

ash-flowtuffs (upper Oligocene, 24-30 Ma) - Regional ash-flowtuffs include the La Jencia, Vicks Peak, Lemitar, South Canyon, Bloodgood Canyon, Shelly Peak, Davis Canyon, Park, Rhyolite Canyon, Apache Spring, and Amalia Tuffs; the tuffs of Horseshoe Canyon, Diamond Creek, Garcia Camp, Caronita Canyon, Turkey Springs, and Little Mineral Creek; and the Jordan Canyon Formation.Includessomelocallyeruptedlavasandtuffswithinthickintracaldera

Kilbourne Hole and Zuni Salt Lake

south margin of caldera

QUATERNARY and TERTIARY

carbonate south of Sierra Ladrones

in northeast, high-level pediment gravels

Albuquerque Basin

units in southwestern basins

Includes minor vent deposits

northwestern Socorro County

Abiguiu, Zia, and other formations

Fe and Gila Groups

Jemez Mountains are Pliocene

Plateau volcanic field are Pliocene

in Tusas Mountains-San Luis Basin area

vent deposits

Basaltic to andesitic lava flows (middle to lower Pleistocene)—Includes

Older rhyolite lavas and early volcaniclastic sedimentary fill deposits

of the Valles caldera (lower Pleistocene)—Units are associated with

resurgent doming or predate doming of the caldera core. Includes minor

middle Pleistocene tuffs of the upper Valles Rhyolite on north side of

BandelierTuff(lowerPleistocene)—Includes large blocks of older and esite

in caldera-collapse breccia facies locally exposed on resurgent dome of

Travertine (Holocene to Pliocene)—Includes some pedogenic

Older piedmont alluvial deposits and shallow basin fill (middle

Includes Camp Rice, Fort Hancock, Palomas, Sierra Ladrones, Arroyo

Santa Fe Group, undivided (middle Pleistocene to uppermost

Oligocene)—Basin fill of the Rio Grande rift. Locally represents upper

Miocene formations of the middle Santa Fe Group in the northern

g Gila Group, Formation, or Conglomerate (middle Pleistocene to uppermostOligocene?)—IncludesMimbresFormationandseveralinformal

Basaltic to andesitic lava flows (upper Pleistocene to lower Pliocene)—

Upper Tertiary sedimentary units (Pliocene to upper Oligocene)—

Includes Bidahochi Formation (Pliocene to upper Miocene), Picuris

Formation, (Miocene to Oligocene), Las Feveras Formation (Pliocene),

lower Gila Group units in the southwest, and unnamed Pliocene unit in

Ogallala Formation (lower Pliocene to middle Miocene)—Alluvial and

eolian deposits, and petrocalcic soils of the southem High Plains. Locally

sandstone, coarse fluvial volcaniclastic sediments, minor eolian facies,

and pedogenic carbonates of the southern Colorado Plateau region

LowerSantaFeGroup (upperMiocene to uppermost Oligocene)—Includes

Hayner Ranch, Rincon Valley, Popotosa, Cochiti, Tesuque, Chamita,

Los Pinos Formation of lower Santa Fe Group (Miocene and upper

Oligocene)—Includes Carson Conglomerate (Dane and Bachman, 1965)

Chuska Sandstone (middle to upper Oligocene)—Restricted to Chuska

Basaltic to andesitic lava flows (Pliocene)—Includes minor vent deposits

and small shield volcanoes. Flows are commonly interbedded in the Santa

Basaltic to andesitic lava flows (Miocene)—Includes minor vent deposits.

Basaltic to andesitic lava flows (Neogene)-Includes minor vent deposits.

Flows are commonly interbedded in the Santa Fe and Gila Groups

Flows are commonly interbedded in the Santa Fe and Gila Groups

Silicic to intermediate volcanic rocks (Neogene, mostly Miocene)

Rhyoliteanddaciteflowswithassociatedminortuffs.Commonlyinterbedded

Intermediate to silicic volcanic rocks (Neogene)—Mostly andesitic to

dacitic stratovolcanoes. Includes rhyolite lavas and tuffs in the Jemez

Mountains, Volcanoes in Jemez Mountains and eastern Colfax County

are upper Miocene. Mount Taylor and composite volcanoes in the Taos

with Santa Fe or Gila Group sedimentary units. Dacitic lavas in northern

Fence Lake Formation (Miocene)—Conglomerate and conglomeratic

Pleistocene to uppermost Pliocene)—Includes Quemado Formation and

Upper Santa Fe Group (middle Pleistocene to uppermost Miocene)—

Ojito, Ancha, Puye, and Alamosa Formations

Ring-fracture rhyolite lava domes of the Valles caldera (uppermost to

lower Pleistocene)—Upper members of the Valles Rhyolite in Jemez

Mountains. Includes 60-ka Banco Bonito and El Cajete Members on

.nits;indudesminorvolcanidasticsedimentaryunitsbetweenthinoutflowsheets Lower middle Tertiary rhyolitic to dacitic pyroclastic rocks of the Datil Group, ash-flow tuffs (lower Oligocene to upper Eocene, 31–36 Ma)— Regional ash-flow tuffs include Hells Mesa, Kneeling Nun, Caballo Blanco, Datil Well, Lebya Well, Rock House Canyon, Blue Canyon, Sugarlump, Oak Creek, Bluff Creek, Gillespie, Box Canyon, Cooney, and Chiquito Peak Tuffs; he tuffs of Steins Mountain, Black Bill Canyon, Woodhaul Canyon, and Farr Ranch: tuffs of the Organ cauldron: and lower tuffs in the Bell Top Formation Includes some locally erupted lavas and tuffs within thick intracaldera units; indudesminorvolcanidasticsedimentaryunitsandlavasbetweenthinoutflow

Lower middle Tertiary andesitic to dacitic layas and pyroclastic flow breccias (upperto middle Eocene, 33-43 Ma)-Indudes Rubio Peak Formation, rejon Andesite, andesite of Dry Leggett Canyon, andesite of Telephone Canyon, and other units in southwestern, central, and northern New Mexico. Localvindudesminormaficlavas. Ancientlandslideblocks of Madera Limestone as much as one mile long, occur within Rubio Peak lavas in the central Black Range, west of Winston

Upper middle Tertiary volcanic rocks (lower Miocene to upper Oligocene, younger than 30 Ma)—Mostly a combination of basaltic andesite lavas and rhyolitic ash-flow tuffs of the Mogollon Group (Tuau +Tual+Turp). Includes locally erupted lavas and tuffs in some calderas | Lowermiddle Tertiary volcanic rocks (lower Oligocene to upper Eocene, older than 31 Ma)—Mostly intermediate lavas of the lower Datil Group and intermediate volcanidastic sediments of the lower Spears Group (Tla + Tvs). Locally includes ash-flow tuffs of the upper Datil Group (Tlrp) Includes intermediate volcaniclastic sedimentary rocks of the Conejos

Middle Tertiary volcanic rocks, undifferentiated (lower Miocene to upperEocene)—Includesthepredominantlyandesitictodaciticstratovolcano complex at Sierra Blanca (Oligocene to upper Eocene) and many smaller Tertiary intrusive rocks of intermediate to silicic composition (Pliocene to Eccene)-Indudesmonzonitictograniticplutons, stocks, laccoliths, and porphyritic dikes in deeply eroded magmatic centers; and andesitic, dacitic, or rhyolitic

Formation in northern New Mexico

plugsand dikes near cauldrons or stratovolcanoes. In the Latir field, fine-grained rhyoliticolikescommonly out coarse-grained granitic plutons. Includes alkaline laccoliths, plugs, and dikes in Colfax County. North-trending dikes near Capitan include some mafic diabase dikes Tertiary mafic intrusive rocks (Pliocene to upper Eocene)—Includes many ■ long basaltic andesite dikes of Oligocene age near Pie Town, Acoma. Rilev. Chupadera, Truth or Consequences, Roswell, Raton, and Dulce; and several elongate or shoestring-like sills of basalt or basaltic andesite. Also includes basaltic necks of Pliocene age that dot the landscape northeast of Mount Taylor. Where dikes extend into Quatemary alluvium the contact is an

Paleogene sedimentary units—Includes Baca, Galisteo, El Rito, Blanco Basin, Hart Mine, Love Ranch, Lobo, Sanders Canyon, Skunk Ranch, Timberlake, and Cub Mountain Formations Tsj San Jose Formation (Eocene) — San Juan Basin

Tn Nacimiento Formation (Paleocene) — San Juan Basin Toa Ojo Alamo Formation (Paleocene)—San Juan Basin TERTIARY and CRETACEOUS Poison Canyon Formation (Paleocene and Upper Cretaceous)—Proximal

Raton Formation (Paleocene and Upper Cretaceous)—Distal sandstones, Mudstones, and coal beds in eastern Raton Basin. Middle barren zone laterally equivalent to Poison Canyon Formation. K/Thoundary discontinuously exposed about 100 m above basal conglomerate in area southwest of Raton Poison Canyon and Raton Formations (Paleocene and Upper Cretaceous)— Broadlyintertonguing conglomeratics and stones, sand stones and mudstones;

conglomerates and sandstones in western Raton Basin; generally lacking coal

beds. Cretaceous beds mostly restricted to subsurface

Animas Formation (Paleocene and Upper Cretaceous)—Volcaniclastic sedimentary rocks of intermediate composition in northem San Juan Basin Tertiary-Cretaceous andesitic to dacitic lavas and pyroclastic breccias (Paleocene and Upper Cretaceous)—Includes many remnants of eruptive centers in Grant and Hidalgo Counties and Upper Cretaceous andesitic lavas in Sierra County Tertiary-Cretaceous intrusive rocks (Paleocene and Upper Cretaceous)—

Kpg Pescado Tongue of the Mancos Shale and Gallup Sandstone uronian)—In Zuni Basin only: Pescado is chronostratiaraphic equivalen of Juana Lopez Member of Mancos Shale

Tres Hermanos Formation (Turonian) – Formerly designated as lower Gallup Sandstone in the Zuni Basin Kma Moreno Hill Formation and Atarque Sandstone (Turonian)—In Salt Lake coal field and extreme southern Zuni Basin Km Mancos Shale (Cenomanian to Campanian)—Divided into upper and lower parts by Gallup Sandstone

> Kml Mancos Shale, lower part (Turonian and Cenomanian) Dakota Sandstone (Cenomanian) and Rio Salado Tongue of the Mancos Shale—In northwest Socorro County locally includes overlying Kgc Greenhorn Formation and Carlile Shale, undivided (Turonian to Cenomanian)—Locally includes Graneros Shale

**Kgg** Greenhorn Formation and Graneros Shale (Turonian and Cenomanian)—Limited to northeastern area **Greenhorn Formation** (Turonian to Cenomanian)—Limited to northeastern area; the upper member (Bridge Creek Limestone Member) can be traced into western area where it is commonly shown as a bed-rank unit in Mancos Shale on detailed maps

Satan Tongue of Mancos Shale

of Socorro County

Kms Satan Tongue of Mancos Shale (Santonian)

Hosta Tongue of Point Lookout Sandstone (Santonian) – Transgressive

Crevasse Canyon Formation (Santonian to Coniacian)—Coal-bearing

units are Dilco and Gibson Coal Members; other members are Bartlett

Rio Salado Tongue of the Mancos Shale (Turonian)—Overlies Twowells

ongue of Dakota Sandstone; mapped only where Tres Hermanos

Formation or the Atarque Sandstone is present; mapped as Kdr in parts

To compare this map nomenclature to the USGS nomenclature, see the

Upper and Middle Jurassic rocks, undivided. In southwest includes

San Rafael Group (Middle Jurassic)—Consists of Entrada Sandstone,

Todilto and Summerville Formations, Bluff Sandstone, and locally Zuni

diagram included on this sheet (at right)

Cretaceous?-upper Jurassic)

Jze Zuni and Entrada Sandstones, undivided

Sandstone (or only Acoma Tongue of Zuni)

Je Entrada Sandstone (Middle Jurassic)

Jm Morrison Formation—Upper Jurassic nonmarine rocks

Barren, Dalton Sandstone, and Borrego Pass Sandstone (or Lentil)

Kg Gallup Sandstone (Turonian) – Generally regressive marine sandstone

Gallup Sandstone and underlying D-Cross Tongue of the Mancos Shale (Turonian)

Kmm Mulatto Tongue of Mancos Shale (Santonian to Coniacian)

Intertongued Mancos Shale and Dakota Sandstone of west-central New Mexico (Cenomanian)—Includes the Whitewater Arroyo Tongue Point Lookout Sandstone (Campanian to Santonian)—Regressive marine of Mancos Shale and the Twowells Tongue of the Dakota sandstone in McKinley and Sandoval Counties; the lower, Hosta Tongue, Dakota Sandstone (Cenomanian)—Includes Oak Canyon, Cubero, and Paquate Tonques: includes Clark A. T. of Point Lookout is transgressive and is separated from main body by the Paguate Tongues; includes Clay Mesa Tongue of Mancos Shale Upper and Lower Cretaceous rocks of east-central and northeast New Mexico – Consists of Dakota Group, which includes Romeroville

> Sandstone (Cenomanian), Pajarito Shale, and Mesa Rica Sandstone (Albian); the underlying Tucumcari Shale (Albian) in Tucumcari area; and Glencairn Formation (Albian) in Union County Mancos Shale (Cenomanian) and Beartooth and Sarten Formations (Albian) – Mancos includes what was formerly referred to as Colorado Shale, which in turn may include equivalents of Tres Hermanos Formation Lower Cretaceous, undivided—In northern Lea and Roosevelt Counties includes equivalents of Transpari St. Let 10 includes equivalents of Tucumcari Shale; in Cornudas Mountains includes Campaarande and Cox Formations and Washita Group; at Cerro de

> > Cristo Rey includes several formations of the Fredericksburg and Washita

Groups, and the Boquillas Formation (Cenomanian); in the southwest,

includes Mojado, U-Bar (Aptian), and Hell-to-Finish Formations, which are

equivalent to Bisbee Group of Arizona

Chinle Formation of previous workers (e.g., Stewart et al., 1972) is used here as Chinle Group, following Lucas (1993 Triassic rocks, undivided—Continental red beds Rock Point Formation of Chinle Group (Upper Triassic)—May locally include Wingate Sandstone (Triassic)

Morrison Formation and upper San Rafael Group (lowermost Chinle Group (Upper Triassic)—Map unit includes Moenkopi Formation (Middle Triassic) at base in many areas; in eastern part of state the following five formations are mapped **Zuni Sandstone** (Callovian) – Consists of undivided equivalents of the Redonda Formation (Upper Triassic) mmerville Formation and Bluff Sandstone; restricted to Zuni Basin area

Rb Bull Canyon Formation (Norian) Trujillo Formation (Norian) Tig Garita Creek Formation (Carnian)

Santa Rosa Formation (Carnian)—Includes Moenkopi Formation (Middle Triassic) at base in most areas Upper Chinle Group, Garita Creek through Redonda Formations, undivided Rm Moenkopi Formation (Middle Triassic)

MESOPROTEROZOIC PALEOPROTEROZOIC

PALEOZOIC Pz Paleozoic rocks, undivided P Permian rocks, undivided

**Pam** Quartermaster Formation (Upper Permian)—Red sandstone and siltstone Pqr Quartermaster and Rustler Formations (Upper Permian)

Pr Rustler Formation (Upper Permian)—Siltstone, gypsum, sandstone, and dolomite Salado Formation (Upper Permian) – Evaporite sequence, dominantly Pc Castile Formation (Upper Permian) – Dominantly anhydrite sequence Pat Artesia Group (Guadalupian)—Shelf facies forming broad south-southeast

Seven Rivers, Queen and Grayburg Formations (Guadalupian). May locally include Moenkopi Formation (Triassic) at top Pty Tansill and Yates Formations (Guadalupian) – Sandstone, siltstone, limestone, dolomite, and anhydrite Seven Rivers Formation (Guadalupian) – Gypsum, anhydrite, salt, dolomite, and siltstone

trending outcrop from Glorieta to Artesia area; includes Tansill, Yates,

**Pqg** Queen and Grayburg Formations (Guadalupian)—Sandstone, gypsum, anhydrite, dolomite, and red mudstone Pcp Capitan Formation (Guadalupian)—Limestone (reef facies) **Pbc Bell Canyon Formation** (Guadalupian) – Basin facies – sandstone, limestone, and shale Pcc Cherry Canyon Formation (Guadalupian)—Basin facies—sandstone, limestone, and shale

> San Andres Formation (Guadalupian in south, in part Leonardian to north)—Limestone and dolomite with minor shale Psg San Andres Limestone and Glorieta Sandstone (Guadalupian and Leonardian)

Pco Cutoff Shale (Leonardian)—In Brokeoff Mountains only Victorio Peak Limestone (Leonardian)—In Brokeoff Mountains only Yeso Formation (Leonardian)—Sandstones, siltstones, anhydrite, gypsum, halite, and dolomite Abo Formation (Wolfcampian) – Red beds, arkosic at base, finer and ore mature above; may include limestone beds of Pennsylvanian age

(Virgilian) in Zuni Mountains; in Robledo Mountains the Abo may be considered a member of the Hueco Formation Pau Upper part of Abo Formation (Wolfcampian) Pal Lower part of Abo Formation (locally Virgilian to Upper Pennsylvanian) Psy San Andres, Glorieta, and Yeso Formations, undivided

Pya Yeso and Abo Formations, undivided (Lower Permian) Pct Cutler Formation (Wolfcampian to Upper Pennsylvanian) – Used in northern areas and Chama embayment only Ph Hueco Formation or Group (Wolfcampian) – Limestone unit restricted 🔲 to south-central area. Pendejo Tonque of Hueco Formation divides Abo Formation into upper and lower parts in Sacramento Mountains Bursum Formation (lowermost Permian to uppermost Pennsylvanian) – Shale, arkose and limestone

Shale, arkose, and limestone PPP Permian and Pennsylvanian rocks, undivided – Includes Concha, Scherrer, Colina, Epitaph, and Earp Formations (Permian) and Horquilla Limestone (Permian to Pennsylvanian) PIPsc Sangre de Cristo Formation (Wolfcampian to Desmoinesian)—In Sangre de Cristo Mountains

Pennsylvanian rocks, undivided – In Sangre de Cristo Mountains may include Sandia, Madera, La Pasada, Alamitos, and Flechado Formations; elsewhere may include Bar-B, Nakaye, Red House, Oswaldo, and Syrena Madera Group (Pennsylvanian)—In Manzano Mountains includes Wild

v Formation and Los Moyos Limestone; in Lucero Mesa includes Red Tanks, Atrasado, Gray Mesa Formations; in Sacramento Mountains includes the non-Madera Holder, Beeman, and Gobbler Formations. May include strata lumped as Magdalena Group in a few areas Sandia Formation (Atokan)—Predominantly clastic unit (commonly arkosic) with minor black shales, and limestone in lower part; map unit locally includes Morrowan Osha Canyon Formation in Sierra Nacimiento Panther Seep Formation (Virgilian)—In Organ, Franklin, and San Andres Mountains

Lead Camp Formation (Atokan to Missourian) – In San Andres and Organ Mountains Mississippian rocks, undivided – Arroyo Peñasco Group in Sangre de Mountains, Sierra Nacimiento, San Pedro Mountains, and Sandia Mountains: Lake Valley Limestone in south-central New Mexico Mississippian and Devonian rocks, undivided—Includes Helms, Rancheria, Cruces, Lake Valley, and Caballero Formations and Escabrosa Group (Mississippian); Percha Shale, Contadero, Sly Gap, and Oñate Formations of south-central New Mexico, and Canutillo Formation of northern Franklin

Mountains and Bishops Cap area (Devonian) Mississippian through Cambrian rocks, undivided—Includes Lake Valley stone (Mississippian); Devonian rocks, undivided; El Paso Formation and Montoya Group or Formation (Ordovician); and Bliss Sandstone (Ordovician and Cambrian)

Devonian rocks undivided—Includes Percha Shale, Oñate, and Sly Gap SO Silurian and Ordovician rocks, undivided SO€ Silurian through Cambrian rocks, undivided O-C Ordovician and Cambrian rocks, undivided – Includes Montoya rmation (or Group), El Paso Formation, and Bliss Sandstone

O€p Ordovician and Cambrian plutonic rocks of Florida Mountains

Supracrustal NEOPROTEROZOIC

Zi Neoproterozoic mafic dikes—Exposed in Taos Range Yi Mesoproterozoic mafic dikes, diabase, metadiabase, metadiorite-

—— Mainly in Burro Mountains; age not well constrained Mesoproterozoic sedimentary rocks—Exposed in Sacramento Mountains, present in subsurface in southeastern New Mexico as De Baca Group Mesoproterozoic granitic plutonic rocks—Mainly 1.45–1.35 Ga gacrystic granites, generally weakly foliated except locally at their

YXp Mesoproterozoic and Paleoproterozoic plutonic rocks, undivided Paleoproterozoic granitic plutonic rocks—Variably foliated granites and ınitic gneisses; 1.71 –1.65 Ga in northern New Mexico; 1.66–1.65 Ga in central and southern New Mexico Paleoproterozoic pelitic schist—Includes Rinconada Formation in northern
New Mexico and Blue Sector Colored to the Colored to New Mexico and Blue Springs Schist in Manzano Mountains

Paleoproterozoic quartzite—Includes ~1.70 Ga Ortega Quartzite and equivalents in northern Nove Maria quivalents in northern New Mexico and ~1.67 Ga quartzites in central Raleoproterozoic metasedimentary rocks—Pelitic schist, quartz-muscovite chist, immature quartzite, and subordinate amphibolite; includes parts of Vadito Group in northern New Mexico, immature metasedimentary rocks

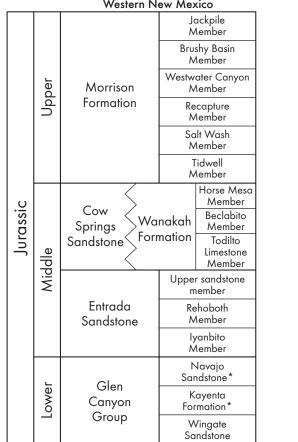
in Burro Mountains Paleoproterozoic rhyolite and felsic volcanic schist-Includes 1.70 Ga Vadito Group in northern New Mexico and ~1.68 Ga Sevilleta Metarhyolite in central New Mexico Paleoproterozoic calc-alkaline plutonic rocks—Granodiorite, diorite, and gabbro complexes; 1.78-1.71 Ga; interpreted to be intrusive part

of central New Mexico, and Bullard Peak Series mixed supracrustal rocks

of juvenile volcanic arc basement Paleoproterozoic mafic metavolcanic rocks with subordinate felsic metavolcanic rocks—Includes the 1.78-1.72 Ga Moppin (Tusas Mountains) complexes; interpreted to be supracrustal part of juvenile volcanic arc basement



~~~~~~ Proterozoic ductile shear zone Playa



Western New Mexico Eastern New Mexico Rock Point Member Formation Owl Rock Member Central New Mexico Correo Sandsto member Member Formation Dockum Petrified Forest Group Sonsela Sandstor Member Sandstone Tecovas Formation Salitral Shale Monitor Butte Member Tongue Santa Rosa Shinarump Member Sandstone Anton Chico Moenkopi Formation Formation

Formal stratigraphic terminology of Triassic and Jurassic rocks in New Mexico, as used in the

National Geologic Map Database\* of the U.S. Geological Survey. This terminology differs

significantly from the Triassic and Jurassic stratigraphy represented on this map.

http://ngmdb.usgs.gov/geolex\_gs.html

EXPLANATION FOR

## Geologic Map of New Mexico

1:500,000

New Mexico Bureau of Geology and Mineral Resources Celebrating 75 Years of Service

A DIVISION OF NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY Peter A. Scholle, State Geologist

2003



PUBLISHED IN COOPERATION WITH THE U.S. GEOLOGICAL SURVEY



This map represents the first substantial revision of the geologic map of New Mexico at this scale since the appearance of the State Geologic Map of New Mexico by Carle H. Dane and George O. Bachman, published in two sheets by the U.S. Geological Survey (in cooperation with the New Mexico Bureau of Mines and Mineral Resources) in 1965. The present compilation was started in 1985 by G. Robert Osburn, under the directorship of Frank Kottlowski. The bulk of the compilation was accomplished between 1987 and 1998 by Orin J. Anderson and Glen E. Jones. Since 1998 the map has been reviewed and revised by many other workers (listed below). The present map reflects substantial revisions to the Anderson and Jones compilation. Earlier versions of that compilation appeared in 1994 as Open-file Report # 408 of the New Mexico Bureau of Mines and Mineral Resources, and in 1997 as Open-file Report 97-52 of the U.S. Geological Survey. Work on this project has spanned the administrations of three directors at the New Mexico Bureau of Geology and Mineral Resources: Frank Kottlowski, Charles Chapin, and Peter Scholle. This map was created in Macromedia Freehand from ArcInfo files created by Greg Green, U.S. Geological Survey.

> Unless otherwise noted, all persons listed are present or former members of the staff of the New Mexico Bureau of Geology and Mineral Resources

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## Principal Sources of Data Numbered 1; $\times$ 2; quadrangles shown on index map. \*References for Thaden, R. E., and Zech, R. S., map listed separately below.

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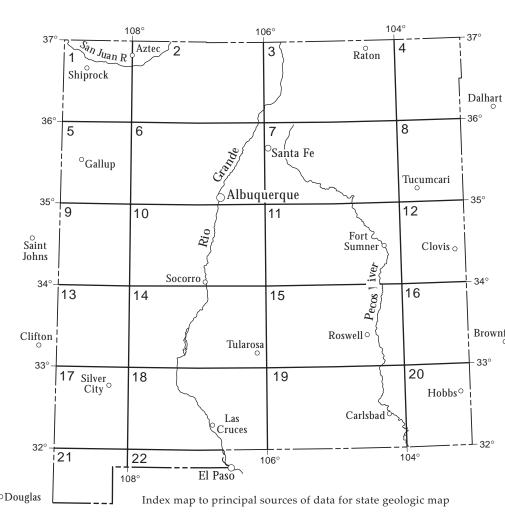
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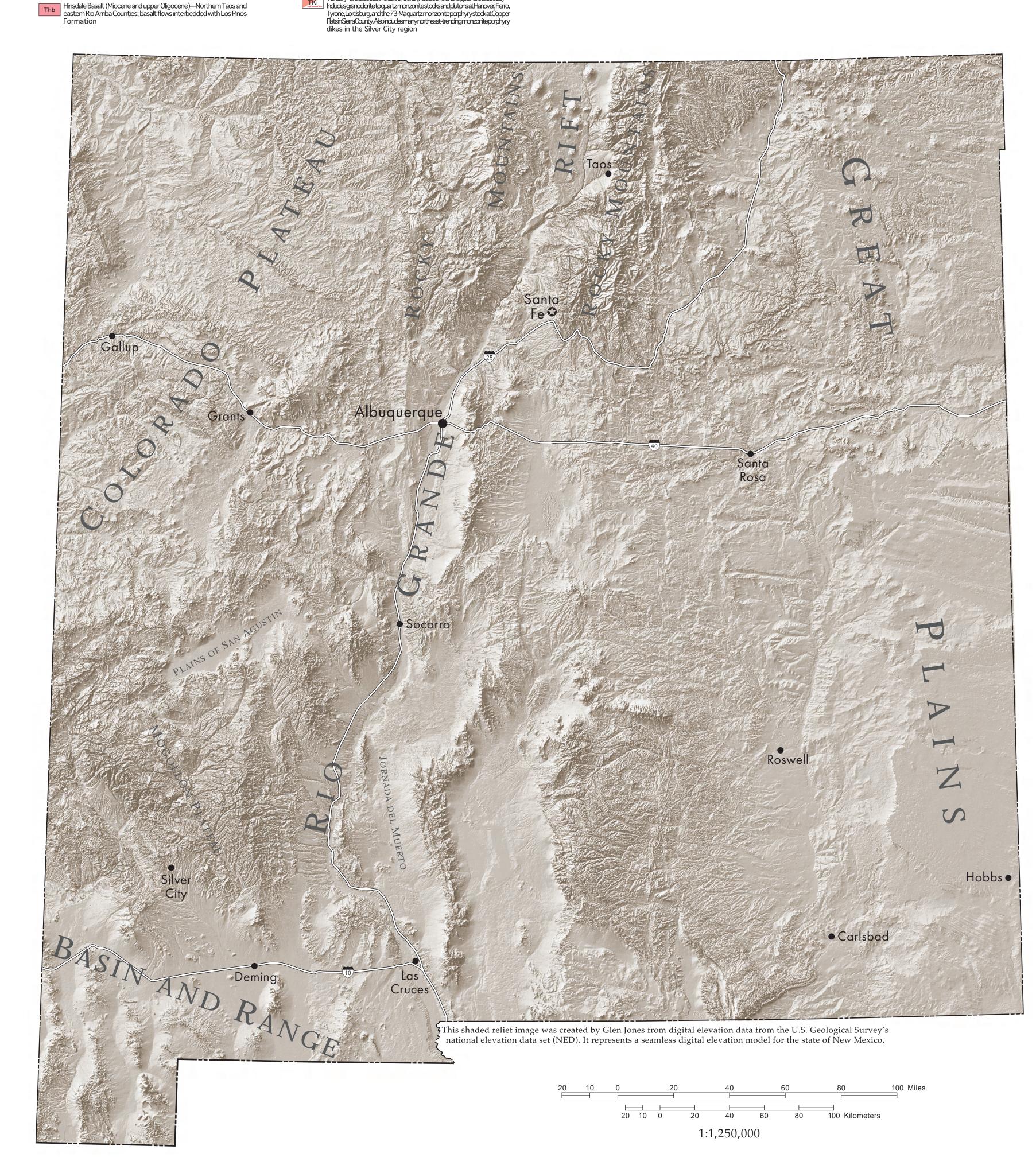
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## Cenozoic Tectonic Features of New Mexico

The shortening, stretching, translation, uplift, subsidence, fusion, crystallization, eruption, and erosion of New Mexico's crust, in response to global plate motions, have produced a complex collage of enchanting landforms during the

last 1.8 billion years. The modern landscape formed mostly in Cenozoic time, in the last 65 million years. The riverine axis of New Mexico is dominated by tilted fault block ranges and extensional basins of the Rio Grande rift. Closely spaced faulting and domino-style block tilting along the rift axis represent brittle stretching of the upper crust in response to plastic flow of hotter rocks in the middle and lower crust. The rift is a northward narrowing arm of the strongly extended Basin and Range province. It separates the Colorado Plateau microplate from the Great Plains province and the rest of cratonic North America. Westward flow of the underlying mantle, initially associated with roll back (retreat) of the subducted Farallon plate and later differential motion between the Pacific and North American plates, has caused the relatively rigid Colorado Plateau to slowly drift away from the Great Plains in the last 30 million years. Westward stretching, focused along the hotter rift zone, has accommodated this differential separation of microplates at an average rate of roughly 0.5-1.0 millimeters per year. Compared to California, New Mexico is now in a plate tectonic "backwater." Broad zones of moderate-to-slight crustal extension generally parallel the evolving (warming) margins of the Colorado Plateau and Great Plains. These transition zones are marked by shallow depressions and a few north-trending upper Cenozoic normal faults that occur south of Grants and along the east shoulder of the rift from Eagle Nest to Estancia and to the Brokeoff Mountains west of Carlsbad. Synclinal blocks of the Mogollon Plateau and Jornada del Muerto, which occur within the rifted terrane, appear to represent moderately wide rafted blocks similar to the Colorado Plateau microplate. Fusion and dehydration of the batholithic crust under the Mogollon Plateau may have given it additional strength. The Colorado Plateau initially drifted away from the Mogollon Plateau to form the Plains of San Agustin, an incipient transverse arm of the Rio Grande rift. Quaternary fault patterns suggest that the Mogollon Plateau is now largely coupled to the Colorado Plateau. In late Mesozoic to early Cenozoic time, crustal welts of the southern Rocky Mountains were squeezed and jostled upward along the east margin of the Colorado Plateau as it was pushed northeastward against the less resistant margin of the craton. This Laramide zone of crustal shortening has apparently guided later development of the Rio Grande rift and peripheral zones of extension. For example, in northern New Mexico younger rift basins have partially inverted

-Richard M. Chamberlin

(collapsed) the core area of the older Laramide Rocky Mountains.