GEOLOGIC MAP OF THE CARRIZOZO EAST 7.5-MINUTE QUADRANGLE, LINCOLN COUNTY, NEW MEXICO

BY

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INTRODUCTION

Below are descriptions for geologic map units depicted in the Carrizozo East 7.5-minute quadrangle, New Mexico. The namesake of the quadrangle, the town of Carrizozo, is located in the southwest corner of the map. U.S. Highway 54 extends across the western half of the quadrangle and U.S. Highway 380 crosses the southwestern quadrangle. Most of the map area is used for cattle grazing. Grassland characterizes the vegetation over much of the quadrangle, although pinon-juniper woodland covers uplands near the eastern quadrangle boundary. Average annual precipitation is 28 to 43 cm (11 to 17 inches) and the average annual air temperature is 7 to 13° C (45-56° F; Sprankle, 1983).

The topography in most of the quadrangle is a gently west-sloping alluvial plain (or alluvial slope). Two important, generally dry, drainages traverse this plain: White Oaks Draw to the north and Nogal Arroyo to the south. White Oaks Draw drains highlands in the vicinity of White Oaks (east of the northeast corner of the quadrangle) and Nogal Arroyo extends around Church Mountain to the town of Nogal (southeast of the quadrangle). The alluvial plain is generally underlain by Quaternary alluvium. A number of prominent hills are found between the northeast corner and center of the quadrangle. These hills include Baxter Mountain (in the northeast corner), Bald Hills, and two smaller, conical hills south of the Bald Hills. Steep slopes associated with the foot of Carrizozo Peak are found along the eastern quadrangle boundary, but most of the peak is located in the next quadrangle to the east. Baxter Mountain is topped by metamorphosed Gallup Sandstone, whereas the other aforementioned hills are associated with sills that cap Cretaceous strata. Low, sparsely wooded hills along the western quadrangle boundary, south of White Oaks Draw, are underlain by Gallup Sandstone. Slightly raised topography associated with this formation extends eastward immediately south of White Oaks Draw.

In the northeast corner of the quadrangle, in the vicinity of Baxter Mountain, is the White Oaks Mining District. Gold, and to a lesser extent, tungsten, were the primary metals produced by the White Oaks Mining District, which was primarily active from 1880 until the early 1900s (Varney, 1981). Only one important mine, the Homestake South, is located on this quadrangle. The other prominent producers are located within 1.6 km (1 mi) north of the northeast corner of the quadrangle.

DESCRIPTION OF MAP UNITS

We arrange map units in the Carrizozo East quadrangle into three categories: 1) Quaternary, 2) igneous intrusions, and 3) Cretaceous fluvial and marine strata. Quaternary units on this quadrangle are grouped into the following three categories: 1) sheetflood and eolian deposits, 2) debris flow and hillslope deposits, and 3) alluvial deposits.

These units were mapped by field traverses, orthophotos, and aerial photography (White Sands Missile Range project, January and March of 1986). Field mapping emphasized bedrock units, particularly igneous intrusions, whereas aerial photography and orthophotos were used for much of the Quaternary deposits. Aerial photographs from the White Sands Missile Range project only cover the western 50-65% of the quadrangle. Aerial photographs that covered the eastern quadrangle (from the U.S. Forest Service) were ordered but did not arrive before the map deadline. Consequently, Quaternary mapping of the eastern 40% of the quadrangle is of lesser quality compared to the western 60% of the quadrangle. Note that access restrictions prohibited field-checking in the extreme southeast corner of the quadrangle.

Grain sizes follow the Udden-Wentworth scale for clastic sediments (Udden, 1914; Wentworth, 1922) and are based on field estimates. Pebbles are subdivided as shown in Compton (1985). The term “clast(s)” refers to the grain size fraction greater than 2 mm in diameter. Descriptions of bedding thickness follow Ingram (1954). Colors of sediment are based on visual comparison of dry samples to the Munsell Soil Color Charts (Munsell Color, 1994). Soil horizon designations and descriptive terms follow those of the Soil Survey Staff (1992), Birkeland et al. (1991), and Birkeland (1999). Stages of pedogenic calcium carbonate morphology follow those of Gile et al. (1966) and Birkeland (1999). Discussion of a unit’s age control is presented in the accompanying report. The report also presents interpretations regarding structure and geologic history.

SHEETFLOOD AND EOLIAN DEPOSITS

Note: These two deposits are grouped together because most eolian sheet deposits have been affected to some degree by sheetflooding

Qse **Sheetflood and eolian deposits (uppermost Pleistocene to upper Holocene) –** Very fine-lower to medium-lower sand (mostly fine-upper sand) and silty-clayey fine sand (5-15% estimated volume for fines). Color of light yellowish brown to yellowish brown to dark yellowish brown (10YR 5-6/4 and 4-5/6) to pale brown (10YR 6/3) to very pale brown (10YR 7/4). Locally at depth, color changes to brownish yellow (10YR 6/6). Internally massive, but at base of tall slopes there may be thin to medium, lenticular beds of sandy pebbles. Minor, variable medium-upper to very coarse-upper sand and very fine to very coarse pebbles of sandstone and calcium carbonate (felsic igneous clasts are common in eastern half of quadrangle). Grains are subrounded to subangular, moderately to moderately well sorted, and composed of quartz, 15-20% feldspar, and 7-15% lithic and mafic grains. Pebbles are subangular to angular. Upper 0.5-1.0 dm is loose; below, sediment is harder and marked by ped development. Typically there is a pebble lag on the surface (10-20% surface coverage by pebbles). At base of tall slopes there may be Unit appears to have somewhat higher amounts of feldspar and lithic grains than found in the Gallup Sandstone. Unit includes minor coppice dunes, generally < 1 m-tall. Sand in dunes is very pale brown (10YR 7/4), fine-lower to medium-lower (mostly fine-upper), subrounded to subangular, well-sorted, and composed of quartz, ~15% feldsar, and 8% lithics and mafics. Unit grades laterally into unit Qay and defining the contact between the two is difficult. Unit is less than 1 m-thick, but may be thicker at the base of steep slopes.

Qse/Kgs Sheetflood and eolian deposits overlying Gallup Sandstone – Sheetflood and eolian deposits, as described in unit **Qse**, which overlie Gallup Sandstone. Generally less than 1 m-thick.

Qse/Qao Sheetflood and eolian deposits overlying older alluvium – Sheetflood and eolian deposits, as described in unit **Qse**, which overlie older alluvium. Generally less than 50 cm-thick.

Qecr **Coppice dunes on a sand ramp (upper Holocene) –** Coppice dunes on an eolian sand ramp; dunes are up to 2 m-tall, commonly centered around junipers. Sand color of reddish yellow to brownish yellow (7.5-10YR 6/6) to very pale brown (10YR 7/4). Sand is mostly fine-upper grain size, with lesser fine-lower or medium-lower grain sizes, and subrounded to subangular, well-sorted, and composed of quartz, ~5% feldspar, and 5-10% gray lithic grains and black mafic grains. Loose. Eolian sand ramp thickness is estimated at 1-6 m.

DEBRIS FLOW AND HILLSLOPE DEPOSITS

Qdct Debris flow deposits, colluvium, and talus (upper Pleistocene to Holocene) – Poorly sorted and well-graded, commonly matrix-supported pebbles through boulders in a sandy or clayey-silty sand matrix. Gravel are angular to subrounded; gravel composition varies with source lithology of a given drainage. Matrix is light yellowish brown (10YR 6/4), very fine- to very coarse-grained sand that isporly sorted and subangular to subrounded. Variable clay and silt (1-15% of sediment volume, estimated). Moderately consolidated. 1-12 m-thick.

Qlsbm Landslide deposit on slopes of Baxter Mountain (middle to late Pleistocene) – Cobbles and boulders (and minor pebbles) composed of quartzitic Gallup Sandstone and pebbles to cobbles of Mancos Shale and/or Baxter Mountain melatrachyte in a matrix of disarticulated (ground-up) Mancos Shale. No bedding. Sandstone clasts are very poorly sorted and angular to subrounded. Shale clasts are angular. Matrix is light yellowish brown (2.5Y 6/3) sand with an estimated 10-15% clay. Sand is very fine- to very coarse-grained, and poorly sorted. Medium- to very coarse-grained sand is comprised of angular to subrounded pieces of Mancos Shale. Very fine- to fine-grained sand is composed of subrounded to subangular quartz, grains of Mancos Shale, and minor feldspar. 1-15(?) m-thick.

Qlswoc Landslides on west slope of the mouth of White Oak Canyon (upper Pleistocene to Holocene) – Slump blocks within the D-cross Tongue of Mancos Shale or the lower Crevasse Canyon Formation, locally capped by fractured, transported trachyte sill. 2-10(?) m-thick.

Qlscp Landslide deposits on slopes of Carrizozo Peak (lower to middle Pleistocene) – Very poorly sorted pebbles, cobbles, and boulders, composed of Carrizozo Peak trachyte-syenite complex, in a sandy matrix. Clasts are well-graded, subrounded (mostly) to subangular, and monolithic. There is a single, 2 m-thick tabular zone where syenite-trachyte clasts are mixed with yellow, clayey-silty very fine-grained sandstone (from Crevasse Canyon Formation?). Matrix is very fine- to very coarse-grained sand that is well-graded, subangular to subrounded, and composed of igneous syenite-trachyte fragments with ~5% gypsum and/or calcite. Moderately consolidated. Greater than 30 m-thick.

QTls Outlier landslide remnants west of Baxter Mountain (upper Pliocene to middle Pleistocene?) – Jumbled boulders of Gallup Sandstone (metamorphosed to quartzite) in a finer-grained matrix. No intact bedding. No exposure. Up to 20 m-thick.

ALLUVIAL DEPOSITS

Qay **Younger alluvium (Holocene) –** Very fine- to fine-grained sand, with minor medium- to very coarse-grained sand and scattered (commonly 3-15%) pebbles. Unit generally is inset below the top of adjoining **Qao** deposits and has a relatively weak soil. Colors of grayish brown to brown (10YR 5/2-3), light brownish gray to pale brown (10YR 6/2-3), or grayish brown to light olive brown (2.5Y 5/2-3). Sediment becomes redder near the base of the deposit (brown to strong brown, 7.5YR 5/4-6). Variable clay-silt mixed with sand, typically 1-10% fines (estimated volume) but ranging up to 40%. Typically massive, with varying degrees of bioturbation. Sand is moderately to poorly sorted and subrounded to subangular. Medium- to very coarse-grained sand is generally lithic grains (igneous detritus, sandstone, hornfels, or shale – depending on source area) whereas very fine- to fine-grained sand is composed of quartz, feldspar, and lithic grains. 1-10% very thin to medium (mostly thin), lenticular beds of medium to very coarse sand and gravel. Gravel is generally pebbles with minor, variable amounts of cobbles. Clasts are subrounded to subangular (locally rounded), poorly sorted, and locally imbricated. Clast composition varies with source area. In White Oaks Draw, gravel consist of felsic igneous clasts, sandstone, hornfels, and shale. Generally, there is a cumulic soil developed throughout the sediment. Ped development is moderate to strong, medium to very coarse, subangular blocky to prismatic; peds are generally hard in a dry state. Clay illuviation is marked by faint to very faint clay films on ped faces and faint clay bridges. Calcium carbonate accumulation is characterized by a stage I to I+ carbonate morphology. Minor gypsum accumulation below a meter depth. Locally, a sandier subunit (<1 m-thick) is found at the top of this unit, disconformably overlying older **Qay** strata; containing minor pebbles (10-20%), this upper unit exhibits very thin to thin, lenticular bedding or horizontal-planar laminations. In White Oaks Canyon, gravel beds are common in this unit (clast-supported pebbles and cobbles with lesser boulders), fining-upward into the finer-grained deposits described above. Weakly to moderately consolidated, mostly moderately consolidated. Unit includes minor modern and historical alluvium that are generally in narrow, incised arrows. Typical thickness of 1-3 m.

Qao **Older alluvium (middle to late Pleistocene) –** Deposit of variable texture that underlies higher geomorphic surfaces and typically has a strong calcic horizon on or near its surface. Typically a sandy gravel near topographic highs along the eastern border of the quadrangle, but within a few kilometers the sediment grades laterally eastward into interbedded sand (mostly fine sand), slity-clayey fine sand, silt, and clay, with 1-5% intercalated pebble-cobble beds. Gravel is locally scattered withyin finer sediment. Colors of pale brown to very pale brown (10YR 6-7/3) or pale yellow (2.5Y 7/3) or light yellowish brown (2.5Y-10YR 6/4). Non-gravelly sediment is generally in very thin to medium, tabular beds. Gravel beds are very thin to medium and lenticular. Deposit is commonly gypsiferous (1-15% gypsum filaments comprised of sand-size gypsum grains). Gravel are subrounded to angular, poorly sorted, and composed of various igneous clasts, with sandstone and hornfels common in the northeast corner of the quad. Sand is generally subrounded to subangular and moderately to poorly sorted. Medium- to very coarse-grained sand is composed of lithic grains; very fine- to fine-grained sand is composed of quartz, feldspar, and minor lithic grains. A soil with a strong calcic soil horizon (stage II+ to III carbonate morphology) has formed on the surface of this unit; this calcic horizon has moderate to strong, very fine to coarse, subangular blocky peds that are slightly hard to very hard. Except where removed by erosion, a strong brown to reddish yellow (7.5YR 5-6/6) Bw or illuviated clay (Bw) soil horizon overlies the calcic soil. Stratigraphic relations 0.5-1.0 km southeast of Fetters Spring indicate significant erosion followed deposition of this unit and the strong calcic soil found on the unit's surface formed after this erosion event. Weakly to moderately consolidated. Sandy-pebbly channel-fills transmit groundwater in this unit, which discharges at two localities on the quadrangle: Carrizozo spring and Fetters spring – both of which are marked by relatively low discharges.

Unit **Qao** underlies a geomorphic surface that is 1-10 m lower than the surface on unit **QTa**. However, we cannot state with confidence that **Qao** is a distinct deposit; in other words, mapped **Qao** may be equivalent to an eroded **QTa**. An exposure of **QTa** (data point C-497 on map) and an exposure of **Qao** (data point C-361 on map) exhibit similar sediment characteristics. At exposure C-497, 1.5 – 2.0 m of sediment underlies the surface associated with **Qao**, and this sediment is inset into **QTa**. However, this relatively thin, inset sediment was not observed at exposure C-361. Because of this uncertainty, we do not know the thickness of **Qao**. Combined thicknesses of **Qao-QTa** are discussed under unit **Qao-QTa**.

Qao-QTa **Combined unit of Qao and QTa (upper Pliocene to upper Pleistocene) – Used in cross-section A-A' only.** Because of uncertainty associated with the base of **Qao**, this combined unit is used in cross-section A-A'. Three wells and an alluvium isopach map (obtained from a local landowner, Stirling Spencer, who in turn received it from a coal mining company) were used to estimate the base of this unit in the cross-section. The isopach map was constructed from coal prospect borings and indicates a westward-trending paleovalley associated with Nogal Draw. Unit **Qao-QTa** is about 30 m-thick in this paleovalley and about 15-20 m-thick on either side. The unit thins south of Nogal Draw. Near Carrizozo, well data suggest a bedrock high near the north part of town (**Qao-QTa** thicknesses of 5-7 m at the Cimarron Mining Corporation site) and deeper alluvium to the south (26 m at well T-3271).

QTa **Alluvium underlying high-level surfaces in the northeastern quadrangle (upper Pliocene to middle Pleistocene) –** Sandy pebbles-boulders (mostly cobbles to boulders) that are poorly to non-bedded; generally interpreted as debris flow deposits. Gravel are subrounded (mostly) to subangular, very poorly sorted, and composed of Carrizozo Peak syenite-trachyte; maximum observed boulder length is about 2 m. Sand is light yellowish brown to pale yellow (2.5Y 6/3-7/4) or light gray to very pale brown (10YR 7/2-3), very fine- to very coarse-grained, angular to subangular (mostly) to subrounded, and poorly sorted. Medium to very coarse sand is composed of trachyte-syenite grains, and very fine to fine sand is composed of trachyte-syenite grains, quartz, and feldspar.

Along White Oaks Canyon, lower 2-3 m of deposit is mostly imbricated sandy gravel. Bedding is generally vague, thin-medium, and lenticular; locally cross-stratified (2 m-thick foresets). Gravel consists of well-graded pebbles-boulders of diverse lithologic types. Clasts are subrounded to subangular and include Carrizozo Peak syenite-trachyte, other igneous rock types (mostly felsic), hornfels, and sandstone. Sand is light gray to very pale brown (10YR 7/2-3), fine- to very coarse-grained (mostly coarse- to very coarse-grained), poorly sorted, and includes a well-graded mixture of quartz, feldspar, and lithic grains. Moderately consolidated. 12 m-thick.

Ta **High-level gravel in northwest corner of quadrangle (Pliocene?) –** Gravel consisting of very fine to very coarse pebbles, cobbles, and ~15% boulders. Clasts are subrounded (mostly) to subangular and poorly sorted. Gravel are composed of trachyte-syenite, minor sanstone and hornfels, and 1-3% limestone. Exposure does not permit observations of bedding. All clasts have thick calcium carbonate coats and there is evidence of a stage IV calcic horizon on the surface of this unit. At least 6 m-thick.

Igneous intrusions

Baxter Mountain melatrachyte

The Baxter Mountain melatrachyte is a distinctive, darker igneous rock that intruded around Baxter Mountain. The largest intrusion is a stock in the vicinity of the South Homestake Shaft. A multitude of dikes emanate south from this stock as far as White Oaks Draw. On the southwest slopes of Baxter Mountain, this igneous rock occurs as both sills and dikes. This rock cross-cuts other syenite-trachyte igneous rocks and appears to be the youngest intrusive rock in the quadrangle. We assign a tentative late Oligocene age to this intrusion. Various degrees of hydrothermal alteration occurred in this rock on the east side of Baxter Mountain. Fluids evidently preferred to flow through this rock than the lower-permeability Mancos Shale. This fluid flow likely occurred shortly after the emplacement on the intrusion and is associated with mineralization. Most of the prospect pits, adits, and shafts in the northeast quadrangle are associated with this unit.

Tibmt **Baxter Mountain melatrachyte (upper(?) Oligocene) –** Light gray to very light yellowish gray, porphyritic trachyte with significant amounts of mafic phenocrysts. Phenocryst assemblage includes: 7-15% mafic minerals, 0.2-6.0 mm long and euhedral to subhedral, and 12-15% potassium feldspar phenocrysts, 0.5-6.0 mm-long and euhedral to subhedral. Mafic minerals are mostly augite and hornblende, with minor and variable amounts of biotite. Hornblende phenocrysts may be up to 20 mm in length. Mafic minerals locally "plucked" or dissolved, leaving casts. Groundmass is 0.1-0.2 mm in size and consists of feldspar with 25% mafic minerals. Unit correlates to melatrachyte of Grainger (1974).

Tibmtd **Baxter Mountain melatrachyte dike (upper(?) Oligocene) –** Light gray to very light yellowish gray, porphyritic trachyte with significant amounts of mafic phenocrysts. Phenocryst assemblage includes: 7-13% mafic minerals, 0.2-5.0 mm long (locally as much as 22 mm-long) and euhedral (mostly) to subhedral, and 10-20% potassium feldspar phenocrysts, 0.3-6.0 mm-long and subhedral (mostly) to euhedral. Mafic minerals are mostly augite and hornblende, with minor and variable amounts of biotite. Hornblende phenocrysts may be up to 20 mm in length. Groundmass is 0.1 (mostly) to 0.5 mm and composed of potassium feldspar with ~10% mafics. Unit correlates to melatrachyte of Grainger (1974). Locally, megacrysts of hornblende or potassium feldspar are present (up to 30 mm). Dikes are up to 4 m-wide. Mapped as a line only.

Tibmts **Baxter Mountain melatrachyte sill (upper(?) Oligocene) –** Similar to unit Tibmt, but in a sill form.

Tibmta **Altered Baxter Mountain melatrachyte (upper(?) Oligocene) –** Yellowish to reddish orange, porphyritic trachyte that has been notably hydrothermally altered. Phenocryst assemblage includes: 8-20% mafic minerals, 0.1-8.0 mm long and euhedral to subhedral, and 0-20% potassium feldspar phenocrysts, 1-5 mm-long and subhedral. Mafic minerals are mostly augite and hornblende, with minor and variable amounts of biotite. Hornblende phenocrysts may be up to 20 mm in length. Unit correlates to melatrachyte of Grainger (1974).

Tibmtad **Altered Baxter Mountain melatrachyte dike (upper(?) Oligocene) –** As in unit **Tibmta**, but occurring in sub-vertical dikes1 to 4 m-wide. Unit locally mineralized and was the focus of past mining activity. Locally silicified. Phenocrysts consist of: 1) 5-20% 1-10 mm-long potassium feldspar (mostly 0.5-3.0 mm) that is locally replaced by bluish-gray minerals; 2) 10-15% pyroxene and hornblende that are commonly dissolved and replaced by a rusty, fine-grained substance (goethite or limonite). Mafic casts are typically 0.5-6.0 mm. Hornblende casts are as much as 20 mm-long. Matrix is about 0.1-0.5 mm grain-size and composed of potassium feldspar with 3-5% mafic minerals. Locally trace to 1% biotite. Unit correlates to melatrachyte of Grainger (1974). Dikes are up to 4 m-wide. Mapped as a line only.

Tibmtas **Altered Baxter Mountain melatrachyte sill (upper(?) Oligocene) –** Altered Baxter Mountain melatrachyte in a sill. Pinkish white, weathering to very pale brown. Similar to unit **Tbmtad;** locally, some of the mafic grains are biotite. Unit correlates to melatrachyte of Grainger (1974).

Andesite

A single stock(?) of andesite was identified near the mouth of White Mountain Canyon. This stock appears to cross-cut a sill of trachyte and is thus younger than the trachyte. We suspect this andesite is a less-alkalic derivative of the Baxter Mountain melatrachyte.

Tiap **Porphyritic andesite (lower to upper Oligocene) –** Gray color, weathering to an orangish gray. Matrix is mostly 0.1-0.3 mm (grain size) and composed of feldspar laths with 1-20% hornblende, pyroxene, and biotite. Phenocrysts comprise 3-10% of rock surface area and consist of 0.2-10 mm-long pyroxene, hornblende, and +/- biotite. Unit correlates to andesite of Grainger (1974).

Tibap **Baxter Mountain porphyritic andesite (upper Eocene?) –** Bluish gray, weathering to a brown varnish. Groundmass is composed of 0.2-0.5 mm plagioclase with 20-25% anhedral mafic minerals. Phenocrysts include: 1) 20-25% plagioclase (0.5-5.0 mm-long and subhedral); 2) 15% of an unknown, granular, greenish mineral forming subhedral phenocrysts; and 3) 3-5% augite (1-8 mm-long and euhedral to subhedral). Unit appears to have intruded into a trachyte sill (**Tits**).

Tiapd **Porphyritic andesite dike (lower to upper Oligocene) –** Porphyritic andesite, as described in unit **Tiap**, but in a dike form.

Tiaps **Porphyritic andesite sill (lower to upper Oligocene) –** Porphyritic andesite, as described in unit **Tiap**, but in a sill form.

Syenite-trachyte stocks, sills and dikes

Portions of two large stocks of trachyte are found in the northeastern part of the quadrangle. To the south is the Carrizozo Peak syenite-trachyte complex. Finer-grained trachyte is found in the map area, but to the east this trachyte appears to grade into a syenite. Various sills and dikes of trachyte that are mapped in White Oaks Canyon are probably associated with the Carrizozo Peak syenite-trachyte complex. These trachytes are invariably cross-cut by the Baxter Mountain melatrachyte and thus pre-date that unit. North of Baxter Mountain is a distinctive prophyritic syenite-trachyte that occurs as a stock in the north-central part of the main White Oaks mining area. We informally refer to this as the White Oaks syenite-trachyte complex. This intrusion has larger alkali feldspar phenocrysts than the Carrizozo Peak syenite-trachyte complex. On the northwest slopes of Baxter Mountain, north-striking dikes of the White Oaks syenite-trachyte complex extend south onto this quadrangle. Here, a dike of Baxter Mountain melatrachyte cross-cuts the trachyte-syenite and thus the trachyte-syenite is older. Felsic tuffs have returned ages of 28-29 Ma in the Sierra Blanca volcanic complex. Felsic intrusions in the Gallinas Mountains (trachyte, syenite, and rhyolite) have been dated by the K/Ar method at 29.9 Ma (Perhac, 1970).

Thus, a 28-29 Ma age is reasonable for the syenite and trachyte intrusions on this quadrangle.

Carrizozo Peak igneous complex

Ticpst Carrizozo Peak syenite-trachyte complex (lower to upper(?) Oligocene) – Porphyritic syenite-trachyte complex that composes Carrizozo Peak, a landmark located about 1 km east of the eastern quadrangle boundary. Rock is very light gray weathering to pale yellow. Groundmass is potassium feldspar (0.1-0.4 mm grain size). 0.5-3% phenocrysts composed of subhedral potassium feldspar 0.5-5.0 mm-long; phenocrysts have been locally altered. Trachyte predominates on this quadrangle, which is inferred to laterally grade eastward into syenite at the core of the complex.

Titd Trachyte dike (lower to upper(?) Oligocene) – Trachyte dike that is non- to variably (but minor) altered. Non-altered rock is white and composed of feldspar (probably potassium feldspar). 0.1-0.3 mm grain size. 3-4% mafic minerals (probably pyroxene and hornblende) that includes some biotite. Rock has a foliated or sheared fabric. Within sheared areas are grayer or oranger zones containing north-south elongated vugs, many of which are filled by quartz. Generally less than 8 m-wide.

Tits Trachyte sill (lower to upper(?) Oligocene) – Slightly to non-porphyritic trachyte sill that is non- to variably (but minor) altered. Non-altered rock is white to orangish white to very pale brown, weathering to various orange and tan shades. Groundmass is composed of feldspar (probably potassium feldspar) of 0.1-0.5 mm grain size. 0-4% mafic minerals (probably pyroxene and hornblende) that includes some biotite. <2% phenocrysts, which include potassium feldspar (up to 4 mm-long and subhedral) and mafic grains (0.3-3.0 mm-long hornblende or pyroxene). Locally FeO stains on fracture faces.

Titbs Trachyte sill at Bald Hills (lower to upper(?) Oligocene – Slightly porphyritic trachyte sill that caps the Bald Hills. Groundmass is aphanetic and white to light gray. Rock weathers to light gray. 1-3% phenocrysts that are 0.2-2.0 mm, anhedral, and composed of pyroxene(?) and biotite. Base is not exposed and thickness is highly uncertain; our best estimate is 40-50 m-thick. .

Titms Trachyte sills northwest of Moss Windmill (lower to upper(?) Oligocene) – Slightly porphyritic sill that caps the two conical hills northwest of Moss Windmill, 1-2 km south of the Bald Hills. Groundmass is aphanetic and white to tannish white. Rock weathers to light gray. ~1% phenocrysts of pyroxene(?) that are 0.5-4.0 mm and anhedral. 10-15% phenocrysts that are 0.1-2.0 mm, anhedral, and are altered to a reddish brown, unknown mineral; original mineral was likely biotite based on alteration rims of trace observed biotite. Southern hill not described. Possibly up to 60 m-thick but base is poorly exposed.

Titps **Porphyritc trachyte sill (lower to upper(?) Oligocene) –** Porphyritic trachyte. Very pale brown to yellow color, weathering to light gray. Phenocryst assemblage: 15-25% potassium feldspar phenocrysts (euhedral to subhedral) that range from 0.5-10 mm. Matrix consists of potassium feldspar (subhedral) that is 0.1-0.5 mm-long.

Titad **Altered trachyte dike (lower to upper(?) Oligocene) –** Trachyte dike that has been altered. White to light gray to very pale brown to pinkish gray, weathering to a creamy orange or yellow color. Grain size is 0.1-0.5 mm. Rock composed of potassium feldspar laths that are not aligned, in addition to 10% original mafic minerals (pyroxene or hornblende) that have been altered to rust-colored, replacement minerals. Locally, quartz fills vugs that are 1-3 mm-long and elongated. Variable precipitation of limonite and/or goethite. Locally abundant cavities (generally less than 1 cm across). 4 to 15 m-wide. Mapped as a line only.

Titas **Altered trachyte sill (lower to upper(?) Oligocene) –** Pale yellow sill that is 1.5 m-thick. Sill is equigranular (~0.3 mm grain size) and composed of potassium feldspar that is altered (to kaolinite?). About 2% altered and corroded biotite grains are present. Alteration of this sill is greater than the dike that cross-cuts it (unit Titad). Mapped as a line only.

Titpad **Porphyritic trachyte dike that is altered (lower to upper(?) Oligocene) –** Porphyritic dike that is creamy white to orange in color. 1-3% casts of former mafic minerals (probably pyroxene or hornblende), which have dissolved or weathered away. Casts are 1-8 mm-long and euhedral. 0-1% potassium feldspar phenocrysts 0.5-1.0 mm-long. Groundmass is 0.1-0.5 mm (mostly ~0.1 mm) and composed of subhedral potassium feldspar. Weathering may produce a pattern of swirly laminae on exposed surfaces.

Titpas **Porphyritic trachyte sill that is altered (lower to upper(?) Oligocene) –** Porphyritic sill; pink to white to light gray fresh color that weathers to pale yellow, reddish yellow, very pale brown, and yellow. Matrix is composed of 0.1-0.4 mm potassium feldspar grains. 3-10% phenocrysts that are 0.2-4.0 mm long, euhedral, and composed of mafic minerals (hornblende or pyroxene) that are altered to a rust-colored mineral or completely dissolved away (leaving casts). 0-3% relatively unaltered potassium feldspar that may have formed during hydrothermal alteration. 0.5-1% vugs (1-3 mm-wide) filled with calcite. Composition of rock similar to that of **Titad**.

White Oaks igneous complex

Tiwst **White Oaks syenite-trachyte stock (lower to upper(?) Oligocene) –** Porphyritic trachyte. Phenocryst assemblage: 30% potassium feldspar phenocrysts (euhedral) that range from 0.2-6.0 mm, and 1-7% hornblende (euhedral) that ranges from 0.2-5.0 mm. Unit correlates to trachyte-syenite porphyry stock of Grainger (1974).

Tiwstd **White Oaks syenite-trachyte dike (lower to upper(?) Oligocene) –** Porphyritic trachyte-syenite; gray, weathering to light gray. Rock has 10% phenocrysts composed of euhedral to subhedral potassium feldspar that are 1-11 mm in length. 5-6% phenocrysts composed of euhedral biotite, hornblende, and pyroxene that are 0.5-3.0 mm in length. Groundmass is 0.2-0.4 mm, anhedral to subhedral, and composed of potassium feldspar with ~5% mafic minerals (biotite with lesser pyroxene and hornblende).

Tiwsts **White Oaks syenite-trachyte sill (lower to upper(?) Oligocene) –** Porphyritic trachyte-syenite, as described in unit **Tiwstd** but in a sill form.

Tiwstb **White Oaks breccia sill (lower to upper(?) Oligocene) –** Porphyritic trachyte sill, as described in **Tistps**, but with abundant clasts of argillite and hornfels. Clasts are fine to very coarse pebble-size and subangular.

Tiwsta **White Oaks syenite-trachyte stock that is significantly altered (lower to upper(?) Oligocene) –** Porphyritic trachyte that has been significantly altered by hot fluids. Phenocryst assemblage: 30% potassium feldspar phenocrysts (euhedral) that range from 0.2-6.0 mm, and 1-7% hornblende (euhedral) that ranges from 0.2-5.0 mm (mostly 1 mm). Locally, it is corroded, vuggy and heavily sericitized. Locally, there is 1% syn-alteration(?) biotite 0.5-1.0 mm. Abundant FeO stains in vugs and fracture faces.

Tiwstad **White Oaks syenite-trachyte dike that is significantly altered (lower to upper(?) Oligocene) –** Rock is similar to that in unit Tistpa but occurs in dikes 1-3 m-wide.

Miscellaneous trachytic rocks

Tiptd **Plagioclase-bearing trachyte dike (lower to upper(?) Oligocene) –** Porphyritic, sericitized dike rock. Color is slightly greenish white, weathering to pale yellow. Matrix is composed of potassium feldspar and minor plagioclase (anhedral and 0.2-1.0 mm). Phenocrysts are elongated amphibolite(?) and biotite (0.5-5.0 mm, with biotite being the longest). 0.5% secondary quartz. Dike is 5-6 m-wide and strikes 325 degrees. Mapped as a line only.

Tite **Epidotized trachyte intrusion (lower to upper(?) Oligocene) –** Epidotized intrusion of trachyte. Color is white to light gray, weathering to yellow to creamy orange. Grain size evenly ranges from 0.2-4.0 mm. Matrix is composed of euhedral to subhedral potassium feldspar. 15% phenocrysts of euhedral biotite and slender prisms of hornblende, both generally 0.2-2.0 mm in length; more hornblende than biotite and trace hornblende phenocrysts (up to 13 mm-long).

1% unknown mafic mineral. Epidotization of mafics is observed. Erodes into spheroidal blocks

Tite+Tmah **Epidotized trachyte intrusion plus argillite of the Mancos Shale (lower to upper(?) Oligocene) –** Epidotized trachyte intrusion (**Tite**) complexly intruding argillite of the Mancos Shale (**Kma**). Intrusions are too small to be mapped at 1:24000 scale.

Tis **Extremely sericitized and altered dike (lower to upper(?) Oligocene) –** Yellowish white to shiny white, very fine-grained clayey rock in a dike form. Locally, 1% elongated vugs (1-7 mm) filled by a rusty substance. No mafics seen. Interpreted as an extremely altered igneous dike. Cannot tell original composition. Mapped as a line only.

Rhyolite rocks

We have mapped rhyolite only in a single dike immediately northwest of White Mountain Draw. This dike is splotchy in appearance and has abundant argillitic xenoliths. Its relation to other intrusive rocks is unclear.

Tird **Rhyolite dike (lower Oligocene?) –** A distinctive, splotchy rhyolite; gray and aphanetic. About 50% of rock consists of brownish clasts of argillite that have been folded and flattened; minor fossils have also been incorporated into the dike. 1 m-wide. Mapped as a line only.

Basaltic andesite and trachygabbroic rocks

A distinctive suite of mafic rocks are mapped in the northeast and northwest parts of the quadrangle. In the northeast corner is a distinctive megacrystic basaltic andesite that occurs in north-striking dikes that are several meters-wide. A similar, but less porphyritic, dike strikes east-northeast in the vicinity of Manchester Spring. On the northwest slope of Baxter Mountain, a porphyritic trachyte-syenite dike, related to the White Oaks complex, appears to cross-cut a megacrystic basaltic andesite intrusion, but this cross-cutting relation is not conclusive. An extrusive equivalent to these basaltic andesites is found stratigraphically low in the Sierra Blanca volcanic complex and beneath any felsic tuffs or extrusions (i.e., northeast slopes of Jackass Mountain, Oscura Peak quadrangle of Koning et al, 2010). We use these observations to assign a relatively old age to the basaltic andesite rocks (upper Eocene?). Above the lower tongue of the Gallup Sandstone is a trachygabrro sill that is up to 10 m-thick. This sill is similar to others mapped south of Carrizozo. One of these sills to the south returned an $^{40}Ar/^{39}Ar$ age of 36.32 ± 0.35 Ma (Dowe et al., 2002).

Tibap **Porphyritic basaltic andesite (upper Eocene to lower Oligocene) –** Very dark gray (N3/), porphyritic andesite. 25% plagioclase phenocrysts that are 0.5-4.0 mm-long (euhedral to subhedral). 0.5-1% pyroxene phenocrysts that are 0.5-1.5 mm-long. Groundmass is composed primarily of 0.1-0.2 mm plagioclase.

Tibam **Megacrystic basaltic andesite (upper Eocene to lower Oligocene) –** Very dark gray to dark gray color, weathering to gray. Rock contains distinctive megacrysts of plagioclase that are 1-20 mm long and tabular. These megacrysts are commonly aligned subparallel to dike strike and are euhedral to subhedral. Groundmass is 0.1-0.5 mm (mostly 0.2-0.3 mm) and composed of subequal, subhedral(?) mafic and plagioclase crystals; pilotaxitic texture noted by Grainger (1974). Unit correlates to the basalt porphyry dikes of Grainger (1974). This worker measured an anorthite content of An60-62 in the plagioclase megacrysts and An46-49 in groundmass plagioclase. He also noted olivine and augite in the ground mass.

Titgs **Trachygabbro sill (middle(?) to upper Eocene) –** Light gray to grayish brown, weathering to gray-grayish brown. Rock is composed of plagioclase (euhedral and 0.5-3.0 mm long) with 10-40% hornblende and pyroxene (mostly anhedral, ranging to euhedral, and 1-7 mm long). Plagioclase minerals are locally aligned. 5-10% bronze-colored mica, which may be secondary. A similar sill at the Three Rivers Petroglyph site returned an $^{40}Ar/^{39}Ar$ age of 36.32 ± 0.35 Ma (Dowe et al., 2002), and was called a trachybasalt sill by McLemore (2002). 3-10 m-thick.

Cretaceous fluvial and marine strata

Kccm **Crevasse Canyon Formation, middle part (upper Cretaceous, middle Coniacian to Maastrichtian Stage) –** Interbedded yellow sandstone and yellow to gray mudstone. Unit has relatively distinct fluvial channel and floodplain facies in an estimate ration of 35-45% to 55-65%. Channel-fills are composed of fine- to medium-grained sandstone in thin to thick (mostly medium to thick), tabular beds that are internally massive, horizontal-planar laminated, or tangential cross-laminated. Sandstone beds are white to light gray (5Y 8/1) to yellow (5Y 7/3), weathering yellow or orange. Sand is subrounded to subangular, well-sorted, and composed of quartz with 3-15% feldspar and 3-10% gray lithic grains and black mafic grains; common glauconite. Swirly weathering patterns locally found on exposed sandstone. Fossils were not found. Floodplain deposits are light yellowish brown (2.5Y 6/3), dark gray to light gray (2.5Y 4-5/1), yellow (5Y 7/3), light olive brown to yellowish brown (2.5Y 5/6) mudstone, claystone, siltstone, and very fine-lower to fine-lower sand. Floodplain strata are mostly horizontal-planar laminated, with subordinate very thin to medium, tabular beds. Exposed strata on this quadrangle lacks pebbles or coarse sandstone in the channel-fills, so it appears to lie below the Ash Canyon Member. Greater than 150 m-thick.

Kccl **Crevasse Canyon Formation, lower, coal-bearing part (upper Cretaceous, middle Coniacian Stage) –** Gray claystone (N5/) interbedded with light gray (2.5Y 7/1) siltstone, and very fine- to fine-grained sandstone interbedded with coal seams. Sandstone is in thin to thick, tabular beds. Siltstone and claystone are in thin to medium, tabular beds. Only exposure of this unit showed 5-25% coal seams that are up to 15 cm-thick. Sand is subrounded to subangular, well-sorted, and composed of quartz, ~15% feldspar, and 7% gray lithic and black mafic grains. Sand has up to 10% clay-silt in matrices. Lack of exposure hampers definition of top of unit. We provisionally assign the top of the unit as the stratigraphic level corresponding to the base of the sill at Bald Hill, but the coal-bearing may not extend up that high. This definition results in a thickness of 120-130 m.

Kgs **Gallup Sandstone (upper Cretaceous, lower Coniacian Stage) –** Unit dominated by sandstone that is described in different parts of the quadrangle. 100-130 m-thick.

North of mouth of Baxter Creek (C-475): Yellow sandstone with variable amounts of glauconite. Medium to thick, tabular beds that are internally planar-horizontal laminated (mostly) to low angle- or tangential-cross-laminated. Rock varnishes strongly. Sand grain size is fine-lower to medium-lower (mostly fine-upper). Sand is subrounded to subangular, well-sorted, and composed of quartz with 10% mafics and unknown amounts of probable feldspar. Friable to indurated.

South of mouth of Baxter Creek (C-433_wpt_84): Pale yellow, weathering red to purplish red. Thick beds of sandstone that are internally horizontal-planar laminated to very thinly bedded. 5% low angle, tangential cross-stratification (laminated to very thin); foresets are 1-2 ft-thick. Sand grain size is fine-upper to medium-lower. Sand is subrounded to subangular, well-sorted, and composed of quartz with trace lithics and mafics and 1-5% feldspar.

In plains east of highway 50: Very pale brown to light gray (10YR 7/1-3) or pale yellow (2.5Y 8/3-4) sandstone, commonly in medium beds. Sand is fine- to medium-grained, subangular to subrounded, well-sorted, and composed of quartz, 5-15% feldspar, and 5-12% lithic grains. Locally fossiliferous.

In NW corner of quad: Light yellowish brown (mostly) to very pale brown (2.5Y-10YR 6-7/4) to pale yellow (2.5Y 8/2-4) sandstone, weathering to yellowish brown (10YR 5/6), very pale brown (10YR 8/2), strong brown (7.5YR 5/6), light yellowish brown (10YR 6/4), or light gray (2.5Y-10YR 7/2). Locally strongly varnished. Medium to thick, tabular beds that are internally cross-stratified (laminated to very thin beds) or internally massive; subordinate planar-horizontal, laminated to very thin beds; local bioturbation. Sand grains are mostly fine-upper, with slightly subordinate, but variable, fine-lower and medium-lower (locally minor very fine-grained sand, but very fine-grained sand is not typical), subangular to subrounded, well-sorted, and composed of quartz, 3-15% feldspar, and 3-15% mafic and lithic grains; locally as much as 20% feldspar and 20% lithic + mafic grains. Glauconitic and locally calcareous. Locally fossiliferous; invertebrate shells are especially common in calcareous, yellow to light yellowish brown, fine-lower to coarse-lower sandstone beds. Minor interbeds of a white, quartzose sandstone that weathers to a purplish color; sand is fine-grained, subrounded, well-sorted, and has 3-5% dark gray-black lithic grains and ~5% feldspar. In a very few areas, there are very fine to medium, quartzite and chert pebbles in coarse- to very coarse-grained, subrounded sandstone (composed of quartz with 10% lithic grains). Lowest sandstone tongue is tangentially cross-stratified to planar-horizontal bedded (laminated to very thinly bedded), with foresets up to 40 cm-thick; sand is bright white, weathering to pale yellow (2.5Y 8/2-3), and fine-upper, subangular to subrounded, well-sorted, and composed of quartz with 1% dark gray lithic grains and black mafic grains. Upper 6 m of the lower tongue is ledge-former (~6 m-thick), fine-upper to medium-lower sandstone, where the sand is pale yellow to white (2.5Y 8/1-3), subrounded to subangular, well-sorted, and composed of quartz, 20% feldspar, and 10% dark gray lithics and black mafics (uppermost part of this ledge is heavily burrowed or internally massive). Sandstone is generally well-cemented.

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Kgsm **Gallup Sandstone marker bed (upper Cretaceous, lower Coniacian Stage) –** A distinctive, thick bed with abundant oysters (probably crassostria soleniscus) in the upper part of the Gallup Sandstone. Sandstone is pale brown to light yellowish brown (10YR-2.5Y 6/3), very fine- to fine-grained, and very calcareous. Bed was mapped to illustrate tight folding.

Kgsq **Gallup Sandstone metamorphosed to a quartzite (upper Cretaceous, lower Coniacian Stage) –** Quartzite in very thin to thick, tabular beds. Internal bedding is massive or horizontal-planar laminated, with 20-25% low-angle, tangential cross-laminations. Original sand quartz grains have been fused together. 1-3% un-identified mafic minerals. About 60 m preserved thickness.

Kmd **Mancos Shale, D-Cross Tongue (upper Cretaceous, upper Turonian Stage) –** Very dark gray and very fissile (weathering to 0.1-0.5 mm-thick plates); very thin bedded to horizontal planar-laminated near upper contact. Trace cobble-size concretions that are strongly cemented by calcium carbonate. Non-calcareous. Unit seems more fissile than the Rio Salado tongue and weathers to a darker color. Approximately 110-120 m-thick.

Kth **Tres Hermanos Formation (upper Cretaceous, Turonian Stage) –** Very fine- to fine-grained sandstone. Color of pale yellow to light gray, weathering to brownish yellow, very pale brown, or pale yellow. Sandstone is in thin to medium, tabular beds that are locally internally tangential cross-laminated (up to 13 cm-thick). Local burrows are observed. Upper 1 m of formation is in very thin to thin, tabular beds that are locally ripple-marked. Woody debris and organic litter is locally present in the upper part of the unit. 10-15 m-thick.

Kms **Sandstone interval in Mancos Shale below Tres Hermanos Formation (upper Cretaceous, Turonian Stage) –** Olive-colored, calcareous, very fine- to medium grained sandstone (mostly fine-grained) that is in very thin to thin (minor medium), tabular beds. Locally low angle, tangential cross-laminations. Common bioturbation and marine fossils. Sandstone contains minor shale interbeds. Unit constitutes a useful marker on the western slopes of Baxter Mountain. 3 m-thick.

Kmrs **Mancos Shale, Rio Salado Tongue (upper Cretaceous, upper Cenomanian to lower Turonian Stage) –** Hard, calcareous shale; very dark gray, weathering to gray to light gray to light yellowish brown. Generally planar-horizontal laminated, with subordinate wavy laminations, and minor very thin to thin, tabular beds. Cross-section suggests 200 m-thickness, but this may be too high.

Kmrsb **Bridge Creek Limestone Beds of the Rio Salado Tongue, Mancos Shale (upper Cretaceous, lower Turonian Stage) –** Marker interval consisting of closely spaced, medium- to thick-bedded, tabular limestones. Limestones are dark gray, weathering to light gray and micritic. Internally massive, with local shells. Unit does not include a limestone bed found about 10-11 m above this marker interval. Interval is 4.0-4.5 m-thick and is mapped as a line.

Kmah **Mancos Shale, undifferentiated, metamorphosed into an argillite and hornfels (upper Cretaceous, Turonian Stage) –** Light gray to light brownish gray argillite, with vague to none planar-horizontal laminations. Unit includes meta-sandstone hornfels that is typically white to light gray to light yellowish gray to pale yellow, very fine- to fine-grained (sand-size), mostly very fine-grained, and quartzose. Hornfels locally weathers to an orange or red color. Rock is more resistant than non-metamorphosed Mancos Shale and erodes into angular, blocky to platy clasts. Approximately 140-150 m-thick.

Kds **Dakota Sandstone (upper Cretaceous) –** Cross-stratified sandstone. Sand is white, varnishing to a near-black color. Strata are tangential cross-laminated (mostly) to cross- very thinly bedded. Sand is grain size is fine-upper to medium-upper. Locally (~10%) coarse to very coarse sand. Trace very fine pebbles of quartz, quartzite, and chert; however, these likely increase in abundance towards the bottom of the unit. Sand is subrounded (minor subangular), well-sorted, and composed of quartz with 1% lithic and mafic grains. Indurated. No strong vertical joint sets observed, but on surface rock readily fractures along bed planes. 46-61 m-thick (Smith, 1964; Haines, 1968).

SUBSURFACE UNITS IN CROSS-SECTION A-A'

Tr **Triassic strata, Chinle Group overlying the Santa Rosa Formation or Moenkopi Formation (middle Triassic) –** The Chinle Group is described by

Grainger (1974) as red to purple, variegated shale and siltstone intercalated with subordinate red to brown sandstone and minor pebble-conglomerate lenses. Strata are mostly thinly bedded and total 75 m-thick. The Santa Rosa Formation, which we suspect may actually be Moenkopi Formation, was described by Grainger (1974) as a dark reddish-brown, micaceous, quartz sandstone and siltstone having a thickness of 60-90 m. A total thickness of 150 m was used for this unit in the cross-section.

Pag **Grayburg Formation, Artesia Group (upper Permian) –** In the Little Black Peak quadrangle to the northwest, where it was called the Bernal Formation, this unit is red to buff, calcareous sandstone, siltstone, and shale; 60-90 m-thick (Smith and Budding, 1959).

Psa **San Andres Formation, undifferentiated (lower to upper Permian) –** Interbedded limestone, sandstone, dolomite, anhydrite, and gypsum beds. Near the base is a 6-12 m-thick sandstone (Weber, 1964). ~180 m-thick to the north of this quadrangle (Smith and Budding, 1959).

Py **Yeso Formation (lower Permian) –** Yellow and red siltstone, limestone, and gypsum. A thickness of 630 m is given in the Three Rivers quadrangle to the south (Koning, 2009).

Pa **Abo Formation (lower Permian) –** Reddish color; consists of overbank deposits of mudstone and clayey fine-grained sandstone that are intercalated with coarse channel-fills of sandstone and pebbly sandstone. Thickness not known in map area and unit may not even be present.

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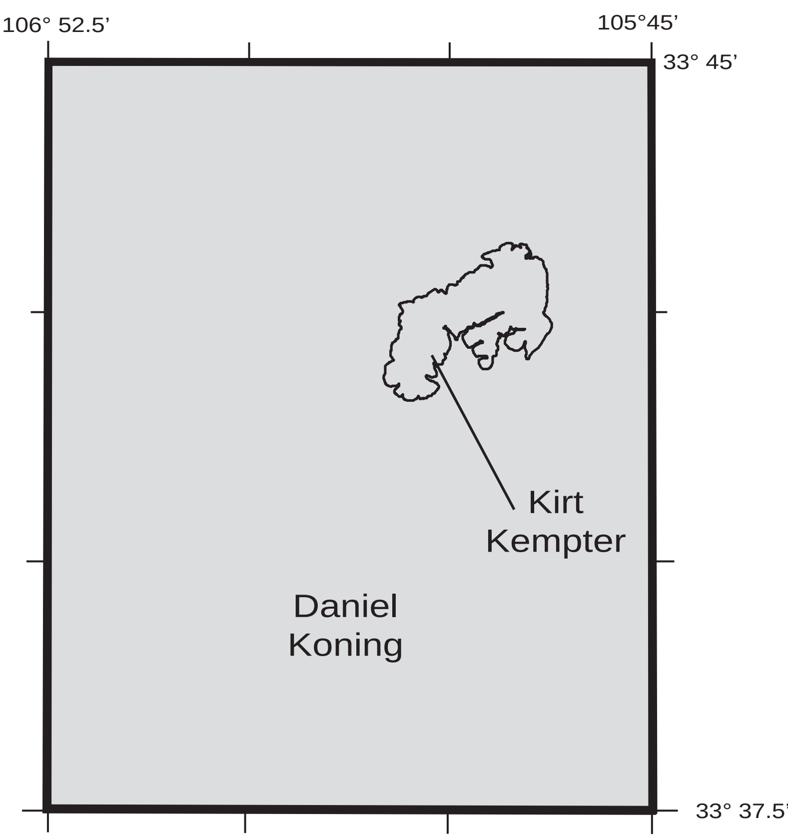
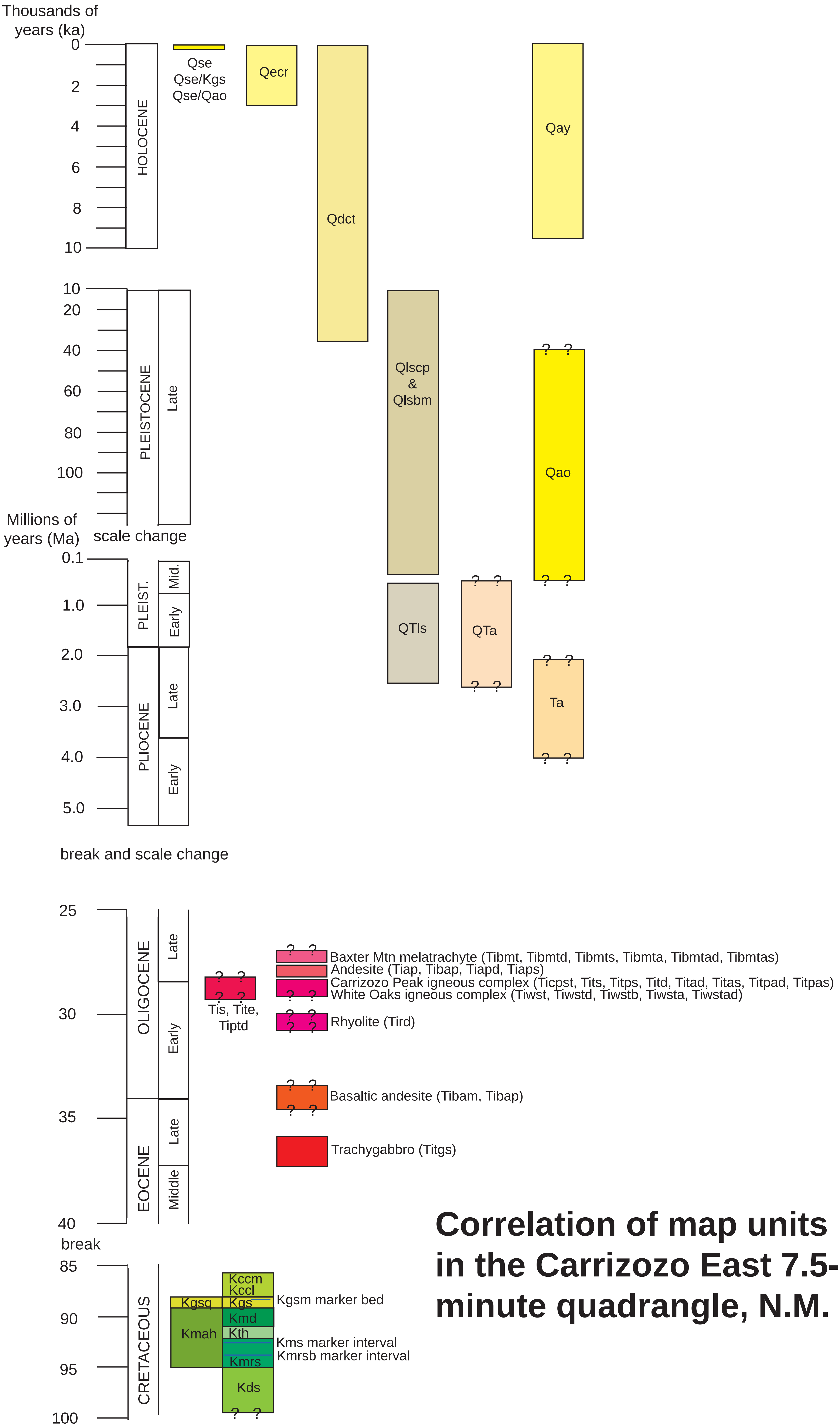
FIGURE 1 **Map areas of respective authors**



CARRIZOZO 7.5-MINUTE QUADRANGLE, NM

FIGURE 2



Correlation of map units in the Carrizozo East 7.5-minute quadrangle, N.M.

Photo captions for Carrizozo East quadrangle

Quad_photo_background_v2.jpg

View from Baxter Mountain looking south across most of the quadrangle area. Much of the quadrangle corresponds to a gently west-sloping alluvial plain that is underlain by Quaternary alluvium (map units Qay and Qao). A trachyte sill caps the Bald Hills to the left (map unit Titbs) and isolated exposures of the Gallup Sandstone occur in undulating topography immediately beyond White Oaks Draw (east of State Highway 349).

Tibmd.jpg

Dikes north of White Oaks Canyon are mostly composed of the Baxter Mountain melatrachyte. These dikes are commonly altered by hydrothermal fluids and have been the focus of gold prospecting in the past. In this exposure, relatively unaltered, dark gray melatrachyte grades rightward into orange-colored, altered melatrachyte (with limonite or goethite). To the right of the orange-colored, altered melatrachyte is gray Mancos Shale (Rio Salado Tongue). Note the subvertical shear foliation along the right margin of the dike. It is common to see the highest alteration along the margin(s) of a given dike, presumably because these areas were most permeable. There is typically little hydrothermal alteration in the adjacent Mancos Shale. Evidently, flow of hydrothermal fluids appears to have been largely restricted to dikes and sills because of the relatively low permeability of the Mancos Shale. Rock hammer for scale. Outcrop location: 429836 m E and 3733280 m N (NAD 27).

Altered_dike.jpg

View of an intrusive contact between a hydrothermally altered melatrachyte dike (orange-colored rock to right) and relatively unaltered, gray Mancos Shale (Rio Salado Tongue). Orange colors are due to iron hydroxides (limonite and/or goethite). Pink ruler is 15 cm-long. Note that dike rock along the contact (~10 cm-wide) has been silicified. This silicified zone has abundant quartz-filled vugs, 1 mm-wide quartz veinlets, and iron-oxide concretions (not obvious in photo). Gray xenoliths of Mancos Shale are present within this 10 cm-wide contact zone. It is in hydrothermally altered zones such as this that gold mineralization occurred in the White Oaks mining district, commonly associated with hematite (Grainger, 1974). Outcrop location: 429801 m E and 3733297 m N (NAD 27).

Kmrsb_dikes.jpg

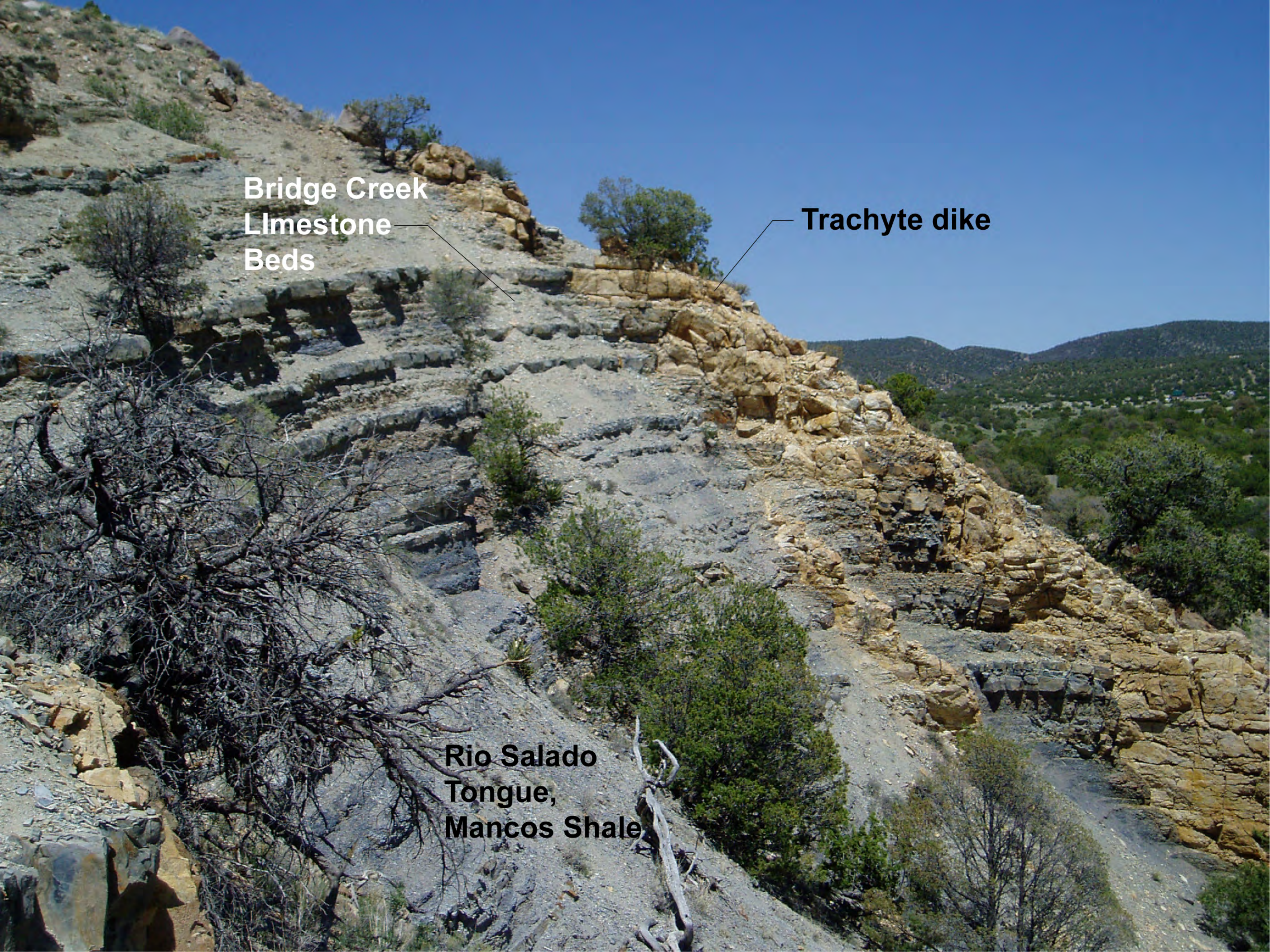
Along White Oaks Canyon are good exposures of various igneous dikes and sills. In this exposure, an altered trachyte dike cross-cuts the Bridge Creek Limestone Beds of the Rio Salado Tongue of the Mancos Shale. Outcrop location: 429860 m E, 3733300 m N, (NAD 27).

Qay_Qao.jpg

Exposure of Holocene alluvium (**Qay**) overlying Pleistocene alluvium (unit **Qao**). Exposure is approximately 6 m (20 ft) in height. Unit **Qay** is probably late Holocene in age at this location because of its very weak soil development. Note the coarser texture of the late Holocene alluvium compared to the Pleistocene alluvium -- the latter mostly being clay, silt, and very fine- to fine-grained sand. A pronounced soil having a stage III carbonate morphology developed on top of unit **Qao**, and calcium carbonate nodules have precipitated 2-3 m below the soil. Some springs in the quadrangle (e.g., Fetters and Carrizozo springs) are sourced in Pleistocene alluvium but they tend to have low discharges. Exposure location: 425020 m E and 3724558 m N (NAD 27).


Willow Hill
Carrizozo
Bald Hills
State Hwy 349
White Oaks Draw


dike contact
Rio Salado Tongue,
Manco Shale
Altered mela-
trachyte dike


Bridge Creek
LImestone
Beds
Trachyte dike
Rio Salado
Tongue,
Mancos Shale


Qay
Qao