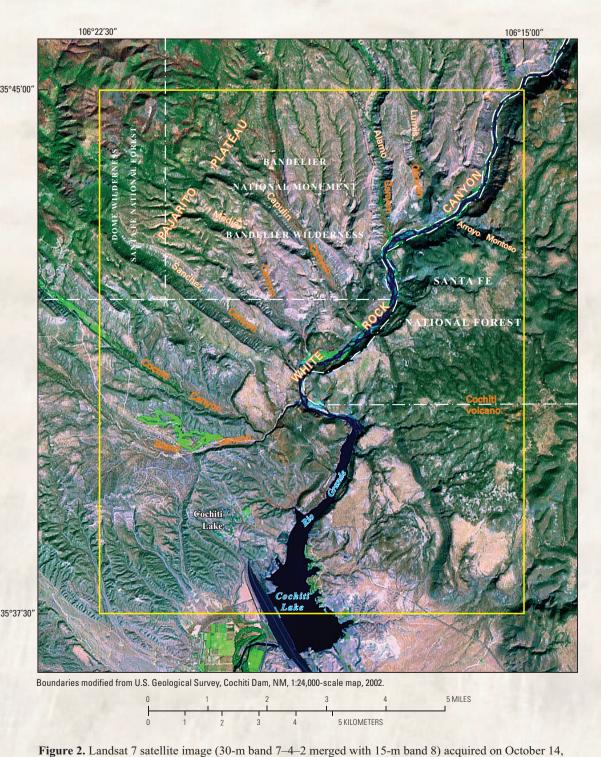


embayment) is modified from Gardner and Goff (1996). Volcanic fields: CdRvf, Cerros del Rio volcanic field; SAMvf,

Santa Ana Mesa volcanic field; TPvf, Taos Plateau volcanic field. Faults: EB, Embudo fault, JZ, Jemez fault; LB, La

Bajada fault; PJ, Pajarito fault; SF, San Francisco fault.

APPROXIMATE MEAI DECLINATION, 2008

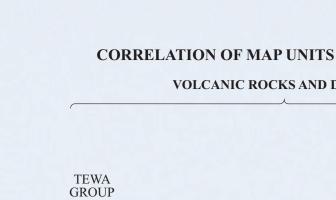


1999, of Cerros del Rio, New Mexico area (image clip from Sawyer and others, 2004), showing select

geologic features and geographic names. Yellow rectangle is the boundary of the Cochiti Dam 7.5-minute

CONTOUR INTERVAL 20 FEET

NATIONAL GEODETIC VERTICAL DATAUM OF 1929



SURFICIAL DEPOSITS

SEDIMENTARY ROCKS

AND DEPOSITS

Santa Fe Group deposits

Pre-Santa Fe Groun

**DESCRIPTION OF MAP UNITS** 

SURFICIAL DEPOSITS

The surficial map units on this map are informal allostratigraphic units of the North American

reason, subdivisions of stratigraphic units use time terms "late" and "early" where applied to

ment (presence and type of B horizons) and the morphologic stage of pedogenic carbonate

Quaternary deposits in the area (Birkeland, 1999).

contacts obscured by colluvium

Exposed thickness 2–4 m, base not exposed

structures

accumulation, Stage I to Stage IV, provide another means of estimating the approximate age of

Artificial-Fill deposits

Alluvial deposits

Fan alluvium (Holocene to middle Pleistocene)—Cross-bedded, poorly sorted

cobble to boulder gravel and poorly sorted, matrix-rich debris-flow deposits.

slopes from 4° to 10°. Includes eolian deposits and local areas of ~55 ka El

silty sand exposed along the Rio Grande, along active channels of tributary

arroyos, beneath adjacent low (< 3 m) terraces and on low-gradient alluvial fans

at the mouths of Sanchez and Medio Canyons. Beds generally less than 0.5 m

thick. Includes some late Pleistocene deposits in upland areas northeast of the

Town of Cochiti Lake. Actual thickness is probably greater than 10 m along the

Rio Grande. Soils thin (< 0.5 m) ranging from A/C profiles to profiles with Bw

pebbly sand, and thin beds of silty sand beneath narrow terraces 3–10 m above

the Rio Grande. Beds generally <0.5 m thick. Most extensive deposits located 1

Pleistocene and Pliocene cobble gravel of the Santa Fe Group; axial facies. These

deposits contain laterally extensive boulder layers. Sandy to silt rich piedmont

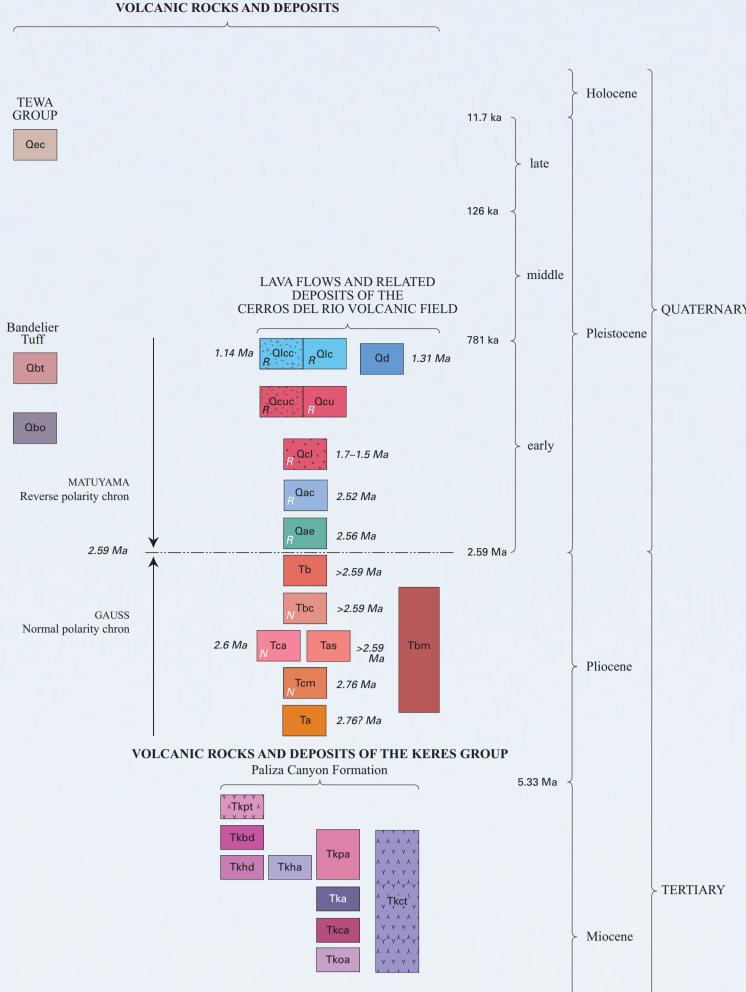
alluvium 2–8 m thick derived from eastern sources and layers of angular

km south of Alamo Canyon. Soils thin (<0.5 m) ranging from A/C profiles to

profiles with Bw and (or) Bk horizons with Stage II carbonate morphology.

and (or) Bk horizons with Stage II carbonate morphology on low terraces.

Alluvial deposit 5 (Holocene to late Pleistocene)—Cross-to planar-bedded sand and



Sheetwash deposit

Colluvial deposits

SEDIMENTARY ROCKS AND DEPOSITS

Santa Fe Group and deposits

Canyon and the Town of Cochiti Lake, upper 2–10 m of the Cochiti Formation

Canyon ignimbrite (Spell and others, 1990; Smith and Kuhle, 1998). Interbedded

some of it tubular and nearly aphyric, correlated with the ~1.8 Ma San Diego

with unit Tsfa south of the Town of Cochiti Lake and near the intersection of

alluvium. Dips gently northeast near the Town of Cochiti Lake, more steeply

(>10°) near faults. Northwest of the Pajarito fault zone, Cochiti Formation of

Goff and others (1990) is a black to gray volcaniclastic unit consisting of debris

flows, local zones of fluvial sediments and andesitic cinder cone debris, and

flows of andesite too thin to show at map scale, interbedded with volcanic rocks

2001). Thick deposits tend to be covered by colluvium, estimated maximum

lithified pebble to cobble gravel rich in rounded clasts, arkosic sand, and thin

beds of silty sand. Coarse units are 0.5-3.0 m thick, massive to cross-bedded, and

resistant rocks from northern New Mexico; andesitic and dacitic rocks from the

or arkosic. Along White Rock Canyon, locally includes areas of pink silty

sandstone that may correlate with the middle Santa Fe Group. Maximum

in the southern part of the quadrangle on both sides of the Rio Grande. Fills

landslide deposits, Pliocene basalt, or hydromagmatic deposits at most

locally planar-bedded. Gravel generally >70 percent quartzite, granite and other

Jemez Mountains common locally: vesicular basalt uncommon. Matrix quartzose

thickness along Cañada de Cochiti; extensive exposures near Medio Canyon and

channels in and locally interbedded with Cochiti Formation (QTc). Lies beneath

exposures. Paleocurrent direction measured on channels, gravelly crossbeds, and

imbricated cobbles range from 140°–230°, and averages about 180°. Mainly

undeformed except near faults. Near the mouth of Medio Canyon interlayered

with a basaltic flow dated at about 2.5 Ma (Bachman and Mehnert, 1978).

moderately lithified, planar-bedded to massive silty sandstone, siltstone, and

cross-bedded pebbly sand in sparse channels. Sandstone beds up to 4 m thick;

channels <1 m. Coarse units locally cemented with sparry calcite. Clasts mainly:

(1) intermediate volcanic rocks and quartzite from southern Colorado and the

northern Sangre de Cristo Range, and (2) Precambrian granite and associated

rocks from the southern Sangre de Cristo Range. Matrix arkosic. Locally beneath

tuffs of Canovas Canyon (Tkct) and unconformably overlies Galisteo Formation

(Tgs) in the northwestern map area. Dips gently  $(<8^\circ)$  to the west and northwest.

Correlates, in part, with the Tesuque Formation of Galusha and Blick (1971), and

the Ancha Formation of Spiegel and Baldwin (1963). Thickness >100 m

Galisteo Formation (Eocene)—Tan and pink to brownish red beds of well-indurated

sandstone, siltstone, arkose, and conglomerate; conglomerate beds locally

contain limestone, chert, and granitic fragments from pebble to boulder size

eroded from Paleozoic and Precambrian rocks. Exposed on rotated fault block

with beds dipping steeply west in northwest part of map area. Unconformably

underlies Santa Fe Group; base of unit not exposed; maximum observed

Pre-Santa Fe Group sedimentary deposits

VOLCANIC ROCKS AND DEPOSITS

Qec El Cajete tephra (late Pleistocene)—White to gray, poorly sorted rhyolitic pumice

Bandelier Tuff

Obt **Tshirege Member of Bandelier Tuff (early Pleistocene)**—White to pink slightly

fall deposits; pumice clasts contain sparse phenocrysts of quartz, sanidine,

biotite, and clinopyroxene. Most exposures have been reworked and concentrated

by fluvial or slope processes. Overlies buried soil containing a well-developed Bt

horizon invaded by carbonate. Derived from the El Cajete vent in the Valles

Caldera (fig. 1); age ~50 to 60 ka (Reneau and others, 1996). Exposed in local,

velded pyroclastic flows and a thin (< 0.5 m) pumiceous fall unit, both of

five pyroclastic flows separated by pumice concentrations or thin, sorted

rhyolitic composition and containing abundant phenocrysts of chatoyant sanidine

and quartz and trace clinopyroxene, hypersthene, and fayalite. Consists of two to

partings, exposed along deep canyons west of the Rio Grande; thinner (<25 m)

flow sections are preserved locally in shallow canyons east of the Rio Grande.

Thickness generally <60 m, but locally >90 m along Medio Canyon. Paleoflow

directions to the southeast. Overlies lower Bandelier Tuff or pumiceous piedmont

alluvium of the Toledo interval. Derived from the Valles caldera area northwest

of the map area.  ${}^{40}\text{Ar}/{}^{39}\text{Ar}$  age is  $1.22 \pm 0.02$  Ma (Izett and Obradovich, 1994)

rhyolitic ash-flow tuff and a laminated to poorly sorted compound pumiceous fall

sanidine, quartz and sparse mafic phenocrysts. The Otowi Member consists of

30 m. Lithic fragments generally are more abundant than in unit Qbt. Best

one to three thick ash-flow units comprising a compound-cooling unit as thick as

Otowi Member of Bandelier Tuff (early Pleistocene)—White to pink, nonwelded

unit as thick as 10 m, both containing abundant phenocrysts of chatoyant

Undivided Santa Fe Group (Pliocene to upper Miocene)—White, tan and pink,

QTsfa Santa Fe Group, axial channel facies (lower Pleistocene and Pliocene)-Slightly

thickness >30 m, base not exposed

Thickness 5 to >70 m

thickness about 200 m

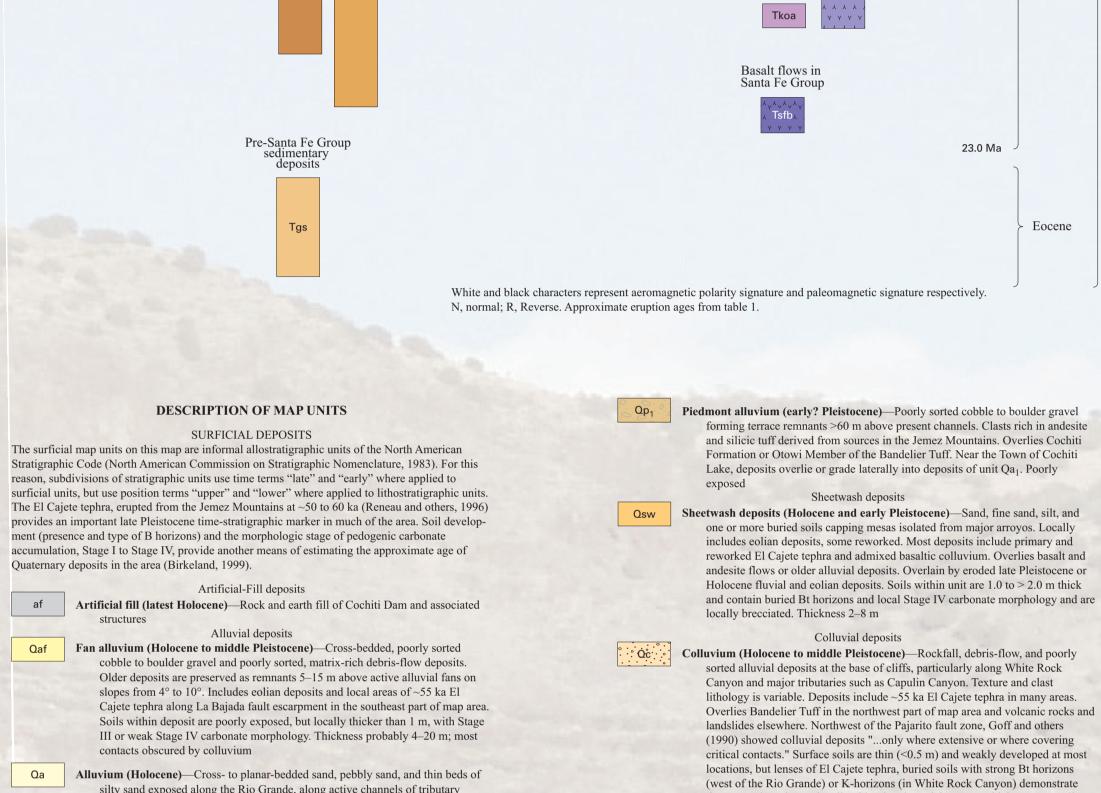
dune-like outcrops as thick as 8 m

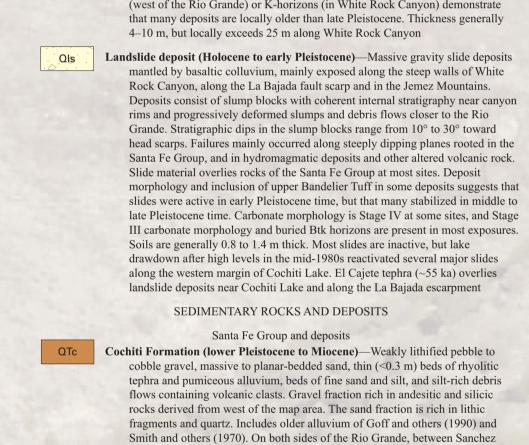
of the Keres Group (Gardner, 1985; Gardner and others, 1986; Smith and others,

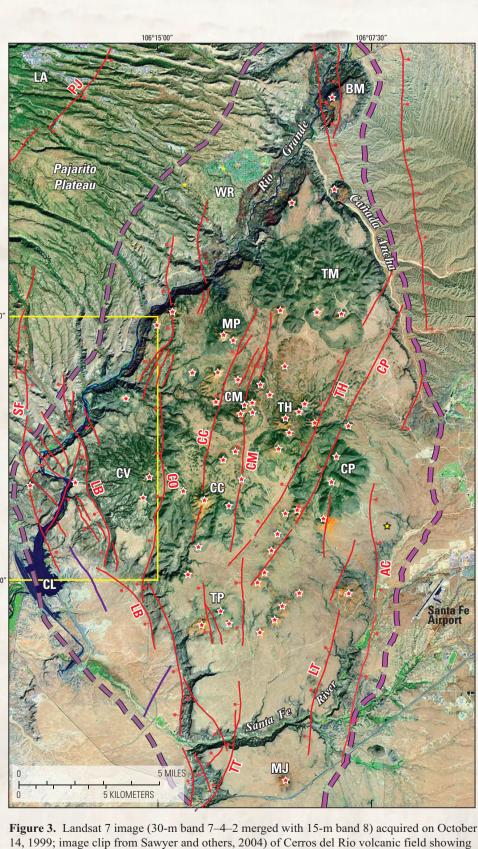
Cochiti and Bland Canyons. Underlies lower Bandelier Tuff or piedmont

consists of dark-colored sand containing beds and concentrations of pumic

23.0 Ma







approximate eruptive extent as purple dashed line, mapped vent areas as red stars and

LA, Los Alamos; WR, White Rock; CL, Cochiti Lake; BM, Buckman Mesa; OM, Ortiz

Mountain; MP, Montoso Peak; CM, Cerro Micho; TH, Twin Hills; CP, Cerro Portillo; CC

shown in purple. Fault abbreviations: PJ, Pajarito fault; SF, San Francisco fault; LB, La

fault; TH; Twin Hills fault; CP, Cerro Portillo fault; LT, Las Tetillitas fault; AC, Arroyo

Calabasas fault. Quadrangle outline in yellow.

Cerro Colorado; CV, Cochiti Volcano; TP, Tetilla Peak; MJ, Mesita de Juana. Major mapped

Bajada fault; TT, Tetilla fault; CM, Cerro Micho fault; CC, Cerro Colorado fault; CO, Cochiti

presumed buried vents based on aeromagnetic data as yellow stars. Geographic abbreviations

The geology was mapped from 1997–1999 and modified in 2004–2008. The primary

volcanic field, and a preliminary version of fault distribution. Thompson and Hudson

field. Thompson, Minor and Hudson mapped surface exposures of faults and Hudson

mapping responsibilities were as follows: Dethier mapped the surficial deposits.

digital compilation of the geologic map.

QUADRANGLE LOCATION

Exposed thickness 3–10 m, base not exposed Alluvial deposit 4 (late Pleistocene)—Well-sorted cobble to boulder gravel, cross-bedded sand, and thin-bedded sand of fluvial origin and fluvial and eolian silty sand beneath terrace remnants 14–20 m above the Rio Grande. Exposed mainly at mouths of tributaries such as Medio Canyon and in the southern part of the map area. Overlies Santa Fe Group deposits, landslide deposits, or older alluvium. Deposits are extensive near Cochiti Dam, where 5–10 m of axial river cobble-gravel overlies basaltic boulders and underlies piedmont alluvium mainly derived from the west. Deposits apparently lie beneath the ~55 ka El Cajete tephra. Soils <1.0 m thick and poorly exposed with Stage II or weak Stage III carbonate morphology. Thickness probably 4-20 m Alluvial deposit 3 (middle Pleistocene)—Well-sorted cobble to poorly sorted boulder gravel, cross-bedded sand, and thin-bedded sand beneath terrace remnants 25–45 m above the Rio Grande, preserved at mouths of tributaries and in an extensive deposit near Alamo Canyon that contain angular boulders as large as 3.5 m. Clasts are predominantly axial river lithologies but are locally rich in andesitic and dacitic rocks derived from volcanic terrane to the west. Overlie and truncates rocks of the Santa Fe Group, landslide deposits, older alluvium or basin-fill sedimentary deposits, Miocene to Quaternary volcanic deposits of the Jemez hydromagmatic deposits. Extensive deposits on both sides of Rio Grande near the mouth of Alamo Canyon are overlain by El Cajete tephra. Soils 0.5–1.0 m mapped the Pliocene and Quaternary volcanic deposits of the Cerros del Rio volcanic thick contain Stage II or Stage III carbonate morphology and local buried Bt horizons. Thickness 4–15 m conducted paleomagnetic studies for stratigraphic correlations. Thompson prepared th Alluvial deposit 2 (middle? Pleistocene)—Well-sorted cobble to boulder gravel containing layers composed of boulders as large as 3 m, exposed beneath terrace remnants approximately 50 to 70 m above the Rio Grande. Contact relations best exposed on both sides of Cochiti Lake, south and southwest of the Tetilla Peak overlook, where 8–25 m of gravelly axial channel deposits overlie lower

> boulders of basalt interfinger with and overlie the axial alluvium in the southeastern part of map area. Overlies Santa Fe Group or landslide deposits. Deposits contain clasts of upper Bandelier Tuff and a local bed of ~0.55 Ma tephra derived from Valles caldera. Amino-acid ratios from gastropods in the upper 5 m of the deposits suggest a local age of 250 to 300 ka (see Dethier and McCoy, 1993). Deposits are overlain by El Cajete tephra (~55 ka; Reneau and others, 1996) and may be in part coeval with unit Qal. Soils are 0.8–1.5 m thick and contain Stage IV carbonate in gravel; finer piedmont deposits expose several buried Bt horizons locally and carbonate development is Stage III. Thickness generally 10–30 m Alluvial deposit 1 (early Pleistocene)—Poorly sorted boulder gravel containing clasts of volcanic rock as large as 4 m, well-sorted cobble gravel and beds of coarse sand exposed beneath terrace remnants 80–130 m above the Rio Grande south of the mouth of Capulin Canyon. Boulder-rich beds contain abundant clasts of andesite and welded Bandelier Tuff and minor basalt or axial-river lithologies derived from sources northwest of the modern river. Most exposures contain boulders of, and are thus younger than, the 1.22 Ma Tshirege Member of the Bandelier Tuff (Izett and Obradovich, 1994); basal exposures at several sites contain no axial lithologies and fill narrow paleodrainages cut into the Tshirege Member of the Bandelier Tuff. Deposits SE of the Town of Cochiti Lake contain boulders of the 1.61 Ma Otowi Member of the Bandelier Tuff (Izett and Obradovich, 1994). Deposits overlie basaltic or andesitic rocks in most areas. Overlain by eolian deposits, El Cajete tephra, and locally derived alluvium. Soils are 1.0 to > 2.0 m thick; finer overlying piedmont deposits expose multiple buried Bt horizons locally. Carbonate development is Stage III+ or Stage IV; carbonate-rich horizons locally brecciated and broken by vertical veins. Deposits at several sites between Alamo Canyon and Sanchez Canyon fill narrow paleocanyons cut before deposition of lower Bandelier Tuff (Reneau and Dethier, 1996). Locally overlain by upper Bandelier Tuff. Thickness generally 10-30 m, but thicker near the mouth of Medio Canyon Piedmont deposits Piedmont alluvial deposit 5 (Holocene to late Pleistocene)-Cross-to planar-bedded sand and pebbly sand and poorly sorted gravel. Clasts predominantly andesite and silicic tuff derived from the Jemez Mountains to the west; matrix rich in lithic fragments and quartz. Deposits 0.5–4.0 m thick are exposed beneath terraces 3–10 m above Rio Chiquito and adjacent tributaries graded to the Rio Grande. Beds generally <0.5 m thick. Soils are thin (<0.5 m) ranging from A/C profiles to profiles with Bw and (or) Bk horizons with Stage II carbonate. Exposed thickness 3–10 m, base not exposed Piedmont alluvial deposit 4 (late Pleistocene)—Poorly sorted cobble to boulder gravel, sand, and local silty sand. West of the Rio Grande, clasts are predominantly andesite and silicic tuff derived from the Jemez Mountains to the west and the matrix is rich in lithic fragments and quartz. To the east, granitic and metamorphic clasts predominate and matrix is arkosic. Deposits 0.5–8.0 m thick are exposed beneath terraces 14–20 m above present channels graded to the Rio Grande. Exposures are extensive near Rio Chiquito and south to Bland Canyon. Overlies Cochiti Formation or Otowi Member of the Bandelier Tuff. Soils generally thin (<1 m) and moderately developed having local Stage III carbonate morphology and buried Bt horizons Piedmont alluvial deposit 3 (middle Pleistocene)—Poorly sorted cobble to boulder

> > tephra. Deposits 0.5–8.0 m thick are exposed beneath terraces 25–40 m above

and massive sand and local silt beds in the southeast part of the map area beneath

terrace remnants 45-60 m above present channels. West of the Rio Grande, clasts

are predominantly andesite and silicic tuff derived from sources in the Jemez

Mountains west of the map area and the matrix is rich in lithic fragments and

guartz. East of the Rio Grande, clasts are mainly granitic and metamorphic cl

and matrix is arkosic. Overlies Cochiti Formation, lower Bandelier Tuff, or

deposits of the Santa Fe Group. Extensive exposures west of Santa Cruz Arroyo

are interfingered with middle(?) Pleistocene alluvial deposits (Qa<sub>2</sub>) and include

several carbonate horizons with Stage II or Stage III carbonate morphology and

Piedmont alluvium (middle? Pleistocene)—Poorly sorted cobble to boulder gravel

present channels graded to the Rio Grande

locally strongly developed buried Bt horizons

The Pajarito Plateau area of the southeastern Jemez Mountains (fig. 1) is underlain by the Otowi (Qbo) and Tshirege (Qbt) Members of the Pleistocene Bandelier Tuff, erupted during collapse of the Valles caldera. These tuffs were deposited unconformably on underlying basaltic volcanic rocks of the Cerros del Rio volcanic field and on precaldera volcanic rocks of the Keres Group. Postcaldera volcanic deposits in the La Bajada constriction area are limited to reworked pumice and ash deposits of the approximately 55 ka El Cajete tephra (Reneau and others, 1996; Wolf and others, 1996). This pumice and ash blanket the northeastern slopes of eroded volcanic highlands east of the Rio Grande. gravel and sand. West of the Rio Grande, clasts are predominantly andesite and silicic tuff derived from the west and the matrix is rich in lithic fragments and quartz. East of the Rio Grande granitic and metamorphic clasts predominate and matrix is arkosic. Overlies Cochiti Formation, Otowi Member of the Bandelier Tuff, or Santa Fe Group deposits. Extensive exposures are preserved north of Bland Canyon. Soils are 0.5–1.0 m thick with Stage II or Stage III carbonate morphology; strongly developed Bt horizons locally are buried by El Cajete

## Geologic Map of the Cochiti Dam Quadrangle, Sandoval County, New Mexico

David P. Dethier, Ren A. Thompson, Mark R. Hudson, Scott A. Minor, and David A. Sawyer

## Prepared in cooperation with the National Park Service

## exposed south of Capulin Canyon and southwest of the Town of Cochiti Lake. Overlies 2 to 5 m of gray pumiceous alluvium (upper Cochiti Formation) in areas southwest of Lummis Canyon. Locally overlies axial gravel deposits (Qa<sub>1</sub>). Overlain by upper Bandelier Tuff, and andesitic flows. Derived from the Valles caldera northwest of the map area. ${}^{40}\text{Ar}/{}^{39}\text{Ar}$ age is 1.61±0.01 Ma (Izett and Obradovich, 1994) LAVA FLOWS AND RELATED DEPOSITS OF THE CERROS DEL RIO VOLCANIC FIELD The Cerros del Rio volcanic field is a predominantly basaltic to andesitic volcanic plateau along the southeast flank of the Jemez Mountains (fig. 1) of northern New Mexico. Lavas and related pyroclastic deposits of this field are locally exposed over 700 km<sup>2</sup> and reflect eruption of at least 120 km<sup>3</sup> of rift-related mafic magma, mainly between 2.7 and 1.1 Ma. Most of the lava flows are of Pliocene and early Pleistocene age and predate large-volume silicic caldera eruptions in the nearby Jemez Volcanic Field; however, late-stage eruptions from the Cerros del Rio volcanic field post-date eruption of the Tshirege Member (1.2 Ma; Valles Caldera) of the Bandelier Tuff in the Jemez volcanic field. Most of the eruptive centers in the Cerros del Rio volcanic field are centralvent volcanoes ranging from low-relief shield centers to remnants of steep-sided, breached cinder cones. These lavas have from 49 to 64 weight percent $SiO_2$ and exhibit a strong correlation between landform and whole-rock chemistry. The low-silica, subalkaline basaltic lavas erupted from broad shield volcanoes and formed thin ( $\leq$ 3–4 m) low-viscosity flows that traveled far; conversely transitional to mildly alkaline basalts and basaltic andesites formed thick (as much as 30 m) discontinuous lavas flows that erupted from high-relief, steep-sided, dissected vents. Dacitic lavas are related to late-stage dome growth and eruption of thick (as much as 50 m), even more viscous blocky lava flows that issued from one well-defined vent area at Tetilla Peak about 2 km south of the map area (Sawyer and others, 2002) and locally in tributary canyons of the Rio Grande, west of the map area. Volcanic deposits of the Cerros del Rio volcanic field are divided into a three-fold classification representing early (1), middle (2), and late (3) phases of eruption that persisted from about 2.7 Ma to 1.1 Ma. Volcanic units in the map area are believed to represent products of monogenetic eruptive centers of the early (>2.7-2.59 Ma), middle (2.59-2.1 Ma), and late (1.5-1.1 Ma) volcanic phases of Thompson and others (2006). These subdivisions are based on 1:24,000-scale geologic mapping, stratigraphic studies, <sup>40</sup>Ar/<sup>39</sup>Ar geochronology, and paleomagnetic and aeromagnetic data. Some geochemical data were used to identify rock lithologies within the stratigraphic subdivisions for the entire field and were incorporated in unit descriptions, where available, for volcanic deposits in the map area. Volcanic rock names are based on the standard IUGS classification scheme (Le Bas and Streckeisen, 1991), however, only root names are used in map unit description. Some volcanic units contain rocks of variable composition, spanning classification boundaries. In these cases, the dominant rock type was used for the unit name and ranges of compositions are presented in table 1. Preliminary results of new <sup>40</sup>Ar/<sup>39</sup>Ar age determinations are presented in unit descriptions. Locations for samples referenced in the text are presented in table 2. In places, map units represent the consolidation of deposits of limited extent and are based on similar lithologic character, stratigraphic position, inferred age, aeromagnetic and paleomagnetic signatures, and aerial extent of similar or related deposits. Map-unit nomenclature for the volcanic deposits in part reflects that proposed by Aubele (1978, 1979). Colors of the lava flows and cinder deposits used in unit descriptions were determined by comparison with a Munsell color chart Munsell Color, 1995). Andesite of Little Cochiti cone (early Pleistocene) —Reddish brown to medium gray and esite $(58-60 \text{ weight percent SiO}_2)$ lava flows (Qlc) and associated pyroclastic deposits (Qlcc) erupted from small volcanic cone in the southeastern part of the map area herein referred to as Little Cochiti cone. Little Cochiti cone deposits post-date down-to-west offset along the La Bajada fault, whose footwall formed a topographic escarpment over which westward flowing lava cascaded toward the present day course of the Rio Grande. Subsequent down-to-west offset along the La Bajada fault may have accentuated the offset of deposits preserved on the hanging wall and footwall blocks. Basal lava flows are typically thin (3–5 m), platy and discontinuous. Sparse phenocrysts include olivine, pyroxene and plagioclase in decreasing order of abundance, xenocrysts of plagioclase and lesser quartz are common near the vent area centered about hill 6598' on the Caja del Rio. Maximum exposed thickness is 70 m **Cinder deposits**—Near-vent pyroclastic deposits, predominantly scoria and spatter agglutinate and minor flow material, present only in proximity to eroded vent

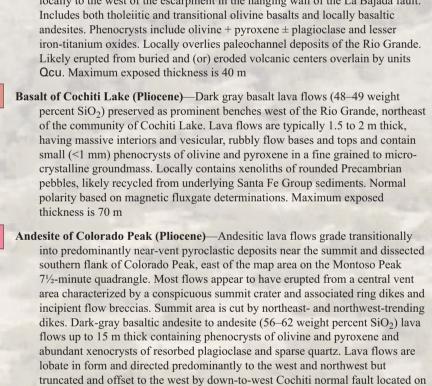
**Lava flows**—Medium to dark gray andesite lava flows; typically thin (3–5 m), aty and discontinuous and are everywhere overlain by near-vent deposits, predominantly cinder and lesser amounts of spatter. An <sup>40</sup>Ar/<sup>39</sup>Ar isotopic age of 1.14±0.13 Ma was obtained from a lava flow near the head of Santa Cruz Arroyo (sample 96TCD08). Lava flows have reversed aeromagnetic signature and reverse magnetic polarity based on magnetic fluxgate determinations Dacite of Arroyo Montoso (early Pleistocene)—Dark gray to black, fine grained to glassy, aphyric dacite lava flows and dome remnants (64–65 weight percent SiO<sub>2</sub>) best exposed near the confluence of the Rio Grande and Arroyo Montoso. Lava flows are thick (up to 20 m) and massive with brecciated flow bases and flow foliated tops. Sparse phenocrysts of olivine  $\pm$  pyroxene  $\pm$  plagioclase occur locally in a microcrystalline to cryptocrystalline groundmass. Partially resorbed xenocrysts of plagioclase  $\pm$  quartz are sparse but ubiquitous. An 40Ar/39Ar isotopic age of 1.31±0.08 Ma was obtained from a lava flow above the Rio Grande (sample DN85113). Locally overlies deposits of unit Qbo. Maximum exposed thickness is 170 m Andesite of Cochiti volcano (early Pleistocene)-Reddish brown to medium gray lava flows and oxidized cinder and spatter erupted from Cochiti volcano near the southwestern boundary of the map area. Cochiti volcano deposits post-date down-to-west offset along the Cochiti fault, whose footwall scarp formed a topographic barrier to eastward deposition of lava flows. Consists of an upper (Qcu) and lower (Qcl) sequence of preserved lava flows and near vent pyroclas tic material (Qcuc) associated with the upper unit. Vent area for upper unit is coincident with eroded, conical summit of Cochiti volcano in on the eastern margin of the map area. Maximum exposed thickness is 350 m Upper unit, cinder deposits—Near-vent pyroclastic deposits, predominantly scoria and spatter agglutinate and minor flow material. Deposits are only present along the eastern edge of the map area Upper unit, lava flows-Medium to dark gray andesite lava flows (59-62 weight percent SiO<sub>2</sub>); typically thin (3–5 m), platy and discontinuous and are everywhere overlain by near-vent deposits, predominantly cinder and lesser amounts of spatter. Sparse phenocrysts include olivine, pyroxene and plagioclase in

decreasing order of abundance. An <sup>40</sup>Ar/<sup>39</sup>Ar isotopic age of 1.51±0.05 Ma was

obtained from a lava flow near the base of the section on the northwest side of

Cochiti volcano (sample 3MRG3). These flows have reverse aeromagnetic and





the Montoso Peak quadrangle. An <sup>40</sup>Ar/<sup>39</sup>Ar isotopic age of 2.60±0.10 Ma was

(sample 96TMP38). Normal magnetic polarity based on paleomagnetic and

Andesite of Sanchez Canyon (Pliocene)—Medium gray to reddish brown (56 weight

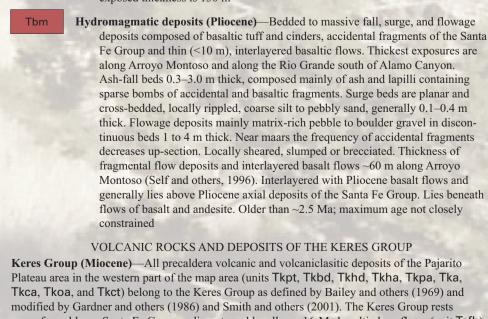
percent  $SiO_2$ ) and esite lava flows and associated near vent pyroclastic deposits

to the east on the adjacent Montoso Peak quadrangle

obtained from a lava flow near the summit of Colorado Peak east of the map area

aeromagnetic signature. Maximum exposed thickness is 75 m, but exceeds 225 m





dacite lavas, pyroclastic deposits, volcanic breccias, and sedimentary deposits (Gardner and others

1986; Lavine and others, 1996). Age of the volcanic rocks ranges from approximately 12 Ma near

the base of the Paliza Canyon Formation to approximately 6.5 Ma, the youngest age reported for

the Bearhead Rhyolite; most volcanism occurred between 10 and 8 Ma (Gardner and others, 1986;

McIntosh and Quade, 1995; Lavine and others, 1996; Justet, 1999). Unit descriptions are modified

Paliza Canyon Formation

pumice fragments contain phenocrysts of quartz, potassium feldspar,

type locality 6.81±0.15 Ma; maximum observed thickness about 170 m

biotite+plagioclase; lithic fragments consist of volcanics from nearby sources.

for all tuff units unknown; K-Ar age of lowermost tuff bed at Peralta Canyon

Tkpt fills in rugged volcanic topography on earlier Keres Group rocks; sources

**Peralta Tuff Member of Bearhead Rhyolite**—White to tan, lithic-rich ash-fall tu

from Goff and others (1990).

