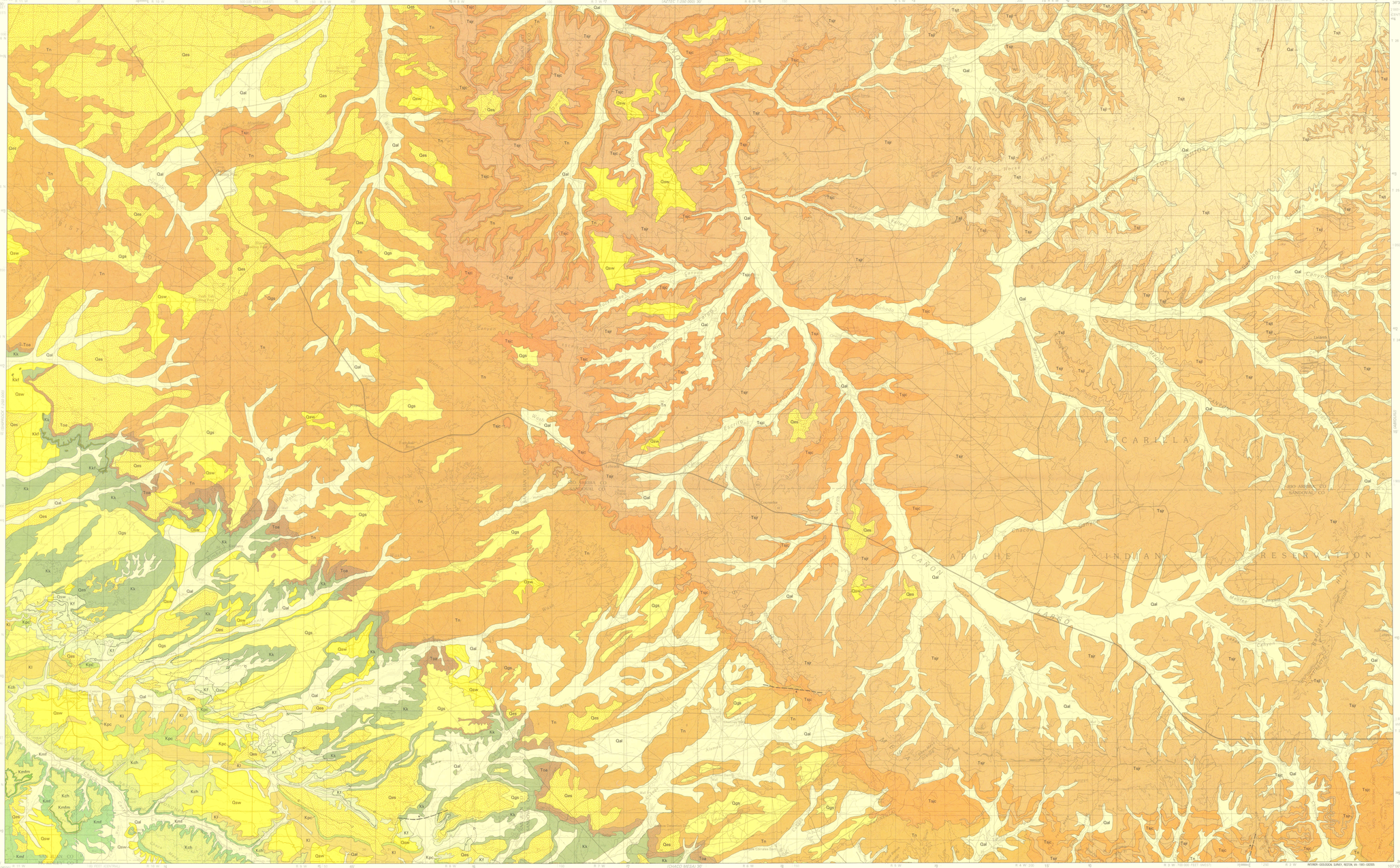
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

COAL INVESTIGATIONS
MAP C-92A



Base from U.S. Geological Survey, 1976

SCALE 1:100 000

1 ½ 0 1 2 3 4 5 MILES

1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 20 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

APPROXIMATE MEAN DECLINATION, 1983

NEW MEXICO
QUADRANGLE LOCATION

Geology compiled in 1978; revised in 1981

SOURCES OF GEOLOGIC DATA

1. Manley and Scott, 1978.
2. Baltz, 1967.
3. Olson, A. B., 1977, unpub. mapping.
4. Stone, W. J., 1979, unpub. mapping.
5. Schneider, Weide, Mytton, and Scott, 1979.
6. Schneider, Weide, and Scott, 1979.
7. Weide, Schneider, Mytton, and Scott, 1979a.
8. Weide, Schneider, Mytton, and Scott, 1979b.
9. Weide, Mytton, and Scott, 1979.
10. Brown, J. L., 1981, unpub. mapping.

GEOLOGIC MAP OF CHACO CANYON 30′ × 60′ QUADRANGLE, SHOWING COAL ZONES OF FRUITLAND FORMATION, SAN JUAN, RIO ARRIBA, AND SANDOVAL COUNTIES, NEW MEXICO

By
James W. Mytton
1983

CORRELATION OF MAP UNITS

Qal	Holocene	QUATERNARY	
Qes			
Qgs	Pleistocene		
Ti	Miocene(?)	TERTIARY	
Tsjt	Eocene		
Tsjl			
Tsjr			
Tsjc			
Unconformity			
Tn	Paleocene		
Toa			
Unconformity			
Kk	Upper Cretaceous	CRETACEOUS	
Kkf			
Kf			
Kpc			
Kl			
Kch			
Kmfm			
Kmf			

DESCRIPTION OF MAP UNITS

Qal ALLUVIUM (HOLOCENE)—Stream-deposited clay, silt, sand, and gravel on valley floors and in lowest terrace deposits. Generally consists of light-gray to white fine- to coarse-grained sand and dark-gray silt derived from sandstone bedrock or reworked deposits of older alluvium. In southwest part of quadrangle contains clasts of sandstone and ironstone from local bedrock and sparse well-rounded red quartzite pebbles and fragments of petrified wood. Includes some tan and sheetwash alluvium consisting of grayish-brown, poorly consolidated, fine to slightly indurated, thinly laminated and cross-stratified sand and silt equivalent to Naha Alluvium of Hack (1941). Thickness as much as 10 m (30 ft)

Qsw SHEETWASH ALLUVIUM (HOLOCENE)—Poorly consolidated clay, silt, and coarse- to medium-grained sand. Includes fine- to coarse-grained colluvium on steep slopes. On Fruitland Formation and Kirtland Shale, sheetwash deposits may include small mudflows. Thickness 1–3 m (3–10 ft)

Qes EOLIAN SAND (HOLOCENE TO UPPER PLEISTOCENE—PINEDALE AGE)—Loose to slightly consolidated sand in sheets or dunes. Younger deposits consist of white, well-sorted, cross-stratified, loose quartz sand in active linear or crescent-shaped dunes along valleys. Older deposits weather light-brown and consist of slightly consolidated fine- to medium-grained sand containing subrounded to rounded frosted grains in stabilized linear dunes and sand sheets on uplands. Thickness as much as 5 m (16 ft)

Qgs GRAVELLY SAND (PLEISTOCENE)—Very pale brown to grayish-orange, stratified, gravelly sand containing chert and quartzite pebbles averaging about 2.5 cm (1 in.) in diameter. Pebbles are more abundant in lower part and decrease in abundance and size upward. Size and composition of clasts varies with location in quadrangle and whether source of deposit is nearby or distant. In southwestern part of quadrangle, quartzitic sandstone and chert clasts are chiefly from Ojo Alamo Sandstone (Toa); ironstone and clinker (rock baked by heat from burning coal) are chiefly from the Fruitland Formation. Deposits occur as sheets overlying pediment-like surfaces cut across nonresistant bedrock and sloping toward Chaco Wash to the southwest and Gallegos Canyon and Blanco Wash to the north. At least seven erosion surfaces and their associated gravelly sand deposits are recognized in the drainage basin of Chaco Wash and each reflects an erosional episode related to changes in the grade of the Chaco River or the San Juan River northwest of the quadrangle. Thickness 3–7 m (10–23 ft)

Ti INTRUSIVE IGNEOUS ROCKS (MIOCENE?)—Lamprophyre dikes and sills of probable Miocene age. The dikes at the surface are 1–3 km (0.62–1.9 mi) long and as much as 10 m (30 ft) wide.

SAN JOSE FORMATION (EOCENE)—Sandstone, shale, and minor conglomerate. Divided into four lithologic units (Baltz, 1967)

Tsjt Tapacitos Member—Maroon and variegated shale and intercalated lenticular, brown to yellowish-buff, coarse-grained, locally conglomeratic, cross-stratified sandstone. Represents flood-plain and stream-channel deposits. Lower part of member interfingers locally with upper part of Llaves Member. Maximum thickness about 150 m (500 ft)

Tsjl Llaves Member—Light-tan, coarse-grained, conglomeratic, cross-stratified sandstone, containing quartz grains and feldspar fragments, and some pebbles and cobbles of metaquartzite. Pebbles and cobbles of granite common at some places. Contains numerous thin beds of maroon, green, and gray clay shale, mudstone, sandy shale, and shaly sandstone. Deposited as an alluvial fan made up of coarse detritus carried by streams from site of present Brazos and Sangre de Cristo uplifts. Lower part tongues out to south into the Regina Member. Thickness about 400 m (1,300 ft)

Tsjr Regina Member—Light-gray, tan, or olive-gray to dull-purple, maroon, and green clay shale, siltstone, mudstone, shaly sandstone and sandy shale with numerous beds of white to buff, gray and brown, fine- to coarse-grained, argillaceous sandstone and sparse, resistant, conglomeratic, arkosic, cliff-forming sandstone. Floodplain and stream-channel deposits derived mostly from the tectonically active Nacimiento uplift. Thickness as much as 490 m (1600 ft)

Tsjc Cuba Mesa Member—Buff and yellow, rusty-weathering, cross-stratified, coarse-grained, conglomeratic sandstone with pebbles and cobbles of quartzite and granite derived from highlands east and northeast of present San Juan Basin. Silicified and carbonized logs common at some places. Lower part contains thin lenses of gray and purplish-gray sandy shale. Intertongues with Regina Member. Thickness nearly 245 m (800 ft) in east, thinning to about 60 m (200 ft) in west

Tn NACIMIENTO FORMATION (PALEOCENE)—Gray to olive-gray clay shale and sandy shale, some sandstone, and a few minor resistant sandstone interbeds in southern part of quadrangle; mostly sandstone in northern part. Intertongues with the Animas Formation north of the quadrangle. Thickness as much as 580 m (1,900 ft)

Toa OJO ALAMO SANDSTONE (PALEOCENE)—Brown, cross-stratified sandstone containing conglomeratic rare base, and buff, tan, and brown, medium-grained to very coarse grained sandstone containing local lenses of olive-green to gray shale. Pebbles varying in size from 2.4 cm (0.5 in.) to several centimeters in diameter scattered through sandstone; pebble-to-cobble conglomeratic in lower part. Fossil logs replaced by silica and limonite common. Intertongues with the Animas Formation north of quadrangle. Thickness 25–65 m (80–200 ft)

Kk KIRTLAND SHALE (UPPER CRETACEOUS)—Shale, siltstone, mudstone, and minor coal beds that usually are no more than 0.3 m (1 ft) thick. Upper part contains variegated mudstone and interbedded lenses of friable sandstone; thins southeast of quadrangle. Lower part consists of gray to greenish-gray, silty and sandy mudstone with a few interbeds of buff siltstone and sandstone; contains carbonaceous beds and sparse coal; mudstone is commonly bentonitic. Thickness as much as 170 m (560 ft). In the adjoining Shiprock 1° x 2° Quadrangle (O'Sullivan and Beikman, 1963) to the west, the formation is divided into an upper shale member, the intermediate Farmington Sandstone Member, and a lower shale member

Kkf Farmington Sandstone Member—Interbedded sandstone, siltstone, and mudstone. Sandstone beds are cliff-forming and distinguish the member from the upper and lower parts of formation. Member pinches out short distance east of western boundary of quadrangle

Kf FRUITLAND FORMATION (UPPER CRETACEOUS)—Highly variable sequence of gray to yellowish-gray interbedded lenticular sandstone, siltstone, and mudstone; and dark-brown to black carbonaceous shale and coal. Mudstone units are commonly 0.1–6 m (0.3–20 ft) thick and contain swelling clay layers. Sandstone lenses are commonly 0.5–8 m (1.5–27 ft) thick, but locally are as much as 14 m (47 ft) thick, and at places contain ironstone concretions as large as 1.2 m (3.5 ft) in diameter. Formation is restricted to principal coal zones and the contact between the Fruitland and Kirtland is arbitrarily placed at the top of uppermost principal coal bed. Individual coal beds are commonly 0.2–6 m (0.5–20 ft) thick. In places, red clinker marks the outcrops of coal beds. Thickness of formation is 20–40 m (65–130 ft) near western boundary of quadrangle and 18 m (60 ft) near southern boundary, but within the quadrangle may be as much as 52 m (170 ft) in thickness

Kpc PICTURED CLIFFS SANDSTONE (UPPER CRETACEOUS)—Upper part consists of yellowish-gray to grayish-orange, massive, cross-stratified, marine sandstone interbedded with a few thin beds of shale. Intertongues with Fruitland Formation and distinct units of Pictured Cliffs lithology within the Fruitland are common. Lower part interbedded brown sandstone and gray marine shale. *Ophiomorpha* major characteristic of formation. Thickness about 18 m (60 ft)

Kl LEWIS SHALE (UPPER CRETACEOUS)—Upper part olive-gray, calcareous, sandy, marine shale with light-brown sandstone interbeds 0.3–1.5 m (1–5 ft) thick; gradational with the overlying Pictured Cliffs Sandstone. Middle part light-gray to dark-olive-gray claystone and siltstone, thin sandstone beds, and scattered beds of concretionary limestone. Lower part sandy and gradational with the underlying Cliff House Sandstone. Concretions in formation contain marine invertebrate fossils equivalent in age to Pierre Shale of eastern Colorado. Thickness 30–35 m (100–115 ft)

Kch CLIFF HOUSE SANDSTONE (UPPER CRETACEOUS)—White to dark-yellowish-orange, thin- to thick-bedded, fine- to medium-grained, lenticular, and cross-stratified to massive marine sandstone, and gray or brown carbonaceous shale lenses. Forms prominent cliffs in area of Chaco Culture National Historical Park. Chaco Canyon is locally divisable into upper and lower massive sandstone units separated by a middle unit consisting of interbedded sandstone and shale. Intertongues with both the Lewis Shale and Menefee Formation. Thickness about 100–112m (300–340 ft)

Kmf MENEFEE FORMATION (UPPER CRETACEOUS)—Yellowish-gray, lenticular, cross-stratified, fine to medium-grained sandstone interbedded with greenish-gray claystone, gray shale and siltstone; contains black carbonaceous shale and thin coal beds; coal is burned in some areas. Only the upper part of formation in quadrangle. Thickness of formation in quadrangle about 165 m (550 ft)

Kmfm Mudstone tongue (UPPER CRETACEOUS)—Gray mudstone and siltstone, black carbonaceous shale, and thin beds of highly-weathered coal interbedded with gray and brown lenticular sandstone. Extends into the Cliff House Sandstone from the southwest. Thickness 0–55 m (0–180 ft)

CONTACT

PROBABLE FAULT—Dashed where approximately located. Bar and ball on downthrown side

COAL ZONE—Dashed where approximately located; dotted where concealed.

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_____1979b, Geologic map of the Sargent Ranch quadrangle, San Juan County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF–1120, scale 1:24,000.

Note: Chaco Canyon National Monument was increased in size and designated Chaco Culture National Historical Park December 19, 1980

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