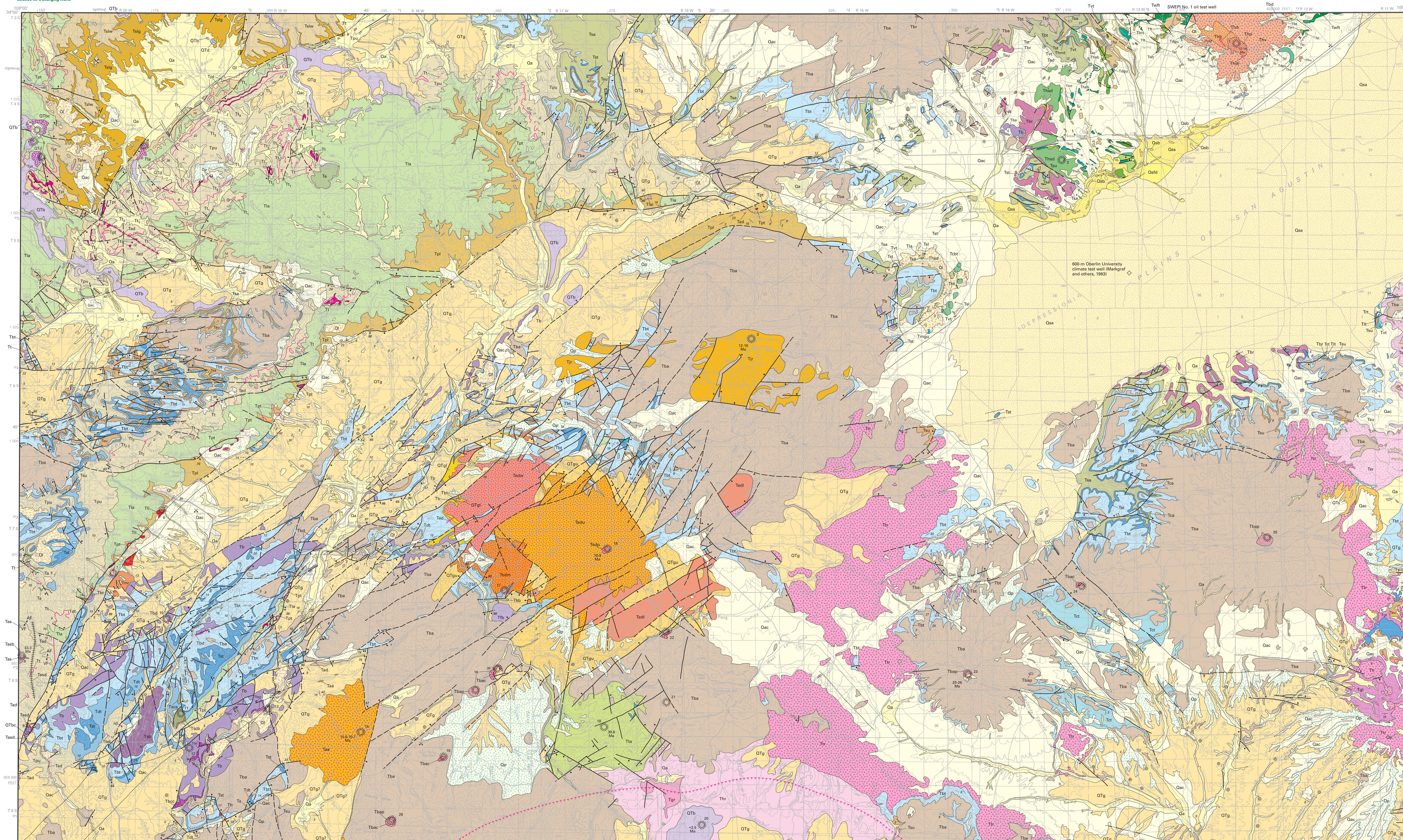
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, a division of the NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

GEOLOGIC INVESTIGATIONS SERIES I–2619
Pamphlet accompanies map



Base from U.S. Geological Survey, 1983
Projection and 10,000-meter grid, zone 12
Universal Transverse Mercator
25,000-foot grid ticks based on New Mexico coordinate system, west zone. 1927 North American datum

APPROXIMATE MEAN DECLINATION, 1996

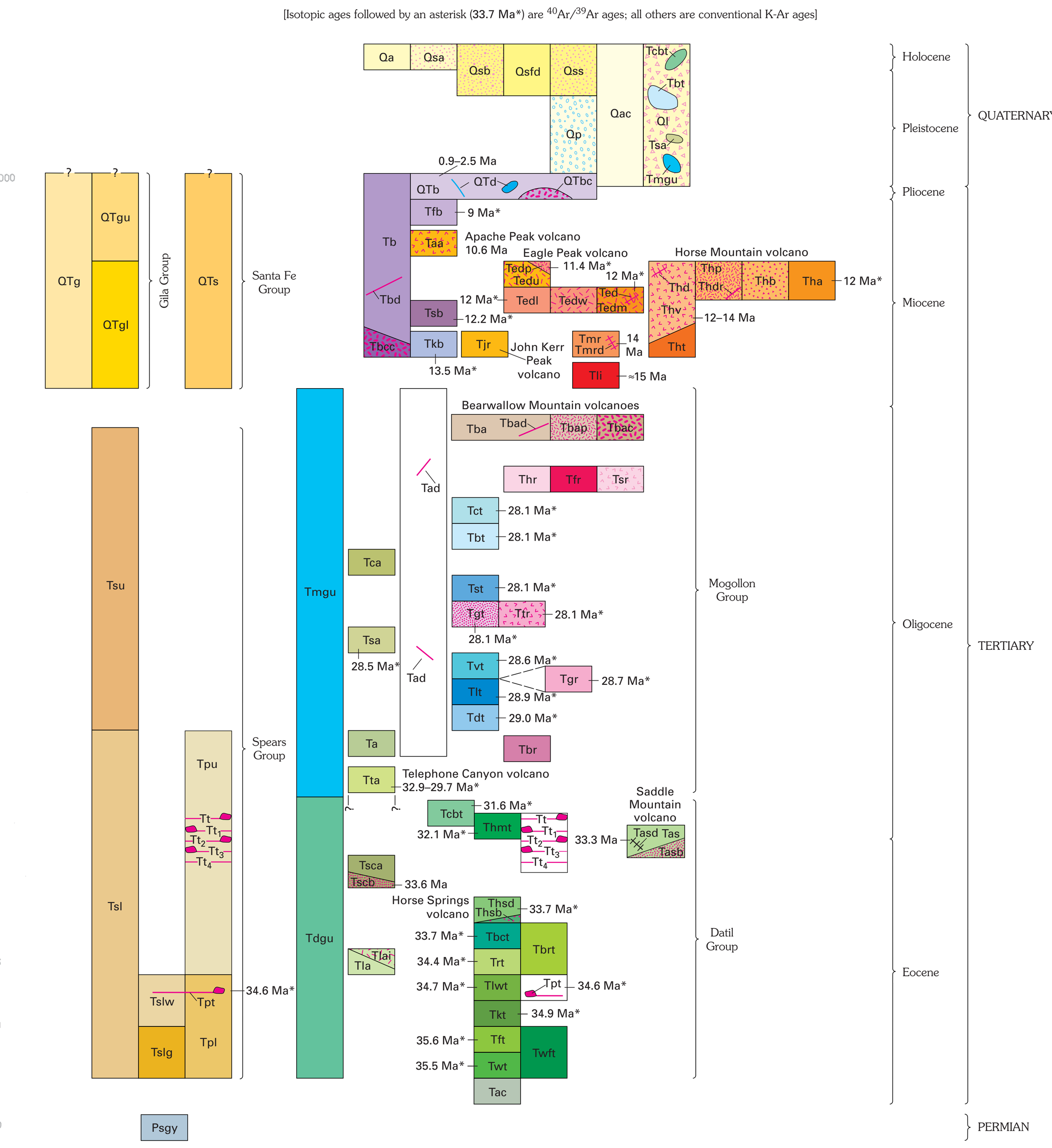
SCALE 1:100 000

CONTOUR INTERVAL 50 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Edited by Diane E. Lane. Cartography by Dennis Welp and Joe Romero. Geology digitized by Mark M. Mansell, K.E. Fresch, and G.E. Jones, New Mexico Bureau of Mines and Mineral Resources; Nancy Shock; and Diane E. Lane. Digital cartography by Diane E. Lane and Dennis Welp.
Manuscript approved for publication November 3, 1997.

CORRELATION OF MAP UNITS

[Isotopic ages followed by an asterisk (33.7 Ma*) are $^{40}Ar/^{39}Ar$ ages; all others are conventional K-Ar ages]



LIST OF MAP UNITS

[Isotopic ages followed by an asterisk (33.7 Ma*) are $^{40}Ar/^{39}Ar$ ages; all others are conventional K-Ar ages]

SURFICIAL DEPOSITS

- Qa — Alluvium (Holocene)
- Qsa — Playa alluvium of the Plains of San Agustin (Holocene)
- Deposits of prehistoric lake San Agustin (B.B. Houser *in* Ratté and others, 1990)
  - Qsb — Bar and barrier ridge deposits (Holocene and Pleistocene)
  - Qsfd — Fan delta deposits (Holocene and Pleistocene)
  - Qss — Shoreline deposits (Holocene and Pleistocene)
- Qac — Colluvium and alluvium (Holocene and Pleistocene)
- Ql — Landslide deposits (Holocene and Pleistocene)
- Qp — Piedmont slope deposits (Pleistocene)

VOLCANIC AND VOLCANICLASTIC ROCKS

- Volcaniclastic rocks of the Gila Group
  - QTg — Gila Group, undivided (Pleistocene(?) to early Miocene)
  - QTgu — Upper Gila Group (Pleistocene(?) to middle Miocene)
  - QTgl — Lower Gila Group (middle to early Miocene)
- QTs — Volcaniclastic rocks of the Santa Fe Group (Pleistocene to Miocene)
- Volcanic rocks interlayered with the Gila Group
  - QTb — Basalt (Pleistocene and Pliocene, 0.9–2.5 Ma*)
  - QTd — Basalt dikes (Pleistocene and Pliocene)
  - QTbc — Basalt scoria (Pleistocene and Pliocene)
  - Tb — Basalt, andesite, and dacite, undivided (Miocene)
  - Tbd — Basalt dikes (Miocene)
  - Tbcc — Basaltic scoria, cinders, and bombs (Miocene)
  - Tfb — Basalt on Flat Top Mesa (Ratté, Bove, and McIntosh, 1994) (Miocene, 9 Ma*)
  - Rocks of Apache Peak volcano
    - Taa — Andesite at Apache Peak (Miocene, 10.6 Ma, H.H. Mehnert, oral commun., 1990)
  - Rocks of Eagle Peak volcano
    - Tedp — Central dacite plug (Miocene, 11.4 Ma*)
    - Tedu — Upper dacite flows (Miocene)
    - Tedl — Lower andesite and dacite flows (Miocene, 12 Ma*)
    - Tedw — Wilson Canyon andesite flows (Miocene)
    - Tedm — Milligan Mountain andesite-dacite flows (Miocene, 12 Ma*)
    - Ted — Andesite dike at Dry Mesa (Miocene)
  - Rocks of Horse Mountain volcano
    - Thv — Predominantly dacitic, rhyolitic to andesitic lava flows (Ratté and others, 1990) (Miocene, 12–14 Ma*)
    - Thd — Northwest-trending, andesitic-dacitic breccia dikes (Miocene)
    - Tht — Pyroclastic rocks (Miocene)
    - Thp — Dacite plug (Miocene)
    - Thdr — Aplite dikes (Miocene)
    - Thb — Vent(?) breccia (Miocene)
    - Tha — Megacrystic andesite lava flow (Miocene, 12 Ma*)
  - Tsb — Basalt of Saliz Hill (Ratté, 1980) (Miocene, 12.2 Ma)
  - Tkb — Basalt at Kiehnes Canyon (Ratté, Bove, and McIntosh, 1994) (Miocene, 13.5 Ma*)
  - Rocks of John Kerr Peak volcano
    - Tjr — Rhyolite domes and flows (Smith, 1976) (Miocene, ≈13 Ma, Marvin and others, 1987)
  - Tmr — Rhyolite near Maverick Peak (Ratté, 1989) (Miocene, ≈14 Ma)
    - Tmrd — Rhyolite dike in rhyolite near Maverick Peak (Miocene)
  - Tli — Porphyritic quartz-diorite intrusions at Wet Leggett Spring (Ratté, 1989) (Miocene, ≈15 Ma, Marvin and others, 1987)
- Volcaniclastic rocks of the Spears Group (Osburn and Chapin, 1983) (Oligocene and Eocene)
  - Tsu — Upper Spears Group (Oligocene)
  - Tsl — Lower Spears Group, undivided (Oligocene and Eocene)
    - Tslw — White sandstone sequence of lower Spears Group (Eocene)
    - Tslg — Green to gray sandstone sequence of lower Spears Group (Eocene)
  - Tpu — Upper Pueblo Creek Formation (Oligocene and Eocene)—Units Tt and Tt_{1-4} are discontinuous, thin (0 to about 5 m thick) Datil Group ignimbrites interlayered in upper Pueblo Creek Formation
  - Tpl — Lower Pueblo Creek Formation (Eocene)
- Volcanic rocks of the Mogollon Group (Cather and others, 1994) (Miocene and Oligocene)
  - Tmgu — Mogollon Group, undivided (Miocene and Oligocene)
  - Tad — Andesite dikes (Miocene and Oligocene)
  - Bearwallow Mountain Andesite (Oligocene, 25–26 Ma, Marvin and others, 1987)
    - Tba — Basaltic-andesite to dacite lava flows (Oligocene)
    - Tbad — Andesitic dike (Oligocene)
    - Tbap — Andesite plugs (Oligocene)
    - Tbac — Andesitic cinder and scoria deposits (Oligocene)
  - Thr — Rhyolite of Hay Canyon (Oligocene?)
  - Tfr — Rhyolite at Frying Pan Creek (Oligocene?)
  - Tsr — Rhyolite of Stallings Tank (Oligocene)
  - Tct — Tuff of Triangle C Ranch (Ratté and others, 1990) (Oligocene, 28.1 Ma*, McIntosh and others, 1992)
  - Tbt — Bloodgood Canyon Tuff (Elston, 1976) (Oligocene, 28.1 Ma*, McIntosh and others, 1992)
  - Tca — Basaltic-andesite of Cottonwood Canyon (Oligocene)
  - Tst — Shelley Peak Tuff (Ratté and Gaskill, 1975) (Oligocene, 28.1 Ma*, McIntosh and others, 1992)
  - Taylor Creek Rhyolite and associated rocks
    - Tgt — Tuff of Garcia Camp (Lawrence, 1985; Duffield and Dalrymple, 1990) (Oligocene, 28.1 Ma*, McIntosh and others, 1992)
    - Ttr — Taylor Creek Rhyolite (Duffield and Dalrymple, 1990) (Oligocene, 28.1 Ma*, McIntosh and others, 1992)
  - Tsa — Squirrel Springs Canyon Andesite (Rhodes and Smith, 1976) (Oligocene, 28.5 Ma*, McIntosh and Chamberlin, 1994)
  - Tvt — Vicks Peak Tuff (Osburn and Chapin, 1983) (Oligocene, 28.6 Ma*, McIntosh and others, 1992)
  - Tgr — Rhyolite of Gwynn Canyon (Oligocene, 28.7 Ma*, unpub. age, D.J. Bove, 1993)
  - Tlt — La Jencia Tuff (Osburn and Chapin, 1983) (Oligocene, 28.9 Ma*, McIntosh and others, 1992)
  - Tdt — Davis Canyon Tuff (Ratté and Gaskill, 1975) (Oligocene, 29.0 Ma*, McIntosh and others, 1992)
  - Ta — Andesite flows (Oligocene)
  - Tbr — Rhyolite of Bat Cave Wells (Ratté and others, 1990) (Oligocene)
  - Rocks of Telephone Canyon volcano
    - Tta — Andesite of Telephone Canyon, undivided (Oligocene, 32.9–29.7 Ma*, D.J. Bove, unpub. ages, 1993)
- Volcanic rocks of the Datil Group (Osburn and Chapin, 1983; Cather and others, 1994) (Oligocene and Eocene)
  - Tdgu — Datil Group, undivided (Oligocene and Eocene)
  - Tcbt — Caballo Blanco Tuff (Elston, 1957) (Oligocene, 31.6 Ma*, McIntosh and others, 1992)
  - Thmt — Hells Mesa Tuff (Osburn and Chapin, 1983) (Oligocene, 32.1 Ma*, McIntosh and others, 1992)
  - Tt — Distal outflow of regional ignimbrites (Oligocene and Eocene)—Labeled Tt_{1-4} where present in sequence
  - Rocks of Saddle Mountain volcano
    - Tas — Andesite lava flows (earliest Oligocene or latest Eocene, about 33.3 Ma)
    - Tasb — Andesite agglomerate (Oligocene or Eocene)
    - Tasd — Andesite dikes (Oligocene or Eocene)
  - Tsca — Andesitic intrusive-extrusive complex of Saliz Canyon (Eocene)
    - Tscb — Andesitic vent(?) breccia (Eocene, 33.6 Ma, Marvin and others, 1987)
  - Tla — Andesite of Dry Leggett Canyon (Ratté, 1989) (Eocene)
    - Tlai — Possible plug or vent for andesite of Dry Leggett Canyon (Eocene)
  - Rocks of Horse Springs volcano or volcanic center
    - Thsd — Horse Springs dacite (Ratté and others, 1990; Ratté, Modreski, and others, 1994) (Eocene, 33.7 Ma*, W.C. McIntosh, written commun., 1995)
      - Thsb — Megabreccia and mesobreccia (Eocene)
  - Tbct — Blue Canyon Tuff (Lopez and Bornhorst, 1979; Osburn and Chapin, 1983) (Eocene, 33.7 Ma*, McIntosh and others, 1992)
  - Trt — Rock House Canyon Tuff (Osburn and Chapin, 1983) (Eocene, 34.4 Ma*, McIntosh and others, 1992)
  - Tbrt — Blue Canyon and Rock House Canyon Tuffs, undivided (Eocene)
  - Tlwt — Tuff of Lebya Well (Ratté and others, 1990) (Eocene, 34.7 Ma*, McIntosh and others, 1992)
  - Tpt — Tuff of Bishop Peak (Ratté, 1989) (Eocene, 34.6 Ma*, McIntosh and others, 1992)
  - Tkt — Kneeling Nun Tuff (Elston and others, 1975) (Eocene, 34.9 Ma*, McIntosh and others, 1992)
  - Tft — Tuff of Farr Ranch (Ratté and others, 1990) (Eocene, 35.6 Ma*, McIntosh and others, 1992)
  - Twt — Datil Well Tuff (Lopez and Bornhorst, 1979) (Eocene 35.5 Ma*, McIntosh and others, 1992)
  - Twft — Datil Well Tuff and (or) tuff of Farr Ranch, undivided (Eocene)
  - Tac — Basaltic lava flow of Alamocito Canyon (Eocene)

OLDER SEDIMENTARY ROCKS

- Psgy — Sedimentary rocks, undivided (Permian)

- **Depositional contact**
- **Fault**—Showing dip; dashed where approximately located or inferred; dotted where concealed or uncertain. Bar and ball on downthrown side; dike, Tbd, shown along fault
- **Rhyolite dike** (rd)—Mapped only in upper Pueblo Creek Formation (unit Tpu) on east flank of Brushy Mountains north of Highway U.S. 180, in central part of Saliz Pass 7½-minute quadrangle, and in Bloodgood Canyon Tuff (unit Tbt) near crest of Saliz Mountains west of Hightower Spring, in central part of Reserve 7½-minute quadrangle
- **Gradational contact between vent facies (VF) and alluvial facies (AF) of upper Pueblo Creek Formation of Spears Group**—Mapped only near southwest corner of quadrangle on west side of Pueblo Creek
- **Scarp within landslide area**
- **Inferred structural margin of Bursum caldera**
- **Volcanic center or vent**—Showing age where known; locality number corresponds to entry in figure 4
- **Road metal quarry**
- **Strike and dip of sedimentary beds or compaction foliation of ignimbrites (ash-flow tuffs)**
  - **Inclined**
  - **Horizontal**
  - **Apparent**

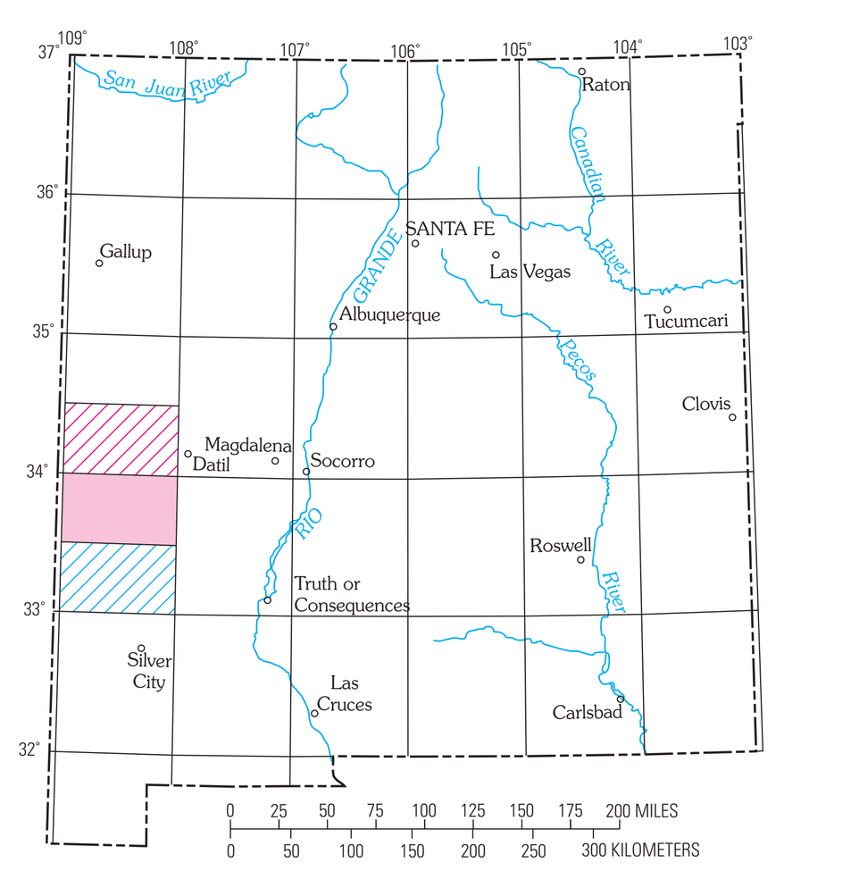


Figure 1. Index map of New Mexico showing location of Tularosa Mountains 30′ × 60′ quadrangle, pink shaded; Quemado 30′ × 60′ quadrangle, pink diagonal lines (Chamberlin and others, 1994); and Mogollon Mountains 30′ × 60′ quadrangle, blue diagonal lines.

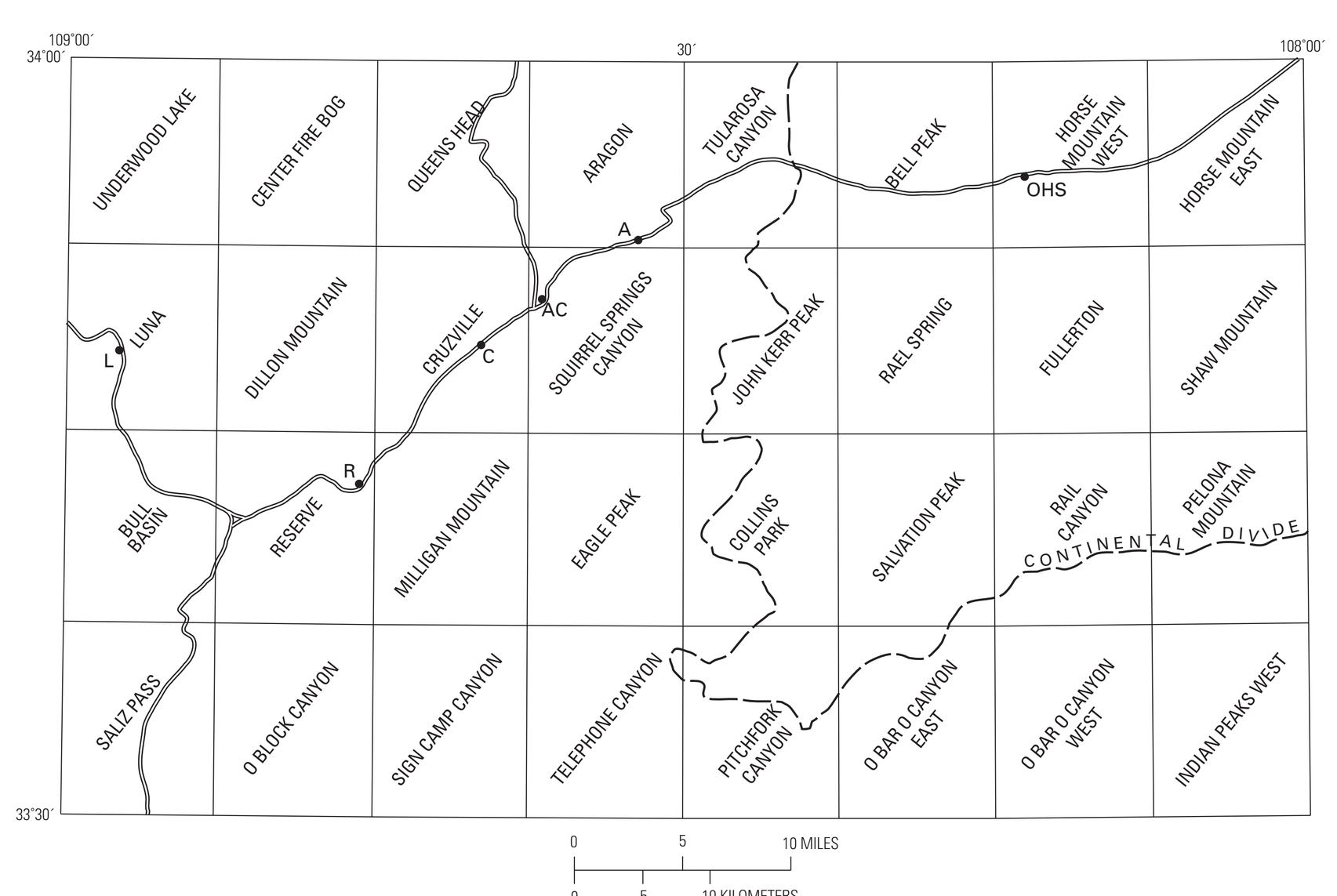


Figure 2. Index to 7½-minute topographic quadrangles in the Tularosa Mountains 30′ × 60′ quadrangle showing principal highways, settlements, and the Continental Divide. Settlements (•): A, Aragon; AC, Apache Creek; C, Cruzville; L, Luna; OHS, Old Horse Springs; R, Reserve (Catron County Seat).

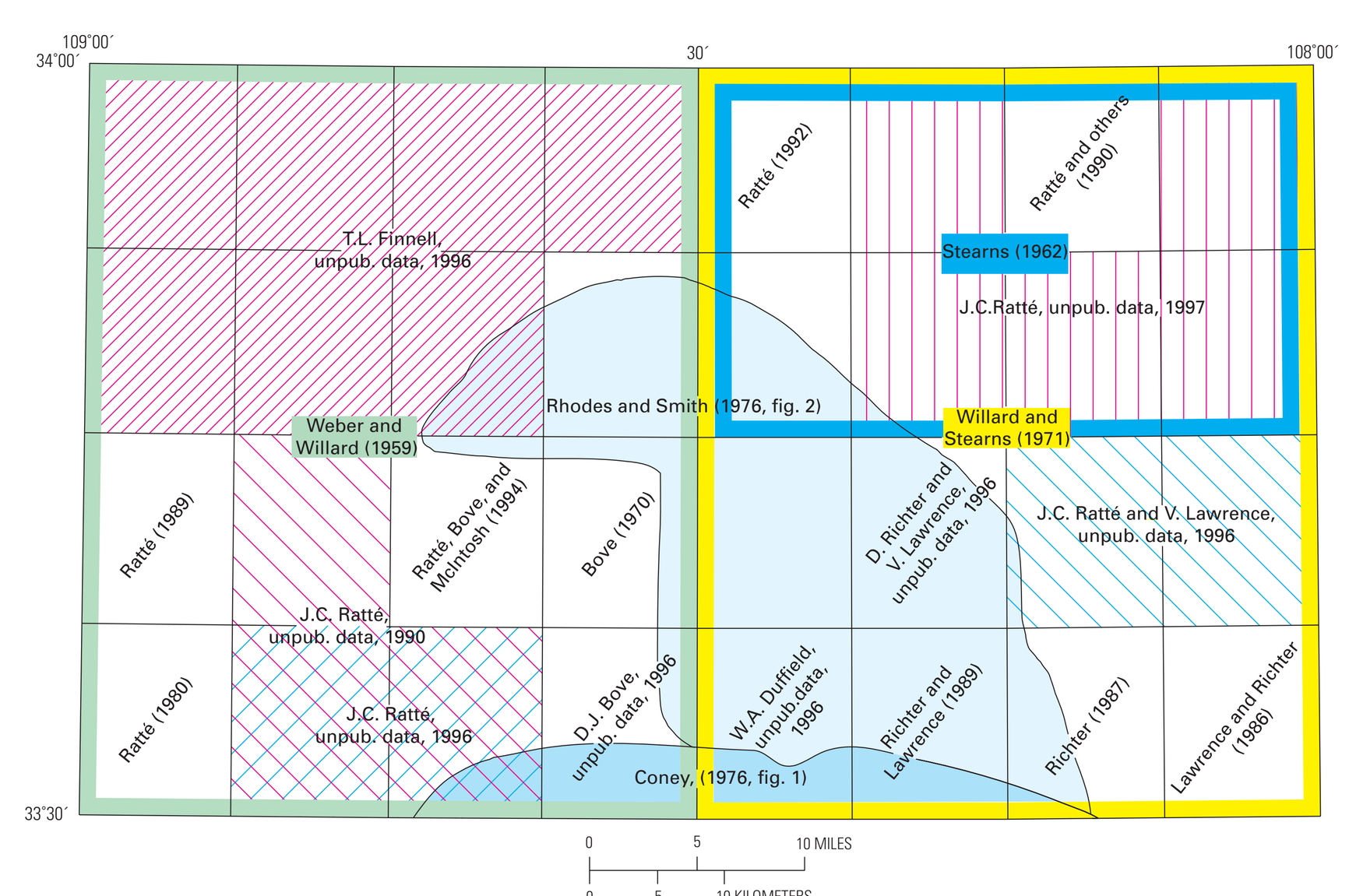


Figure 3. Index to published geologic maps and unpublished data in the Tularosa Mountains 30′ × 60′ quadrangle.

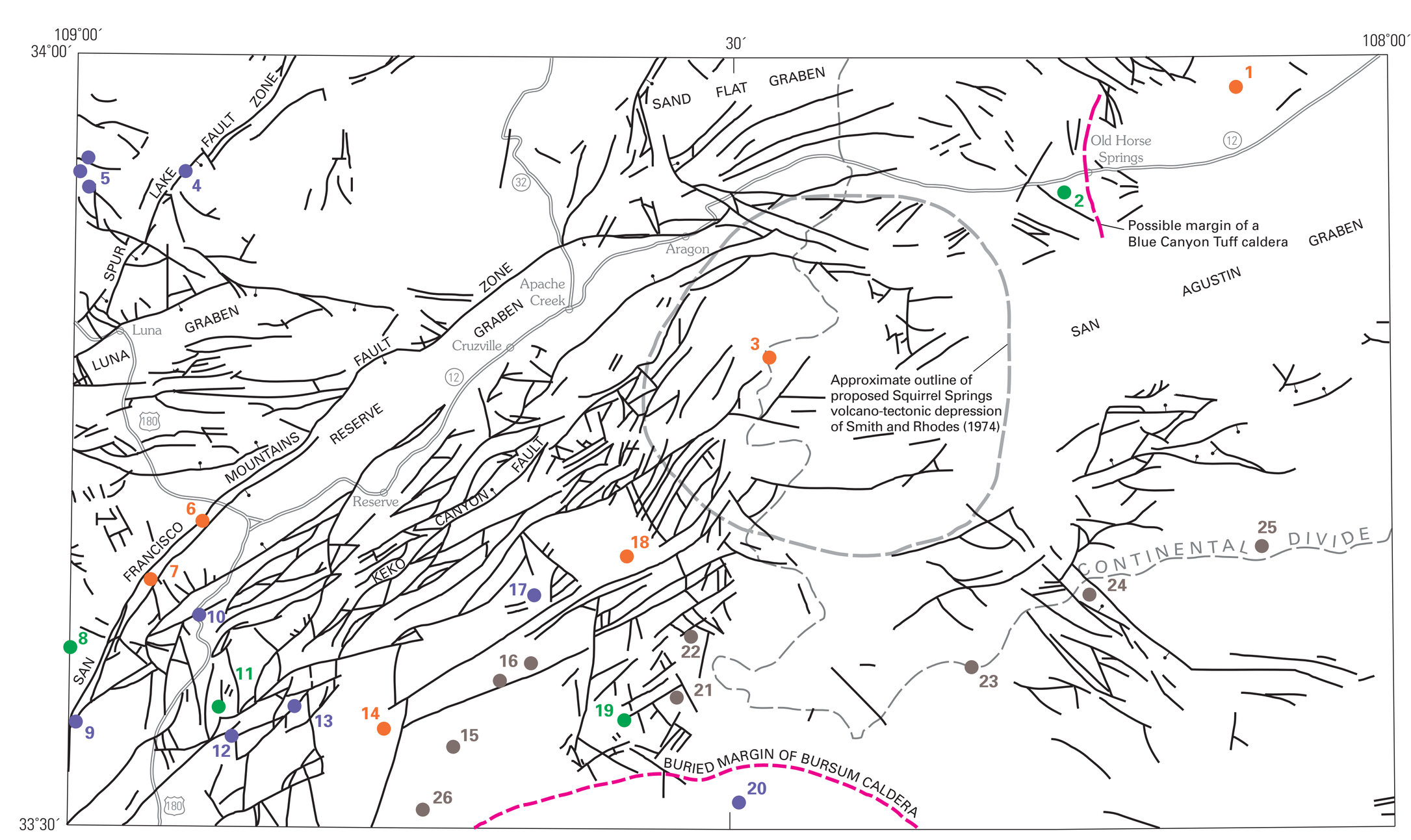


Figure 4. Structural features of the Tularosa Mountains 30′ × 60′ quadrangle showing fault pattern and major named fault zones, volcanic eruptive centers, and proposed caldera boundaries (red, this study; gray, prior study). Bar and ball on downthrown side of selected faults.

EXPLANATION

● 4 Pliocene to Pleistocene basaltic eruptive centers marked by cinder cones, dike feeders of flows associated with cinder cones, or small dike swarms associated with cinder and scoria deposits.
4. Red Butte cinder cone
5. Underwood Lake cinder cones
9. Cinder cone on Pueblo Creek south of Saddle Mountain
10. Cinder cone remnants and associated dike and flows along upper Saliz Canyon
12. Cinder deposits and scoria associated with a swarm of small dikes along lower Saliz Canyon
13. Exhumed cinder cone and feeder dike along San Francisco River above mouth of Saliz Canyon
17. Small plug and associated flows and cinder deposits along Kiehnes Canyon north of Negrito Creek
20. Isolated flows and eruptive center landforms of Feathery Hill southeast of Negrito Airstrip and U.S. Forest Service Fire Base

● 1 Miocene andesitic to rhyolitic volcanoes aligned along both sides of the northeast-trending Morenci-Reserve fault zone or Morenci lineament
1. Horse Mountain composite volcano; domes and flows of andesite to rhyolite
3. John Kerr Peak composite domes of dacite and rhyolite
6. Leggett Spring andesite stock and associated smaller intrusions or flows
7. Maverick Peak eruptive center and associated rhyolitic flows
14. Apache Peak andesite composite domes
18. Eagle Peak andesite and dacite composite domes and flows

● 15 Bearwallow Mountain Andesite Oligocene shield volcanoes and associated flows and satellitic cinder cones, mainly aligned along northeast-trending Morenci-Reserve fault zone and Morenci lineament on southeast side of San Agustin graben
15. Plug(?) and associated scoria deposits on Sign Camp Mountain
16. Cinder cone remnants along Sign Camp Canyon
21. Cinder cone in Sheepherders Ball Park, north of Eckleberger Canyon
22. Cinder cone remnants along North Fork Negrito Creek
23. O Bar O Mountain shield volcano consisting of central plug and extensive lava-flow apron
24. Satellitic cinder cone remnant and associated plug(?) and feeder dike(?) on southwest flank of Pelona Mountain
25. Pelona Mountain shield volcano having central plug and extensive lava-flow apron
26. Plug and surrounding scoriaceous cinder cone deposits south of Mogollon Divide

● 2 Eocene volcanoes of andesitic to rhyolitic composition
2. Cerro Caballo dome or cone, and associated pyroclastic flows, block and ash flows, and flows(?) along the western margin of a possible source caldera for the Blue Canyon Tuff at Old Horse Springs
8. Saddle Mountain hornblende-pyroxene andesite dome or cone and associated hornblende-rich dikes at west edge of quadrangle
11. Saliz Canyon andesitic eruptive center
19. Telephone Canyon composite andesite volcano; in northern wall of Bursum caldera along upper Negrito Creek

CONVERSION FACTORS

Multiply	By	To obtain
centimeters (cm)	0.3937	inches (in.)
meters (m)	3.281	feet (ft)
kilometers (km)	0.6214	miles (mi)

GEOLOGIC MAP OF THE TULAROSA MOUNTAINS 30′ × 60′ QUADRANGLE, CATRON COUNTY, NEW MEXICO

Compiled by
James C. Ratté
2001

Printed on recycled paper

ISBN 0-607-88927-6

Any use of trade names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Geological Survey

For sale by U.S. Geological Survey Information Services
Box 25286, Federal Center, Denver, CO 80225
1–888–ASK–USGS

This map is also available as a PDF file online at
http://geology.cr.usgs.gov