NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES
A DIVISION OF NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY

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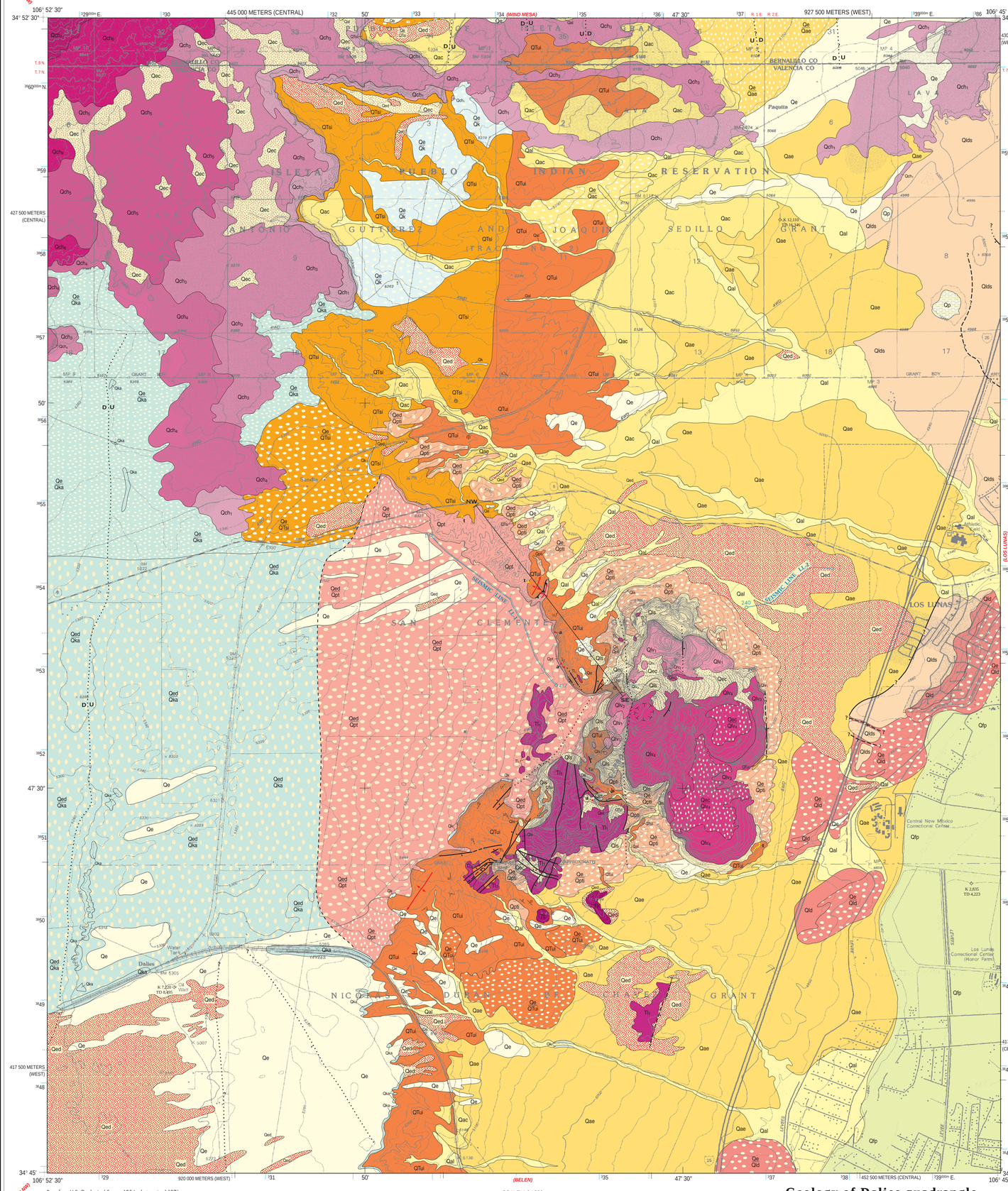
DALIES QUADRANGLE
NEW MEXICO



Unit Descriptions

Rock chart colors are from Goddard and others (1948). The stratigraphy for the lava flows of the Cat Hills was modified from Kelley and Kudo (1978). Lava flow 2 of the Cat Hills is not found in this quadrangle, but occurs in the adjacent Rio Puerco quadrangle to the west. The lava flow sequence 1 through 7 is used here for the sake of clarity in discussion of the Cat Hills lava field. Modal analysis of Cat Hills lava flows are from Frank Byers, Jr. (U. S. Geological Survey, written commun., 1997). The stratigraphy of Los Lunas volcanoes is modified greatly from Kelley and Kudo (1978).

SURFICIAL DEPOSITS

Qfp **Historic floodplain of Rio Grande** between artificial barriers and valley margins. Consists of silt and clay overlying sandy overbank and channel deposits. Commonly disturbed by agricultural fields and subdivisions.

Qal **Younger alluvial deposit (Historic, Holocene)**—Composed of a stack of beds comprised of yellowish gray (5Y7/2) unconsolidated sorted to unsorted, fine to coarse sand interbedded with gravel beds. The gravels are composed of clasts of pebble to cobble size, predominantly of calcic soils of the Llano de Albuquerque (described below) and clasts eroded from the *QTui* unit. Unit resembles *QTui* and Qae units. Deposited in arroyos inset into older alluvial deposit mapped as Qae. Locally includes eolian sand.

Qac **Older alluvial deposit (Holocene)**—Comprised of interbeds of sand and gravel deposited as colluvium and fans on moderate slopes. Sand is unconsolidated, yellowish gray (5Y7/2) to grayish gray (5Y8/4) and contains pebbles. Gravels are unconsolidated, pea to cobble size clasts composed of Qla and clasts eroded from the QTsp unit. Locally includes eolian sand. A charcoal sample from this unit in the adjacent Dalies Northwest quadrangle (Maldonado and Atencio, 1998) to the west has been dated at 1950 ± 50 years (Jack McGeehin, U. S. Geological Survey, written commun, 1997) using the ^{14}C method.

Qae **Older alluvial deposit (Holocene and Late Pleistocene)**—Sandy and pebbly alluvium and eolian deposits in tributary drainages and alluvial aprons along lower valley margins. Comprised of interbeds of sand and gravel deposited as channels, overbanks, and fans. Sand is unconsolidated, yellowish gray (5Y7/2) to grayish gray (5Y8/4) and contains pebbles. Gravels are unconsolidated, pea- to cobble-size clasts composed of *Qka* and clasts eroded from the *Qtui* unit. Locally includes eolian sand.

Qp **Playa deposits (Historic and Holocene) on Los Duranes Formation**—Deposits are sand, silty sand, and clay. Sandy lunette poorly developed to northeast, downwind of larger playa.

Qe **Eolian sheet (Pleistocene-Holocene) with subdued or no dune forms**—Light brown (5YR6/4), grayish orange (10/YR7/4) to very pale orange (10YR8/2), unconsolidated, fine grained, well rounded, well sorted sand composed mostly of quartz. Sheets are generally fairly thin but thicken near fault scarps. Locally contains Qka and Qec. Commonly deposits have one or more intervals of soil development beneath the surface.

Qec **Unconsolidated colluvium and eolian sand (Pleistocene-Holocene)** partially covering lava flows and intrusives. The wind-blown sand and silt and volcanic clasts are typically deposited in topographically low areas within the lava flows and near fault traces.

Qed **Eolian dune (Late Holocene)**—Light brown (5YR6/4), grayish orange (10/YR7/4), to very pale orange (10YR8/2), unconsolidated, fine grained, angular to well rounded, well sorted sand composed mostly of quartz. Cross-bedding is common. Extended arms of blown out parabolic dunes are found in the southern three-quarters of the map area where orientation of dunes indicate winds dominantly from the west-southwest.

Qe Qed **Eolian sheet and older alluvium (Pleistocene-Holocene)**—Eolian sand on Los Duranes Formation (*Qld* - described below).

Qe Qpti **Eolian sand and piedmont alluvium (Pleistocene-Holocene)**—Inset in canyons below Los Lunas volcanoes and piedmont apron (*Qpt*).

Qe Qpt **Eolian sand and piedmont alluvium (Pleistocene-Holocene)**—On piedmont apron surrounding Los Lunas volcanoes.

Qe QTsi **Eolian sand and fine-grained facies of Isleta Reservation (Pleistocene-Holocene)**—Eolian sand overlying fine-grained facies of Isleta Reservation.

Qe QTsl **Eolian sheet and the sand and gravel facies of the Rio Puerco fluvial deposits of the Santa Fe Group (Pleistocene-Holocene)**—Eolian sand on sand and gravel facies of the Rio Puerco fluvial deposits of the Santa Fe Group.

Qe Qka **Eolian sheet and soils of the Llano de Alburquerque (Pleistocene-Holocene)**—Eolian sheet sand overlying soils of the Llano de Alburquerque (described below). Sand is light brown (5YR8/2), unconsolidated, composed of fine grained, well rounded and well sorted quartz grains. Locally contains sand and pebbles composed predominantly of chert, quartzite, calcedony, granite, petrified wood, sandstone, basalt, and limestone derived from the underlying soils of the Llano de Alburquerque and *Qtui*.

Qls **Landslide, talus, and colluvial deposits (Pleistocene-Holocene)** on steep slopes adjacent to Los Lunas volcanoes. Landslides progress downslope from large coherent rotated toreva blocks of lava to disintegrated talus boulders to colluvial wedges at the base of the slopes. Interstitital eolian sand, reworked sediments (*Qtui*), and pedogenic stage II to stage IV calcium carbonate accumulations are common between lava clasts. Some talus includes flow-front breccia extending beyond the lava flows. *QTls* includes fluvial volcanically-derived gravel and volcanic talus adjacent to lavas of the older volcano.

Qld **Los Duranes Formation (Pleistocene) and segundo alto terrace of Rio Grande of Lambert (1968).** Los Duranes Formation is 40 m thick, consisting of coarse cobble gravel at base, overlain by crossbedded sand, and parallel-bedded fine sand, silt and clay in fining-upward packages. In deposits on the Isleta Quadrangle to the northeast, at least two separate sand layers show convoluted bedding similar to seismites (Seilacher, 1969). Local pale gray sand and silt units contain fossil snails.

Qlds **Stabilized top of Los Duranes Formation known as segundo alto terrace.** Contains stage II calcium carbonate horizone beneath eolian mantle.

Qpt **Piedmont alluvium, talus, and eolian deposits (Pleistocene-Holocene) downslope from Los Lunas volcanoes**—Light brown (5YR6/4), grayish orange (10YR7/4), to very pale orange (10YR8/2), mixture of unconsolidate, poorly sorted sand, gravel, and talus overlain by eolian sand and talus blocks. Base of *Qpt* unconformable on Santa Fe beds and includes boulders of Qlv_1 and Tshiregе ash as much as 0.6 m thick (1.22 Ma, from Valles Caldera). Thickness as much as 50 meters.

Qpti **Piedmont alluvium (Pleistocene) inset along canyons and erosional scarps adjacent to Los Lunas volcanoes.** Light brown (5YR6/4), grayish orange (10YR7/4), to very pale orange (10YR8/2) poorly sorted sand, gravel, and talus overlain by eolian sand and talus blocks.

Qk **Exposures of calcic soil (Pleistocene)**—White (N9) to bluish-white (5B9/11) thick, stage II-III (Birkeland, 1984; Machette, 1985) calcic horizon developed in alluvial and eolian units on alluvial slopes.

Qka **White (N9) to bluish-white (5B9/11) thick, stage III-IV (Birkeland, 1984; Machette, 1985) calcic horizon** that has developed at the top of sands and gravels of the *QTui* unit on the Llano de Alburquerque. Contains clasts of chert, quartzite, chalcedony, granite, petrified wood, sandstone, basalt, jasper, limestone, and lava. As much as 2 meters thick.

VOLCANIC ROCKS
Cat Hills

Qch_7 **Lava flow 7 of Cat Hills (Pleistocene)**—Dark-gray (N3) to grayish black (N2) very-fine grained, vesiculated, basaltic lava flow. Groundmass is microgranular mixture of plagioclase, clinopyroxene, opaques (ilmenite and magnetite), and olivine. Contains approximately 9 percent phenocrysts of plagioclase (58 percent) to about 2 mm, olivine (41 percent) to about 3 mm, and clinopyroxene (1 percent). Ridges or mounds are common and are characterized by apical grabens that are filled with eolian sand. Near the cinder cones to the northwest, the flows form hogbacks dipping away from the cones. Mapped as Qbr by Kelley and Kudo (1978). Dated at 250,000 ± 0.08 years using $^{40}Ar/^{39}Ar$ (Geochronology Laboratory, New Mexico Institute of Mining and Technology, written commun. 1997). This date is discordant because the oldest Cat Hills flow (Qch_1) is dated at about 100,000 years. Estimated maximum thickness about 30 m.

Qch_6 **Lava flow 6 of Cat Hills (Pleistocene)**—Dark-gray (N3) to grayish black (N2) fine- to medium-grained, vesiculated, basaltic lava flow. Groundmass is microgranular mixture of plagioclase, clinopyroxene, opaques (ilmenite and magnetite), and olivine. Contains approximately 6 percent phenocrysts of olivine (70 percent) to about 3 mm, and plagioclase (30 percent) to about 2 mm. Characterized by ridges and grabens that in some areas form a triple junction. These grabens typically are filled with eolian sand that in some cases have allowed trees to grow within them. Mapped as Qb_{3a} by Kelley and Kudo (1978). Estimated thickness as much as 50 m.

Qch_5 **Lava flow 5 of Cat Hills (Pleistocene)**—Dark-gray (N3) to grayish black (N2) fine-grained, vesiculated, porphyritic, basaltic lava flow. Groundmass is microgranular mixture of plagioclase, clinopyroxene, opaques (ilmenite and magnetite), and olivine. Composed of 6 percent phenocrysts of olivine (51 percent) to about 3 mm, and plagioclase (49 percent) to about 2 mm. Ridges with grabens common and filled with eolian sand. Flow resembles lava flow 6. Mapped as Qb_3 by Kelley and Kudo (1978). Estimated thickness as much as 25 m.

Qch_4 **Lava flow 4 of Cat Hills (Pleistocene)**—Dark-gray (N3), fine-grained, vesiculated, basaltic lava flow. Groundmass is composed of plagioclase, olivine (may include orthopyroxene with some clinopyroxene) and opaques (magnetite?). Contains about 3.5 percent phenocrysts of plagioclase (29 percent) and olivine (71 percent). Mapped as Qb_{2a} by Kelly and Kudo (1978). Estimated thickness as much as 15 m.

Qch_3 **Lava flow 3 of Cat Hills (Pleistocene)**—Grayish black (N2) very-fine to medium-grained, vesiculated, porphyritic, basaltic lava flow. Groundmass is composed of plagioclase, olivine (may include orthopyroxene with some clinopyroxene) and opaques (magnetite?). Consists of about 6 percent phenocrysts of olivine (84 percent) to about 5 mm, and plagioclase (16 percent) to about 2 mm. Vesicles contain microcrystalline filling of quartz, alkali feldspar, and anhydrous minerals. Mapped as Qb_2 by Kelley and Kudo (1978). Estimated thickness as much as about 20 m.

Qch_2 **Lava flow 1 of Cat Hills (Pleistocene)**—Dark-gray (N3) to grayish black (N2) fine- to medium-grained, vesiculated, porphyritic, basaltic lava flow. Groundmass is microgranular mixture of plagioclase, clinopyroxene, opaques, and olivine. Composed of 6 percent phenocrysts of olivine (78 percent) to about 4 mm, plagioclase (20 percent) and clinopyroxene (2 percent). Overlies the soils of the Llano de Albuquerque (*Qla*). Mapped as Qb_1 by Kelley and Kudo (1978) and dated at 0.140 ± 0.038 (Kudo and others, 1977) using the K-Ar method. New $^{40}Ar/^{39}Ar$ dates are 0.11±0.02 and 0.098 ± 0.03 Ma. Estimated thickness as much as 20 m.

Los Lunas Volcano

Qlv_4 **Lava flow 4 of Los Lunas volcano (Pleistocene)**—Light gray (N7) to pale brown (5YR5/2) fine-grained trachyandesite lava flows. Groundmass is microgranular and microvesicular containing plagioclase, pyroxene, Fe-Ti oxides, + olivine. Phenocrysts (up to 4 mm) include plagioclase and pyroxene. Crustal xenoliths are common and are angular to subrounded, making up < 1 percent of the rock. The unit consists of symmetrical lava lobes that appear to originate from a central depression (buried crater?) near the main summit of Los Lunas volcano. Lava overlies talus, eolian sand and Qlv_1 and Qlv_2 on northeast flank of summit. Lava flow 4 overlies Qlv_3 on east side of the volcano. Maximum thickness of the unit is estimated to be 8 m.

Qlv_3 **Lava flow 3 of Los Lunas volcano (Pleistocene)**—Medium gray (N5), fine-grained trachyandesite lava flows. Finely porphyritic with phenocrysts of pyroxene and plagioclase (both up to 3 mm). The groundmass is holocrystalline, nonvesicular, and contains plagioclase, pyroxene, Fe-Ti oxides, + olivine. The unit is exposed only on the east side of the volcano where it ranges up to 24 m thick. It overlies Qlv_1 and dscends to the south. It has been truncated on the east side, either by a fault or by bluff-cutting erosion of the Rio Grande prior to deposition of the Los Duranes Formation.

Qlv_2 **Scoria deposite of Los Lunas volcano (Pleistocene)**—Blackish read (5R2/2) to moderate reddish brown (10R4/6), fine-grained, scoriaceous and agglutinated trachyandesite pyroclastic breccia. Groundmass is glassy with 1-2 percent microphenocrysts of plagioclase and quartz. Individual bombs and lapilli are partially welded to adjoining volcanic fragments. Associated lithics represent 2-5 percent of the total rock volume. This unit mantles the pre-eruption topography and is 2-3 m thick at a cliff exposure on the norther and eastern sides of the summit.

Qlv_1 **Lava flow 1 of Los Lunas volcano (Pleistocene -1.22 ± 0.13 Ma by $^{40}Ar/^{39}Ar$ plateau age geochronology)**—Light gray (N7) at lower 1 m of base to pale brown (5YR5/2) fine-grained, vesiculated trachyandesite lava flow. Groundmass is microgranular, containing plagioclase, olivine, pyroxene, and Fe-Ti oxides. Microphenocryst phases include plagioclase, olivine, and pyroxene. Crustal xenocrysts/xenoliths are common throughout the flow, are subrounded, range in size from 0.5 cm to 6 cm, and represent < 1 percent of the total rock volume. The flow is massive and generally fractured along concoidal planes. This unit is present across the lower elevations on the north side of the volcano. The flow generally is less than 15 m thick but is thicker at north edifice, at ponded area on west side (18 m), and at low northeastern edge of exposures (55 m). Mapped as Qo_1, Qo_2, and Qa_3 by Kelley and Kudo (1978).

Ti **Intrusives of Los Lunas (Pliocene?)**—Grayish black (N2) very fine-grained, dacitic sill or laccolith (?). Groundmass is microgranular, containing plagioclase, pyroxene, and + olivine. Vesicles are 2-10 percent of rock volume and display an anastomosing texture throughout the unit. Mapped as Qia by Kelley and Kudo (1978). Contacts between slightly different textures within these bodies include sheets, dikes, and autobreccias. No baked contacts or abundant inclusions of surrounding sediments have been found. Instead, these bodies have been buried by sediments that incorporate clasts of these bodies. Therefore, although these bodies are mapped as intrusive, they must have been exhumed, buried by sediments (*Qtui*), and currently are being exhumed again.

Tl_1 **Lava flow of Los Lunas (Pliocene; 3.88 +0.04 Ma, 40Ar/39Ar plateau age)**—Medium dark gray (N4) at base to grayish black (N2), very fine-grained, vesicular, trachyandesite lava flow. Groundmass is micro-granular, containing plagioclase, pyroxene, and + olivine. Microphenocryst phases consist of plagioclase and pyroxene. Flows are massive and generally fractured into large blocks. Some flows include extensive flow breccia below and in front of the massive part. The lower medium dark gray base is heavily fractured into thin (5-cm) lensoids, possibly a texture resulting from cooling and/or shear stress. This unit is restricted to the southwestern portion of the volcano. A massive flow locally overlies a vent breccia near the south edge of exposures. This vent breccia overlies another local lava flow. The main flow body overides a dark, dacitic ash in the canyon separating the old flows from the younger volcano. The flows may be repeated by fault or slump blocks. Mapped as Ql and Qia by Kelley and Kudo (1978).

SANTA FE GROUP

Fluvial, alluvial, and eolian deposits of the upper Santa Fe Group (Pliocene-Pleistocene)— This sequence of sediments represents detritus related to the ancestral Rio Puerco and Rio Grande (?) that may be equivalent to Machette's (1978) Sierra Ladrones Formation. The sediments have been divided into the following mappable facies: sand and gravel (*QTui*), and finer-grained facies (*QTsi*) consisting of sand, silt, and clay with extremely minor lenses of gravel. The finer-grained facies appear to fill a north-south graben and sag structure within the Llano de Alburquerque.

QTsi **Sand, silt, and clay lithofacies of Isleta Reservation (Pliocene-Pleistocene)—**Grayish orange (10YR7/4), grayish yellow (5Y8/4) to yellowish gray (5Y7/2) sand, silt, and clay with minor thin gravel beds. Exposed thickness about 25 m.

QTui **Sand and gravel facies of Isleta Reservation (Pliocene-Pleistocene?)—**Composed of a stacked sequence of alternating grayish-orange-pink (5YR7/2) to very pale orange (10YR8/2) poorly consolidated intercalated sand, silt, clay, and gravel beds deposited by the ancestral Rio Puerco and local beds of the Rio Grande (?) exposed along the western margin of the Rio Grande valley. Pebbles appear to be bimodal in size with 95 percent less than 3 cm in length; the remaining 5 percent ranging up to 70 cm in length. The small pebbles are predominantly well rounded siliceous bebbles such as quartzites, jaspers, cherts, chalcedony, and silicified wood, as well as granite, limestone, basalt, intermediate volcanic rocks, and reworked pelecypods. Larger pebbles, cobbles, and boulders are predominantly subrounded basalt, granitic rocks carbonate-cemented sandstones (recycled from Santa Fe Group), Pedernal chert, other sedimentary rocks, and rare intermediate and siliceous volcanic rocks. Local units north of Los Lunas volcano include a pumice debris flow with scoraceous basalt clasts and cross-bedded pumiceous sandy gravels with small obsidian pebbles. Fragments of two species of camels (Blancan land-mammal age; identified by Gary Morgan, New Mexico Museum of Natural History and Science, oral commun., 1998). Were recovered from an exposure in the central part of the map. *Tul* Local unconformity in *Qtui* related to deformation during emplacement of ash and Tl_1.

Explanation of Map Symbols
Dalies 7.5′ Quadrangle

- Contact, currently solid for digitizing purposes, will be dashed where approximate, dotted where concealed.
- Normal fault, dashed where approximate, dotted where buried
- Reverse fault, teeth on upthrown side
- Approximate edge of piedmont slope deposits on top of the Llano de Alburquerque west of Los Lunas volcano
- Plunging anticline
- Plunging syncline
- Strike and dip of beds
- Horizontal beds
- Summit depression
- a — Small outcrops of Tshiregе ash within Qpt
- t — Small outcrops of tephra layers within Qtui
- K-2,835 TD 4,223 — Oil well. Numbers refer to depth to Cretaceous rocks and total depth

Comments to Map Users

A geologic map graphically displays information on the distribution, nature, orientation and age relationships of rock and surficial units and the occurrence of structural features. These data are derived from geologic field mapping, compilation of published and unpublished work, and photogeologic interpretation. Locations of geologic unit contacts are not surveyed; therefore, the accuracy of contact locations depends on the scale of mapping and the interpretation of the geologist. Portions of the study area may have been mapped at scales smaller than depicted on the geologic map; therefore, the user should be aware of significant variations in map detail. Any enlargement of this map could cause misunderstanding in the detail of mapping and may result in erroneous interpretations. Site-specific conditions should be verified by detailed surface mapping or subsurface exploration.

This quadrangle map has been Open-filed in order to make it available as soon as possible. The map has not been reviewed according to New Mexico Bureau of Mines and Mineral Resources standards, and due to the ongoing nature of work in this area, revision of this map is likely. As such, dates of revision will be listed in the upper right corner of the map and on the accompanying report. ***The contents of the report and map should not be considered final and complete until it is published by the NMBMMR.***

Base from U.S. Geological Survey 1954, photorevised 1976
Universal Transverse Mercator projection, 1983 North American datum, 2,500-meter grid based on New Mexico coordinate system of 1983, cental and west zones
1000-meter Universal Transverse Mercator grid ticks, zone 13, shown in blue

D. W. Love: Quaternary and Tertiary sedimentary geology and deformation, Los Lunas volcanic stratigraphy and deformation, schematic cross section;
F. Maldonado: geology of the Isleta Reservation, particularly lava flows of Cat Hills and Upper Santa Fe Group units; B. Hallett, K. Panter, W. McIntosh, and N. Dunbar: geology, geochemistry, and geochronology of Los Lunas volcano;
C. B. Reynolds: seismic profiles LL-1 and LL-2

D. J. McCraw and P. Brown: digital cartographic production

UTM GRID AND 1995 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24,000
1 MILE
1000 FEET
1 KILOMETER
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

NEW MEXICO — QUADRANGLE LOCATION

Mapping of this quadrangle was funded by a matching-funds grant from the 1998 STATEMAP program of the National Geologic Mapping Act coordinated by the U.S. Geological Survey and the New Mexico Bureau of Mines and Mineral Resources (Dr. Charles E. Chapin, *Director and State Geologist*; Dr. Paul W. Bauer, *Geologic Mapping Program Manager*).

Geology of Dalies quadrangle, Bernalillo and Valencia Counties, New Mexico

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by David W. Love[1], Florian Maldonado[2], Bruce Hallett[3], Kurt Panter[4], Charles Reynolds[5], William McIntosh[1], and Nelia Dunbar[1]

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