



DESCRIPTION OF MAP UNITS

General notes: Gravel in the Santa Fe Group is composed of (1) pink granite, pegmatite, amphibolite, sparse clasts of sedimentary rock, and minor fragments of epikrite derived from Precambrian terrane to the northeast and east of the quadrangle; and (2) gray volcanic rocks, mainly of intermediate composition, derived from Tertiary volcanic terrane to the north. Axial river gravel in the Puye Formation and in Quaternary alluvial and channel deposits consists mainly of (1) quartzite, granite, metatoolite rocks, and pegmatite derived from Precambrian terrane to the north (Griggs, 1964); (2) lesser amounts of northern Tertiary siliceous and intermediate volcanic rocks; and (3) less than 5 percent basalt and dark to light-colored chert. Piedmont gravel consists mainly of dacitic rocks eroded from the Tschicoma and Puye Formations, lesser amounts of pumice eroded from the Banderler Tuff, and pumice and obsidian from the tuffaceous deposits of the Cerro Toledo interval of time that is, after eruption of the Otowi Member and before eruption of the Tshirege Member of the Banderler Tuff. I use Piedmont alluvium of the Cerro Toledo interval as a shortened form of "Tschicoma and volcaniclastic sediments of the Cerro Toledo interval," the name recommended by investigators from Los Alamos National Laboratory (see Broton and Renau, 1995, p. 11) for alluvial and epikritic deposits that were deposited between eruptions of the two members of the Banderler Tuff. Smith and others (1970) referred to these deposits as "tuffs and associated sediments" of the Cerro Toledo Rhyolite, but in the Puye quadrangle these deposits are chiefly dacitic alluvium derived from the Tschicoma Formation to the west. Geologic units are described as observed in gravel pits and pumice mines.

MAN-MADE DEPOSITS

**f Fill (Holocene)**—Recent sand, gravel, and other compacted construction materials beneath roadways. Thickness probably 3-8 m. Present beneath State Routes 502 and 30, but mapped only at their intersection.

STREAM ALLUVIUM

**Qal Channel and flood-plain deposits of the Rio Grande and tributary rivers (Holocene)**—Cross to planar-bedded sand, pebbly sand, pebbly cobble gravel, and thin beds of silty sand exposed along the Rio Grande, Rio Pajarito (immediately east of Rio Grande), and beneath adjacent low terraces (<4 m above river). Beds generally less than 0.5 m thick. Exposed thickness 2-4 m in the southeastern part of map area. Actual thickness probably more than 10 m along the Rio Grande. Base not exposed. Soils thin (<0.5 m) with A/C or Bw horizons (Birkeland, 1999) on low terraces.

**Qa1a Alluvial deposits (upper Pleistocene)**—Well-sorted cobble to boulder gravel, cross-bedded sand, and thin-bedded silt and silty sand beneath terrace remnants 14-20 m above the Rio Grande, exposed near the mouth of Los Alamos Canyon. Clasts predominantly axial-river types (see General notes); locally rich in dacitic rocks derived from the Jemez Mountains. Thickness probably 4-20 m. Overlies or inset against rocks of the Santa Fe Group. Soils less than 1.0 m thick and poorly exposed; carbonate morphology is Stage II or Stage III (Birkeland, 1999).

**Qa1b Alluvial deposits (middle(?) Pleistocene)**—Well-sorted cobble to poorly sorted boulder gravel and cross-bedded sand beneath terrace remnants 25-45 m above the Rio Grande, preserved at the mouth of Los Alamos Canyon. Clasts predominantly axial-river types (see General notes); locally rich in dacitic rocks derived from the Jemez Mountains. Thickness ranges from 4 to more than 15 m. Overlies and truncates rocks of the Santa Fe Group or landslide deposits. Soils 0.5-1.0 m thick contain Stage II or Stage III carbonate morphology (Birkeland, 1999) and local buried B horizons.

**Q1a Older alluvial deposits (lower Pleistocene and upper Pliocene?)**—Well-sorted pebbly gravel and beds of coarse sand and overlying eolian and fine-grained basal deposits on mesa tops exposed from Canada de las Marias to the southeast map area. Clasts rich in axial-river types (see General notes); matrix arkosic. Exposed locally about 180-240 m above the Rio Grande at elevations of about 6,100-6,300 ft. Thickness mainly 1-5 m. Overlies upper Pliocene(?) lacustrine facies of the Puye Formation, includes an isolated outcrop north of Otowi Bridge (Rio Grande at south border of map), 145 m above the Rio Grande, that overlies Pliocene basalt and contains clasts of Banderler Tuff pumice, axial gravel, and dacitic boulders. Soils poorly exposed.

PIEDMONT ALLUVIUM

**Otp Piedmont alluvium (Holocene)**—Poorly sorted cobble to boulder gravel, cross to planar-bedded sand, boulder-rich debris-flow deposits, and eolian sediment exposed along active channels of large drainages such as Gaule and Santa Clara Canyons and their major tributaries and beneath adjacent low surfaces. Deposits generally sand-rich west of and above exposures of the Puye Formation. Exposed thicknesses generally less than 4 m, but as much as 10 m in borrow pits along lower Bajo and Gaule Canyons. Generally overlies Santa Fe Group, Puye Formation, or Quaternary units; locally inset against or gradational with alluvial fan deposits or older piedmont alluvium. In Bajo Canyon, <sup>14</sup>C ages from buried charcoal layers 3-6 m below the modern channel range from 4930 to 4280 yr B.P. (Rihmaki and Dethier, 1998).

**Otp5 Piedmont alluvium (Holocene to upper Pleistocene?)**—Cross-bedded to planar-bedded sand and pebbly sand and poorly sorted gravel beneath terrace remnants adjacent to active channels of major drainages such as Santa Clara, Gaule, and Pueblo Canyons and their tributaries. Clasts predominantly dacitic and other rock types derived from the Puye Formation and recycled Tschicoma Formation; matrix rich in subangular lithic fragments (mainly dacitic and quartzite). Deposits 0.5-0.9 m thick exposed beneath terraces 3-8 m above modern channels. Beds generally less than 0.5 m thick. Exposed thickness 3-8 m. Base not exposed. Soils thin (<0.5 m) with multiple buried A/C and Bw horizons; locally contains Stage II carbonate (Birkeland, 1999).

**Otp4 Piedmont alluvium (middle(?) Pleistocene)**—Poorly sorted cobble to boulder gravel, sand, and silty sand. Clasts predominantly dacitic; surface rich in boulders. Deposits mainly 0.5-1.5 m thick, locally as thick as 18.0 m, exposed beneath terraces 15-25 m above drainages graded to the Rio Grande between Chapuderos and Santa Clara Canyons. Overlies Santa Fe Group. Soils poorly exposed but generally thin (<1.0 m) and moderately developed with local Stage II carbonate (Birkeland, 1999) and buried B horizons.

**Otp3 Piedmont alluvium (middle(?) Pleistocene)**—Poorly to moderately well sorted cobble to boulder gravel and sand. Clasts predominantly dacitic mixed locally with quartzite and other resistant gravel derived from northern sources; matrix rich in dacitic fragments and quartz. Deposits mainly 0.5-1.5 m thick, locally as thick as 20 m; exposed beneath terraces 30-40 m above present drainages graded to the Rio Grande. Overlies Santa Fe Group or Puye Formation. Best exposed between Chapuderos and Santa Clara Canyons. Soils 0.5-1.0 m thick contain Stage II or Stage III carbonate (Birkeland, 1999) and locally strongly developed B horizons.

**Otp2 Piedmont alluvium (middle Pleistocene)**—Poorly sorted cobble to boulder gravel in deposits 0.5-3 m thick beneath isolated terrace remnants 45-60 m above present channels. Clasts predominantly dacitic. Overlies Santa Fe Group near the intersection of Gaule and Los Alamos Canyons and Puye Formation at isolated exposures in Santa Clara Canyon. Soils poorly exposed, but locally contain Stage III carbonate (Birkeland, 1999).

**Otp1 Piedmont alluvium (middle to lower(?) Pleistocene)**—Poorly sorted cobble to boulder gravel, sand, and local eolian silty sand beneath terrace remnants at several levels between 60 and about 100 m above present channels. Clasts predominantly dacitic. Deposits mainly 1-10 m thick, but poorly exposed. Overlies and locally includes areas of Puye Formation too small to show at this map scale. Mapped mainly north of Gaule Canyon.

**Otpu Piedmont alluvium, undivided (upper to middle(?) Pleistocene)**—Poorly exposed cobble to boulder gravel, sand, and local eolian silty sand in the western map area. Clasts predominantly dacitic derived from the Tschicoma Formation. Deposits 0.5 to more than 20 m thick beneath broad-terrace remnants and elongate ridges 20-40 m above local arroyos, mainly on upland surfaces. Faulted (?) terrace remnants 40-60 m above the floor of upper Chapuderos and Garcia Canyons are mapped as Otpu, but may be older than other deposits in the western half of the map area. Overlies deposits of the Cerro Toledo interval, lower part of Banderler Tuff, or Puye Formation. Soils poorly exposed. Several elongate ridges of unit Otpu appear to be topographically inverted channels active during Cerro Toledo time.

**Otpb Piedmont alluvium (lower Pleistocene?) and upper Pliocene**—Poorly to moderately sorted dacitic cobble gravel and beds of coarse sand and boulder-rich debris-flow deposits interbedded with eolian fine sand and silt. Basal deposits

