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Inset Map of the Northern Part of Cross Section D–D' Tsb QTI Tc

older than the Servilleta Basalt; the drillers log lists "basalt" from 840 to 900 ft, and "fractured basalt" from 900 to 920 ft; given that the surface unit is the Chama-El Rito Member of the Tesuque Formation (Ttc, Miocene), the 80-ft-thick lava flow may be Oligocene in age; such Oligocene lavas do exist at the surface north of the study area, where they are known as the Conejos Formation (ca. 30 to 29 Ma) and the Hinsdale Formation (ca. 26 Ma) (Thompson and Machette, 1989; Thompson et al., 1991); these lavas are related to the San Juan volcanic field, which predates the formation of the structural Rio Grande rift; approximately 24 m thick. 03-00-00-00–heading01–Rio Grande Rift and Pre-rift Deposits–Rio Grande Rift and Pre-rift Deposits—Rio Grande Rift and Pre-rift Deposits Cieneguilla in the Carson quadrangle, about 2 m above the floor of the modern wash, 03-01-00-00-unit01-Tg?-High-level gravel-Unexposed, moderately well-sorted, returned a conventional 14C age of 2,795 ± 50 BP; three charcoal samples from the rounded to subrounded gravel dominated by quartzite clasts with possibly some Tertiary volcanic clasts and/or Paleozoic sandstone clasts up to about 5 cm in diameter; this deposit is mapped only on the hill north of Vadito, and is inferred from float of quartzite-rich gravel on the north side of the hill; the south side of the hill is mantled by relatively coarse gravel/cobbles (up to about 50 cm) that contain the above clasts plus common, subrounded to subangular, basalt clasts that are either mixed with a pre-basalt deposit that is coarser than the north-side exposures (such as an eroded gravel that post-dates the basalt), or derived from an unidentified pre-Tbo basalt that contributed clasts to Tg; the inferred gravel layer is estimated to be 1 to 3 m thick. 03-02-00-00–00–heading02–Santa Fe Group–Santa Fe Group–Basin-fill clay, silt, sand, pebbles, cobbles, and boulders of the Rio Grande rift. In the map area, the unit is

03-02-01-00-00-unit01-QTg-Alluvial and minor colluvial deposits at high levels of

d/or colluvium located south of the Picuris Mountains: the alluvium and colluvium

the Santa Fe Group—Terrace gravels and more angular basement-derived alluvium

at least 1,000 m thick.

uried or rarely interfingers with the terrace gravels; gravel com relatively thin "ribbons" of gravel along ridges, with extensive aprons o bes below; it is unclear whether these rocks represent one geomorphic downslope; occurs on slopes marked by hummocky topography and downslope- 03-02-02-00-00 – unit01 – QT1 – Lama formation of the Santa Fe Group – Poorly sorted facing scarps; includes small earth flow, block-slump, and block-slide deposits; sand, pebbles, and cobbles; clasts consist of basalt, quartzite, other metamorphic rock includes large, rotational, Toreva slide blocks within the Rio Grande and Rio Pueblo de types and other volcanic rock types; locally high percentage of angular to subangular quartzite pebbles and cobbles; commonly cross-bedded and stained with black of intact Servilleta Basalt (Tsb); south of the Rio Grande, landslide deposits do not form manganese oxide and yellowish-orange iron oxide coatings; oxidized; clasts are typically weathered or grussified; contains distinct discontinuous sandy interbeds; commonly crudely imbricated; imbrication suggests westerly flow direction in the area north of the Taos Municipal Airport (Los Cordovas quadrangle), and southerly flow direction in areas north and west of the Rio Pueblo de Taos, with northwesterly flow direction in areas southeast of the Rio Pueblo de Taos; well drillers records in the Questa area show clay layers in the shallow subsurface that are interpreted as lacustrine deposits; the unit is present between the Sangre de Cristo Mountains range front and the Rio Grande gorge over most of the area; correlative with 1) Lambert's (1966) two informal facies of the "Servilleta Formation" (the "sandy gravel facies" found south of the Rio Hondo, and the "gravelly silt facies" found between the Rio Hondo and the Red River), 2) Kelson's (1986) informal "Basin Fill deposit," 3) the unit previously informally called "Blueberry Hill formation" in the Taos area, and 4) Pazzaglia's (1989) late Neogene-Quaternary rift fill sequence (unit Q1) which he informally named the Lama formation; herein, for this study area, the Lama formation is defined as the uppermost, pre-incision, sedimentary rift fill, and, where extant, represents the uppermost member of the Santa Fe Group; the unit therefore includes all of the basin fill between the oldest Servilleta Basalt at 5.55 ± 0.37 Ma near Cerro

formation and the underlying Chamita Formation are texturally and compositional similar and may be indistinguishable in boreholes, although Koning et al. (2015) noted 03-03-04-00-00 – unit01 – Tpa – Andesitic porphyry of the Picuris Formation – Poorly a coarsening of sediment (southwest of the map area) that roughly coincides with the exposed, reddish-gray, and esitic porphyry that is exposed only in a single small rked by a sharp unconformity and color/textural contrasts with overlying gravels: it contains of several laterally variable components of sedimentary fill that th various provenance areas related to east- or west-flowing tribut en fairly persistent in the late Cenozoic; locally contains ry (Guadalupe Mountain quadrangle, elevation ca. 7,160 ft) was ו nearby ca. 5 Ma volcanic units (R. Thompson, persor 015); a tephra in the uppermost Lama formation yielded a date of chemical correlation with the 1.61 Ma Guaje Pumice Bed in ins (elevation ca. 7,660 ft, M. Machette, USGS, personal communication, athwest of the map area; thickness ranges from zero to an exposed nickness of about 25 m at the southwestern end of Blueberry Hill (Taos quadrangle), but may be considerably thicker in other parts of the map area. 03-02-02-01-00—unit02—Tcc—Clay layer in the Lama formation of the Santa Fe 01-13-00-00—heading02—Alluvial Fan Deposits—Alluvial Fan Deposits—Alluvial Group—Distinctive, thin, light-gray clay layer that is locally exposed in the walls of the Rio Grande gorge, downstream from the confluence with the Rio Pueblo de Taos; the clay is composed of very small (20 to 50 microns), well-sorted crystals of quartz and eldspar in a clay matrix that most likely formed in a lake that existed behind a basalt-

Azul (Taos Junction quadrangle, D. Koning, personal communication, 2015) and the

oldest Rio Grande (and tributary) terrace gravels (e.g., Qt0rg, Qt0rr); the Lama

dammed ancestral Rio Grande; the clay lies within the clastic beds of the Lama formation (QTI), above the lowermost Servilleta Basalt; this clay layer has hydrologic significance between the Taos Junction bridge and Pilar, as on the north slope of the gorge, as it is spatially related to a series of small springs and seeps that exist at levations of approximately 6,200 ft; the clay layer extends downstream, where it hosts a number of larger springs that emerge from the north gorge wall downstream from Pilar; the known, exposed lateral extent of the layer is a minimum of 17 km (11 mi) in the gorge; additionally, the clay likely extends up the Rio Pueblo de Taos, where it is observed in several of the wells used in this study; estimated to be 1 to 3 m thick. See the Explanation of Map Symbols for the symbology used in the map. 03-02-03-00-00—heading03—Chamita Formation—Chamita Formation of the Santa Fe 03-04-01-00-00—unit01—Th—Older Tertiary rocks—In cross section only. Volcanic, Group—Chamita Formation of the Santa Fe Group 03-02-03-01-00-unit01-Tc-Chamita Formation of the Santa Fe Group

undivided—Sedimentary deposits between the lowest Servilleta Basalt and the esuque Formation; typically rounded to subrounded pebble- to cobble-size clasts in a to silt matrix; thick sections to the south reflect Proterozoic clast provenance an are dominated by schist, quartzite, and amphibolite with lesser volcanic clasts derived 04-01-00-00-unit01-IPu-Pennsylvanian sedimentary rocks of the Taos Trough, from the Latir volcanic field; locally, thin interbeds are typically dominated by pebble- undivided – Poorly exposed; greenish, reddish, yellowish, buff, tan, black, and brown; size clasts in a fine sand to silt matrix and commonly include the rock types above in very friable to firm; sandy to clayey; thinly to thickly bedded; poorly to moderately addition to subangular and subrounded volcanic clasts derived locally from adjacent olcanic highlands of the Taos Plateau volcanic field; the top of Tc is herein defined as the sediments below the youngest Servilleta Basalt flows. 03-02-03-01-01-unit02-Tcpm-Pilar Mesa member of the Chamita Formation, San granitic, metamorphic and sedimentary rocks south of the Rio Pueblo de Taos; clasts Fe Group – Very pale-brown to light-yellowish-brown, moderately to well-sorted, subangular to rounded, mostly tabular, thin- to thick-bedded, loose to weakly cemented, very fine to coarse sand and silty sand interbedded with dark-colore moderately to very poorly sorted, angular to subrounded (often platy), medium- t thick-bedded, mostly clast-supported lenses and beds of sandy conglomerate; conglomerates contain clasts of Proterozoic quartzite, Tertiary volcanic rocks, Pilar Formation slate (Ytp), Paleozoic sandstone, siltstone, and limestone, granitic rocks, and are amphibolite, carbonate nodules, and rip-ups of fines resembling adjacent dstone interbeds; this unit was informally described as the Cieneguilla member (the Tesuque Formation by Leininger (1982); approximately 230 m thick. -02-04-00-00-heading03-Chamita and Tesuque Formations-Chamita Formations of the Santa Fe Group—Chamita and Tesuque Formations of the 03-02-04-01-00—unit01—Tc+Tto—Chamita Formation and Ojo Caliente Sandstone

Group—Rio Grande rift related basin-fill deposits of clay, silt, sand, pebbles, cobbles, and boulders. 03-02-05-01-00—unit01—Ttbc—Cejita Member of the Tesuque Formation, Santa Fe tinctive eolian sand dune deposit sourced from the southwest (Galusha and Blick, 3 to 5.0 cm thick; OFL proportions near Dixon (Velarde, NM) average 62% guartz, 28% feldspar, 10% lithics and LvLsLm ratio averages 82% Lv, 8% Ls, and 10% Lm (Steinpress, 1980); thin reddish-brown, finely laminated siltstone horizons exist loca lar cross-beds are common, with sets over 4 m in height; the best exposures me of the sand in the Pilar Mesa member is probably ne Member and/or sand derived from the same source dr r time; age range of 13.5 to 10.9 Ma is based on regional relationships g et al., 2005); approximately 250 m thick. 01-14-01-00-00 – unit01 – Qty – Young stream-terrace deposits – Poorly sorted deposits 03-02-05-02-00 – unit01 – Tto – Ojo Caliente Sandstone Member of the Tesuque deposits of silt, sand, pebbles, cobbles, and boulders; deposits are typically clast-supported and 🛛 👘 Formation, Santa Fe Group—Buff to greenish, moderately to poorly sorted, medi

Member of the Tesuque Formation, Santa Fe Group, undivided—In cross section only.

03-02-05-00-00—heading03—Tesuque Formation—Tesuque Formation of the Santa Fe

Tc and Tto undivided, see descriptions of individual units.

quartzite, Paleozoic sandstone, siltstone, and limestone, and Tertiary volcanic clasts; overlies both the Ojo Caliente Sandstone Member and Dixon member of the Tesuque Formation; Lithosome B refers to the lithologic designations of Cavazza (1986), also see Koning and Aby (2003); age range of 13.2 to 7.0 Ma based on regional relationships bedrock and are typically on valley floors of large to medium drainages, whereas Qfy (Koning and Aby, 2005). 03-02-05-03-00—unit01—Ttqa—Quartzite-rich unit of the Tesuque Formation, Santa Fe 01-14-02-00-00-unit01-Oto-Stream terrace deposits, undivided-Poorly sorted Group-Mostly light-colored (buff to very pale-brown), moderately(?) to poorly deposits of silt, sand, and pebbles; deposits are typically matrix-supported and poorly sorted, loose to weakly cemented, medium to thick-bedded(?), silty sandstone(?) to sandy cobble conglomerate composed of quartzite and <25% granitic clasts; this unit is more granitic-rich to the south on the Truchas quadrangle where tephra layers, high in the stratigraphic section in the western part of the quadrangle, yielded 40Ar/39Ar ages of 11.7 and 11.3 Ma (Smith et al., 2004); in the Truchas quadrangle the lower section is 04-04-02-00-00-unit01-Mt-Tererro Formation of the Arroyo Peñasco Group-Near probably older than 15 Ma based on provisional correlations to strata in adjacent Ponce de Leon Springs; consists of 1 to 2 m of basal stromatolitic, limy sandstone quadrangles (Smith et al., 2004); in the Truchas quadrangle the total thickness is approximately 500 m.

to thick-bedded, sandy conglomerate to pebbly sandstone and subordinate coarse- to

fine-grained silty sandstone containing rounded to subangular clasts of Proterozoic

______03_02_05_04_00_11nit01 — Ttd — Dixon member of the Tesugue Format istically greenish, moderately to very poorly sorted, often preferent carbonate-cemented, thinly to thickly bedded conglomerates and fine- to coa grained, arkosic sandstones between \approx 0.5 and \approx 5 m thick; conglomerates co abundant, poorly to moderately well-rounded clasts of Proterozoic quartzi Paleozoic sandstone, limestone, and siltstone; sedimentary features other than pla lamination are not common but include ripple marks, cross-beds, and lateral accretion (point-bar) foresets; contacts between beds are typically abrupt and the bases of

sandstones and conglomerates are commonly scoured with from 0.01 to 1 m of relief;

imbrication of clasts is locally moderately well developed; paleocurrent indicators (imbrications and the strikes of channel walls) indicate transport primarily from the south, east, and northwest; sandstones and conglomerates are preferentially cemented with calcium carbonate; carbonate cement locally forms a sparry white matrix between 👘 grains; in this area, Smith et al. (2004) demonstrated that the Dixon member and Cejita Member of the Tesuque Formation are indistinguishable in the field where not separated by the Ojo Caliente Sandstone; age of ≈13 to 11.8 Ma (latest Barstovian) is based on fossils (Tedford and Barghoorn, 1993); minimum of 250 m thick. 03-02-05-00-unit01-Ttcu-Upper part of the Chama-El Rito Member of t Tesuque Formation, Santa Fe Group – Very pale-brown to light-yellowish-brown moderately to poorly sorted, subangular to subrounded, thinly to thickly bedded tabular, loose to moderately carbonate-cemented, fine- to coarse-grained, silty sandstone interbedded with moderately to poorly sorted, subangular to subrounded dium- to thick-bedded, tabular to broadly lenticular(?), sandy conglomerat osed of variable amounts of Proterozoic guartzite, Pilar Formation slate (N schist, Tertiary volcanic rocks, Paleozoic sandstone, limestone and siltstone, gra nd rare rip-up clasts; the lower contact is gradational (interfingeri nama-El Rito Member (Ttc); the lower contact is drawn at appro clasts; the upper contact is not exposed but is probably grad with the Ojo Caliente Sandstone Member (Tto); largely (uvium, however, some moderately good exposures over ome beds of Ttc near the contact contain anomalog nitic clasts and some Pilar Formation slate whi they are included in Ttc here rather than defining a separate member hese rocks; age range of 14 Ma to 11 Ma is based on the age of overlying and underlying units; where unfaulted the unit is at least 200 m thick. 03-02-05-06-00 – unit01 – Ttc – Chama-El Rito Member of the Tesuque Formation, Santa Fe Group—Buff, whitish, pink, red and brownish, moderately to very poorly sorted,

massive, plane-bedded, or cross-bedded, loose to carbonate-cemented muddy siltstone to silty, very fine to very coarse sandstone interbedded with moderately to poorly sorted, mostly subrounded, medium- to very thick-bedded tabular beds and broad lenses of silty/sandy and sandy pebble conglomerate; clasts consist mostly of Tertiary c rocks and quartzite with lesser amounts of Paleozoic sandstone, granitic rocks, Pilar Formation (Ytp) slate, schist, and rare amphibolite; ranges in age regionally from possibly >22 Ma to ≈13 Ma (Aby, 2008); thickness unknown, but is expected to range considerably in the subsurface. 03-02-06-00-00-heading03-Other Deposits of the Santa Fe Group-Older Deposits of the Santa Fe Group—Older Deposits of the Santa Fe Group limestone; overlies the Servilleta Basalt (Tsb) north of Pilar Mesa, but is inset into Tsb 03-02-06-01-00 – unit01 – Tbca – Basal colluvial and alluvial deposits of the S on Pilar Mesa in the Carson quadrangle; locally may contain clasts of Tertiary Amalia Group—Alluvial and colluvial material underlying Ttc, Ttd, and Tptc s (13S 432003mE 3998789mN, NAD83) yielded a plagioclase 40Ar/39Ar date of

subangular to subrounded, tabular to lensoidal(?), thinly to very thickly bedded,

 7 ± 0.4 Ma; approximately 3 to 30 m thick. 3-02-07-00-00—heading03—Tesuque and Picuris Formations—Tesuque Formation of the Santa Fe Group and Picuris Formation—Tesuque Formation of the Santa Fe Group and Picuris Formation 03-02-07-01-00—unit01—Ttc+Tpt—Chama-El Rito Member of the Tesuque Formation, Santa Fe Group and/or tuffaceous member of the Picuris Formation, undivided—Interbedded and/or complexly faulted, poorly exposed, sparse outcrops of tuffaceous and pumiceous silty sandstones (Tpt) and volcaniclastic sandstone and conglomerate (Ttc); stratigraphic/temporal relations between the tuffaceous members of the Picuris Formation (Tpt) and the Chama-El Rito Member (Ttc) are discernible (and clearly 'layer cake') in the southern Picuris Mountains, however, locally the tuffaceous member is either absent or not exposed along most of the range front; along the northeastern edge of the map area are poorly exposed, and possibly complexly faulted, outcrops of both tuffaceous and volcaniclastic rocks that indicate possible interfingering of the two units; elsewhere, these rocks were referred to as the middle tuffaceous member of the Picuris Formation (Aby et al., 2004); age is less than ≈25 Ma based on abundant clasts of 25 Ma Amalia Tuff, but minimum age is unknown; thickness in the map area is unknown.

3-03-00-00–heading02–PicurisFm–Picuris Formation–Picuris m in the Rio Grande gorge approximately 16 km northwest of Taos; locally subdivided 03-03-01-00-00 – unit01 – Tp – Picuris Formation, undivided – In cross section only. In is Mountains area (Aby et al., 2004) consists of an upper member of and pumiceous silty sandstones and volcaniclastic sandstone and nglomerate; a member of buff to white and/or pinkish, silty sandstone to fine cobble conglomerate and non-friable to strong, very fine-lower- to very coarse-upper-grained, ery poorly to moderately sorted, rounded to subangular, thinly to thickly bedded, silica-cemented silty to pebbly sandstone that locally contains a basal portion of poorly sorted pebbly/gravelly sandstone and/or cobble/boulder conglomerate composed exclusively of Proterozoic clasts; a member of light-buff, yellowish, and locally white, samples and mineral separates (Brookins et al., 1979) could be considered a minimum ash-rich, quartzose, silty, fine sand to pebbly, pumiceous sandstone; a lower member of age for crystallization. red, greenish, and yellowish, moderately to very poorly sorted, subangular to subrounded, pebbly/silty sandstone and mudstone containing very thick(?) to thin beds and/or lenses and/or isolated clasts of subangular to rounded Proterozoic

quartzite (up to 3 m across) and massive quartzite conglomerate; paleo-flow

measurements indicate source to the north (Rehder, 1986); age range is from at least

34.5 Ma to less than 25 Ma; thickness unknown, but at least 450 m thick in the Picuris

01-00-00-00-heading01-Sedimentary Rocks and Deposits of the Rio Grande Rift 02-03-01-00-00-unit01-Tbo-Older basaltic rocks-In cross section only. Within the 03-03-02-00-00-unit01-Tpt-Tuffaceous member of the Picuris-Pecos 05-03-03-08-unit01-Xhow-Massive white quartzite of the Ortega Formation, and Adjacent Highlands—Sedimentary Rocks and Deposits of the Rio Grande Rift and buff, yellowish, and locally white, ash-rich, granitic rock and buff, yellowish, and locally white, ash-rich, granitic rock and buff, yellowish, and locally white to light-gray, vitreous quartzite with dark layers of fault only; typically consists of pink to white, medium-grained, mica-rich, granitic rock and buff, yellowish, and locally white to light-gray, vitreous quartzite with dark layers of pebbly, pumiceous sandstone; very friable to somewhat friable, moderately to very poorly sorted, commonly bimodal, and massive; very thickly to thinly bedded with locally well-developed fining upward sequences; most sandstone beds contain a small percentage of medium-lower- to coarse-upper-grained sand of Pilar Formation (Ytp) slate and quartzite; thin to thick (5 cm to 1.5 m) interbeds and channel-fills of buff to slate and quartzite-rich and/or Tertiary pumice-rich conglomerate; the lower portion, Mountains to the northwest of the map area. sand; small-scale fining upward sequences indicative of fluvial deposition are exposed qu the slopes of Cerro Blanco; near the abandoned power substation in Section 32, 3N R012E the deposit contains rare pebbly/gravely channels that are rich in granite, pidote, slate, amphibolite, and schist(?), and a single exposure of boulder erate composed of Peñasco quartz monzonite porphyry, quartzite, and exposures north of the Rio Pueblo drainage contain white ash beds (15 to nk, mafic-poor, with phenocrysts of quartz and plagioclase; near, ar act is a biotite-rich pumice; the lower contact is not exposed in the r the upper contact is mapped as the base of the ; pumice from the Amalia Tuff eruption has been identified at several long the southeastern edge of the Picuris Mountains; two additional opulations of pre- and post-caldera pumice at 23 Ma and 27 Ma have been identified; based on 40Ar/39Ar geochronology, this unit was deposited starting about 28 Ma in the northern Picuris Mountains (based on the age of the Llano Quemado breccia) and starting about 25 to 26 Ma in the southern Picuris Mountains (based on the age of an ash that is low in the section); deposition ended by at least 18.6 Ma in the northern Picuris Mountains and by 19.8 Ma in the southern Picuris Mountains based on ages of basalt clasts in Ttc (Aby et al., 2004; Bauer et al., 2005); approximately 125 m thick. 03-03-02-01-00 – unit02 – Tptc – Cemented part of the tuffaceous member of the Picuris Formation—Buff to white and/or pinkish, silty sandstone to fine cobble conglomerate and non-friable to strong, very fine-lower- to very coarse-upper-grained, very poorly to moderately sorted, rounded to subangular, thinly to thickly bedded, silica-cemented silty to pebbly sandstone; locally contains a basal portion of poorly sorted Chamisal exposures' of Aby et al., 2004) the lowest, exposed, cemented part of the tuffaceous member is at least 13 m of moderately well-sorted, thickly bedded, subrounded to angular, cobble and boulder conglomerate composed of Proterozoic anite (46%), quartzite (26%), amphibolite (26%), phyllite (1%), and schist (1%); the per contact is placed at the top of the last silica-cemented bed, and locally displays ne structures; rare paleocurrent indicators show transport from the northwest, n, and northeast; age is probably between about 23 Ma and 20 Ma based on //39Ar ages of pumice clasts in this unit, and a basalt clast in the overlying rocks

(Aby et al., 2004); approximately 10 to 35 m thick. 8-03-00-00—unit01—Tplq—Llano Quemado breccia member of the Picuris—Li ed, monolithologic volcanic breccia of distinctive extremely angular, po light-gray, recrystallized rhyolite clasts in a generally reddish matrix; rhyolite ontain phenocrysts of biotite, sanidine, and quartz; highly lithified due to al welding of the matrix rather than silica or carbonate cement; ridge-former; the nit shows both clast and matrix support; the beds are generally 1 to 8 m thick; clasts terpreted as a series of flows from a now-buried, nearby rhyolite vent (Rehder, 1986); 40Ar/39Ar date on sanidine from a rhyolite clast collected 1 km southwest of Ponce de Leon Springs is 28.35 ± 0.11 Ma; apparent thicknesses of 5 to 45 m, although subsurface extent is unknown. Lama contact in the map area: the top of the Lama formation is typically exposure in northern Miranda Canyon where it appears to underlie Tplq; age unknown, although it may be related to the volcanic component of the Tplq.

03-03-05-00-00 – unit01 – Tpl – Lower member of the Picuris Formation – Most

poorly exposed, red, greenish, and vellowish, moderately to very poorly sorted subangular to subrounded, pebbly/silty sandstone and mudstone containing thick(?) to thin beds and/or lenses and/or isolated clasts of subangular ' oterozoic quartzite (up to 3 m across) and massive quartzite cong ommonly highly weathered with fractured clasts; most available exposure ery well-carbonate-cemented guartzite pebble and cobble conglomerate in near mapped faults; the lower contact is placed at the ozoic clasts (quartzite, Pilar Formation slate [Ytp] tzite-cobble conglomerate (Figure 7 of A 5 well-imbricated clasts in this interval suggest deriva average paleo-transport direction is 143°), at o tion that this unit was derived from the Picuris Mountains to the southea. ger, 1982); this unit was informally named the "Bradley conglomerate member The Tesuque Formation (Leininger, 1982) for exposures near the Village of Pilar, but quadrangle) the unit is approximately 200 m thick. at name has been abandoned; this unit has also been referred to as the "lower nglomerate member" of the Picuris Formation (Aby et al., 2004) but, locally, muc e unit is fine-grained; near the top(?) of the section in Agua Caliente Canyon is an ash layer dated at 34.5 ± 1.2 Ma by 40Ar/39Ar (Aby et al., 2004); regionally, this unit contains variable amounts of intermediate-composition volcanic rocks (dated by 40Ar/39Ar at 32.4 to 28.8 Ma; Aby et al., 2007), and fluvially reworked Llano Quemado breccia (28.35 Ma); the oldest ashes are dated at 35.5 Ma and 35.6 Ma (Aby et al., 2004), but the maximum age of the unit is unknown; where not faulted the unit is at least 250

03-04-00-00–heading02–Older Tertiary Units–Older Tertiary Units–Older Tertiary Units volcaniclastic, and clastic rocks that predate the Tesuque Formation; may include the Hinsdale Formation, Los Pinos Formation, and similar units. 04-00-00-00–00—heading01—Sedimentary Rocks of the Taos Trough—Sedimentary Rocks of the Taos Trough–Sedimentary Rocks of the Taos Trough well-cemented(?), sandy to clayey siltstone, mudstone, and shale interbedded with

mostly greenish and brownish, firm to very strong, poorly to moderately well-sorted, poorly to moderately well-rounded, thin- to very thickly bedded, moderately to very well-cemented, quartzose, feldspathic, and arkosic, silty to pebbly sandstone and limestone of the Alamitos and Flechado Formations; contains a rich assortment of ssils; sandstones commonly contain plant fragments that have been altered to limonite(?); contacts between beds are generally sharp, rarely with minor scour (less than ≈ 20 cm); the lower contact is sharp, planar(?), and disconformable(?) where it overlies Mississippian rocks; the lower contact is mapped at the top of the Del Padre Sandstone Member (Mdp) or highest Mississippian carbonate, or at the base of the lowest sedimentary bed where Mississippian rocks are absent; conglomeratic layers in the lower part of the unit locally contain rare, sometimes banded, chert pebbles; equivalent to the Sandia, Madera, and La Posada Formations to the south; colluvial deposits have not been mapped on the Tres Ritos quadrangle, but most of the and the random orientation of larger clasts within a matrix of usually dark, organic- to 400 m. personal communication, 2000); Miller et al. (1963) measured an incomplete section of garnet-bearing; approximately 25 m thick.

of the volume of Pennsylvanian rock in the map area. ; 04-03-00-00-unit01-IPbs-Basal sandstone, Pennsylvanian sedimentary rocks of the Taos Trough—Mostly white with some yellowish, brownish, and/or reddish streaks and staining, very hard, moderately well-sorted, angular to moderately wellrounded, medium- to thick-bedded(?), well to very well-silica-cemented quartz sandstone, pebbly sandstone, and minor breccia(?); this well-indurated unit can be difficult to distinguish from the Ortega Formation (Xho) quartzite, as both rock types break across grains; this unit is also similar to the Del Padre Sandstone (Mdp, Mississippian) as they occupy similar stratigraphic positions and are virtually identical in some hand samples; however, the basal sandstone has slightly more matrix, sparse, altered feldspar grains, generally poorer rounding of grains, and a less diverse range of colors than the Del Padre Sandstone; the lower contact is mapped at the top of Proterozoic rocks; the upper contact is mapped at the top of the highest well-cemented sandstone; partial erosion of Mississippian carbonates regionally makes it likely that of the Ortega (Xho) and Rinconada Formations (Xhr). the Pennsylvanian basal sandstone directly overlies the Del Padre Sandstone in places; in such cases the two units would be indistinguishable as mappable units, and the Del adre Sandstone would be included within the basal Pennsylvanian sandstone on th

4-04-00-00-00-heading02-Arroyo Peñasco Group-Arroyo Peñasco Group-Arroyo quadrangle that are pervasively fractured and faulted; U-Pb analyses of detrital Penasco Group 04-01-00-00—unit01—Mu—Sedimentary rocks of the Arroyo Peñasco Group, Taos trough. overlain by about 7 m of dolomitic limestone, overlain by about 12 m of calcitic dolomite with stromatolites and bedded and nodular chert (Armstrong and Mamet, 1990); approximately 20 m thick. 04-04-03-00-00-unit01-Mc-Espiritu Santo Formation and Tererro Formation carbonates, Arroyo Peñasco Group—Where rarely exposed, the carbonate-rich rocks a the top of the Del Padre Sandstone (Mdp) grade into overlying Tererro Formation (Mt carbonate sedimentary rocks; on the Ranchos de Taos quadrangle near Ponce de Leon Springs, the Tererro Formation consists of 1 to 2 m of basal stromatolitic, limy stone overlain by about 7 m of dolomitic limestone, overlain by about 12 m of tic dolomite with stromatolites and bedded and nodular chert (Armstrong and met, 1990); Espiritu Santo and Tererro rocks (Mes) are lumped due to their thinnes xposure, and the disagreements among published descriptions and stratigraphi (Miller et al., 1963; Armstrong and Mamet, 1979; Baltz and Meyers, 1999)[,] thickness is approximately 20 m.

l-04-00-00-unit01-Mes-Espiritu Santo Formation of the Arroyo Peñasco undivided—The basal Del Padre Sandstone Member (Mdp) is composed of a in basal conglomerate, quartz sandstone, and minor limestone beds at top; an upper, rbonate-rich section grades into overlying Tererro Formation. 04-04-01-00—unit02—Mdp—Del Padre Sandstone Member of the Espiritu Santo mation, Arroyo Peñasco Group—White, tan, yellowish, green, red, and/or mottled, fine-upper- to very coarse-upper-grained, strong-to-very strong, moderately to very well-sorted, well-rounded to subangular, thinly to very thickly bedded, mostly horizontally laminated to low angle cross-bedded, quartz-overgrowth cemented sandstone, pebbly sandstone, sandy conglomerate, and minor breccia(?); contacts are generally sharp and parallel, although minor (<20 cm) scouring exists locally; jointing is prominent; exposures are good relative to other Paleozoic rocks due to its resistance to erosion, but is variable in general; lichens typically obscure sedimentary features and bedding even where exposure is relatively good; unconformably overlies Proterozoic rocks in much of the Sangre de Cristo Mountains of northern New Mexico (Armstrong and Mamet, 1979); Miller et al. (1963) reported an unusually thick (≈50 m) section of the Del Padre north of the Rio Pueblo in Osha Canyon (Peñasco quadrangle) just west of the mica mine, however, a similar exposure reported by Miller et al. (1963) contains Pennsylvanian fossils (Cather, et al., 2007), and therefore the exposures in Osha Canvon, may also be Pennsylvanian; differentiating the Del Padre Sandstone 05-03-03-02-06 – unit01 – Xhr3q – R3 cross-bedded quartzite member of the R³ from the Pennsylvanian basal sandstone is not feasible in areas of poor exposure; Formation, Hondo Group—White, gray, bluish-green, and blue, medium-grainer however, the presence or absence of the Espiritu Santo carbonates can be useful in distinguishing the two: the basal contact of the Del Padre is herein mappe vest identifiable clastic beds, although such a selection can be pro Del Padre overlies the Ortega Formation (Xho) quartzite, as the two a per contact is mapped at the top of the highest strongly cemented san al . 1963), ≈17 m (Armstrong and Mamet, 1979) and ≈8 m (Baltz and Meyers 999); this mapping supports the higher estimates. 00-00-00—heading01—Metamorphic and Plutonic Rocks of the Picu

ntains—Metamorphic and Plutonic Rocks of the Picuris Mountains—Metamorphic and Plutonic Rocks of the Picuris Mountains 국부출수학 트 mixture of Proterozoic Hondo Group (Xhu), Vadito Group (Xvu), and granitic rock along the Tertiary Picuris-Pecos fault; the unit is a distinct ridge former where the breccia is strongly solidified. 05-02-00-00–heading02–Plutonic & Metaplutonic Rocks–Plutonic & Metaplutonic Rocks—Plutonic & Metaplutonic Rocks 05-02-01-00-00—unit01—Zd—Diorite dike—Dark-green-gray quartz diorite dikes intruded into Proterozoic rocks; dikes are vertical, with strikes clustered around an azimuth of 150°; composed of pale-green clinopyroxene (Cr-diopside?), zoned

altered to chlorite and clay; pyroxene and feldspar show normal plutonic textures; locally, dikes are laced with carbonate veins; generally less than 1 m wide; contacts between diorite and country rock are sharp and commonly contain zones of brecciation and faulting; faults are sub-vertical with dip-slip fault striations; dikes are parallel to the Pilar-Vadito fault and other southeast-striking faults of the Picuris Mountains. See the Explanation of Map Symbols for the symbology used in the map. 05-02-02-00-00-unit01-Yp-Pegmatite-Includes both simple (quartz-K-felds) plagioclase-muscovite) pegmatites and complex zoned pegmatites containing rare ; pegmatite bodies typically are dikes or lenses, locally aligned para natite bodies and plutonic bodies, and no ev nected to plutons at depth; more than 50 Ma (Long, 1976). See the Explanation of Map Symbols for the symbology used in the map. 05-02-03-00-00 – unit01 – Yhp – Harding pegmatite – Complex, asymmetrically zoned 05-03-03-03-03-03-04 – Unit01 – Xho5 – Kyanite quartzite of the Ortega Formation, Ho

Ewing, 1976) in the southern Picuris Mountains; the disk-shaped body is elongate down-dip and inclined in a plane that dips 10° to 15° south; the body is about 350 m long, and its thickness ranges from 1 m at the edge to about 25 m at the core; major minerals include quartz, albite, microcline, muscovite, lepidolite, and spodumene; principal accessory minerals are beryl, garnet, microlite, and tantalite-columbite; about 40 other minerals have been identified (Jahns and Ewing, 1976); lath-shaped spodumene crystals are up to 5 m long; in general, from top to bottom, the eight lithologic units of the body are beryl zone, quartz zone, quartz-lath spodumene zone, "spotted rock" unit, rose muscovite-cleavelandite unit, cleavelandite unit, perthite zone, and aplite zone; replacement features are common; Northrup and Mawer (1990) concluded that the pegmatite is internally deformed, probably syntectonically as the melt was emplaced in locally dilatant extension fractures that developed late in the brittle-ductile shearing history; an age of 1,366 Ma based on Rb-Sr of whole-rock 00-00—unit01—Ypgm—Peñasco guartz monzonite—Biotite guartz monzonite : composed of quartz, plagioclase, microcline, and biotite: euhedu ematite, apatite, and zircon; locally contains tabular megacrysts of ed microcline up to 9 cm in length; myrmekite and albite rims on nmon; massive to weakly foliated, except locally along co o compositional border zone; mafic microgranitoid incl

mean 207Pb/206Pb zircon age of $1,450 \pm 10$ Ma.

5-02-04-01-00—unit02—Yppqm—Pegmatitic phase of the Peñasco quartz

with euhedral megacrysts of feldspar; these granitic rocks are everywhere weathered rutile, hematite, and ilmenite that define cross-bedding; fine muscovite is commonly looking, fairly equigranular, and commonly crumbly; appears to intrude the Rio Pueblo Schist (Xvrp) along its southern contact; pegmatites are locally voluminous; contains at least one tectonic foliation; three closely spaced, orthogonal joint sets cause unit plus the underlying reddish quartzite (Xhor). this rock to weather into small, angular blocks; age unknown, but it is similar in black, friable, moderately to poorly sorted, subangular to subrounded Pilar Formation occurrence and texture to the ca. 1.6 Ga Tres Piedras Granite of the east-central Tusas in Section 29, T023N R012E, is poorly sorted, fine- to coarse-grained, grussy, pebbly nd zones of ductile shearing; foliation is generally parallel to the dominant foliat n the country rock; contact with the Puntiagudo granite porphyry (Xpgp) is a ductile shear zone; contains a discontinuous, fine-grained border zone of l muscovite granite; in general, strongly discordant with compositional layering in country rock; U-Pb zircon isotopic age of 1,674 ± 5 Ma (Bell, 1985). 05-02-06-01-00—unit02—Xrqmb—Border phase of the Rana quartz monzonite – Includes fine-grained porphyritic granite of quartz-muscoviteplagioclase-microcline, and medium-grained muscovite granite and quartz monzonite; 05-03-03-03-12 – unit01 – Xhog – Gray quartzite of the Ortega Formation, Hondo accessory minerals are allanite, epidote, zircon, hematite, biotite, and garnet; distinctly Group—Medium-gray, fine-grained, vitreous quartzite with well-developed, south more leucocratic than the main body of Rana quartz monzonite; contact with Xrqm is gradational; border-zone rocks commonly project out into country rocks as dikes or tongues; well-developed foliation is concordant with the regional foliation trend.

granodiorite; phenocrysts of Carlsbad-twinned microcline (<1 cm) and rounded quartz in fine- to medium-grained matrix of plagioclase, K-feldspar, biotite, and nuscovite: accessory minerals are epidote, allanite, sphene, and zircon; displays ocal, narrow, fine-grained border zone; displays a sharp, discordant contact with Vadito Group (Xvu) schists; locally, thin dikes of fine-grained rock project into the country rock; the contact with the Rana quartz monzonite (Xrqm) is a zone of inten luctile shearing; a pervasive, moderately to well-developed foliation is parallel regional foliation; U-Pb zircon isotopic age of 1,684 ± 1 Ma (Bell, 1985). pebbly/gravelly sandstone and/or cobble/boulder conglomerate composed exclusively 05-02-08-00-00 – unit02 – Xgp – Picuris Pueblo granite – Located on the west side of the of Proterozoic clasts; in exposures along NM-76 between Chamisal and Peñasco (the Picuris-Pecos fault only; medium- to coarse-grained granitic rocks that show a variety 05-04-01-02-00 – unit01 – Xvf – Felsic schist of the Vadito Group, undivided – Inclu local textures ranging from coarse-grained, pink, feldspar-rich rock to white, quartzrich rock; in thin section these rocks show interlocking mosaics of microcline, plagioclase, quartz, biotite, and iron-oxide minerals; most samples exhibit considerable alteration of feldspars and mica; these granitic rocks are intimately interlayered with supracrustal Vadito Group (Xvu) country rock; blocks of orthoquartzite within the plutonic rock suggest an intrusive relationship between the two, although southdipping ductile faults may exist as well; contacts between granitic rock and supracrustal rock invariably trend east, parallel to bedding in the country rock; this name supersedes the informally named Granite of Picuris Peak of Bauer (1988); Daniel

05-02-07-00-00-unit01-Xpgp-Puntiagudo granite porphyry-Ouartz monzonite to

et al. (2013) calculated a mean 207Pb/206Pb zircon age of 1,699 ± 3 Ma. 05-03-00-00–heading02–Metasedimentary Rocks–Metasedimentary Rocks-Metasedimentary Rocks 05-03-01-00-00—heading03—Marqueñas Formation—Marqueñas Formation—Marqueñas Formation up to 15 cm in diameter and overall clast size decreases southward; less than 1% of 05-03-01-01-00 – unit01 – Ym – Marqueñas Formation, undivided – Fine- to medium. asts are Proterozoic slate and weathered Tertiary volcanic rocks; the breccia is grained, grayish, texturally immature, schistose quartzite; cross-beds are small-scale metaconglomerates containing dominantly rounded quartzose clasts in a quartz-mic matrix; previously considered to be part of the ca. 1,700 Ma Vadito Group (Xvu), but Pb analyses of detrital zircons from a metaconglomerate were interpreted to nstrain the basal unit to be less than about $1,450 \pm 7$ Ma in depositional age (Gray et

Formation—Predominantly composed of flattened quartzite pods; micaceous quartzite matrix contains scattered clasts, up to 10 cm long, of metasedimentary quartzite (66%), felsic schist (34%), and traces of vein quartz; alternating lithologic layers that might indicate original bedding are absent; gradational with the Marqueñas Formation quartzite (Ym2) to the south; 207Pb/206Pb analyses on detrital zircons yielded peak ages of 1,716 Ma and 1,457 Ma (Daniel et al., 2013); on the Trampas quadrangle this unit is approximately 150 to 180 m thick. 05-03-01-03-00-unit01-Ym2-Ouartzite of the Marqueñas Formation-Fine- to medium-grained, gravish, texturally immature, schistose quartzite; can be sub-divided 05-04-01-04-01-unit02-Xyrpw-Muscovite member of the Rio Pueblo Schist, Vadi into a lower massive grav quartzite and an upper cross-laminated quartzite (Scott,

1980); contains abundant cross-beds that range from small-scale features defined by black mineral laminae to large festoons with cross-laminations several centimeters thick; cross-beds consistently young to the north; pebble-rich layers also define bedding; contacts with adjacent metaconglomerates are gradational; 207Pb/206Pb analyses on detrital zircons yielded peak ages of 1,711 Ma, 1,697 Ma and 1,471 M (Daniel et al., 2013); where exposed 0.5 km east of Cerro de las Marqueñas (Tran 3-01-04-00—unit01—Ym1—Southern metaconglomerate of the Marqueñas tion—Polymictic metaconglomerate containing rounded clasts of quart (54%), silicic metavolcanic rock and quartz-muscovite schist (40%), and white veir juartz in a muscovite quartzite matrix; clasts are flattened and constricted in the lominant foliation; aspect ratios average 1:2:3 to 1:2:6, with extremes of 1:2:16 or greater; in general, clast size increases southward and westward; quartzite clasts are up to 1 m long; the matrix averages about 30% of the volume of the rock; minor phases in the matrix include ilmenite, biotite, magnetite, hematite, zircon, and tourmaline; the contact with Vadito Group (Xvu) rocks may represent a 250 million-year-old angular unconformity (Gray et al., 2015); 207Pb/206Pb analyses on detrital zircons yielded pea ages of 1,716 Ma and 1,472 Ma (Daniel et al., 2013); U-Pb analyses of zircons in a metarhyolite clast yielded an age of 1,450 ± 7 Ma, interpreted as a maximum depositional age for the base of Ym1 (Gray et al., 2015); 0.5 km east of Cerro de las Marqueñas (Trampas quadrangle) the unit is approximately 150 m thick. 05-03-02-00–heading03–Trampas Group (Informal)–Trampas Group (Informal)—Trampas Group (Informal) 05-03-02-01-00—unit01—Ytu—Trampas group, undivided—In cross section only Schist, quartzite, metaconglomerate, phyllite, and slate deposits of the Piedra Lun

bl) and Pilar Formations (Ytp); previously considered to be part of the ca. 1.68 1,700 Ma Hondo Group; this informal group name was proposed by Daniel et al 013) based principally on ages of detrital zircons in the Piedra Lumbre and Pil 05-03-02-02-00—unit01—Ytpl—Piedra Lumbre Formation of the Trampa sandy conglomerate and less common thin- to thick-bedded, grayish and blackish group—Includes several distinctive rock types: 1) quartz-muscovite-biotite-garnetstaurolite phyllitic schist with characteristic sheen on crenulated cleavage surfaces; 05-04-01-07-00 – unit01 – Xvqb – Quartz-biotite rock of the Vadito Group – Lenses and euhedral garnets are 1 mm, biotite books are 2 mm, and scattered anhedral stauro are up to 5 mm in diameter; 2) finely laminated light-gray phyllitic quartz-muscovitebiotite-garnet schist and darker bluish-gray fine-grained biotite quartzite to metasiltstone; quartzite layers are 1 cm to 1 m thick; and 3) light-gray to gray garnet schist with lenses of quartzite to metasiltstone; calc-silicate layers exist locally; original sedimentary structures including graded bedding are preserved; well-developed cleavage parallel to both layering and axial surfaces of small intrafolial isoclinal folds; 05-04-01-08-00 – unit01 – Xvcam – Cerro Alto metadacite of the Vadito Group – Grav dominant layering in much of this unit is transpositional; in the core of the Hondo metadacite composed of fine-grained quartz, plagioclase, microcline, biotite, and syncline, the unit is thicker, contains a greater variety of rock types, and is gradational muscovite; relict phenocrysts of quartz and/or feldspar are <4 mm long; accessor Pennsylvanian rocks are covered by brown to nearly black, loose, very poorly sorted, with the Pilar Formation; U-Pb analyses of detrital zircons from a quartizte in the minerals are epidote, allanite, sphene, magnetite, and zircon; the main mass of rounded to angular, massive- to very crudely bedded, sandy to silty conglomerate and upper part of the section (unit Ytplq?) were interpreted to constrain the unit to be less pebbly to silty sand; this material is clearly colluvial based on its landscape position than about 1,470 Ma in depositional age (Daniel et al., 2013); apparent thickness is 200

rich fines; windthrow (movement of soil by toppling of trees) is thought to be an active process in the map area, and is probably responsible for the pervasive colluvial mantle; fusulinids collected in the Taos quadrangle are Desmoinesian in age (Bruce Allen, 1,756 m along the Rio Pueblo near the Comales Campground (Tres Ritos quadrangle), and an aggregate thickness of Pennsylvanian strata in the map area of >1,830 m. (1) The height of the Piedra Lumbre Formation, Trampas (1) The Piedra Lumbre Formation, Trampas of the Hondo syncline east of the Pilar-Vadito fault. Group (Lithosome B) – Very pale-brown (10 YR7/4), well- to moderately well-sorted, and biotite (<3 cm); grades to find ubrounded to rounded, loose to moderately well-indurated sandstone; this unit is a Taos Trough-Light-gray limestone in scattered discontinuous layers; fossiliferous to black, carbonaceous phyllitic slate; extremely fine-grained homogeneous rock except non-fossiliferous; fossils include phylloid algae, crinoids, brachiopods, and other shell for rare, 1- to 2-cm-thick, light-colored bands of quartz and muscovite that may 971); dominant grain size is fine sand; CaCO3 concretions are abundant, brown, and fragments; well-bedded to poorly bedded; outcrops are typically highly weathered represent original sedimentary bedding; in thin section, the fine-grained matrix and, locally, are highly fractured; limestone represents a very small percentage (<1%) consists of quartz (50 to 70%), muscovite (15 to 30%), and prominent streaky areas of graphitic material; lenticular porphyroblasts (0.1 to 0.5 mm) are altered to yellowbrown limonite; pervasive slaty cleavage is locally crenulated; displays small isoclinal folds locally; basal 1.5-m-thick, black to blue-black, medium-grained, garnet quartzite is distinctive; garnet perphyroblasts are aphedral, avidized, and red weathered: gradational with the Piedra Lumbre Formation (Ytpl); Daniel et al. (2013) calculated mean 207Pb/206Pb zircon age of 1,488 ± 6 Ma for a 1- to 2-m-thick, white, schistose layer that was interpreted as a metamorphosed tuff, and therefore represents the depositional age of the sedimentary protolith; thickness unknown due to extreme ductile deformation. 05-03-03-00–00—heading03—Hondo Group—Hondo Group—Hondo

05-03-03-01-00—unit01—Xhu—Hondo Group, undivided—Schist and quartzite units 5-03-03-02-00—heading04—Rinconada Formation—Rinconada Formation—Rinconada Formation 05-03-03-02-01-unit01-Xhr-Rinconada Formation of the Hondo Group, undivided—Undivided schists and quartzites near the Pilar-Vadito fault in the Carson

zircons from two quartzite units were interpreted to constrain the unit to be less than about 1,700 Ma in depositional age (Daniel et al., 2013). ided—In cross section only. Undivided sedimentary Mississippian rocks of the 05-03-03-02-02—unit01—Xhr6—R6 schist member of the Rinconada Formation, Hono Group—Tan, gray, silver quartz-muscovite-biotite-staurolite-garnet schistose phyl interlayered with fine-grained, garnet-bearing, muscovite quartzite; euhedral staurolites (<5 cm) abundant in some layers; small euhedral garnets (<2 mm) throughout; strong parting along well-developed foliation; sharp contact with the Pilar Formation (Ytp) might represent a significant unconformity; approximately 90 m thick 05-03-02-03-unit01-Xhr5-R5 guartzite member of the Rinconada Format Group—Variety of white to blue medium-grained quartzites interlayer ed schistose quartzites and quartzose schists: measured section h bobttom: 1) tan to white, friable, thinly layered, cr artzite; 2) blue, medium-grained, thickly layere cross-bedded; 3) white to tan, friable schis nicaceous quartzite layered with quartzcross-bedding; 5) blue and white streaked, thickly bedded, medium-grain zite with abundant cross-bedding; and 6) tan, thinly layered, micaceous quartzite rlayered with quartz-rich quartz-muscovite schist; abundant cross-bedding; gradational contact with Xhr6; approximately 75 m thick. 05-03-02-04 – unit01 – Xhr4 – R4 schist member of the Rinconada Formation, Hondo Group—Medium- to coarse-grained, silvery gray, quartz-muscovite-biotite-staurolitegarnet schist containing one or more distinctive 0.5- to 2.0-m-thick layers of glassy blue uartzite; rusty red-weathering garnetiferous white quartzite; massive, extremely hard, red-weathering, olive-brown biotite-staurolite-garnet-orthoamphibole rock; 05-04-01-14-02 – unit01 – Xvs2b – Knotty quartz-muscovite-(±biotite) schist of the white, glassy, hornblende quartzite; gray biotite-hornblende calc-schist; mylonitic blue Vadito Group—Contains a variety of fine-grained, quartz-muscovite-biotite schist to pink and blue glassy quartzite; and white to gray calcite marble. The latter four rock with ubiquitous scattered, rounded, and elongate, altered porphyroblast knots.

types are not present on the south limb of the Copper Hill anticline, but are present in the Trampas quadrangle on both the upright and overturned limbs of the Hondo syncline in Sections 7, 8, 9 and 10, T023N R011E; a well-exposed reference section of this thicker Xhr4 sequence can be found on the south-facing slope and crest of the ridge making up the northern half of the SW quarter of Section 8, T023N R011E in the 05-04-01-15-00 – unit01 – Xvs1 – Pelitic schists of the Vadito Group, Trampas quadrangle (Hall, 1988); sharp contact with Xhr5; about 50 to 175 m thick. undivided—Includes a variety of pelitic to semi-pelitic schists; relatively massive, 95-03-03-02-05—unit01—Xhr3—R3 guartzite member of the Rinconada Formation Group—Interlavered cross-bedded quartzites and pelitic schists; a distinctive narker layer near the center of the unit is a 25-m-thick, white, thinly bedded, ridgeforming quartzite; sharp contact with Xhr4; approximately 75 m thick.

thinly to thickly bedded, resistant quartzite with abundant cross-beds. 05-03-02-07-unit01-Xhr3s-R3 schist member of the Rinconada Formation, Hondo Group—Locally includes two mappable layers of pelitic schist that resemble Xhr4 and upper Xhr1/2. 05-03-02-08–unit01–Xhr1/2–R1/R2 schist member of the Rinconada Formation, Hondo Group—Lower unit of fine- to medium-grained, tan to silver, quartzmuscovite-biotite schist with small euhedral garnets (<2 mm) and scattered euhedral staurolite twins (<1.5 cm); near the base are black biotite books (<2 cm) and on the upright limb of the Hondo syncline in Section 7, T023N R011E are spectacular, andalusite porphyroblasts up to 8 cm across; an upper unit of gray to tan, redveathering, coarse-grained quartz-muscovite-biotite-staurolite-albite-garnet schist contains interlayers of 1 to 10 cm, red-, gray-, or tan-weathering, fine-grained, m in diameter; abundant garnets are euhedral and small (<2 mm); the unit show ong parting along foliation planes; sharp to gradational contact with Xhr3; lower d upper unit have previously been subdivided into R1 and R2 members, pectively, based on mineralogy (Nielsen, 1972); approximately 265 m thick. 3-03-03-00—heading04—Ortega Formation—Ortega Formation—Ortega

05-03-03-03-01 – unit01 – Xho – Ortega Formation of the Hondo Group, plagioclase (labradorite?), and minor quartz, magnetite, and ilmenite; commonly undivided—Gray to grayish-white, medium- to coarse-grained quartzite; generally massive and highly resistant to weathering; locally well-cross-bedded, with kyanite or sillimanite concentrated in thin, schistose, muscovite-rich horizons; cross-beds are 05-04-01-19-00 – unit01 – Xvb – Fragmental biotite schist of the Vadito Group – Dark are ilmenite, hematite, tourmaline, epidote, muscovite, and zircon; gradational contact 1) white, gray, red, and black subrounded quartzite pebbles (1 to 15 cm); 2) dark-olive with the Rinconada Formation (Xhr); U-Pb analyses of detrital zircons from two quartzite layers were interpreted to constrain the unit to be less than about 1,700 Ma in depositional age (Daniel et al., 2013); 800 to 1,200 m thick. 05-03-03-02—unit01—Xho6—Andalusite quartzite of the Ortega Formation, Hondo Group—Clean, white to tan, sugary quartzite interlayered with lenses and layer massive, foliated, grey knobby andalusite quartzite; layers range from centimete meters thick; fine muscovite and scattered kyanite, sillimanite, and fuchsite are present biotite schist, and various felsic to mafic schistose units. in the quartzite; and alusites are large, lentil-shaped, poikiloblastic grains, with up t 50% guartz inclusions, mantled by coarse muscovite crystals; matrix is fine guar coarse kyanite, fine muscovite, euhedral rutile, and minor hematite and tourmal equivalent to Oq3 of Williams (1982); mapped only on Copper Hill in the Trampas quadrangle where the unit is several meters thick. pegmatite body in the schists and amphibolite of the Vadito Group (Xvu, Jahns and Group-Sugary to vitreous quartzite characterized by kyanite blades and distinctive opalescent quartz eyes; bedding-parallel, kyanite-rich layers give unit a vague

foliation; fine muscovite grains are scattered between quartz grain boundaries; r the predominant heavy mineral; on Copper Hill, a foliated iron-stained rock containing kyanite and staurolite grains (<0.5 cm), overlies the kyanite quartzit equivalent to Oq2 of Williams (1982); mapped only on Copper Hill in the Trampas quadrangle where the unit ranges from 3 to 5 m thick. 05-03-03-04—unit01—Xho4—Massive gray quartzite of the Ortega Formation Hondo Group—Massive, light- to dark-gray, vitreous quartzite with dark layers of rutile, hematite, and ilmenite that define cross-bedding; fine muscovite is commonly present on quartz grain boundaries and kyanite is commonly associated with dark ayers; this unit is host to much of the fracture-filling, oxidized copper mineralizatior on Copper Hill and La Sierrita on the Trampas quadrangle; mineralization is related to ward migration of host fluids during Proterozoic retrograde metamorphism Williams and Bauer, 1995); upper part is equivalent to Oq1 of Williams (1982); mapped only on Copper Hill in the Trampas quadrangle where the unit is approximately 30 m thick. 05-03-03-03-05 – unit01 – Xho3 – Mixed guartzites of the Ortega Formation, Honde Group—Various quartzites including reddish coarse-grained quartzite, brown medium-grained quartzite, gray quartzite, garnet-bearing dark quartzite, and tan cross-bedded quartzite; mapped only on La Sierrita ridge (Trampas and Peñasco quadrangles), where the unit is approximately 250 m thick. 05-03-03-06-unit01-Xho2-Black quartzite of the Ortega Formation, Hondo Group—Dark-gray to black, massive, medium-grained quartzite; commonly cross sotopic age of about 1,450 Ma (Bell, 1985); Daniel et al. (2013) calculated a bedded, and generally contains a well-developed extension lineation defined by kyanite; mapped only on La Sierrita ridge (Trampas and Peñasco quadrangles);

approximately 200 m thick. monzonite – Coarse-grained, quartz, K-feldspar, and plagioclase granitic body with 05-03-03-07 – unit01 – Xho1 – Laminated schist of the Ortega Formation, Hondo pronounced myrmekitic texture; distinctive intergrowth of plagioclase and vermicular Group—Reddish to orange-brown to white quartz-muscovite schist containing thin quartz is common; no visible foliation; located in the southeastern corner of the interlayers of light quartz-rich and darker mica-rich schist; exposed only in a small

present on quartz grain boundaries, and kyanite commonly is associated with the dark layers; northeast of the Pilar-Vadito fault, most of the Ortega Formation consists of this 03-03-09—unit01—Xhor—Reddish quartzite of the Ortega Formation, Hon oup—Reddish, coarse-grained quartzite; probably equivalent to some of the Xho2/Xho3 section southwest of the Pilar-Vadito fault; generally sharp contact with Xhow. 05-03-03-03-10 – unit01 – Xhos – Quartz-mica schist of the Ortega Formation, Hor Group—White to pink, quartz-muscovite schist with quartz eyes; typically contain ak foliation kyanite and andalusite; this unit has mineralogy and textures that are transitional between the Vadito Group feldspathic schist (Xvf) and the Hondo Group (Xhu) quartzites. 05-03-03-03-11 – unit01 – Xhosq – Schistose quartzite of the Ortega Formation, Hondo Group—Thin horizon of white, muscovite-rich, well-bedded quartzite located northeast of the Pilar-Vadito fault, west of Picuris Canyon (Taos SW and Peñasco quadrangles); may be equivalent to part of the quartz-mica schist of the Ortega Formation (Xhos). plunging, kyanite extension lineation; much of this unit is a quartz mylonite, wit abundant evidence for grain size reduction and dynamic recrystallization; shearing spatially related to the adjacent Plomo fault; located northeast of the Pilar-Vadito fault, near Picuris Canyon (Taos SW and Peñasco quadrangles).

NMBGMR Open-File Geologic Map

Last Modified November 2

Rocks-Metasedimentary and Metaigneous Rocks-Metasedimentary and Metaigneous Rocks 05-04-01-00-00—heading03—Vadito Group—Vadito Group—Vadito 05-04-01-01-00—unit01—Xvu—Vadito Group, undivided—Vadito Group metavolcanic, metavolcaniclastic, and metasedimentary rocks; U-Pb analyses of detrital zircons from a schist and a conglomerate layer were interpreted to constrair the unit to be less than about 1,700 Ma in depositional age (Daniel et al., 2013). pinkish, quartz-plagioclase-muscovite-biotite, opaque, slightly schistose units with polycrystalline quartz eyes (2 to 8 mm); eyes are slightly flattened in foliation and probably represent relict phenocrysts of felsic volcanic rocks; trace minerals include sphene, apatite, and tourmaline; finer-grained felsic rocks are similar in mineralogy t coarser units, but lack the abundant quartz eyes; small, red, idioblastic garnets an rare; small, lensoidal bodies of tan to orange-red, garnet-bearing, quartz-muscov opaque schist are found locally; many of the felsic schist bodies appear to be intru into Vadito Group schists.

05-04-00-00-00-heading02-Metasedimentary and Metaigneou

Group—Feldspathic quartz-muscovite schist and quartzose schist exposed in isolate exposures along the northern flank of the Picuris Mountains and in the Pilar cliffs; white, light-gray, pink, or green; commonly contains megacrysts of feldspar and rounded and flattened quartz in a fine-grained matrix of quartz, muscovite and eldspar; contact with overlying Ortega Formation (Xho) is a south-dipping ductile shear zone; pervasive extension lineation in schist plunges south; upper 40 m of sch is pinkish, and contains anomalous manganese and rare earth elements, and unusual minerals such as piemontite, thulite, and manganese-andalusite (viridine); L.T. Silve reported a preliminary U-Pb zircon age of ca. 1,700 Ma (Bauer and Pollock, 1993); ma be equivalent to the Rio Pueblo Schist (Xvrp) and the ca. 1,700 Ma Burned Mountain Formation of the Tusas Mountains; base unexposed; minimum of about 200 m thick. 05-04-01-04-00—unit01—Xvrp—Rio Pueblo Schist of the Vadito Group—East of the Picuris-Pecos fault only; well-bedded, white, gray, and pink feldspathic quartzof the Marqueñas muscovite quartz-eve schist: locally composed of up to 40% coarse, white muscovite flakes in a matrix of granular quartz and feldspar; quartz-eyes are abundant an consistently flattened in the dominant foliation plane; the Miranda granite (Xm intrudes and crosscuts layering in the schists; along the southern contact with massive gray quartzite; a manganese-rich horizon occurs stratigraphically below quartzite; piemontite and altered porphyroblasts that might be pseudomorphs after manganese-andalusite are found along the schist-quartzite contact; this mineralized

horizon is similar to that exposed in the Glenwoody Formation (Xvg) of the Pilar cliff in the Carson and Trampas quadrangles. ll-bedded, white, muscovite-quartz schist exposed in isolated patch . a matrix of granular quartz and feldspar; probably a highly altered par Rio Pueblo Schist; hosts the best mica deposits and all of the major mica mines; thickness unknown. 05-04-01-05-00—unit01—Xvht—Transitional rocks of the Vadito Group—Exposed of the east side of Picuris Canyon (Taos SW and Peñasco quadrangles); includes a variet of rock types intermediate in mineralogy and texture between the metavolcanic rocl of the Vadito Group and metasedimentary rocks of the Hondo Group (Xhu); conglomeratic schistose quartzite, white quartz-muscovite feldspathic schist, gra quartzite and metaconglomerate, conglomeratic quartzite and schistose quartzite w clasts of bull quartz, quartzite, and fine-grained black rock, schistose metaconglomerate, and quartz-eye conglomerate; gradational eastward along str with feldspathic schists (Xvf) of the Vadito Group; might be equivalent to part of transitional section south of Kiowa Mountain (Las Tablas quadrangle) in the Tusas Mountains (Bauer and Williams, 1989), however, in this map area it has been disrupt

05-04-01-06-00—unit01—Xvg—Micaceous guartzites and metaconglomerates of th Vadito Group, undivided—Includes both lenticular micaceous quartzite bodies an scattered metaconglomerates; micaceous quartzites are variably colored, and consist inly of granoblastic quartz grains, aligned muscovite grains, and layered ions of opaque minerals; local conglomerate horizons delineate bedding; th onglomerate units in the area crop out southwest of Cerro Alto (Trar angle, referred to as the Embudo Creek quartzite by Bell, 1985) and in the Picuris Mountains; the metaconglomerate consists of rounded,

e metaconglomerate near the Harding Pegmatite Mine yielded a peak ag of 1,707 Ma (sample J10-PIC7 of Daniel et al., 2013). discontinuous layers of gray, quartz-biotite rock found in schist and amphibolite; ligh to medium-gray, fine-grained quartz-biotite-(± muscovite) rock with local green epidote pods and veins; other minerals visible in thin section include plagioclase microcline, sphene, garnet, hematite, and ilmenite; these rocks are similar to sills of the Cerro Alto metadacite (Xvcam). metadacite is a stock-like body with sharp intrusive contacts with the country rock especially along the western margin; abundant isolated sills are contained in adjace

amphibolites; the unit is crosscut by other plutonic rocks, and found as xenoliths within them; a moderately well-developed foliation is parallel to the regional trend this body may be the remnant of a larger subvolcanic complex originally emplaced fairly shallow level within the Vadito Group; Daniel et al. (2013) calculated a mea 207Pb/206Pb zircon age of 1,710 ± 10 Ma that is interpreted to represent the age of Vadito Group—Includes several varieties of schist; fine-grained quartz-muscovite grained, pale olive-green quartz-muscovite-chlorite schist with 1 to 2 mm garnets, 2 t 25 mm staurolites, and 0.5 to 2 mm biotites; locally shows compositional layers of mm-thick, gray quartz-rich rock and <6-mm-thick, greenish, quartz-muscovite-chlorite schist; small grains (0.1 mm) of tourmaline, apatite, and sphene or monazite.

ounded knots of andalusite cores and alteration rims; 3 mm biotite porphyroblasts a randomly oriented; local compositional layers, 0.5 to 2 cm thick, of white quartzite and silver-blue phyllitic schist; 20- to 40-cm-long elongate pods of granular quartz, chlorite muscovite, and minor copper oxides are aligned in the foliation. 05-04-01-11-00-unit01-Xvs5-Streaky schist of the Vadito Group-Dark-gray t reen, fine-grained quartz-muscovite-biotite, opaque schist; streaky look results fro - to 2-mm-thick, lens-shaped bodies of white quartz-plagioclase-muscovite schist an gray, biotite-quartz-muscovite-chlorite, opaque schist; locally, <2 mm biotite porphyroblasts are present; lenses are strongly folded and transposed; microscopi rnets have overgrown the foliation; a quartz-rich schist in the southwestern Picu ountains yielded a detrital zircon peak age of 1,705 Ma (sample CD12-1 of Danie 4-01-12-00—unit01—Xvs4—Streaky knotty phyllitic schist of the Vadito ilver-gray to silver-green, very fine-grained to phyllitic, quartz-muscovi

chlorite schist interlayered with white, quartz-rich layers; layering is discontinuou and probably transposed; contains altered knots of muscovite and green chlorite, a istinctive pods of fine- to medium-grained granular quartz; gradational contact with streaky schist. 05-04-01-13-00—unit01—Xvs3—Andalusite-biotite phyllitic schist of the Vadito Group—Silver-blue to gray-green, very fine-grained, quartz-muscovite-chlorite phyllitic schist with black, biotite porphyroblasts and coarse-grained, and alusite kn compositional layering is defined by lenses and layers of light and dark phyllite and white quartzitic schist; and alusites are 1 to 20 cm, dark-gray-blue, unaltered masse that are slightly flattened in the plane of foliation, and contain included interna foliation trails; black, randomly oriented biotite porphyroblasts average 4 mm i diameter; minerals such as staurolite, plagioclase, and garnet are present locally distinctive marker horizon of cordierite-bearing, quartz-muscovite schist is prese near the main amphibolite body; cordierite porphyroblasts are gray, up to 20 cm lo and typically exhibit an orthorhombic (pseudohexagonal) crystal habit; the foliat wraps around the cordierite porphyroblasts; in thin section, cordierites are optically continuous, and contain abundant quartz inclusions that define two relict included foliations; gradational with Xvs1 to the northeast.

05-04-01-14-00-heading04-KnotSchist-Knotty quartz-muscovite-(±biotite) sch (Xvs2) of the Vadito Group–Common rock type is divided into three mappable si units (Xvs2a, Xvs2b, Xvs2c,), each displaying gradational contacts with the other 05-04-01-14-01-unit01-Xvs2a-Knotty quartz-muscovite-(±biotite) schist of th Vadito Group—Light-gray, fine-grained, quartz-muscovite, phyllitic schist with blac speckles of biotite and opaque minerals; the most phyllitic unit in Xvs2; in general these rocks become more quartzose and less phyllitic from northwest to southeast; all units contain altered knots of fine-grained muscovite, chlorite, and quartz. 05-04-01-14-03—unit01—Xvs2c—Knotty guartz-muscovite-(±biotite) schist of the Vadito Group—Similar to Xvs2b with the exception of less abundant knots of altered muscovite-chlorite-quartz; knots may be altered cordierite porphyroblasts.

e, garnet, and andalusite; fine-grained quartz-muscovite schist w porphyroblasts of biotite; also includes local horizons of interlayered amphibol 05-04-01-16-00—unit01—Xvsa—Andalusite schist of the Vadito Group—Distinctive, black, biotite schist containing large knobs of andalusite; this unit is only a few meter thick and appears to pinch out laterally in both directions. 05-04-01-17-00 – unit01 – Xag – Amphibolite in granite of the Vadito Group – Includes a variety of amphibolite bodies, lenses, and layers within the Miranda granite (Xmg the predominant rock type is fine- to medium-grained, dark-gray-green to black

weakly foliated amphibolite composed of blue-green to olive-green hornblende, interstitial quartz and plagioclase, sphene, and epidote; faint compositional layering formed by 1- to 2-mm-thick white layers; epidote veins and zones are common. 01-18-00—unit01—Xva—Amphibolite of the Vadito Group—Includes a wi of amphibolite bodies, lenses, layers, and textures; the large amphibolite bod st of the Harding pegmatite is a complex unit containing metamorphos rmed volcanic, sedimentary, and volcaniclastic rocks; the predominant s fine- to medium-grained, dark-gray-green to black, weakly foliated amphibolite ody include biotite schist, metadacite, felsic and various schists; smaller layers and lenses scattered throughout the

o schists are mainly fine- to medium-grained amphibolites that range considerably in texture and mineralogy. defined by concentrations of black iron-oxide minerals; common accessory minerals schistose matrix of biotite-quartz-plagioclase contains varying percentages of clasts o green to brown, fine-grained, lithic fragments that are strongly flattened in foliation white, felsic fragments that are extremely flattened in foliation; and 4) boulder-sized dark-green-black, fine-grained amphibolites; this unit also contains lensoidal bodies of metadacite. 05-04-01-20-00—unit01—Xvmix—Mixed metavolcanic rocks of the Vadito Group—Undivided amphibolites, fragmental amphibolites, biotite schist, fragmental common; exposed only in the southeastern Trampas quadrangle, where

it is intruded by Rana quartz monzonite. 05-05-00-00-heading02-Proterozoic-Proterozoic-Proterozoic 05-05-01-00-00 – unit01 – XYu – Proterozoic rocks, undivided – Supracrustal metamorphic rocks and plutonic and metaplutonic rocks.

