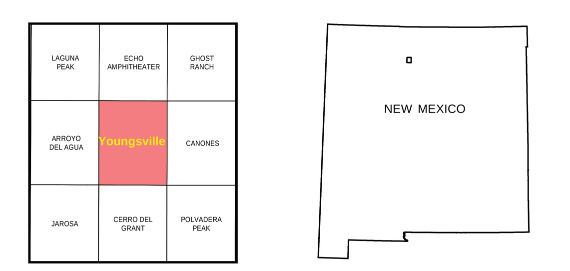
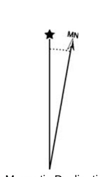
Base from U.S.Geological Survey 1953, from photographs taken 1951 and field checked in 1953. Map edited in 1979
1927 North American datum, UTM projection -- zone 13N
1000- meter Universal Transverse Mercator grid, zone 13, shown in red



QUADRANGLE LOCATION



Magnetic Declination
May, 2005
10º 2' East
At Map Center

1:24,000

1 0.5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

This draft geologic map is preliminary and will undergo revision. It was produced from either scans of hand-drafted originals or from digitally drafted original maps and figures using a wide variety of software, and is currently in cartographic production. It is being distributed in this draft form as part of the bureau's Open-file map series (OFGM), due to high demand for current geologic map data in these areas where STATEMAP quadrangles are located, and it is the bureau's policy to disseminate geologic data to the public as soon as possible.

After this map has undergone scientific peer review, editing, and final cartographic production adhering to bureau map standards, it will be released in our Geologic Map (GM) series. This final version will receive a new GM number and will supercede this preliminary open-file geologic map.

DRAFT

Geologic map of the Youngsville quadrangle, Rio Arriba County, New Mexico

June 2005
Updated June 2007

by
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New Mexico Bureau of Geology and Mineral Resources

Open-file Geologic Map **106**

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

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.

The map has not been reviewed according to New Mexico Bureau of Geology and Mineral Resources standards. The contents of the report and map should not be considered final and complete until reviewed and published by the New Mexico Bureau of Geology and Mineral Resources. The views and conclusions contained in this document are those of the authors 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.

Photograph of cliff of eolian Mesita Blanca member of Permian Yeso Formation below a channel sandstone in the Shinarump Formation of the Triassic Chinle Group. Shinarump channel in foreground. Photo taken looking north from 3537381 3999244 (NAD 27).

Geologic features on the Youngsville quadrangle in north-central New Mexico include classic Colorado Plateau stratigraphy and monoclinal structures, N-to NE-trending down-to-the-east Rio Grande rift normal faults , and volcanic rocks in northern Jemez volcanic field. A rich and complex history of late Paleozoic through Mesozoic deposition, late Cretaceous to Eocene Laramide compressional deformation and associated deposition, Oligocene to Miocene Rio Grande rift deposition and deformation, and eruption of late Miocene mafic to intermediate lavas and Pleistocene rhyolitic tuff from the Jemez volcanic field is recorded here.

The two most significant findings of this work are the discovery of the northernmost pinchout of the Mesita Blanca member of Permian Yeso Formation in this part of New Mexico, and recognition of a possible deformation event during the deposition of the Poleo sandstone member of the Triassic Chinle Group. We also recognize possible reactivation of Laramide faults during Rio Grande rift extension.

Photograph of the weathering horizon at the top of the Permian Yeso Formation (UTM coordinates 354771 4001419(NAD 27)).

Qal Alluvium (Holocene). Unconsolidated clay, silt, sand, and gravel deposited in major modern drainages and tributaries; up to 5 m thick.

Qe Eolian silt (Holocene). Unconsolidated windblown tan to brown silt and clay deposited in low-elevation spots and on pediment surfaces. Usually 1 to 3 m thick, but can be 10 m thick.

Qc Colluvium (Holocene). Hillslope colluvial deposits composed of pebble to boulder size unconsolidated debris derived from local volcanic and sedimentary rocks. **Qcb** designates colluvium composed mainly of Lobato basalt, **Qc-a** is colluvium made of Lobato andesite, **Qcbt** is Bandelier Tuff colluvium. Qc refers to colluvium made up of a variety of lithologies. Up to 35 m thick.

Qt Terrace deposits (middle Pleistocene to Holocene). Alluvial silt, sand, cobble, and boulder deposits of rounded to subrounded Lobato Formation, Pedernal Chert, Mesozoic sandstone, as well as recycled Proterozoic quartzite, granite, and metamorphic pebbles from the Oligocene Lower Abiquiu Formation and the Permian Cutler Formation. At least two terrace levels are present along the Rio Puerco, one at ~60 feet above modern grade, and one at ~100 feet above modern grade. 1 to 3 m thick.

Qp Pediment gravels (middle Pleistocene to Holocene). Unconsolidated deposits of angular to subangular pebble to boulder size blocks of Lobato Formation, Pedernal Chert, Mesozoic sandstone, as well as rounded recycled Proterozoic quartzite, granite, and metamorphic pebbles from the Oligocene Lower Abiquiu Formation and the Permian Cutler Formation resting on surfaces graded to the level of the highest terraces. The largest surface, covering several square kilometers, is on La Joya del Pedregal, which is cut on the approximate contact between the Poleo Formation and Petrified Forest Formation of the Chinle Group. Most of the pediment surfaces are covered with eolian silt (**Qe**). Approximately 1to 10 m thick.

Q1s Landslide deposits (middle Pleistocene to Holocene). Unconsolidated, unsorted deposits composed of locally derived, relatively cohesive blocks of bedrock. The base often rests on shales of the Eocene El Rito or Triassic Chinle formations and top of the deposit is typically hummocky, Landslides on the northern and western flanks of Encino Point cover several square kilometers, appear to run over a rugged pre-existing topography, and often involve distinct concentrations of all three members of the Abiquiu Formation, as well as Lobato Formation. Landslides along the escarpment of the Rio Puerco are composed of Poleo Formation, typically are rotated so that top of the blocks dip toward the canyon rim, and the slides sole into the underlying shales of the Salitral Formation. Similarly, the northwest side of Naranjo Mesa is covered with a slide of Poleo Formation sandstone blocks moving on the underlying Salitral mudstone and shale. Massive landslides coming off the mesa in the northwest corner of the quadrangle sole into the Petrified Forest Formation of the Chinle Group. These deposits may be up to 35 m thick.

Qb Bandelier Tuff (Pleistocene). pumaceous air-fall tephra, nonwelded to weakly welded rhyolitic ash-flow tuff, and local volcaniclastic sediments; divided into two members, from younger to older:

Qbt Tshirege Member. White to orange to pink non-welded to weakly welded rhyolitic, ash-flow tuff (ignimbrite). The tuff contains abundant phenocrysts of sanidine and quartz, rare microphenocrysts of black clinopyroxene, trace microphenocrysts of hypersthene and fayalite, and pumice fragments in a fine-grained matrix of vitric ash. The sanidine typically displays blue iridescence. The tuff is composed of multiple flow units in a compound cooling unit (Smith and Bailey, Gardner et al., 2000); includes basal white pumiceous tephra deposits (1-2 m thick) of the Tsankawi Pumice. Qbt forms conspicuous orange to tan cliffs on a knob east of Coyote Creek and on the east side of Rito Encino south of Temoline Canyon, where the tuff infills a rugged paleotopography. $^{40}Ar/^{39}Ar$ age is 1.22 ± 0.01 Ma (Izett and Obradovich, 1994; Spell et al., 1996). Up to 30 m thick.

Qbo Otowi Member. White to pale pink, generally poorly welded rhyolitic ash-flow tuff containing abundant phenocrysts of sanidine and quartz, and sparse mafic phenocrysts; sanidine may display a blue iridescence. Contains abundant accidental lithic fragments; consists of multiple flow units in a compound cooling unit. The stratified pumice fall and surge deposit at base of unit (Guaje Pumice) is not found in this area. Qbo discontinuously fills in rugged topography on a pre Toledo caldera age volcanic surface and the upper surface can be quite undulatory due to erosion. Very difficult to distinguish from upper Bandelier Tuff in hand samples; best distinguished by poorer degree of welding, greater tendency to form slopes instead of cliffs, more abundant lithic fragments, less abundant iridescent sanidine, and stratigraphic position beneath the Tsankawi Pumice. $^{40}Ar/^{39}Ar$ ages 1.61± 0.01 to 1.62±0.04 Ma (Izett and Obradovich, 1994; Spell et al., 1996). Up to 100 m thick in the southeast corner of the area but more generally on the order of 2 to 10 m thick.

QTg Fluvial gravel (Pleistocene to Pliocene). Unconsolidated round to subround fluvial gravel . A thin gravel (<0.5 m) is present under the Otowi member of the Bandelier Tuff in the vicinity of Coyote Creek and south of Youngsville and sits on Triassic Chinle Formation. The gravel is composed primarily of clasts of rounded local Mesozoic sandstone, as well as subrounded Pedernal Chert, and Proterozoic granite and quartzite clasts recycled out of the lower Abiquiu Formation. In contrast, a gravel dominated by round Lobato Formation clasts and Tschicoma dacite, as well as Pedernal Chert and quartzitie, underlies the Tshirege member of the Bandelier Tuff along Rito Encino south of Temoline Canyon and sits on Abiquiu Formation. This gravel, which is up to 25 m thick, may correlate with the Puye Formation in the northeastern Jemez Mountains.

T1 Lobato Formation (7.2 Ma to 8.7 Ma). Includes andesites, basalt, and local dacite occurring as lavas, dikes, and vents exposed in the escarpment of Encino Point, and on Banco Largo, Cerro Pedernal, and Mesa Escoba. K-Ar ages are 7.8 ± 0.7 Ma on Cerro Pedernal and 7.9 ± 0.5 on Mesa Escoba (Manley and Mehnert, 1981). The unit sits on the Ojo Caliente member of the Tesuque Formation. In the Youngsville area, nothing caps the Lobato Formation except for occasional pockets of eolian silt (Qe).

Tld Lobato dacite (late Miocene, <7.85 Ma). Gray, weakly porphyritic, plagioclase-augite-hypersthene±biotite dacite exposed as dikes on Banco Largo (Singer, 1985).

Tla Lobato andesite (late Miocene). Dark gray, fine-grained, weakly porphyritic, plagioclase-clinopyroxene-olivine basaltic-andesite and andesite with quartz xenocrysts (Singer, 1985). Individual flows are typically 7 to 20 m thick with thin (<2m) basal pyroclastic and scoria layers associated with a shield cone at Encino escarpment (Singer, 1985). Includes remnant andesitic dikes and pyroclastic debris on Banco Largo. Singer (1985) determined a K-Ar age of 7.85 ±0.22 Ma for an andesite flow near the top of the flow sequence at Encino Point. The maximum thickness of the andesitic sequence, which includes as many as 8 flows, is ~100m (Singer, 1985).

Tlb Lobato basalt (late Miocene). Porphyritic olivine basalt on Cerro Pedernal. Phenocrysts include 23% subhedral zoned labradorite (An_5 , 12%, 1.5 mm); subhedral to euhedral olivine (9%, 2.5 mm), with strong iddingsite replacement and magnetite rims; subhedral augite (2%, 2.5 mm) containing poikilitic plag, partly twinned or with orthopyroxene reaction rims. Basal flow, 17-m thick, in a series of flows and interlayered pyroclastic beds totaling 80 m thick (Lawrence, 1979).

Tdf Debris flow deposit (late Miocene). .Local deposit north of Encino Point, along the southern edge of the quadrangle that contains volcaniclastic sediments of round pebble to cobble-size Tertiary volcanic (rhyolite, andesite, and basalt), Precambrian clasts, upper Abiquiu sandstone and Ojo Caliente sandstone. Fine to coarse-grained, tuffaceous, pebbly sandstone interbedded with volcaniclastic conglomerate of fluvial or alluvial fan origin. Sequence contains angular fragments of Lobato Formation basalt. The deposit is capped with bombs from a phreatomagmatic basaltic eruption and the entire sequence is altered and contains calcite veins. Sits on Ojo Caliente sandstone, capped by phreatomagmatic Lobato Formation. 33 m thick (Lawrence, 1979).

Tst Tesuque Formation of the Santa Fe Group (late Miocene)

Tsto Ojo Caliente member of the Tesuque Formation (late Miocene). Pink to tan-colored, well-sorted, fine-grained, cross-bedded, feldspathic and quartzo-feldspathic sandstone of eolian origin; is well-cemented and forms cliffs in the vicinity of faults, but otherwise is poorly cemented. Underlain by Abiquiu Formation with an angular unconformity of up to 10° (Lawrence, 1979) and overlain by Lobato Formation; both contacts are sharp. Up to 100 m thick.

Ta Abiquiu Formation (late Oligocene to early Miocene). Informally divided into three subunits including, from younger to older:

Tau Upper sandstone member. White, light gray, and buff-colored fine- to medium-grained, tuffaceous and volcaniclastic sandstone and mudstone, locally conglomeratic **(g)**. The upper sandstone is a slope-forming unit comprised of moderately sorted, moderately indurated volcanic detritus representing diverse lithologies including pumice, basalt, intermediate volcanics and 25 Ma Amalia Tuff. A K-Ar age of 18.9 Ma from a basalt near the top of the unit and an Ar/Ar age of an Amalia Tuff clast of 25 Ma near the base bracket the age of the unit (Smith et al., 2002, Moore, 2000). ~150 m thick (Lawrence, 1979) to 315 m thick (Moore, 2000).

Tap Pedernal Chert member. Varicolored, white, blue to gray, black, cryptocrystalline, massive chert, limey chert, and limestone containing nodular chert, conspicuous ledge former, 2 to 35 m thick. The chert is locally interlayered with thin beds of arkosic sandstone and conglomerate and is typically more limey at its base.

Tal Lower conglomerate member. Pinkish tan to gray, generally coarse arkosic conglomerate and fine- to medium-grained sandstone, slope forming. The lower conglomerate member is poorly sorted, weakly to moderately indurated, calcareous, and characterized by well rounded pebble to boulder-size (up to 50 cm) clasts composed of Precambrian quartzite, granite, pegmatite, gneiss and schist, as well as fine-grained (Madera?) limestone and mudstone. K-Ar ages on a basalt near the base of the unit northeast of the quadrangle and 40Ar/39Ar ages on Amalia Tuff in the upper Abiquiu bracket the age of the unit between 25.1 and 27 Ma (Smith et al., 2002, Moore 2000). ~100 m thick

Ter E1 Rito Formation (Eocene). Orange-red to brick-red, hematitic, micaceous mudstone and siltstone and lenses of fine- to medium-grained arkosic sandstone, slope forming,. The E1 Rito Formation locally has a 2-to 10-m-thick basal conglomerate section made up of very well rounded hematitic Proterozoic Ortega quartzite, as well as Proterozoic schist and gneiss cobbles and boulders (up to 1 m) in a weakly to well indurated matrix of coarse ferruginous sand. Underlies the Abiquiu Formation and overlies Cretaceous Mancos Shale, Dakota Sandstone, or Jurassic Morrison Formation with erosional unconformity. Estimated 50 to 140 m thick

Km Mancos Shale (Late Cretaceous). Dark gray and brown, weakly consolidated, calcareous, carbonaceous shale and interlayered thin beds of fossiliferous orange silty limestone, slope forming,. Only the lowermost part of the section is locally present; upper contact is an erosional unconformity of moderate relief. 0 to 65 m thick

Kd Dakota Sandstone (Late Cretaceous). Tan to yellow-brown, fine-grained quartzose sandstone, well sorted, locally kaolinitic. The lowest part of the unit contains local fluvial channels with rare white to gray to tan chert pebbles, which may correspond to the Encinal Canyon member of the Dakota Sandstone (Aubrey, 1986). The Dakota Formation in the western part of the area tends to have cross-bedded sandstone at the base and interbedded shale and sandstone upsection. Thick to thin-bedded to massive. Locally contains thin interbeds of black, carbonaceous shale.. Conspicuous as a cliff former, 60 to 67 m thick.

Kbc Burro Canyon Sandstone (Cretaceous). White to tan, fine-grained, kaolinitic, quartzose sandstone, moderately to well indurated. Contains abundant thin beds of chert and quartz pebble conglomerate. The rounded chert pebbles are usually tan, white, and gray, and rarely black to red and much of the chert is tripolitized (Saucier, 1974; Aubrey, 1986). Locally exhibits medium-scale cross bedding. Thin light green to pink mudstone is interbedded with the conglomeritic sandstone, indicating recycling of the underlying Brushy Basin mudstones (Saucier, 1974). Conspicuous cliff-forming unit, thick bedded to massive, 57 to 67m thick.

We follow the Jurassic stratigraphy for the Chama Basin outlined by Lucas and Anderson (1998).

Jm Morrison Formation (Late Jurassic)

Jmb - Brushy Basin Member. Variegated green to reddish orange to dark reddish brown siltstone and grayish-white to gray, very fine-grained subarkosic, cross-bedded sandstone, slope forming, 110 m thick.

Js Summerville Formation (Late Jurassic). The basal 8 to12 m of this unit consists of white to light gray, fine- to very fine grained quartzose sandstone, thin-bedded, containing small-scale ripple marks, gypsum blade casts, and soft-sediment deformation. The basal sandstone is overlain by variegated maroon and gray quartzose to subarkosic siltstone. This unit tends to form slopes. The upper contact is the stratigraphically highest maroon siltstone that contains abundant pedogenic carbonate concretions, located above the Bluff Sandstone interval. The Bluff Sandstone, a tan fine grained, cross-bedded sandstone that is about 10 m thick, is included in the Summerville Formation on this map. Approximately 60 m thick.

Jt Todilto Formation. (Late Jurassic). White to gray, dominantly fine-grained, massive gypsum, sloping-forming unit; with a 2- to 3-m-thick basal section of gray, laminated, fissile shale and/or thin-bedded limestone. In one locality, a limestone breccia with angular to subrounded clasts overlies the gypsum. Hilpert (1969) describes the uranium mine in Box Canyon. Mineralization at Box Canyon is associated with a fault and includes tyuyamunite/metatyuyamunite (W. Berglof, personal communication, 2004), hematite, chalcopyrite, and calcite. Total unit thickness up to 26 m (Lawrence, 1979).

Je Entrada Sandstone (Late Jurassic). White, pink, and yellowish tan, fine- to very fine-grained quartzose sandstone, well sorted, moderately indurated, exhibits large-scale eolian dunal cross-bedding; a cliff former. The sandstone is 61 m thick in the NE1/4, sec. 22, T. 22N, R3E on the east side of Coyote Creek (Lawrence, 1979).

TRc Chinle Group (Late Triassic). Three informal units are mapped at the 1:24,000 scale, from younger to older:

TRcu an upper unit that contains the Rock Point Formation and Painted Desert member of the Petrified Forest Formation. The Petrified Forest Formation is composed of an upper red-brown mudstone-dominated section (Painted Desert member) (Lucas et al. 2003). Both the upper and lower contacts of this formation are gradational. The Petrified Forest Formation is up to 176 m thick. The stratigraphically highest unit in the Chile Group is the Rock Point Formation, reddish brown to gray-red siltstone and fine-grained sandstone that is 0-70 m thick (Lucas et al., 2003). 100 m of this upper unit is exposed in NW1/4, sec. 22, T22N, R3E on the east side of Coyote Canyon (Lawrence, 1979).

TRcp Mesa Montosa member of the Petrified Forest Formation and the Poleo Formation. The basal red-brown to green laminated sandstone-dominated section of the Petrified Forest Formation (Mesa Montosa member) was lumped with the yellow-brown, yellow- gray, white and red medium to fine-grained, micaceous, quartzose sandstone, conglomeritic sandstone and conglomerate of the Poleo Formation because the contact is between the two is gradational and thus hard to map. The conglomerate in the Poleo Formationis often black and contains both intrabasinal siltstone clasts and extrabasinal siliceous clasts; locally cross-bedded. This unit forms prominent cliffs. The base of the unit is sharp (corresponds to the Tr-4 unconformity of Lucas (1993)) and the upper contact is gradational into the overlying Painted Desert member of the Petrified Forest Formation. The Poleo Formation is about 48 m thick and the Mesa Montosa member is 4 m thick at the Piedra Lumbre section of Lucas et al., 2003 located along the Rio Puerco just north of the quadrangle boundary. However the thickness of the Poleo thins dramatically toward the southwest of this measured section and the Mesa Montosa member thickens in concert. This unit marks the beginning and end of sandstone deposition in the Chama Basin during Chinle time.

TRcl a lower unit that contains the Salitral Formation and the Shinarump Formation (TRcs). The Shinarump Formation consists of white quartz sandstone, conglomeritic sandstone, and extrabasinal conglomerate that includes clasts of quartz, chert, and quartzite (Lucas et al., 2003). Petrified wood is common. Both the basal and upper contacts are sharp; the basal contact corresponds to the Tr-3 unconformity of Lucas (1993). In places on the map, the Shinarump Formation (**TRcs**) is shown as a distinct unit. The Salitral Formation is an olive-gray to brown sandstone to silty mudstone near the base (Piedra Lumbre member) and a reddish brown mudstone (Youngsville member) near the top. Upper bed of the Piedra Lumbre member, called the El Cerrito Bed, is a local yellow to brown intraformational conglomerate (Lucas et al. 2003). In places an orange chert that formed on a paleo-weathering horizon marks the contact between the Piedra Lumbre member mudstone and the Youngsville member siltstone units. The Salitral Formation varies greatly in thickness, ranging from 3 to 30 m.

Py Yeso Formation (Permian)

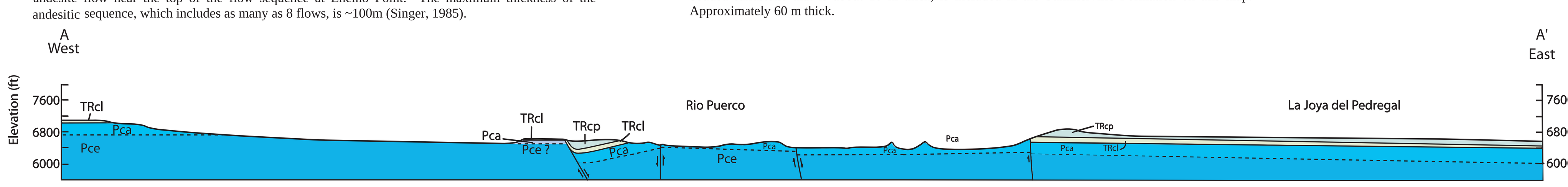
Pym Mesita Blanca member. Red to red-brown, cross-bedded, fine-grained, moderately sorted quartz sandstone with angular to subrounded grains. Pinches out toward the north in Coyote Creek. Capped by a paleo-weathering horizon. Lucas and Krainer (2005) recommend following the suggestion of Baars (1962). Baars (1962) suggests that Permian eolian sandstone in northern New Mexico be assigned to the De Chelly Sandstone. 0 to 10 m thick.

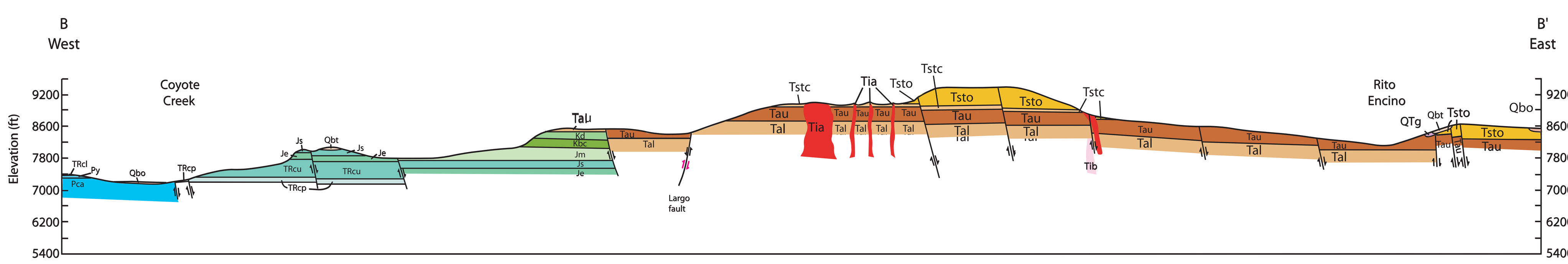
Pc Cutler Group (Late Pennsylvanian - Early Permian). Two formations are recognized in the Chama Basin (Lucas and Krainer, 2005):

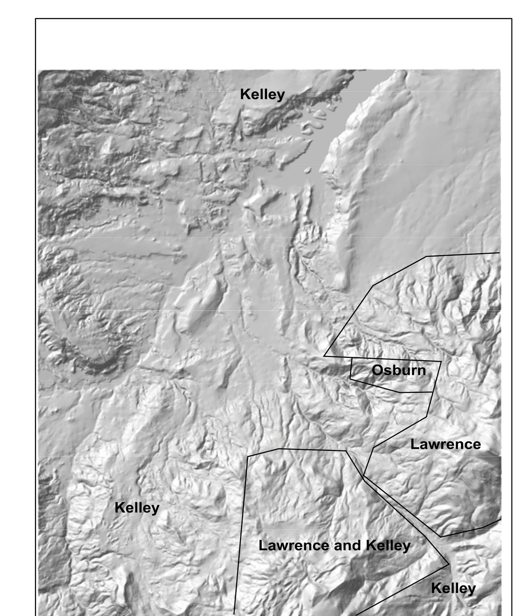
Pca Arroyo del Agua Formation. Orange-red micaceous siltstone with thin, trough cross-bedded sheet arkosic sandstone. Contains extensive calcrete nodule horizons. Little conglomerate is present in this formation; both intraformational and extraformational (quartzite other Proterozoic rocks) clasts are present in the rare conglomerate beds This unit tends to form slopes. Conformably overlies the El Cobre Canyon Formation. Underlies the Triassic Shinarump Formation with a slight angular unconformity. Up to 120 m thick.

A thick channel that contains well-rounded quartzite, metaconglomerate, granite, and granitic gneiss cobbles is exposed at the top of the formation on the east side of Mesa Naranja. Quartzite is gray, green, yellow, and rarely white, some clasts are from a highly strained quartzite source. Eberth (1987), Eberth and Miall (1991), and Eberth and Berman (1993) referred to this unit as megasequence 3.

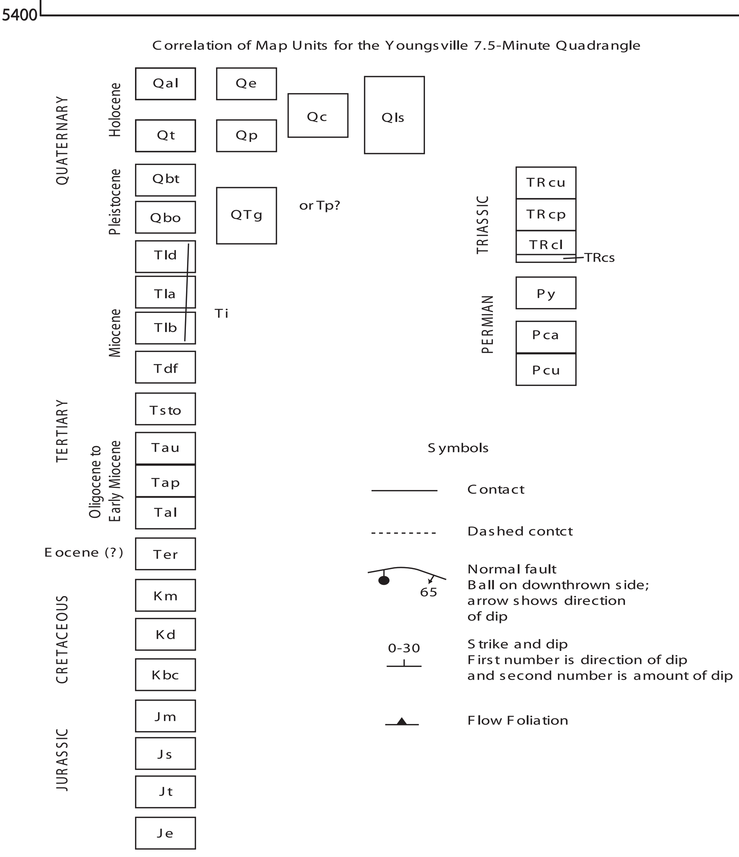
Pce El Cobre Canyon Formation. Dark brown siltstone and sandstone with extrabasinal conglomerate containing clasts of quartzite and other Proterozoic metamorphic rocks. The sandstone bodies are multistoried with relatively thin brown siltstone interbeds. The top of the unit is defined as the base of the first orange siltstone bed (Lucas and Krainer, 2005). Up to 500 m thick (Lucas and Krainer, 2005).







Youngsville Mapping Responsibilities



Photograph of steeply dipping Poleo Formation sandstone and conglomerate apparently overlain by a relatively flat-lying Poleo conglomerate in the background above the backpack. View towards the east. UTM coordinates 358160 4008640 (NAD 27).

Photograph of the steeply dipping Poleo Formation near fault at UTM coordinates 358890 4001550 (NAD 27). View to the northeast.

Photograph of Poleo Formation conglomerate apparently sitting on the northeastern end of the block shown in the figure above.