Stratigraphic Chart 1

New Mexico Bureau of Mines & Mineral Resources

A DIVISION OF NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY 1983

Nomenclature for Cenozoic rocks of northeast Mogollon–Datil volcanic field, New Mexico

by Glenn R. Osburn and Charles E. Chapin

Introduction

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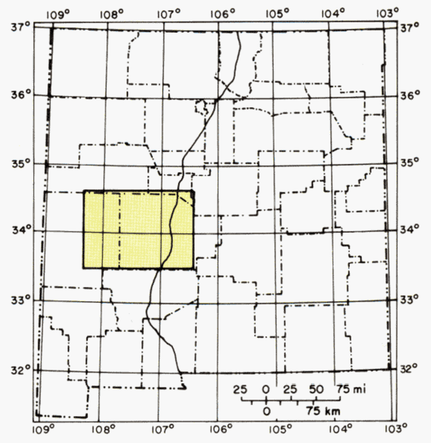

FIGURE 1—Index map of New Mexico showing location of area covered by this stratigraphic chart and the Socorro-Magdalena project (fig. 2).

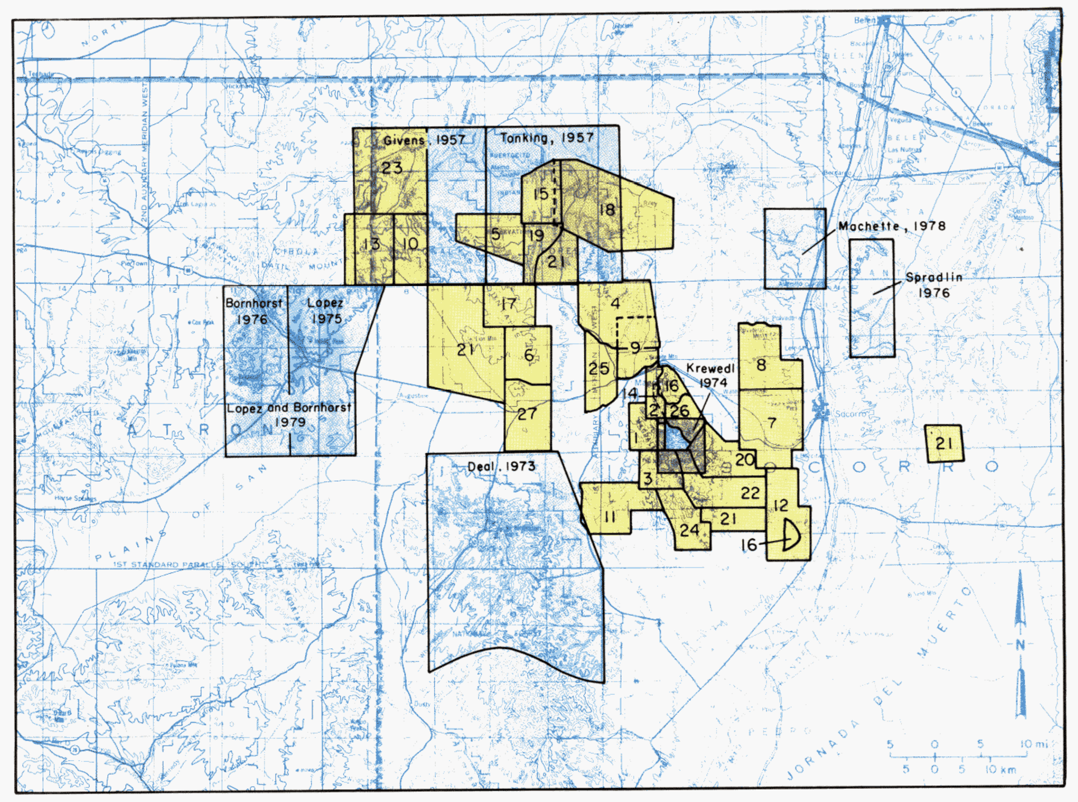

FIGURE 2—Location map showing major geologic studies that provide data base for this chart.

TABLE 1—Socorro-Magdalena project studies.

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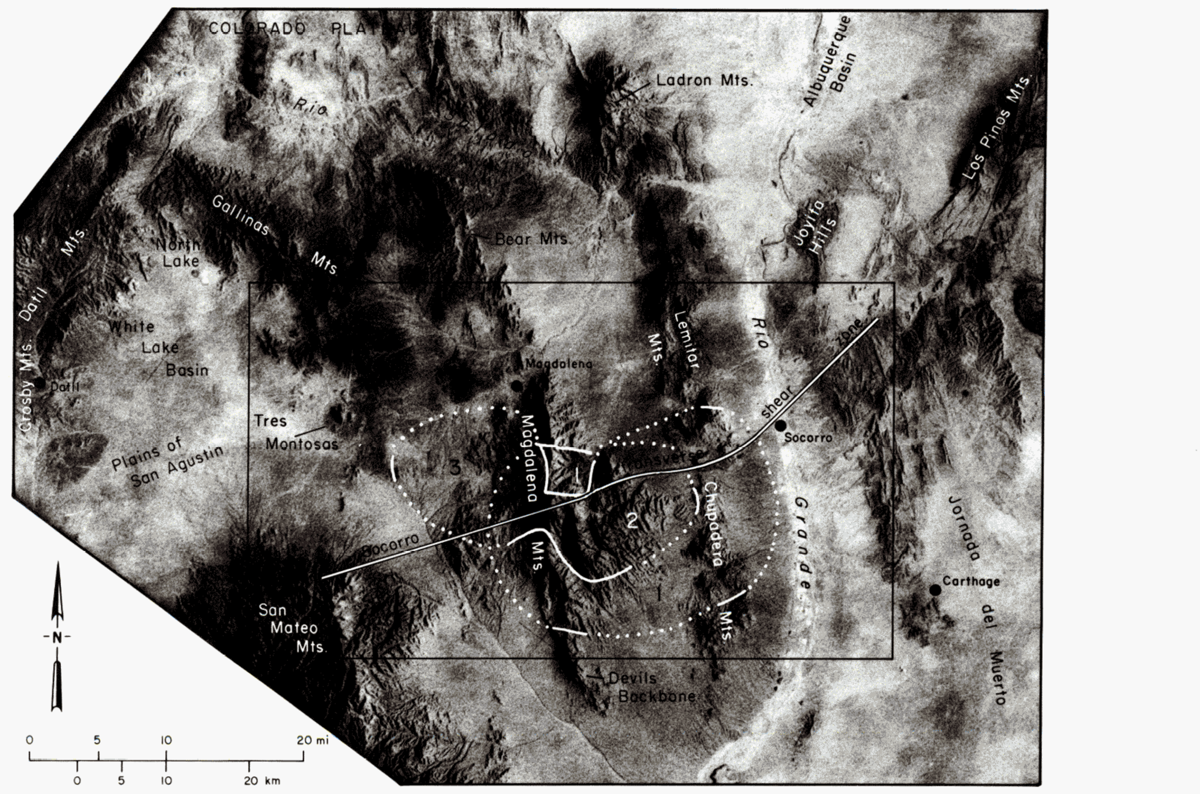

FIGURE 3—Location map showing position of major volcanic structures and transverse shear zone relative to topographic and cultural features.

Santa Fe Group

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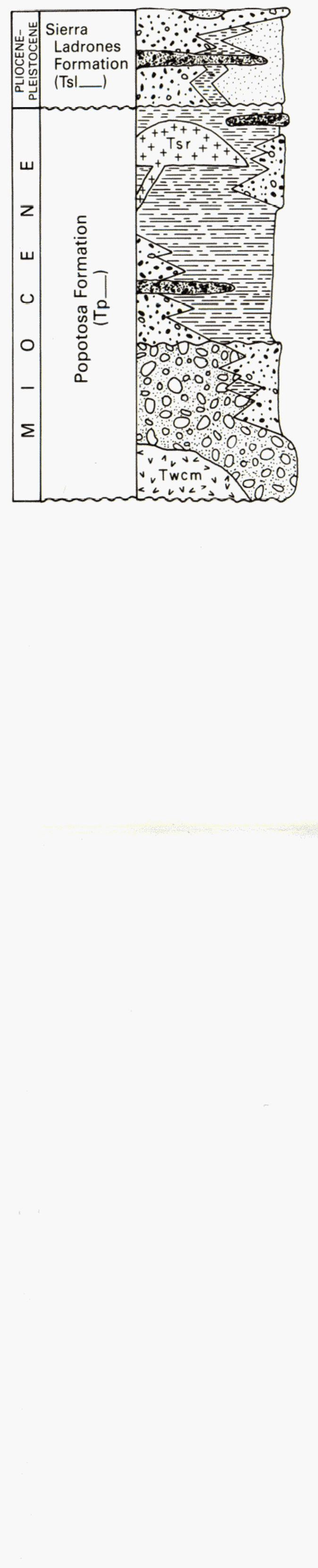


(1–3%), biotite (1–3%), and traces of hornblende.

Upper flow—10.8 ± 0.4 m.y.; 0–400 ft (0–120 m); rhyolite lavas.
Dense, flow-banded, porphyritic lava flows containing 10–25% phenocrysts of plagioclase (9–20%), biotite (2%), and hornblende (1.5%).

Ash-flow tuffs—0–300 ft (0–90 m).
Sequence of thin ash-flow and air-fall tuffs at base of lava flows. Two distinct lithologies usually compiled together. Lower, buff, poorly welded interval has mineralogical composition similar to the lower lava; the upper, usually vitric, densely welded tuff is similar in mineralogy to the upper lava.

Magdalena Peak Rhyolite [Allen, 1979; just south of Magdalena]—14.8 m.y., average of 2 dates; 0–600 ft (0–180 m); rhyolite lavas and minor ash-flow tuffs at base.
Pink, buff, or gray, flow-banded rhyolite lavas. Frequently have flow lineation, elongate gas cavities, and flow folds. Contain 10–20% phenocrysts consisting of plagioclase, biotite (2–3%), sanidine (1%), and traces of hornblende. Some samples southeast of Magdalena Peak, the only known vent area, contain more quartz and sanidine. This variation in mineralogy may indicate older flows from a different source.

Kelly Ranch, basalt of [Chamberlin, 1980; eastern Lemitar Mountains]—0–165 ft (0–50 m) composite of all flows; basaltic lava flows.
Grayish-black, dense, slightly porphyritic basalt or basaltic-andesite lavas. Series of from one to four flows, locally interbedded with Popotosa sedimentary rocks at several stratigraphic horizons. All flows older than the quartz-latitic lavas of the Socorro Peak Rhyolite. Contain a few percent plagioclase and olivine phenocrysts.

Council Rock, basaltic andesite of [Chamberlin, 1974; Wilkinson, 1976; Mulligan Gulch west of Magdalena]—17.4 m.y., average of 2 dates; 0–100 ft (0–30 m); basalt or basaltic-andesite lavas and intrusive rocks.
Dense, gray to black, fine-grained, porphyritic, vesicular lavas. Contain 10–15% phenocrysts consisting of plagioclase (10%), olivine (3–6%), and pyroxene (2–4%). Known related intrusive rocks occur in a linear trend for 2 mi (3.2 km) south of Council Rock (sec. 1, T. 2 S., R. 6 W.)

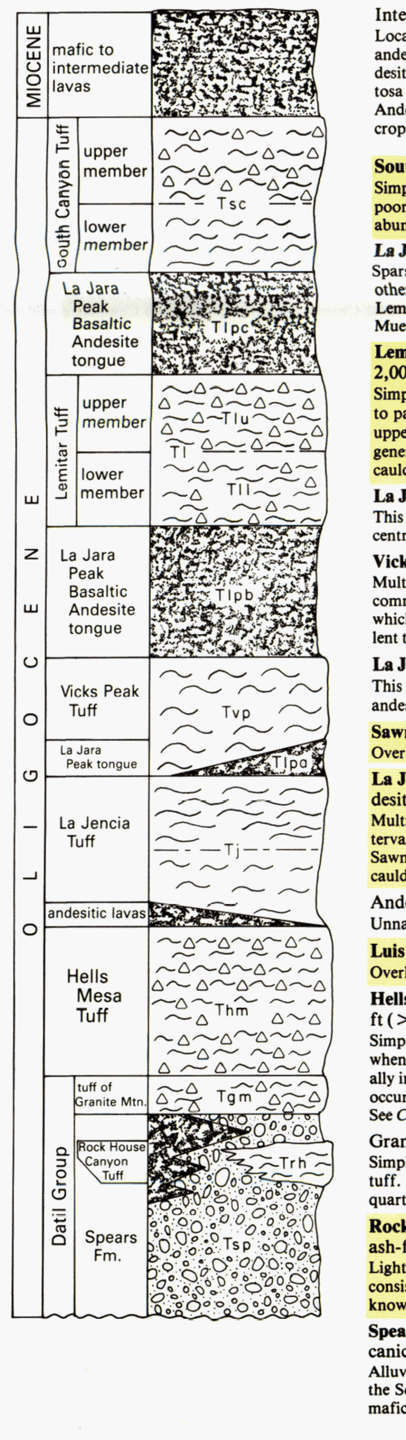
Water Canyon Mesa, rhyolite of [Osburn, 1978]—20.5 ± 0.8 m.y.; 0–600+ ft (0–180+ m); rhyolitic lava flows.
Dense, pinkish-gray to red, porphyritic, flow-banded rhyolite lavas. Finely to crudely flow-foliated and moderately to very porphyritic. Usually contain 15–40% phenocrysts consisting of plagioclase (15–35%), biotite (1–2%), hornblende (0.5–1%), and magnetite. In most areas the rock is considerably altered by potassium metasomatism with resultant oxidation of hornblende and replacement of plagioclase by potassium feldspars or clays.

Dry Lake Canyon, fanglomerate of [Brown, 1972; Mulligan Gulch west of Magdalena]—0–1,200+ ft (0–360+ m); volcaniclastic sedimentary rocks.
Upper member of the Popotosa Formation along the western side of the Bear Mountains. Deposits consist of fanglomerates and mudflow deposits (dominantly of La Jara Peak Basaltic Andesite clasts), sandstones, and siltstones. Shed westward from ancestral Magdalena Mountains (Bruning, 1973).

Arroyo Montosa, unit of [Simon, 1973; Mulligan Gulch west of Magdalena]—volcanic and sedimentary rocks.
Volcanic facies—25.9 ± 1.2 m.y.; 0–100 ft (0–30 m); lava flows.
Light-gray to reddish-gray, porphyritic lava flows of intermediate composition. Contain 20–30% phenocrysts of plagioclase, sanidine (2–15%), quartz (1–3%), and traces of highly altered biotite and hornblende. Plagioclase phenocrysts reach 1.5 inches (3.8 cm) in length.
Conglomerate facies—0–700 ft (0–215 m); volcaniclastic sedimentary rocks.
Reddish-brown, highly indurated, pebble to cobble conglomerates, and interbedded medium- to coarse-grained sandstone lenses. Basal Popotosa unit in area of occurrence.

Outflow volcanic units

Magdalena, Lemitar, Bear, and eastern Gallinas Mountains and the Joyita Hills



Intermediate and mafic lavas.
Local accumulations of mafic to intermediate lavas above the South Canyon Tuff in parts of the Magdalena Mountains. Include the andesitic lavas on Water Canyon Mesa (Osburn, 1978), lavas in the South Baldy–Hardy Spring area (Bowring, 1980), and basaltic andesites (possible tongue of La Jara Peak [Tlpd]) south of Squaw Peak (Donze, 1980). The volcanic facies of the unit of Arroyo Montosa (Simon, 1973) also occupies this interval. Lithologies vary from sparsely porphyritic basaltic andesites (La Jara Peak Basaltic Andesite ?) to very porphyritic quartz latites. See individual studies for details of occurrence and petrology of units. Many of the outcrops in the central Magdalenas are considerably altered.

South Canyon Tuff [Osburn, 1978]—26.7 m.y., average of 2 dates; 0–650 ft (0–200 m); ash-flow tuffs.
Simple to compound cooling unit of quartz-rich, one-feldspar rhyolite tuff. Lower member of light-gray to brownish-gray, crystal-poor (1–4%) tuff and an upper member of medium-gray to purple-gray, moderately crystal-rich (15–25%), one-feldspar tuff with abundant chatoyant sanidine and euhedral quartz. The two members are usually mapped together. Source unknown.

La Jara Peak Basaltic Andesite [Tonking, 1957]—0–600 ft (0–180 m); basaltic-andesite lavas.
Sparsely porphyritic, fine-grained, basaltic-andesite lava flows continuous in some areas and interfingering laterally as tongues with other units in many areas. Commonly containing small, red, deuterically altered, ferromagnesian phenocrysts. This tongue present in Lemitar, Bear, Gallinas, and Magdalena Mountains and in the Joyita Hills; absent on Devils Backbone and in northern Jornada del Muerto.

Lemitar Tuff [Osburn, 1978; Chamberlin, 1980]—28.4 m.y., average of 4 dates; 0–400 ft (0–125 m) outflow; 800–2,000 ft (250–600 m) in Sawmill Canyon–Magdalena cauldrons; ash-flow tuffs.
Simple to compound cooling unit of densely welded tuff showing strong compositional zoning. Usually divided into lower, light-gray to pale-red, crystal-poor (10–15%), rhyolitic member and an upper, medium-red to light-yellowish-gray, crystal-rich member. The upper member is zoned from a lower, plagioclase-rich, quartz-poor, quartz latite at the base to a quartz-rich rhyolite at the top. In general, the lower member is thin and restricted in distribution on the outflow sheet and thick where the unit has puddled in older cauldrons. Source is probably in northern or central San Mateo Mountains.

La Jara Peak Basaltic Andesite—0–100 ft (0–30 m); basaltic-andesite lavas.
This tongue is present in the Lemitar, Gallinas, and Bear Mountains and in the Joyita Hills; absent in Chupadera, Magdalena, and central San Mateo Mountains.

Vicks Peak Tuff [Deal and Rhodes, 1976]—31.3 ± 2.6 m.y.; 0–800 ft (0–250 m) outflow; ash-flow tuffs.
Multiple-flow, simple cooling unit of densely welded, crystal-poor, one-feldspar ash-flow tuff. Lower gray, very densely welded, commonly lithophysal, very crystal poor interval grades upward into a less crystal-poor interval containing abundant large pumice, which often contain euhedral vapor-phase minerals. Upper interval not present in south and central San Mateo Mountains. Equivalent to former upper member A-L Peak Tuff and upper member tuff of Bear Springs.

La Jara Peak Basaltic Andesite—0–100 ft (0–30 m); basaltic-andesite lavas.
This tongue is present in the Lemitar, Bear, and Gallinas Mountains and in the Joyita Hills. Equivalent stratigraphic unit, the basaltic andesite of Deep Well, present in the Datil Mountains.

Sawmill Canyon Formation [Tx_].
Overlies La Jencia Tuff within the Sawmill Canyon–Magdalena cauldrons. See *Cauldron stratigraphy* section.

La Jencia Tuff [new name; formerly lower member A-L Peak Tuff]—30.9 ± 1.5 m.y., date on overlying basaltic andesite of Deep Well; 0–500 ft (0–150 m) outflow; >2,500 ft (>750 m) cauldron facies; ash-flow tuffs.
Multiple-flow, compound cooling unit of densely welded, crystal-poor, often flow-lineated, one-feldspar tuff. Lower pumice-poor interval grades upward into a flow-banded interval that typically has strongly lineated pumice. Unit erupted from interconnected Sawmill Canyon and Magdalena cauldrons. The intracauldron member is well exposed in the Sawmill Canyon cauldron. These two cauldrons were later filled by the Sawmill Canyon Formation. See *Cauldron stratigraphy* section.

Andesite to basaltic-andesite lava flows—0–300 ft (0–90 m).
Unnamed intermediate to mafic lavas filling broad, shallow paleovalleys in the Bear and Lemitar Mountains and in the Joyita Hills.

Luis Lopez Formation [Tz_].
Overlies the Hells Mesa Tuff within the Socorro cauldron. See *Cauldron stratigraphy* section.

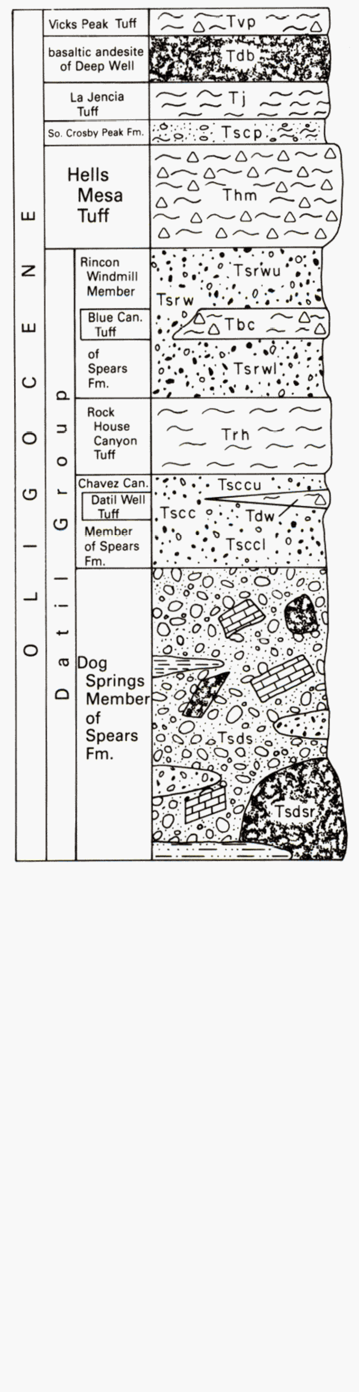
Hells Mesa Tuff [Deal, 1973; Simon, 1973]—33.1 m.y., average of several dates; 0–800 ft (0–245 m) outflow; >3,000 ft (>900 m) cauldron facies; ash-flow tuffs.
Simple cooling unit of densely welded, crystal-rich, quartz-rich, two-feldspar rhyolite tuff. Pink to reddish-brown when fresh, gray when propylitically altered (mainly in the western half of the cauldron and in the Magdalena mining district). Pumice foliation typically indistinct in outcrop. Unit is zoned from quartz-free quartz latite at base to quartz-rich rhyolite; abrupt increase in quartz usually occurs 10–25 ft (3–8 m) above base. Erupted from Socorro cauldron (fig. 3) and overlain by Luis Lopez Formation within cauldron. See *Cauldron stratigraphy* section.

Granite Mountain, tuff of—0–200 ft (0–60 m); ash-flow tuffs.
Simple cooling unit of reddish-brown (fresh) to dark-greenish-gray (propylitically altered), densely welded, crystal-rich, lithic-rich tuff. Quartz latite in mineralogy, containing 25–45% phenocrysts consisting of plagioclase, sanidine, biotite, magnetite, minor quartz, and traces of pyroxene.

Rock House Canyon Tuff [new name; formerly tuff of Main Canyon, tuff of Nipple Mountain]—0–350 ft (0–107 m); ash-flow tuffs.
Light-gray, poorly to moderately welded, crystal-poor, moderately pumiceous rhyolite ash-flow tuff. Contains 4–10% phenocrysts consisting mainly of sanidine with minor plagioclase and biotite and traces of quartz, clinopyroxene, and opaque oxides. Source unknown. Unit is usually altered in the Socorro–Magdalena area but is much fresher in the Datil and western Gallinas Mountains.

Spears Formation [Tonking, 1957; Brown, 1972]—39.6–33.1 m.y., range of several dates; 0–3,000 ft (0–900 m); volcanic conglomerates, mudflow deposits, and volcaniclastic sandstones.
Alluvial-fan, braided-stream, and lacustrine deposits separated into several members by intercalated, regional ash-flow tuff sheets. In the Socorro–Magdalena area most deposits consist of purple to gray conglomerates, mudflow deposits, and sandstones with minor mafic to intermediate lava flows. Deposits coarsen and contain more lava flows upward and to the south.

Datil and western Gallinas Mountains



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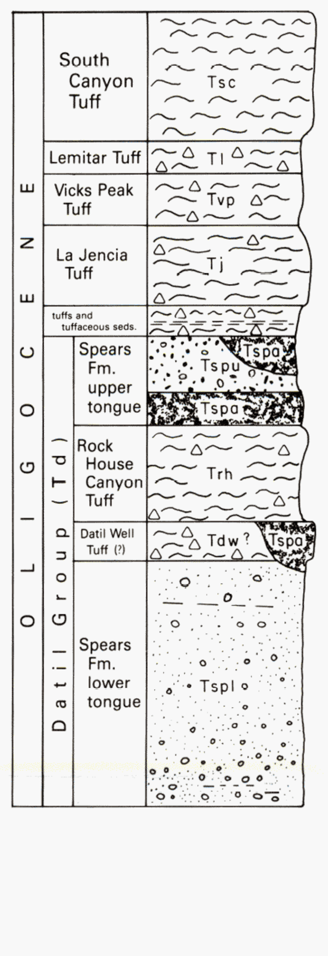
North Jornada del Muerto



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Cauldron stratigraphy

Socorro cauldron

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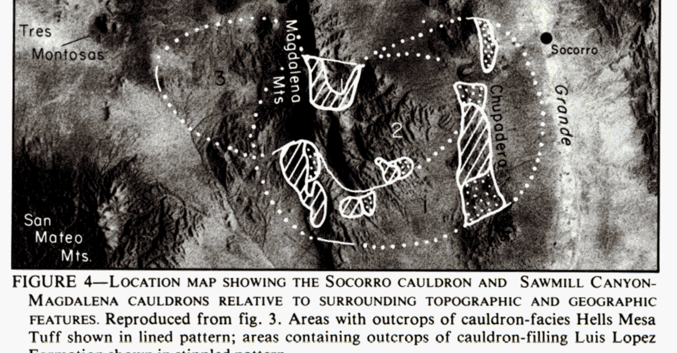

FIGURE 4—Location map showing the Socorro cauldron and Sawmill Canyon–Magdalena cauldrons relative to surrounding topographic and geographic features.

Stratigraphic units in the southwest Magdalena Mountains

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Stratigraphic units in northern Chupadera Mountains and on Socorro Peak

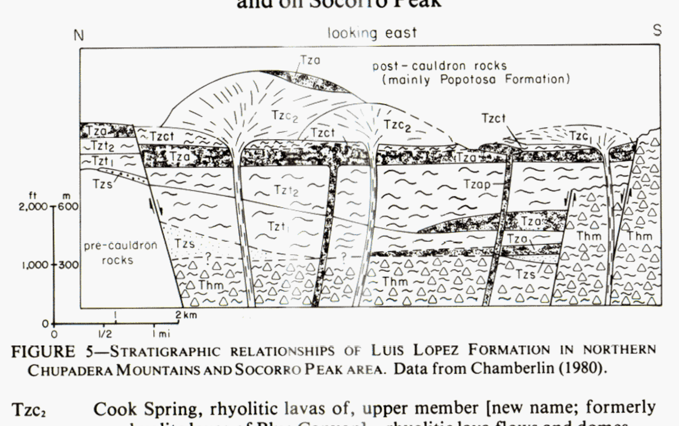

FIGURE 5—Stratigraphic relationships of Luis Lopez Formation in northern Chupadera Mountains and Socorro Peak area.

Stratigraphic units in the south-central Chupadera Mountains and southeast Magdalena Mountains

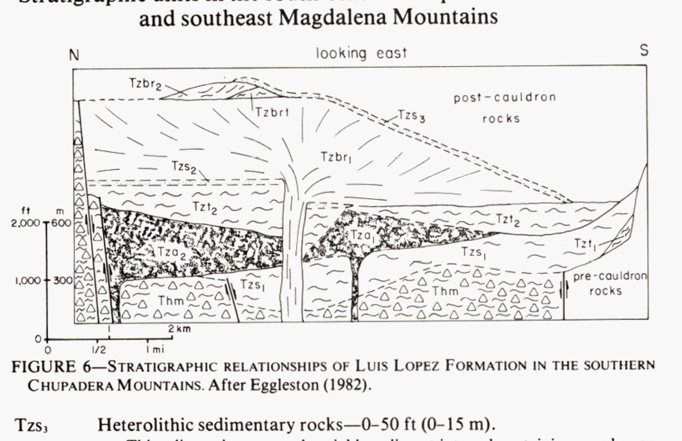

FIGURE 6—Stratigraphic relationships of Luis Lopez Formation in the southern Chupadera Mountains.

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Sawmill Canyon–Magdalena cauldrons

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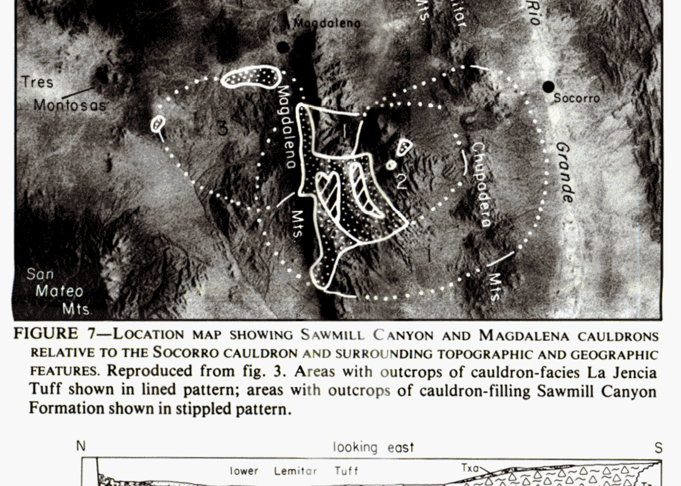

FIGURE 7—Location map showing Sawmill Canyon and Magdalena cauldrons relative to the Socorro cauldron and surrounding topographic and geographic features.

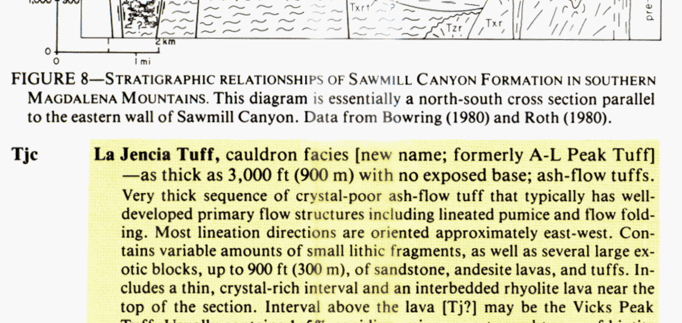

FIGURE 8—Stratigraphic relationships of Sawmill Canyon Formation in southern Magdalena Mountains.

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Layout artists: Teresa Mueller and Jane Calvert Love

Glossary of major stratigraphic units

This glossary lists only stratigraphic names pertinent to the northeast Mogollon–Datil volcanic field (fig. 1). Units outside the area are not listed except for those units that have been correlated into the northeast part of the field in maps or other publications. Units of limited lateral extent, such as local basalt flows or members of complex cauldron-fill units, are not listed unless they have appeared in a publication or have some special stratigraphic significance. Both formal and informal names are included. Obsolete names are included to facilitate transition to the new nomenclature.

The numbered entries listed under each stratigraphic unit refer to the categories below (N/A signifies not applicable). The format follows that used by Elston (1976) for ease of comparison with his more comprehensive glossary.

(1) Area of occurrence
(2) Origin of the name and/or location of the type locality
(3) First mention in the literature; other important references
(4) Rock type; general nature of thickness and continuity
(5) Age, radiometric dates (published K-Ar dates have been adjusted for the new IUGS constants using the tables of Dalrymple, 1979)
(6) Stratigraphic position (youngest underlying and oldest overlying unit; intertonguing units)
(7) Source of eruption
(8) Suggested correlation, synonyms
(9) Comments

For obsolete names, only items two and three and the reasons for abandonment are given. The reader is referred to the original papers for details of these units. For more detailed information on units listed, the reader is referred to the unit descriptions on the stratigraphic columns and to the references cited.

Formal names previously used and accepted are shown in bold type, accepted informal names are shown in medium type using the informal format of geographic name and lithologic designation; for example, Bear Canyon, basalt of, member of Popotosa Formation. Obsolete names are shown in medium type followed by the word "obsolete" enclosed in brackets. For several units not previously used in a formal sense, we here state our intention to name them formally. These units are capitalized and shown in bold type on a pale yellow background throughout this publication. For each of these units, the information required by the Code of Stratigraphic Nomenclature for formal naming can be found in this glossary and in a separately enclosed section. More detailed treatment of supporting data for these units will be given in a subsequent series of New Mexico Bureau of Mines and Mineral Resources circulars.

A-L Peak Rhyolite, A-L Peak Tuff, A-L Peak Formation [OBSOLETE]
(2) A-L Peak in northeast San Mateo Mountains, approximately 20 mi (32 km) southwest of Magdalena; secs. 33, 34, 35, T. 4 S., R. 6 W., Mount Withington 7½-min quadrangle. (3) Deal, 1973; Simon, 1973; and Deal and Rhodes, 1976. (9) Name abandoned in this report because the type section on A-L Peak was miscorrelated with outflow exposures of an older unit, now called La Jencia Tuff (formerly tuff of Bear Springs). The rocks on A-L Peak are now correlated with and called the South Canyon Tuff, the third regional ash-flow tuff above La Jencia Tuff. See **La Jencia Tuff** and **Vicks Peak Tuff.**

Allen Well, tuff of [OBSOLETE]
(2) Allen well in Dry Lake Canyon, approximately 7 mi (11 km) northwest of Magdalena; sec. 36, T. 1 S., R. 5 W., Silver Hill 7½-min quadrangle. (3) Brown, 1972; and Simon, 1973. (9) Name no longer used, because unit is correlative with the Lemitar Tuff. Both members of the Lemitar Tuff are present at Allen well; however, only the crystal-rich upper member of the Lemitar Tuff was called tuff of Allen Well by Simon (1973). He miscorrelated the crystal-poor lower member of the Lemitar Tuff with the lower part of La Jencia Tuff (then called A-L Peak Tuff) and, therefore, concluded that the tuff of Allen Well was part of La Jencia (A-L Peak) Tuff. Both crystal-poor and crystal-rich members are now known to be Lemitar Tuff, the second regional ash-flow tuff above La Jencia Tuff.

Arroyo Montosa, unit of, member of the Popotosa Formation
(1) Mulligan Gulch graben, approximately 6 mi (10 km) northwest of Magdalena. (2) Arroyo Montosa; secs. 14, unsurveyed, 23, 24, T. 2 S., R. 5 W., Silver Hill 7½-min quadrangle. (3) Simon, 1973; and Chapin and Seager, 1975. (4) Interbedded fanglomerates and quartz-latite to dacite lava flows; local unit. (5) 25.9 ± 1.2 m.y. K-Ar date (plagioclase) on quartz-latite flow. (6) Above South Canyon Tuff and Hale Well stock; below Tertiary–Quaternary piedmont gravels. (7) Vent not exposed but must be local. (8) Correlative in age and lithologic character to basal Popotosa Formation.

Ary Ranch, tuff of [OBSOLETE]
(2) Earl Ary Ranch, approximately 1.3 mi (2 km) east-northeast of Datil; sec. 7, T. 25 S., R. 9 W., Datil 7½-min quadrangle. (3) Lopez, 1975; Bornhorst, 1976; and Lopez and Bornhorst, 1979. (9) Name abandoned in this report because unit is correlative with Hells Mesa Tuff and, therefore, name is unnecessary. The tuff of Ary Ranch is not interbedded with the volcaniclastic rocks of South Crosby Peak Formation as described by Lopez and Bornhorst (1979), nor does it overlie the tuff of Rock Tank. Both the tuff of Ary Ranch and the tuff of Rock Tank (Lopez and Bornhorst, 1979) are part of the outflow sheet of the Hells Mesa Tuff.

Baca Formation
(1) Along north edge of Mogollon–Datil volcanic field from near Springerville, Arizona, to Riley, New Mexico; also present east of Rio Grande in Joyita Hills, northern Jornada del Muerto, and Carthage areas. (2) Baca Canyon in northeast Bear Mountains, approximately 15 mi (24 km) north of Magdalena; secs. 4, 5, 8, 9, T. 1 N., R. 4 W., Mesa Cencerro 7½-min quadrangle. (3) Wilpolt and others, 1946; Tonking, 1957; Snyder, 1971; Johnson, 1978; and Cather, 1980. (4) Red to light-gray sandstones, red mudstones, local coarse conglomerates; little or no detritus of Tertiary volcanic rocks except possibly in Quemado–Springerville area. (5) Contains Eocene vertebrate fossils. (6) Above Crevasse Canyon Formation (Cretaceous); below Spears Formation; contact with Spears commonly gradational over 20–30 ft (6–9 m). (7) N/A. (8) Eager Formation in Springerville area, Arizona; Mogollon Rim gravels in Arizona.

Bear Canyon, basalt of, member of the Popotosa Formation
(1) Socorro area. (2) Bear Canyon, approximately 7 mi (11 km) southwest of Socorro and just south of US–60 in the northern Chupadera Mountains; sec. 1, T. 4 S., R. 2 W., Luis Lopez 7½-min quadrangle. (3) Chamberlin, 1980, 1981. (4) Basalt flow, thin, local, discontinuous. (5) Not dated. (6) Interbedded with playa-claystone section of Popotosa Formation. (7) Unknown.

Bear Springs, tuff of [OBSOLETE]
(2) Bear Springs in southern Bear Mountains, approximately 8 mi (13 km) north of Magdalena; sec. 9, T. 1 S., R. 4 W., Magdalena NW 7½-min quadrangle. (3) Brown, 1972. (9) Name abandoned by Deal (1973) and Simon (1973) in favor of A-L Peak Tuff, which is here renamed La Jencia Tuff (formerly lower member A-L Peak Tuff) and Vicks Peak Tuff (formerly upper member A-L Peak Tuff). See **La Jencia Tuff** and **Vicks Peak Tuff.**

Beartrap Canyon formation [DEFINITION INADEQUATE, USE WITH CAUTION]
(2) Beartrap Canyon, San Mateo Mountains, approximately 22 mi (35 km) southwest of Magdalena; secs. 7, 18, T. 6 S., R. 7 W., Bay Buck Peaks 7½-min quadrangle. (3) Deal, 1973; and Deal and Rhodes, 1976. (9) Definition inadequate because the Beartrap Canyon formation (Deal and Rhodes, 1976) included cauldron-fill units of two or more overlapping cauldrons in the northern San Mateo Mountains plus younger units in the western Magdalena Mountains (Deal, 1973) that are correlative with the Popotosa Formation (Donze, 1980). Deal and Rhodes (1976) and Deal (1978, fig. S33) also extended the Beartrap Canyon formation into the southern San Mateo Range to include cauldron-fill deposits in the Nogal Canyon cauldron. Thus, the formation was used to include deposits of at least three cauldrons plus younger synrift deposits and ranges in age from about 30 m.y. to 14 m.y. The name, Beartrap Canyon formation, should not be used outside the northern San Mateo Range and should be used with caution until the San Mateo Range is mapped in detail and the stratigraphic relationships established.

Bianchi Ranch, rhyolite of, member of Luis Lopez Formation
(1) Central Chupadera Mountains. (2) Bianchi Ranch along Nogal Canyon, approximately 12 mi (19 km) southwest of Socorro; sec. 6, T. 5 S., R. 1 W., Luis Lopez 7½-min quadrangle. (3) Eggleston, 1982. (4) Rhyolitic lavas, thick but local. (5) Not dated. (6) Overlies cauldron-facies Hells Mesa Tuff and overlain by La Jencia Tuff. Restricted to moat of Socorro cauldron. (7) Local vents. (8) Correlative in stratigraphic position and age with rhyolitic lavas of Cook Spring.

Black Mountain, basalt of [OBSOLETE]
(2) Black Mountain, approximately 5 mi (8 km) southwest of Socorro; sec. 30, T. 3 S., R. 1 W., Socorro 7½-min quadrangle. (3) Bachman and Mehnert, 1978. (9) Abandoned in this report because of possible confusion with other Black mountains and Black mesas. See *Socorro Canyon, basalt of* for description.

Blue Canyon, rhyolite of [OBSOLETE]
(2) Blue Canyon in Socorro Peak area, approximately 3 mi (5 km) west of Socorro; secs. 9, 16, 21, T. 3 S., R. 1 W., Socorro 7½-min quadrangle. (3) Chamberlin, 1980. (9) Name abandoned here because of possible confusion with the Blue Canyon Tuff. The rhyolite domes and flows near Blue Canyon in the Socorro Peak area are part of the Luis Lopez Formation and have been renamed the rhyolitic lavas of Cook Spring.

Blue Canyon Tuff of the Datil Group
(1) Datil Mountains and northwest Gallinas Mountains. (2) Blue Canyon, approximately 7 mi (11 km) north of Datil; type section in Main Canyon near junction with Blue Canyon; NE¼SE¼ sec. 1, T. 1 S., R. 10 W., Cal Ship Mesa 7½-min quadrangle. (3) Lopez, 1975; Bornhorst, 1976; and Lopez and Bornhorst, 1979. (4) Quartz-latite ash-flow tuff, moderately crystal rich; as thick as 100 ft (30 m) and continuous in Datil Mountains but thins to east and is largely absent in Socorro–Magdalena area. (5) 33.3 ± 1.2 m.y. K-Ar biotite date and 33.2 ± 1.7 zircon fission-track date (Bornhorst and others, 1982). (6) Above Rock House Canyon Tuff; below Hells Mesa Tuff; interbedded with volcaniclastic rocks of Spears Formation. (7) Unknown. (8) Correlative with [Ts_{t2}] of Mayerson (1979).

FIGURE 10—Type section of Blue Canyon Tuff. Route of section measurement was up cliff along dashed line, then N. 60° W. across bench to first exposure of upper part of Rincon Windmill Member. **Tsrwl** = lower part of Rincon Windmill Member of Spears Formation, **Tbc** = Blue Canyon Tuff. Arrow points to geologist for scale.

Blue Mesa, basalt of
(1) Northeast end of Datil Mountains. (2) Blue Mesa, approximately 20 mi (32 km) northeast of Datil and approximately 5 mi (8 km) south of D Cross Mountain (unsurveyed), D Cross Mountain 7½-min quadrangle. (3) Harrison, 1980; and Robinson, 1981. (4) Basalt flows, thin and local. (5) Not dated. (6) Above Spears Formation and Hells Mesa Tuff; caps mesa. (7) Vent on Blue Mesa. (8) Part of Santa Fe basalt as used by Givens (1957). (9) Probable Pliocene age judging from K-Ar dates on other basalt flows and necks along the southern boundary of the Colorado Plateau.

Broken Tank, basalt of
(1) West-central Chupadera Mountains. (2) Broken tank, approximately 13 mi (21 km) southwest of Socorro; secs. 25, 35, 36, T. 4 S., R. 2 W., Molino Peak 7½-min quadrangle. (3) Eggleston, 1982. (4) Basalt flows, local. (5) Not dated. (6) Interbedded in, or overlying, uppermost gravels of the Santa Fe Group. (7) Unknown. (8) None.

Caronita Canyon, tuff of, member of the Sawmill Canyon Formation
(1) Southern and central Magdalena Mountains; north and northwest San Mateo Mountains. (2) Caronita Canyon in southern Magdalena Mountains, approximately 15 mi (24 km) southwest of Socorro; secs. 5, 6, T. 4 S., R. 2 W., Molino Peak 7½-min quadrangle. (3) Petty, 1979; Bowring, 1980; Roth, 1980; and Osburn, 1982. (4) Rhyolite ash-flow tuffs; thick but restricted in extent; red, crystal-poor (biotite, plagioclase) lower member; light-gray, crystal-rich (quartz, sanidine) upper member. (5) 30.2 ± 1.1 m.y. K-Ar biotite date. (6) Above La Jencia Tuff; below Lemitar Tuff; near top of cauldron fill in Sawmill Canyon cauldron. (7) Possibly from Sawmill Canyon cauldron. (8) Informal member, Sawmill Canyon Formation.

Cerritos de las Minas, basaltic andesite at, tongue of La Jara Peak Basaltic Andesite
(1) Lemitar Mountains. (2) Cerritos de las Minas (small hills) on east side of Lemitar Mountains, approximately 18 mi (29 km) north-northwest of Socorro and 3 mi (5 km) south of the Rio Salado; well exposed along Cañon del Ojito; Sevilleta Grant, unsurveyed, San Acacia 7½-min quadrangle. (3) Machette, 1978. (4) Basaltic-andesite flows, breccias, and plugs; thick but local. (5) 27.0 ± 1.1 m.y. K-Ar biotite date (Bachman and Mehnert, 1978). (6) Mostly below Popotosa Formation but interbedded across 15–30 ft (5–10 m) interval with basal fanglomerate of Popotosa; no base exposed. (7) Local eruptive center. (8) Tongue of La Jara Peak Basaltic Andesite.

Chavez Canyon Member of the Spears Formation of the Datil Group
(1) Datil and Gallinas Mountains. (2) Chavez Canyon in northwest Gallinas Mountains, approximately 17 mi (27 km) northeast of Datil; S½ sec. 27, T. 2 N., R. 8 W., unsurveyed, Dog Springs 7½-min quadrangle. (3) Harrison, 1980; and Coffin, 1981. (4) Volcaniclastic conglomerates and sandstones; usually thicker than 1000 ft (300 m) and widespread. (5) Not dated. (6) Above Dog Springs Member of Spears Formation; below Rock House Canyon Tuff. Locally split into two parts by interbedded Datil Well Tuff. (7) N/A. (8) Correlations with units of Lopez (1975), Bornhorst (1976), and Lopez and Bornhorst (1979) uncertain but includes their feldspathic sandstone member and lower volcanic sedimentary unit.

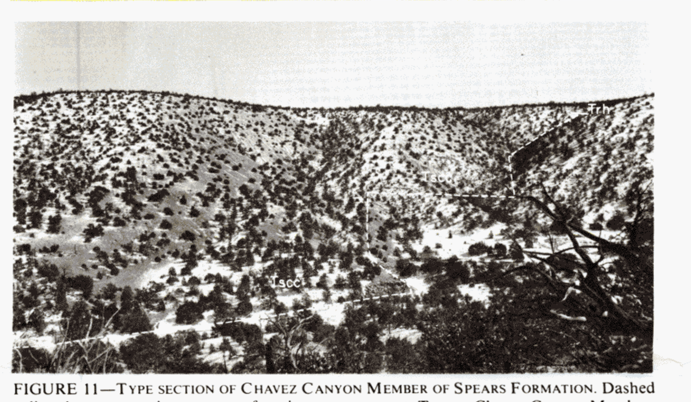

FIGURE 11—Type section of Chavez Canyon Member of Spears Formation. Dashed line shows approximate route of section measurement. **Tscc** = Chavez Canyon Member, **Trh** = Rock House Canyon Tuff.

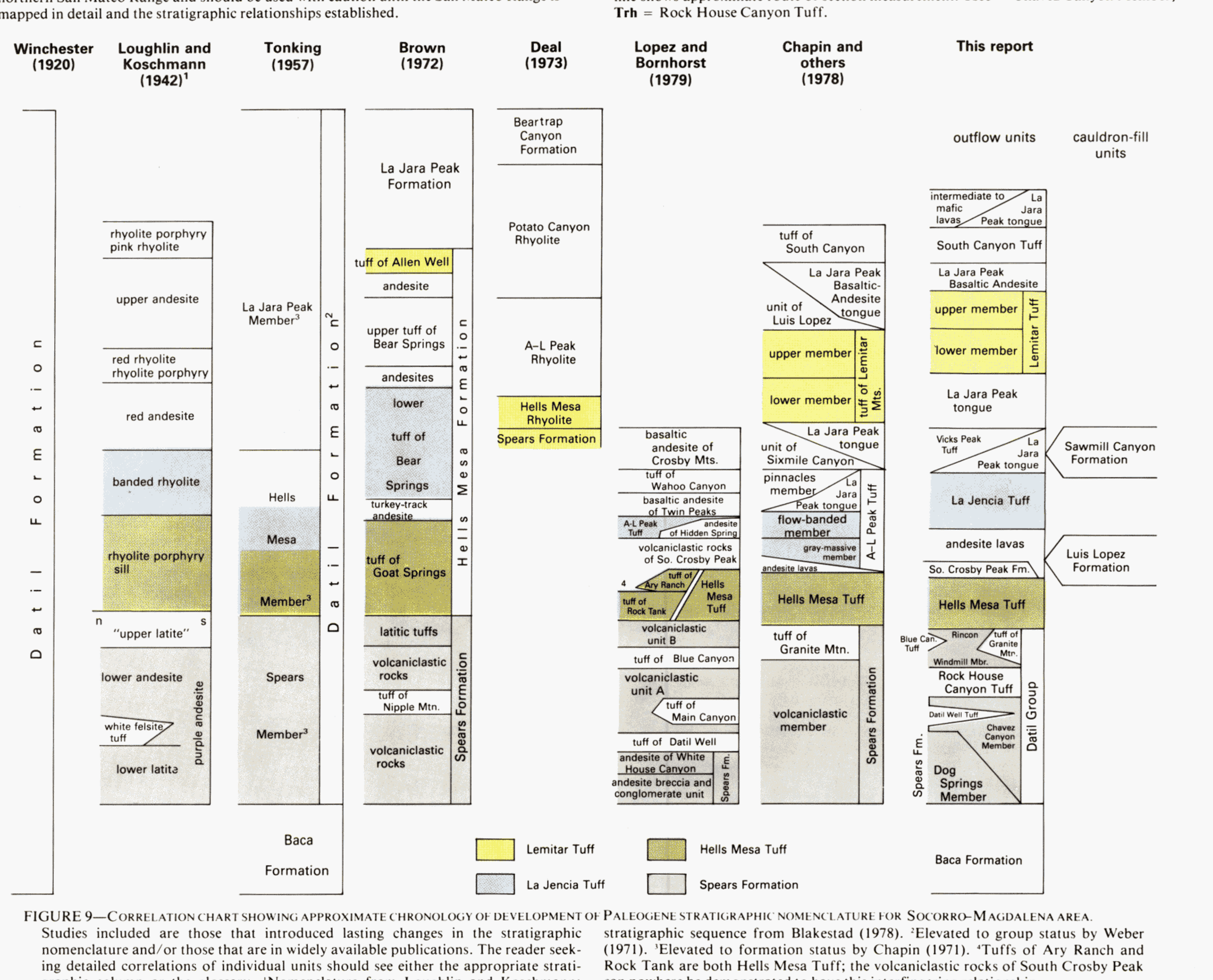

FIGURE 9—Correlation chart showing approximate chronology of development of Paleogene stratigraphic nomenclature for Socorro–Magdalena area. Studies included are those that introduced lasting changes in the stratigraphic nomenclature and/or those that are in widely available publications. The reader seeking detailed correlations of individual units should see either the appropriate stratigraphic column or the glossary. [1]Nomenclature from Loughlin and Koschmann; stratigraphic sequence from Blakestad (1978). [2]Elevated to group status by Weber (1971). [3]Elevated to formation status by Chapin (1971). [4]Tuffs of Ary Ranch and Rock Tank are both Hells Mesa Tuff; the volcaniclastic rocks of South Crosby Peak can nowhere be demonstrated to have this interfingering relationship.

Cook Spring, rhyolitic lavas of
(1) Northern Chupadera Mountains and southern part of Socorro Peak. (2) Cook Spring, approximately 2 mi (3.2 km) west-southwest of Socorro; sec. 15, T. 3 S., R. 1 W., unsurveyed, Socorro 7½-min quadrangle. (3) New name. (4) Rhyolite lavas, domes, and minor associated pyroclastic rocks; local. (5) 29.4 ± 1.1 m.y. K-Ar biotite date. (6) Domes and flows within Luis Lopez Formation; fill of Socorro cauldron. (7) Local. (8) Formerly rhyolite of Blue Canyon (obsolete) and rhyolite of Highway Sixty (obsolete) of Chamberlin (1980). Correlative in age and stratigraphic position with rhyolite of Bianchi Ranch in southern Chupadera Mountains.

Council Rock, basaltic andesite of, member of the Popotosa Formation
(1) Mulligan Gulch graben west of Magdalena. (2) Council Rock, approximately 15 mi (24 km) northwest of Magdalena; T. 2 S., R. 5 W., unsurveyed, Gallinas Peak 7½-min quadrangle. (3) Chamberlin, 1974; and Wilkinson, 1976. (4) Basalt and basaltic-andesite lava flows; thin, erosional remnants scattered along Mulligan Gulch graben from Council Rock to Cat Mountain. (5) 17.4 m.y., average of two K-Ar whole-rock dates. (6) Caps piedmont gravels of Santa Fe Group that fill Mulligan Gulch graben; also caps Cat Mountain where it rests on South Canyon Tuff. (7) Dikes in Council Rock area. (8) None.

Crosby Mountain, tuff of [OBSOLETE]
(2) Crosby Mountain, approximately 6 mi (10 km) southwest of Datil; sec. 25, T. 2 S., R. 11 W., Sugarloaf Mountain 7½-min quadrangle. (3) Lopez, 1975. (9) Name abandoned by Bornhorst (1976) and Lopez and Bornhorst (1979) in favor of including this tuff within the volcaniclastic rocks of South Crosby Peak, herein referred to as the South Crosby Peak Formation.

Crosby Mountains, basaltic andesite of
(1) Crosby Mountains. (2) Crosby Mountains, approximately 6 mi (10 km) west of Datil; secs. 10, 11, T. 2 S., R. 11 W., Crosby Springs 7½-min quadrangle. (3) Bornhorst, 1976; and Lopez and Bornhorst, 1979. (4) Basaltic-andesite flows, thick but local. (5) 24.3 ± 0.6 m.y. K-Ar whole-rock date (Bornhorst and others, 1982). (6) Above Vicks Peak Tuff; below isolated remnants of an ash-flow tuff that caps mesa in SE¼ sec. 2, T. 2 S., R. 11 W. and SE¼ sec. 18, T. 2 S., R. 11 W. This higher tuff may be South Canyon Tuff or a tuff from the west. (7) Unknown but probably local. (8) Correlative with northern outcrop area of basaltic andesite of Hidden Spring (Lopez and Bornhorst, 1979), secs. 1, 2, T. 2 S., R. 11 W.; stratigraphically equivalent to tongue b or c of La Jara Peak Basaltic Andesite but not considered here as part of La Jara Peak because of geographic separation.

Datil Group [REDEFINED]
(1) Present throughout northeast Mogollon–Datil volcanic field. (2) Datil Mountains. (3) Winchester (1920) introduced the term Datil Formation for "the Tertiary bedded volcanic rocks, sandstones, and conglomerates . . . which make up these mountains . . ." "These mountains" referred to the Datil, Gallinas, and Bear Mountains. The formation was named for the Datil Mountains, but the type section was measured at the north end of the Bear Mountains. Wilpolt and others (1946) removed the lower 684 ft (208 m) from Winchester's Datil Formation and named them the Baca Formation (Eocene). Tonking (1957) subdivided the remaining Datil Formation into a basal Spears Member of volcaniclastic rocks, a medial Hells Mesa Member of welded tuffs, and an upper La Jara Peak Member of mafic lava flows. Willard (1959) removed the mafic lava flows from Tonking's Datil Formation, and Weber (1971) elevated the remaining Datil Formation (Spears and Hells Mesa Members) to group status. As detailed mapping progressed during the 1970's, geologists realized that other major ash-flow sheets and thick sequences of cauldron-fill rocks belonged to the stratigraphic interval of Weber's Datil Group but were not present at the type locality. Because these rocks vary in chemical and mineralogical characteristics, come from different source areas, and span a time interval of about 10 m.y., the Datil Group of Weber (1971) became untenable. For several years a gentleman's agreement existed among various workers to abandon the term Datil or to use it only in an informal, catch-all sense. However, the term is so deeply entrenched in the literature that it seems impossible to kill it. Therefore, we have decided to redefine the term and use it to denote the group of rocks above the Baca Formation (Eocene) and below the Hells Mesa Tuff (restricted sense). The Datil Group represents the early volcaniclastic apron of the northeast Mogollon–Datil volcanic field and the volcanic rocks interbedded within it. Chemically and mineralogically, Datil rocks are similar in that they range from andesite to low-silica rhyolite in composition and generally lack phenocrystic quartz. The underlying Baca Formation and the overlying Hells Mesa Tuff are present throughout most of the northeast part of the volcanic field and provide a well-defined, easily recognized stratigraphic bracket for the Datil Group as here defined. A major advantage of this scheme is that the term Datil, after a long and confusing evolution, will return to a meaning similar to that for which it was coined: "The Tertiary bedded volcanic rocks, sandstones, and conglomerates . . . which make up these mountains" (Winchester, 1920, p. 2). The Datil Mountains are made up largely of volcanic and volcaniclastic rocks that stratigraphically lie between the Baca Formation (Eocene) and the Hells Mesa Tuff (Oligocene); see maps by Lopez and Bornhorst, 1979; Harrison, 1980). The Datil Group as here redefined includes the Spears Formation, which is mostly volcaniclastic rocks with minor lava flows, and several interbedded ash-flow tuff sheets, which are each given formational names and type localities. (4) Volcaniclastic rocks (Spears Formation), lava flows, and ash-flow tuffs (Datil Well Tuff, Rock House Canyon Tuff, Blue Canyon Tuff, and tuff of Granite Mountain), all of intermediate composition and generally lacking quartz phenocrysts; thick and continuous. (5) About 39–33 m.y. based on several K-Ar and fission-track dates plus several K-Ar dates on the overlying Hells Mesa Tuff. (6) Above Baca Formation; below Hells Mesa Tuff. (7) Unknown. (8) See discussion under (3); equivalent to Rubio Peak Formation of southeast Mogollon–Datil volcanic field.

Datil Well Tuff of the Datil Group
(1) Datil Mountains and northern Jornada del Muerto. (2) Datil Well Campground, approximately 1.2 mi (1.9 km) northwest of Datil; type section is on northeast side of White House Canyon across US–60 from Datil Well Campground; NW¼SW¼ sec. 2, T. 2 S., R. 10 W., Datil 7½-min quadrangle. (3) Lopez, 1975; Bornhorst, 1976; and Lopez and Bornhorst, 1979. (4) Rhyolite ash-flow tuff, moderately crystal rich; thin but relatively continuous in Datil Mountains; absent to east except for a few isolated remnants. (5) 36.7 m.y., average of a zircon fission-track date and a K-Ar sanidine date (Bornhorst and others, 1982). (6) Above Dog Springs Member of Spears Formation; below Rock House Canyon Tuff; interbedded with Chavez Canyon Member of Spears Formation. (7) Unknown. (8) Petrographically similar to, and possibly correlative with, a tuff in the northern Jornada del Muerto. See appropriate stratigraphic column.

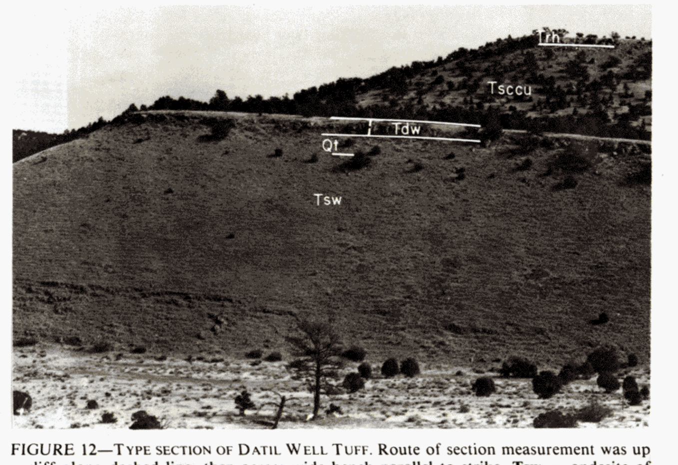

FIGURE 12—Type section of Datil Well Tuff. Route of section measurement was up cliff along dashed line, then across wide bench parallel to strike. **Tsw** = andesite of White House Canyon (informal member of Spears Formation), **Qt** = talus, **Tdw** = Datil Well Tuff, **Tsccu** = upper part of Chavez Canyon Member of Spears Formation, **Trh** = Rock House Canyon Tuff.

Deep Well, basaltic andesite of
(1) Datil Mountains and northwest Gallinas Mountains. (2) Outcrops near Deep Well windmill in northeast Datil Mountains, approximately 11 mi (17 km) northeast of Datil and 4 mi (6.4 km) due west of North Lake; sec. 6, T. 1 S., R. 8 W., unsurveyed, Dog Springs 7½-min quadrangle. (3) New name. (4) Basaltic-andesite lava flows, thin and discontinuous. (5) 30.9 ± 1.5 m.y. K-Ar whole-rock date. (6) Above La Jencia Tuff; below Vicks Peak Tuff. (7) Unknown. (8) Formerly called basaltic andesite of Twin Peaks by Lopez (1975), Lopez and Bornhorst (1979), Harrison (1980), and Coffin (1981). Stratigraphically equivalent to a tongue of La Jara Peak Basaltic Andesite but not considered here as part of La Jara Peak because of geographic separation.

Dog Springs Member of the Spears Formation of the Datil Group
(1) Datil Mountains and northwest Gallinas Mountains. (2) Dog Springs Canyon in the northwest Gallinas Mountains, approximately 20 mi (32 km) northeast of Datil; S½, T. 2 N., R. 8 W., and north edge of T. 1 N., R. 8 W., unsurveyed, D Cross and Dog Springs 7½-min quadrangles. (3) Harrison, 1980; and Coffin, 1981. (4) Mudflow breccias, volcaniclastic rocks, and autobrecciated intrusive rocks of andesite to quartz-latite composition; includes numerous exotic blocks of Paleozoic limestones and autobrecciated Tertiary volcanic rocks; minor tuffaceous lacustrine rocks. (5) 39.6 ± 1.5 m.y. K-Ar date on biotite from a quartz-latite clast in lower part; 38.6 ± 1.5 m.y. zircon fission-track date on an andesite clast (Bornhorst and others, 1982). (6) Above Baca Formation; below lower interval of Chavez Canyon Member of Spears Formation. (7) Unknown except for local intrusives. (8) Andesite breccia and conglomerate unit of Spears Formation (Lopez and Bornhorst, 1979).

Dry Lake Canyon, fanglomerate of, member of the Popotosa Formation
(1) Mulligan Gulch graben between Bear Mountains and Gallinas Mountains. (2) Dry Lake Canyon, approximately 8 mi (13 km) northwest of Magdalena; T. 1 S., R. 5 W., unsurveyed, Silver Hill 7½-min quadrangle. (3) Brown, 1972; and Chapin and Seager, 1975. (4) Fanglomerate composed mainly of clasts derived from La Jara Peak Basaltic Andesite. (5) Not dated. (6) Above La Jara Peak Basaltic Andesite and an older facies of the Popotosa Formation; below Tertiary–Quaternary piedmont gravels. (7) N/A.

Goat Springs, tuff of [OBSOLETE]
(2) Goat Springs, approximately 5 mi (8 km) north of Magdalena; SE¼ sec. 26, T. 1 S., R. 4 W., Magdalena NW 7½-min quadrangle. (3) Brown, 1972. (9) Name abandoned by Deal (1973) and Simon (1973) in favor of Hells Mesa Tuff (restricted sense).

Granite Mountain, tuff of
(1) Magdalena, Lemitar, and Gallinas Mountains and Tres Montosas area. (2) East slope of Granite Mountain, approximately 1 mi (1.6 km) northeast of Magdalena; secs. 12, 13, T. 2 S., R. 4 W., Magdalena NW 7½-min quadrangle. (3) Wilkinson, 1976. (4) Crystal-rich, quartz-latite ash-flow tuff; thick locally but of restricted lateral extent. (5) Not dated. (6) Interbedded in uppermost part or overlying the Spears Formation; overlain by Hells Mesa Tuff. (7) Unknown. (8) None. (9) Can be confused with, and locally may include, lower quartz-poor parts of the Hells Mesa Tuff.

Gray Hill, tuff of [OBSOLETE]
(2) Gray Hill, approximately 15 mi (24 km) southwest of Magdalena; secs. 22, 27, T. 3 S., R. 6 W., Tres Montosas 7½-min quadrangle. (3) Wilkinson, 1976. (9) Name abandoned in this report because most of unit is now correlated with lower member Lemitar Tuff.

Hardy Ridge, rhyolite of, member of the Luis Lopez Formation
(1) Southwest Magdalena Mountains. (2) Hardy Ridge, the high ridge of the Magdalena Mountains extending south from Langmuir Laboratory along the west side of Sawmill Canyon, approximately 16 mi (26 km) south of Magdalena; secs. 23, 24, 25, 26, 35, 36, T. 4 S., R. 4 W., South Baldy 7½-min quadrangle. (3) Petty, 1979; Bowring, 1980; and Roth, 1980. (4) A thick sequence of rhyolitic lavas and minor poorly welded ash-flow tuffs. (5) Not dated. (6) Above cauldron-facies Hells Mesa Tuff and other members of the Luis Lopez Formation; below Lemitar Tuff. (7) Local vents within the Socorro cauldron. (8) Informal member of the Luis Lopez Formation, the cauldron-fill unit of the Socorro cauldron. (9) Reduced to member status and restricted to rhyolitic units in western Magdalena Mountains upon discovery that the North Baldy and Socorro cauldrons are the same structure, making previous Hardy Ridge unit equivalent to Luis Lopez Formation.

Hells Mesa Tuff
(1) Present throughout northeast Mogollon–Datil volcanic field except southern Chupadera Mountains and northern Jornada del Muerto. (2) Hells Mesa in northeast Bear Mountains; type section approximately 17 mi (27 km) north-northwest of Magdalena and approximately 3.6 mi (5.7 km) northwest of Hells Mesa; center of side common to sec. 36, T. 2 N., R. 5 W. and sec. 31, T. 2 N., R. 4 W., Mesa Cencerro 7½-min quadrangle. (3) Tonking, 1957; Deal, 1973; Simon, 1973; Chapin and Seager, 1975; Deal and Rhodes, 1976; and Lopez and Bornhorst, 1979. (4) Quartz-latite to rhyolite ash-flow tuff, thick and continuous. (5) 33.1 m.y., average of several K-Ar biotite dates. (6) Above all units of Datil Group; below La Jencia Tuff; overlain by volcaniclastic rocks of South Crosby Peak Formation in Datil area. (7) Socorro cauldron. (8) As originally defined by Tonking (1957), the Hells Mesa Member of the Datil Formation included all rhyolitic rocks between the Spears and La Jara Peak Members of the Datil Formation. Givens (1957) divided the Hells Mesa Member into seven units [Tdh₁ through Tdh₇]. Chapin (1971) raised the Hells Mesa to formation status. Brown (1972) divided the Hells Mesa Formation into a basal tuff of Goat Springs, a medial tuff of Bear Springs, and an upper tuff of Allen Well. Deal (1973) and Simon (1973) restricted the term Hells Mesa to the basal crystal-rich, quartz-rich ash-flow cooling unit of Tonking's Hells Mesa Member. This restricted definition has worked well and is retained here. Correlates with tuff of Rock Tank and tuff of Ary Ranch of Lopez and Bornhorst (1979). (9) The Hells Mesa Tuff is one of the thickest and most widespread ash-flow sheets of the Mogollon–Datil volcanic field. It also marks a compositional boundary in that rocks older than Hells Mesa tend to be intermediate in composition and lack quartz phenocrysts, whereas ash-flow tuffs of Hells Mesa and younger age tend to contain phenocrystic quartz.

FIGURE 13—Type section of Hells Mesa Tuff. Dashed line shows route of section measurement. **Ts** = Spears Formation, **Thm** = Hells Mesa Tuff, **Tj** = La Jencia Tuff, **Tvp** = Vicks Peak Tuff.

Hidden Spring, basaltic andesite of [OBSOLETE]
(2) Hidden Spring in Crosby Mountains, approximately 6 mi (10 km) west of Datil; secs. 1, 2, T. 2 S., R. 11 W.; sec. 18, T. 2 S., R. 10 W., Crosby Springs 7½-min quadrangle. (3) Bornhorst, 1976; and Lopez and Bornhorst, 1979. (9) Abandoned in this report because unit is stratigraphic equivalent of basaltic andesites of Deep Well (Twin Peaks) and Crosby Mountains. Miscorrelation of the tuff capping mesas in SE¼ sec. 2, T. 2 S., R. 11 W. and SE¼ sec. 18, T. 2 S., R. 11 W. with their A-L Peak Tuff (Vicks Peak Tuff as used in this report) caused Lopez and Bornhorst (1979) to add an extra basaltic andesite unit to their stratigraphic column.

Highway Sixty, rhyolitic lavas of [OBSOLETE]
(2) US–60, approximately 6 mi (10 km) southwest of Socorro; sec. 32, T. 3 S., R. 1 W.; sec. 6, T. 4 S., R. 1 W., Socorro 7½-min quadrangle. (3) Chamberlin, 1980. (9) Name abandoned in this report because Highway Sixty is not sufficiently site specific. These rhyolitic lavas, domes, and minor pyroclastic rocks are part of the Luis Lopez Formation and are now included as a tongue of the rhyolitic lavas of Cook Spring.

Kelly Ranch, basalt of, member of the Popotosa Formation
(1) Rio Grande valley just north of Socorro Peak. (2) J. B. Kelly Ranch, approximately 5 mi (8 km) northwest of Socorro; secs. 20, 29, 30, T. 2 S., R. 1 W., Socorro 7½-min quadrangle. (3) Chamberlin, 1980, 1981. (4) Basalt flows, thin and discontinuous. (5) 9.3 ± 0.5 m.y. K-Ar whole-rock date is probably too young. (6) Interbedded in the playa facies of the Popotosa Formation; stratigraphically below a tuff horizon believed to have come from the Strawberry Peak dome and dated at 11.9 ± 0.8 m.y. (Kim Manley, unpublished fission-track date on zircon 1980). (7) Unknown but local. (8) None.

La Jara Peak Basaltic Andesite
(1) Major shield volcano in Bear Mountains with equivalent flows present across the northern edge of the Mogollon–Datil volcanic field from the Datil Mountains to the Joyita Hills. (2) La Jara Peak, a basaltic neck approximately 20 mi (32 km) north-northwest of Magdalena and approximately 2.5 mi (4 km) north of the Bear Mountains; the type section (Tonking, 1957) is approximately 3 mi (5 km) south-southwest of La Jara Peak; sec. 27, T. 2 N., R. 5 W., Mesa Cencerro 7½-min quadrangle. (3) Tonking, 1957; Chapin, 1971; Brown, 1972; Chapin and Seager, 1975; and Chapin and others, 1978, 1979. (4) Lava flows and dikes ranging from alkali basalt to andesite but predominantly basaltic andesite, thick and continuous. (5) Age ranges from about 31 to 24 m.y. on the basis of nine K-Ar whole-rock dates on flows and dikes and on the age range of ash-flow sheets that are interbedded with tongues of La Jara Peak. (6) Tongues of La Jara Peak Basaltic Andesite occur between La Jencia Tuff and Vicks Peak Tuff [Tlpa], between Vicks Peak Tuff and Lemitar Tuff [Tlpb], between Lemitar Tuff and South Canyon Tuff [Tlpc], and above South Canyon Tuff [Tlpd]. The uppermost tongue is sometimes interbedded with bolson sediments of the basal Popotosa Formation. (7) Major shield volcano and dike swarm in the Bear Mountains–Riley area, smaller volcano at Cerritos de las Minas east of Lemitar Mountains, and widely scattered local vents probable. (8) Named La Jara Peak Member of Datil Formation by Tonking (1957); separated from Datil Formation by Willard (1959); raised to formation status by Chapin (1971); tongues of La Jara Peak have been given informal local names by various authors, such as andesite of Rosa de Castillo (Spradlin, 1976). (9) The basaltic neck after which La Jara Peak Basaltic Andesite was named is a Pliocene feature (3.6 ± 0.2 m.y. K-Ar whole-rock date) completely unrelated to the late Oligocene–early Miocene basaltic andesites. This is unfortunate, but because the name is so well established and so few features are named on maps of that area, we have decided to retain it.

La Jencia Creek, tuff of [OBSOLETE]
(2) La Jencia Creek, approximately 3 mi (5 km) northwest of Magdalena; secs. 9, 16, T. 2 S., R. 4 W., Silver Hill 7½-min quadrangle. (3) Simon, 1973. (9) Abandoned in this report because outcrops were found to be Lemitar Tuff.

La Jencia Tuff
(1) Present throughout the northeast Mogollon–Datil volcanic field. (2) La Jencia Basin; good exposures are present along both sides of the basin in the Bear and Lemitar Mountains; type section is in southern Bear Mountains approximately 6.5 mi (10.5 km) north of Magdalena; NW¼ sec. 22, T. 1 S., R. 4 W., Magdalena NW 7½-min quadrangle. See Brown (1972) for measured section. (3) Middle part of Tonking's (1957) Hells Mesa Member of Datil Formation; lower part of tuff of Bear Springs of Brown (1972); later miscorrelated with tuffs on A-L Peak in the San Mateo Mountains by Deal (1973), and Chapin and Deal (1976), and widely referred to as the lower member of the A-L Peak by other authors. (4) Rhyolite ash-flow tuffs, crystal-poor. (5) About 31 m.y. as evidenced by a 30.9 ± 1.5 m.y. K-Ar whole-rock date on the basaltic andesite of Deep Well (Twin Peaks) that overlies the unit; age also constrained by 33.1 m.y. age of underlying Hells Mesa Tuff and 30.2 ± 1.1 m.y. K-Ar biotite date on tuff of Caronita Canyon and 29.7 ± 1.1 m.y. biotite date on a bedded tuff, both of which are in cauldron fill of Sawmill Canyon cauldron from which La Jencia Tuff was erupted. (6) Above Hells Mesa Tuff; below Vicks Peak Tuff; interbedded with tongues of La Jara Peak Basaltic Andesite. (7) Erupted from contemporaneous Sawmill Canyon and Magdalena cauldrons. (8) Outflow sheet is correlative with the original type section of Brown's (1972) lower unit of the tuff of Bear Springs and with the middle part of Tonking's (1957) Hells Mesa Member of the Datil Formation. La Jencia Tuff is not present on nor near A-L Peak, which is made up of a thick section of South Canyon Tuff. Hence, the term A-L Peak has been abandoned for this stratigraphic interval.

Landavaso Reservoir, andesite of, member of the Sawmill Canyon Formation
(1) Magdalena area. (2) Landavaso Reservoir, approximately 4 mi (6 km) southwest of Magdalena; sec. 36, T. 2 S., R. 5 W., Arroyo Landavaso 7½-min quadrangle. (3) Simon, 1973; Chapin and Seager, 1975; and Wilkinson, 1976. (4) Andesite flows of variable composition and character. (5) Not dated. (6) Above La Jencia Tuff; below Lemitar Tuff. (7) Local vents within the Sawmill Canyon and Magdalena cauldrons. (8) Informal member of Sawmill Canyon Formation, the cauldron-fill unit of the contemporaneous Sawmill Canyon and Magdalena cauldrons. (9) Some outcrops originally mapped as Landavaso Reservoir by Chamberlin (1974) and possibly the westernmost outcrops mapped as Landavaso Reservoir by Wilkinson (1976) are a similar but much younger stratigraphic unit now called the andesite of Lion Mountain.

Lemitar Tuff
(1) San Mateo, Magdalena, Lemitar, and Chupadera Mountains, Joyita Hills and northern Jornada del Muerto; missing in Bear, Gallinas, and Datil Mountains. (2) Lemitar Mountains, approximately 8 mi (13 km) northwest of Socorro; NW¼SE¼SE¼ sec. 12, T. 2 S., R. 2 W., Lemitar 7½-min quadrangle. (3) Osburn, 1978; and Chapin and others, 1978. See Chamberlin (1980) for type section. (4) Rhyolite ash-flow tuffs; crystal-poor lower member grades upward to crystal-rich upper member; thick and continuous. (5) 28.4 m.y., average of four K-Ar biotite dates. (6) Above Vicks Peak Tuff; below South Canyon Tuff; underlain and overlain by tongues of La Jara Peak Basaltic Andesite on outflow sheet. Above Sawmill Canyon Formation in Sawmill Canyon and Magdalena cauldrons where Vicks Peak Tuff is apparently absent. (7) Probably a cauldron in the northern San Mateo Mountains. (8) Part of Potato Canyon Rhyolite of Deal (1973), tuff of Allen Well (Brown, 1972; and Simon, 1973), tuff of La Jencia Creek (Simon, 1973), and part of upper tuffs (Simon, 1973); not present at type section of Tonking's (1957) Hells Mesa Member of Datil Formation.

Lion Mountain, andesite of
(1) Western edge of Gallinas Mountains from US–60 north for approximately 9 mi (14.5 km). (2) Lion Mountain, approximately 16 mi (26 km) east-northeast of Datil; secs. 34, 35, T. 1 S., R. 7 W., unsurveyed, Lion Mountain 7½-min quadrangle. (3) Osburn and Laroche, 1982. (4) Porphyritic andesite lavas; thick local flows. (5) Not dated. (6) Overlies South Canyon Tuff; unconstrained upper contact. (7) Local sources. (8) Correlates with andesite of Landavaso Reservoir of Chamberlin (1974) and perhaps with westernmost outcrops of Landavaso Reservoir of Wilkinson (1976). (9) Similar in lithology to turkey-track andesites in the Spears Formation.

Luis Lopez Formation
(1) Socorro Peak and Chupadera and Magdalena Mountains. (2) Luis Lopez manganese district, approximately 11 mi (18 km) southwest of Socorro and 7 mi (11 km) southwest of the village of Luis Lopez; secs. 20, 29, 31, 32, T. 4 S., R. 1 W.; secs. 4, 5, 6, 8, 9, T. 5 S., R. 1 W., Luis Lopez 7½-min quadrangle. (3) Chapin and others, 1978; Chamberlin, 1980, 1981; and Eggleston, 1982. (4) Cauldron-fill unit of Socorro cauldron; includes rhyolite domes and flows, local ash-flow tuffs, volcaniclastic rocks, breccias, andesite flows, and intrusives; very thick but restricted to Socorro cauldron and immediate vicinity. (5) Not dated. (6) Above Hells Mesa Tuff; below La Jencia Tuff. (7) Local vents in Socorro cauldron. (8) Unit of Hardy Ridge (Petty, 1979; Bowring, 1980; and Roth, 1980); Luis Lopez Formation placed too high in section by Chapin and others (1978) and Chamberlin (1980) because of miscorrelation of cauldron-facies Hells Mesa Tuff with upper member Lemitar Tuff.

Madera Canyon, basalt of, member of the Popotosa Formation
(1) Eastern Magdalena Mountains. (2) Madera Canyon, approximately 13 mi (21 km) southwest of Socorro; sec. 21, T. 4 S., R. 2 W., Molino Peak 7½-min quadrangle. (3) Osburn and others, 1981. (4) Basaltic lava flows, thin to thick, discontinuous, local. (5) Not dated. (6) Above South Canyon Tuff; below rhyolite of Pound Ranch, Socorro Peak Rhyolite. (7) Unknown but local. (8) None.

Magdalena Peak Rhyolite of the Santa Fe Group
(1) West flank of Magdalena Range. (2) Magdalena Peak, approximately 1.25–5 mi (2–8 km) south of Magdalena; sec. 34, T. 2 S., R. 4 W.; secs. 2, 3, 10, 11, 14, 15, T. 3 S., R. 4 W., Magdalena SW 7½-min quadrangle. (3) Allen, 1979; Bowring, 1980; Donze, 1980; Bobrow, 1983; and Bobrow and others, 1983. (4) Rhyolite domes and flows; thick and continuous for approximately 10 mi (16 km). (5) 14.8 m.y., average of two K-Ar biotite dates. (6) Above fanglomerates of Popotosa Formation; erosional top. (7) Magdalena Peak; other vents may be found. (8) None. (9) Similar in age and petrographic character to Pound Ranch and Socorro Peak rhyolites.

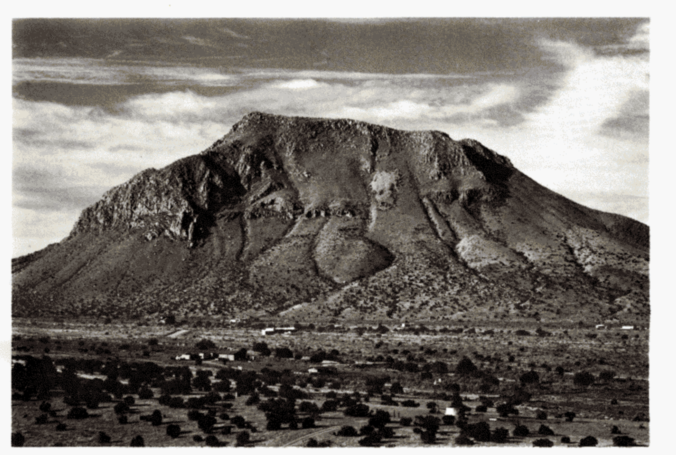

FIGURE 14—Magdalena Peak, type area for Magdalena Peak Rhyolite. A plug of intrusive rhyolite fills the former vent and forms the rugged nonlayered area on the left (SE) shoulder. The prominent ledge to the right (NW) of the vent is well-indurated pyroclastic material from an early violent stage of the eruptions. The upper third of the mountain consists of rhyolitic lavas, which piled up around the vent; silicic lavas from this vent also flowed several miles to the south to form one of the larger rhyolite lava fields in New Mexico.

Main Canyon, tuff of [OBSOLETE]
(2) Main Canyon in Datil Mountains, approximately 6 mi (10 km) north of Datil; secs. 1, 12, T. 1 S., R. 10 W., Datil 7½-min quadrangle. (3) Lopez, 1975; and Lopez and Bornhorst, 1979. (9) Abandoned here in favor of Rock House Canyon Tuff because name preempted by prior use elsewhere.

Nipple Mountain, tuff of [OBSOLETE]
(2) Nipple Mountain, approximately 4 mi (6 km) northeast of Magdalena; sec. 1, T. 2 S., R. 4 W., Magdalena NW 7½-min quadrangle. (3) Brown, 1972; Chamberlin, 1974; and Wilkinson, 1976. (9) Abandoned here in favor of Rock House Canyon Tuff because relationships are better exposed in Rock House Canyon.

Piñon Well, rhyolite of
(1) Southwest Gallinas Mountains. Occurs from US–60 north for approximately 5 mi (8 km). (2) Piñon well, approximately 20 mi (32 km) west of Magdalena; sec. 8, T. 1 S., R. 6 W., unsurveyed, Gallinas Peak 7½-min quadrangle. (3) Osburn and Laroche, 1982. (4) Quartz-latite to rhyolite lavas; local unit. (5) Not dated. (6) Overlies La Jencia Tuff (inferred since contact nowhere exposed) and overlain by South Canyon Tuff. (7) Local vents. (8) Correlative in age with Sawmill Canyon Formation. (9) Similar in mineralogy to La Jencia Tuff.

Popotosa Formation of the Santa Fe Group
(1) Socorro–Magdalena area. (2) Cañada Popotosa, a tributary of the Rio Salado that drains the southeast side of the Ladron Mountains, approximately 22 mi (35 km) northwest of Socorro; T. 2 N., R. 2 W., unsurveyed, San Acacia 7½-min quadrangle. (3) Denny, 1940; Bruning, 1973; Chapin and Seager, 1975; Machette, 1978; Chapin and others, 1978; and Chamberlin, 1980. (4) Bolson deposits ranging from fanglomerates to playa mudstones; volcanic clasts predominate; interbedded volcanic rocks; thick and continuous. (5) Age ranges from about 27 m.y. to about 7 m.y. as evidenced by flows of La Jara Peak Basaltic Andesite, dated at 27.0 and 27.3 m.y., that are interbedded with basal Popotosa and by rhyolitic domes and flows as young as 7 m.y. that are interbedded with upper Popotosa in Socorro Peak area. (6) Generally above South Canyon Tuff, although Popotosa-like sediments occur beneath the South Canyon Tuff in the northern Gallinas Mountains; below upper beds of Santa Fe Group and below Sierra Ladrones Formation (Machette, 1978); interbedded with La Jara Peak Basaltic Andesite at base; also interlayered with two major volcanic units of formation rank, the Socorro Peak Rhyolite and the Magdalena Peak Rhyolite; and including as members several other volcanic and volcaniclastic units of local extent. These are the unit of Arroyo Montosa, the fanglomerate of Dry Lake Canyon, the rhyolite of Water Canyon Mesa, the basaltic andesite of Council Rock, the basalt of Kelly Ranch, and the basalt of Bear Canyon. Other volcanic units, including the basalt of Broken Tank and the basalt of Sedillo Hill, are of uncertain age but may be within the age span of the Popotosa Formation. (7) N/A. (8) Late Oligocene to late Miocene basal portion of Santa Fe Group; commonly lumped with other Santa Fe units as Santa Fe undifferentiated; miscorrelated with Spears Formation by DeBrine and others (1963).

Potato Canyon Rhyolite Tuff [OBSOLETE]
(2) Potato Canyon in northern San Mateo Mountains, approximately 20 mi (32 km) southwest of Magdalena; sec. 12, T. 5 S., R. 6 W., Mount Withington 7½-min quadrangle. (3) Deal, 1973; Deal and Rhodes, 1976; Chapin and Seager, 1975; and Wilkinson, 1976. (9) Abandoned in this report because unit is mixture of South Canyon Tuff, Lemitar Tuff, La Jencia Tuff, Hells Mesa Tuff, and tuff of Caronita Canyon. The type locality contains South Canyon Tuff; the other units were miscorrelated with this unit in other parts of the San Mateo Mountains.

Pound Ranch, rhyolite of, member of the Socorro Peak Rhyolite
(1) Eastern Magdalena Mountains. (2) Pound (Gianero) Ranch, approximately 12 mi (19 km) southwest of Socorro; secs. 3, 4, 9, 10, 15, 16, T. 4 S., R. 2 W., Molino Peak 7½-min quadrangle. (3) Osburn, 1978; Petty, 1979; Chapin and others, 1978; and Chamberlin, 1980. (4) Rhyolite flows, domes, and minor tuffs; thick but local. (5) Lower flow, 12.1 ± 0.5 m.y. K-Ar biotite date; upper flow, 10.8 ± 0.4 m.y. K-Ar biotite date. (6) Unconformably above South Canyon Tuff, basalt of Madera Canyon, and lower Popotosa fanglomerates and mudflow deposits; below upper Popotosa playa mudstones. (7) Local vents. (8) Similar in age and lithology to some flows of Socorro Peak Rhyolite; lumped with Socorro Peak Rhyolite by Chapin and others (1978).

Rincon Windmill Member of the Spears Formation
(1) Datil and Gallinas Mountains. (2) Rincon windmill in northeast Datil Mountains, approximately 14 mi (22.5 km) northeast of Datil; type section at NW¼NW¼ sec. 18, T. 1 N., R. 8 W., unsurveyed, Dog Springs 7½-min quadrangle. (3) New name; Harrison, 1980. (4) Volcaniclastic sandstones and conglomerates; widespread fluvial and eolian sandstones at top; thick and widespread. (5) Not dated. (6) Above Rock House Canyon Tuff; below Hells Mesa Tuff. Locally split into two tongues by interbedded Blue Canyon Tuff. (7) N/A. (8) Middle and upper sedimentary units of Lopez (1975), second and third volcanic sedimentary units of Bornhorst (1976), upper part of volcaniclastic sedimentary unit A and volcaniclastic sedimentary unit B of Lopez and Bornhorst (1979), middle sedimentary unit of Harrison (1980), and middle volcaniclastic rocks of Coffin (1981).

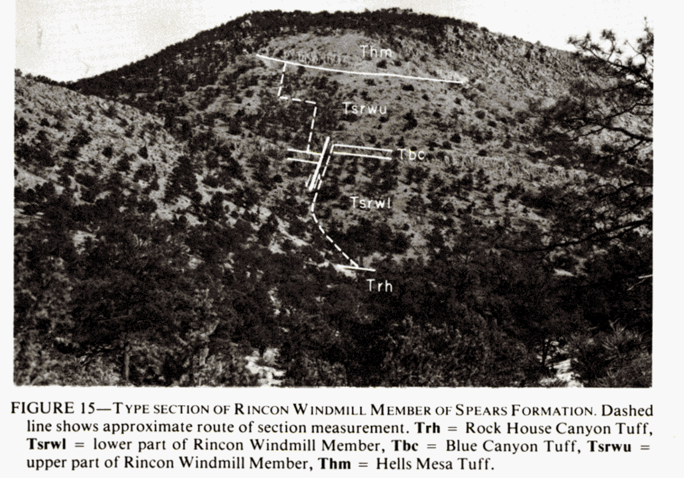

FIGURE 15—Type section of Rincon Windmill Member of Spears Formation. Dashed line shows approximate route of section measurement. **Trh** = Rock House Canyon Tuff, **Tsrwl** = lower part of Rincon Windmill Member, **Tbc** = Blue Canyon Tuff, **Tsrwu** = upper part of Rincon Windmill Member, **Thm** = Hells Mesa Tuff.

Rock House Canyon Tuff of the Datil Group
(1) Datil, Gallinas, Crosby, and Magdalena Mountains and Tres Montosas–Magdalena area. (2) Rock House Canyon in northwest Gallinas Mountains, approximately 15 mi (24 km) northeast of Datil; type section at junction of Rock House Canyon and Long Canyon; SW¼ sec. 13, T. 1 N., R. 8 W., unsurveyed, Dog Springs 7½-min quadrangle. (3) Coffin, 1981. (4) Rhyolite ash-flow tuff, crystal poor; relatively thick and continuous in Datil and Gallinas Mountains and Tres Montosas area; thins to east and is usually absent east of the Magdalena area. (5) Not dated. (6) Above Chavez Canyon Member of Spears Formation; below Rincon Windmill Member of Spears Formation. (7) Unknown. (8) Tuff of Nipple Mountain; tuff of Main Canyon.

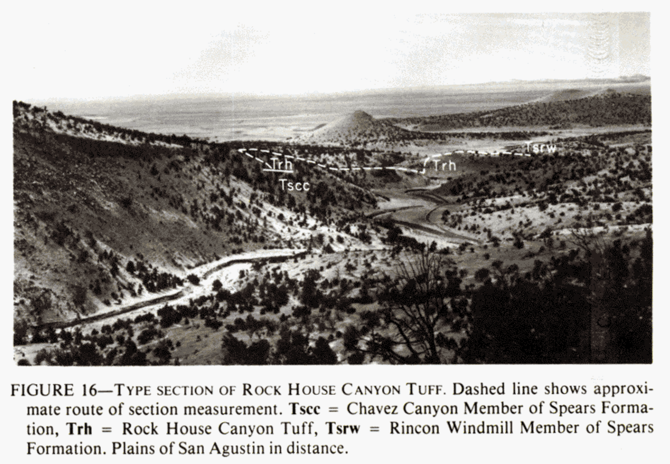

FIGURE 16—Type section of Rock House Canyon Tuff. Dashed line shows approximate route of section measurement. **Tscc** = Chavez Canyon Member of Spears Formation, **Trh** = Rock House Canyon Tuff, **Tsrw** = Rincon Windmill Member of Spears Formation. Plains of San Agustin in distance.

FIGURE 17—Cliffs of Rock House Canyon Tuff at junction of Rock House Canyon and Long Canyon (foreground).

Rock Tank, tuff of [OBSOLETE]
(2) Rock tank in the Crosby Mountains, approximately 7 mi (11 km) southwest of Datil; secs. 35, 36, T. 2 S., R. 11 W.; secs. 1, 2, T. 3 S., R. 11 W., Sugarloaf Mountain 7½-min quadrangle. (3) Bornhorst, 1976; and Lopez and Bornhorst, 1979. (9) Abandoned in this report because unit is correlative with Hells Mesa Tuff. The tuff of Rock Tank and the tuff of Ary Ranch (Lopez and Bornhorst, 1979) are indistinguishable and are part of the outflow sheet of the Hells Mesa Tuff.

Rock Tank Canyon, conglomerate of
(1) Northeast end of Datil Mountains. (2) Rock Tank Canyon, approximately 20 mi (32 km) northeast of Datil and approximately 6 mi (10 km) southeast of D Cross Mountain; T. 2 N., R. 8 W., unsurveyed, D Cross Mountain 7½-min quadrangle. (3) Robinson, 1981. (4) Conglomerates and sandstones, thick but local. (5) Not dated. (6) Above Spears, Baca, and Crevasse Canyon Formations; below Quaternary gravels. (7) N/A. (8) Part of gravel deposits assigned to Santa Fe Formation by Givens (1957); part of Tertiary piedmont deposits of Harrison (1980). (9) Stratigraphic position within Santa Fe Group not known.

Rosa de Castillo, andesite of, tongue of La Jara Peak Basaltic Andesite
(1) Joyita Hills. (2) Arroyo Rosa de Castillo in the Joyita Hills, approximately 12 mi (19 km) north-northeast of Socorro; Sevilleta Grant, T. 1 S., R. 1 E., unsurveyed, Mesa del Yeso 7½-min quadrangle. (3) Spradlin, 1976. (4) Basaltic-andesite lava flows. (5) Not dated. (6) Above Lemitar Tuff; below South Canyon Tuff. (7) Unknown. (8) Equivalent to tongue c of La Jara Peak Basaltic Andesite.

San Acacia, basalt of, member of the Sierra Ladrones Formation
(1) Rio Grande valley. (2) San Acacia, approximately 14 mi (22 km) north of Socorro; T. 1 S., R. 1 E., unsurveyed, San Acacia 7½-min quadrangle. (3) Machette, 1978. (4) Basaltic flows, thin and local. (5) 4.6 ± 0.1 m.y. K-Ar whole-rock date (Bachman and Mehnert, 1978). (6) Interbedded in lowest exposed part of piedmont-slope and alluvial-flat deposits of the Sierra Ladrones Formation. (7) Feeder dike exposed at southwest corner of mesa on north side of Rio Grande. (8) None.

Santa Fe Group
(1) Present in all basins of the northeast Mogollon–Datil volcanic field. (2) Santa Fe, Española Basin. (3) Hayden, 1869; Bryan, 1938; Denny, 1940; Baldwin, 1963; Hawley and others, 1969; Galusha and Blick, 1971; Hawley, 1978; and Machette, 1978. (4) Bolson deposits ranging from fanglomerates to playa mudstones, interbedded volcanic rocks, axial-river deposits of the ancestral Rio Grande, and laterally equivalent piedmont gravels. (5) Late Oligocene to middle Pleistocene. (6) Above South Canyon Tuff and La Jara Peak Basaltic Andesite; below middle Pleistocene to Holocene deposits that postdate the incision of drainage following capture of the Rio Grande at El Paso. (7) N/A. (8) Arbitrary geographic boundary between Santa Fe Group and Gila Formation placed at Continental Divide. (9) The Santa Fe Group is the basin-fill deposits of the Rio Grande rift and adjacent late Cenozoic basins. In the Socorro–Magdalena area, it consists of the very thick and complex Popotosa Formation (Denny, 1940) overlain by the Pliocene to middle Pleistocene Sierra Ladrones Formation (Machette, 1978). We are here defining the Santa Fe Group to include synrift volcanic units, the Magdalena Peak Rhyolite, Socorro Peak Rhyolite, and several local lava flows: basalts of Socorro Canyon, Sedillo Hill, Broken Tank, Bear Canyon, and Kelly Ranch; rhyolite of Water Canyon Mesa; basaltic andesite of Council Rock; fanglomerate of Dry Lake Canyon; and unit of Arroyo Montosa. See *Santa Fe Group* stratigraphic column. The alluvial deposits of the San Agustin Basin and northern Jornada del Muerto Basin are not exposed and have not been studied.

Sawmill Canyon Formation
(1) Magdalena Mountains. (2) Exposures along Sawmill Canyon in the southern Magdalena Mountains, approximately 16 mi (26 km) southeast of Magdalena; secs. 3, 4, 9, 10, 11, 14, 15, T. 5 S., R. 3 W., South Baldy 7½-min quadrangle. (3) Formerly unit of Sixmile Canyon (Osburn, 1978; and Chapin and others, 1978). (4) Complex cauldron-fill unit of the contemporaneous Sawmill Canyon and Magdalena cauldrons; andesite flows, rhyolite flows and domes, exotic blocks, and volcaniclastic rocks; tuff of Caronita Canyon at top. (5) About 31–29 m.y. as evidenced by 31 m.y. age of both basaltic andesite of Deep Well and Vicks Peak Tuff, a 29.7 ± 1.1 m.y. K-Ar biotite date on a bedded tuff within the cauldron fill, and a 30.2 ± 1.1 m.y. K-Ar biotite date on tuff of Caronita Canyon at the top of the cauldron fill. (6) Above La Jencia Tuff; below Lemitar Tuff. (7) Local vents in Sawmill Canyon and Magdalena cauldrons. (8) Unit of Sixmile Canyon. Informal members include andesite of Landavaso Reservoir and tuff of Caronita Canyon. Name Sawmill Canyon Formation used by Krewedl (1974) for La Jencia Tuff of this report.

Sawmill Canyon, unit of [OBSOLETE]
(2) Sawmill Canyon in the southern Magdalena Mountains, approximately 18 mi (29 km) south of Magdalena; secs. 30, 31, 32, T. 4 S., R. 3 W.; sec. 5, T. 5 S., R. 3 W., South Baldy 7½-min quadrangle. (3) Roth, 1980; and Donze, 1980. (9) Name abandoned in this report because of duplication with Sawmill Canyon Formation (new name). The rhyolite intrusives and pyroclastic deposits for which Roth and Donze used the term unit of Sawmill Canyon are local rocks that will be given a different informal name when mapping of the southern Magdalena Range is completed.

Sedillo Hill, basalt of
(1) Socorro Peak area. (2) Sedillo Hill on US–60, approximately 9 mi (14 km) southwest of Socorro; secs. 14, 15, 23, 26, T. 3 S., R. 2 W., Magdalena SE 7½-min quadrangle. (3) Chapin and others, 1978; and Chamberlin, 1980, 1981. (4) Basaltic lava flows, thin and local. (5) Not dated. (6) Above playa claystone facies of Popotosa Formation; below piedmont gravels of La Jencia Basin, which are probably equivalent to Sierra Ladrones Formation. (7) Two local vents. (8) Previously correlated (Chapin and others, 1978; and Chamberlin, 1980, 1981) with basalt of Socorro Canyon, but this correlation is now in doubt. (9) Because of reservations about the above correlation, we have given the basalt flows on Black Mountain the informal designation basalt of Socorro Canyon until further work can prove or disprove the correlation.

Sierra Ladrones Formation of the Santa Fe Group
(1) Rio Grande valley. (2) Exposures in the Sierra Ladrones (low foothills east and southeast of the Ladron Mountains), approximately 25 mi (40 km) north-northwest of Socorro; T. 1, 2 N., R. 1, 2 W., unsurveyed, San Acacia 7½-min quadrangle. (3) Machette, 1978; Chapin and others, 1978; and Chamberlin, 1980. (4) Axial-river sands of the ancestral Rio Grande plus related floodplain, piedmont, and alluvial-fan deposits; thick and continuous along Rio Grande valley. (5) Early Pliocene to middle Pleistocene based on K-Ar ages of interbedded basalts, vertebrate fossils, and soils data (Machette, 1978). (6) Above Popotosa Formation; below middle Pleistocene to Holocene deposits that postdate incision of the ancestral Rio Grande deposits. (7) N/A. (8) Upper formation of Santa Fe Group.

Sixmile Canyon andesite [OBSOLETE]
(2) Sixmile Canyon in eastern Magdalena Mountains, approximately 11 mi (18 km) southeast of Magdalena; sec. 4, T. 4 S., R. 3 W., unsurveyed, South Baldy 7½-min quadrangle. (3) Krewedl, 1974. (9) Name changed by Osburn (1978) and Chapin and others (1978) to unit of Sixmile Canyon to include all postcollapse cauldron-fill units of the Sawmill Canyon cauldron. Name abandoned here in favor of Sawmill Canyon Formation.

Sixmile Canyon, unit of [OBSOLETE]
(2) Sixmile Canyon in eastern Magdalena Mountains, approximately 11 mi (18 km) southeast of Magdalena; secs. 3, 10, T. 4 S., R. 3 W., unsurveyed, South Baldy 7½-min quadrangle. (3) Osburn, 1978; and Chapin and others, 1978. (9) Abandoned in this report in favor of Sawmill Canyon Formation because of better exposures and a more representative cross section of the cauldron-fill stratigraphy in the Sawmill Canyon cauldron and because the name has been preempted by prior use elsewhere.

Socorro Canyon, basalt of, member of the Sierra Ladrones Formation
(1) Socorro Peak area. (2) Socorro Canyon, approximately 6 mi (10 km) southwest of Socorro; secs. 27, 30, T. 3 S., R. 1 W., Socorro 7½-min quadrangle. (3) Previously called basalt of Sedillo Hill (Chapin and others, 1978; and Chamberlin, 1980, 1981) or "basalt flow, Black Mountain, Socorro Canyon" (Bachman and Mehnert, 1978). (4) Basalt flows, thin and local. (5) 4.1 ± 0.3 m.y. K-Ar whole-rock date (Bachman and Mehnert, 1978). (6) Above playa claystone facies of Popotosa Formation; above axial-stream deposits (ancestral Rio Grande) of Sierra Ladrones Formation; below piedmont gravels of Sierra Ladrones Formation. (7) Unknown; source previously thought to be vents at Sedillo Hill, but this correlation is uncertain. (8) Basalt of Sedillo Hill(?).

Socorro Peak Rhyolite of the Santa Fe Group
(1) Socorro Peak and vicinity. (2) Socorro Peak, approximately 3 mi (5 km) west and southwest of Socorro; secs. 5, 8, 16, 17, 21, 28, T. 3 S., R. 1 W., Socorro 7½-min quadrangle. (3) Chapin and others, 1978; and Chamberlin, 1980, 1981. (4) Rhyodacite to rhyolite domes and flows with minor pyroclastic rocks, thick but local. (5) About 12–7 m.y. as evidenced by several K-Ar dates. (6) Above Popotosa fanglomerate and playa deposits; interbedded with upper Popotosa playa mudstones. Includes rhyolite of Pound Ranch. (7) Numerous vents in Socorro Peak area. (8) Similar petrographically but slightly younger than Magdalena Peak Rhyolite.

South Baldy Peak andesite [OBSOLETE]
(2) South Baldy, the highest peak in the Magdalena Range, approximately 10 mi (16 km) south of Magdalena; sec. 6, T. 4 S., R. 3 W., South Baldy 7½-min quadrangle. (3) Krewedl, 1974. (9) Name abandoned in this report because unit as defined included andesites of the Sawmill Canyon Formation (eastern two thirds of outcrop area) and andesites above South Canyon Tuff, which are probably correlative with tongue d of La Jara Peak Basaltic Andesite (western one third of area).

South Canyon Tuff
(1) Present throughout the northeast Mogollon–Datil volcanic field except in the Datil area, the northern Gallinas Mountains, and the Bear Mountains. (2) Mouth of South Canyon in the eastern Magdalena Mountains, approximately 12 mi (19 km) southwest of Socorro; type section at SW¼ sec. 30, T. 3 S., R. 2 W., Magdalena SE 7½-min quadrangle. (3) Osburn, 1978; and Chapin and others, 1978. (4) Rhyolite ash-flow tuffs, crystal poor to moderately crystal rich, thick and continuous. (5) 26.7 m.y., average of two K-Ar dates on biotite. (6) Above Lemitar Tuff and tongue c of La Jara Peak Basaltic Andesite; youngest major ash-flow sheet of the northeast Mogollon–Datil volcanic field; below Popotosa Formation, unit of Arroyo Montosa, and basalt of Madera Canyon. (7) Unknown but probably in northern San Mateo Mountains. (8) Part of upper tuffs of Simon (1973); part of Potato Canyon Tuff of Deal (1973), Deal and Rhodes (1976), Chapin and Seager (1975), Spradlin (1976), and Wilkinson (1976); part of A-L Peak Tuff of Chamberlin (1974).

South Crosby Peak Formation
(1) Crosby and Datil Mountains; thin deposits of similar material present as far east as the northern Jornada del Muerto. (2) South Crosby Peak, approximately 4.3 mi (7 km) southwest of Datil; type section approximately 1.8 mi (3 km) northeast of South Crosby Peak; NE¼ sec. 19, T. 2 S., R. 10 W., Sugarloaf Mountain 7½-min quadrangle. (3) Lopez, 1975; Bornhorst, 1976; Lopez and Bornhorst, 1979; Harrison, 1980; and Coffin, 1981. (4) Interbedded volcaniclastic sedimentary rocks and air-fall and reworked tuffs; poorly welded, lithic-rich rhyodacite to rhyolite ash-flow tuffs; thick in Crosby Mountains but thins rapidly northeastward in Datil Mountains; present as thin, discontinuous lenses at base of La Jencia Tuff in Magdalena area and northern Jornada del Muerto. (5) Not dated. (6) Above Hells Mesa Tuff; below La Jencia Tuff. Lower part of unit miscorrelated by Lopez and Bornhorst (1979) with upper part of Spears Formation. The tuff of Ary Ranch (Hells Mesa Tuff) is not interbedded with the South Crosby Peak Formation as described by these authors. (7) Unknown. (8) Tuff of Crosby Mountain (Lopez, 1975); volcaniclastic rocks of South Crosby Peak (Lopez and Bornhorst, 1979).

FIGURE 18—Type section of South Crosby Peak Formation. Dashed line shows approximate route of section measurement. **Tscp** = South Crosby Peak Formation, **Tdb** = basaltic andesite of Deep Well.

Spears Formation of the Datil Group
(1) Present throughout northeast Mogollon–Datil volcanic field. (2) Spears Ranch on northeast side of Bear Mountains, approximately 14 mi (22 km) north of Magdalena; secs. 8, 17, T. 1 N., R. 4 W., Mesa Cencerro 7½-min quadrangle. (3) Spears Member of Datil Formation (Tonking, 1957); Spears Formation (Chapin, 1971; Brown, 1972; Chamberlin, 1974; Wilkinson, 1976; Spradlin, 1976; and Chapin and others, 1978). (4) Volcaniclastic rocks consisting mainly of andesitic to latitic clasts and subordinate lava flows of basaltic andesite to dacite composition. (5) About 39–33 m.y. as evidenced by several K-Ar and fission-track dates and the age of the overlying Hells Mesa Tuff. (6) Above Baca Formation (Eocene); below Hells Mesa Tuff. As used here, the Spears Formation includes all volcaniclastic rocks and lava flows between the underlying Baca Formation and the overlying Hells Mesa Tuff. In the Datil and Gallinas Mountains, the Spears volcaniclastic rocks have been divided into three members, which, in ascending order, are the Dog Springs, Chavez Canyon, and Rincon Windmill Members. Elsewhere, the Spears Formation has not been split into members. Three regional ash-flow sheets, the Datil Well Tuff, Rock House Canyon Tuff, and Blue Canyon Tuff, are interbedded in the Spears Formation. Together, the Spears Formation and the interbedded ash-flow sheets comprise the Datil Group as defined herein. (7) Vent areas not known except for several intrusives in the Dog Springs Member and an andesitic volcano in the Gallinas Mountains. (8) Spears Member of Datil Formation (Tonking, 1957); Lopez and Bornhorst (1979) used the following terms, from bottom up, to describe various units within the Spears: andesite breccia and conglomerate unit, andesitic flows and volcaniclastic rocks, volcaniclastic sedimentary unit A, volcaniclastic sedimentary unit B.

Timber Peak rhyolite [OBSOLETE]
(2) Timber Peak in central Magdalena Mountains, approximately 11 mi (18 km) south of Magdalena; sec. 9, T. 4 S., R. 3 W., unsurveyed, South Baldy 7½-min quadrangle. (3) Krewedl, 1974. (9) Abandoned here because several different ash-flow tuffs and local lavas were included in this unit.

Twin Peaks, basaltic andesite of [OBSOLETE]
(2) Twin Peaks, approximately 2 mi (3 km) southeast of Datil; secs. 18, 19, T. 2 S., R. 9 W., Datil 7½-min quadrangle. (3) Lopez, 1975; Lopez and Bornhorst, 1979; Harrison, 1980; and Coffin, 1981. (9) Abandoned in this report because overlying Vicks Peak Tuff is not present at type locality. Without this upper constraint these rocks could be correlative with the basaltic andesite of Crosby Mountains. Type section moved to better constrained locality near Deep Well windmill approximately 10 mi (16 km) to the northeast. Unit renamed basaltic andesite of Deep Well.

Vicks Peak Tuff
(1) Southern San Mateo, Datil, Gallinas, Bear, Lemitar, and Magdalena Mountains and the Joyita Hills. Also present in northern Black Range. (2) Vicks Peak, the high point at the south end of the San Mateo Mountains, approximately 42 mi (68 km) south-southwest of Magdalena; secs. 2, 11, T. 9 S., R. 6 W., Vicks Peak 7½-min quadrangle. (3) Rhyolite of Vicks Peak (Furlow, 1965) and Vicks Peak Rhyolite (Farkas, 1969); redefined by Deal and Rhodes (1976). (4) Rhyolite ash-flow tuff, crystal poor, quartz poor. A distinctive tuff in the southern San Mateo Mountains where the cauldron facies and thick proximal facies are very crystal poor and pumice poor with abundant lithophysal cavities. This distinctive facies of the Vicks Peak Tuff thins rapidly north of San Juan Peak in the central San Mateo Mountains and loses most of its lithophysal cavities. To the north, the very crystal poor facies comprises only the basal part of the unit and changes gradationally upward into tuff that contains more crystals and pumice and is very similar in appearance to the underlying La Jencia Tuff. However, the pumice in the Vicks Peak Tuff tends to be larger and usually contains drusy fillings of quartz and other vapor-phase crystals. (5) 31.3 ± 2.6 m.y. zircon fission-track date (Bornhorst and others, 1982). (6) Above La Jencia Tuff; below Lemitar Tuff. (7) Nogal Canyon cauldron. (8) Equivalent to Brown's (1972) upper tuff of Bear Springs, upper part of Tonking's (1957) Hells Mesa Member, upper or pinnacles member of Deal's (1973) A-L Peak Tuff. (9) We considered using upper member La Jencia Tuff for this unit but decided in favor of Vicks Peak Tuff because of historic precedent and because of the distance separating the cauldron sources of La Jencia and Vicks Peak Tuffs. The type section on Vicks Peak is poorly constrained; therefore, Brown's (1972) measured section of the upper tuff of Bear Springs (S½ sec. 22, T. 1 S., R. 4 W., Magdalena NW 7½-min quadrangle) is here declared a principal reference section.

Wahoo Canyon, tuff of [OBSOLETE]
(2) Wahoo Canyon near Dusty in northern Black Range, approximately 36 mi (58 km) south-southeast of Datil; secs. 2, 3, 4, 9, 10, 11, T. 8 S., R. 9 W., Dusty 7½-min quadrangle. (3) Fodor, 1976; and Lopez and Bornhorst, 1979. (9) Abandoned here because type locality consists of La Jencia and Vicks Peak Tuffs. Where mapped in the Datil Mountains by Lopez and Bornhorst (1979), tuff of Wahoo Canyon is the Vicks Peak Tuff.

Water Canyon Mesa, rhyolite of, member of the Popotosa Formation
(1) Eastern Magdalena Range. (2) Water Canyon Mesa, approximately 15 mi (24 km) west of Socorro; secs. 25, 26, 35, 36, T. 3 S., R. 3 W., Magdalena SE 7½-min quadrangle. (3) Osburn, 1978; and Chapin and others, 1978. (4) Silicic lavas and tuffs, thick but local. (5) 20.5 ± 0.8 m.y. K-Ar biotite date. (6) Above interval of mafic to intermediate lavas that overlie South Canyon Tuff; below fanglomerate and mudflow deposits of Popotosa Formation. Basal contact overlies an unconformity cut as deep as the upper Lemitar Tuff. (7) Unknown but local. (8) Water Canyon Mesa lavas (Osburn, 1978).

White House Canyon, andesite of, member of the Spears Formation
(1) Datil Mountains. (2) White House Canyon between 1 and 5 mi (1.6–8 km) northwest of Datil; secs. 29, 32, T. 1 S., R. 10 W., Crosby Springs 7½-min quadrangle. (3) Lopez, 1975; Bornhorst, 1976; and Lopez and Bornhorst, 1979. (4) Porphyritic basaltic-andesite flows with large plagioclase and clinopyroxene phenocrysts, thick but local. (5) Not dated. (6) Above volcaniclastic rocks of Spears Formation; below Datil Well Tuff. (7) Unknown but local. (8) Informal member of Spears Formation.

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