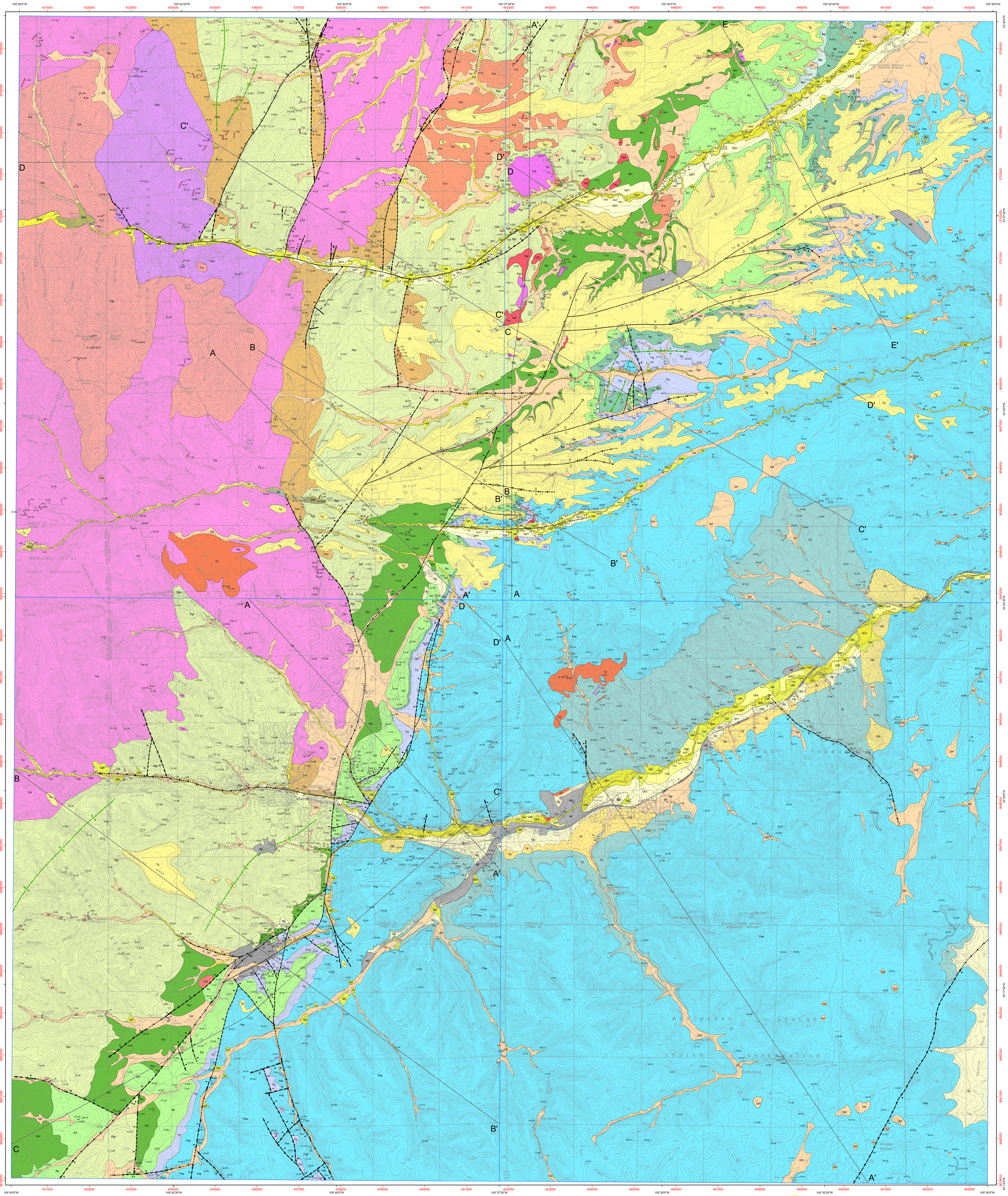


Explanation of map symbols

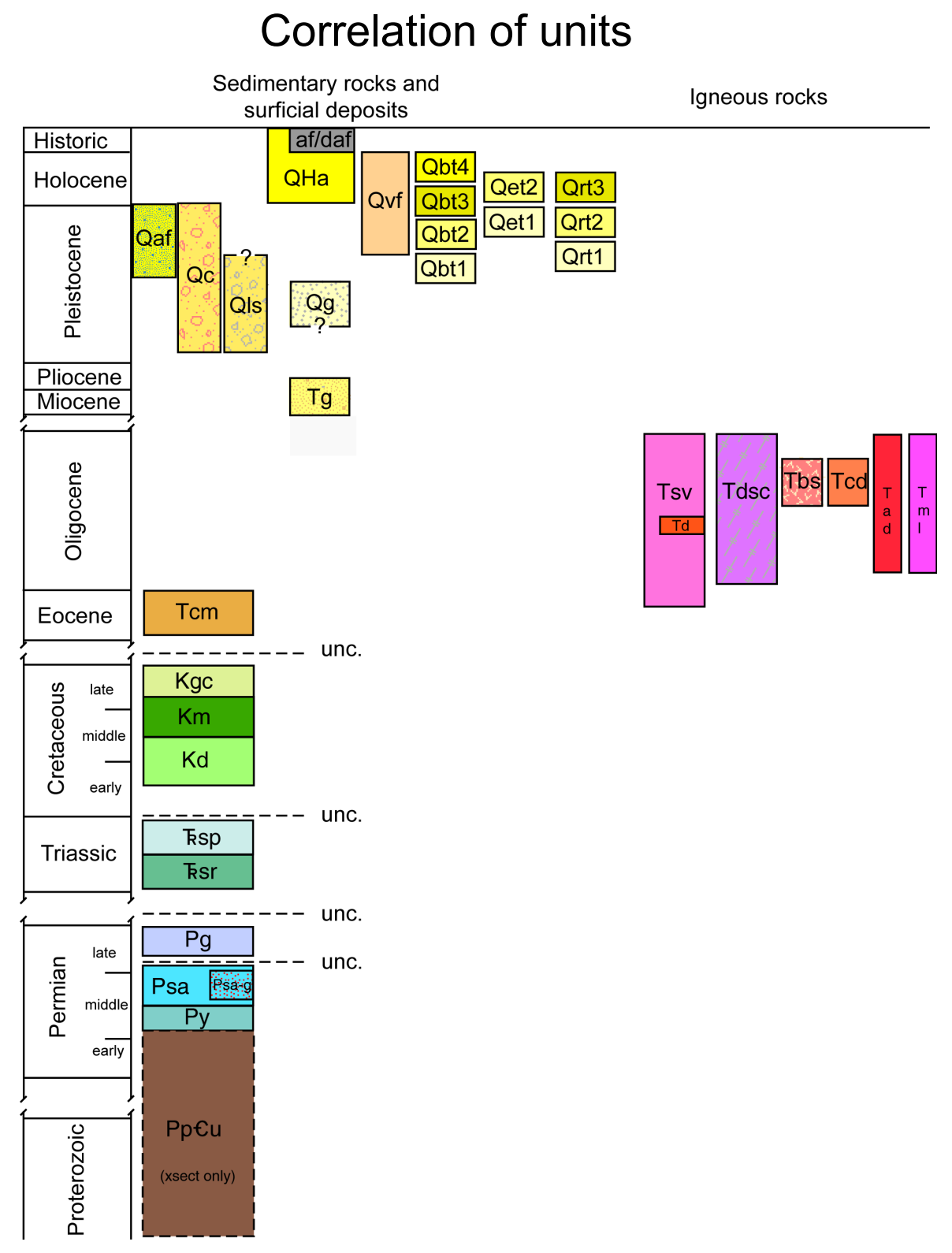
- 135 vertical bedding, showing strike
- 10-045 inclined bedding, showing dip and dip direction
- 135 vertical joint, showing strike
- 80-045 inclined joint, showing dip and dip direction
- 72-303 252-62 small fault, showing dip and dip direction, with slickenline, showing trend and plunge
- 60-045 plane of mapped fault, showing dip and dip direction
- 045 paleocurrent measured from clast imbrication, showing trend
- 20-045 eutaxitic foliation in tuff, showing dip and dip direction
- horizontal bedding
- certain contact: exposed
- certain contact: intermittantly exposed and/or obscured
- probable contact: exposed
- probable contact: intermittantly exposed and/or obscured
- landslide headscarp: intermittantly exposed and/or obscured
- probable landslide headscarp: intermittantly exposed and/or obscured
- certain fault, solid where exposed, dashed where intermittantly exposed and/or obscured, dotted where concealed
- probable fault, dashed where intermittantly exposed and/or obscured, dotted where concealed
- uncertain fault, dashed where intermittantly exposed and/or obscured, dotted where concealed

fault decorations indicating sense of movement

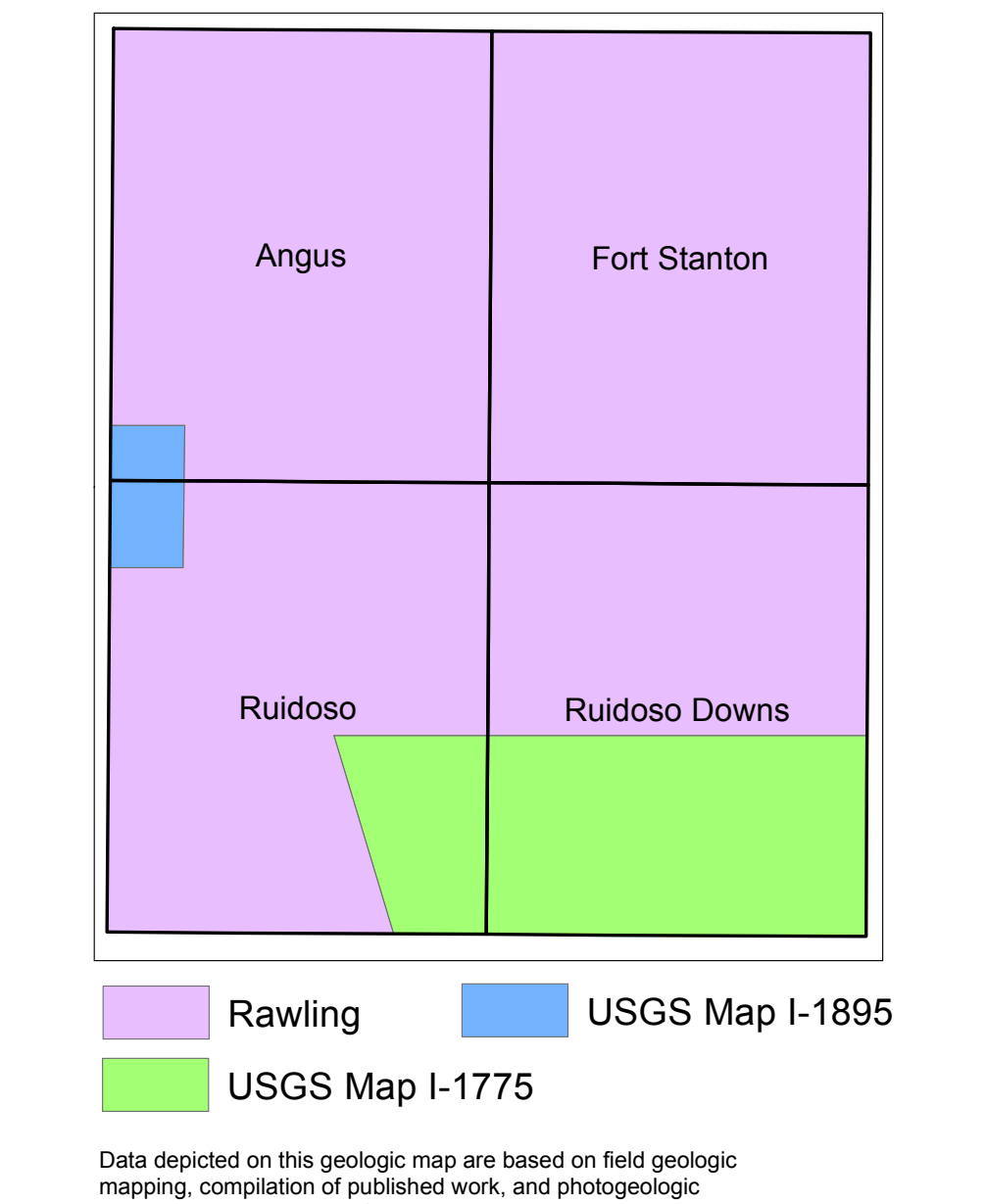
- dip-slip movement, bar and ball on downthrown side
- D U dip-slip movement on concealed fault, U and D indicate upthrown and downthrown sides, respectively
- dextral and sinistral strike-slip movement, respectively; queried where uncertain
- ? termination of fault is uncertain
- certain anticline: intermittantly exposed and/or obscured
- probable anticline: dashed where intermittantly exposed and/or obscured, dotted where concealed. Arrowhead shows plunge
- certain syncline: dashed where intermittantly exposed and/or obscured, dotted where concealed
- probable syncline: dashed where intermittantly exposed and/or obscured, dotted where concealed. Arrowhead shows plunge
- cross section line
- quadrangle boundary

- af - artificial fill
- daf - disturbed land and/or artificial fill
- QHa - Alluvium
- Qvf - Valley fill
- Qbt4 - Lowest terrace deposit of Rio Bonito
- Qbt3 - Intermediate terrace deposit of Rio Bonito
- Qbt2 - Intermediate terrace deposit of Rio Bonito
- Qbt1 - Highest terrace deposit of Rio Bonito
- Qrt3 - Lowest terrace deposit of Rio Ruidoso
- Qrt2 - Middle terrace deposit of Rio Ruidoso
- Qrt1 - Highest terrace deposit of Rio Ruidoso
- Qet2 - Lower terrace deposit of Eagle Creek
- Qet1 - Upper terrace deposit of Eagle Creek
- Qaf - Alluvial fan deposits
- Qc - Colluvium
- Qls - Landslide deposits
- Qg - Stream gravel deposits
- Tg - Pediment gravel deposits
- Tsv - Sierra Blanca volcanic rocks
- Td - Diorite and associated rocks
- Tdsc - Dike and sill complex
- Tbs - Bonito Stock
- Tcd - Diorite of Champ Hill
- Tad - Andesite/diorite and associated rocks
- Tml - Monzonite/latite and associated rocks
- Tcm - Cub Mountain Formation
- Kgc - Gallup Sandstone and Crevasse Canyon Formation, undivided
- Km - Mancos Shale
- Kd - Dakota Sandstone
- Ꞧsp - San Pedro Arroyo Formation
- Ꞧsr - Santa Rosa Formation
- Pg - Grayburg Formation
- Psa - San Andres Formation
- Psa-g - Glorieta Sandstone tongue
- Py - Yeso Formation

Correlation of units



Sources of Data



Data depicted on this geologic map are based on field geologic mapping, compilation of published work, and photogeologic interpretation. Locations of contacts are not surveyed, but are plotted by interpretation of the position of a given contact onto a topographic base map; therefore, the accuracy of contact locations depends on the scale of mapping and the interpretation of the geologists involved.

The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the State of New Mexico, or the U.S. Government. Reference to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not constitute or imply its endorsement,recommendation, or favoring by the The State of New Mexico or any agency thereof.

Cross-sections are constructed based upon the interpretations of the author made from geologic mapping and subsurface (drillhole) data. Cross-sections should be used as an aid to understanding the general geologic framework of the map area, and not be the sole source of information for use in locating or designing wells, buildings, roads, or other man-made structures.

Descriptions of Geologic Units

Anthropogenic Deposits

af - Artificial fill for stock tanks and highway embankments.

daf - Heavily disturbed land and artificial fill. Mapped where extensive, underlying deposits are obscured, and/or geomorphic surfaces are extensively altered.

Quaternary and Tertiary Surficial Deposits

QHa - Alluvium (Holocene to Historic) – Unlithified gravel and poorly to moderately sorted clay, silt, sand in active stream channels and ephemeral arroyos. Generally incised into **Qvf** and terrace deposits. Only mapped where extensive; unit is otherwise lumped with **Qvf**. Thickness: 0 to 4 (?) meters.

Qvf - Valley fill (upper Pleistocene to Holocene) - Unlithified valley fill composed of poorly sorted clay, silt, and sand, commonly with angular to subrounded cobbles of local bedrock. Matrix material is light to dark brown. Grades into minor alluvial and colluvial fans on toes of hillslopes. Anthropogenic disturbance is common in developed areas. Generally incised by active drainages, floored by sand and cobble to boulder gravel of **QHa**. Thickness: 0 to 12 (?) meters

Qaf – Alluvial fan deposits (middle to upper Pleistocene) – Alluvial fans composed of poorly sorted cobbles, boulders, sand, silt, and clay. Fans head in short, steep tributary canyons and interfinger with and/or spread out onto **Qvf** and terrace deposits. Stabilized by vegetation and apparently no longer active, and locally incised by drainages floored with **QHa**. Only mapped along major drainages where geomorphic expression is clear on aerial photos. Thickness: 0 to 8 (?) meters.

Qc – Colluvium (lower to upper Pleistocene) - Unlithified valley margin deposits composed of poorly sorted clay, silt, and sand, with abundant angular to subrounded cobbles and boulders of San Andres limestone. Cobbles and boulders are much more abundant than in unit **Qvf**. Unit mantles Yeso Formation and Quaternary stream gravels (**Qg**) at the toes of steep slopes on the south side of the Rio Ruidoso valley in the Ruidoso Downs quadrangle. Thickness: 0 to10 (?) meters.

Qls – Landslide deposits (lower to middle (?) Pleistocene) - Landslide and colluvium complexes. Deposits on steep slopes northeast of Palo Verde Canyon in the Ruidoso Downs quadrangle are composed of poorly sorted angular to subrounded blocks of San Andres limestone some of which are back-rotated towards the cliff. Debris obscures the San Andres Formation – Yeso Formation contact, and scattered Yeso outcrops are present. Deposits on the steep north slope of Dude Mesa in the Ruidoso quadrangle are composed of poorly sorted angular blocks of San Andres limestone some of which are back-rotated towards the slope at the head of the slide. The toe is cut by Rio Ruidoso terraces. Deposits in the "Ranches of Sonterra" area of the Fort Stanton quadrangle are composed of Mancos shale and scattered blocks of Mesa Verde group sandstone with steep and varied dips. Gravels of the Rio Bonito are locally mixed with the landslide debris at the slide toe. Thickness: 0 to 60 meters (Ruidoso Downs and Fort Stanton quadrangles); 0 to 30 (?) meters (Ruidoso quadrangle).

Rio Bonito terrace deposits (Qbt1, 2, 3, 4) - Within the Fort Stanton quadrangle the Rio Bonito crosses a prominent diorite sill just west of the Fort Stanton Recreation Area boundary, forming a waterfall. Terraces with similar relative geomorphic positions upstream and downstream of this knickpoint may not be directly correlated, although they are identified as such on the map.

Qbt4 – Lowest terrace deposit of Rio Bonito (Holocene) – Poorly to well-sorted alluvial deposits composed of interstratified fine to coarse tan sand and sandy cobble to boulder gravel. Deposit is approximately at grade of the Rio Bonito and generally only present within small meander bends of the active stream channel. Largely mapped from aerial photographs. Thickness: 0 to 2 (?) meters.

Qbt3 – Intermediate terrace deposit of Rio Bonito (Uppermost Pleistocene to Holocene) – Poorly to well-sorted alluvial deposits composed of interstratified fine to coarse tan sand and sandy cobble to boulder gravel. Deposit is similar to **Qbt4** in geomorphic appearance and vegetative cover but has a terrace tread above stream grade. Largely mapped from aerial photographs. Thickness: 0 to 3 (?) meters.

Qbt2 – Intermediate terrace deposit of Rio Bonito (Upper Pleistocene) – Poorly to well-sorted alluvial deposits composed of interstratified fine to coarse tan sand and sandy cobble to boulder gravel. Deposit forms a terrace whose tread is generally preserved and is 3 – 4 meters above present stream grade. Downstream (east) of the diorite sill which crosses the Rio Bonito west of the Fort Stanton Recreation Area the terrace is in part a strath terrace with discontinuous bedrock exposures along the terrace riser. Largely mapped from aerial photographs. Thickness: 0 to 4 meters.

Qbt1 – Highest terrace deposit of Rio Bonito (Middle Pleistocene) - Poorly to well-sorted alluvial deposits composed of interstratified fine to coarse tan sand and sandy gravel of rounded cobbles and boulders. Deposit forms a terrace whose tread is generally dissected and is 5 – 10 meters above present stream grade. Downstream (east) of the diorite sill which crosses the Rio Bonito west of the Fort Stanton Recreation Area the terrace is in part a strath terrace with discontinuous bedrock exposures along the terrace riser. Grades into and/or is locally overlapped by hillslope colluvium. Largely mapped from aerial photographs. Thickness: 0 to 6 (?) meters.

Eagle Creek terrace deposits (Qet1, 2)

Qet2 – Lower terrace deposit of Eagle Creek (Holocene) – Poorly to well-sorted alluvial deposits composed of interstratified fine to coarse tan sand and sandy cobble to boulder gravel. Deposit forms a terrace whose tread is generally preserved and is within a meter of present stream grade. Becomes indistinguishable from **Qet1** approximately 2 miles east of the western edge of the Fort Stanton quadrangle; stream deposits in the Eagle Creek drainage to the east are then mapped as **Qvf**. Largely mapped from aerial photographs. Thickness: 0 to 3 meters.

Qet1 – Upper terrace deposit of Eagle Creek (upper Pleistocene) - Poorly sorted alluvial deposits composed of interstratified fine to coarse sand and sandy gravel of rounded cobbles and boulders. Deposit forms a terrace whose tread is preserved and is 3 – 4 meters above present stream grade. Becomes indistinguishable from **Qet2** approximately 2 miles east of the western edge of the quadrangle; stream deposits in the Eagle Creek drainage to the east are then mapped as **Qvf**. Largely mapped from aerial photographs. Thickness: 0 to 5 (?) meters.

Rio Ruidoso Terrace deposits (Qrt1, 2, 3)

Qrt3 - Lowest terrace deposit of Rio Ruidoso (Holocene) - Poorly to moderately sorted alluvial deposits composed of interstratified fine to coarse sand and sandy cobble to boulder gravel. Clasts are rounded intrusive and volcanic igneous rocks with lesser limestone and sandstone. Deposit forms the active floodplain of the Rio Ruidoso and its surface is within a few meters of present stream grade. Largely mapped from aerial photographs. Thickness: 0 to 5 (?) meters.

Qrt2 – Middle terrace deposit of Rio Ruidoso (upper Pleistocene) - Poorly to moderately sorted alluvial deposits composed of interstratified fine to coarse sand and sandy cobble to boulder gravel. Clasts are rounded intrusive and volcanic igneous rocks with lesser limestone and sandstone. Forms discontinuous remnants between units **Qrt3** and **Qrt1**. Deposit forms a terrace whose tread is 5 - 6 meters above present stream grade, dissected, and generally affected by human disturbance. Largely mapped from aerial photographs. Thickness: 0 to 6 (?) meters.

Qrt1 – Highest terrace deposit of Rio Ruidoso (middle Pleistocene) - Poorly to moderately sorted alluvial deposits composed of interstratified fine to coarse sand and sandy cobble to boulder gravel. Clasts are rounded intrusive and volcanic igneous rocks with lesser limestone and sandstone. The surface of the deposit forms a terrace tread 12-15 meters above present stream grade, which is variably eroded, and strongly affected by human disturbance. Largely mapped from aerial photographs. Thickness: 0 to 10 (?) meters.

Qg – Stream gravel deposits (lower (?) to middle Pleistocene) - Moderately lithified, crudely bedded pebble to boulder gravel in Gavilan Canyon. Approximately 45 meters lower in elevation than **QTg** deposits. Poorly exposed, but appears to have smaller, more angular, and less weathered clasts than **QTg**. Postdates incision of modern drainages. Correlated by Moore et al (1988a) to the Palomas gravel of the Tularosa basin. Thickness: 0 to 20 (?) meters.

Tg – Pediment gravel deposits (Miocene to Pliocene) – Moderately lithified, crudely bedded pebble to boulder gravel with reddish clayey sand matrix and local lenses of sand and sandy clay. Largest boulders in deposits within the Angus and Fort Stanton quadrangles are 80 cm in diameter. Deposits on Grindstone Mesa in the Ruidoso quadrangle include clasts up to 4 m in diameter. Clasts are > 90 % Sierra Blanca volcanic rocks and associated intrusive igneous rocks. Clasts on surface of deposit are heavily weathered and fractured. Surface is partly stripped. Contains stage III to III+ carbonate soil near surface and local strong carbonate buildup (equivalent to stage IV carbonate soil development) at base of unit. Roadcuts in the Sonterra Ranch area expose irregular blebs and lenses of subsurface carbonate cementation, possibly deposited by groundwater. Extensive downslope colluvium makes identification of the base of unit difficult where not exposed in roadcuts. Caps hills and forms broad flat mesas and predates the incision of modern drainages. Base of unit slopes east at 100 to 130 feet per mile, with the slope decreasing to the east. Correlated by Kelley (1971) to the Ogallala Formation. Thickness: 0 to 40 (?) meters.

Cenozoic Igneous Rocks

Tbs – Bonito Stock (upper Oligocene, 26.6 Ma) – Light purple to gray porphyritic- phaneritic syenite. Rock is dominantly potassium feldspar with 10 to 15 % hornblende and biotite and < 5% quartz. Propylitic alteration of mafic minerals to chlorite and epidote is common. Intrusive contact in Mineral Farms Canyon exhibits dikelets and apophyses of purple syenite with aphanitic cooling rind in dark grey aphanitic andesite of **Tdsc**. Extensive bleaching and silicification due to hydrothermal alteration is common along northern margin with **Tsv**. Remainder of margin is often marked by a variably bleached and iron-stained border facies of grayish-lavender aphanitic-porphyritic or very fine-grained phaneritic porphyritic syenite. Southwest of Villa Madonna the syenite grades into greenish gray monzonite with more plagioclase than potassium feldspar and extensive alteration of mafic minerals to chlorite. (Age is K-Ar from Thompson, 1972). Thickness: Base and top not exposed; > 1200 meters (?).

Tad – Andesite/diorite and associated rocks (Oligocene) - Aphanitic to very fine-grained phaneritic or phaneritic-porphyritic dike rocks. Generally dark gray on fresh surface and brown to black on weathered surfaces. When phaneritic, often has a "salt and pepper" appearance due to fine-grained equigranular white feldspar and black to brown augite (?). Phenocrysts include augite, hornblende, and tabular intermediate (?) plagioclase. Tabular plagioclase phenocrysts are up to 4 cm in diameter and are usually aligned with the dike margins. Thickness: dikes are < 1 up to 5 meters wide.

Tml – Monzonite/latite and associated rocks (Oligocene) – Tan to brown aphanitic to very fine-grained phaneritic igneous rocks forming dikes, sills and irregular intrusive masses. Also forms a small dome or laccolith in the northeast corner of the Fort Stanton quadrangle. Typically composed of approximately equal amounts of white feldspar and tan to brown mafic minerals with little or no quartz. Feldspar is largely intermediate (?) plagioclase with lesser amounts of potassium feldspar and forms a felted network of interlocking crystals. Includes rocks ranging from syenite to diorite in composition. Thickness: dikes are < 1 to 5 meters wide; base and top of larger igneous masses and the laccolith are not exposed.

Tcd – Diorite of Champ Hill (Oligocene) - Dark gray to grayish-brown fine-grained phaneritic diorite with 10-15% phenocrysts of augite. Forms an irregular pluton underlying Champ Hill and much of the surrounding area east of NM 48 in the north-central portion of the mapped area. Subcrop and float of this rock and similar rocks with more or fewer phenocrysts of augite and plagioclase and variable phenocryst size cover a large area with inliers or xenoliths of Mesa Verde sandstone. Probably a stock (forming Champ Hill) and associated dikes and sills. Float of similar rocks from dikes and sills is common in the northern half of the mapped area. Thickness: dikes are < 1 to 5 meters wide; base and top of Champ Hill pluton not exposed.

Td – Diorite and associated rocks (Oligocene) – Within the Angus quadrangle, a shallow subvolcanic sill or non-vesicular flow concordant with over- and underlying **Tsv** flow breccias. Medium to dark gray aphanitic to very fine-grained phaneritic matrix with 10 – 45% plagioclase phenocrysts from <1 to 4 centimeters in length and 5 – 7% augite phenocrysts generally less than 1 cm in length. Plagioclase phenocrysts are often aligned horizontally or grouped in radial rosettes. Within the Ruidoso Downs quadrangle, light to dark brown very fine-grained phaneritic to phaneritic-porphyritic sills and small stocks. Phenocrysts include augite, hornblende and tabular intermediate (?) plagioclase. Tabular plagioclase phenocrysts are up to 4 cm in diameter and are usually aligned with the dike margins. Includes rocks ranging from diorite to theralite and gabbro in composition. Thickness: Sill in Angus quadrangle is ~ 90 meters thick; in the Ruidoso Downs quadrangle, dikes are < 1 up to 5 meters wide and the sill in Johnson Canyon is > 75 meters thick.

Tsv – Sierra Blanca volcanic rocks (upper Eocene to Oligocene) - Walker andesite breccia of Thompson (1972). Interbedded dark purple, purplish-red, red, and light to dark gray and gray –green volcanic flow breccias, volcanic debris flows, shallow intrusive sills, lahars, and volcaniclastic sedimentary rocks from the Sierra Blanca volcanic center. Rocks are generally alkalic and range from mafic (tephrite, phonotephrite, trachybasalt) to intermediate (andesite and latite) to felsic (rhyolite, trachyte, phonolite) in composition. Flow breccias are dominant and consist of varicolored angular to subrounded clasts of volcanic and lesser intrusive rocks in a purple or purplish-gray fine-grained matrix. Matrix is often propylitically altered. Clast population may be monolithologic or varied. Outcrops are massive to crudely bedded and individual flow units are generally 2 to 3 meters thick. Shallow intrusive sills are light to dark gray and aphanitic. Lahar deposits and volcaniclastic sedimentary rocks are red to purple muddy sandstones to conglomerates with variably developed bedding and sorting. Sandstones are well-bedded, often with fining-upward graded beds less than 0.5 cm thick. Natural exposures of all units are poor and individual units are not laterally traceable. Good exposures are in roadcuts on NM 532 and display interbedded volcanic and volcaniclastic units folded into 50 to 100 meter wavelength synclines and anticlines, probably due to faulting and forcible intrusion of numerous dikes and sills. Thickness: > 250 meters.

Tdsc – Dike and sill complex (Oligocene) – Area northeast of the Bonito Stock in the Angus quadrangle characterized by float of a wide variety of intermediate and felsic igneous rocks including andesite, diorite, monzonite, and latite, but very sparse outcrop. Appears to be > 90% igneous rocks. No outcrop or float of Bonito Stock, or textures indicative of flow breccias, lava flows, or tuffs. Field relations suggest that felsic rocks such as monzonite are more common as irregular, discordant masses, whereas intermediate rocks such as diorite are more common as dikes and sills. Isolated subcrop on hilltop west of Mills Canyon of white to tan quartz sandstone is either Mesa Verde group sandstone or contact metamorphosed Cub Mountain formation sandstone and is the only sedimentary rock observed in this unit. Unit is probably a dike and sill complex. Roadcut at Bonito Store exhibits several vertical andesite dikes intruded into gray aphanitic andesite sills. Contact with **Tsv** is gradational between Mills and Vickers Canyons. Thickness: Base and top not exposed; > 600 meters (?).

Cenozoic Sedimentary Rocks

Tcm – Cub Mountain Formation (Eocene) – White to tan sandstones, dark red sandy mudstones, and purplish-red silty mudstones. Sandstones are medium- to thick- bedded, cross-bedded, medium-grained, and arkosic to volcaniclastic. Pebble conglomerate lenses, mudballs, and ripup clasts of red mudstone, and olive, black, and gray siltstone and shale are locally common. Sandstones are generally more friable than underlying Cretaceous sandstones. Sandy and silty mudstones are thick-bedded to massive and micaceous. Several outcrops are volcaniclastic in nature, and the unit thus includes the Sanders Canyon Formation of Cather (1991), but the two formations are not mappable separately. Unit is ubiquitously intruded by igneous dikes, sills and irregular masses. Thickness: > 450 meters.

Mesozoic Sedimentary Rocks

Kgc – Cretaceous Gallup Sandstone and Crevasse Canyon Formation, undivided (upper Cretaceous) – Lavender to tan sandstone and conglomerate, olive to gray sandy siltstone and siltstone, and dark gray, grayish-purple, and black shale. Sandstones are fine- to medium-grained, medium- to very thick-bedded, trough cross-bedded, and composed of subrounded to subangular grains and are dominantly quartose and resistant, but locally arkosic and friable. Conglomerate is present as lenses within sandstone beds. Iron concretions and plant fossils are common. Shales are carbonaceous and fissile and usually interbedded with blocky weathering thin- to medium-bedded, occasionally micaceous, siltstone and sandy siltstone layers with ripup clasts of black shale. The Gallup Sandstone forms prominent cliffs in the northwestern corner of the Fort Stanton quadrangle, but to the south and west the two formations are not separately mappable. Unit is ubiquitously intruded by igneous dikes, sills and irregular masses. Adjacent to these bodies shales are often contact metamorphosed to low grade hornfelses and weather into gray angular chips rather than black flakes. Thickness: Up to 425 meters in the Angus and Ruidoso quadrangles.

Km – Mancos Shale (middle to upper Cretaceous) – Black to purplish-gray laminated fissile shale. Ovoid calcareous concretions are locally abundant. Black to dark gray to olive thin-bedded fine-grained sandstone and siltstone beds less than 0.5 meters thick and thin- to medium-bedded limestones 1 - 2 meters thick are minor constituents except north of the Rio Bonito, where thin- to medium-bedded gray limestone beds form up to 75% of the unit. The contact with the underlying Dakota sandstone is transitional over at least a 50 foot interval, with thin medium-grained quartz sandstone beds within black fissile shale. Igneous intrusions are common. Very poorly exposed except in stream cuts and manmade excavations Thickness: 250 to 375 meters.

Kd – Dakota Sandstone (lower to middle Cretaceous) – Gray to tan to purple sandstone and minor black shale. Sandstone is medium- to thick-bedded, trough to tabular cross-bedded, ripple-marked, and composed of subangular to subrounded vitreous quartz grains. Orange to rusty red liesegang bands are common on bedding planes and fracture surfaces. Sandstone is more resistant, forms more prominent outcrops, and weathers into more angular fragments than Mesa Verde and Santa Rosa sandstones. Matrix-supported sandy chert pebble conglomerate is present as a 1 meter thick layer at the base of unit and as sparse lenses throughout the unit. Thin discontinuous beds of black shale similar to the overlying Mancos Shale are sparsely distributed throughout the upper portions of the unit. Thickness: 50 to 60 meters.

Ꞧsp **– San Pedro Arroyo Formation (upper Triassic)** - Dark brownish-red to purplish-red fine-grained, micaceous, usually crossbedded sandstone, siltstone, and conglomerate, and dark red and purplish-red, massive and bioturbated mudstone. Poorly exposed, except for outcrops on north side of Rio Bonito Valley near Fort Stanton. Generally only appears as dark red soils and subcrop. Unit is truncated by basal Dakota unconformity on south side of Rio Bonito Valley; two erosional outliers appear along Little Creek. Unit is the upper formation of the Chinle Group (Lucas 1991). Thickness: 0 to 30 meters.

Ꞧsr **- Santa Rosa Formation (upper Triassic)** – Medium brown, yellowish-brown, and tan sandstone, conglomerate, and conglomeratic sandstone. Sandstones are medium- to fine-grained, broadly trough-cross-bedded and composed of rounded to subrounded quartz, black chert, and altered ferromagnesian minerals and/or lithic fragments. Base of the unit is often marked by a gray, orange, or red medium-to thick-bedded quartzite and chert pebble conglomerate with a matrix of coarse chert-rich sand. Conglomerate is frequently scoured into underlying Grayburg Formation. Intervals of similar thick-bedded, resistant, chert pebble to cobble conglomerate are prominent in exposures along the north side of Little Creek. Unit is the lower formation of the Chinle Group (Lucas 1991), thins to the southwest, and is truncated by the basal Dakota unconformity on the north side of Moon Mountain. Thickness: 0 to 98 meters.

Paleozoic Sedimentary Rocks

Pg - Grayburg Formation (upper Permian) – Gray, tan, yellowish-brown, and locally red, very fine- to medium-grained sandstone and subordinate siltstone. Sandy limestone beds are locally common near the top of the unit. Sandstones and siltstones are thin- to thick-bedded, parallel-bedded to crossbedded, and composed of well-rounded and well-sorted quartz grains. Red, massive, very fine sandstone and siltstone with white reduction spots is locally present at base and throughout the unit. Unit was locally deposited in karst depressions within the underlying San Andres Formation, e.g. at the northeast end of Fort Stanton Mesa and along Eagle Creek north of Gavilan Ridge. Unit is the lowest formation of the Artesia Group and is generally friable and poorly exposed. Thickness: 20 to 135 meters.

Psa - San Andres Formation (middle to upper Permian) - Light to dark gray and bluish-gray limestone and dolomite. Limestones and dolomites range from thin- to very thick-bedded, and are carbonate mudstones, wackestones, and grainstones. Freshly broken surfaces are darker gray than weathered surfaces and often fetid. Beds are often silty or sandy. Dark brown irregular chert nodules are sparse. Fossils are sparse and are dominantly crinoid stem fragments. Intraformational solution breccias and paleokarst features are common along faults at the top of the unit. They are characterized by terra rossa, red and yellow breccia fragments, and anomalous thicknesses of the overlying Grayburg Formation. The base of the unit is locally characterized by irregular bedding dips due to gypsum dissolution in the underlying Yeso Formation. Delineation of the San Andres into the lower thick-bedded Rio Bonito Member and upper thin-bedded Bonney Canyon member (Kelley, 1971) was not possible due to steep topography, heavy vegetation, and sparse outcrop. The lowest portions of the unit do contain abundant thick beds, but in the mapped area vertical changes in bedding thickness and bed color are not mappable distinctions. Thickness: ~ 335 meters.

Psa-g – Glorieta Sandstone tongue (middle Permian) - Discontinuous beds of gray and light to medium brown fine- to medium-grained sandstone consisting of frosted and well-rounded quartz grains. Only observed as float and very sparse outcrop. Thickness: 0 to 6 (?) meters.

Py – Yeso Formation (middle Permian) - Yellow to tan siltstone and fine sandstone, red to pink muddy siltstone and fine sandstone, gray to tan silty limestone and dolomite, and white to gray gypsum. Siltstone and sandstones are thin- to medium-bedded and friable. Muddy siltstones and sandstones are laminated to very thin-bedded and locally contain paleosol carbonate nodules in trains. Limestones are very thin- to thin-bedded, rarely medium- to thick-bedded. In general, they are thinner bedded than overlying basal San Andres beds. Meter scale interbedding of carbonate, siltstone, and sandstone is common. Bedding dips are chaotic due to dissolution of gypsum and (and carbonates?) and individual beds are generally not traceable laterally for more than a few 10s of meters. Natural exposures are poor except in stream cuts and very steep slopes and the upper contact is usually mantled by colluvium and/or landslides from the overlying San Andres Formation. Thickness: Base not exposed; ~ 240 meters exposed along Rio Ruidoso Canyon in the Ruidoso Downs quadrangle.

PpꞒu **- Permian to Proterozoic rocks, undivided (cross section only)** – Paleozoic sedimentary rocks and Proterozoic igneous and metamorphic rocks, undivided. Thickness of Sub-Yeso Paleozoic rocks is unknown.

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Magnetic Declination
10º 30' East of North
At Map Center
May, 2002

1:24,000

1927 North American datum, Universal Transverse Mercator Projection
1000- meter UTM grid ticks, zone 13, shown in red
contour interval 40 feet

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Geology of the Ruidoso Area, Lincoln and Otero Counties, New Mexico

by Geoffrey C. Rawling

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