Petrography and age of plutonic rocks of Florida Mountains, New Mexico--Preliminary report

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New Mexico Geology, v. 4, n. 3 pp. 33-38, Print ISSN: 0196-948X, Online ISSN: 2837-6420.
https://doi.org/10.58799/NMG-v4n3.33

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New Mexico GEOLOGY
• Science and Service

Volume 4, No. 3, August 1982

Petrography and age of plutonic rocks of Florida Mountains, New Mexico—preliminary report

by *Russell E. Clemons*, New Mexico State University, Las Cruces, NM

Introduction

The Florida Mountains, southeast of Deming, New Mexico (fig. 1), are part of an east-tilted basin-and-range fault block. Bedrock exposures extend for approximately 10 mi north-south and 5 mi east-west. Elevations range from 4,300 ft to a high of 7,448 ft on Florida Peak. This paper presents partial, preliminary results of an ongoing geologic and mineral-resources study of the region.

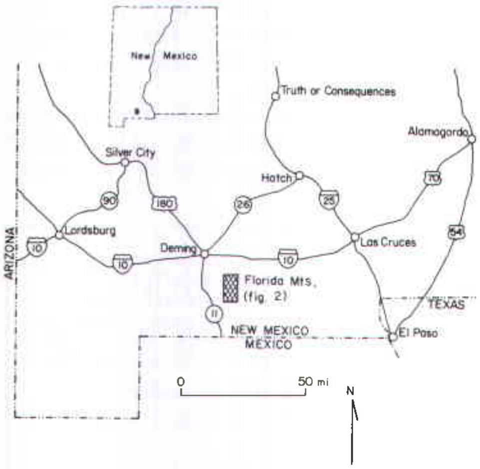

FIGURE 1—INDEX MAP OF STUDY AREA IN SOUTHWEST NEW MEXICO.

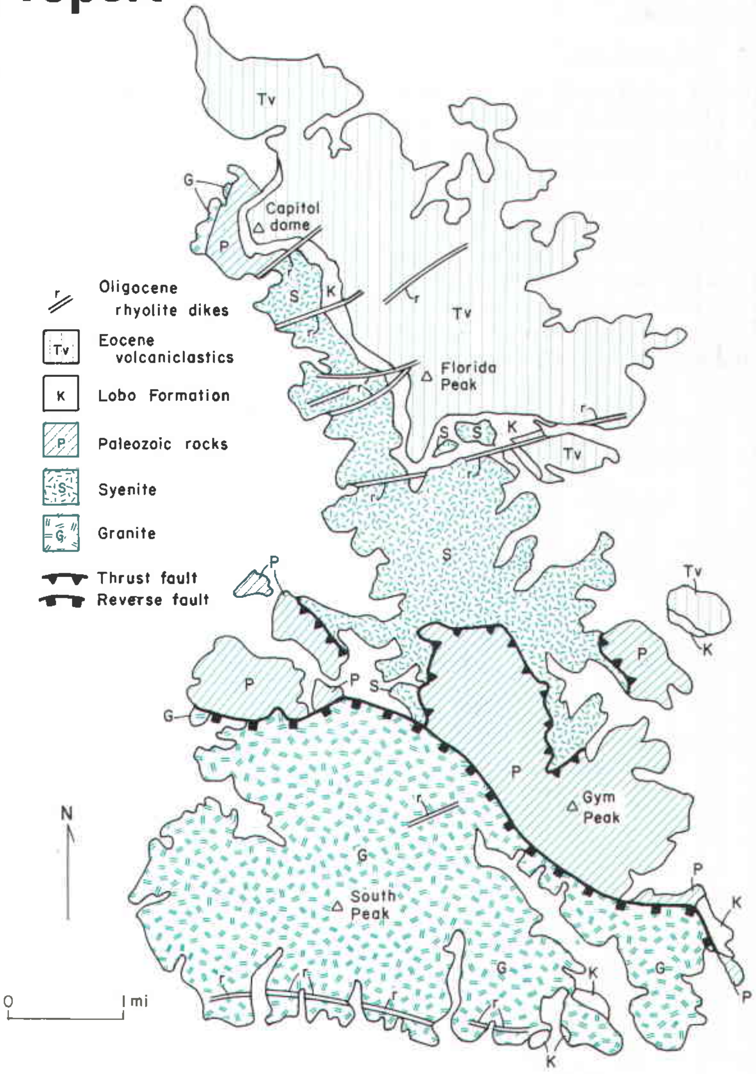

FIGURE 2—GENERALIZED GEOLOGIC MAP OF FLORIDA MOUNTAINS.

Slightly more than half of the exposed rocks are granitic to syenitic, locally containing abundant mafic xenoliths. The plutonic rocks are overlain by Paleozoic and Late Cretaceous (?) sedimentary rocks that underlie Eocene volcaniclastic strata (fig. 2). All these rocks are cut by middle to late Tertiary andesitic and rhyolitic dikes. Darton (1916, 1917) provided the first geologic maps of the mountains, but some of the mineral prospects had been described briefly by Lindgren and others (1910). Griswold (1961) provided additional knowledge about the mineralization, and Corbitt (1971) remapped the range.

Development of an enigma

Darton (1916, 1917) mapped all of the plutonic rocks as Precambrian granite. Griswold (1961) recognized four types of Precambrian rocks including three kinds of granite and a diorite intruded by one of the granites. Corbitt (1971) mapped and described the plutonic rocks as Precambrian granite and Mesozoic syenite intruded by gabbro and anorthosite. Corbitt (1974) recognized the possibility of the syenite, gabbro, and anorthosite being Precambrian rocks whose radiometric clocks were reset at some later time. He later (personal communication, 1980) changed his interpretation of intrusive contacts between the syenite and Paleozoic sedimentary rocks to thrust-fault contacts.

Meanwhile Brookins (1974a, 1974b, 1980a, 1980b), Brookins and Corbitt (1974), and Brookins and others (1978) reported ages for

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COMING SOON

1938–39 earthquake sequence in Mogollon Mountains the plutonic rocks ranging from 371 m.y. to 1.60 b.y. Brookins (1980b) also mentioned a quartz-monzonite-granodiorite suite.

Brookins (1980a) and Woodward (1970) stated that some of the plutonic rocks are intrusive into Paleozoic strata. Loring and Armstrong (1980) used Brookins' data as supporting evidence for Ordovician alkalic intrusives in southwest New Mexico, although they recognized the fact that some of the Florida Mountains' plutonic rocks had to be pre-Late Cambrian. Corbitt and Woodward (1970, 1973b) and Woodward and Duchene (1981) related thrust faulting to "granitic rocks of probable Mesozoic age."

Discussion

The age and petrography of the Florida Mountains' plutonic rocks need clarification in order to: 1) aid mineral exploration in the range, 2) interpret episodes of plutonism, 3) interpret structures which cut the plutonic rocks, and 4) understand the basement composition of southwest New Mexico. This preliminary report is based on parts of 2 yrs of geologic field investigation and gathering of petrographic data. Field mapping is being compiled at a scale of 1:24,000 except in complex areas where 1:6,000 scale is used. About 200 thin sections of plutonic rocks have been examined. Approximately one-fourth of the plutonic rock outcrops (southwest part of range) remain to be mapped, sampled, and examined in detail (fig. 3). Reconnaissance indicates that these outcrops are mostly granite with abundant mafic xenoliths at least in the southern part. Zircon-apatite separates are being made from two syenites (central part of range), a granite, and a diorite (southern end of range) for U/Pb and fission-track age determinations.

Wide variations exist in the percentages of quartz and alkali feldspars, and the plutonic rocks studied are predominantly alkali-feldspar granites, quartz alkali-feldspar syenites, and alkali-feldspar syenites according to the IUGS classification of igneous rocks (Streckeisen, 1976). The predominant mineral in the granite and syenites is perthite (fig. 4). Microcline and orthoclase are locally common, but typically subordinate. All are kaolinized, and most show sericitization. Moderately to strongly undulose quartz content ranges to a maximum of 40% (table 1). The feldspars and quartz are commonly fractured, and alteration products of iron oxides, chlorite, epidote, and carbonate form fracture fillings. The primary mafic mineral in the less-altered alkalic rocks is predominantly hastingsite with minor biotite. The majority of thin sections examined contain secondary alteration products that probably replaced the hastingsite and biotite (table 1). Zircon, apatite, and magnetite are common accessory minerals. Aplite (fine-crystalline, hastingsite alkali-feldspar granite) dikes are common throughout the syenite and quartz-syenite outcrops. These dikes vary in width from a few inches to tens of feet, vary in attitude from vertical to horizontal, and generally have gradational contacts with the host rock. The dikes apparently represent late-crystallizing phases of the quartz-syenitic magma.

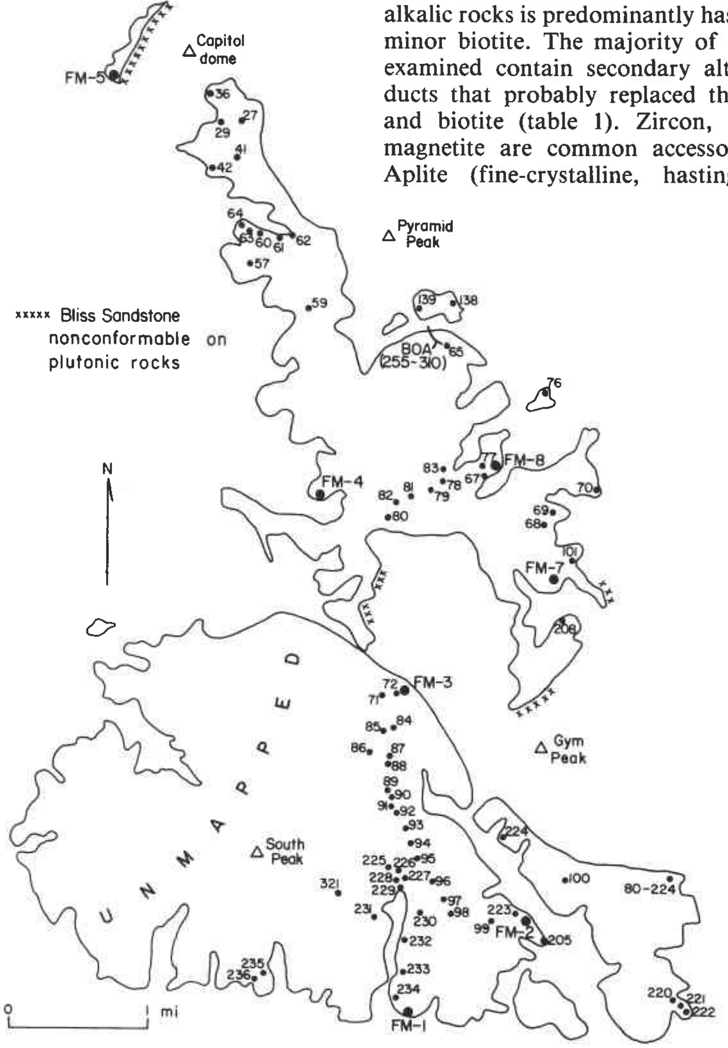

FIGURE 3—SKETCH MAP OF PLUTONIC ROCK OUTCROPS IN FLORIDA MOUNTAINS, showing sample locations and approximate distribution of rock types.

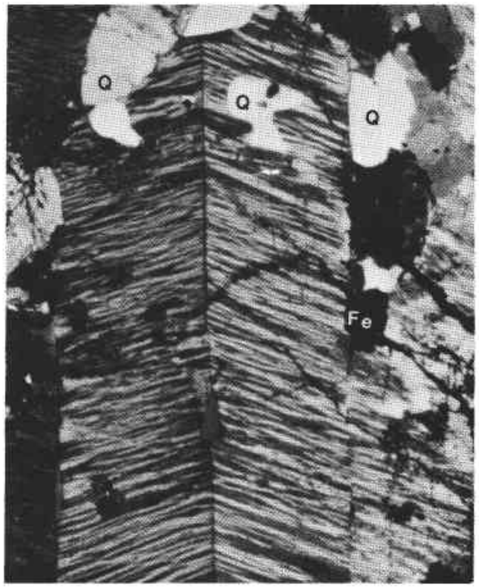

FIGURE 4—PHOTOMICROGRAPH OF STRING AND BRAID PERTHITE WITH ORTHOCLASE; albite ratio approximately 1:1. Q, quartz; Fe, iron oxides; width of field 2.5 mm.

Variations in rock types, the wide range in reported ages, and the suggestion that syenite intruded Paleozoic strata led to the specula-

New Mexico
GEOLOGY
• Science and Service
Volume 4, No. 3, August 1982

published quarterly by
New Mexico Bureau of Mines and Mineral Resources
a division of New Mexico Institute of Mining & Technology

New Mexico Institute of Mining & Technology
Acting President .... Charles R. Holmes
New Mexico Bureau of Mines & Mineral Resources
Director .... Frank E. Kottlowski
Deputy Director .... George S. Austin

Subscriptions: Issued quarterly, February, May, August, November; subscription price $5.00/yr.

Editorial matter: Contributions of possible material for consideration in future issues of NMG are welcome. Address inquiries to Marla D. Adkins-Heljeson, editor of *New Mexico Geology*, New Mexico Bureau of Mines & Mineral Resources, Socorro, NM 87801

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Circulation: 1,400

Printer: University of New Mexico Printing Plant

tion that the plutonic rocks may represent several episodes of magmatism. The plutonic rock west and immediately south of Capitol dome (fig. 2) is alkali-feldspar granite. Alkali-feldspar granite is also the prevailing rock south of the reverse fault between Gym and South Peaks. Alkali-feldspar syenite and quartz alkali-feldspar syenite, with aplite dikes, form the outcrops in the central part of the Florida Mountains. The alkali-feldspar granite south of Capitol dome, the quartz alkali-feldspar syenite northwest of Florida Peak, and the alkali-feldspar granite south of South Peak intruded meladiorite, diorite porphyry, and diabasic rocks. Xenoliths of these mafic rocks locally comprise 50% of the outcrop. Leucodiorite (anorthosite of Corbitt) was also intruded by the quartz alkali-feldspar syenite west of Florida Peak.

The coarse-crystalline, alkali-feldspar granite west of Capitol dome (figs. 2 and 3) was exposed and eroded before deposition of the Bliss Sandstone during Late Cambrian time (about 510 m.y.). North of Capitol dome, a section of Precambrian (?) diamictite (Corbitt and Woodward, 1973a) was deposited on eroded alkali-feldspar granite and then was covered by the Bliss Sandstone. Three well-exposed outcrops in the central part of the range contain depositional contacts of Bliss Sandstone resting nonconformably on coarse-crystalline, alkali-feldspar syenite (fig. 3). The basal Bliss Sandstone at one outcrop is composed largely of well-rounded, alkali-feldspar syenite cobbles and pebbles; thus the alkali-feldspar syenite and quartz alkali-feldspar syenite were uplifted and partly eroded prior to about 510 m.y. B.P. The oldest rocks deposited on alkali-feldspar granite south of the reverse fault (fig. 2) are of probable Late Cretaceous age. Brookins (1974b, 1980a) assigned ages to this granite ranging from 1.06 to 1.60 b.y. The meladiorite and associated mafic rocks were intruded by this Precambrian granite south of South Peak and similar meladiorite and leucodiorite were intruded by alkali-feldspar granite, quartz alkali-feldspar syenite, and alkali-feldspar syenite west and northwest of Florida Peak.

Alteration of the plutonic and overlying conglomeratic or volcaniclastic rocks is widespread and pervasive. The entire sequence of more than 1,600 ft of Eocene volcaniclastic rocks (fig. 2) north of Florida Peak has been intensely propylitized. Epidote concretions up to 12 inches in diameter are abundant locally in the Eocene section as, for example, beneath Florida Peak. Thin sections show that the sandstones are chiefly plagioclase replaced by epidote, carbonate, and clay minerals(?). Joints and fractures in the Lobo Formation south of Florida Peak are also coated with epidote and other secondary minerals. The vast majority of plutonic rocks in the central part of the range, from one flank to the other, are sheared and contain abundant iron oxides (mostly limonite). Six of the seven drill cores taken by Brookins and others (1978) and stored at the New Mexico Bureau of Mines and Mineral Resources contain intensely sheared, brecciated, altered rocks stained with iron oxides; some closely resemble gossan. Locations of these drill-core sites are shown by FM-1 through FM-8 symbols (FM-6 does not exist) on fig. 3. The alkali-feldspar syenites beneath horizontal or nearly horizontal aplite dikes are much more altered than the aplites or alkali-feldspar syenites above the aplites. This greater alteration may be a result of damming of ascending hydrothermal fluids beneath the less porous aplites.

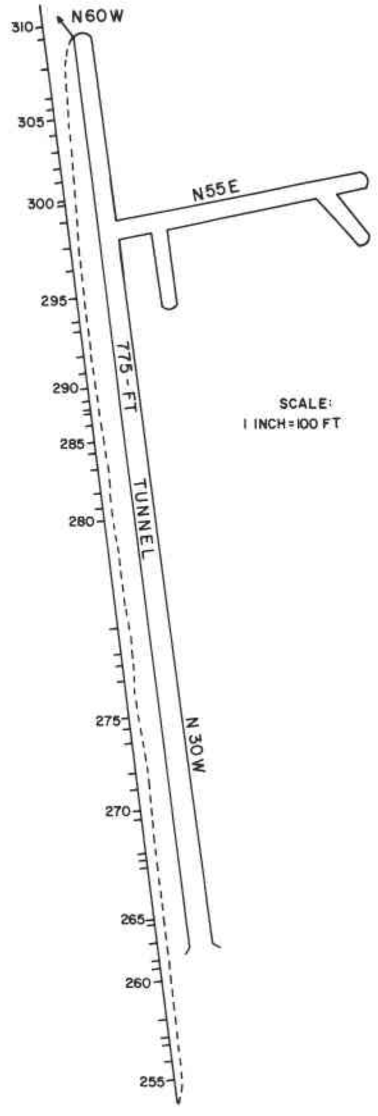

FIGURE 5—PLAN-VIEW SKETCH OF BARITE OF AMERICA TUNNEL AND CORE, showing locations of samples 255–310.

Barite of America recently excavated a 775-ft tunnel approximately 1 mi southeast of Florida Peak in an exploratory attempt to transect a barite vein. A horizontal, 900-ft, 2-inch-diameter core was taken from the end of the tunnel (fig. 5). Thin-section and hand-specimen study of alkali-feldspar syenite and quartz alkali-feldspar syenite core samples (fig. 5 and table 1: samples 255–310) revealed that: 1) approximately half of the core consisted of intensely brecciated and altered rocks; 2) only three samples contained recognizable hastingsite—the rest have chlorite, epidote, and carbonate replacing hastingsite(?); 3) microscopic as well as megascopic breccia zones are abundant (fig. 6); 4) many of the breccia zones contain carbonate mineral, fluorite, and barite(?); and 5) pyrite and chalcopyrite coat some of the fracture surfaces as well as being present in some breccia veins (fig. 7).

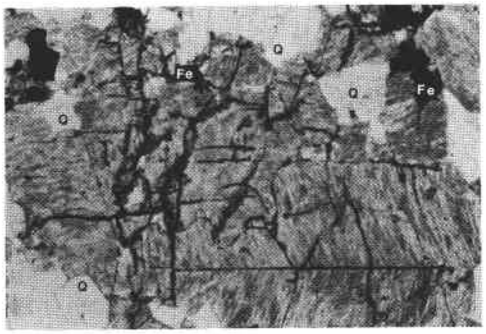

FIGURE 6—PHOTOMICROGRAPH OF IRON OXIDES (Fe) REPLACING MAFIC MINERALS AND FILLING FRACTURES IN PERTHITE; Q, quartz; width of field 4.5 mm.

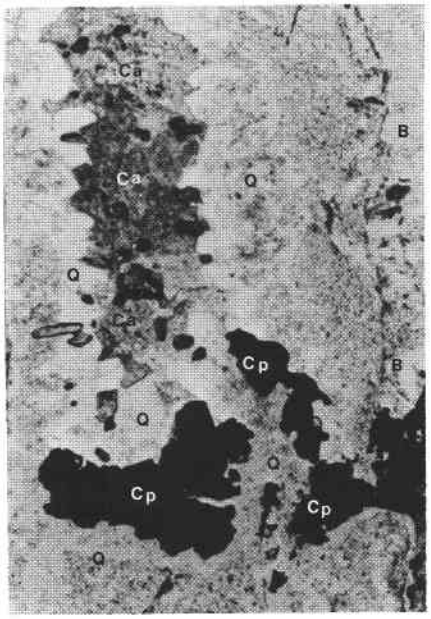

FIGURE 7—PHOTOMICROGRAPH OF CALCITE (Ca), VEIN QUARTZ (Q), AND CHALCOPYRITE (Cp) FILLING 2-MM-WIDE VEIN IN BRECCIATED (B) SYENITE. Width of field 2.5 mm.

Low-grade mineralization is widespread in the Florida and Little Florida Mountains. Exact mineral production figures are unknown, but the ores contained manganese, fluorspar, barite, zinc, lead, silver, copper, and gold. The lead, zinc, and silver ores occur mainly in Paleozoic carbonate rocks. A vein of galena, fluorite, barite, calcite, and quartz was mined in the Lobo Formation and in syenite less than 1 mi south of Florida Peak. Oxidized copper minerals are present in the meladiorite and syenite about 1 mi southeast of Capitol dome. Lead, copper, and zinc(?) prospects have been described by Griswold (1961) in the Eocene volcaniclastic rocks. Manganese, fluorite, and barite veins were deposited in fanglomerate derived from 23.6-m.y.-old rhyolite in the Little Florida Mountains.

Conclusions

Field evidence, consisting of contact relations with overlying Precambrian(?) and Late Cambrian strata, gradational lithologies within the alkalic plutonic rocks, and intrusive contacts between these and older mafic rocks, indicate that all of the Florida Mountains' plutonic rocks are of Precambrian age. The probable cause of the spurious radiometric dates is alteration related to middle to late Tertiary volcanism and mineralization. Field and petrographic data show intense hydrothermal alteration of most of the plutonic rocks and of other rocks as young as the late(?) Eocene volcaniclastic strata. This study has provided information supporting the following chronologic sequence of events in the Florida Mountains.

The oldest plutonic rocks in the Florida Mountains are a complex of meladiorite, leucodiorite, and diabase(?). These rocks were intruded during Precambrian time by an alkalic magma from which alkali-feldspar granite, quartz alkali-feldspar syenite, and alkali-feldspar syenite crystallized by partial differentiation. Overlying country rock was removed and the pluton partly eroded prior to Late Cambrian time and probably before close of Precambrian. The pluton was then covered by about 3,700 ft of Paleozoic sedimentary rocks. Uplift at the close of the Paleozoic and/or during early Mesozoic time and subsequent erosion removed much of the cover from the plutonic rocks once again. The Lobo Formation of probable Late Cretaceous or early Tertiary age was deposited on the eroded Precambrian rocks west and south of Florida Peak and at the southeast end of the range. Following deposition of a thick volcaniclastic blanket during middle to late(?) Eocene time, rhyolitic and andesitic dikes were emplaced, probably during the Oligocene or early Miocene. Hydrothermal fluids from underlying magmas, associated with or contemporaneous with early Miocene volcanism in the Little Florida Mountains, produced extensive alteration of the plutonic rocks and mineralization.

ACKNOWLEDGMENTS—The New Mexico Bureau of Mines and Mineral Resources, F. E. Kottlowski, Director, provided financial support for the fieldwork and thin-section preparation. Hospitality of area ranchers and claim owners provided easy access to the range. Discussions with G. Brown, C. E. Chapin, L. L. Corbitt, R. E. Denison, F. E. Kottlowski, G. Mack, W. R. Seager, and S. Thompson III during the investigation provided ideas and aided in formulating the interpretations presented here. L. Horton and Barite of America kindly provided access to their exploration tunnel and donated samples of the core for study. W. R. Seager also read the original manuscript and made several suggestions for its improvement. I extend my sincere thanks and appreciation for all this aid. An earlier version of this paper was presented at the 1982 annual meeting of The Metallurgical Society-AIME in Dallas, Texas. Publication of this revised, expanded paper is with their permission.

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TABLE 1—MODAL ANALYSES OF FLORIDA MOUNTAINS' PLUTONIC ROCKS (Kf, alkali feldspars; Qz, quartz; Pl, plagioclase An > 5; Bi, biotite; Am, amphibole; Px, pyroxene; Al, chlorite, epidote, iron oxides, carbonates; and Ac, apatite, zircon, magnetite).

Sample No.	Kf	Qz	Pl	Bi	Am	Px	Al	Ac	Name
27	76	18					4	2	Quartz Syenite
28			43	1	tr	48	1	7	Diabase
29	58	15		1	8	14	3	1	Quartz Syenite
36	61	33			3		3		Granite
42			52	2	23	19		4	Diorite
57	87	5			7			1	Quartz Syenite
59	92	3			4			1	Syenite
60			47				53		Diorite
61			57	2	6		35	tr	Diorite
62			30	1	21	17	22	9	Meladiorite
64	73	4			7		15	1	Syenite
65	79	8					13	tr	Quartz Syenite
67	71	26			2			1	Aplite
68	72	19			6			3	Aplite
69	70	26			4			tr	Aplite
70	76	4					20	tr	Syenite
71	71	22					6	1	Granite
72	66	24					10	tr	Granite

(continued)

New bibliography publication introduced

The New Mexico Bureau of Mines and Mineral Resources has issued a new publication in cooperation with the American Geological Institute and GeoRef Information System, *Bibliography and index of New Mexico geology*. This edition, containing approximately 750 references, represents published and unpublished material that was added to the GeoRef database in 1981. The components of this annual bibliography for New Mexico are: serials list, citations by author with cross references, subject index, county index, and rock-unit index.

Many publications released in 1981 are included, but this volume is not a comprehensive annual bibliography and contains additional citations for papers and reports released in earlier years. The Bureau did not participate in collecting or in formating the references for this volume; therefore, many citations may duplicate those appearing in earlier Bureau bibliographies or its forthcoming bibliography for 1976–1980 (Bull. 109).

The New Mexico Bureau of Mines and Mineral Resources will continue to issue a GeoRef bibliography on an annual basis. Between editions the Bureau will work with GeoRef to make corrections and find omissions. Users of the bibliography are encouraged to contact the Bureau editing staff when errors or omissions are discovered and to comment critically on the volume's scope and format. Coverage of the literature will become increasingly more comprehensive with each successive edition as Bureau and user participation in the database-building process continues to grow.

The annual GeoRef bibliography is a timely supplement to the Bureau's bibliographic literature bringing more recent publications in geoscience to researchers. The bibliography sells for $5.00 and is available from the Publications Office, New Mexico Bureau of Mines and Mineral Resources, Socorro, New Mexico 87801.

—Jane Calvert

TABLE 1 (*continued*)

Sample No.	Kf	Qz	Pl	Bi	Am	Px	Al	Ac	Name
76	85	4					10	1	Syenite
77	70	24					6	tr	Aplite
78	74	3					23	tr	Syenite
79	80	1					17	2	Syenite
81	74	2					23	1	Syenite
82	80	tr					18	2	Syenite
83	76	15					9	tr	Quartz Syenite
84	66	19					15	tr	Quartz Syenite
85	65	23					12	tr	Granite
86	63	28					9	tr	Granite
87	76	16			8			tr	Quartz Syenite
89	61	31					8	tr	Granite
90	67	30					3	tr	Aplite
91	67	26			5			2	Granite
92		tr	40		46		8	6	Meladiorite
93	62	30			7		1	tr	Granite
94			49	1	46	tr	tr	4	Meladiorite
95	64	28			7			1	Aplite
96			67		26		2	5	Diorite
97			42	2	37	6	5	8	Meladiorite
98			54	17	24		3	2	Diorite
99	68	21					11	tr	Granite
100	63	30			7			tr	Granite
101	91	1					8	tr	Syenite
205	61	24					14	1	Granite
208	91	3					6	tr	Syenite
220	62	34					4	tr	Granite
221	50	41					9	tr	Granite
223	47	41					12	tr	Granite
224	43	5	26				25	1	Quartz Monzonite
225	61	30					9	tr	Granite
226	62	30					2	6	Granite
227		2	54	12	14	15		3	Diorite
228	44	32	24		tr			tr	Aplite
229	37	31	28		tr		2	2	Aplite
230	69	21			10		tr	tr	Granite
231			44		50		2	4	Meladiorite
232	65	23					12	tr	Granite
233	58	24					18	tr	Granite
234	86	6			5		3		Quartz Syenite
235	65	28			7		tr	tr	Granite
236	83	17						tr	Quartz Syenite
253	73	16					11	tr	Quartz Syenite
255	84	5					11	tr	Quartz Syenite
256	84	8			4		3	1	Quartz Syenite
257	85	5					9	1	Quartz Syenite
258	86	4					10	tr	Syenite
259	86	2					11	1	Syenite
260	85	5					10	tr	Quartz Syenite
261	88	1					11	tr	Syenite
262	83	8					9	tr	Quartz Syenite
263	78	15					7	tr	Quartz Syenite
265	84	11					5		Quartz Syenite
266	84	8					8	tr	Quartz Syenite
267	79	7					14	tr	Quartz Syenite
268	83	4					13	tr	Syenite
269	75	15					10	tr	Quartz Syenite
270	82	11					7	tr	Quartz Syenite
271	83	10					7	tr	Quartz Syenite
272	86	4					10	tr	Syenite
273	90	1					9	tr	Syenite
274	78	13					9	tr	Quartz Syenite
275	71	6					23	tr	Quartz Syenite
276	83	4					13	tr	Syenite
277	80	10					10	tr	Quartz Syenite
278	85	6					9	tr	Quartz Syenite
279	83	4					12	1	Syenite
280	68	4					27	1	Syenite
281	76	4					19	1	Syenite
282	87	2					11	tr	Syenite
283	71	15					14	tr	Quartz Syenite
284	75	14					10	1	Quartz Syenite
285	88	2					10		Syenite
286	79	9					11	1	Quartz Syenite
287	82	8			1		9	tr	Quartz Syenite

(*continued*)

New Mexico's minerals

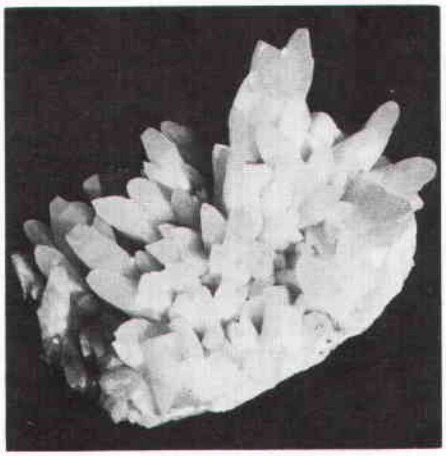

Photo by K. S. Rider

CALCITE, $CaCO_3$. LORDSBURG MINING DISTRICT, HIDALGO COUNTY, NEW MEXICO
Crystal system: hexagonal (rhombohedral)
Hardness: 3
Specific gravity: 2.71
Cleavage: $\{10\bar{1}1\}$, perfect

Color: colorless to white; can be tinted various colors by impurities. Specimen pictured has a very light pink tint, probably because of iron or manganese impurities.

Specimen pictured: 3½ inches wide, 3¼ inches tall

Calcite is a common rock-forming mineral and is the principal constituent of limestone, chalk, and marble. Also a common cave deposit, calcite forms stalactites and stalagmites. Calcite is a common gangue mineral formed in many hydrothermal ore deposits, such as those of the Lordsburg district. The name calcite comes from the Latin "calx" which means burnt lime.

—Robert M. North

Seismic activity in central New Mexico

Three minor earthquakes were felt at Socorro in May of this year: two on the 18th at 12:00 a.m. (MDT) and 12:09 a.m. (MDT) and one on the 24th at 12:32 a.m. (MDT). These shocks, with magnitudes of 2.6, 2.6, and 2.7, respectively, had depths near 11 km and epicenters near 34° 4.4′ N. and 106° 51.6′ W. Because the epicenters were only 2 mi northeast of Socorro, the shocks were felt by a large number of people in and near the town. The felt shocks were the strongest events in an earthquake swarm that commenced on May 8th and as of June 3rd had produced over 200 recorded shocks at Socorro from the same general hypocentral region.

—Allan Sanford and Larry Jaksha

Florida Mountains—

TABLE 1 (*concluded*)

Sample No.	Kf	Qz	Pl	Bi	Am	Px	Al	Ac	Name
288	84	5			6		3	2	Quartz Syenite
289	88	1			5		6	tr	Syenite
290	69	19			10		1	1	Quartz Syenite
291	81	3		1	8		6	1	Syenite
292	85	2			8		4	1	Syenite
293	68	12					18	2	Quartz Syenite
294	81	2					16	1	Syenite
295	88	2					10	tr	Syenite
296	58	13					28	1	Quartz Syenite
297	82	2					16	tr	Syenite
298	82	5			tr		12	1	Quartz Syenite
299	79	9			tr		11	1	Quartz Syenite
300	92	3					5	tr	Syenite
301	83	8					8	1	Quartz Syenite
302	83	2					15	tr	Syenite
303	84	6					9	1	Quartz Syenite
304	86	2					11	1	Syenite
305	84	5					10	1	Quartz Syenite
306	87	3					8	2	Syenite
307	83	4					13	tr	Syenite
308	86	2					12	tr	Syenite
309	85	2					13	tr	Syenite
310	84	2					13	1	Syenite
320			45		47		2	6	Meladiorite
321	48	33	16				2	1	Granite
FM1- 3	67	26					7	tr	Granite
10	56	20					24	tr	Granite
19	67	16					17	tr	Quartz Syenite
28	67	23					10	tr	Granite
32	68	18					14	tr	Quartz Syenite
38	59	26					15	tr	Granite
41	66	25					8	1	Granite
46	74	21					5	tr	Granite
FM2- 2	59	26					15	tr	Granite
8	60	28					11	1	Granite
11	63	28					9	tr	Granite
17	50	43					6	1	Granite
21	58	25					17	tr	Granite
29	49	43					8	tr	Granite
31	56	29					15	tr	Granite
36	70	20					10	tr	Granite
37	68	24					8	tr	Granite
38	52	41					6	1	Granite
FM4- 2	83	2		2	7		4	2	Syenite
9	80	2		3	12			3	Syenite
11	93	1		1	4			1	Syenite
16	90	1		1	6		1	1	Syenite
20	86	1		2	5		5	1	Syenite
FM5- 3	68	29	tr				3	tr	Granite
8	80	18	tr				2	tr	Quartz Syenite
14	75	22	tr				3	tr	Granite
16	67	28	tr				5	tr	Granite
22	65	28	tr				7	tr	Granite
30	65	22	3				10	tr	Granite
FM7- 4	85	2					13	tr	Syenite
11	85	3					12	tr	Syenite
25	87	3					10	tr	Syenite
32	72	4					23	1	Syenite
41	79	14					6	1	Quartz Syenite
47	67	16					17	tr	Quartz Syenite
53	69	1					29	1	Syenite
FM8- 1	77	15					8	tr	Quartz Syenite
8	81	18					1	tr	Quartz Syenite
10	80	9		1	8		1	1	Quartz Syenite

□

Gallery of Geology

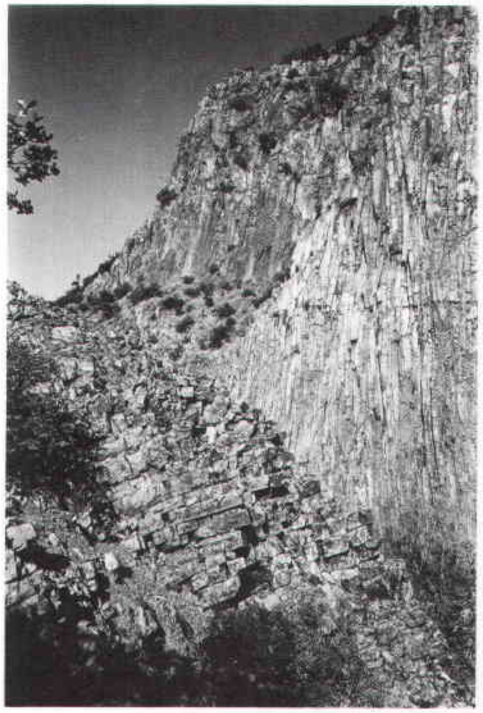

Photo by Glenn R. Osburn

Columnar jointing in La Jencia (Vicks Peak) Tuff in Cold Springs Canyon, eastern San Mateo Mountains, Socorro County, New Mexico. These joints average approximately 1 ft apart. This unit is a densely welded ash-flow tuff of regional extent that was erupted from the Nogal Canyon cauldron in the southeast San Mateo Mountains. In Cold Springs Canyon, near the cauldron, the tuff is approximately 800 ft thick. The view is toward the north; Cold Springs Canyon runs from lower right to middle left in the photo separating the areas of shallowing dipping joints in the foreground from the vertically jointed area in the background. In volcanic rocks, columnar joints form by contraction during cooling. These joints are typically vertical, perpendicular to the upper and lower cooling surfaces of the unit. The nearly horizontal joints in the foreground probably formed near a cliff or valley wall that was buried by the tuff. A more comprehensive treatment of the geology of this area has recently been prepared by Glenn Atwood (M.S. thesis, University of New Mexico, 1982).

—*Glenn R. Osburn*

Announcement—Call for papers

The 3rd biennial New Mexico Minerals Symposium will be held Saturday and Sunday, November 13 and 14, 1982, at the Macey Conference Center on the campus of the New Mexico Institute of Mining and Technology in Socorro. The purpose of the New Mexico Minerals Symposium is to bring together for an exchange of items both professionals and amateurs interested in the mineralogy of the state. The symposium provides both groups a forum to present their cumulative knowledge of mineral occurrences in New Mexico. In addition to the formal papers, informal discussions among mineralogists, geologists, and hobbyists should benefit all.

Persons wishing to give papers at the symposium are asked to submit abstracts by October 15, 1982. More information may be obtained from:

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