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TO ACCOMPANY MAP MR-70

FLUORSPAR DEPOSITS IN COLORADO

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INTRODUCTION

Increased fluorine consumption (U.S. Bureau of Mines, 1946–1971) coupled with limited proved reserves has stimulated extensive exploration for fluorine and intensive research into developing new sources of fluorine or substitutes. A summary of the distribution, geochemical and geologic environments, and production history of selected fluorspar occurrences, deposits, and districts is provided here with the hope that this information will help to stimulate exploration and discovery of additional fluorspar resources in Colorado to augment our dwindling domestic supply.

The compound calcium fluoride (CaF_2), which crystallizes in the isometric system as the mineral fluorite, is the most common naturally occurring simple fluoride. This translucent to transparent mineral ranges from colorless varieties through various shades of yellow, brown, green, blue, and purple. Fluorite crystallizes over a wide temperature range and occurs in mineral deposits of a diverse nature, most often of primary origin. Fluorite, frequently a gangue mineral associated with base- and precious-metal ores, is primarily a vein mineral and occurs occasionally as the principal constituent. Aggregates of cubic and less frequently octahedral fluorite crystals occur as granular masses or as constituents in banded or crustified veins. Most commercial fluorine is derived from the industrial commodity fluorspar (an ore) of which fluorite is the principal mineral. Economically significant fluorspar deposits usually contain at least 30 percent CaF_2.

Specific economic aspects and generalized statements concerning fluorine distribution in the Western United States have been reported by Lindgren (1933), Burchard (1934), Gillson (1945), Peters (1958), and Worl (1974). A comprehensive investigation of the distribution, associations, genesis, geologic and geochemical environments, production, and future resources of fluorine in the United States has recently been prepared by geologists of the U.S. Geological Survey (Shawe, 1975). Studies of fluorspar deposits by Aurand (1920), Cox (1945), and Van Alstine (1947, 1964) have contributed significantly to the evaluation of fluorine resources in Colorado.

FLUORSPAR

Three specific grades of commercial fluorspar are produced in response to industrial requirements. These are classified as acid-, ceramic-, and metallurgical-grade fluorspar. Acid-grade fluorspar, which is used in the finely powdered form, must contain a minimum of 97 percent CaF_2. Admixed silica and calcium carbonate are restricted to less than 1.5 percent and 1.0 percent, respectively, and more stringent limitations are imposed on iron oxide and sulfur contents (Hodge, 1971). Specifications for ceramic-grade fluorspar, although not universally standardized, commonly require concentrates to contain 95 percent CaF_2 and limit the iron oxide content to approximately 0.1 percent, the calcium carbonate content to 1.5 percent, and the contained silica to a maximum of 3 percent. Metallurgical-grade fluorspar must contain a minimum of 60 percent effective CaF_2 and must also be very low in silica and sulfur. Effective CaF_2 units are determined by subtracting 2.5 times the silica content from the initial CaF_2 concentraltion.

Fluorspar has numerous applications in the steel, chemical, and ceramic industries. Metallurgical-grade fluorspar, in the form of lumps, artificial pellets, or fine flotation concentrates, is used in the open-hearth manufacture of steel and as a flux in the smelting of aluminum, gold, silver, copper, and lead. Substantial quantities of acid-grade fluorspar are consumed in the production of hydrofluoric acid, the chief source of fluorine for the chemical industry. The rapidly expanding fluocarbon chemical industry uses large amounts of fluorine in the manufacture of special plastics, insecticides, and refrigerants. The ceramic industry, which utilizes finely powdered fluorspar in the fabrication of opaque or colored glass, and certain enamels, consumes the smallest tonnage of commercial fluorspar.

GEOLOGIC ENVIRONMENT

GEOCHEMISTRY

Fluorine, a lithophile and biophile element, is a primary constituent of fluoride minerals and is commonly present in certain silicate and phosphate minerals. Fluorine often occupies vacant atomic positions in the defective apatite lattice, and freely substitutes for OH^-, and less often for 0^{-2} in topaz, tourmaline, hornblende, phlogopite, biotite, lepidolite, amblygonite, monazite, and xenotime. Fluorite is the primary source of commercial fluorine, although minor quantities of fluorine may be commercially prepared by electrolysis of a fused mixture of potassium fluoride and hydrogen fluoride.

FLUORINE ASSOCIATED WITH IGNEOUS ROCKS

As a common volatile constituent in residual crystallization fluids, fluorine is often associated with, or is close to, intrusive or extrusive bodies. Wright and Fiske (1971) have convincingly demonstrated that fluorine may be effectively concentrated by differentiation processes. Silicic hypabyssal and plutonic rocks, including pegmatites, as well as alkalic intrusives and carbonates frequently exhibit a variable affiliation with a particular fluoride or other fluorine-bearing minerals. Minor amounts of accessory fluorite occur in the Mount Ethel pluton in northern Colorado (G. L. Snyder oral commun., 1972), in the Pikes Peak Granite, and in many other plutons within the Colorado Front Range. At the northern extremity of the Colorado mineral belt, important fluorspar vein and breccia deposits near Jamestown occur close to a genetically related Tertiary granite-quartz monzonite intrusive. The close association of fluorite with the bostonite dikes and alkalic plutons in the area extending southwestward from Central City toward Leadville, where more intermediate silicic intrusive stocks prevail, has been noted by Lindgren (1933). Disseminated fluorite in porphyry deposits, commonly present in amounts of less than one percent, occurs at Climax, Henderson, and Urad (Wallace and others, 1968). Minor concentrations of fluorite associated with carbonatite intrusives have been noted near the complex at Iron Hill in Gunnison County (Larsen, 1942), and as an uncommon accessory mineral in the vicinity of Gem Park (Parker and Sharp, 1970). With the exception of the veins and breccia pipes in the Barstow mine (Red Mountain) in Ouray County, fluorine mineralization along the southwestern extension of the mineral belt is restricted to gangue constituents, small replacement pods, and minor veins within base and precious metal deposits in the San Juan volcanic province. Pneumatolytic topaz [$Al_2\ SiO_4\ (OH, F)_2$] occurs commonly in lithophysae in rhyolites exposed at Chalk Mountain, Lake County (Cross, 1884), Nathrop, Chaffee County (Cross, 1886), and near Rosita, Saguache County (W. N. Sharp, oral commun., 1973). Similar high-fluorine silicic-alkalic volcanic rocks in States adjoining Colorado, which contain more significant amounts of topaz associated with garnet and bixbyite, occur along the southwestern caldera margin in the Thomas Range, Utah (Staatz and Carr, 1964), and in the Black Range, New Mexico (Ericksen and others, 1970).

FLUORINE ASSOCIATED WITH METAMORPHIC ROCKS

Fluorine is characteristic of certain pneumatolytic deposits, such as greisens. Near Lake George in Park County variable amounts of fluorite, accessory muscovite, quartz, topaz, molybdenite, and minor quantities of base-metal sulfides were deposited within irregular greisen stringers, and along the contact between the greisen and the adjacent Precambrian Redskin Granite (Hawley, 1969). Topaz, a common constituent in metamorphic rocks, may be a future source of fluorine, especially where associated with other valuable minerals which could be extracted as coproducts. Concentrations of topaz that constitute between 23 and 67 percent of the bulk rock have been identified in a Precambrian belt of quartz-topaz-sillimanite gneiss northwest of Evergreen (Sheridan and others, 1968). This body, which also contains 2 to 4 weight percent rutile, ranges from 11 to 100 feet (3-30 m) in width, and is exposed for 7,000 feet (2,133 m) along strike.

FLUORINE IN HYDROTHERMAL DEPOSITS

The most significant commercial source of fluorine in Colorado is from hydrothermal fluorspar deposits. Deposits formed both in the near-surface environment, which contain appreciable accumulations of fluorspar, and in the deep-seated environment associated with economically significant concentrations of metals. Minerals other than fluorite are sparse in the shallow deposits, and usually only traces of base-metal sulfides are present. Ore shoots in the principal deposits were controlled by northwest- to northeast-trending tension fractures and breccia zones. Recurrent brecciation and deposition, a common feature in these deposits, gives a granular appearance to the ore; however, varicolored banded spar coexists with the fluorite breccia ore in many deposits. Fine-grained granular to cryptocrystalline silica may either coexist with fluorite as an intimate intergrowth. or occur by itself.

Variable quantities of hydrothermal fluorite commonly exist as an accessory within orebodies containing base or precious metals. Although fluorspar is present in many metal deposits, production has been restricted to veins and irregular replacement masses, which constitute a limited section of the mineralized zone. The fluorspar deposits at Jamestown, the largest source of commercial fluorspar in Colorado, are associated with metallic deposits.

Hot springs commonly contain appreciable amounts of fluorine, and they should be evaluated as future potential fluorine sources. Past productive fluorspar deposits which show a genetic relationship to hot springs include those at Wagon Wheel Gap in Mineral County and those at Browns Canyon, Poncha Springs, and Poncha Pass in Chaffee County.

TABLE 1.—*Annual fluorspar production in Colorado*

Year	Dollar value	Production (short tons)	Average value/ton
1880-1909[1]	27,766	5,807	4.78
1910	1,608	268	6.00
1911	4,226	721	5.86
1912	9,834	1,639	6.00
1913	26,592	4,432	6.00
1914	12,992	1,978	6.57
1915	1,482	247	6.00
1916	42,457	8,669	4.90
1917	196,633	17,104	11.50
1918	416,780	38,475	10.83
1919	150,739	9,678	15.58
1920	251,308	12,852	19.55
1921	39,907	3,143	12.70
1922	20,169	2,309	8.73
1923	59,710	6,044	9.88
1924	135,411	12,301	11.01
1925	153,707	11,776	13.05
1926	128,211	10,440	12.28
1927	82,503	6,432	12.83
1928	18,040	1,815	9.94
1929	56,607	4,808	11.77
1930	101,758	9,248	11.00
1931	5,921	529	11.19
1932	3,330	333	10.00
1933	6,778	742	9.13
1934	83,137	6,537	12.72
1935	88,454	6,978	12.68
1936	109,411	9,412	11.62
1937	98,493	7,883	12.49
1938		1,704	. .
1939	107,459	7,569	14.20
1940	163,285	11,032	14.80
1941	225,069	15,566	14.46
1942	640,938	31,743	20.19
1943	1,164,868	49,145	23.70
1944	1,604,043	65,209	24.60
1945	1,333,735	52,437	25.43
1946	925,867	32,539	28.45
1947[2]	1,066,013	36,050	29.57
1948	0		....
1949	394,932	22,324	34.19
1950	289,306	18,489	35.38
1951	215,997	20,661	39.70
1952	1,456,281	29,185	51.60
1953	2,790,146	53,276	53.91
1954	3,027,000	59,197	54.01
1955	3,489,111		
1956	3,340,315		
1957	3,424,600		
1958	3,126,438		
1959	1,462,908	....	
1960	1,239,444	....	
1961	1,427,616	.....	
1962	1,619,460	...	
1963	438,075		
1964	565,740		
1965	630,750	.....	
1966	927,700	.....	
1967	829,230	.....	
1968	1,284,240	...	
1969	2,272,167	. .	
1970	3,738,645	. ...	
1971	3,887,210	...	
1972	5,435,118	.....	....
1973	4,061,117	.....	....
Total	60,938,797	[3]1,900,119	

[1] 1880-1946 Annual production data tabulated by Argall (1949, p. 194).
[2] 1947-1972 Total dollar value compiled from data listed by Jones (1948), Scott (1950-1959), Franz (1960-1969); and Blake (1970-1974).
[3] Estimated total production in short tons 1880-1973, excluding 1948, and utilizing fluorspar value data from the U.S. Bureau of Mines (1946-1973).

PRODUCTION

Until the early 1950's, production of fluorspar in the United States was about equal to domestic consumption; since then, consumption has steadily outstripped production until by the early 1970's, the United States was producing only about 20 percent of its total fluorspar demand. About 55 percent of the U.S. fluorspar production is from southern Illinois near Rosiclare and Cave-in-Rock, and the rest is mostly from various Western States. Colorado has been a significant producer of fluorspar since 1880 (table 1) and in 1972 accounted for about 20 percent of the total U.S. production. Colorado production trends have roughly paralleled national trends, although fluctuations in price and supply-demand relationships have caused slight deviations from the domestic production curve (fig. 1). Colorado fluorspar production deviates noticeably from the national production trend according to the level of activity at Northgate in Jackson County or at Jamestown in Boulder County, the major productive districts in the state. For example, Colorado fluorspar production may exceed 20 percent of the total domestic production at times when Northgate is active, and less than 10 percent when Northgate is inactive. Although commercial fluorspar production began in 1880, about 80 percent of the total dollar-value of fluorspar concentrates from Colorado has been produced within the last 25 years. The annual contribution from Colorado, which accounted for 15 percent of the total domestic dollar-value fluorspar production during the same period, is illustrated in figure 1. The principal production from 1947 to 1972 expressed in dollar value is tabulated beneath the county from which the fluorspar was mined (table 2).

The mineralized breccia zones and vein deposits of the Jamestown district in Boulder County have

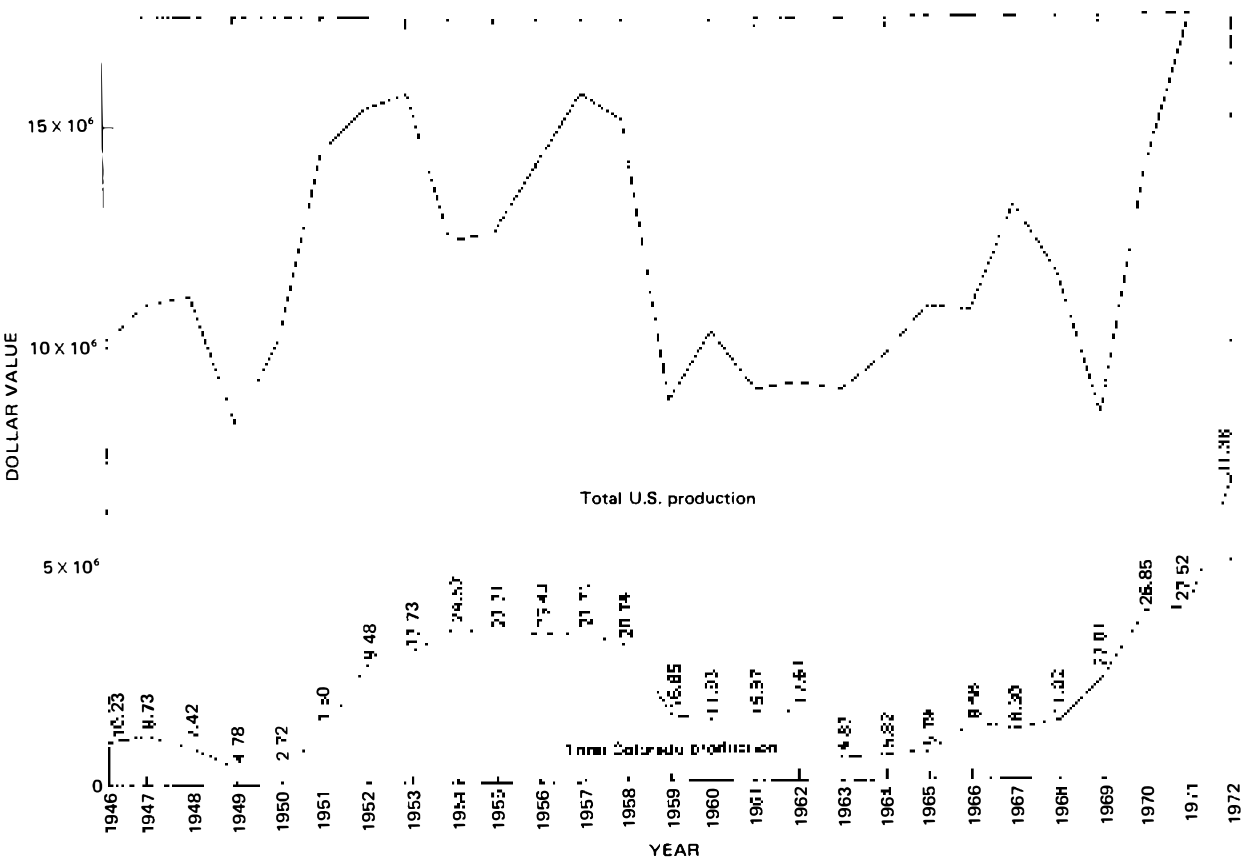

FIGURE 1.—Contribution to total U.S. dollar-value fluorspar production from Colorado for the years 1946–72. U.S. production figures compiled from data listed by U.S. Bureau of Mines (1946–72). Figures between the curves designate the percent of total production from Colorado.

accounted for 48 percent of the total net worth of fluorspar mined in Colorado within the last quarter century. The vein deposits in Jackson County, mainly at Northgate, but including minor production from the Crystal fluorspar district, have contributed 47 percent to the 1947–72 State total. Productive but somewhat less significant deposits include those in the Browns Canyon district, Chaffee County, and in the Wagon Wheel Gap area, Mineral County. Minor past production has come from fissure veins near Kenosha Pass in Jefferson County; the St. Peters Dome district, El Paso County; the Antelope Creek and Cotopaxi deposits in Fremont County; and the Poncha Pass deposits, Chaffee County.

LOCALITY DESCRIPTIONS

FLUORSPAR

A brief description of the magmatic or hydrothermal deposits mostly of Tertiary age, which contain variable amounts of fluorspar, is given to provide information about mineralogical and geochemical associations, and the environmental conditions favorable to fluorine mineralization. The spatial distribution, geologic character, and production of the various fluorspar occurrences, deposits, or major districts, are shown on the accompanying map.

BOULDER COUNTY

Jamestown district.—The Jamestown mining district lies in the central part of Boulder County at the northeastern extremity of the Colorado mineral belt. Jamestown is 8 miles west of Colorado Highway 7 along James Creek at lat 40°07′30″ N.; long 105°23′00″ W.

Jamestown, the most important currently active fluorspar district in Colorado, has accounted for about 60 percent of the total state fluorspar production to date. Active mining within the district began in 1874. Prior to 1940 initial developments at Jamestown were restricted to lead-silver, pyritic gold, and gold-telluride deposits. Although fluorspar was primarily a byproduct of the precious and base-metal ores, production began in 1903 with the shipment of 400 tons of metallurgical-grade fluorspar (Kelley and Goddard, 1969). Continuous shipments since 1942 from the Burlington mine by Allied Chemical Corp. have accounted for 700,000 tons of acid-grade fluorspar valued in excess of $24,000,000 dollars (data published with permission of Allied Chemical Corp.). The Emmett, Argo, and Blue Jay mines, operated by Harry Williamson and Son, produced fluorspar intermittently from 1940 to 1956 (Shawe, 1975). Shrinkage stoping has been the mining method used in many deposits in the district. The combination breccia-zone and vein deposits in the Emmett and Burlington

TABLE 2.—*Annual fluorspar production by county (1947-73) expressed in dollar value*

	Boulder	Chaffee	Jackson	Jefferson	Mineral
1947	562,013	250,000			254,000
1948					
1949	181,906	154,000			59,026
1950	181,906				107,400
1951	215,997				
1952	528,646	296,901	630,734		
1953	1,394,580	269,290	1,126,276		
1954	1,130,000	538,169	1,358,831		
1955	1,702,290		1,786,821		
1956	1,733,465		1,606,850		
1957	2,070,000		1,354,600		
1958	1,409,102		1,717,336		
1959	1,401,453		60,654	801	
1960	1,239,444				
1961	1,427,616				
1962	1,619,460				
1963	438,075				
1964	565,740				
1965	630,750				
1966	927,700				
1967	829,230				
1968	1,277,640		6,600		
1969	862,845		1,409,322		
1970	997,845		2,740,800		
1971	1,064,210		2,823,000		
1972	817,010		4,618,108		
1973	245,259		3,815,858		
Total	25,454,182	1,508,360	25,055,790	801	420,426
Percent of total dollar-value production (1947–1972)	45.54	2.87	47.78	<0.002	0.80

[1]Production data compiled from Jones (1948), Scott (1950–1959), Franz (1960–1969), and Blake (1970–1974).

mines have been developed to depths exceeding 1,000 feet (305 m).

An early report of the fluorspar deposits at Jamestown was made by Aurand (1920, p. 38). More detailed geologic descriptions have been provided by Goddard (1935, 1946), Lovering and Goddard (1950), and Kelley and Goddard (1969).

Silver Plume Granite of Precambrian age, which contains many small lenses of schist and hornblende gneiss, is the main unit exposed in the district (Goddard, 1946). Two Tertiary plutons with associated dikes were intruded into this Precambrian complex. Intrusion of a hornblende-granodiorite stock preceded the emplacement of a granite-quartz monzonite porphyry stock. Extensive brecciation along the southern and southwestern margins of the granite-quartz monzonite porphyry occurred contemporaneously with emplacement of the stock (Goddard, 1935).

A series of northwest-trending faults is located a few thousand feet south of Porphyry Mountain, the topographic expression of the granite-quartz monzonite stock. The faults occur within the Precambrian complex, and are cut by the Tertiary stocks and related dikes. Goddard (1946) postulated that these Late Cretaceous faults and associated breccia zones, termed breccia reefs, served as deep channels for the circulation of ore-forming fluids. Immediately west of the principal fluorspar deposits, northwest-trending extensions of the Maxwell and Hoosier reefs cross the district. Although fluorite is sporadically associated with pyritic gold veins and gold-telluride veins in these major fracture zones, localization of the significant fluorspar deposits is seemingly related to emplacement of the granite-quartz monzonite porphyry. A close genetic relationship between the fluorite mineralization and the intrusion of the granite-quartz monzonite porphyry has been demonstrated by Goddard (1935).

The principal fluorspar deposits lie within the breccia zones along the southern and western borders of the granite-quartz monzonite intrusive. The breccia zones are from 10 to 70 feet (3–21 m) wide, and from 150 to 1,000 feet (45–305 m) long (Goddard, 1946). The breccia zones and the enclosed fluorspar deposits vary greatly in mineral composition and structure. Discontinuous veins, large lenticular masses, and pipelike structures are characteristic of the steeply inclined orebodies. The abundance of brecciated granitic blocks, and locally scattered fragments of quartz and lead-silver ore included within the breccia zones affect the tenor of the ore. Fluorspar concentrations averaging 60 to 90 percent CaF_2 occur within the central zones of the deposits, and are commonly enclosed by lower grade brecciated ore containing 5 to 60 percent CaF_2 (Goddard, 1946). The fluorspar commonly contains appreciable quantities of silica; however, quartz or chalcedony generally occur as host rock constituents rather than intimate intergrowths with the ore. Hence, low-grade ores are amenable to economic concentration through conventional beneficiation techniques.

As a result of multistage brecciation and ore deposition, the pink to deep violet fluorspar usually appears fragmental. Various clay minerals, quartz, sericite, and trace amounts of pyrite, galena, and euthedral biotite are the principal constituents of the fine-grained breccia matrix.

Fluorspar has been produced intermittently since the early 1900's. Approximately 100,000 tons of combined acid- and metallurgical-grade fluorspar were processed during the period 1903-44. Acid-grade fluorspar presently (1973) is being produced by the Industrial Chemical Division of Allied Chemical Corp. from depths below 1,400 feet (425 m) in the Burlington mine. In the lower levels of the mine the smaller high-grade fluorspar veins coalesce to form a larger vein zone of lower grade, and brecciated wall rock is less common at depth. Further exploration of the more significant deposits at depth seems to be warranted. The potential of the district is enhanced by the recovery of trace amounts of base-metals in the fluorspar ores.

Nederland.—Minor occurrences of fluorite have been noted by Lovering and Tweto (1953) from a few localities within the Boulder County tungsten district. Trace amounts were reported from the Lower Rambler, Logan, Grand Republic, Vasco No. 10, and Oregon mines. The largest concentration of fluorite occurs as a narrow discontinuous band of purple fluorspar 1 to 3 feet (30-90 cm) wide, cementing brecciated gray horn quartz within the Quaker City vein of the Oregon mine. The principal associated metallic minerals are ferberite, galena, sphalerite, tetrahedrite, proustite, pyrargyrite, and pyrite.

Magnolia.—The gold-telluride ores in the Magnolia district contain minor amounts of fluorite within the steeply inclined west- to northwest- trending mineralized breccia reefs. Fluorine mineralization is sparse in these shallow deposits, and no veins of commercial fluorspar were found during development of the district.

CHAFFEE COUNTY

Browns Canyon district.—The Browns Canyon fluorspar district lies between the Arkansas River and U.S. Highway 285 in the southern end of the Arkansas Valley about 9 miles north of Poncha Springs. These deposits were worked by several companies between 1927 and 1949 when the final shipments were made. Commercial concentrates exceeding 130,000 short tons and valued at approximately $5 million were produced during this period (Van Alstine, 1969). The principal production has come from a mineralized northwest-trending shear zone which separates a Precambrian granitic and metamorphic complex on the east from adjacent Tertiary volcanic rocks. The most productive vein, which occurs at a fault intersection located between the rhyolite and granitic gneiss, has been mined for 1,600 feet (485 m) along strike (Del Rio, 1960, p. 87). Several small independent faults in the vicinity have had minor production. The principal vein minerals are fluorite and microcrystalline and chalcedonic quartz; however, minor quantities of calcite, barite, pyrite, marcasite, and various manganese oxides occur locally. Fluorspar resources exceeding two million short tons of crude ore containing 15 percent CaF_2 have been estimated by Van Alstine (1969).

Poncha Springs district.—The Poncha Springs district is on the border of the San Isabel National Forest in the southern half of section 15, T. 49 N., R. 8 E., one mile (1.6 km) south of Poncha Springs. The terrane is characterized by Precambrian granite gneiss and schist which are locally intruded by pegmatite dikes. The Aksarben property (Argall, 1949) is developed by two separate subsurface workings and numerous prospect pits. The main fluorspar body is within the center of a steeply inclined northwest-trending shear zone about 150 feet (45 m) wide. Fluorite in botryoidal masses, radiating columnar aggregates, and thin discontinuous stringers characterize the ore zone. The fluorite veins range from a fraction of an inch to between 4 and 5 feet (150 cm) in width, and are extremely variable laterally and vertically. Although manganese oxides sporadically encrust botryoidal spar, fluorite is the principal vein mineral present. The main development during the 1940's resulted in minor production of metallurgical-and ceramic-grade fluorspar. Shipments from the Aksarben property in 1942 assayed 78.9 to 91.4 percent CaF_2 (Argall, 1949). Complex structure and erratic distribution of the fluorite have restricted extensive development of this deposit.

Poncha Pass deposit.—The Poncha Pass fluorspar deposit lies at the northern end of the San Luis Valley approximately 1 mile (1.6 km) north of Poncha Pass in the southern half of section 4, T. 48 N., R. 8 E.The area is connected to U.S. Highway 285 by an unimproved dirt road about 1.5 miles (2.4 km) long. Precambrian quartzite, schist, and hornblendite constitute the principal hosts for the several small prospects and adits. The fluorspar deposit occurs locally as breccia coatings and small veins within numerous irregularly trending fractures and faults in the quartzite. The principal veins are only a few feet in width, and contain considerable amounts of brecciated quartzite. Quartz, chalcedony, and trace quantities of manganese oxides are the predominant accessories. The Divide claims (Argall, 1949) include a few small pits and adits from which the principal production came. The discontinuity of fractures and the dispersed nature of fluorspar within these deposits restricted production to a few thousand tons.

Vulcan Mountain.—A short, narrow vein that contains quartz and fluorite crops out on the east side of Vulcan Mountain near the Continental Divide, 4 miles (6.5 km) northwest of Garfield at lat 38°34′40″ N.; long 106°21′47″ W. The discontinuous vein transects Miocene volcanic breccia, and was formed by hydrothermal solutions associated with post-consolidational stages of the volcanic rocks (Dings and Robinson, 1957).

Winfield-Clear Creek area.—A few discontinuous veins composed of quartz and fluorite crop out along the northern slope of Cross Mountain 0.5 mile (0.8 km) east of Winfield along Clear Creek between 10,240 (3,121 m) and 10,600 feet (3,230 m) altitude (Brock and Barker, 1972). These north-trending veins, which are only a few feet in maximum width, lie within Tertiary Twin Lakes Granodiorite and vary in dip from 80° W. to 75° E.

Small amounts of fluorite occur associated with the veins which contain quartz and molybdenite in the Banker mine, immediately south of Winfield along the South Fork of Clear Creek. The mineralization at the Banker mine is related to late-stage hydrothermal activity associated with crystallization of the Tertiary Twin Lakes intrusive (Brock and Barker, 1972).

CLEAR CREEK COUNTY

Georgetown.—Fluorite occurs commonly in bostonite dikes, and as minor veinlets along the margins of these intrusives in the Leavenworth Mountain district; however, fluorite is relatively uncommon as a gangue mineral in the silver and gold-bearing veins which are the principal ore zones in the district. The auriferous veins within the Leavenworth Mountain district contain more significant concentrations of fluorite than do the argentiferous veins. Minor amounts of light-green and purple fluorite were noted by Spurr and Garrey (1908) occurring as a primary mineral contemporaneous with tourmaline along a fractured pegmatite in the Prudential tunnel; metallic minerals are absent in the pegmatite.

Argentine-McClellan Mountain area.—In contrast to the silver-bearing veins at Leavenworth Mountain, the argentiferous deposits of the Argentine-McClellan Mountain district contain locally abundant fluorite. Galena, sphalerite, pyrite, and tetrahedrite constitute the chief ore minerals, and quartz, calcite, and fluorite are the principal gangue minerals.

Urad.—Trace amounts of fluorite are dispersed through the extensive low-grade molybdenum deposit on the southwest flank of the Red Mountain porphyry stock west of Empire. The fluorite is not recovered during beneficiation of the molybdenum ore, presumably because it is too sparse to be recovered economically.

CUSTER COUNTY

Antelope Creek deposit.—Fluorspar has been mined from the Antelope Creek deposit in the southeastern part of Custer County. The vein deposit is on the border of the San Isabel National Forest a few hundred feet south of Piltz Creek, a tributary of Antelope Creek in the NW¼NW¼ sec. 18, T. 23 S., R. 70 W. Light-green to brown fluorite occurs as a narrow vein 20 inches to 4 feet (51–122 cm) in width and 110 feet (33 m) in length (Aurand, 1920, p. 53) within a northeast-trending fissure zone in Precambrian granite and gneiss. The finely fractured fluorspar grades into fine-grained siliceous material, the primary impurity of the ore. The property, which is extensively caved, has not been worked since 1920, when the Jocmo Mining Co. shipped over 1,000 tons of fluorspar averaging 80 percent CaF_2 to the Colorado Fuel and Iron Co. at Pueblo.

DOLORES COUNTY

Rico.—Colorless to white and purple fluorite occurs as a common gangue mineral in the ore deposits of CHC Hill (the lower west slope of Dolores Mountain) and in the Rico-Argentine mine (Ransome, 1901b). Irregular pods and open-space fillings as much as a foot across are present in massive pyritic bodies. Fluorite also occurs as discontinuous veinlets and minor disseminations in hydrothermally altered alaskite porphyry dikes within the Pigeon tunnel, the most northerly important workings on CHC Hill. Pyrite, chalcopyrite, sphalerite, galena, tetrahedrite, argentite, and proustite are the common sulfide minerals in these replacement deposits.

DOUGLAS COUNTY

C and S deposit.—The C and S fluorspar deposit was originally located on a map by Van Alstine (1964, p. 161). Van Alstine referred to the deposit as an area which contained minor fluorspar veins; however no additional information is available regarding this fluorspar locality.

EL PASO COUNTY

St. Peters Dome district.—The St. Peters Dome district lies at the eastern margin of the Front Range approximately 8 miles (13 km) southwest of Colorado Springs along the Gold Camp road. The district lies within a northeast-trending belt of Precambrian Pikes Peak Granite 1,200 feet (365 m) wide and 1,700 feet (518 m) long. The medium- to coarse-grained porphyritic granite is locally intruded by Precambrian aplite, lamprophyre, cryolite-bearing pegmatite dikes, and a mid-Tertiary(?) lamprophyre dike (Steven, 1949). The dikes occupy three distinct joint sets which transect the arch-like granite structure. Two periods of vein mineralization are noted. The first mineralization period is characterized by finely granular to chalcedonic chlorite-bearing quartz. During the second period, fluorite-quartz veins were formed in a narrow north-trending zone of shear joints and en echelon fractures which cut the earlier structures. Brecciated white, green, and purple fluorite is commonly associated with thin, discontinuous siliceous veinlets. The fluorite-enriched fractures and breccia zones are extremely irregular. Vein-widths vary from a few inches to 7 feet (2 m). Originally prospected for gold and silver, these deposits have yielded 16,000 tons of fluorspar (Steven, 1949). Although the tenor varies considerably, near-surface ore reserves are estimated to exceed 65,000 tons containing a minimum of 35 percent CaF_2 (Steven, 1949).

FREMONT COUNTY

Canon City area.—Narrow veins of fluorspar occur along thin fissures in Ordovician limestone at several localities in section 31, T. 16 S., R. 70 W., about 12 miles (19 km) north of Canon City. Green- and white-banded fluorite crops out along a zone a few hundred feet long, and the veins have a maximum thickness of 6 inches (13 cm). Where exposed in a prospect trench along the mineralized zone, the vein appears to pinch out both laterally and vertically. Although the vein deposits seem to have limited potential, the area is of interest because the sedimentary carbonate country rocks are potential hosts for fluorspar replacement deposits or mantos.

Cotopaxi.—The Blue Spar deposit is located in Falls Gulch about 3 miles (5 km) southwest of Cotopaxi at lat 38°20′00″ N.; long 105°43′00″ W. Fluorspar occurs as an 18-inch- (45 cm) wide vein which strikes N. 10° E. and dips 60°-80° toward the west. Country rock consists of fractured and decomposed coarse-grained Precambrian biotite granite. The prospect, now extensively caved, was developed by a shaft, drift, and a few raises. The principal development of this property occurred during 1936, when several carloads of purple and white fluorspar averaging 90 percent CaF_2 were shipped to the Colorado Fuel and Iron Co. at Pueblo (Argall, 1949).

GILPIN COUNTY

Central City.—Green, purple, or more rarely colorless fluorite is a characteristic gangue mineral of telluride ores in parts of the Central City district. Commonly, although not invariably, fluorite is associated with enargite in composite pyrite-bearing veins, which are associated with bostonite porphyry dikes. Fluorite has been noted in the Chase, War Dance, Kokomo, Silver Dollar, Hampdon, Powers, Iroquois, Anchor, Hazeltine, Togo, and Hill-Bunk House mines (Bastin and Hill, 1917).

GUNNISON COUNTY

Brittle Silver Basin.—Fluorspar mineralization in the Brittle Silver Basin is confined mainly along several northeast-trending quartz-fluorite veins, which crop out within a narrow belt 0.25 mile (0.4 km) wide and 1.75 miles (2.8 km) long on the west side of Central Mountain. The Day Star mine, located at lat 38°36′08″ N.; long 106°22′27″ W., marks the northern extent of the veins composed of fluorite and quartz. The veins vary in width from 1 to 5 feet (30 cm-1.5 cm), and although some veins are short and narrow stringers, most veins are at least 500 feet (150 m) long (Dings and Robinson, 1957). These moderately to steeply inclined fissure veins have strikes ranging from N. 20° W. to N. 20° E. across the Tertiary (quartz latite, quartz monzonite, and quartz monzonite porphyry of the) Mount Princeton Quartz Monzonite and Mount Aetna Quartz Monzonite Porphyry. Alternating quartz and fluorite stringers, sinuous networks of veinlets, and vugs partially or entirely filled with fluorite crystals are the principal modes of occurrence. Base-metal sulfides are inconspicuous, and only rare minor quantities of pyrite, galena, sphalerite, chalcopyrite, and sparse stephanite crystals occur in association with the veins that contain quartz and fluorite. Fluorite mineralization is presumably related to hydrothermal solutions active during post-consolidational stages of Tertiary volcanic breccias exposed within the area (Dings and Robinson, 1957).

Quartz Creek.—Fluorite associated with quartz in a northeast-trending vein system extends 5,000 feet (1,525 m) across secs. 7 and 18, T. 50 N., R. 5 E., at an approximate altitude of 10,500 feet (3,200 m). The main vein, which cuts argillized Precambrian Silver Plume Granite, strikes N. 35°-45° E. and dips steeply toward the northwest. The green and purple fluorspar occurs as small veinlets as much as 4 inches (10 cm) wide, enclosed in an 8- to 10-foot-wide (2.8- to 3-m-wide) zone of fine-grained or microcrystalline quartz. The fluorspar content of the entire vein is probably less than 20 percent, which would restrict economic development.

Lead King Basin.—Fluorite is the principal gangue mineral associated with the base-metal ores from Lead King Basin which is 1.8 miles (2.9 km) north east of Crystal (Vanderwilt, 1937). Quartz and pyrite, generally abundant in deposits of this type, are not common here. Colorless, pink, and green fluorite commonly occur as fissure-fillings or veins associated with chalcopyrite and sphalerite. The ore in the basin was localized along the intersection of northwest-trending fractures and the basal part of the limestone member of the Upper Cretaceous Mancos Shale (Vanderwilt, 1937).

Powderhorn.—Fluorite veins in Cambrian carbonatites and pyroxenites occur in the upper drainage of Deldorado Creek (Larsen, 1942). Minor discontinuous veins of fluorite which cut Precambrian granite have been reported (J. C. Olsen, oral commun., 1973) about 5 miles (8 km) east of Powderhorn in the SE¼SE¼ sec. 5, T. 46 N., R. 1 W., between an altitude of 9,900 (3,017 m) and 10,000 feet (3,048 m). However, the sparse distribution of these fluorite stringers prohibits economic development.

Paradise Pass.—Minor amounts of fluorite occur with quartz, pyrite, and base-metal sulfides in veins which cut a quartz diorite stock of Oligocene age at the pass south of Paradise Basin. The pass is at an altitude of 11,280 feet (3,438 m), between Cinnamon Mountain on the west and Mount Baldy on the east, at approximately lat 38°59′45″ N.; long 107°03′45″ W. Mineralization is restricted to stockwork molybdenite deposits and base-metal sulfide veins. The limited amount of sulfides and the irregularity of the veins have prohibited economic development.

Treasure Mountain.—The concentrically zoned mineral deposits associated with the Miocene and Pliocene granite of Treasure Mountain contain varying amounts of fluorite. The district is situated along Yule Creek 4 miles (6.4 km) southeast of Marble. Veins which contain quartz, fluorite, and various sulfides are in skarn next to the intrusive, and copper sulfides occur along the outermost margin of the dome (Mutschler, 1968). Fluorite is found in all vein and replacement deposits. Pyrite, galena, sphalerite, tetrahedrite, and molybdenite are commonly associated with the fluorite.

HINSDALE COUNTY

Galena.—Minor amounts of pale-green fluorite associated with the lead-silver ore from the Hidden Treasure mine were noted by Aurand (1920). These epithermal base-metal deposits occur as fissure fillings within brecciated andesitic rocks of the Picayune Formation.

Fluorite has been recorded as a gangue mineral in a narrow vein in the Chord Extension shaft (Bancroft and Irving, 1911). Tetrahedrite, galena, and chalcopyrite constitute the principal metallic minerals of the vein, which strikes N. 10° E. through a monzonite porphyry intrusive.

HUERFANO COUNTY

Wet Mountains.—In the vicinity of Badito cone, a Tertiary hypabyssal rhyolite intrusive at the southern end of the Wet Mountains, lavender to purple fluorite cements altered Cretaceous Dakota Sandstone which contains accessory thorium, uranium, and zirconium minerals (Boyer, 1961). Trace amounts of thorium and uranium are also present in the fluorite cement. The most extensive mineralization is localized near the Stumbling Stud mine, along the southwestern flank of the Greenhorn anticline in NW¼SE¼ sec. 20, T. 26 N., R. 68 W. A conspicuous fault, which extends outward from Badito cone and passes near the mine, may have controlled migration of the mineralizing solutions.

JACKSON COUNTY

Crystal district.—The Crystal fluorspar district lies on the eastern border of the Park Range within the Routt National Forest 18 miles (29 km) west of Walden at lat 40°41′00″ N.; long 106°35′00″ W. The terrane is predominantly a Precambrian granitic and metamorphic complex overlain along its eastern margin by sedimentary rocks ranging in age from Triassic to Pleistocene. A detailed description of the character and distribution of the rocks within the area is presented by Hail (1965).

Precambrian intrusive rocks in the Crystal district include granite and quartz monzonite which may have porphyritic textures. These intrusive rocks are extensively altered and silicified along the numerous fractures which cut the pluton. Although not clearly evident, three ages of the faults are assumed: Precambrian, Laramide, and middle to late Tertiary. Fluorite mineralization is confined to fissure-filling veins along north- to northeast-trending tension fractures in the Precambrian granitic rock (fig. 2). Fluorite veins exhibit pronounced multistage brecciation and depositional features characteristic of other epithermal fluorspar deposits. Unpatented lode claims, which cover several thousand acres of National Forest, have been issued to Ozark-Mahoning Co., Geo Surveys, Inc., W. D. Tripp, Beta Mining Co., and Richard Flesh & Co.

The Crystal fluorspar mine presently (1973) operated by the Ozark-Mahoning Co. is in the NW¼NW¼ sec. 10, T. 8 N., R. 72 W. The property is developed by two drifts at 9,050 (2,758 m) and 9,200 feet (2,804 m) altitude and by numerous trenches along the surface. The main vein at its southern end strikes N. 25°-35° W. and dips 54° SW. This segment of the vein, which is 1,000 feet (305 m) long, then intersects an adjoining fault which it follows along a bearing of N. 5° W., dipping 63° W., for another 2,000 feet (610 m). Total vein length, therefore, is about 3,000 feet or 915 m (fig. 2). The vein thickness is highly variable, ranging from a maximum of 12 feet (3.6 m) to a complete pinchout locally. Purple, green-, and white-banded fluorite is common; however, several periods of deposition coupled with recurrent movement along fault zones has brecciated the ore. Metallic sulfides are not visible at surface outcrops, but occur sporadically as inclusions in massive fluorite. Marcasite and minor pyrite, which are generally altered to hematite and limonite, are the principal sulfides present. The marcasite and pyrite inclusions vary in size from minute grains to masses greater than 1 foot (30 cm) in diameter. Finely granular to cryptocrystalline quartz is ubiquitous in the veins, but the amount is extremely variable. Silicification is confined to the narrow north-trending tension-fracture zones. Near the Crystal

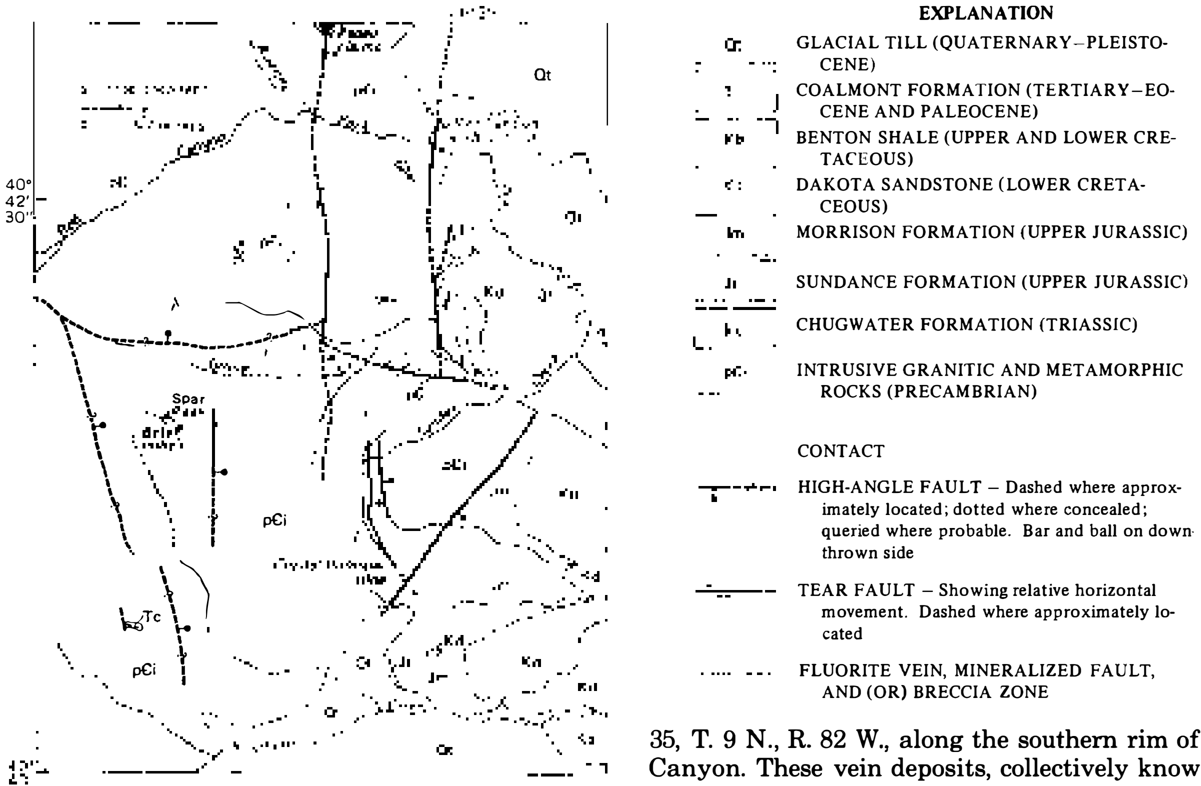

FIGURE 2.—Geologic sketch map showing the distribution of significant fluorspar veins in the Crystal mining district, Jackson County Modified from Hail (1965).

mine, microcrystalline quartz veinlets commonly contain fluorite breccia fragments.

The Crystal mine is presently (1973) the only productive mine in the district. Although both cut-and-fill and open-stoping methods are to be employed, no ore has yet been removed from either the 9,050- (2,758-m) or 9,200-foot (2,804 m) levels. The ore obtained to date has come from open cuts. Between 150 and 200 tons of fluorspar, ranging from 40 to 70 percent CaF_2, is trucked daily to the mill at Northgate, 40 miles northeast of the Crystal mine.

The Beta mine is located on the summit of Spar Peak (fig. 2) a prominent ridge composed of silicified and faulted granite. Like other deposits in the area, fluorite is restricted to narrow breccia zones adjacent to silicified north-trending faults. In contrast to nearby veins, the fluorite at Beta has a mammillary texture. White finely crystalline fluorite intergrown with microcrystalline quartz is abundant. These breccia deposits, which are 8 feet (2.4 m) in maximum width, probably do not exceed a few hundred feet in length and are discontinuous laterally and vertically. No ore has been shipped from this locality; however, a few tons of fluorspar are stockpiled near the shaft.

Numerous thin randomly oriented discontinuous veins of fluorite crop out within secs. 32, 33, 34, and 35, T. 9 N., R. 82 W., along the southern rim of Red Canyon. These vein deposits, collectively known as the Spar claims, are controlled by Geo Surveys, Inc. The finely crystalline white fluorspar contains varying amounts of admixed microcrystalline quartz. A few veins could be traced for distances exceeding 1,000 feet (305 m); however, the dispersed occurrence of the fluorspar and the high silica content may deter development of these deposits.

Additional occurrences of purple uraniferous fluorite within the Crystal district have been reported by Malan (1957). Fluorite is associated with autunite, pyrite, galena, chalcopyrite, and quartz in the Pedad claims along a dominant north-trending fault in sec. 27, T. 9 N., R. 82 W.

Fluorspar in the Crystal district is mainly along silicified north-trending fractures in Precambrian rocks. Fluorite occurs in stockworks and fissure-fillings in the breccia zones. The veins presumably do not extend to depths below a few hundred feet. Near the headwaters of Raspberry Creek, a small remnant of the Paleocene and Eocene Coalmont Formation is exposed at an altitude of 10,400 feet (3,170 m). These sandstones contain tiny veinlets, interstitial fluorite, and minute euhedral crystals generally less than 1 millimetre in diameter (G. L., Snyder, oral commun., 1973). This occurrence provides the only clue as to the age of mineralization within the area. Steven (1960) has shown that the latest of two distinct mineralization stages within the Northgate district 40 miles (64 km) to the northeast occurred after deposition of the Oligocene White River Formation.

Delaney Butte area.—Several easterly-trending fluorite veins crop out between 9,000 and 9,300 feet (2,740 and 2,835 m) on Delaney Butte in NE¼NE¼

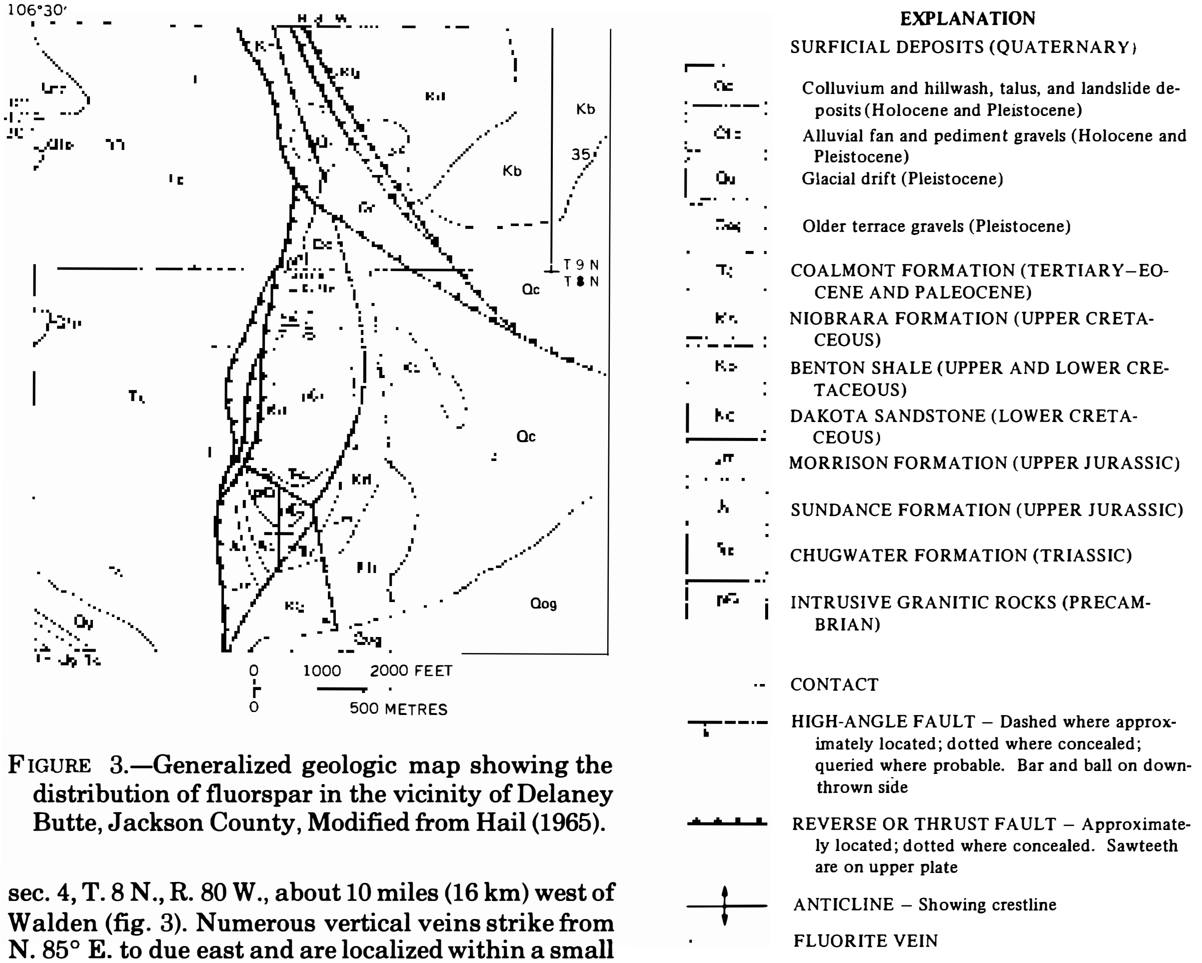

FIGURE 3.—Generalized geologic map showing the distribution of fluorspar in the vicinity of Delaney Butte, Jackson County, Modified from Hail (1965).

sec. 4, T. 8 N., R. 80 W., about 10 miles (16 km) west of Walden (fig. 3). Numerous vertical veins strike from N. 85° E. to due east and are localized within a small area near the summit of Delaney Butte. The colorless to light-green fluorspar veins, best exposed on the west side of the Butte, occupy tension fractures in Precambrian granite. These veins pinch and swell in a highly irregular manner. They range in thickness from a few inches (a few cm) to 4 feet (1.2 m) and rarely exceed a few hundred feet in length. Most fluorite in the veins is octahedral, and cubic crystals are rare. No metallic sulfides were observed in direct association with fluorite. However, trace amounts of pyrite were noted as minute disseminated grains within the Precambrian granite host. Preliminary investigations by the Colorado Fuel and Iron Co. indicate that the veins have a tenor ranging from 15 to 70 percent CaF_2. Regardless of tenor, the ore reserve is too small to support a mining operation, although conceivably these veins might be a future source of a small tonnage of fluorspar.

Northgate district.—The Northgate district is situated along the western flank of Pinkham Mountain at the southern tip of the Medicine Bow Mountains 14 miles (22 km) north of Walden along Colorado Highway 127. The substantial fluorspar deposits at Northgate, exceeded only by those at Jamestown in total output, have accounted for approximately 32 percent of the total fluorspar production in Colorado to date. Commercial development within the district was initiated by Colorado Fluorspar Corp. between 1922 and 1927 and resulted in the production of 15,000 tons of metallurgical-grade fluorspar (Steven, 1960). Mining ceased after 1927 until 1941 when the Western Fluorspar Corp. leased the Colorado Fluorspar Corp. claims and resumed production. Approximately 115,000 tons of fluorspar were extracted from the Fluorspar-Gero-Pember and the Fluorine-Camp Creek vein zones until operations were stopped in 1945 (Steven, 1960). Production in the district was re-initiated in 1951 by Ozark-Mahoning Co., the present operator, and concentrating-mill capacity was increased in 1968 from 300 tons to 650 tons per day (Worl, 1974).

The most comprehensive geologic description of the Northgate district is by Steven (1960). Earlier publications by Steven (1956, 1957) described the petrology of the Precambrian crystalline rocks and geomorphic history in the vicinity of Northgate. Brief descriptions of the fluorspar deposits at Northgate are given in publications by Burchard (1934), Cox (1945), Van Alstine (1947), and Warne (1947).

The terrane at Northgate is characterized by Precambrian quartz monzonite and hornblende-biotite gneiss unconformably overlain by, and locally faulted against, intensely folded northwest-trending Triassic to Holocene sedimentary rocks. Tertiary rocks, which comprise siltstones, sandstones, and gravels of the Miocene North Park Formation, as well as siltstone and arkosic sandstone of the Paleocene and Eocene Coalmont Formation, occupy Tertiary valleys cut into the Mesozoic and Precambrian rocks in the North Park intermontane basin (Steven, 1960).

The Independence Mountain fault, a pronounced east-trending reverse fault, is the most prominent structural feature in the district. Mesozoic sedimentary rocks on the hanging wall contain substantial quantities of fluorspar but only sparse amounts of fluorite have been noted in the footwall, which is composed of Precambrian quartz monzonite. The principal production has come from the Fluorspar-Gero-Pember and the Fluorine-Camp Creek vein zones, which, respectively, extend 1 mile (1.6 km) north and 2 miles (3.2 km) northwest of the Independence Mountain fault (Steven, 1960). Argillic and siliceous alteration zones are prevalent in the siltstone and arkosic sandstone of the White River Formation adjacent to the Fluorine-Camp Creek vein zone. However, in the Fluorspar-Gero-Pember zone the quartz monzonite hostrocks are characterized by siliceous and pyritic alteration zones.

The fluorite occurs as a complex network of irregular veins in fault-breccia which was formed during late Tertiary movement along north- to northwest-trending faults on Pinkham Mountain. With the exception of sporadic sparsely mineralized zones along the Fluorine-Camp Creek vein system, fluorite deposition was fairly continuous and extended over a vertical range of 1,000 feet (305 m) (Steven, 1960). The anastomosing and sinuous veins range from a fraction of an inch to a few feet in maximum thickness. The ore zone is characterized by multicolored brecciated or granulated fluorspar associated with coarse-textured fault gouge and is enclosed locally by relatively pure fluorite veins along the outer margins of the mineralized zone. No conspicuous depositional sequence was determined for these deposits, as repeated brecciation and silicification have masked the paragenetic sequence. Abundant chalcedony, and minor quantities of quartz, pyrite, barite, and manganese oxides accompany the brecciated, banded, or crustified fluorspar at Northgate. The tenor of the ore, although extremely variable, averages between 40 and 50 percent CaF_2 (Steven, 1960). A significant tonnage of fluorspar is currently being produced by the Ozark-Mahoning Co. from underground workings along the Fluorspar-Gero-Pember vein system and by open pit and underground workings along the Fluorine-Camp Creek zone. These epithermal deposits have yielded fluorspar concentrates exceeding 16.6 million in value between 1947 and 1971, and account for over 38 percent of the total Colorado fluorspar production during that period.

JEFFERSON COUNTY

Eldorado Springs area.—Aurand (1920) and Wells (1967) have reported minor occurrences of fluorspar southwest of Eldorado Springs. The fluorite fills fractures and forms small veinlets in north-northwest-trending zones of intensely silicified and fractured quartz monzonite and quartzite. Quartz, muscovite, andalusite, and minor opaque oxides constitute the principal accessory minerals associated with the purple fluorite. Because of the high silica content and the sporadic distribution of the fluorite within the breccia reefs, these prospects are economically insignificant.

Bankers lode claim is located along a north-trending breccia zone within Precambrian Boulder Creek Granodiorite (and a granite gneiss) in the SE¼NW¼ sec. 9, T. 2 S., R. 71 W., at an altitude of about 8,500 feet (2,590 m). The mine was originally developed by a drift approximately 500 feet (152 m) long, two raises, and a crosscut; however, these workings are now extensively collapsed. King, Sheridan, and Adams (1954) prepared a preliminary report and geologic map of this mine in conjunction with uranium reconnaissance investigations within the Copperdale district. Primary fluorite and chalcocite(?) are associated with secondary malachite, cuprite, tenorite(?), and schroeckingerite(?). Quartz, hematite, and limonite constitute the principal gangue minerals.

Evergreen area.—The Augusta mine, originally developed as a lead, zinc, and copper prospect, produced over 1,000 tons of fluorspar during the early 1900's (Aurand, 1920). These workings were developed along a fissure vein which strikes N. 35° W. and dips 82° SW. across Precambrian hornblende-biotite granite and gneiss. Light-purple and green fluorspar veins, which cross Cub Creek 1.75 miles (2.8 km) south of Evergreen, range from 1 to 5 feet (0.3-1.5 m) in thickness and average 2 feet (0.6 m) in width. This fissure vein, which is now extensively collapsed, grades both laterally and longitudinally into quartz and pegmatite dikes.

Buffalo area.—Fluorspar was found in two drifts near Buffalo during prospecting for gold and silver in 1897 and 1898 (Aurand, 1920). Deep-purple fluorite, which was extensively fractured, occurred as thin seams a few inches wide within a northwest-trending fissure zone in Precambrian biotite granite. Alternating quartz and fluorite stringers are associated with galena, pyrite, and barite.

LA PLATA COUNTY

La Plata.—Fluorite has been observed in the Copper Hill-Bedrock Creek area approximately 1.5 miles (2.4 km) west of La Plata (Eckel, 1949). Lavender to purple fluorite occurs as a gangue mineral associated with platinum-bearing chalcopyrite ores. Irregular lenses and discontinuous veins which contain fluorite and admixed finely crystalline quartz crop out in the upper part of Bedrock Creek near the Allard tunnel. Translucent cubes as much as one-half inch (1.3 cm) on edge associated with gold and silver tellurides in the Gold King mine have also been recorded (Eckel, 1949).

Mason mine.—Minor amounts of fluorite occur with gold, cinnabar, native mercury, and sylvanite-bearing ores from the Mason mine between Tripp Gulch and Falls Creek, 2.5 miles (4 km) west of Trimble.

Needle Mountains.—Mineralized fissures contain varying amounts of fluorspar in Chicago and Vallecito Basins, approximately 5 miles (8 km) southeast of Needleton, near the headwaters of Needle Creek. Pale-green and white coarsely crystalline fluorite associated with light- to dark-gray cryptocrystalline quartz occurs as thin stringers within the central zone of the northwest- and northeast-trending fractures (Cross and others, 1905). These fissures constitute two distinct perpendicular steeply inclined sets in plan, which intersect in Chicago Basin, where they cut Tertiary granitic intrusives. Base-metal sulfides that include pyrite, chalcopyrite, galena, and sparsely disseminated sphalerite were deposited along the margins of the mineralized fissures. Rhodochrosite, chalcedony, and fluorite were deposited during the last stages of crystallization within these crustified veins.

LAKE COUNTY

Leadville.—Millers adit, located along the western flank of Mount Evans at lat 39°16′00″ N.; long 106°11′00″ W., contains the only reported occurrence of fluorite within the Leadville district (Behre, 1953). The tunnel was driven along a steeply inclined northeast-trending fault which crosses the contact between the Peerless Formation and the Sawatch Quartzite. Minor amounts of fluorite were deposited within the fault fissures.

Climax. —Colorless, green, and purple fluorite occurs in the Climax district and is noticeably abundant adjacent to zones containing high-grade molybdenite ore. Fluorite also occurs in the stock as small disseminated octahedrons and irregular masses generally less than a few inches (5 cm) across. The disseminated fluorite is generally associated with sericite in tiny fractures that occur randomly throughout the intrusive rocks (Wallace and others, 1968). The fluorite is not recovered during beneficiation of the molybdenum ore.

LARIMER COUNTY

Prairie Divide.—Small amounts of fluorite were reported by Sims and others (1958) following an investigation of the Prairie Divide property, Larimer County. The Copper King mine, originally prospected for copper and zinc, was developed subsequently as a uranium mine. The fluorite occurs sparsely disseminated adjacent to pitchblende-siderite veinlets in altered Precambrian granite (Sims and others, 1958).

Moose Mountain.—Tiny discontinuous veinlets and fracture fillings of fluorite occur within a northeast-trending shear zone in the Precambrian Silver Plume Granite 9.7 miles (15.6 km) northwest of Lyons along Colorado Highway 66. The amount of purple fluorite occurring here is too small to be economically inportant.

MESA COUNTY

Unaweep Canyon deposit.—A few northwest-trending fluorspar veins are exposed along the north side of East Creek near Nancy Hanks Bridge, 13 miles (20 km) southwest of Whitewater along Colorado Highway 141. These veins were prospected originally for gold, silver, and base metals, and occur as closely spaced mineralized fissures within a Precambrian metamorphic complex. Calcite and quartz are the principal accessory minerals associated with the green fluorite in these irregular, discontinuous fluorspar veins. Additional fluorspar occurs in the Upper Triassic Wingate Sandstone, which unconformably overlies the Precambrian granitic and metamorphic rocks at the Wooden Door prospect. The Wooden Door prospect is along the northwest extension of the fissure veins in the Wingate Sandstone near Nancy Hanks Bridge. These sinuous veins, which average a few inches (5 cm) in thickness, would probably yield less than 20 percent CaF_2 (J. A. Younger, oral commun., 1972).

On the Uncompahgre Plateau near the Wiel (Taylor) Ranch, several prominent northeast-trending fissure veins cut the Wingate Sandstone. These fractures, which dip 60° to 80° SE., contain minor amounts of green coarsely crystalline fluorite. Calcite and wallrock fragments constitute the major part of the fractured zone. The fluorite concentration does not appear to increase markedly with depth. The limited extent of mineralization, and the discontinuity of the fluorite veins make these deposits economically insignificant.

Ryan Park.—Minor fluorine mineralization occurs in Precambrian igneous rocks and the overlying Wingate Sandstone in the NW¼ sec. 24, T. 22 S., R. 25 E., along the south side of Ryan Creek in Utah immediately west of the Colorado State line. The pale-green fluorite defines a series of nearly vertical veins distributed erratically in the country rocks. These discontinuous veins, 4 feet (1.2 m) in maximum thickness, form sharp contacts with the granitic host. Finely disseminated green fluorite is present locally in the Wingate Sandstone. Minor amounts of barite and galena occur with the fluorite. This type of mineralization may extend into Colorado, but I noted no apparent indications of this.

MINERAL COUNTY

Wagon Wheel Gap.—The Wagon Wheel Gap fluorspar deposit is along the east side of Goose Creek 1.5 miles (2.4 km) south of the Rio Grande. Granular white fluorite is the principal mineral in the fissure-vein, which strikes N. 80° E. Lesser amounts of yellow, green, brown, lilac, and purple fluorite occur as encrustations on fissure walls, as bands near the vein margins, as euhedral crystals lining cavities, and as crystalline masses deposited along watercourses. Mineralization is confined to a few subparallel fractures, dipping 70° to 80° S., which cut Oligocene Farmers Creek Tuff. The main lode has been developed laterally, and to a depth exceeding 700 feet (213 m) below the surface. The principal vein averages from 6 to 8 feet (1.8–2.4 m) in width, and the maximum width found during development was 35 feet (10.6 m; Burchard, 1934). Large quantities of coarsely crystalline and euhedral barite occur with fluorite near the surface; however, only sparse amounts of barite were noted at depths below 25 feet (7.6 m; Aurand, 1920). Pyrite, commonly altered to limonite and hematite, as well as calcite, microcrystalline quartz, and minor traces of gold and silver also occur in the ore zone and in adjacent altered host rock. Owned first by the American Fluorspar Mining Co., the property was sold to the Colorado Fuel and Iron Co. in 1924 (Van Alstine, 1947). Intermittent operation, beginning in 1913 and ending in 1950, produced metallurgical-grade fluorspar exceeding $674,000 in value (Del Rio, 1960, p. 207).

Creede.—Minor amounts of white fluorite in the Holy Moses and Solomon mines along the west side of East Willow Creek, 2 miles (3.2 km) north of Creede, were noted by Emmons and Larsen (1923). The fluorite occurs as a gangue mineral associated with galena, sphalerite, and pyrite-bearing ores in a north-trending fissure zone in the Oligocene Willow Creek Bed of the Bachelor Mountain Member of the Carpenter Ridge Tuff. Fluorite also occurs in the Amethyst mine and in several small fissure veins in the Creede district (J. C. Ratté, oral commun., 1973).

MONTROSE COUNTY

Vernal Mesa.—An 8-inch (20-cm) fluorite stringer occurs in a 20-foot-wide (6.1-m-wide) siliceous vein along the south wall of the Black Canyon of the Gunnison. The occurrence, originally described by Aurand (1920), lies in highly contorted Precambrian metamorphic rocks. Abundant quartz and iron oxide impurities occur as inclusions in the green- and salmon-colored fluorite. The limited mineralization, the relative inaccessibility of the deposit, the large amount of undesirable impurities, and the discontinuity of the vein all combine to make this occurrence of fluorite economically unexploitable.

OURAY COUNTY

Uncompahgre.—Pale-green fluorite associated with precious metals in near-surface deposits and with base-metal sulfides at depth occurs in several mines within Ouray County. White to green mottled aggregates of fluorite, quartz, sericite, and calcite occur as irregular stringers along the hanging wall of the main lode in the Camp Bird mine. The principal vein, located near the head of Imogene Basin at the intersection of Canyon and Sneffels Creeks, strikes N. 80° W. and dips 65° to 86° S. in fractured andesite breccia of the Oligocene San Juan Formation (Ransome, 1901b). Thin fluorite layers adjacent to narrow undulating bands of sulfide minerals occur along the walls of the zoned fissure deposit. Quartz, minor calcite, and free gold are dominant in the central part of the vein.

The Chappman and Geneva claims are 1,500 feet (457 m) north of Thistledown on the west side of Hayden Mountain at an altitude of 10,510 feet (3,203 m). The veins occur along a series of parallel joints in the San Juan Formation. Thin interbanded quartz and fluorite veins constitute the principal mineralization within these fissure deposits.

Mineral Point.—Well-crystallized fluorite occurs with copper-bearing silver ore in the Indiana tunnel on the western slope of Brown Mountain in Gray Copper Gulch. The main vein, which transects dark pyroxene-bearing rhyodacite and quartz latite flows of the upper member of the Oligocene Burns Formation, strikes N. 20° E. and dips 70° SE., and crops out between 10,550 feet (3,215 m) and 11,050 feet (3,368 m) altitude (Burbank and Luedke, 1969).

Coarse bright-green fluorspar occurs in the upper workings of the Mickey Breen mine, a small vein striking N. 85° W., dipping 85° N., which contains numerous small stringers of tetrahedrite, galena, sphalerite, pyrite, and chalcopyrite. The Grizzly Bear mine, located in Poughkeepsie Gulch, is developed on a vein which contains minor amounts of fluorite associated with base-metal sulfides similar to those in the Mickey Breen mine.

Red Mountain.—A 3- to 5-foot-wide (0.9- to 1.5-m-wide) fluorspar vein was intersected in the Barstow mine while driving the main drift along the principal gold-bearing vein. The fluorspar vein, which strikes N. 21° W. and dips 85° NE., at one point is displaced 5 feet (1.5 m) in a southeasterly direction by a minor fault. The host rock for the fluorspar vein is relatively unaltered andesite of Oligocene age. Although some varicolored banded fluorite is locally present, the majority of the fluorite is bright green and relatively free of quartz. Limited amounts of unbeneficiated fluorspar averaging 85 to 90 percent CaF_2 were hauled to Ouray for shipment in 1917 and 1918 (Aurand, 1920).

PARK COUNTY

Bear Cat deposit.—This deposit, which is about 24 miles (38 km) northwest of Tarryall, contains several small fluorspar veins. This deposit was originally located on a map by Van Alstine (1964, p. 161); however, no additional data regarding the type of deposit, or the geology of the deposit are available.

Jefferson.—A well-defined northeast-trending fluorspar vein crops out along the north side of Guernsey Gulch 4 miles (6.4 km) north of Jefferson. The light-green and purple fluorite defines an 18-

inch-wide (46-cm-wide) vein within a 3- to 15-foot-wide (0.9- to 4.6-m-wide) silicified zone which strikes from N. 59° E. to N. 42° E. across the NW¼NW¼ sec. 20 and the SE¼SW¼ sec. 17, T. 7 S., R. 75 W. The main lode is composed of many minor veinlets generally less than 1 inch (2.5 cm) thick. This network of fluorite veinlets cuts Precambrian hornblende-biotite granite, and crops out discontinuously for more than 3,000 feet (914 m). The two patented claims and one unpatented location claim are known as the Donna Lou Nos. 1, 2, and 3. The property, which is now extensively collapsed, was developed by two short drifts, each with some crosscuts. Between 4 and 5 carloads of ore averaging 50 percent CaF_2 were shipped from these workings in 1913 (Aurand, 1920); however, there has been no additional development since that time.

Tarryall deposits.—Many small occurrences of fluorite are associated with beryllium in Redskin Gulch within the Lake George beryllium areas (Hawley, 1969). The most significant fluorite mineralization is in secs. 11 and 15, T. 11 S., R. 72 W., and additional deposits are located in secs. 9, 10, 13, 14, and 23. Discontinuous white fluorite veins locally containing sparse irregular inclusions of purple fluorite occupy steeply inclined northwest-trending fissures in Precambrian Pikes Peak and Redskin Granites. Mineralization is presumably genetically related to these intrusive bodies (Hawley, 1969). The fluorite veins, 10–15 feet (3–45 m) in maximum width, locally contain barite, galena, sphalerite, and copper sulfides, as well as rare-earth elements (Ce, Dy, Er, Gd, La, Nd, Y, Yb) in trace quantities.

Alma.—Translucent purple fluorite cubes up to one-half inch (1 cm) across occur in gangue associated with galena, pyrite, and tetrahedrite in the Rhodochrosite mine (Aurand, 1920). This mine is located along Buckskin Creek about 5 miles (8 km) northwest of Alma at lat 39°20′15″ N, long 106°07°30″ W. The small fissure fillings within fractured Precambrian granite gneiss are related genetically to Tertiary quartz monzonite dikes.

Kyner deposit.—The Kyner deposit, owned by the Lake George Fluorspar Co., is in the SE¼NW¼ sec. 8, T. 12 S., R. 71 W., along the west side of the South Platte River at an altitude of 7,900 feet (2,408 m). Colorless and blue fluorspar in en echelon veinlets, which strike N. 15° W. to due north, transects jointed biotite granite (Argall, 1949, p. 190). The mineralized zone has a maximum width of about 15 feet (4.6 m), and does not exceed 300 feet (91 m) in length; however, the maximum width of the principal vein within this zone is about 20 inches (50 cm). Production was less than 100 tons of metallurgical-grade fluorspar averaging 92–97 percent CaF_2 (Argall, 1949, p. 190).

SAGUACHE COUNTY

Liberty.—Two small veins containing variable amounts of white and green fluorite are exposed in open cuts along Pole Creek near Liberty, a small site on the east side of the San Luis Valley 9 miles (14.5 km) southeast of Crestone. The main fluorspar vein, which strikes N. 52° W. and dips 28° SE., is exposed in an extensively collapsed opencut in fractured quartzite but does not crop out at the surface. Finely crystalline quartz and minor calcite are associated with the fluorite.

Bonanza.—Light-green and sparse purple fluorite have been noted in the Express, Eagle, and Oregon veins in the Bonanza mining district in the Rio Grande National Forest 8 miles (12.8 km) south-southwest of Poncha Pass (Burbank and Henderson, 1932). Base-metal sulfides occur in north- to northwest-trending fissure veins associated with a quartz, fluorite, and rhodochrosite gangue in altered and locally brecciated Tertiary intrusive latite. The fluorite, although common in the mines south of Eagle Gulch, is not present in economically significant quantities.

Beryl deposit.—The Beryl fluorspar deposit is on the west flank of the Sangre de Cristo Range on the north side of Rito Alto Creek, 12 miles (19 km) southeast of Mineral Hot Springs at an altitude of 9,500 feet (2,895 m). This vein deposit, originally prospected for manganese, is developed by four adits. A vein of translucent coarsely crystalline fluorite 2 feet (0.6 m) in maximum width is exposed in the upper two adits at approximately 9,510 and 9,540 feet (2,898 and 2,907 m) altitude. The vein, composed of about 60 percent fluorite and 40 percent quartzite and chert breccia fragments, strikes N. 15° W. and dips 75° SW. Locally pockets of psilomelane, various other manganese oxides, and boxworks of quartz occur with the fluorite.

SAN JUAN COUNTY

Silverton.—Fluorite associated with hübnerite occurs as thin stringers and irregular masses concentrated along the hanging wall of the Empire-Victoria vein. The principal lode, mostly tetrahedrite with lesser amounts of galena, sphalerite, chalcopyrite, and pyrite, is 150 feet (45.7 m) above the bed of Mineral Creek on the northeast slope of Sultan Mountain, 1 mile (1.6 km) southwest of Silverton. The vein strikes N. 35° E. and dips 85° SE. through a fractured monzonite host.

Aurand (1920) noted minor amounts of fluorite and hübnerite as gangue minerals associated with pyrite and chalcopyrite-bearing ore from the Anglo Saxon mine.

Considerable quantities of dark-green fluorspar occur with quartz in veins 2 feet (0.6 m) in maximum width in the Aspen mine 2 miles (3.2 km) northeast of Silverton along the Animas River at an altitude of 9,800 feet (2,987 m). One such vein, 8 inches (20 cm) wide, intersects the main sulfide lode and strikes N. 37° W. and dips 85° NE. through brecciated rhyolite of Oligocene age. Small amounts of fluorite were noted in gangue in the massive lead-silver ore of the main ore shoot (Aurand, 1920).

Gold is primarily disseminated in lilac and green fluorite in the Dakota mine (Aurand, 1920). The principal vein strikes N. 67° W. and dips 80° S. across Boulder Gulch between Boulder and Tower Mountains. This vein branches at both ends to form numerous smaller veinlets. Many quartz stringers and large amounts of intergrown microcrystalline quartz prohibit economic extraction of fluorite from these veins.

Well-crystallized fluorite and lesser amounts of quartz occur in a N. 10° E.-striking vein which dips 85° SE. in altered andesite of Oligocene age. The vein occurs on the western slope of Bonita Peak at an altitude of 11,300 feet (3,444 m; Ransome, 1901a). This prospect is known as the Adams claim. Bronze to brown hübnerite crystals occur disseminated throughout the 3- to 4-foot-wide (0.9- to 1.2-m-wide) vein, which constitutes the main lode.

Gladstone.—In the Sunnyside and Gladstone veins, lilac fluorite occurs closely associated with free gold. Additional occurrences of fluorite have been reported by Ransome (1901a) from a prospect immediately east of Lake Como and from another claim 100 feet (30 m) north of the Old Lout mine, where fluorite is associated with quartz.

SAN MIGUEL COUNTY

Telluride.—Light-green fluorite, a rare constituent of the gold-bearing ores in most of the Telluride district, occurs abundantly in the Tomboy mine 3 miles (4.8 km) east of Telluride near the head of Savage Basin at an altitude of 12,130 feet (3,697 m). Irregular fractured fluorite stringers more than 2 feet (0.6 m) wide indicate zones favorable for gold within the main lode (Purington, 1896). The principal mineralization is confined to a zone 4–7 feet (1.2–2.1 m) wide, which locally attains a maximum width of 12 feet (3.6 m). The steeply inclined northwest-trending fissure veins in the Tomboy mine are confined to the augite-andesite host rock, which overlies breccias of the Tertiary San Juan Formation. The Morning vein of the Japan mine is approximately 600 feet (183 m) southwest of the Tomboy lode and contains significant amounts of pale-green and white coarsely crystalline fluorite associated with varying amounts of galena and sphalerite in a quartz and rhodochrosite gangue (Ransome, 1901a). This ore shoot, which closely parallels the productive Tomboy vein, averages 5 inches (12.7 cm) in width and has not been developed. Light-green fairly coarse grained fluorite is also abundant in the veins at the lower end of Bridal Veil Creek, where it is associated with microcrystalline quartz (Vhay, 1962).

SUMMIT COUNTY

Dillon area. —The Hammer (Blue Star) fluorspar prospect lies in the Blue River valley between Maryland and North Willow Creeks about 2 miles (3.2 km) north of Silverthorne. Two claims are located on the property immediately adjacent to Colorado Highway 9 in secs. 26 and 34, T. 4 S., R. 78 W. Fluorite cleavage fragments, generally less than one-quarter of an inch (0.6 cm) in diameter, are disseminated in the Pliocene colluvium of an active landslide (Tweto and others, 1970). The colluvium contains fragments of vein-quartz and various altered rocks derived from the Gore Range Frontal fault. Colorless to pale-green fluorite is restricted to specific areas within the slide detritus. Encrustations of fluorite deposited on various distinct colluvial fragments indicate that mineralization occurred after the colluvium accumulated. Subsequent movement of the colluvium produced substantial fluorite fragments.

Parker-Sheldon (North Star Mountain) area.—Minor amounts of fluorite occur with hübnerite, scheelite, chalcopyrite, sphalerite, galena, and molybdenite in a vein composed mainly of quartz. The vein trends northeastward across Monte Cristo Creek, a tributary of the Blue River 7 miles (11.3 km) south of Breckenridge. The fissure vein, localized along a narrow fault zone, extends through Precambrian gneiss and schist northeast from North Star Mountain to the summit of Quandary Peak. Except for tungsten, significant quantities of potentially economic minerals have not been found at this property.

TELLER COUNTY

Cripple Creek.—Fluorite, a widespread mineral in the Cripple Creek district, occurs with quartz in the gangue of the characteristic gold telluride ores. Miners considered fluorite to be an indicator of gold-bearing ore zones. Veins of massive fluorite occur throughout the area, and anhedral fluorite occurs sporadically as a replacement of the altered and brecciated trachytic and phonolitic rocks of the Tertiary Cripple Creek volcano. The association between gold and other metals (Fe, Pb, Hg, La, Sb, As, V, and Mn) within the district has been reported by Gott and others (1969). Elemental fluorine values exceeding 0.5 percent, coextensive with the existing northwest-trending metal anomalies, have been measured, and define areas of greatest potential suggested as future exploration targets (J. H. McCarthy, Jr., oral commun., 1972).

PEGMATITES

The presence of fluorite, commonly associated with fluorapatite, tourmaline, topaz, and biotite in pegmatites of Colorado, mostly outside of the mineral belt has been extensively documented. Except for the Tertiary pegmatites in the Mount Antero-White Mountain area, the pegmatites discussed here are Precambrian in age. The pegmatites, which contain variable amounts of fluorite and a diversity of associated minerals, are briefly described beneath the county in which they occur.

CHAFFEE COUNTY

Yard, Luella, and Trout Creek Pass pegmatites.—The Yard and Luella pegmatites, sources of feldspar during the 1940's, contain abundant fluorite as irregular pods and veinlets distributed erratically from the core margins outward to the wall zones. Large concentrations of white to buff fluorite occur as replacement pods within the pegmatites and are principally associated with gadolinite, monazite, euxenite, and muscovite (Heinrich, 1948). Fluorite associated with rare-earth minerals is present in the Trout Creek Pass pegmatites.

Mount Antero-White Mountain area.—Switzer (1939) mentions numerous occurrences of deep-purple and less commonly colorless and green octahedral fluorite crystals in the hydrothermal veins and pegmatite dikes in the Mount Antero-White Mountain area. Octahedrons may range in size from 1 mm to 20 cm. Euhedral fluorite is associated with beryl, phenacite, and bertrandite in the pegmatite dikes. Fluorite also occurs with phenacite, quartz, molybdenite, and adularia in the hydrothermal vein deposits.

DOUGLAS COUNTY

Pine Creek pegmatites.—Rough, iron-stained amber to yellow fluorite cubes, 3 inches (7.6 cm) in maximum dimension, occur in several pegmatites 1 mile (1.6 km) west of Nighthawk Hill, near the confluence of Pine Creek and the South Platte River. Smoky quartz and amazonite are local accessory minerals in the pegmatites which cut the coarse-grained, commonly allanite-bearing granite host.

Skeleton No. 2 pegmatite.—The Skeleton No. 2 pegmatite, worked for feldspar by M & S, Inc., of Denver, contains varying amounts of white to pale-purple fluorite. Small crystals of fluorite, generally less than 1 inch (2.5 cm) in diameter, occur within an intermediate microcline-bearing zone. Fluorite stringers as much as 4 inches (10.1 cm) wide are locally present along the contact between the central quartz core and the intermediate feldspar zone (Hanley and others, 1950). The northwest-trending pegmatite dike, within the Pikes Peak Granite, is about 5.5 miles (8.8 km) south of Devils Head along Rampart Range Road in sec. 36, T. 9 S., R. 69 W.

EL PASO COUNTY

Cascade and Ute Pass area.—Aurand (1920) noted minor amounts of fluorite in several tunnels of the Colorado Midland Railroad in Ute Pass, and from an unnamed locality near Cascade.

FREMONT COUNTY

Pine Ridge and Colorado feldspar pegmatites.—Irregular pods of white fluorite associated with sericite and plagioclase replace microcline in the Pine Ridge and Colorado feldspar pegmatites. These north-trending pegmatite dikes cut gneissic Precambrian granite, which crops out north of Cotopaxi.

JEFFERSON COUNTY

South Platte pegmatites.—Fluorite and yttrofluorite (CaF_2 with variable amounts of YF_3—as much as 50 percent) deposited by late-stage fluids related to crystallization of the Pikes Peak batholith occur within numerous concentrically zoned rare-earth-bearing pegmatite bodies near South Platte. Although sporadically developed, the inner-intermediate zones commonly contain euhedral fluorite crystals (Haynes, 1965). Perthite, cleavelandite, biotite, cyrtolite, allanite, smoky quartz, amazonite, and various rare-earth minerals are associated with fluorite in these pegmatites.

PARK COUNTY

Teller Peak pegmatite.—Large yttrium-bearing fluorspar blocks occur as irregular replacement masses in a microcline pegmatite within the Pikes Peak Granite 0.5 mile (0.8 km) south of Lake George on Elevenmile Canyon Road (Glass and others, 1958). Significant quantities of xenotime and gadolinite occur as inclusions in the pink fluorite. Allanite, monazite, and light-green or deep-purple fluorite are less common minerals in the deposit.

TELLER COUNTY

Crystal Peak pegmatite.—Green to purple fluorite cubes, as much as 6 inches (15 cm) on edge, have been reported by Aurand (1920) from the numerous pegmatites near Crystal Peak, 6 miles (9.6 km) north of Florissant. Microcline, amazonite, smoky quartz, topaz, and phenacite are common accessories.

SUMMARY

Although most of the previously described fluorine-bearing occurrences are not productive, they provide useful indicators to favorable environments that may contain fluorite mineralization. As noted by Peters (1958), areas defined by substantial fluorine concentration in the underlying basement rocks, or surficial rocks will remain potential sites of fluorine mineralization regardless of differentiation processes active in the dispersal of the element. Fluorite is common in the Precambrian pegmatites which are widespread in Colorado; however, the economic potential of these deposits is small. Fluorspar concentrates produced in Colorado to date exceed 1.9 million short tons, which accounts for about 10 percent of the total United States' production since 1880. Approximately 80 percent of the total State dollar-value of fluorspar mined in Colorado has been produced within the last 25 years. The principal fluorspar production in Colorado has come from the breccia zones and vein deposits of the Jamestown district in Boulder County, and from the vein deposits in Jackson County, primarily at Northgate but including minor production from the Crystal district. Deep-seated troughlike structures and post-intrusive faults provide adquate avenues of transport for fluorine-enriched solutions. Intersection of such structures commonly creates favorable depositional sites for fluorine mineralization in stockworks and veins. The extensive fluorspar deposits near Jamestown are of this type. Areas characterized by hot springs, shallow hydrothermal deposits, and plutons of alkalic affinity constitute important future exploration targets for fluorspar. An increasingly important source of fluorine in the future will be fluorite or other fluorine-bearing minerals which are produced as coproducts of lead, zinc, tin, beryllium, molybdenum, and rare-earth element ores.

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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with the
COLORADO STATE MINING AND INDUSTRIAL DEVELOPMENT BOARD
AND THE COLORADO STATE GEOLOGICAL SURVEY

MINERAL INVESTIGATIONS
RESOURCE MAP MR-70

EXPLANATION

FLUORSPAR DEPOSITS

Type of deposit	Size category, production and reserves in short tons of CaF_2			
	Major Greater than 250,000 tons (226,950 metric tons)	Important Less than 50,000 tons (45,390 metric tons)	Minor 50,000–100,000 tons (45, 390–90,780 metric tons)	Fluorspar occurrences
Veins	●	●	●	×
Stockworks or pipes	▲			×
Disseminations			◆	×

ASSOCIATED METALS OR MINERALS IN MINING DISTRICT.–Shown by position of tick mark (north, east, south, or west) on the side of the fluorspar deposit symbol

- Base metals, precious metals, Hg, or Sb
- Barite, gypsum, or celestite
- Rare elements (Sn, Be, U, Th, or R_2O_3)
- Ferrous metals (Ma, Fe, Mo, or W)

FLUORSPAR-BEARING PEGMATITE. – No known fluorspar production

○ TOPAZ OCCURRENCE. – Localities not discussed in text

Base from U.S. Geological Survey, 1968

SCALE 1:500 000
10 0 10 20 30 40 50 MILES
10 0 10 20 30 40 50 KILOMETERS
CONTOUR INTERVAL 500 FEET
DATUM IS MEAN SEA LEVEL

Interior–Geological Survey, Reston, Va.–1975

MAP SHOWING FLUORSPAR DEPOSITS IN COLORADO

Compiled by
Bruce T. Brady
1975

For sale by U. S. Geological Survey
Denver, Colo. 80225 and Reston, Va. 22092, price 75 cents
Explanatory pamphlet accompanies map