# Geologic Map of the Ruidoso Quadrangle, Lincoln and Otero Counties, New Mexico

By

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***Open-file Digital Geologic Map OF-GM 93***

**Scale 1:24,000**

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Mapped and compiled by Geoffrey Rawling

## EXPLANATION OF MAP UNITS

### Anthropogenic Deposits

**af** Artificial fill for stock tanks and highway embankments.

**daf** Heavily disturbed land and/or 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, reflecting soil development processes. Probably deposited largely by alluvial processes with subordinate sheetwash and colluvial processes. Grades into minor alluvial and colluvial fans on toes of hillslopes. Anthropogenic disturbance common in developed areas. Generally incised by active drainages, floored by sand and cobble to boulder gravel of **QHa**. Thickness: 0 to12 (?) meters

**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 isolated 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 - Upper 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. Between Upper Canyon and the confluence of Rio Ruidoso and Carrizo Creek the deposit forms the alluvial cover of a strath terrace incised by the Rio Ruidoso into the Mesa Verde Group (and Cub Mountain Formation ?). Downstream of the confluence the nature of the terrace (strath or cut and fill) is not apparent. 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.

**Qaf – Alluvial fan deposits (middle to upper Pleistocene) -** Alluvial fans composed of poorly sorted rounded to angular cobbles, boulders, sand, silt, and clay. Fans head in 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.

**Qls – Landslide deposits (lower to middle Pleistocene?)** - Landslide complex on the steep north slope of Dude Mesa 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. Headscarp is indicated by normal fault symbols. Toe is cut by Rio Ruidoso terraces. Thickness: 0 to 30 (?) meters.

**Qg – Stream gravel deposits (lower to middle (?) Pleistocene) -** Moderately lithified, crudely bedded pebble to boulder gravel in upper reaches of Gavilan Canyon, lower reaches of Cherokee Bill Canyon, and along the Rio Ruidoso near the confluence of the three canyons. Exposures along the Rio Ruidoso have sandy clast-supported gravel interbedded with channels deposits of sand and silty clay. Deposits in Gavilan Canyon are approximately 45 meters lower in elevation than nearby **QTg** deposits in the Angus quadrangle. Clasts are limestone and igneous rock , and are generally smaller and less weathered than clasts in **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.

**QTg – Pediment gravel deposits (Pliocene (?) – lower Pleistocene) -** Isolated deposits on Moon Mountain, Dude Mesa, and the ridge south of Inn of the Mountain Gods. Poorly lithified, crudely bedded pebble to boulder gravel with reddish clayey sand matrix and local lenses of sand and sandy clay. Largest boulders are 80 cm in diameter. Clasts are > 90 % Sierra Blanca intrusive igneous rocks. Clasts on surface of deposit are weathered and fractured. Surface is partly stripped. Extensive downslope colluvium makes base of unit hard to define. Deposited by steep gradient streams draining the Sierra Blanca, predating incision of modern drainages. Probably equivalent to the Ogallala formation and thus at least lower Pleistocene in age (Kelley, 1971). Thickness: 0 to 30 (?) meters.

**QTgg - Glacial outwash gravel (Pliocene (?) to lowest (?) Pleistocene) -** Deposits on Grindstone Mesa and outliers to east and west along ridge top. Rounded cobbles and boulders up to 4 m in diameter of intrusive igneous rocks, dominantly purplish gray syenite of the Three Rivers Stock. Average clast size is much larger than that of **QTg**. Clasts are heavily weathered to a soil of grus. Base of deposit slopes eastward at ~130 feet per mile and projects to ~ 130 feet above **QTg** deposits on Dude Mesa. Thickness: 0 to 40 (?) meters.

## Cenozoic Igneous Rocks

**Tsv – Sierra Blanca volcanic rocks, undivided (upper Eocene to Oligocene)** - Walker andesite breccia of Thompson (1972). Interbedded purplish red, red, dark purple, and light to dark gray volcanic flow breccias, volcanic debris flows, lava flows, shallow intrusive sills, tuffs, lahars, and volcaniclastic sedimentary rocks from the Sierra Blanca volcanic center to the west of the quadrangle. 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 rocks in a generally 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. Tuffs are pink to purple with white feldspar phenocrysts, clasts of other volcanic rocks, and dark purple fiamme forming a eutaxitic foliation that is locally highly contorted. Natural exposures of all units are poor and individual units are not laterally traceable. Not subdivided except in areas compiled from Moore et al (1988b, see below). Thickness: 0 to ≥ 300 meters.

**Tsv-tp – Trachyphonolite porphyry flows** - Fine- to medium-grained medium to dark-gray-green flows with plagioclase phenocrysts. Unit from Moore et al. (1988b). Thickness: ≥ 25 meters.

**Tsv-tf – Trachybasalt flows -** Fine- to very fine-grained dark gray aphyric flows. Unit from Moore et al. (1988b). Thickness: ~ 60 meters.

**Tad – Andesite/diorite dike, undivided (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 of 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. Map unit includes small diorite stock west of Mescalero Lake. Includes rocks ranging from diorite to theralite and gabbro in composition. Thickness: dikes are < 1 up to 5 meters wide.

**Tmz – Monzonite (?) dike (Oligocene) -** Tan to brown aphanitic to very fine grained phaneritic dike rocks. Typically composed of approximately equal amounts of white feldspar and brown mafic minerals with little or no quartz. Often weathers in a granular fashion resulting in a surface texture resembling sandstone. 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 up to 5 meters wide.

## 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 in the quadrangle. Unit is ubiquitously intruded by igneous dikes, sills and irregular masses. Thickness: 240 (?) meters.

## Mesozoic Sedimentary Rocks

**Kmv – Cretaceous Mesa Verde Group, 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. 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. Subdivsions of the unit (e.g., Gallup Sandstone, Crevasse Canyon Formation) are not mappable in the quadrangle. 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: 240 to 430 meters.

**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. The contact with the underlying Dakota sandstone is transitional over at lest a 50 foot interval, with thin medium grained quartz sandstone beds within black fissile shale. Igneous intrusions are common. Thickness: 330 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 overlying Mesa Verde 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: 105 to 120 meters.

**TRsr - Santa Rosa Formation (upper Triassic) -** Dark brownish red fine grained sandstone, siltstone, and dark red mudstone. Reduction spots are common in the sandstone and siltstone. Base of the unit is marked by a gray to orange to red medium to thick bedded quartzite and chert pebble conglomerate with a matrix of coarse chert-rich sand. Conglomerate is scoured into underlying Grayburg Formation. Very poorly exposed and usually mantled by colluvium from overlying Dakota Formation. Unit pinches out between Rio Ruidoso and Carrizo Creek. Exposures adjacent to Mescalero Dam have Dakota Sandstone resting on Grayburg Formation. Unit reappears as a feather edge south of the Inn of the Mountain Gods and thickens to the southwest at the expense of the underlying Grayburg formation. Thickness: 0 to 105 meters.

## Paleozoic Sedimentary Rocks

**Pg – Grayburg Formation (upper Permian)** - Gray, tan, and yellowish brown fine grained sandstone and siltstone and minor gypsum. Sandstones and siltstones are very thin to thick bedded, parallel to crossbedded, and composed of quartz. Very poorly exposed. Unit pinches out between Inn of the Mountain Gods and Cherokee Bill Canyon coincident with thickening of overlying Santa Rosa Sandstone. Thickness: 0 to 90 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 occasionally 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 such as collapsed caves are common along faults and as isolated occurrences. They are characterized by red soil and red and yellow stained breccia fragments. Contact with the overlying Grayburg Formation is marked by development of reddish yellow to buff solution breccia and abundant vugs filled with calcite crystals. The base of the unit is 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 attempted but 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 Ruidoso area, vertical changes in bedding thickness and bed color are not mappable distinctions. Thickness: ~ 335 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. Dikes, sills, and irregular masses of igneous rock are common. Exposures are poor and the upper contact is usually mantled by colluvium from overlying San Andres Formation. ). Thickness: ≥ 240 meters based on exposures in Ruidoso Downs quadrangle to east. Wasiolek (1991) reported a regional thickness range of 320 to 380 meters based on wells from the north central part of the Mescalero Reservation.

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

## MAP AND CROSS SECTION SYMBOLS

Location of geologic cross section

Geologic contact, solid where exposed, dashed where approximately located, dotted where concealed, queried where inferred

Normal fault, arrow shows dip and dip direction of fault plane where measured, ball and bar on downthrown side, dashed where approximately located, dotted where concealed. Fault tip is queried where the termination of fault is unknown.

Anticline, trace of axial plane, dashed where approximately located

Syncline, trace of axial plane, dashed where approximately located

Dip and dip direction of bedding, dashed where compiled from Moore et al (1998a)

Dip and dip direction of eutaxitic foliation in welded ash-flow tuff, dashed where compiled from Moore et al (1998b)

Dip and dip direction of joints

Dip and dip direction of plane of small fault

Trend and plunge of slickenside striae

Outcrop and local trace of dike, with dip and dip direction where measured

Water well with NM State Engineer Office W.A.T.E.R.S. database reference number

Water well projected into cross section

## NOTES AND ACKOWLEDGEMENTS

Geology within Mescalero Tribal lands north of the Rio Ruidoso in the northwest corner of the quadrangle was compiled from Moore et al (1988b). Geology within Mescalero Tribal lands south of US 70 and east of Fence Canyon was compiled from Moore et al (1988a).

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