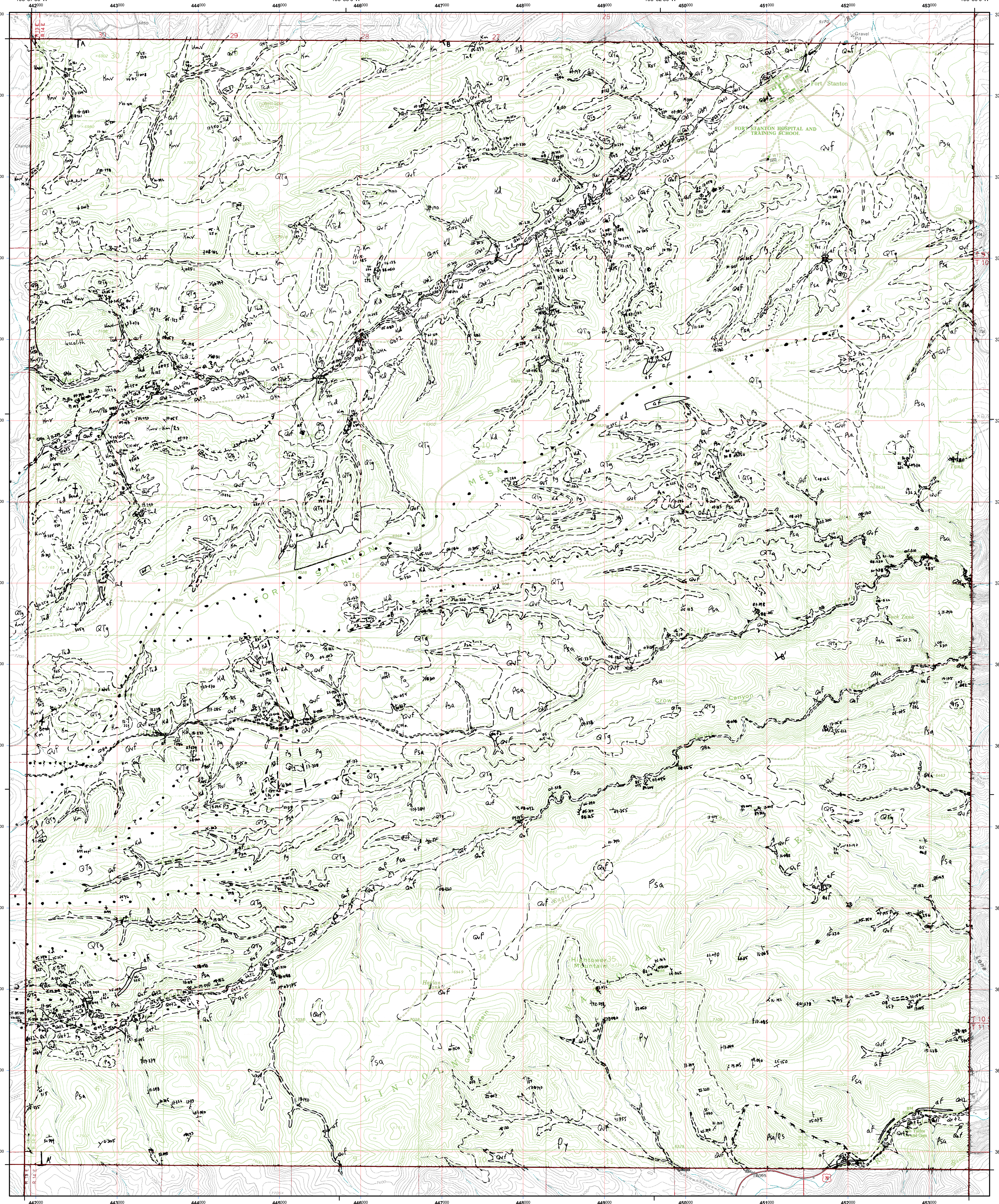
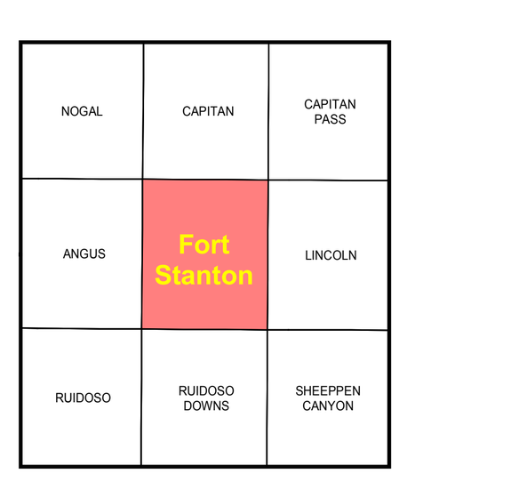
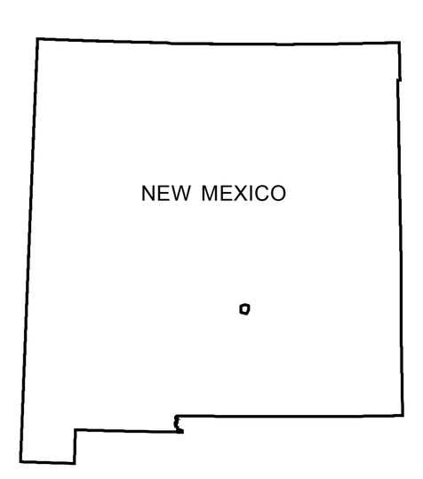
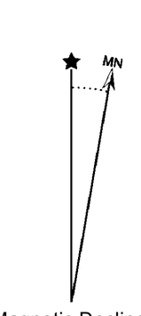


Base map from U.S. Geological Survey 1963, from photographs taken 1963, field checked in 1963.
1927 North American datum, UTM projection -- zone 13N
1000-meter Universal Transverse Mercator grid, zone 13, shown in red





QUADRANGLE LOCATION



Magnetic Declination
May, 2006
9° 10' East
At Map Center

1:24,000

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

New Mexico Bureau of Geology and Mineral Resources
Open-file Map Series
OFGM 119

Mapping of this quadrangle was funded by a matching-funds grant from the STATEMAP program of the National Cooperative Geologic Mapping Act, administered by the U. S. Geological Survey, and by the New Mexico Bureau of Geology and Mineral Resources, (Dr. Peter A. Scholle, *Director and State Geologist*, Dr. J. Michael Timmons, *Geologic Mapping Program Manager*).

New Mexico Bureau of Geology and Mineral Resources
New Mexico Tech
801 Leroy Place
Socorro, New Mexico
87801-4796

[505] 835-5490
http://geoinfo.nmt.edu

This and other STATEMAP quadrangles are (or soon will be) available for free download in both PDF and ArcGIS formats at:

http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/home.html

Geologic map of the Fort Stanton quadrangle, Lincoln County, New Mexico.

May 2006

by
Geoffrey Rawling [1]

[1] *NMBGMR, 801 Leroy Pl., Socorro, NM, 87801*

COMMENTS TO MAP USERS

A geologic map displays information on the distribution, nature, orientation, and age relationships of rock and deposits and the occurrence of structural features. Geologic and fault contacts are irregular surfaces that form boundaries between different types or ages of units. Data depicted on this geologic quadrangle map may be based on any of the following: reconnaissance field geologic mapping, compilation of published and unpublished 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 geologist(s). Any enlargement of this map could cause misunderstanding in the detail of mapping and may result in erroneous interpretations. Site-specific conditions should be verified by detailed surface mapping or subsurface exploration. Topographic and cultural changes associated with recent development may not be shown.

Cross sections are constructed based upon the interpretations of the author made from geologic mapping, and available geophysical, 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.

Explanation of map 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 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.

Rio Bonito terrace deposits – 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.

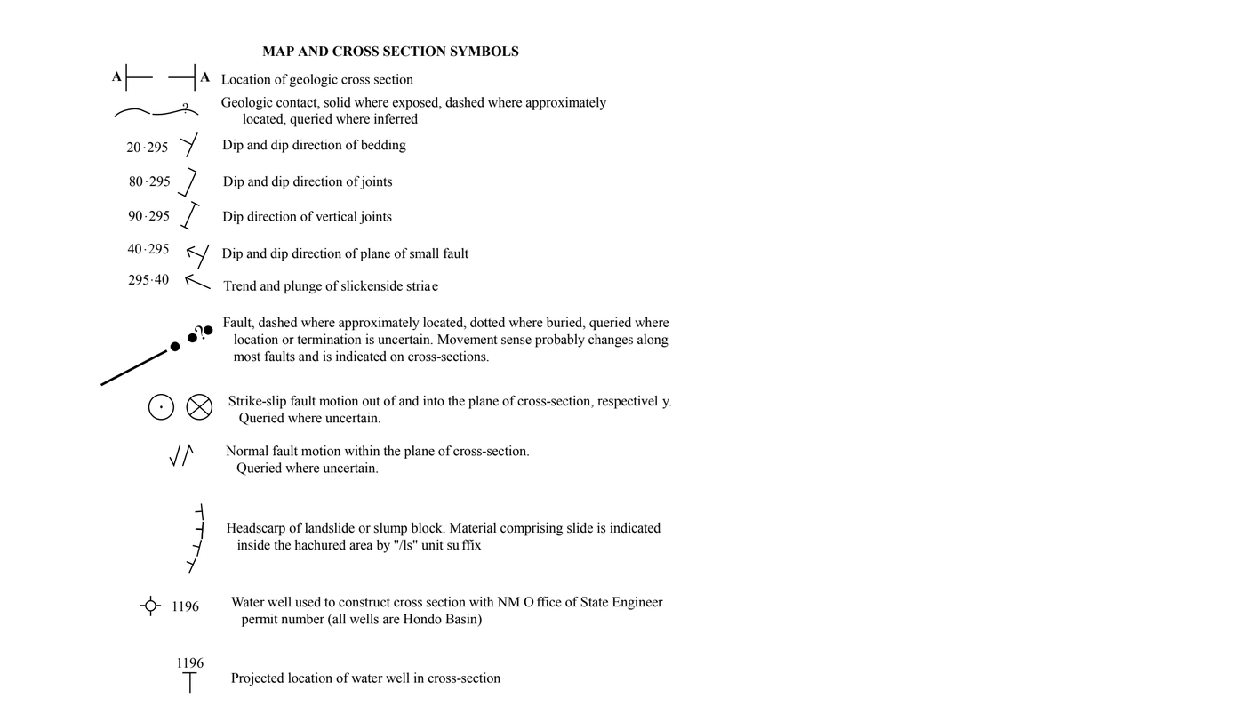
Qbt2 – Intermediate terrace deposit of Rio Bonito (Upper Pleistocene) – Poorly to well-sorted alluvial deposits composed of interstratified fine to coarse tan sand and sandy cobble to boulder gravel. Deposit forms a terrace whose tread is generally preserved and is 3 – 4 meters above present stream grade. 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

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 **Qet2** approximately 2 miles east of the western edge of the quadrangle; stream deposits in the Eagle Creek drainage are then mapped as **Qvf**. Largely mapped from aerial photographs. Equivalent to unit Qet2 of the Angus quadrangle (Rawling, 2004a). 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 **Qet1** approximately 2 miles east of the western edge of the quadrangle; stream deposits in the eagle Creek drainage are then mapped as **Qvf**. Largely mapped from aerial photographs. Equivalent to unit Qet1 of the Angus quadrangle (Rawling, 2004a). Thickness: 0 to 5 (?) meters.



Km - Mancos Shale (middle to upper Cretaceous) - Black to purplish gray laminated fissile shale. Black to dark gray to olive thin-bedded fine-grained sandstone and siltstone beds less than 0.5 meters thick are minor constituents . Thin- to medium-bedded gray limestone beds form up to 75% of the unit north of the Rio Bonito. Igneous intrusions are common. Generally only well exposed in stream cuts and manmade excavations. Thickness: ~ 335 meters.

Kd - Dakota Sandstone (lower to middle Cretaceous) - Gray to tan to light 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 commonly present at the base of unit and as 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: ~ 106 meters.

@sr **Santa Rosa Formation (upper Triassic)** – Dark brownish-red fine-grained, micaceous, sandstone, siltstone, and conglomerate, and dark red, often massive and bioturbated, mudstone. Very poorly exposed, except for outcrops on north side of Rio Bonito Valley in the vicinity of Fort Stanton. Generally only appears as dark red soils and subcrop. Reduction spots are common. 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 scoured into underlying Grayburg Formation. Unit is cut out by the basal Dakota unconformity in canyons on north side of Fort Stanton Mesa and locally reappears to the southwest in channels cut into the underlying Grayburg Formation. Units present are probably the Tecolotito and Los Esteros Members of the Santa Rosa Formation (Lucas et al., 2001). Thickness: 0 – 30 meters.

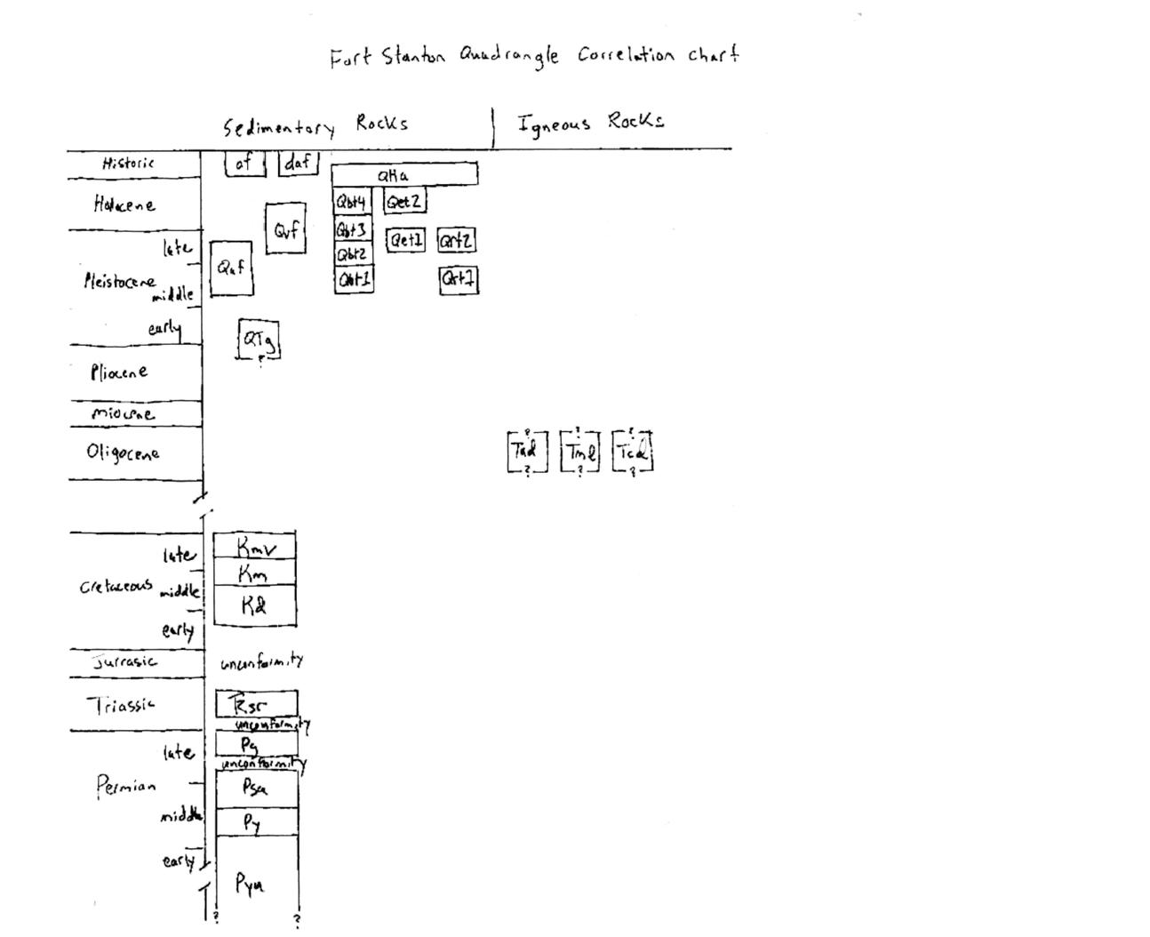
Paleozoic Sedimentary Rocks

Pg - Grayburg Formation (upper Permian) – Gray, tan, and yellowish brown fine- to medium-grained sandstone and subordinate siltstone. Limy sandstone and dolomite beds are locally common. Intervals of thick-bedded, resistant, chert pebble to cobble conglomerate are prominent in exposures along the north side of Little Creek. Sandstones and siltstones are very thin- to thick-bedded, parallel to crossbedded, and composed of quartz. Red, generally massive, very fine sandstone, siltstone and mudstone with white reduction spots is locally present at base. This unit appears to be scoured into or 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 lower member of the Artesia Group. Thickness: 90 – 152 meters.

Psa - San Andres Formation (middle to upper Permian) - Light to dark gray and bluish-gray thin- to very thick-bedded limestone and dolomite. Limestones and dolomites are carbonate mudstones, wackestones, and grainstones. Freshly broken surfaces are darker gray than weathered surfaces and are commonly fetid. Silty and sandy beds common. 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. 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. 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 (Rawling, 2004c).

Pyu – Yeso Formation and older rocks, undivided - cross-section only



Rio Ruidoso Terrace deposits

Qrt2 – Lower terrace deposit of Rio Ruidoso (upper Pleistocene) - Poorly to well-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 a terrace whose tread is 5 - 6 meters above present stream grade, dissected, and generally affected by human disturbance. Mapped from aerial photographs. Equivalent to unit Qrt2 of the Ruidoso Downs quadrangle (Rawling, 2004c). 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. 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. Mapped from aerial photographs. Equivalent to unit Qrt2 of the Ruidoso Downs quadrangle (Rawling, 2004c). Thickness: 0 to 10 (?) meters.

QTg – Pediment gravel deposits (Pliocene (?) to lower Pleistocene) – Moderately 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 dominantly Sierra Blanca volcanic rocks and associated intrusive igneous rocks, although angular clasts of Cretaceous Dakota Sandstone and Mesa Verde Group (Gallup?) sandstone become increasingly common near the base of the deposit in the eastern half of the quadrangle. 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. Extensive downslope colluvium makes base of unit hard to define where not exposed in roadcuts. Deposited by steep gradient streams draining the Sierra Blanca, predating incision of modern drainages. Thickness: 0 to 30 (?) meters.

Cenozoic Igneous Rocks

Tad – Andesite/diorite and associated rocks, undivided (Oligocene) – Aphanitic to very fine-grained phaneritic and phaneritic-porphyritic igneous rocks forming dikes, sills, and irregular intrusive masses. 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 to 5 meters wide.

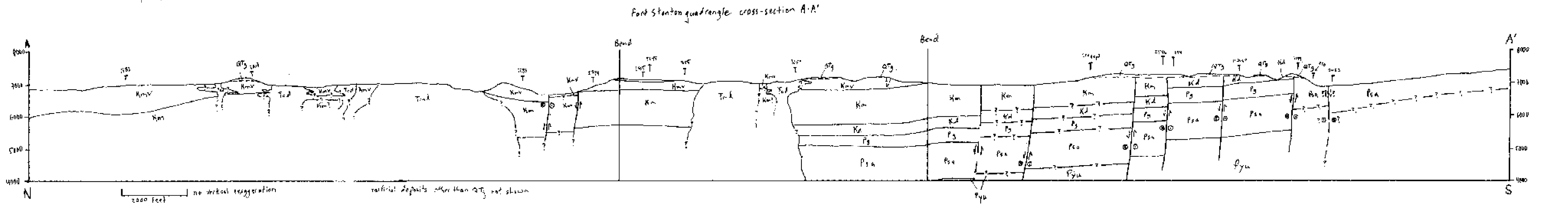
Tml – Monzonite/latite and associated rocks (Oligocene) – Tan to brown aphanitic to very fine-grained phaneritic igneous rocks forming dikes, sills and irregular intrusive masses. Also forms a small laccolith in the northeast corner of the quadrangle. Typically composed of approximately equal amounts 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 10-35% phenocrysts of augite up to several centimeters across. Named for Champ Hill, a stock which straddles the northeastern border of the quadrangle with the Angus quadrangle to the west (Rawling, 2004a). Rocks of similar appearance but varying phenocrysts content form numerous dikes, sills, and irregular intrusive masses, including the prominent northeast –striking sill which crosses the Rio Bonito. Thickness: dikes are < 1 to 5 meters; base and top of larger igneous masses are not exposed.

Mesozoic Sedimentary Rocks

Kmv - Mesa Verde Group, undivided (upper Cretaceous) – Pale lavender to tan sandstone, olive to gray sandy siltstone and siltstone, and dark gray, grayish purple, olive, and minor black shale. Sandstones are fine- to medium-grained, medium- to very thick-bedded, trough cross-bedded, and composed of subrounded to subangular grains. They are dominantly quartose and resistant, but locally arkosic and friable. Sandstones of the lower Mesaverde Group forming prominent cliffs in the northwestern corner of the quadrangle have been tentatively correlated with the Gallup Sandstone (Bodine, 1956; Arkell, 1983). Black shales are carbonaceous and fissile. Shaly sections are 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: > 270 meters, top not exposed in quadrangle. Up to 425 meters thick in the Angus and Ruidoso quadrangles to the west and southwest (Rawling, 2004a; Rawling, 2004b).

Fort Stanton quadrangle cross-section A-A'



Fort Stanton quadrangle cross-section B-B'