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TO ACCOMPANY
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MAP SHOWING OUTCROPS OF PRE-QUATERNARY ASH-FLOW TUFF AND LAHARIC BRECCIA, BASIN AND RANGE PROVINCE, NEW MEXICO

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INTRODUCTION

This map report is one of a series of geologic and hydrologic maps covering all or parts of States within the Basin and Range province of the western United States. The map reports in this series contain detailed information on the geohydrology of the province, including the ground-water hydrology, ground-water quality, surface distribution of selected rock types, tectonic conditions, areal geophysics, Pleistocene lakes and marshes, and mineral and energy resources. This work is a part of the U.S. Geological Survey's program for geologic and hydrologic evaluation of the Basin and Range province to identify prospective regions for further study relative to isolation of high-level nuclear waste (Bedinger, Sargent, and Reed, 1984).

This map report was prepared from published geologic maps and reports utilizing the project guidelines defined in Sargent and Bedinger (1984). The map shows the known occurrences of pre-Quaternary ash-flow tuff and laharic breccia and associated tuff breccia and agglomerate. The Description of Map Units includes the geologic age, radiometric age, if available, the lithology, thickness where available, and sources of data for the tuffs and laharic breccias in outlined and numbered areas in the counties of the study area. The radiometric ages do not necessarily represent the entire age range of the geologic units. Nomenclature of the geologic units in this map report is from published reports and does not necessarily conform to U.S. Geological Survey usage.

DESCRIPTION OF MAP UNITS

[To convert feet (ft) to meters, multiply feet by 0.3048; to convert miles (mi) to kilometers, multiply miles by 1.609]

Part A.--TUFFS AND LAHARIC BRECCIAS

County-area number	Map symbol	Geologic unit	Geologic and radiometric age, in millions of years (m.y.)	Lithology and comments	References for county area
CATRON COUNTY (C)					
C-1	Tt	South Canyon Tuff	Oligocene 26.7 m.y., average age	Multiple flow, simple cooling unit of rhyolite ash-flow tuff; slightly to densely welded with few crystals; outflow facies regionally as much as 600 ft thick. Overlies La Jara Peak Basaltic Andesite.	Chapin and others, 1978; Deal, 1973; Elston, 1976; Elston and others, 1973, 1976; Lopez and Bornhorst, 1979; Machette, 1978; Osburn and Chapin, 1983b
		Lemitar Tuff	Oligocene 28.4 m.y., average age	Multiple flow, compositionally zoned, simple to compound cooling unit of densely welded ash-flow tuff. Outflow facies regionally as much as 400 ft thick. This unit and South Canyon Tuff located in southeasternmost part of county area; locally both include thin andesitic lavas. Overlain and underlain by tongues of La Jara Peak Basaltic Andesite.	
		Vicks Peak Tuff	Oligocene 31.3±2.6 m.y.	Moderately welded, pumiceous, rhyolite ash-flow tuff with few crystals; generally as much as 40 ft thick, locally greater than 200 ft thick. Locally overlain and underlain by tongues of La Jara Peak Basaltic Andesite. Mapped as rhyolite tuff of Wahoo Canyon by Lopez and Bornhorst (1979).	
		La Jencia Tuff	Oligocene	Multiple-flow, compound cooling unit, densely welded, rhyolite ash-flow tuffs with few crystals. Locally overlain by tongue of La Jara Peak Basaltic Andesite. Mapped as A-L Peak Rhyolite by Lopez and Bornhorst (1979).	
		Hells Mesa Tuff	Oligocene 33.1 m.y., average age	Multiple-flow, simple cooling unit, slightly to moderately welded, rhyolite ash-flow tuff with numerous crystals; outflow thickness regionally as much as 800 ft. Locally overlain by volcaniclastic rocks of South Crosby Peak Formation. Unit includes tuff of Ary Ranch and tuff of Rock Tank (Lopez and Bornhorst, 1979).	
		Blue Canyon Tuff	Oligocene 33.3 m.y., average age	Simple cooling unit, slightly to moderately welded, quartz latite tuff with moderate number of crystals; thickness as much as 100 ft. Interbedded with Rincon Windmill Member, upper member of Spears Formation.	
		Rock House Canyon Tuff	Oligocene	Slightly to moderately welded, moderately pumiceous, rhyolite, ash-flow tuff with few crystals; thickness as much as 350 ft. Interbedded between Rincon Windmill and Chavez Canyon Members of Spears Formation.	
		Datil Well Tuff	Oligocene 36.7 m.y., average age	Densely welded, rhyolite ash-flow tuff with moderate number of crystals. Generally 50 ft thick, but locally as much as 80 ft thick. Interbedded in Chavez Canyon Member, Spears Formation.	
	Tl	South Crosby Peak Formation	Oligocene	Volcaniclastic sedimentary rocks, air-fall tuffs, and minor ash-flow tuff; thickness as much as 200 ft. Overlies Hells Mesa Tuff and below La Jencia Tuff. Called volcaniclastic rocks of South Crosby Peak by Lopez and Bornhorst (1979).	

		Spears Formation, Rincon Windmill Member	Oligocene 33.1 to 39.6 m.y.	Conglomerate, sandstone, and eolian sandstone; thickness 275 to 500 ft. Occurs below Hells Mesa Tuff and above Rock House Canyon Tuff and locally is split into two tongues by Blue Canyon Tuff. Age is that of entire Spears Formation.	
		Spears Formation, Chavez Canyon Member	Oligocene	Sandstone, conglomerate, and debris-flow deposits; thickness 250 to 500 ft. Underlies Rock House Canyon Tuff; overlies Dog Springs Member of Spears Formation. Locally split into two parts by Datil Well Tuff.	
		Spear Formation, Dog Springs Member	Oligocene 39.1 m.y., average age	Mud-flow breccias, volcaniclastic sedimentary rocks, autobrecciated intrusive rocks, and local tuffaceous, lacustrine rocks; thickness as much as 3,000 ft.	
C-2	Tt	Pyroclastic rocks	Tertiary	Rhyolitic, pyroclastic rocks, including ash-flow tuffs and lava flows.	Deal, 1973; Deal and Rhodes, 1976; New Mexico Geological Society,1982
	Tl	Lava flows and flow breccias	Oligocene and Eocene	Andesitic in composition.	
C-3	Tt	Rhyolite ash-flow tuff of Slash Ranch	Miocene 21.7±0.7 m.y.	Nonwelded, moderately to intensely indurated, ash-flow tuff. At least four separate tuffs, each as much as 130 ft thick; combined thickness of tuffs as much as 330 ft. Tuffs separated by thin volcaniclastic beds; clastic rocks and breccias at base of unit. Overlain by Gila Conglomerate, underlain by basalt and andesite flows of Bearwallow Mountain Formation. Located along Houghton Canyon.	Elston, 1968, 1976; Elston and others, 1973; Fodor, 1976; Rhodes and Smith, 1976; Richter, 1978; Willard and Stearns, 1971
		Railroad Canyon Rhyolite Tuff	Miocene and Oligocene 22.8±0.7 and 23.4±0.7 m.y.	Slightly to densely welded, ash-flow tuff with numerous crystals; thickness as much as 330 ft; overlain by lava flows of Bearwallow Mountain Formation and Gila Conglomerate.	
		Taylor Creek Rhyolite of Elston (1968), rhyolite ash-flow tuff of Whitewater Canyon	Tertiary	Upper unit of Taylor Creek Rhyolite, slightly to moderately welded ash-flow tuff; pisolitic air-fall at top, pumice, rhyolite breccia and some intercalated volcaniclastic beds at base. Total thickness locally more than 260 ft. Overlies rhyolite flows and breccia. Located in southernmost part of area.	
		Datil Formation, tuff member	Tertiary	Welded, rhyolite tuff, local columnar jointing. Interbedded with rhyolite and latite flows in upper and middle parts of Datil Formation. Relationship of tuffs of Datil Formation in northern part of area to named tuffs in southern part uncertain.	
C-4	Tt	Railroad Canyon Rhyolite Tuff	Miocene and Oligocene 22.8±0.7 and 23.4±0.7 m.y.	Moderately to densely welded, ash-flow tuff with numerous crystals; thickness as much as 330 ft. Despite age discrepancy, possibly identical to Bloodgood Canyon Tuff.	Deal and Rhodes, 1976; Elston, 1976; Ratté 1980; Rhodes and Smith, 1976; Stearns, 1962; Weber and Willard, 1959; Willard and Stearns, 1971
		Apache Spring Quartz Latite(?)	Oligocene	Moderately to densely welded, quartz latite ash-flow tuff with numerous crystals; as much as 195 ft thick. Overlies Squirrel Springs Canyon Andesite.	
		Bloodgood Canyon Rhyolite Tuff	Oligocene 27.4±0.9 and 27.4±3.4 m.y.	Slightly to densely welded, rhyolite ash-flow tuff; thickness as much as 260 ft. Source in Mogollon Mountains. Underlain locally by as much as 30 ft of sandstone.	
		Tuff of Shelley Peak	Oligocene 28.1±1.0 and 29.0±1.0 m.y.	Slightly to densely welded ash-flow tuff; thickness as much as 130 ft. Source in Mogollon Mountains.	
		Tuff of Davis Canyon	Oligocene 28.9±1.0 and 30.7± 1.0 m.y.	Slightly to densely welded, rhyolite ash-flow tuff; thickness about 655 ft in southwest part of area.	

		Tularosa Canyon Rhyolite	Tertiary	Pumiceous, slightly welded, ash-flow tuff with few crystals and minor tuffaceous sandstone; as much as 165 ft thick.	
	Tl	Early andesitic volcanic complex	Oligocene 32 to 34 m.y.	Andesitic lavas, dikes, vent facies breccia, and volcanic breccia that grade to volcaniclastic sandstone and conglomerate. Tuff beds, less than 15 ft thick, locally interbedded with andesitic breccia. One series of andesite flows near base of unit as much as 330 ft thick. Occurs in western part of area.	
		Volcaniclastic rocks	Oligocene	Volcaniclastic sediments containing middle unit at least 165 ft thick of andesite flows. Sediments composed of poorly sorted sandstone, gravel, conglomerate, and mud-flow breccia; about 230 ft thick above, and 165 ft thick below andesite flows. Flows and underlying clastics equivalent to Spears Formation of Deal and Rhodes (1976) to the east in Datil area. Crops out in eastern part of area; relationship to early andesitic volcanic complex uncertain.	
C-5	Tt	Fanney Rhyolite, Deadwood Gulch Member	Oligocene	Member is pyroclastic facies in lower part of Fanney Rhyolite; crudely layered, pumiceous, tuff breccia and partly welded, ash-flow tuff and minor interbeds of volcanic sandstone and conglomerate. Thickness as much as 655 ft.	Rattè, 1981
		Apache Spring Tuff	Oligocene 27.3±0.8 m.y.	Compositionally zoned, rhyolitic to quartz latitic ash-flow tuff; slightly but pervasively altered, locally silicified. Near west wall of Bursum caldera upper part of unit is mainly caldera-fill breccia, which includes large slabs of Davis Canyon Tuff and blocks of Shelley Peak Tuff. Locally as much as 655 ft thick.	
		Bloodgood Canyon Tuff	Oligocene 26 to 27 m.y.	High-silica rhyolite ash-flow tuff, locally silicified and argillized. Major outflow sheet related to Bursum and Gila Cliff Dwellings calderas. Thickness about 165 to 200 ft thick.	
		Shelley Peak Tuff	Oligocene about 28 m.y.	Compositionally zoned, rhyolite ash-flow tuff with numerous crystals; occurs as part of outflow sheet in wall of Bursum caldera. Thickness 165 to 200 ft. Commonly separated from overlying Bloodgood Canyon Tuff by conglomeratic sandstone. Overlies Davis Canyon Tuff.	
		Davis Canyon Tuff	Oligocene	High-silica rhyolite ash-flow tuff; forms outflow tuff sheet in wall of Bursum caldera; thickness may exceed 165 ft. Locally overlain by as much as 10 ft of rhyolitic tuff breccia and volcaniclastic rocks.	
		Fall Canyon Tuff	Oligocene	High-silica rhyolite ash-flow tuff interlayered with as much as 65 ft of Cranktown Sandstone; unit as much as 130 ft thick.	
		Cooney Tuff, Cooney Canyon Member	Oligocene 32±1.5 m.y.	Multiple, simple and compound cooling units of partly to densely welded, rhyolitic to quartz-latitic ash-flow tuff. Thickness as much as 1,640 ft. Overlies Whitewater Creek Member of Cooney Tuff.	
		Cooney Tuff, Whitewater Creek Member	Oligocene 31.8±2.8 m.y.	Simple cooling unit of rhyolite ash-flow tuff; upper part moderately welded, remainder densely welded. Thickness at least 525 ft, base not exposed. Overlain by Cooney Canyon Member of Cooney Tuff.	
C-6	Tt	Fanney Rhyolite, Deadwood Gulch Member	Tertiary	Locally derived, extremely porous, slightly welded, felsic ash-flow and ash-fall tuff, minor conglomerate, and sandstone. Moat-fill of Bursum caldera; as much as 1,150 ft thick.	Elston, 1976; Rattè, 1981; Rattè and Gaskill, 1975; Rhodes, 1970, 1976a

		Apache Spring Quartz Latite	Oligocene 27.3±0.8 m.y.	Moderately to densely welded ash-flow tuff with numerous crystals; ranges from quartz latite at top to rhyolite at base of exposed section. Includes avalanche and mudflow-breccia deposits at southern and western margins of Bursum caldera. Thickness more than 2,620 ft, base not exposed. Locally overlain by lava flows of Sacaton Quartz Latite.	
C-7	Tt	Jordan Canyon(?) Formation	Tertiary	Rhyolite tuff, conglomerate, and sandstone; tuff is lithologically similar to Deadwood Gulch Member of Fanney Rhyolite in county area C-6. Thickness about 1,150 ft. Unit interfingers with basaltic andesite of Bearwallow Mountain Formation. Occurs along West Fork Gila River.	Elston, 1976; Ratté, 1981; Ratté and Gaskill, 1975; Rhodes, 1976a, 1976b
		Bloodgood Canyon Tuff	Oligocene 26.3±0.8 m.y.	Moderately to densely welded, ash-flow tuffs with few lithic fragments. Thickness at least 1,000 ft, base not exposed.	

DOÑA ANA COUNTY (DA)

DA-1	Tt	Thurman Formation	Miocene and Oligocene	Upper part, bedded tuffaceous sediments, 1,300 ft thick. Lower part, ash-flow tuffs and tuffaceous sandstone and mudstone about 575 ft thick; the basal tuff is about 50 ft thick. Upper and lower parts separated by 400 ft of Uvas Basaltic Andesite (26 m.y.)	Seager and Hawley, 1973; Seager and others, 1982
	Tl	Palm Park Formation	Eocene 42 to 51 m.y.	Laharic conglomerate and tuffaceous beds of air-fall origin that thin to the southwest. Formation as much as 2,000(?) ft thick. Correlates with Rubio Peak Formation that crops out west of this county area.	
DA-2	Tl	Palm Park Formation	Eocene 42 to 51 m.y.	Andesitic epiclastic strata of laharic, fluvial, and overbank origin. About 2,000 ft thick. Thins markedly over Laramide-age topographic highs.	Seager, 1975
DA-3	Tt	Bell Top Formation	Oligocene 29.2±1.2 and questionably as old as 39.4±1.5 m.y.	Six air-fall and ash-flow tuffs interbedded with volcanic sedimentary rocks and rhyolite and andesite lava flows. Each tuff less than 350 ft thick.	Clemons, 1976, 1977; Clemons and Seager, 1973; Jicha, 1954; Seager and Clemons, 1975; Seager and others, 1975, 1982
	Tl	Rubio Peak Formation	Oligocene and Eocene about 33 to 45 m.y.	Andesite and latite lavas interbedded with tuffs, sandstone, conglomerate, and laharic breccia, about 2,500 ft thick. Primarily in northwestern part of area.	
		Palm Park Formation	Eocene 42 to 51 m.y.	Andesitic sandstone, mudstone, and conglomerate of laharic, fluvial, and overbank origin. About 3,500 ft thick. Occurs in Sierra de las Uvas; correlative with Rubio Peak Formation.	
DA-4	Tt	Doña Ana Rhyolite	Oligocene 33 to 37 m.y.	Moderately to densely welded, rhyolite ash-flow tuff, minor air-fall tuff, and breccia at base of unit. At least 2,500 ft thick near center of Doña Ana cauldron.	Seager and others, 1976
	Tl	Palm Park Formation	Eocene 42 to 51 m.y.	Epiclastic, andesitic rocks and lava flows; thickness may exceed 1,950 ft locally.	
DA-5	Tt	Soledad Rhyolite, includes tuff of Squaw Mountain, tuff of Achenback Park,and tuff of Cox Ranch	Oligocene 33.0 to 33.7 m.y.	Soledad Rhyolite is densely welded rhyolitic ash-flow tuff about 9,000 ft thick.	Dunham, 1935; Seager, 1973a, 1981
		Cueva Tuff		Cueva Tuff is pumiceous, ash-flow tuff interbedded with epiclastic beds; thickness 200 to 1,350 ft.	

	Tl	Orejon Andesite	Early Oligocene or late Eocene	Interbedded andesitic flows, laharic breccias, and other volcaniclastic rocks. Epidote alteration prevalent. Age based on correlation with Rubio Peak and Palm Park Formations.	

GRANT COUNTY (G)

G-1	Tt	Rhyolite of Mule Creek	Miocene	Pyroclastic member comprises lower part of the Mule Creek. Nonwelded rhyolite ash-flow tuff with numerous lithic fragments; basal part grades laterally into massive-bedded, chunky pumice and reworked air-fall beds. Maximum thickness at least 300 ft. Unit locally overlies about 200 ft of mudlfow breccia and fluvial breccia.	Elston, 1976, 1978; Rattè and Hedlund, 1981; Rhodes and Smith, 1972
		Lava flows of Crookson Peak	Oligocene 27.6±2 m.y.	Undivided dacitic to rhyolitic lava and pyroclastic breccia; thickness 600 to 1,000 ft.	
		Rhyolite of Hells Hole	Oligocene	Intrusive-extrusive, rhyolite dome complex. In descending order: autobrecciated rhyolite, massive to flow-banded, contains obsidian layers; air-fall pyroclastic breccia, bedded, pumiceous, maximum thickness about 150 ft; and rhyolite breccia, massive to thick-bedded, maximum thickness about 500 ft. Total combined thickness at least 1,200 ft.	
G-2	Tt	Pyroclastic rocks	Early Miocene to late Eocene	Quartz latite to rhyolite pyroclastic rocks, including ash-flow tuffs and some flows.	New Mexico Geological Society, 1982; G. R. Osburn, New Mexico Bureau of Mines and Mineral Resources, written commun., 1983
	Tl	Rubio Peak and Spears Formations	Early Oligocene and late Eocene	Volcaniclastic rocks, some of laharic origin.	
G-3	Tt	Bloodgood Canyon Rhyolite	Oligocene	Rhyolitic ash-flow tuff, more welded toward base; thickness as much as 520 ft.	Finnell, 1982
		Ash-flow tuff	Oligocene	Partly welded, quartz latitic ash-flow tuff and basal, air-fall, lapilli tuff; intercalated with basaltic andesite. Thickness as much as 430 ft.	
		Air-fall tuff	Oligocene	Massive beds of air-fall tuff that grade upward and laterally to sandstone; includes a basal tuff breccia and volcanic conglomerate. Thickness as much as 130 ft.	
		Ash-flow tuff	Oligocene	Alternating thin, welded, quartz latitic ash-flow tuff, indurated air-fall tuff, and tuff breccia. Thickness 650 to 1,215 ft.	
		Ash-flow tuffs of Greenwood Canyon	Oligocene	Sequence of quartz latitic ash-flow tuffs interbedded with minor rhyolitic sandstone, tuff breccia, and air-fall tuff; may exceed 3,000 ft in thickness. Individual ash-flow tuffs have various degrees of welding, locally contains lithic fragments; as much as 1,000 ft thick.	
		Ash-flow tuff	Oligocene	Partly welded, quartz latitic ash-flow tuff, as much as 620 ft thick.	
G-4	Tt	Bloodgood Canyon Rhyolite Tuff	Oligocene 26.3±0.8 m.y.	Rhyolitic ash-flow tuff, increasingly welded toward base. Thickness, 100 to 520 ft.	Elston, 1976; Finnell, 1976, 1982; Jones and others, 1970; Rattè, 1981; Rattè and Gaskill, 1975; Rhodes, 1976a
		Tuff of Shelley Peak	Oligocene(?)	Massive, quartz latitic ash-flow tuff. Thickness, as much as 655 ft.	
		Tuff of Davis Canyon	Oligocene	Partly to densely welded ash-flow tuff, forms compound cooling unit; interlayered with latitic and andesitic flows; thickness, 195 to 490 ft	

		Tuff of Fall Canyon	Oligocene	Single cooling unit, partly to densely welded ash-flow tuff. Overlain and underlain by lava flows.	
		Air-fall tuff	Oligocene	Massive beds, 1 to 10 ft thick, of air-fall tuff grade into thin to thick crossbedded sandstone; includes basal tuff breccia and volcanic conglomerate as much as 300 ft thick. Total thickness of tuff as much as 365 ft.	
		Ash-flow tuff	Oligocene	Rhyolitic to quartz latitic, partly welded, ash-flow tuff, grades into well-indurated, bedded air-fall tuff and tuff breccia. Thickness, 650 to 1,215 ft.	
		Ash-flow tuff	Oligocene	Quartz latitic, partly welded ash-flow tuff; thickness as much as 520 ft.	
		Kneeling Nun(?) Tuff	Oligocene	Rhyolitic ash-flow tuff, as much as 420 ft thick.	
	Tl	Rubio Peak(?) Formation	Oligocene	Conglomerate, sandstone, latite flows, and lithic tuff. Tuffs are massive to slightly bedded. Total thickness as much as 520 ft. Occurs in southwestern part of area.	
G-5	Tt	Ash-flow tuffs	Oligocene	Two ash-flow tuffs separated by as much as 700 ft of basaltic andesite. Tuffs are rhyolitic, nonwelded, and locally contain numerous xenoliths. Densely welded to nonwelded Caballo Blanco Rhyolite Tuff Member of Datil Formation forms upper part of lower tuff; base of lower tuff contains laharic breccia. Upper tuff 100 ft thick; lower tuff more than 500 ft thick. Unit underlain and overlain by basaltic andesite.	Aldrich, 1976; Ericksen and others, 1970; Rattè and Gaskill, 1975
G-6	Tt	Tuff and breccia	Oligocene	Rhyolite and latite lava flows with tuff and andesitic breccia; cross-section thickness as much as 500 ft. Occurs on topographic highs.	Cunningham, 1974
G-7	Tt	Datil Formation, Caballo Blanco Rhyolite Tuff Member	Oligocene 29.8±0.8 m.y.	Moderately to densely welded ash-flow tuff, generally about 310 ft thick. Locally overlies slightly welded ash-flow tuff about 35 ft thick.	Elston, 1957; Ericksen and others, 1970; Hedlund, 1978c; Hernon and others, 1964; Jones and others, 1970
		Box Canyon Rhyolite Tuff	Oligocene	Sequence of densely welded ash-flow tuffs interbedded with tuffaceous sandstone and air-fall tuff. Ash-flow tuffs locally nonwelded, well jointed and contain numerous crystals. Total thickness about 225 ft.	
		Mimbres Peak Formation	Oligocene	Rhyolite lava flows, pumiceous tuffs, and tuffaceous sandstone and conglomerate. Thickness greater than 450 ft.	
		Kneeling Nun Tuff	Oligocene 33.4±1.0 m.y.	Welded, quartz latitic to rhyolitic ash-flow tuff with numerous crystals; maximum thickness about 1,150 ft.	
		Sugarlump Tuff	Oligocene	Dominantly air-fall tuff and some interbedded densely welded ash-flow tuff, tuffaceous sandstone, and pebble conglomerate. Thickness as much as 1,075 ft.	
	Tl	Rubio Peak Formation	Early Oligocene and late Eocene	Andesite, rhyodacite, and latite lava flows, conglomerate, flow breccias, agglomerates, and welded ash-flow tuffs; formation thickness highly variable, but as much as 5,000 ft. Pyroclastic rocks consist of bedded and reworked tuffs, crystal tuffs, sandy tuffs, and conglomeratic tuffs.	
G-8	Tt	Tuffs of Wind Mountain and Indian Peak	Oligocene 27.1±0.9 m.y.	Ash-flow tuff of Wind Mountian, slightly to densely welded; as much as 520 ft thick. Tuff of Indian Peak, as much as 395 ft of air-fall tuff and minor tuffaceous sandstone interbeds, and as much as 100 ft of nonwelded ash-flow tuff. Radiometric age from tuff of Wind Mountain.	Hedlund, 1978e, 1978g

G-9	Tt	Tuff of Walking-X Canyon, Kneeling Nun Tuff, tuff of C-Bar Canyon, tuff of Burro Cienaga	Oligocene 33.7±0.8 m.y.	Slightly to densely welded ash-flow tuffs. Tuff of Walking-X Canyon 395 ft thick, of questionable Oligocene age; overlies more than 110 ft of lava flows and volcaniclastics. Kneeling Nun Tuff as much as 740 ft thick; radiometric date is from this unit; overlies tuff of C-Bar Canyon. Tuff of C-Bar Canyon, rhyolitic, interbedded with tuffaceous sandstone and tuffaceous breccia; as much as 1,400 ft thick; overlies 150-ft-thick rhyolite dome-flow complex of Burro Cienaga. Tuff of Burro Cienaga interbedded with basalt, tuffaceous sandstone and breccia, and rhyolite flows; unit as much as 260 ft thick.	Ballman, 1960; Hedlund, 1978a, 1978b, 1978d, 1978f, 1980
G-10	Tt	Pryoclastic rocks	Oligocene 33.9±3.1 and 36.2±3.6 m.y.	In descending order: Rhyolitic ash-flow tuffs, slightly to densely welded, with a few crystals, locally a minor basal vitrophyre; thickness as much as 1,800 ft; uppermost tuff Oligocene(?) in age. Rhyolite lava of Coyote Peak, rhyolite lava and clastics, as much as 1,560 ft thick. Volcanics of Pothook, volcanic sediments, quartz latite lava, and rhyolitic to quartz latitic, slightly to moderately welded ash-flow tuffs, as much as 3,280 ft thick; age dates are from this unit. Rhyolitic ash-flow tuffs, slightly to densely welded, thickness as much as 2,560 ft.	Deal and others, 1978; Thorman, 1977; Zeller, 1970
G-11	Tt	Ash-flow tuffs, and volcanics of Pothook	Oligocene 36.2±3.6 m.y.	Rhyolitic ash-flow tuffs; in at least three beds, each 35 to 165 ft thick, in basal part of quartz latite lava unit. Occurs in southern one-half of area. Volcanics of Pothook, rhyolitic to quartz latitic slightly to densely welded, ash-flow tuffs, occur in northern one-half of area; thickness as much as 1,365 ft. Radiometric date from this unit.	Bromfield and Wrucke, 1961; Thorman and Drewes, 1979a

HIDALGO COUNTY (H)

H-1	Tt	Datil Formation	Oligocene	Rhyolitic and latitic tuffs, some tuffaceous sandstone and conglomerate, and some latite(?) and andesite flows. Maximum thickness at least 1,400 ft. Overlain and underlain by mostly basaltic andesite flows.	Griggs and Wagner, 1966; Morrison, 1965
		Volcaniclastic rocks	Tertiary	Upper part is quartz latite flows and welded tuff; locally tuff more than 700 ft thick, but thins rapidly laterally. Lower part, andesitic breccia, agglomerate, and minor andesitic flows. Total thickness of unit greater than 1,500 ft. Located in northernmost part of area. Relationship to Datil Formation uncertain.	
H-2	Tt	Rhyolite of Steins, upper member	Oligocene about 31.4 m.y.	Welded ash-flow tuff, at least 325 ft thick. Underlain by clastic member.	Drewes and Thorman, 1980a
H-3	Tt	Rimrock Mountain Group, and Pyramid Mountains volcanic complex	Oligocene 34.2±0.6 to 36.8±0.8 m.y.	Rimrock Mountain Group, post-cauldron ash-flow tuff intercalated with three basaltic andesite to latite flows and sedimentary beds. Eight ash-flow tuff beds combined may be as much as 2,550 ft thick, and each lava flow as much as 490 ft thick. Pyramid Mountains volcanic complex includes intra-cauldron ash-flow tuffs of Graham Well and Woodhaul Canyon as well as andesitic to rhyolitic flows and intrusive domes. Tuff of Woodhaul Canyon, exposed thickness 1,400 ft. Younger radiometric date from tuff in upper part of Rimrock Mountain Group; older date from tuff of Woodhaul Canyon.	Deal and others, 1978; Thorman and Drewes, 1978.
H-4	Tt	Rhyolite of Weatherby Canyon	Oligocene 25 to 27 m.y.	As much as 2,000 ft of rhyolitic, welded ash-flow tuff and minor air-fall tuff.	Armstrong and others, 1978; Drewes and Thorman, 1980b
H-5	Tt	Tuff of Trail Creek	Tertiary	Tuff with numerous crystals, may correlate with a member of Rhyolite Canyon Formation in Chiricahua Mountains of Arizona.	Deal and others, 1978; Gillerman, 1958; Hayes, 1982

		Tuff	Tertiary	Tuff with few crystals overlain by lava.	
		Weatherby Canyon Ignimbrite of Gillerman (1958)	Tertiary	*Two cooling units* of ash-flow *tuff*; upper unit more than 655 ft thick, lower, 195 to 295 ft thick.	
		Unit of Antelope Pass	Oligocene 26.4±0.7 m.y.	Thick complex of rhyolite flows and domes and interlayered lithic tuff; ring-fracture and moat deposits of Rodeo cauldron. Overlies tuff of Black Mountain or volcaniclastic sediments and lavas.	
		Tuff of Evans Ranch	Tertiary	Probably an upper member of the tuff of Black Mountain. Overlain by volcaniclastic sediments and lavas, separated from underlying tuff of Black Mountain by megabreccia.	
		Tuff of Black Mountain	Oligocene 25.1±1.2 m.y.	Compound cooling unit of ash-flow tuff; lower part densely welded and massive, upper part less welded. Thickness about 3,300 ft; fill of Rodeo cauldron intruded and overlain by flows and domes. Outside of cauldron, tuff overlain by megabreccia.	
H-6	Tt	Tuffs	Tertiary	Several ash-flow and air-fall tuffs interbedded with tuffaceous sandstone and conglomerate. Includes tuff of Skeleton Canyon.	Deal and others, 1978; Hayes, 1982; Wrucke and Bromfield, 1961
		Tuff of Guadalupe Canyon	Oligocene 24.3±0.2 m.y.	Compound cooling unit of tuff with local interbeds of rhyolite lava; thickness 1,380 ft, base not exposed. Fills Geronimo Trail cauldron. Overlain by breccia, conglomerate, mudflows, and lava flows.	
H-7	Tt	Park Tuff	Oligocene 29.6±0.6 m.y.	Welded, rhyolite tuff and basal sandstone; tuff 0 to 300 ft thick, sandstone 20 to 100 ft thick.	Elston and Erb, 1977; Soule, 1972; Zeller, 1959; Zeller and Alper, 1965
		Gillespie Tuff	Oligocene 32.9±0.7 m.y.	Welded, quartz latite tuff, as much as 2,600 ft thick.	
		Tuff of Gray Ranch	Oligocene	Thin tuff with few crystals overlies tuff of Black Bill Canyon. Tentatively correlated with tuff in lower part of Rimrock Mountain Group (see county area H-3).	
		Tuff of Black Bill Canyon	Oligocene	About 1,150 ft exposed thickness; tentatively correlated with a 35.8±0.8-m.y.-old tuff in Pyramid Mountains to north.	
		Basin Creek Tuff	Oligocene	Quartz-latite tuff, tuff breccia, and tuff agglomerate; thickness as much as 700 ft.	
		Oak Creek Tuff	Oligocene 35.2±0.8 m.y.	Quartz-latite tuff containing basal tuffaceous agglomerate and breccia; more than 1,500 ft thick.	
		Bluff Creek Formation	Oligocene(?)	Ash-flow tuff and intercalated, reworked, air-fall tuff, conglomerate, and sandstone; about 2,500 ft thick.	
H-8	Tt	Chapo Formation of Strongin (1958)	Oligocene 30.6±1.1 m.y.	Quartz latite and andesite lavas and ash-flow tuffs; about 5,200 ft thick.	Deal and others, 1978; Peterson, 1976; Strongin, 1958
H-9	Tt	Park(?) Tuff	Oligocene	Ash-flow tuff intercalated in upper part of 410-ft thick sequence of basaltic andesite.	Deal and others, 1978; Zeller, 1959; Zeller and Alper, 1965
		Gillespie Tuff	Oligocene	Tuff; upper 65 to 80 ft, very pumiceous, unwelded and contains few crystals; lower 35 to 50 ft is vitrophyre. Total thickness 720 ft. Overlain by basaltic andesite.	
		Oak Creek Tuff	Oligocene	Probably at least three cooling units of tuff; lowest unit least welded and contains numerous lithic fragments. Crossbedded tuff at base of lower two units may be pyroclastic-surge deposits. Total thickness 655 ft.	
		Tuff of Wood Canyon	Tertiary	Compound cooling unit of ash-flow tuff; about 330 ft thick. Upper part contains breccia zones.	

		Bluff Creek Formation	Oligocene(?)	Multiple ash-flow tuff cooling units with few crystals; interlayered with sedimentary beds, lava flows, and ash-flow tuff with numerous crystals. Upper part contains breccia layer as much as 165 ft thick. Formation thickness about 490 ft. Separated from underlying volcaniclastic rocks by 100 ft of basaltic andesite.	
		Volcaniclastic rocks	Tertiary	Mainly mudflow breccia and mudstone; lava flows also present; thickness about 65 ft.	
				LUNA COUNTY (L)	
L-1	Tt	Ash-flow tuffs, including tuff of Little Grandmother Mountain and latite of Clabbertop Hill	Miocene to Eocene(?) 28.9±1.3 m.y.	Tuffs in central part of area as much as 600 ft thick. Outcrops on periphery of area assigned to latite of Clabbertop Hill. Radiometric age from tuff of Little Grandmother Mountain. Latite of Clabbertop Hill may be as old as Eocene.	Thorman and Drewes, 1979b
L-2	Tt	Kneeling Nun Tuff	Oligocene 33.4±1.0 and 33.6±1.5 m.y.	Compositionally zoned ash-flow tuff 80 ft thick.	Clemons, 1982; Seager and others, 1982
		Sugarlump Formation	Oligocene 36.9±1.5 and 37.7 m.y.	Interbedded, rhyolitic, epiclastic strata, air-fall tuff, and densely welded ash-flow tuff. Combined thickness 470 ft; tuff comprises more than 110 ft of sequence.	
	Tl	Rubio Peak Formation	Oligocene and Eocene 32.6±2.1 to 44.7±1.9 m.y.	Latite to basaltic andesite lavas interbedded with tuffs, sandstone, conglomerate, laharic breccia, and some intrusive plugs and dome-flow complexes. Thickness greater than 1,000 ft.	
L-3	Tt	Lava flows, breccias, and tuffs	Tertiary	Rocks of rhyolite and latite composition. Pyroclastics predominant in northeastern part of area. More than 500 ft thick in southern part of Tres Hermanas Mountains.	Balk, 1961
L-4	Tt	Tuffs and tuff breccia	Tertiary	Rhyolitic, welded, 400 ft or more thick.	Bromfield and Wrucke, 1961
				SANTA FE COUNTY (SF)	
SF-1	Tl	Espinaso Volcanics	Oligocene and Eocene	Latitic tuffs, tuff-breccias, and lava flows. Thickness greater than 2,000 ft.	New Mexico Geological Society, 1982; Smith and others, 1970
				SIERRA COUNTY (SA)	
SA-1	Tt	Rhyolite tuffs of Spring Canyon and Shipman Canyon, and Vicks Peak Rhyolite Tuff	Oligocene >25 to <35 m.y.	Rhyolite tuff of Spring Canyon, ash-flow tuff, may be equivalent to upper part of Potato Canyon Rhyolite Tuff (of former usage). For reclassification of Potato Canyon see county area SO-1. Rhyolite tuff of Shipman Canyon, multiple ash-flow tuff cooling units; thickness as much as 590 ft. Vicks Peak Rhyolite Tuff, ash-flow tuff; outflow deposits of Nogal Canyon cauldron.	Deal and Rhodes, 1976; Elston, 1976; Elston and others, 1976; New Mexico Geological Society, 1982; Osburn and Chapin, 1983b
	Tl	Rubio Peak and Spears Formations	Oligocene	Volcaniclastic rocks and dominantly andesitic flows.	
SA-2		Northern part of area:			Coney, 1976; Deal, 1973; Elston, 1957, 1976; Elston and others, 1975, 1976; Ericksen and others, 1970; Fodor, 1976; Kuellmer, 1954
	Tt	Railroad Canyon Rhyolite Tuff	Miocene 22.8±0.7 m.y.	Ash-flow tuff with numerous crystals; upper part slightly indurated and slightly to densely welded; lower part, slightly to well indurated, dated radiometrically. Both tuff units generally 80 ft thick, but as much as 330 to 410 ft thick; locally separated by basalt flows. Crops out in northern Black Range.	

		Rhyolite of Lookout Mountain	Tertiary	Slightly welded rhyolite ash-flow tuff; as much as 300 ft thick. Locally intensely altered and silicified. Overlies nearly 100 ft of latite porphyry flow which in turn overlies slightly welded, commonly pumiceous, mineralized and altered ash-flow tuff less than 100 ft thick; locally interbedded with pumiceous sandstone and breccia. Regional correlation of rhyolite of Lookout Mountain uncertain.	
		Rhyolite tuff of Wahoo Canyon	Oligocene >27.3±0.8 and <31.8±1.7 m.y.	Ash-flow tuff, very indurated, partly to densely welded, about 490 ft thick. Locally, pumiceous sandstone 10 ft thick at top and bottom. Crops out in northern Black Range.	
		Hells Mesa(?) Formation	Oligocene	Slightly to moderately welded quartz latite ash-flow tuff, overlain by basaltic andesite flows.	
		Central and southern parts of area:			
		Rhyolite of Diamond Creek	Oligocene	Interbedded latitic to rhyolitic ash-flow tuffs, flows, volcanic glasses, and tuffaceous sandstones. Also includes andesite flows and flow breccias and flow-banded rhyolite. Tuffs locally contain numerous crystals. Occurs on west side of central Black Range.	
		Datil Formation, Caballo Blanco Rhyolite Tuff Member	Oligocene 29.8 m.y.	Pumiceous, crystal, ash-flow tuff; thickness as much as 300 ft.	
		Mimbres Peak Formation	Oligocene 32.0±1.0 m.y.	Rhyolitic to latitic air-fall tuff and breccia, talus breccia and associated epiclastic rocks; minor ash-flow tuff and vitrophyre. Formation thickness probably several thousand feet within Emory cauldron; interpreted as moat-fill and cauldron-rim deposits.	
		Kneeling Nun Tuff	Oligocene 33.4±1.0 m.y.	Latitic crystal-vitric, ash-flow tuff, quartz latitic to rhyolitic at base; multiple-flow compound cooling unit. Cauldron facies 1,650 to 3,300 ft thick; outflow facies less than 500 ft thick.	
		Sugarlump Tuff	Oligocene	Tuffaceous sandstone, conglomerate, pumice flows, and thin ash-flow tuffs; as much as 1,485 ft thick.	
	Tl	Rubio Peak Formation	Oligocene	Andesitic to latitic laharic breccia and sediments; tuffaceous. Some air-fall tuff beds and andesitic to latitic flows. Tuffaceous beds zeolitically altered.	
		Spears(?) Formation	Tertiary	Very altered and mineralized, andesite flows, tuffs, and agglomerate, and minor felsic tuff, flows, and sandstone.	
SA-3	Tt	Kneeling Nun Tuff	Oligocene 33.4±1.0 and 33.6±1.5 m.y.	Lithologies of both units similar to descriptions in county area L-2. Kneeling Nun Tuff 10 to 200 ft thick.	Elston and others, 1975; Jicha, 1954; Seager and others, 1982
		Sugarlump Tuff	Oligocene 36.9±1.5 and 37.7 m.y.	Sugarlump about 1,000 ft thick.	
	Tl	Mimbres Peak Formation	Oligocene 32.7±1.0 m.y.	Rhyolitic air-fall tuff and breccia, minor ash-flow tuff, tuffaceous sandstone, and conglomerate; total thickness as much as 800 ft.	
		Rubio Peak Formation	Oligocene and Eocene 32.6±2.1 to 44.7±1.9 m.y.	Lithologically similar to formation in county area L-2; thickness as much as 2,000 ft.	
SA-4	Tl	Palm Park Formation	Eocene 42 to 51 m.y.	Epiclastic strata interbedded with coarser-grained laharic breccia. Lacustrine sediments near top of formation. Generally 2,000 ft thick but locally thins to 100 ft or less.	Seager and others, 1982
SA-5	Tt	Bell Top Formation	Oligocene 36.5±1.4 m.y.	Densely welded ash-flow tuff, air-fall tuff, and sedimentary rock, as much as 500 ft thick.	Seager and others, 1982

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SO-1	Tt	Beartrap Canyon Formation	Tertiary	Thin, interbedded, rhyolitic ash-flow tuff, ash-fall tuff, sandstone, mudflow breccia, and lava flows. Tuff, generally pumiceous, slightly welded, and contains few crystals. Formation characterized by marked lateral and vertical lithologic changes; thickness locally exceeds 840 ft. Moat-fill deposit of Mount Withington cauldron. Formation may include deposits of three cauldrons and name should be restricted to deposits in northern San Mateo Mountains (Osburn and Chapin, 1983b).	Chapin and others, 1978; Deal, 1973; Deal and Rhodes, 1976; Osburn and Chapin, 1983a, 1983b
		South Canyon Tuff	Oligocene 26.7 m.y., average age	Rhyolitic ash-flow tuffs with few to moderate number of crystals. Includes part of previously named A-L Peak and Potato Canyon Rhyolite Tuffs (now obsolete). See Osburn and Chapin (1983b) for reclassification of tuffs in this area.	
		Lemitar Tuff	Oligocene 28.4 m.y., average age	Rhyolitic ash-flow tuffs with few to numerous crystals. Includes part of previously named Potato Canyon Rhyolite Tuff (Osburn and Chapin, 1983b).	
		Vicks Peak Tuff	Oligocene 31.3±2.6 m.y.	Moderately to densely welded, rhyolitic ash-flow tuff with few crystals and locally little pumice; thickness greater than 2,130 ft.	
		La Jencia Tuff	Oligocene about 31 m.y.	Rhyolite ash-flow tuffs with few crystals; formerly miscorrelated with A-L Peak Tuff of former usage (Osburn and Chapin, 1983b).	
		Hells Mesa Tuff	Oligocene 33.1 m.y., average age	Quartz latite to rhyolite ash-flow tuff.	
	Tl	Rock Spring Formation	Early Oligocene	Ash-flow tuff and andesitic to latitic lava and breccia; formation thickness as much as 3,300 ft in southwestern San Mateo Mountains but thins eastward to 660 ft. Overlies about 3,300 ft of andesitic lava and thin interbedded lacustrine sediments of Red Rock Ranch Formation. Both formations may be stratigraphically equivalent to Spears Formation.	
SO-2		Rhyolite of Pound Ranch	Miocene	Ash-flow and air-fall tuffs overlain by rhyolitic to quartz latitic lava flows. Tuffs slightly to densely welded, locally vitric, compositionally similar to overlying lava flows dated at 10.8±0.4 and 12.1±0.5. m.y. Thickness as much as 300 ft.	Chapin and others, 1978; Deal, 1973; Deal and Rhodes, 1976; Elston, 1976; Osburn and Chapin, 1983b
		South Canyon Tuff	Oligocene 26.7 m.y., average age	Simple to compound cooling unit of rhyolite ash-flow tuff with few to moderate number of crystals; thickness as much as 650 ft. Locally overlies La Jara Peak Basaltic Andesite.	
		Lemitar Tuff	Oligocene 28.4 m.y., average age	Simple to compound cooling unit of densely welded, quartz latitic to rhyolitic ash-flow tuff with few to numerous crystals. Thickness 800 to 2,100 ft in Sawmill Canyon and Magdalena cauldrons; outflow facies as much as 400 ft thick. Locally overlain and underlain by tongues of La Jara Peak Basaltic Andesite.	
		Vicks Peak Tuff	Oligocene 31.3±2.6 m.y.	Multiple-flow, simple cooling unit, densely welded, ash-flow tuff with few crystals; thickness as much as 800 ft. Locally overlain and underlain by tongues of La Jara Peak Basaltic Andesite.	
		La Jencia Tuff	Oligocene 30.9±1.5 m.y.	Multiple-flow, compound cooling unit, densely welded, ash-flow tuff with few crystals. In Sawmill Canyon and Magdalena cauldrons as much as 3,000 ft thick; outflow facies as much as 500 ft thick. Radiometric date from overlying basalt.	

		Hells Mesa Tuff	Oligocene 33.1 m.y., average age	Simple cooling unit, densely welded, rhyolite ash-flow tuff with numerous crystals. As much as 5,000 ft thick in Socorro cauldron; outflow thickness as much as 800 ft. Overlain by Luis Lopez Formation rhyolite lavas and domes, intermediate lavas, ash-flow tuffs, and sedimentary rocks within cauldron.	
		Tuff of Granite Mountain	Oligocene	Simple cooling unit, densely welded, quartz latite ash-flow tuff with numerous crystals and lithic fragments; thickness as much as 200 ft.	
		Rock House Canyon Tuff	Oligocene	Slightly to moderately welded, moderately pumiceous, rhyolite ash-flow tuff with few crystals; locally altered. Thickness as much as 350 ft. Interbedded with upper part of Spears Formation.	
	Tl	Sawmill Canyon Formation	Oligocene	Heterolithic Sawmill Canyon cauldron fill of andesite and rhyolite lavas, ash-flow tuffs, conglomerates, and mudflow deposits. Includes tuff of Caronita Canyon (30.2±1.1 m.y.); multiple-flow, simple cooling unit, quartz latitic to rhyolitic ash-flow tuff. Upper part of tuff contains numerous crystals and is moderately to densely welded; lower part contains few to moderate number of crystals, is slightly to densely welded, and locally includes basal vitrophyre. Tuff of Caronita Canyon as much as 1,200 ft thick; thickness of Sawmill Canyon Formation as much as 2,500 ft. Formation overlain by Lemitar Tuff; underlain by cauldron-facies of La Jencia Tuff. Osburn and Chapin (1983b) show more extensive outcrops of this formation than shown on this map.	
		Luis Lopez Formation	Oligocene	Heterolithic fill of Socorro cauldron; rhyolite lavas and domes, intermediate lavas, ash-flow tuffs, and sedimentary rocks. Formation overlain by La Jencia Tuff and underlain by Hells Mesa Tuff. Thickness as much as 3,500 ft. Osburn and Chapin (1983b) show more extensive outcrops of this formation than shown on this map. Ash-flow tuffs in Luis Lopez Formation in Chupadera Mountains and Socorro Peak area on east side of this county area; rhyolitic tuffs slightly to moderately welded, pumiceous with numerous lithic fragments, thickness as much as 1,250 ft in northern part, 700 ft in southern part.	
		Spears Formation	Oligocene 33.1 to 39.6 m.y.	Volcanic conglomerates, mudflows and volcaniclastic sandstones; thickness as much as 3,000 ft. Tuff of Granite Mountain overlies or is interbedded with uppermost part of formation.	
SO-3	Tt	South Canyon Tuff	Oligocene 26.7 m.y., average age	Simple cooling unit, rhyolite ash-flow tuff with few crystals; thickness as much as 650 ft.	Deal and Rhodes, 1976; Elston, 1976; Elston and others, 1976; Osburn and Chapin, 1983b
		Lemitar Tuff	Oligocene 28.4 m.y., average age	Simple to compound cooling unit, slightly to moderately welded ash-flow tuff; thickness as much as 200 ft. Locally overlain and underlain by tongues of La Jara Peak Basaltic Andesite.	
		Vicks Peak Tuff	Oligocene 31.3±2.6 m.y.	Simple cooling unit, slightly to moderately welded, ash-flow tuff with few crystals; thickness as much as 350 ft. Locally overlain and underlain by tongues of La Jara Peak Basaltic Andesite.	
		La Jencia Tuff	Oligocene	Compound cooling unit, moderately to densely welded ash-flow tuff with few crystals; thickness as much as 350 ft.	
		Hells Mesa Tuff	Oligocene 33.1 m.y., average age	Quartz latite to rhyolite ash-flow tuff.	
		Rock House Canyon Tuff	Oligocene	Similar in lithology and thickness to Rock House Canyon Tuff of county area SO-2. Interbedded in upper part of Spears Formation.	

	Datil Well(?) Tuff	Oligocene	Densely welded, ash-flow tuffs with moderate number of crystals; thickness as much as 80 ft. Interbedded with Spears Formation and immediately underlies the Rock House Canyon Tuff.
Tl	South Crosby Peak(?) Formation	Oligocene	Unwelded tuffs with few crystals and tuffaceous sandstones; thickness as much as 100 ft. Occurs below La Jencia Tuff.
	Spears Formation	Oligocene	Upper tongue, basaltic andesite to andesite lavas, coarse conglomerates, and breccias; thickness as much as 325 ft. Lower tongue, sandstones, conglomerates, and minor mud-flow deposits and mudstones; thickness about 2,200 ft. Tongues separated by Rock House Canyon Tuff and Datil Well(?) Tuff.

PART B--CALDERAS AND CAULDRONS

Name	Description	References
	CATRON COUNTY	
Bursum caldera	Formed by eruption of Apache Spring Quartz Latite ash-flow tuff 27.3 m.y. ago. Post-collapse formation of domes and lava flows of Sacaton Quartz Latite in ring-fractures around margins of cauldron. Resurgent doming evident from abrupt thinning of moat deposits (Deadwood Gulch Member of Fanney Rhyolite) against the central dome. Felsic batholith, underlying the Mogollon Plateau, inferred as source of erupted material.	Elston, 1968; Elston and others, 1970; Ratté 1981; Rhodes, 1976a, 1976b
Crosby Mountain cauldron	Shallow, asymmetrical cauldron largely north of Plains of San Augustin; formed by eruption of 32-m.y.-old tuff of South Crosby Peak. Tuff of South Crosby Peak probably included in volcaniclastic rocks of South Crosby Peak of Lopez and Bornhorst (1979).	Bornhorst, 1976; Elston, 1978; Lopez and Bornhorst 1979
Gila Cliff Dwellings caldera	Source of Bloodgood Canyon Tuff 26.3 m.y. old. Partly buried by younger deposits; margin of cauldron approximate. Structural relationship with Bursum caldera unknown. Lava of Taylor Creek Rhyolite of Elston (1968) exposed on northeast side, may represent post-collapse volcanism along ring fractures.	Elston, 1968; Elston and others, 1970; Ratté and Gaskill, 1975; Rhodes, 1976b
	DOÑA ANA COUNTY	
Doña Ana and Dagger Flat cauldrons	The small Dagger Flat cauldron is nested in Doña Ana cauldron. Apparently both formed by eruption of Doña Ana Rhyolite 33 to 37 m.y. ago. Tuff more than 2,500 ft thick near center of Doña Ana cauldron.	Seager, 1975; Seager and others, 1976.
Goodsight-Cedar Hills volcano-tectonic depression	Asymmetrical, shallow volcanic depression that is structurally transitional to a cauldron. Eruptive history 10 to 12 m.y. ago. Sierra de las Uvas dome within the depression and adjacent synclinal moat represent resurgence. Depression filled with maximum thickness of 1,800 ft of rhyolitic ash-flow tuff, epiclastic strata, and Uvas Basaltic Andesite, erupted from vents near center of depression and along major subsidence fracture zone on east margin.	Clemons, 1976, 1979; Elston and others, 1976; Seager, 1973b, 1975; Seager and Clemons, 1975
Organ and Ice Canyon cauldrons	Organ and Ice Canyon cauldrons formed 32.8 to 33.7 m.y. ago. Initial deposition of Cueva Tuff and tuff of Cox Ranch probably preceded major subsidence. Organ cauldron formed during eruption of tuff of Achenback Park. Ice Canyon cauldron later formed with eruption of tuff of Squaw Mountain. Little evidence of resurgence, although Organ Mountain batholith may represent resurgent phase.	Seager, 1975, 1981; Seager and Brown, 1978
	GRANT COUNTY	
Emory cauldron	Large, elongate cauldron formed with eruption of Kneeling Nun Tuff (33.4±1.0 m.y.). A resurgent uplift, roughly 34 mi long and 16 mi wide, nearly fills cauldron. After resurgent doming, Mimbres Peak Formation pumice flows and rhyolite domes and dikes (32.0±1.0 m.y.) were deposited as moat fill.	Elston and others, 1975; Ericksen and others, 1970; Kuellmer, 1954
	HIDALGO COUNTY	
Animas Peak cauldron	Formed by eruption of tuff of Black Bill Canyon, about 36 m.y. old. Domes of Cedar Hill Andesite on north and northeast sides of cauldron may represent ring-fracture domes.	Deal and others, 1978; Zeller and Alper, 1965
Apache Hills cauldron	Formed about 31 m.y. ago by eruption of basalt, andesite, and quartz latite lava and ash-flow tuff (Chapo Formation of Strongin, 1958). Quartz monzonite stock with minimum age of 27.2±0.6 m.y. intruded and domed the cauldron.	Deal and others, 1978; Peterson, 1976; Strongin, 1958
Cowboy Rim cauldron	Probably formed by eruption of Gillespie Tuff (32.9±0.7 m.y.). Northern margin closely aligned to that of Tullous cauldron. Lack of ring-fracture domes and moat deposits indicates that cauldron was pre-existing depression which was filled by Gillespie Tuff.	Deal and others, 1978; Erb, 1978

Geronimo Trail cauldron	Formed by eruption of tuff of Guadalupe Canyon (24.2±0.5 m.y.). Bordered by three concentric zones of ring-fracture and moat deposits on the north and east sides. Slightly domed, probably during resurgence.	Deal and others, 1978; Erb, 1978; Hayes, 1982
Juniper cauldron	Formed by eruption of Oak Creek Tuff (35.2±0.8 m.y.); Basin Creek Tuff and associated lava flows and domes make up moat deposits and ring-fracture domes. Monzonite and quartz monzonite intrusives, 27 to 34 m.y. old, in core and on rim of cauldron, probably represent resurgent phase.	Deal and others, 1978; Elston and Erb, 1977; Zeller and Alper, 1965
Muir cauldron	Formed about 37 m.y. ago by eruption of tuffs of Woodhaul Canyon and Graham Well. Cauldron intruded by composite stock of diorite, monzonite, and rhyolite and by andesitic dikes and sills dated at 29.4±0.7 m.y. Post-collapse ring-fracture deposits and intrusions may represent resurgent phase of magmatism.	Deal and others, 1978; Elston, 1978
Rodeo cauldron	Formed by eruption of tuff of Black Mountain. Minimum age of cauldron is 26 m.y. Dip of strata inside cauldron indicates probable resurgent doming. Cauldron apparently extends westward into Chiricahua Mountains of Arizona.	Deal and others, 1978; Marjaniemi, 1969
San Luis cauldron	May have formed by eruption of Park Tuff now exposed in Animas Mountains (29.6±0.6 m.y.), or tuff of Skeleton Canyon in Peloncillo Mountains (younger than 24.3±0.5 m.y.), see county area H-6. Cauldron probably centered in Sierra San Luis in Mexico. Flows and probable ring-fracture domes occur on north and east sides.	Deal and others, 1978
Tullous cauldron	Asymmetrical cauldron formed by eruption of Bluff Creek Formation (older than 35.2±0.8 m.y.). Only fragments of cauldron are preserved.	Deal and others, 1978

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Magdalena and Sawmill Canyon cauldrons	Interconnected cauldrons formed by eruption of La Jencia Tuff (about 31 m.y.). Tuff overlain by moat-fill deposits of Sawmill Canyon Formation. Moat-fill overlain by Lemitar Tuff which thickens within cauldron margins probably due to ponding (Osburn and Chapin, 1983a). Socorro cauldron overlaps and buries eastern one-half of Sawmill Canyon cauldron.	Chapin and others, 1978; Deal, 1973; Osburn and Chapin, 1983a, 1983b
Mount Withington cauldron	Probably formed by eruption of South Canyon Tuff (26.7 m.y.); may consist of two or more nested cauldrons. Cauldron facies(?) tuff thickest in north-central San Mateo Mountains. Presence of large areas of outflow tuff within cauldron suggests this structure is inadequately defined and that any cauldrons present must be much smaller than previously suggested.	Deal, 1973; Deal and Rhodes, 1976; Osburn and Chapin, 1983a, 1983b
Nogal Canyon cauldron	Probable source of the more than 2,100-ft-thick Vicks Peak Tuff. Southern margin outlined by arcuate faults and small stocks. Quartz latite lava flows, 2,300 ft thick, may represent post-cauldron activity on northern ring-fracture zone.	Chapin and others, 1978; Deal, 1973; Deal and Rhodes, 1976; Osburn and Chapin, 1983a, 1983b
Socorro cauldron	Source of Hells Mesa Tuff; moat filled with sedimentary and volcanic rocks of Luis Lopez Formation. Cauldron probably resurgent; maximum collapse along east side. Elongate east and west, and dimension lengthened by late Cenozoic crustal extension. Geophysical studies indicate rising magma bodies below ring-fracture zone.	Chapin and others, 1978; Deal, 1973; Osburn and Chapin, 1983a, 1983b; Sanford and others, 1977

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