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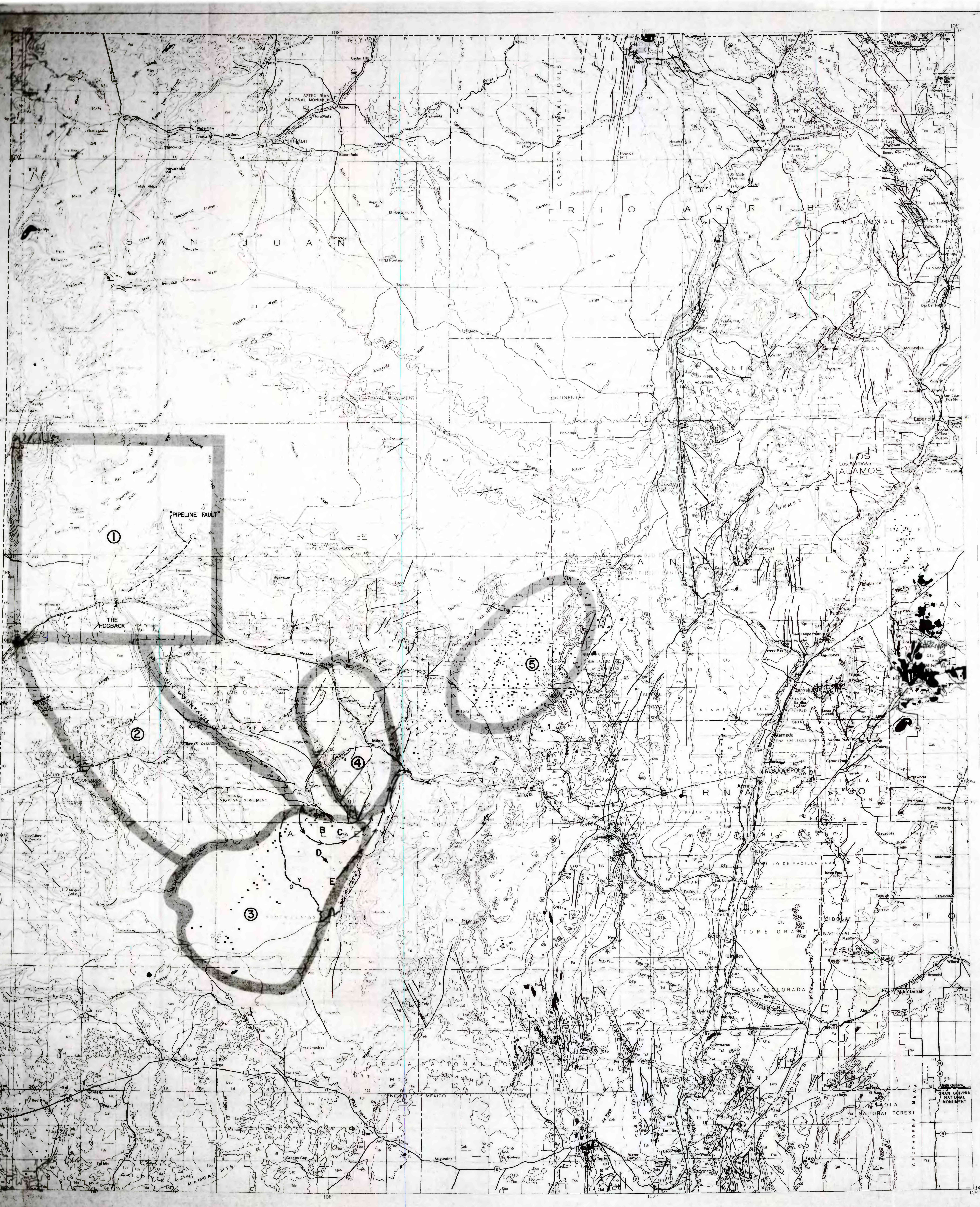
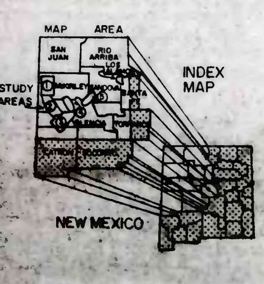


Base from U. S. G. S. map of New Mexico 1:500,000 with some modification in drainage

"PIPELINE" fault - adapted from Chapman, Wood, and Griswood, Inc. (1974, sheet 1)



Area Evaluated

① — Gallup - Tohatchi - Church Rock
② — Zuni Southwest
③ — North Plains — Malpais
④ — Grants — Bluewater
⑤ — Mesa Chivato - Cebolleta Mountains

Key to features in the North Plains - Malpais area

older lava flows Y/O younger lava flows; ⟶ position and direction of named basalt flows

The position of the boundary of the older and younger lava flows is based largely on surface relationships and the relative appearance of the weathered and eroded surface.

A Cerro Bandera and Bandera basalt flow; B Cerritos de Jaspe; C Little-hole-in-the-wall; D Cerro Encierro; E McCartys Crater and McCartys basalt flow. Geologic features adapted from unpublished "Geologic map of the north-eastern part of the Zuni lava field, Valencia County, New Mexico" compiled by A. W. Laughlin from maps by Causey (1970), Goddard (1966), Hatheway and Herring (1970), Thaden, Merrin, and Raup (1967), and Thaden, Santos, and Raup (1967).

(See selected references in text for references referred to above and in other parts of title space)

GEOLOGIC MAP OF THE NORTHWESTERN PART OF NEW MEXICO adapted from Dane and Bachman (1957)
VOLCANIC CENTERS IN NORTH PLAINS - MALPAIS AREA adapted from Kelly and Clinton (1960)

0 5 10 15 20 MILES
0 8 16 24 32 KILOMETRES

Figure 3.-- Geologic map of northwestern New Mexico showing location of areas where potential for development of ground-water resources was evaluated

EXPLANATION

Qal — Alluvium, mainly in floodplains. *In Rio Grande Valley may include some beds that are part of Santa Fe group*

Qb — Bolson, pediment, windblown sand, and high-level terrace deposits

Landslides

Spring deposits

Qm — Morainal deposits

Pleistocene and Recent

SAN JUAN BASIN AND ZUNI MOUNTAINS

Pediment gravel

Chuska sandstone. *Gray to pink crossbedded, tuffaceous sandstone.*

Alluvial and lacustrine deposits. *Reddish sand and clay, soft white sandstone, gray shale, tuffaceous sandstone, and white tuff.*

Miocene, Miocene ?, and Pliocene, Pliocene ?

San Jose formation of Simpson (1948) (Eocene). *Probably also includes beds equivalent to those containing the so-called Tiffany (Eocene) Paleocene. Red, tan, and variegated shale, siltstone, sandstone, and conglomerate.*

Eocene — Oligocene ?

Nacimiento formation. *Also includes the Animas formation north of the San Juan River in San Juan County. Gray, brown, and variegated shale, siltstone, and lenticular sandstone.*

Paleocene

Ojo Alamo sandstone. *White, gray, and brown resistant fine- to coarse-grained conglomeratic sandstone; grades into lower part of Animas formation north of San Juan River.*

McDermott formation. *Brown to purple shale with minor amounts of sandstone.*

Kirtland shale and Fruitland formation. *Includes an unseparated equivalent of McDermott formation in San Juan County. The Kirtland shale contains gray to brown shale with greenish and yellow sandy shale and sandstone, includes the Farmington sandstone member in northwestern San Juan County. The Fruitland formation underlies the Kirtland shale and consists of gray, brown, and black shale with coal and brown to white sandstone.*

Pictured Cliffs sandstone. *White, gray, and yellowish-gray sandstone.*

Lewis shale. *Light- to dark-gray shale with some thin sandstone and limestone and numerous calcareous concretions. Intertongues with underlying Mesaverde group.*

Cliff House sandstone. *Tan and gray, crossbedded, fine- to medium-grained sandstone with interbedded gray shale. Includes La Ventana tongue (Kcl) on eastern side of San Juan Basin.*

Menefee formation. *Gray, brown, and drab claystone and shale; coal; tan and brown sandstone and some layers of ironstone and limestone concretions. In the southern part of the Chuska Mountains includes equivalents of rocks probably as young as Kirtland shale. The Tohachi formation is mapped with the Menefee formation in the southern part of the Chuska Mountains.*

Point Lookout sandstone. *Tan and brown sandstone with lesser amounts of gray shale. In the southern part of the San Juan Basin the Hosta tongue (Kh) is separated from the main body of the Point Lookout sandstone by the Satan tongue (Kms) of the Mancos shale.*

Mesaverde group

Crevasse Canyon formation. *Drab, gray, and dark-gray shale, coal, and tan irregularly bedded and lenticular sandstone. The Crevasse Canyon formation overlies the Gallup sandstone and underlies the Point Lookout sandstone. South of the termination of the Point Lookout sandstone the top of the Crevasse Canyon formation is arbitrarily shown at the top of the undivided coal-bearing unit formed by the Gibson coal member in the upper part of the Crevasse Canyon formation and Cleary coal member in the lower part of the Menefee formation.*

Gallup sandstone. *Tan, brown, and gray thin- to massive-bedded sandstone with lesser amounts of carbonaceous shale, gray shale, and coal. The Gallup sandstone in most places underlies the Crevasse Canyon formation, but in the northeastern part of the San Juan Basin it separates the upper (Km) and lower (Km) parts of the Mancos shale.*

Mancos shale. *Light-gray to dark-gray shale with lesser amounts of tan fine-grained sandstone and siltstone and bedded concretionary limestone. South of the San Juan River, the Mancos shale is divided by the Gallup sandstone of the Mesaverde group. Farther south, the Satan (Kms) and Mulatto tongues of the Mancos extend into younger rocks of the Mesaverde group. In the southern part of the extent of the Mancos shale only its lower part is present.*

Upper Cretaceous

Dakota sandstone. *Brown to tan or gray sandstone, conglomeratic sandstone, and conglomerate that in places contains one or more gray, carbonaceous or partly shale beds.*

Lower ? Cretaceous

Morrison formation, Zuni sandstone, and San Rafael group. *Jm, Morrison formation; Jsr, San Rafael group, undivided; Jz, Zuni sandstone (in McKinley and Valencia Counties) includes equivalents of Morrison formation and upper part of San Rafael group. Todilto limestone and above (Jsr), lower part of San Rafael group mapped where Zuni sandstone is present.*
The Morrison formation is gray, green, tan, and variegated clay and shale interbedded with gray, tan, or pink sandstone and conglomerate. Except in western San Juan, northwestern McKinley, and northern Valencia Counties the limestone and gypsum of the Todilto is included with the Morrison formation.
The Zuni sandstone consists of gray, tan, brown, or pink, thin-bedded to massive sandstone.
The San Rafael group includes the Bluff sandstone, Summerville formation, Todilto limestone, Entrada sandstone, and Carmel formation and equivalent beds in western San Juan, northwestern McKinley, and northern Valencia Counties. The Bluff sandstone is white to gray-brown, massive or thick-bedded, crossbedded sandstone. The Summerville formation is thin-bedded chocolate-colored sandstone, red-brown sandstone, and shale. The Todilto is gray, thin- to medium-bedded limestone and white gypsum. The Entrada sandstone is brick-red to white massive sandstone. The Carmel formation is buff and red sandstone and red and green shale. In southern McKinley County the San Rafael group includes the Thoreau formation of Smith (1954).

Middle and Upper Jurassic

Glen Canyon group, undivided. *Light brick-red shale, siltstone, and sandstone.*

Upper Triassic

NORTHERN SAN JUAN BASIN

TKa — Animas formation. *Gray to greenish and tan shale, lenticular sandstone, and conglomerate that contains much andesitic debris.*

Kmv — Mesaverde group, undivided

Kdm — Dakota sandstone and lower part of Mancos shale, undivided

UPPER RIO GRANDE VALLEY, NACIMIENTO MOUNTAINS AND SAN JUAN MOUNTAINS

Upper part of Santa Fe group, in part including Puyé gravel of Smith (1938), Ancha formation, Tuerto gravel of Stearns (1953), and Tesuque formation of Los Alamos and Santa Fe areas. *Unconsolidated and consolidated brown, red, and gray clay, silt, sand, and gravel. Includes some intraformational basalt flows.*

Santa Fe group, undivided. *As mapped includes the Espinaso volcanics of Stearns (1943) which may be of latest Eocene age.*

Lower part of Santa Fe group. *Includes the Abiquiu formation and upper part of the Carson conglomerate of Just (1937) east of the Rio Grande.*

Carson conglomerate of Just (1937), Los Pinos gravel of Atwood and Mather (1932), and equivalent beds.

"El Rito formation of Smith (1938)". *Red to gray conglomerate with some fine-grained sedimentary rocks.*

Tbb — Blanco Basin formation

Galisteo formation. *Red and tan or variegated shale, siltstone, sandstone, and conglomerate.*

Potosi volcanic series

BERNALILLO AND SOCORRO COUNTIES

Santa Fe group

Popotosa formation of Denny (1940) in Socorro County only, and part of Datil formation along Rio Grande Valley

Purple andesite and latite tuff and breccias

SOCORRO AND CATRON COUNTIES

Tbo — Basalt and basaltic andesite. *Includes some interbedded clastic flows and tuff.*

Td, Tdr, Tds, Tdl — Datil formation

Baca formation (Eocene)

Basalt flows. *Includes small amounts of other rock types, such as trachyte, latite, andesite, and tuff. May include some dikes and other intrusive rocks. May include some flows of Pliocene age.*

Intrusive rocks of varied composition and form

Qb — Basalt flows. *Locally includes trachyte, latite, andesite, and tuff and also some dikes and other intrusive rocks. May include some flows of Pliocene age.*

Note: Location of volcanic vents in Pliocene and Quaternary lava flows indicated by *

VALLES-JEMEZ MOUNTAINS

Rhyolite flows

Bandelier rhyolite tuff of Smith (1938)

Basalt and some andesite

Tb — Basalt flows. *Includes some rhyolitic flows. May include some flows of Pleistocene age.*

Tov — Older volcanic rocks of Valles Mountains. *Basalt, andesite, dacite, quartz latite, and rhyolite. The Valles rocks with several Bandelier flows shown as Tov includes undifferentiated Tertiary and Quaternary volcanics and Tertiary and pre-Tertiary volcanic rocks.*

Quaternary

Tertiary

EXPLANATION (Continued)

ZUNI MOUNTAINS AND WEST SIDE OF SAN JUAN BASIN

San Andres limestone

Pg — Glorieta sandstone and De Chelly sandstone. *Latter in San Juan County only.*

Pa — Abo formation. *Brick-red, maroon, gray, and greenish-gray siltstone, sand-stone, and conglomerate.*

Madera and Sandia formations, undivided

NACIMIENTO MOUNTAINS

Psg — San Andres formation and Glorieta sandstone

Yeso formation

Pc — Cutler formation. *Brick-red, maroon, gray, and greenish-gray shale, siltstone, and sandstone. North of 36° N the Cutler formation replaces the lower part of the Yeso formation and the Abo formation by intertonguing.*

Abo formation. *Brick-red, maroon, gray, and greenish-gray shale, siltstone, sandstone, and conglomerate.*

Madera and Sandia formations, undivided. *Includes in places a basal limestone unit, in part the Arroyo Penasco formation of Mississippian age.*

SANDIA MOUNTAINS, MANZANO MOUNTAINS AND LUCERO UPLIFT

San Andres formation. *Chiefly gray, thin-bedded limestone with some shale partings, but includes an upper limestone and a lower evaporite shale, limestone, and gypsum member in parts of the Rio Grande Valley. Includes overlying Bernal formation east of Rio Grande.*

Glorieta sandstone. *Gray to brown massive sandstone.*

Yeso formation. *Orange-red sandstone, shale, and gray to white limestone, gypsum, and sandstone. Includes the Meseta Blanca sandstone and Los Vallos member west of the Rio Grande and the Meseta Blanca sandstone, Torres, Cañas gypsum, and Joyita sandstone members east of the Rio Grande.*

Abo formation

P̶m — Madera limestone. *Gray limestone and shale, and brown to reddish-brown sandstone, shale, and siltstone. Includes the Red Tanks, Atrasado, and Gray Mesa members. Also includes the Bursum formation of early Permian age in eastern Socorro County.*

Sandia formation. *Gray to brown shale, siltstone, sandstone, and conglomerate. Includes in places a basal limestone, probably of Mississippian age.*

Permian rocks undivided

Carboniferous rocks undivided

Mississippian rocks undivided. *Kelly limestone and Caloso formation of Kelley and Silver (1952) present only south of 35° N. Kelly limestone is bluish gray, thick-bedded, medium to coarsely crystalline. Caloso formation of Kelley and Silver is cherty gray limestone.*

p€ — Precambrian rocks undivided. *Granite, schist, quartzite, and other rocks.*

K — Cretaceous rocks, undivided

J — Jurassic rocks, undivided

ŦR — Chinle formation and Triassic rocks, undivided. *Brick-red, maroon, gray, and greenish-gray shale, siltstone, and sandstone with occasional limestone-pebble conglomerate. Includes the Poleo sandstone lentil, Salitral shale tongue, and Agua Zarca sandstone members of the Chinle formation in the Nacimiento Mountains and the Correo sandstone member and the Shinarump conglomerate as used by Kelley and Wood (1946) in Valencia County. Locally may include representatives of Glen Canyon group and includes small areas of Moenkopi formation (Early and Middle? Triassic age in western McKinley County).*

PERMIAN — PENNSYLVANIAN — MISSISSIPPIAN — CARBONIFEROUS — PRECAMBRIAN — CRETACEOUS — JURASSIC — TRIASSIC

Contact

Approximate location of lateral gradation between map units

Fault

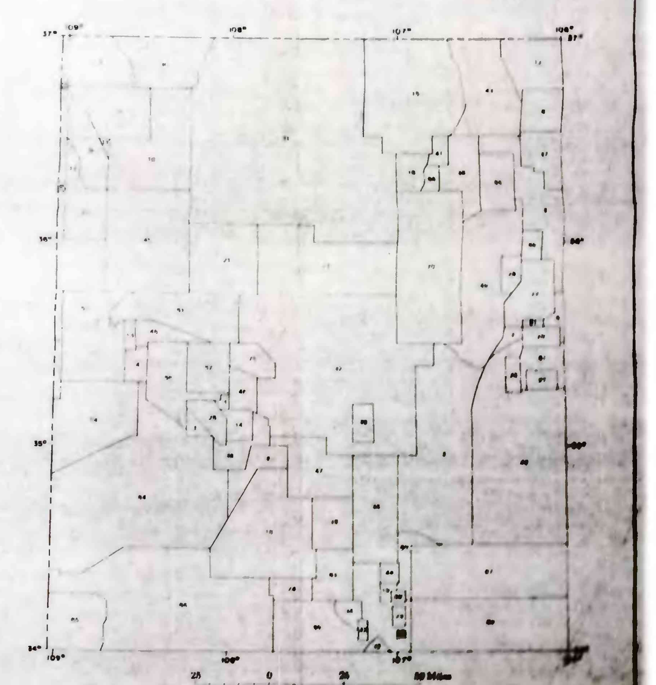
REFERENCES CITED IN EXPLANATION

Atwood, W. W., and Mather, K. F., 1932, Physiography and Quaternary geology of the San Juan Mountains, Colorado: U. S. Geol. Survey Prof. Paper 166.
Denny, C. S., 1940, Tertiary geology of the San Acacia area, New Mexico: Jour. Geology, v. 48, no. 1.
Just, Evan, 1937, Geology and economic features of the pegmatites of Taos and Rio Arriba Counties, N. Mex.: N. Mex. Bur. of Mines and Min. Res. Bull. 13.
Kelley, V. C., and Silver, C., 1952, The geology of the Caballo Mountains: Univ. of New Mexico, Publications in Geology, no. 4.
Kelley, V. C., and Wood, G. H., Jr., 1946, Lucero uplift, Valencia, Socorro, and Bernalillo Counties, N. Mex.: U. S. Geol. Survey Oil and Gas Inv. Prelim. Map 47.
Simpson, G. G., 1948, The Eocene of the San Juan Basin, New Mexico: Am. Jour. Sci., v. 246, no. 5.
Smith, Clay T., 1954, Geology of the Thoreau quadrangle, Valencia and McKinley Counties, N. Mex.: N. Mex. Bur. of Mines and Min. Res. Bull. 31.
Smith, H. T. U., 1938, Tertiary geology of the Abiquiu quadrangle, New Mexico: Jour. Geology, v. 46, no. 7.
Stearns, C. E., 1943, The Galisteo formation of north-central New Mexico: Jour. Geology, v. 51, no. 5.
Stearns, C. E., 1953, Tertiary geology of the Galisteo-Tonque area, N. Mex.: Geol. Soc. America Bull., v. 64, no. 4.

SOURCES OF DATA

Numbers correspond to those given on key map
(*) Indicates unpublished maps

1. Akers, J. P., and Stevens, P. R., U. S. G. S. open-file maps.
2. Allen, J. E., and Balk, Robert, N. Mex. Bur. of Mines and Min. Res. Bull. 36.
3. Bachman, G. O., U. S. G. S. reconnaissance mapping and photogeology (*).
4. Bachman, G. O., and Roberts, T. G., U. S. G. S. reconnaissance mapping (*).
5. Baldwin, Brewster, N. Mex. Bur. of Mines and Min. Res., *in* Spiegel, Zane, and Baldwin, Brewster, U. S. G. S. Water Supply Paper in preparation (*).
6. Barker, Fred, N. Mex. Bur. of Mines and Min. Res., supplemented by reconnaissance mapping by C. B. Read, U. S. G. S. (*).
7. Beaumont, E. C., U. S. G. S. Coal Inv. Map C 29.
8. Beaumont, E. C., and O'Sullivan, R. B., U. S. G. S. reconnaissance mapping (*).
9. Beaumont, E. C., U. S. G. S. Oil and Gas Inv. Map OM 147.
10. Beaumont, E. C., and O'Sullivan, R. B., U. S. G. S. Coal Inv. Map C 32.
11. Beaumont, E. C., U. S. G. S. reconnaissance mapping (*).
12. Butler, A. P., Jr., (U. S. G. S.) geologic mapping for doctorate dissertation, Harvard University (*).
13. Callahan, J. T., and Cushman, R. L., U. S. G. S. (*).
14. Champion, W. L., U. S. G. S. (*).
15. Dane, C. H., U. S. G. S. Oil and Gas Inv. Prelim. Map 78.
16. Dane, C. H., U. S. G. S. (*).
17. Dane, C. H., U. S. G. S. Bull. 860-C, pt. 3.
18. Dane, C. H., and Wanek, A. A., U. S. G. S. reconnaissance mapping and photogeology (*).
19. Denny, C. S., Jour. Geology, v. 48, no. 1.
20. Disbrow, A. E., thesis, Univ. of N. Mex. (*).
21. Dobbin, C. E., U. S. G. S. (*).
22. Emmanuel, R. J., thesis, Univ. of N. Mex. (*).
23. Foster, R. W., N. Mex. Bur. of Mines and Min. Res. (*).
24. Givens, D. B., N. Mex. Bur. of Mines and Min. Res. (*).
25. Goddard, E. N., U. S. G. S. (*).
26. Griggs, R. L., U. S. G. S. (*).
27. Griswold, C. T. (*).
28. Harrison, E. P., thesis, Univ. of N. Mex. (*).
29. Harshbarger, J. W., and Repenning, C. A., U. S. G. S. Circ. 308.
30. Hayes, P. T., and Zapp, A. D., U. S. G. S. Oil and Gas Inv. Map OM 144.
31. Hayes, P. T., U. S. G. S. reconnaissance mapping (*).
32. Hunt, C. B., U. S. G. S. Bull. 860-B, pt. 2 (location of volcanic centers on Mesa Chivato from V. C. Kelley, Univ. of N. Mex.).
33. Jicha, H. L., Jr., N. Mex. Bur. of Mines and Min. Res. (*).
34. Johnson, J. T., thesis, N. Mex. Inst. Mines and Technology (*).
35. Katish, P., thesis, N. Mex. Inst. Mines and Technology (*).
36. Kelley, V. C., Univ. of N. Mex. (*).
37. Kelley, V. C., U. S. G. S. Oil and Gas Inv. Map OM 157, supplemented by unpublished reconnaissance mapping by C. B. Read, U. S. G. S.
38. Kelley, V. C., and Wood, G. H., Jr., U. S. G. S. Oil and Gas Inv. Prelim. Map 47.
39. Koogle, R. L., U. S. G. S. photogeology (*).
40. Lasky, S. G., N. Mex. Bur. of Mines and Min. Res. Bull. 8.
41. Lookingbill, J. K., thesis, Univ. of N. Mex. (*).
42. Loughlin, G. F., and Koschmann, A. H., U. S. G. S. Prof. Paper 200.
43. Muehlberger, W. R., Doney, H. H., and Adams, G. E., Univ. of Texas, unpublished mapping for N. Mex. Bur. of Mines and Min. Res. (*).
44. Noble, E. A., thesis, Univ. of N. Mex. (*).
45. O'Sullivan, R. B., U. S. G. S. Coal Inv. Map C 31.
46. Rapaport, Irving, Hadfield, J. P., and Olsen, R. H., Atomic Energy Commission RMO 642.
47. Rapaport, Irving, Hadfield, J. P., and Olsen, R. H., Atomic Energy Commission (*).
48. Read, C. B., Wilpolt, R. H., Andrews, D. A., Summerson, C. H., and Wood, G. H., Jr., U. S. G. S. Oil and Gas Inv. Prelim. Map 21, supplemented in Ts. 3 to 6 N., Rs. 4 and 5 E. by Stark, J. T., Basham, W. L., and Dorman, H. J., N. Mex. Bur. of Mines and Min. Res. Bull. 34, and in Ts. 12 and 13 N., Rs. 4 and 5 E. by Rich, Ernest, thesis, Univ. of N. Mex. (*).
49. Ross, C. S., and Smith, R. L., U. S. G. S. (*).
50. Schilling, John, N. Mex. Bur. of Mines and Min. Res. reconnaissance mapping (*).
51. Sears, J. D., U. S. G. S. Bull. 860-A, pt. 1.
52. Sears, J. D., and Beaumont, E. C., U. S. G. S. (*).
53. Sears, J. D., U. S. G. S. Bull. 767. In T. 13 N., R. 18 and 19 W. the base of the Ty only is from Franklin T. McCann, Am. Jour. Sci., 5th Ser., v. 36, no. 214.
54. Sears, J. D., idem, but modified by reconnaissance mapping by A. A. Wanek, U. S. G. S.
55. Sears, R. S., thesis, Univ. of N. Mex. (*).
56. Silver, Caswell (*).
57. Smith, Clay T., N. Mex. Bur. of Mines and Min. Res. Bull. 31.
58. Smith, Clay T., N. Mex. Inst. Mines and Technology (*).
59. Smith, H. T. U., Jour. Geology, v. 46, no. 7.
60. Spiegel, Z. E., U. S. G. S. (*).
61. Stearns, C. E., Geol. Soc. America Bull., v. 64, no. 4.
62. Strobell, J. D., Jr., U. S. G. S. Oil and Gas Inv. Map OM 160.
63. Tonking, W. H., N. Mex. Bur. of Mines and Min. Res. Bull. 41.
64. Wanek, A. A., U. S. G. S. reconnaissance mapping (*).
65. Weber, Robert E., N. Mex. Bur. Mines and Min. Res., reconnaissance mapping (*).
66. Willard, M. E., N. Mex. Bur. of Mines and Min. Res., reconnaissance mapping (*).
67. Wilpolt, R. H., MacAlpin, A. J., Bates, R. L., and Vorbe, Georges, U. S. G. S. Oil and Gas Inv. Prelim. Map 61.
68. Wilpolt, R. H., and Wanek, A. A., U. S. G. S. Oil and Gas Inv. Map OM 121.
69. Wilson, G. W., and Stevens, R. G., field problem mapping, Univ. of N. Mex. (*).
70. Wood, G. H., Jr., and Northrop, S. A., U. S. G. S. Oil and Gas Inv. Prelim. Map 57. In Ts. 21 and 22 N., Rs. 1 and 2 E., the base of the Tab only is in part from Church, F. S., and Hack, J. T., Jour. Geology, v. 47, no. 6.
71. Young, R. G., U. S. Atomic Energy Commission Map No. 7.
72. Ziegler, D. L., U. S. G. S. Coal Inv. Map C 30.



INDEX MAP OF NORTHWESTERN PART OF NEW MEXICO
Showing sources of geologic data
(Numbers refer to list of Sources of data)

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