sandstone and siltstone beds

Middle barren member—Cliff-forming, light-gray, fine- to medium-grained sandstone interbedded with siltstone and mudstone

Lower coal member—Yellowish-gray siltstone, carbonaceous shale, and coal interbedded with minor amounts of very fine to fine-grained sandstone. Upper and lower parts of formation deposited on poorly drained, swampy coastal plain; middle part deposited on well-drained coastal plain. Conformably overlies and intertongues with Point Lookout Sandstone

Kpl **Point Lookout Sandstone (Upper Cretaceous)**

Upper part—Yellowish-gray, pale-orange, and light-gray, fine- to medium-grained sandstone. Bedding is in even, low-angle laminations that dip northeastward. Thickness 35–100 ft (10–30 m)

Lower part—Interbedded thin beds of yellowish-gray and light-brown, fine-grained sandstone, and olive-gray to gray sandy shale. Sandstone beds of lower part increase up section in thickness and abundance. Formation deposited as regressive marine sandstone. Conformably overlies Mancos Shale. Thickness 0–300 ft (90 m); whole formation thins eastward

Km **Mancos Shale (Upper Cretaceous)**—Olive-gray, brownish-gray, and black, fissile, fossiliferous shale interbedded with thin beds of light gray, fine-grained sandstone and limestone. Marine shale. Conformably overlies Dakota Sandstone. Total thickness 1,900–2,400 ft (580–730 m); includes Greenhorn Limestone Member (not mapped separately) that occurs 140 ft (43 m) above base and is about 25 ft (7.5 m) thick in Durango area (Zapp, 1949)

Kdb **Dakota Sandstone (Upper Cretaceous) and Burro Canyon Formation (Lower Cretaceous), undivided**—White, light- to medium-gray, and yellowish-brown conglomerate, conglomeratic sandstone, and fine- to medium-grained sandstone; grayish-green to grayish-red, generally nonbentonitic, hackly weathering mudstone; dark- to medium-gray carbonaceous mudstone and siltstone; and minor interbedded coal. Upper and middle parts of Dakota coastal swamp, lagoon, and beach deposits; lower part fluvial deposit; Burro Canyon has fluvial origin. Dakota and Burro Canyon separated by an unconformity. Burro Canyon may disconformably overlie Morrison Formation (W. M. Aubrey, oral commun., 1986). Thickness 180–270 ft (55–82 m); average thickness 200 ft (61 m)

Jmw **Morrison Formation (Upper Jurassic) and Wanakah Formation (Middle Jurassic), undivided**

Morrison Formation

Upper part—Light greenish-gray to reddish-brown, bentonitic mudstone and very fine grained sandstone; also various amounts of conglomeratic sandstone, limestone, and the zeolites analcime and clinoptilolite. Fluvial and lacustrine origin. Intertongues with lower part. About 135 ft (41 m) thick

Lower part—White to light-gray, fine- to medium-grained, lenticular, locally silicified sandstone and greenish-gray mudstone. Fluvial origin. Conformably overlies upper part of Wanakah Formation. About 200 ft (61 m) thick (Craig and others, 1955, p. 154)

Wanakah Formation

Upper part—Light-gray, massive, crossbedded to structureless, fine-grained sandstone. Probably correlates with Junction Creek Sandstone to west. Thickness 100–110 ft (30–34 m)

Middle part—Light to dark reddish-brown and reddish-orange, very fine grained, thin-bedded sandstone and dark reddish-brown and greenish-gray mudstone. Sabkha and marginal marine origin. Thickness 70 ft (21 m)

Pony Express Limestone Member—Medium- to dark-gray, very thin bedded to laminated, generally nonfossiliferous limestone, and light-gray to white, massive gypsum. Top of limestone locally brecciated. Restricted marine origin. Conformably overlies Entrada Sandstone. Limestone 5–15 ft (1.5–4.5 m) thick; gypsum as much as 15 ft (4.5 m) thick

Je **Entrada Sandstone (Middle Jurassic)**—Light-gray to white, fine- to medium-grained sandstone. Coarse grained to conglomeratic locally at base. Crossbedding consists of large-scale, sweeping laminations and minor flatbeds. Eolian origin. Unconformably overlies Dolores Formation. Thickness 230–300 ft (70–91 m)

TRd **Dolores Formation (Upper Triassic)**—Dark red to purple shale and siltstone, and gray to light-brown, lenticular sandstone and limestone-pebble conglomerate. Fluvial and lacustrine origin. Unconformably overlies Cutler Formation. Thickness 0–350 ft (107 m); thickens southward

Pc **Cutler Formation (Lower Permian)**—Gray, red and brown sandstone, arkosic sandstone, and arkosic conglomerate and red to purple shale and siltstone. Fluvial, alluvial fan deposits. Conformably overlies Rico Formation. Thickness at outcrop 0–850 ft (260 m); thickens southward

PIPrm **Rico Formation (Permian and Pennsylvanian), Hermosa Formation (Pennsylvanian), and Molas Formation (Pennsylvanian), undivided**

Rico Formation—Light-gray, crinoidal, sandy, clay-rich limestone interbedded with light- to dark-brown, arkosic, crinoidal sandstone and gray, olive, and red shale. Fan-delta deposits. Conformably overlies Hermosa Formation. Thickness 0–185 ft (56 m)

Hermosa Formation—Medium- to dark-gray limestone interbedded with gray, olive, and red shale and mudstone, and with dark- to light-brown sandstone, arkose, and conglomerate. Fan-delta deposits. Conformably overlies Molas Formation. Thickness as much as 900 ft (275 m)

Molas Formation—Dark-red to purple siliceous shale and siltstone, limestone-pebble conglomerate, and lenticular quartzose sandstone; red and brown basal breccia common. Paleosol and fluvial deposits. Unconformably overlies Leadville Limestone. Thickness 0–25 ft (4.5 m)

Contact—Approximately located

Normal fault—Dashed where approximately located; dotted where concealed; bar and ball on downthrown side

6000 **Structure contours**—Drawn on base of Dakota Sandstone and Burro Canyon Formation, undivided; contour interval 500 ft; supplementary contour at −1750 ft; datum is mean sea level

Anticline—Shows axial trace of anticline; with direction of plunge

Syncline—Shows axial trace of syncline; with direction of plunge

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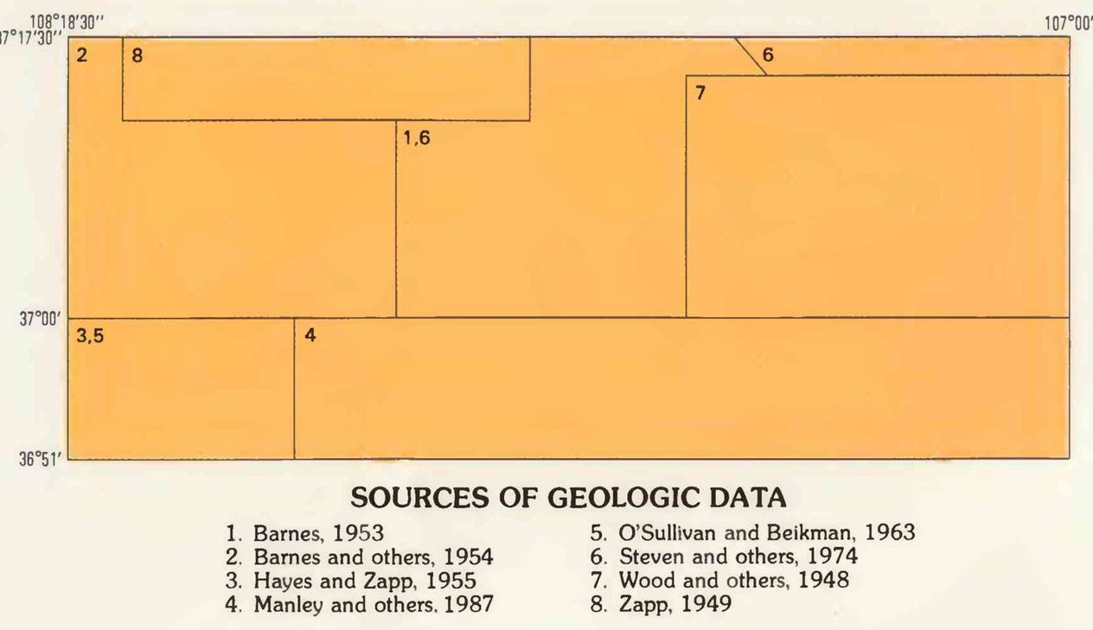
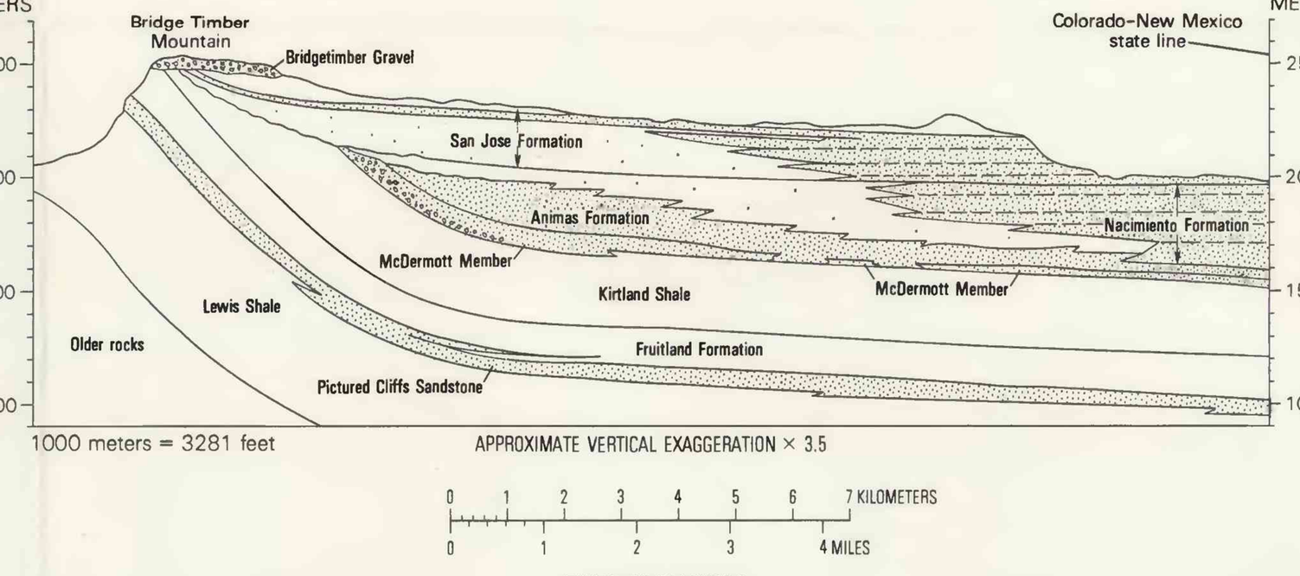


SOURCES OF GEOLOGIC DATA

1. Barnes, 1953
2. Barnes and others, 1954
3. Hayes and Zapp, 1955
4. Manley and others, 1987
5. O'Sullivan and Beikman, 1963
6. Steven and others, 1974
7. Wood and others, 1948
8. Zapp, 1949



DIAGRAMMATIC CROSS-SECTION SHOWING STRATIGRAPHIC RELATIONSHIPS OF TERTIARY UNITS. Bridge Timber Mountain (Sec. 25, T. 34 N., R. 11 W.) southward to the Colorado–New Mexico state line (modified from Baltz and others, 1966).

GEOLOGIC AND STRUCTURE CONTOUR MAP OF THE SOUTHERN UTE INDIAN RESERVATION AND ADJACENT AREAS, SOUTHWESTERN COLORADO AND NORTHWESTERN NEW MEXICO

By
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1992