

**Geology and Flourspar Deposits
of the
St. Peters Dome District, Colorado**

by

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GEOLOGY AND FLUORSPAR DEPOSITS OF THE ST. PETERS DOME DISTRICT, COLORADO¹

by

THOMAS A. STEVEN²

ABSTRACT

The St. Peters Dome district is in El Paso County, Colorado, about 8 miles southwest of Colorado Springs. Fluorite-quartz veins and cryolite-bearing pegmatite dikes are the mineral deposits of the district.

The country rock of the St. Peters Dome district is the Pikes Peak granite of pre-Cambrian age. It is cut by pre-Cambrian aplite, lamprophyre, and cryolite-bearing pegmatite dikes, and by Tertiary (?) lamprophyre dikes.

Most of the district is on an archlike structure in the Pikes Peak granite. A belt of massive granite, 1,200 to 1,700 feet wide, flanked on both sides by jointed granite trends northeastward across the district. Steep joints strike both parallel to and at right angles to the trend of the massive granite, and one group of joints dips away from the massive core, forming the archlike structure. Aplite dikes, the oldest dikes in the district, and a pre-Cambrian lamprophyre dike occur in steep joints which strike roughly normal to the massive core; cryolite-bearing pegmatite dikes occupy joints that make up the arch.

A north-trending series of late shear joints and minor faults cuts across all the earlier structures. Most of the movement took place along a narrow zone of en echelon fractures that extends the full length of the district. Lamprophyre dikes of Tertiary (?) age were injected into some of these fissures at an early stage in the shearing, and quartz veins formed shortly afterward. The fluorite-quartz veins were deposited in fractures after most of the shearing and faulting had occurred. Structural and mineralogic relations suggest that these late lamprophyre dikes and fluorite-

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²Geologist, U. S. Geological Survey.

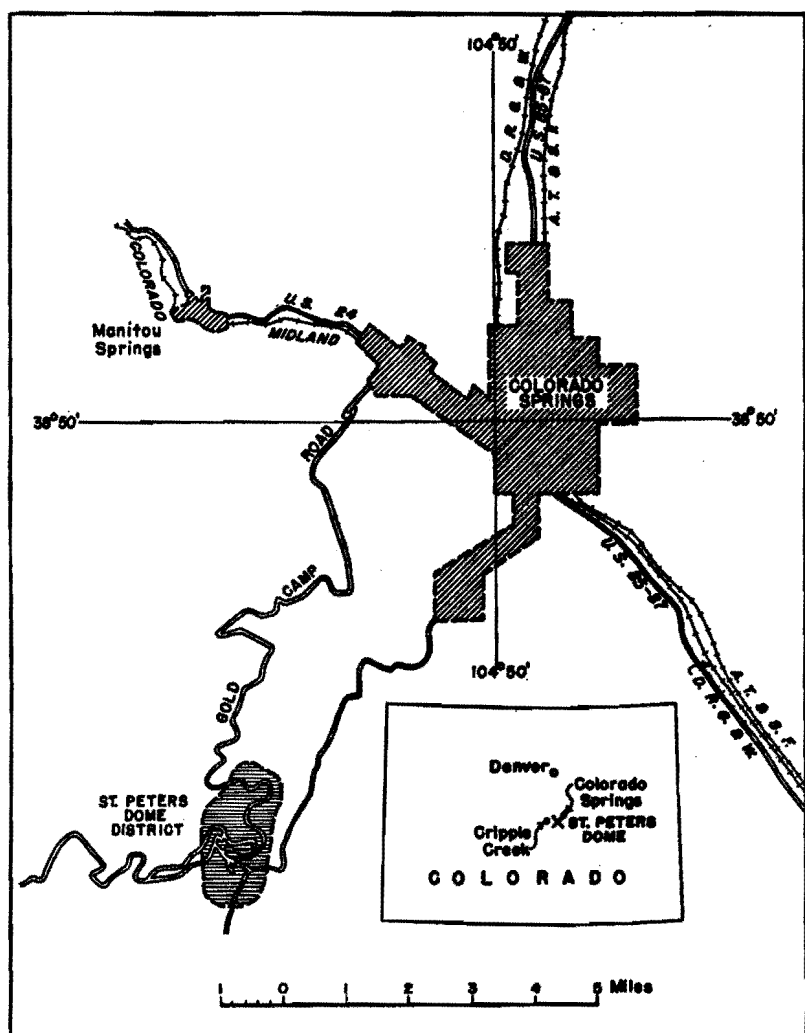


FIGURE 1—INDEX MAP SHOWING THE LOCATION OF THE ST. PETERS DOME DISTRICT, COLORADO

quartz veins are equivalent in age to similar middle Tertiary dikes and veins in the Cripple Creek district about 15 miles to the west.

The fluorite-quartz veins originally were prospected for gold and silver. The first fluorspar production from the district came from the Duffields deposit in 1910 and 1911. In 1917 and 1918 the Timberline deposit was worked for fluorspar. Production figures for this early work are lacking. In 1944 and 1945 mining was resumed in the district, and about 16,100 tons of mine-run fluorspar was produced from the Timberline, Duffields, and Mattie B. deposits.

The fluorspar is known to occur through a vertical range of more than 600 feet, and as the deposits are discontinuous vertically as well as horizontally, fluorspar bodies probably exist that do not crop out.

INTRODUCTION

The St. Peters Dome district is in El Paso County, Colorado, on the eastern slope of the Front Range, approximately 8 miles southwest of Colorado Springs and 15 miles east of Cripple Creek (fig. 1). It is accessible from Colorado Springs by means of the Gold Camp road (Corley Mountain highway), which follows the roadbed of the former Colorado Springs and Cripple Creek District Railway. Most of the district is between 8,000 and 9,800 feet above sea level.

Cryolite-bearing pegmatite, found in numerous dikes in the northern part of the district, was described by Cross and Hillebrand¹ in 1885. In 1916, Finlay² noted that the St. Peters Dome district had been thoroughly prospected for gold. The fluorspar deposits of the district were described first by Aurand³ in 1920. According to Aurand, the veins were prospected originally for gold and silver and later

¹Cross, Whitman, and Hillebrand, W. F., Contributions to the mineralogy of the Rocky Mountains: U. S. Geol. Survey Bull. 20, pp. 40-74, 1885.

²Finlay, G. I., U. S. Geol. Survey Geol. Atlas, Colorado Springs folio (no. 203), p. 15, 1916.

³Aurand, H. A., Fluorspar deposits of Colorado: Colorado Geol. Survey Bull. 18, pp. 55-57, 1920.

were worked for fluorspar. The mineralogy and paragenesis of the pegmatite dikes were discussed briefly by Landes⁴ in 1935. He suggested that the cryolite pegmatite and the fluorspar deposits in the district are related genetically to the surrounding pre-Cambrian Pikes Peak granite. The writer disagrees with this conclusion, and the present paper discusses the age relations and structural control of the pegmatite dikes and the fluorspar veins.

The U. S. Geological Survey began studies of the fluorspar deposits of the St. Peters Dome district in 1943 as part of the Strategic Minerals Investigations. Preliminary examinations of some of the larger deposits were made in 1943 by D. C. Cox and J. O. Fisher, and in 1944 by R. D. Trace, D. M. Henderson, and D. C. Cox.⁵ In the spring of 1946 the writer spent approximately 10 weeks studying the areal geology as well as the fluorspar deposits of the district. The geologic maps and a brief report were issued in 1948.⁶ All the work was done in cooperation with the Colorado State Geological Survey Board and the Colorado Metal Mining Fund.

The writer is indebted to Jewell Glass and R. E. Van Alstine of the U. S. Geological Survey for microscopic examinations of several thin sections, and to the General Chemical Co. and Kramer Mines, Inc., for permission to publish geologic data collected on their properties. Dr. James Gilluly of the Geology Department, University of California at Los Angeles, and Ogden Tweto of the U. S. Geological Survey reviewed the manuscript.

GEOLOGY

The country rock of the St. Peters Dome district is Pikes Peak granite, a pre-Cambrian granite that makes up most of the southern part of the Front Range. The granite is

⁴Landes, K. K., Colorado pegmatites: *Am. Mineralogist*, vol. 20, pp. 322-326, 1935.

⁵Cox, D. C., The fluorspar deposits of the St. Peters Dome district, El Paso County, Colorado: (manuscript report in files of U. S. Geol. Survey) 6 pp., 1944.

⁶Steven, T. A., The fluorspar deposits of the St. Peters Dome district, El Paso County, Colorado: U. S. Geol. Survey Strategic Minerals Investigations Preliminary Report 3-218, 1948.

cut by dikes of aplite, pegmatite, and lamprophyre of pre-Cambrian age, and by later, probably Tertiary, lamprophyre dikes (fig. 2). The dikes follow joint systems in the granite.

Pikes Peak granite.—The Pikes Peak granite is medium- to coarse-grained and porphyritic. Microcline makes up approximately 60 percent of the granite—some in the groundmass, and some as phenocrysts as much as 1 inch long. On fresh surfaces of granite the microcline is light green, but in most of the weathered granite it is pink or red. Anhedral quartz grains constitute 25 to 30 percent of the granite, and biotite and oligoclase each make up less than 10 percent. The accessory minerals are apatite, magnetite, zircon, sphene, and allanite.⁷

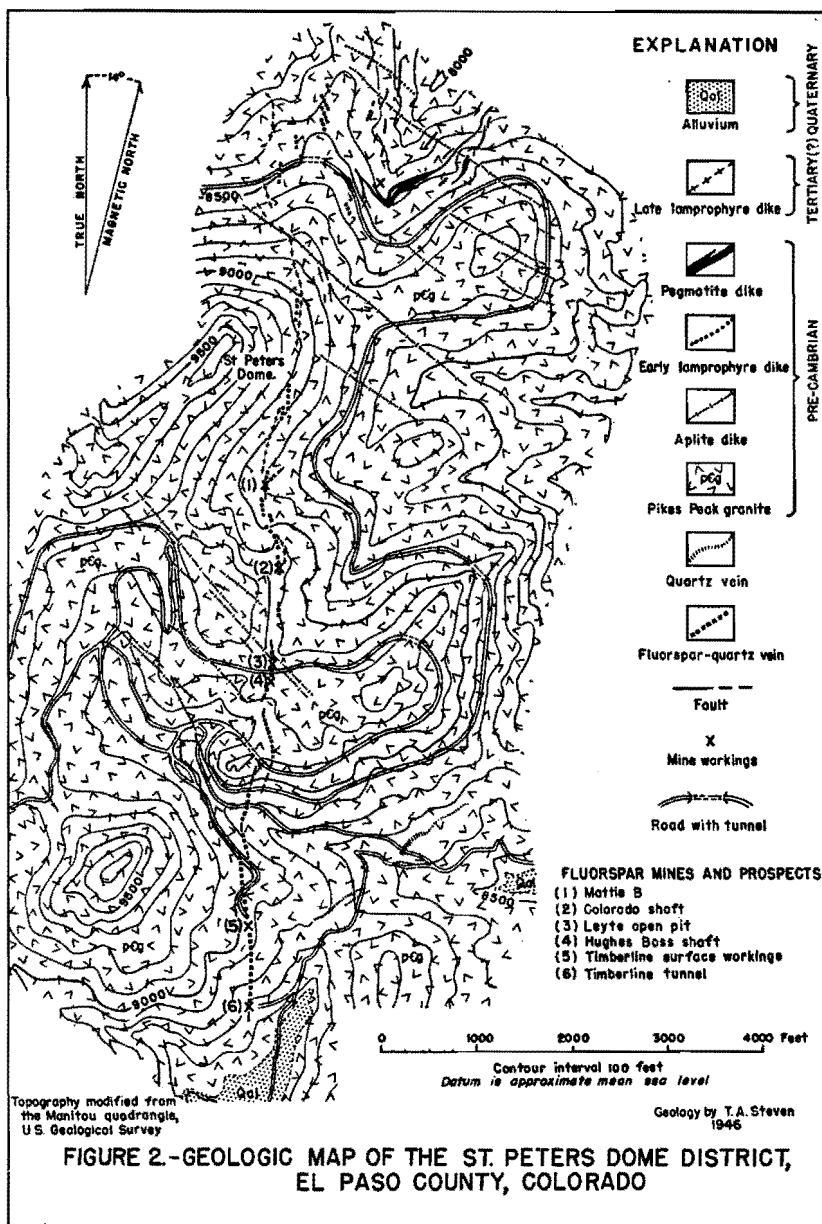
Aplite.—The aplite is made up essentially of feldspar and quartz which form a mosaic of anhedral grains through which small biotite crystals are irregularly distributed. The feldspar is mostly microcline or orthoclase with some oligoclase. In most of the aplite dikes, the rock is fine-grained, but in some it is relatively coarse-grained and has a granitic texture. Small masses of pegmatite are relatively common in the aplite and constitute as much as 40 percent of some dikes. The aplite, which forms the oldest dikes in the St. Peters Dome district, was mapped by Finlay⁸ as Cripple Creek granite. Large bodies of Cripple Creek granite cut the Pikes Peak granite a few miles west of the district. Chemical and mineralogic similarity of the Cripple Creek and Pikes Peak granites suggest that they are closely related genetically.⁹

Pre-Cambrian lamprophyre.—One dike of pre-Cambrian lamprophyre was observed in the northern part of the district. It follows a joint of the same set followed by the aplite dikes. The lamprophyre definitely is cut by the cryolite-bearing pegmatite, but both these rocks contain the relatively rare mineral riebeckite, suggesting that they are

⁷Finlay, G. I., op. cit., p. 4.

⁸Finlay, G. I., op. cit.

⁹Finlay, G. I., op. cit., p. 4.



closely related. As the pegmatite clearly cuts and is later than the aplite, the lamprophyre also probably is later.

The pre-Cambrian lamprophyre is a fine-grained gray rock composed of approximately 60 percent feldspar and 40 percent ferromagnesian minerals. The essential minerals are albite, perthitic orthoclase, biotite, and riebeckite; the accessory minerals are magnetite, fluorite, and sphene. The mineral grains are euhedral, and in places the feldspars are oriented with their longer axis parallel to the dike walls.

Pegmatite.—Numerous dikes of cryolite-bearing pegmatite occur in the northern part of the St. Peters Dome district. The chief constituents of the pegmatite are pink microcline in large subhedral crystals, riebeckite in prismatic, bluish-black crystals, and quartz in anhedral masses. Microcline and quartz make up about 85 percent of the rock, and riebeckite up to 15 percent. Most of the cryolite is intergrown with quartz, and much of it has been altered to secondary minerals. No attempt was made to identify all the minor minerals for which these dikes are widely known,¹⁰ or to study the internal structure of the dikes.

Riebeckite is a characteristic mineral of the Mount Rosa granite, a rock that cuts the Pikes Peak granite a short distance northwest of the St. Peters Dome district; a dike of the riebeckite pegmatite occurs in the Mount Rosa granite. Thus the riebeckite- and cryolite-bearing pegmatites and the Mount Rosa granite probably are related genetically, as Finlay¹¹ suggested.

The pegmatite dikes of the St. Peters Dome district are localized in one of the primary joint systems of the Pikes Peak granite, but they are distinctly later than the aplite dikes and the early lamprophyre.

Tertiary (?) lamprophyre.—Several dikes of Tertiary (?) lamprophyre occur along a shear zone in the Pikes Peak

¹⁰Cross, Whitman, and Hillebrand, W. F., Contributions to the mineralogy of the Rocky Mountains: U. S. Geol. Survey Bull. 20, pp. 40-74, 1885.

Landes, K. K., Colorado pegmatites: Am. Mineralogist, vol. 20, pp. 322-326, 1935.

¹¹Finlay, G. I., op. cit., p. 5.

granite, and are associated with the fluor spar deposits (fig. 2). Where unaltered, the rock is dense, black, and porphyritic. Clusters of biotite crystals and a few phenocrysts of orthoclase are set in a fine-grained, panidiomorphic ground-mass composed of biotite grains, amphibole needles, and orthoclase laths. Apatite, magnetite, and pyrite are accessory minerals. The ferromagnesian minerals are largely altered to chlorite and iron oxide, and as a result most of the dikes have a greenish-gray cast.

The Tertiary (?) lamprophyre is the youngest rock in the St. Peters Dome district. It is believed to be the correlative of the lamprophyre dike rocks in the nearby Cripple Creek district. Structural relations of the dikes at Cripple Creek suggest that they are mid-Tertiary in age.¹²

STRUCTURAL GEOLOGY

As flow structures are either absent or indistinct in the Pikes Peak granite of the St. Peters Dome district, classification of the joints with respect to flow¹³ is not practicable. However, the relative ages of the various fracture systems in the granite are indicated by the age relations of the dikes and veins that occur along them.

Most of the St. Peters Dome district is on an archlike joint structure in the Pikes Peak granite. A belt of massive granite, 1,200 to 1,700 feet wide, flanked by jointed granite, trends northeastward across the district (fig. 3). The first group of joints strikes approximately normal to the belt of massive granite. The second group of joints dips away from the massive core, forming an archlike structure. The joints on the southeastern limb of the arch dip 30°-70° SE., and those on the gentler, northwestern limb dip 10°-40° west or south. The axis of the arch formed by these joints is near the western edge of the core of massive granite and is about parallel to it. The axis appears to plunge gently southwest.

¹²Loughlin, G. F., and Koschmann, A. H., *Geology and ore deposits of the Cripple Creek district, Colorado*: Colorado Sci. Soc. Proc., vol. 13, no. 8, 1935.

¹³Balk, R., *Structural behavior of igneous rocks*: Geol. Soc. America Mem. 5, p. 27, 1937.

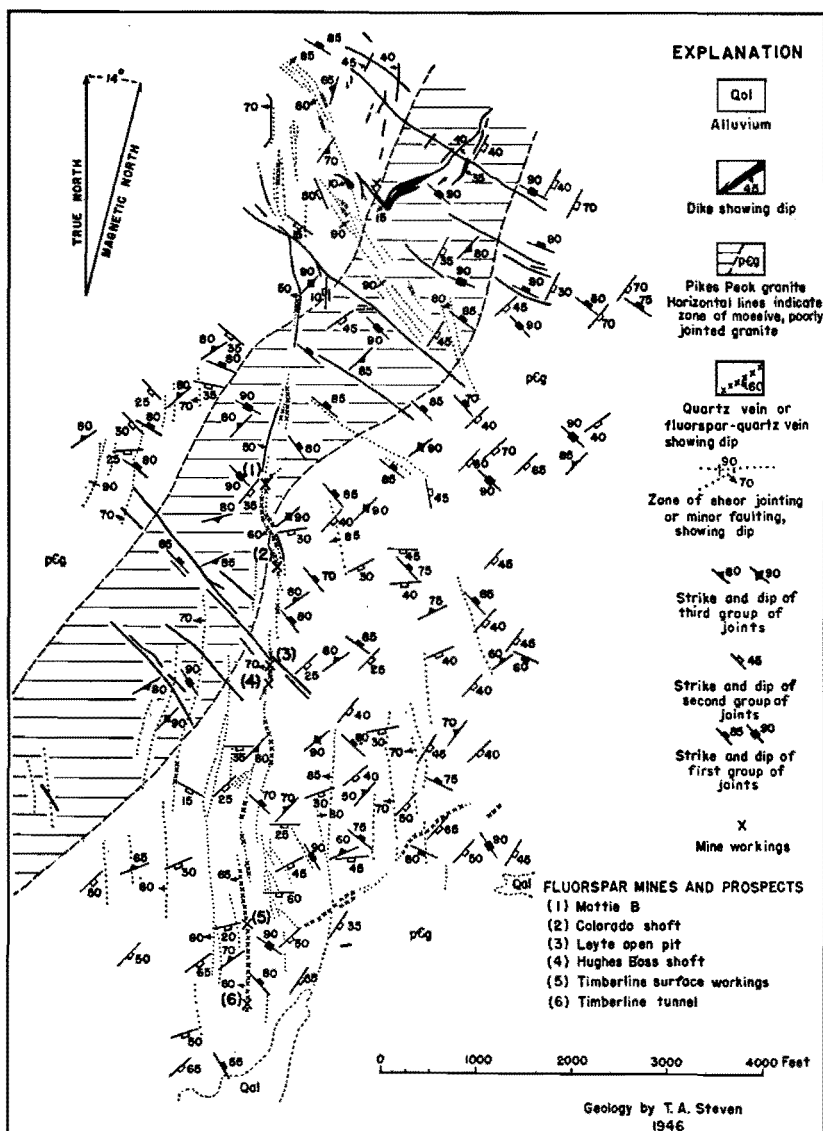


FIGURE 3-STRUCTURAL MAP OF THE ST. PETERS DOME DISTRICT,
EL PASO COUNTY, COLORADO

The third group of joints strikes approximately parallel to the belt of massive granite. A north-trending series of late shear joints and minor faults cuts across all the earlier structures.

First group of joints.—Steep joints of the first group are the most persistent in the district. They are not the most prominent joints, but in most outcrops they are distinct and are more uniformly distributed than are the joints of any other group. Joints of this set strike nearly normal to the trend of the massive granite and most of them dip between 80° SW. and 80° NE.

The aplite dikes follow these early joints and occur only in the vicinity of the massive granite core.

Second group of joints.—Joints of the second group are prominent along the flanks of the joint arch. They show different orientations in various localities, but the system of joints as a whole displays a fairly well defined pattern. On the southeastern flank of the arch the joints strike roughly parallel to the trend of the belt of massive granite. Near the massive granite the dips are mostly between 35° and 45° SE., but farther southeast they increase to as much as 70° SE. A few joints that have the orientation of those on the southeastern flank of the arch are found within the belt of massive granite, particularly in the northern part of the district.

Joints of the second group on the northwestern flank of the arch are less uniform in attitude than those on the southeastern flank. On the St. Peters Dome ridge these joints strike west to northwest and dip south or southwest at 25° - 35° . Near the road northeast of St. Peters Dome these joints, as shown by the pegmatite dikes that follow them, strike northwest and dip 10° - 15° SW. Farther north, and at a still lower altitude, the pegmatite dikes strike north and dip 35° - 45° W. The significance of these local attitudes cannot be evaluated without a knowledge of the regional structure of the Pikes Peak granite.

The pegmatite dikes in the St. Peters Dome district follow the second group of joints on both flanks of the joint arch. One pegmatite dike crosses the axis of the joint arch near the western edge of the belt of massive granite and is thickest near the axis. Several minor aplite dikes follow these joints, and a few of them cross over the axis of the joint arch. A few large quartz veins of the type associated with the Tertiary (?) lamprophyre dikes occur in joints of the second group in the southeastern part of the district.

Third group of joints.—The third group of joints is roughly parallel to the northeast-trending belt of massive granite. These joints can be recognized over much of the area mapped, but they are prominent only locally. They are most abundant along the ridge extending southwest from St. Peters Dome, where they form the main topographic control. Joints of this group are the strongest found within the belt of massive granite, but even so they are relatively weak. In the southeastern part of the district these joints are weak.

Most of the joints of this group strike N. 40°-75° E. The dips range widely. Northwest of the massive granite, particularly in the vicinity of St. Peters Dome, the joints dip uniformly 80° NW.; within the belt of massive granite the dip ranges from vertical to 70° SE.; and in the southeastern part of the district most of these joints dip 50°-75° NW.

Joints of the third group are not followed by dikes or veins, and it is believed that they are of later origin than the first and second groups of joints.

Late shear joints and minor faults.—A series of late shear joints and minor faults cuts across all the earlier structures. Most of the fracturing and movement took place along a narrow, north-trending zone of en echelon fractures that extends the full length of the district. The main zone of fracturing is flanked by discontinuous parallel belts of weaker fractures, particularly in the central and southern parts of the district. Most of the shear joints and minor

faults strike between N. 20° W. and N. 20° E. A few of the joints and faults dip steeply east, but most of them dip from vertical to 50° W.

The main zone of fracturing contains a number of en echelon fissure zones which step progressively eastward from south to north. Joints formed at an early stage in the late period of shearing are particularly prominent in the northern part of the district. Lamprophyre dikes were injected into some of these joints, and quartz veins later formed along others. Joints and minor faults in the central and southern parts of the district formed somewhat later than those in the northern part and are stronger and more prominent. The fluorite-quartz veins filling some of these fractures were formed after most of the shearing and faulting had occurred. The fluorite in the weak fracture zones flanking the main shear zone is scattered and unimportant.

The early, pre-lamprophyre shearing was relatively weak, and the amount of movement along the fractures was small. The second stage of shearing was more intense, and the fractures are marked by considerable gouge and granulated granite. Movement during the second period of shearing was largely restricted to the area between the northern end of the Mattie B. deposit and the southern end of the Timberline deposit.

As the faults are in uniform Pikes Peak granite, it is difficult to determine the direction or amount of displacement along most of them. However, a few of the faults cut and displace aplite dikes and show normal fault movement. Although striations on the fault surfaces range widely in orientation, many of them pitch 60°-75° S. The steeply-dipping aplite dike near the Duffields deposit (fig. 5) is offset to the south on the western, hanging-wall side of the fault, indicating movement of the type suggested by striations.

FLUORSPAR DEPOSITS

Two periods of vein deposition are recognized in the St. Peters Dome district. These are correlated with the late phases of each of the two stages of late (Tertiary?) shearing. Mineralization was strongest where the fracturing is strongest.

First period of vein deposition.—In the main north-trending zone of late fractures, the quartz veins of the first period of deposition and the late lamprophyre dikes have about the same areal distribution and are similar in attitude. The early quartz veins are most abundant and largest in the area between the Mattie B. deposit and the Colorado shaft where they follow en echelon zones of shear joints. A few of them occur as single veins, but the early quartz veins occur more characteristically in networks of interlacing veins. Many of the larger veins contain angular chloritized fragments of granite, but the vein walls show little granulated rock. In the area north of the Mattie B. the veins are similar but not so abundant.

The earliest veins consist almost entirely of green, finely granular to chalcedonic quartz. The green color is due to fine-grained, disseminated chlorite. In places the chlorite-rich quartz is brecciated and recemented with lighter green, less chloritic quartz. The quartz in the larger veins in general is less chloritic and lighter in color than that in the smaller veins.

In the southeastern part of the district several early veins follow the second group of joints. They are filled by gray, reddish-brown, and very light green chalcedony and finely granular quartz. Chlorite is absent.

Many of the early quartz veins were broken by later shearing, and small veins were formed within them during the second period of vein deposition.

Second period of vein deposition.—The second period of vein deposition closely followed the second, stronger stage of late (Tertiary?) shearing and faulting. Lenticular fluor-

ite-quartz veins occur in the more prominent en echelon fractures along the main zone of shearing and the larger deposits appear to be restricted to that part of the zone between the northern end of the Mattie B. deposit and the southern end of the Timberline deposit. In the Timberline deposit movement along the shear zone was distributed along many closely spaced fractures, and the veins are narrow and overlap. Farther north the en echelon faults are more widely spaced, and there was relatively greater movement and brecciation on the individual fractures. The veins in these fissures tend to be larger and less closely associated than the veins farther south.

Gouge and granulated granite are cut by veins and in places are partly replaced by quartz and fluorite, indicating that most of the movement on the faults preceded the mineralization. Movement recurred during vein deposition, however, as shown by repeated brecciation of the veins and by the variation in the mineral composition of the veins. As there was a well-defined sequence of deposition of the various minerals, the minerals of the individual stages were deposited in whatever fractures were open at the time. Thus many of the veins do not contain all of the mineral assemblages represented in the district.

The granite along the late (Tertiary?) fracture zones was silicified early in the second period of mineralization. Not only are the walls of the veins silicified, but granite breccia fragments enclosed by later vein material are silicified markedly.

Most of the fluorite in the district was deposited in the first stage of the second period of vein deposition. The fluorite occurs in veins and as a filling in irregular bodies of breccia. It is moderately to coarsely crystalline and is purple, green, and white. Most of the fluorite is intergrown with quartz, but the amount of quartz ranges widely. Several generations of fluorite are evident, and much of the early fluorite is brecciated and cemented with later fluorite.

The fluorite stage of the deposition is distinctive; the mineralogy of the succeeding stage is markedly different.

Finely granular white quartz is the chief product of the second stage of deposition and is the most common gangue material in the fluorspar deposits. Sulfides were deposited late in the second stage of deposition. They are widely distributed but in small quantities, and only in a few veins do they constitute as much as a few percent of the vein material. Galena and sphalerite are the most abundant and widespread of the sulfide minerals. A trace of pyrite and chalcOPYrite was found in the Timberline tunnel. Small quantities of gold and silver are also found in these veins, but as no detailed chemical or petrographic studies were made of the ores, the mode of occurrence of the gold and silver is not known. Possibly they are associated with the sulfides. A little green fluorite was deposited in the closing phases of the quartz-sulfide stage.

Pink barite is locally abundant, and in two minor veins it was the only mineral deposited. It is common in long, bladed crystals, although in other places it is granular. Most of the barite appears to have been deposited late in the quartz-sulfide stage, but possibly a little was deposited early in the succeeding coarse-quartz stage.

In the third and last stage of deposition veinlets of relatively coarsely crystalline quartz were deposited over a wide area. Comb structure is well formed in these late veinlets, and drusy cavities are common. Quartz of this stage is the only representative of the second period of vein deposition in the southeastern part of the district. These veins contain a little specularite, particularly in the drusy cavities.

Origin and age relations.—The fluorspar deposits of the St. Peters Dome district belong to the epithermal class of mineral deposits. The associated finely granular to chalcodonic quartz, the complexly branching and brecciated nature of the veins, and the mineral assemblage, all are typical of deposits formed under conditions of relatively low temperature and pressure.

The mineral deposits in the St. Peters Dome district have many features in common with the gold deposits in the Cripple Creek district¹⁴ about 15 miles to the west, although the mineralogy of the deposits in the Cripple Creek district is much more complex than that of the St. Peters Dome district. The deposits in both districts are of the epithermal type, and in both they are associated with alkali-rich basic dikes. Following is a comparison of the mineralogy and paragenesis of the two districts:

St. Peters Dome District

Cripple Creek District¹⁵

First period of vein deposition:

Deposition of finely granular to chalcedonic, chlorite-bearing quartz veins.

Second period of vein deposition:

— STAGE I —

Silicification of granite. Deposition of fluorite-quartz veins.

Corrosion of granite and deposition of quartz and adularia. Deposition of quartz-fluorite veins.

— STAGE II —

Deposition of finely granular quartz, small quantities of fluorite, sphalerite, galena, pyrite, chalcopyrite, and barite in cracks and as breccia fillings.

Deposition of quartz, fluorite, pyrite, dolomite or ankerite, celestite, galena, sphalerite, tetrahedrite, gold and silver tellurides, roscoelite and barite. These minerals occur mostly in narrow cracks and vugs.

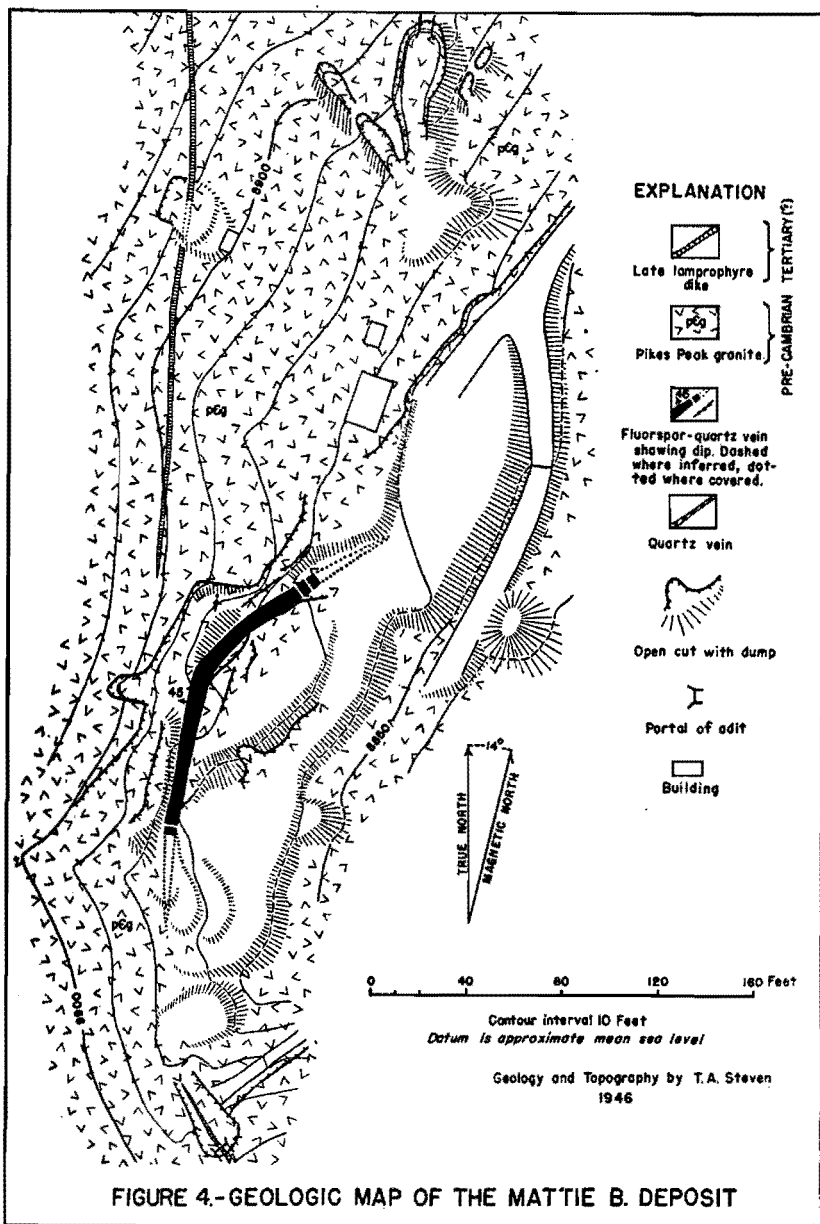
— STAGE III —

Deposition of drusy quartz, barite (?), and specularite.

Deposition of drusy quartz, chalcedony, pyrite, calcite, cinnabar, and very minor quantities of fluorite.

¹⁴Loughlin, G. F., and Koschmann, A. H., *Geology and ore deposits of the Cripple Creek district, Colorado*: Colorado Sci. Soc. Proc., vol. 13, no. 6, 1935.

¹⁵Loughlin, G. F., and Koschmann, A. H., *op. cit.*, pp. 293-297.



The lenticular en echelon arrangement of the veins in the St. Peters Dome district also is characteristic of many of the veins in the Cripple Creek district.¹⁶

The fluorspar deposits of the St. Peters Dome district, like the gold deposits of the Cripple Creek district, are considered to be of Miocene age. The volcanic rocks and bedded sediments in the Cripple Creek caldera, which are older than the mineral deposits, are younger than the Florissant lake beds to the north.¹⁷ The age of the Florissant lake beds formerly was considered to be late Miocene, but in 1935 Gazin¹⁸ presented evidence favoring a late Oligocene or early Miocene age for these beds. As the rocks and ore deposits of the Cripple Creek caldera are clearly younger than the Florissant lake beds, they are considered to be of Miocene age.¹⁹ From the close mineralogic and structural similarity of the St. Peters Dome deposits to the Cripple Creek deposits it is considered probable that the fluorspar deposits in the St. Peters Dome district also are of Miocene age.

INDIVIDUAL DEPOSITS

The first fluorspar mined in the St. Peters Dome district came from the Hughes Boss claim on the southern end of the Duffields deposit. The claim was worked during 1910 and 1911, and a small quantity of hand-sorted fluorspar was shipped. In 1917 and 1918 the Timberline deposit, or the Cather Springs deposit as it was then known, was worked for fluorspar. Production figures for the early mining are lacking, but the Cather Springs deposit is reported to have produced 90 carloads of fluorspar. The district was inactive from 1918 until World War II. In 1944 mining was resumed in the district by Kramer Mines, Inc. Approximately 16,100 tons of ore were treated in the company's mill at Colorado

¹⁶Loughlin, G. F., and Koschmann, A. H., op. cit., pp. 276 and 297.

¹⁷Loughlin, G. F., and Koschmann, A. H., op. cit., pp. 236-239.

¹⁸Gazin, G. L., A marsupial from the Florissant beds (Tertiary) of Colorado: Jour. Paleontology, vol. 9, p. 57, 1935.

¹⁹Koschmann, A. H., personal communication.

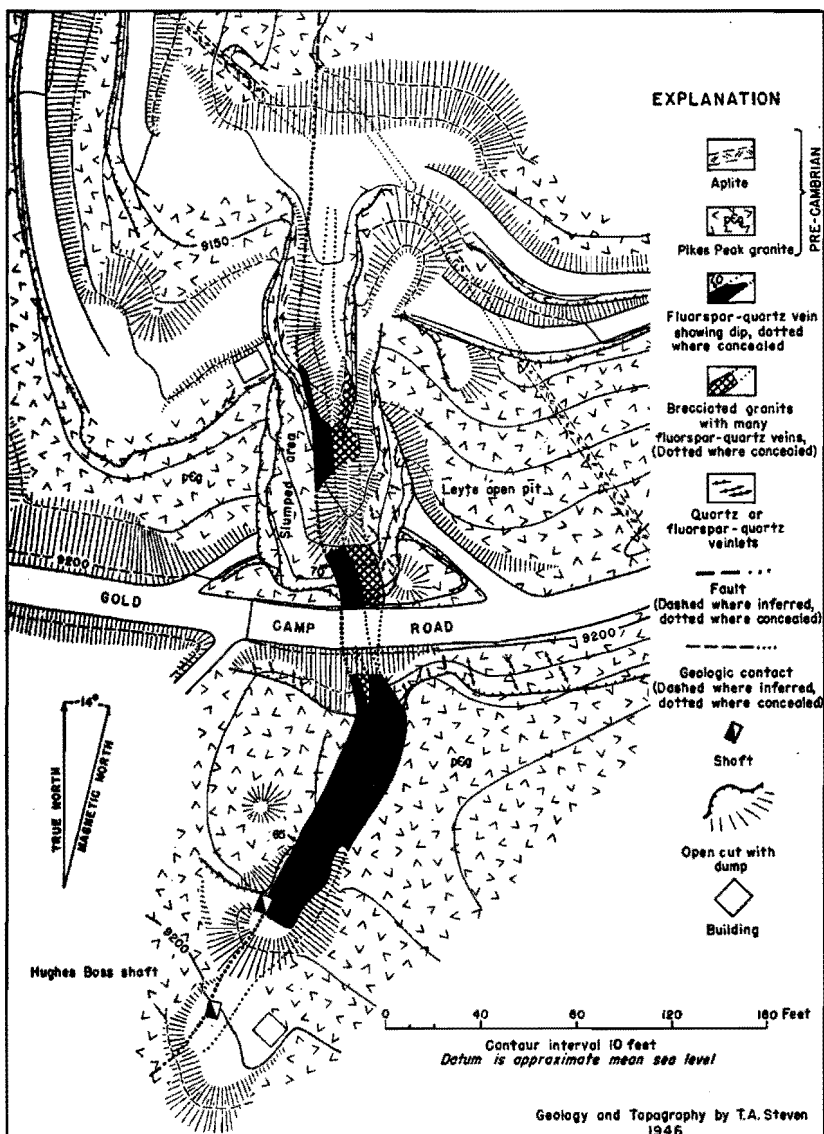


FIGURE 5.-GEOLOGIC MAP OF THE DUFFIELDS DEPOSIT

Springs before operations were stopped in 1945. Of this total, approximately 7,000 tons of ore came from the Leyte open cut, 8,500 tons from the Timberline deposit, and 600 tons from the Mattie B. deposit. Minor values in lead, zinc, silver and gold were recovered in milling the fluorspar ore.

Mattie B. deposit.—The Mattie B. deposit (fig. 4) is the northernmost of the fluorspar deposits. It is localized at a bend in the controlling fault. South of the bend the hanging wall of the vein strikes N. 10° E. and dips about 45° W. At the bend the strike of the vein turns sharply to N. 50° E. and the dip is about 45° NW. The vein is exposed in a bulldozer cut for a length of about 120 feet, and it probably does not extend far beyond the last exposures. The average thickness of the exposed vein is about 4 feet; the maximum thickness is 5 feet, measured near the bend in the vein.

The main vein consists chiefly of brecciated fluorite cemented by abundant granular quartz. The highest grade ore is concentrated adjacent to the gouge and granulated granite on the hanging wall. Toward the footwall of the vein, granite fragments are progressively more abundant, and beyond the limit of ore only scattered veins cut the shattered granite. Many small veins, up to 2 inches in width, parallel the main vein in the gouge and granulated granite of the hanging wall. Second stage quartz was not deposited in these small veins which are higher grade than the main vein.

Most of the production from the Mattie B. deposit came from a shallow open cut on the vein.

Duffields deposit.—The Duffields deposit (fig. 5) was named for a nearby siding on the old Colorado Springs and Cripple Creek District Railway. The workings on the deposit are the Leyte open pit just north of the Gold Camp road and the Hughes Boss shafts 110 and 150 feet south of the road. Most of the production from the deposit came from the Leyte pit in 1944 and 1945.

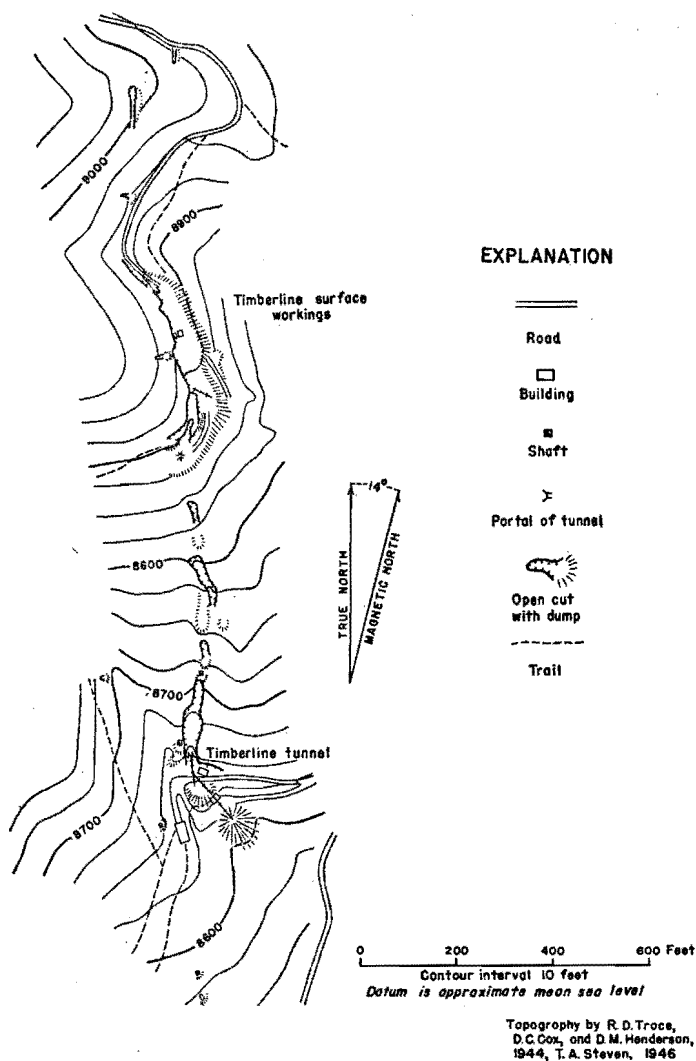


FIGURE 6—TOPOGRAPHIC MAP OF THE TIMBERLINE DEPOSIT

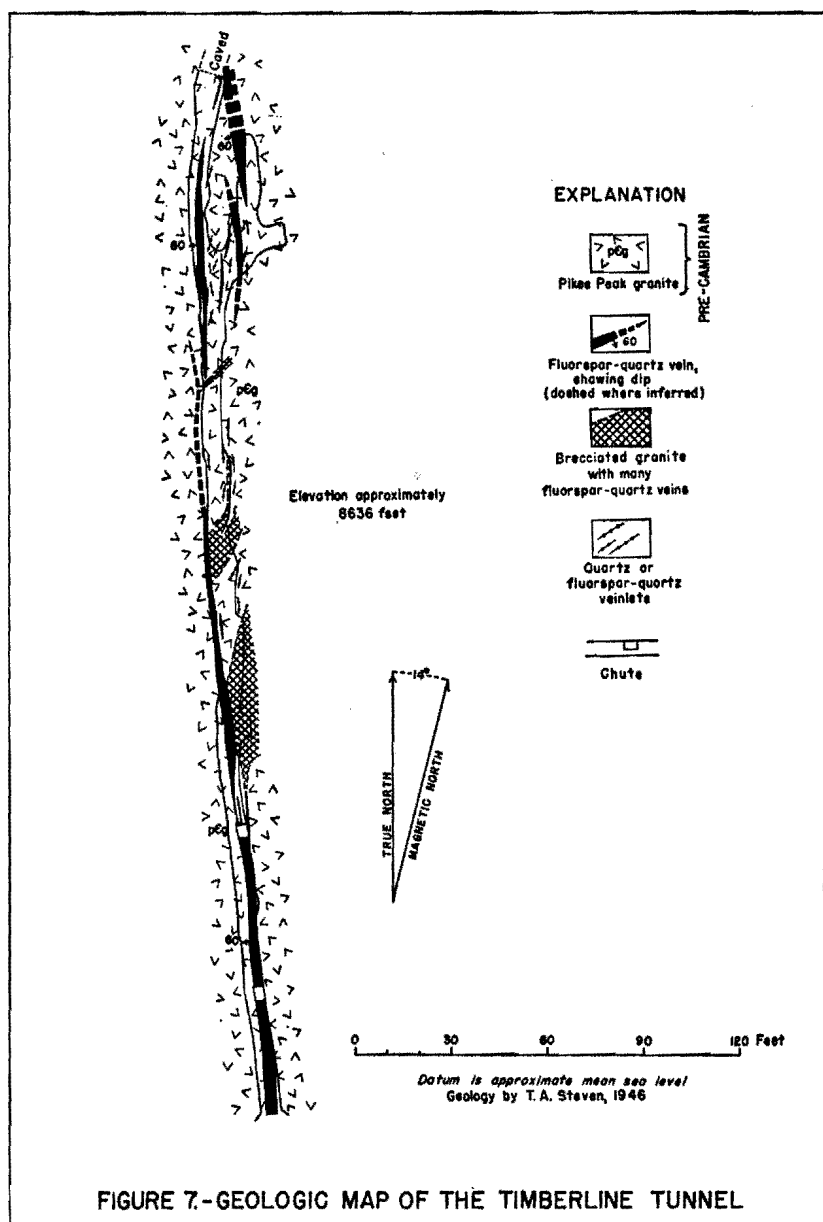
The deposit has been exposed, at one time or another during mining operations, for about 400 feet along the strike. Although neither end of the deposit has been exposed, no evidence that it extends very far beyond the mine workings has been found. The vein is at least 15 feet thick for more than 200 feet along the strike, and just south of the Gold Camp road it is about 20 feet thick.

The Duffields deposit is localized in the shattered rock in the pronounced bend along the controlling fault. In the Hughes Boss shafts the hanging wall of the vein strikes N. 20° E. and dips 65° W. Just south of the road the strike changes, and in the Leyte pit the hanging wall of the vein strikes north and dips 70° W. The vein is thickest where the strike of the fault changes.

The highest grade fluorspar is located near the hanging wall of the vein, and the adjacent gouge is partly replaced. As in the Mattie B. deposit, granite fragments are increasingly abundant toward the footwall where only irregular veinlets cut the fractured granite. The granite of the footwall commonly is silicified beyond the limit of fluorspar deposition.

The vein at the Duffields deposit consists largely of fluorite and quartz of the first stage of the second period of vein deposition. Variable quantities of finely granular white quartz and associated galena and sphalerite occur as a breccia filling. Some barite was seen on the dump of the Leyte pit, but none was found in place.

Timberline deposit.—The Timberline deposit (fig. 6) occurs near the southern end of the mineralized zone in the St. Peters Dome district. It consists of overlapping lenticular veins that crop out for a distance of 1,500 feet. Mine workings include a tunnel (fig. 7) driven northward from the southern end of the deposit and some surface workings (fig. 8) that are 600 to 1,000 feet north of the tunnel portal. Numerous prospect pits have been dug along the length of the deposit. Most of the production in 1917 and 1918 came



from the Timberline tunnel; in 1944 and 1945 the open cuts supplied most of the production, although the Timberline tunnel also was worked.

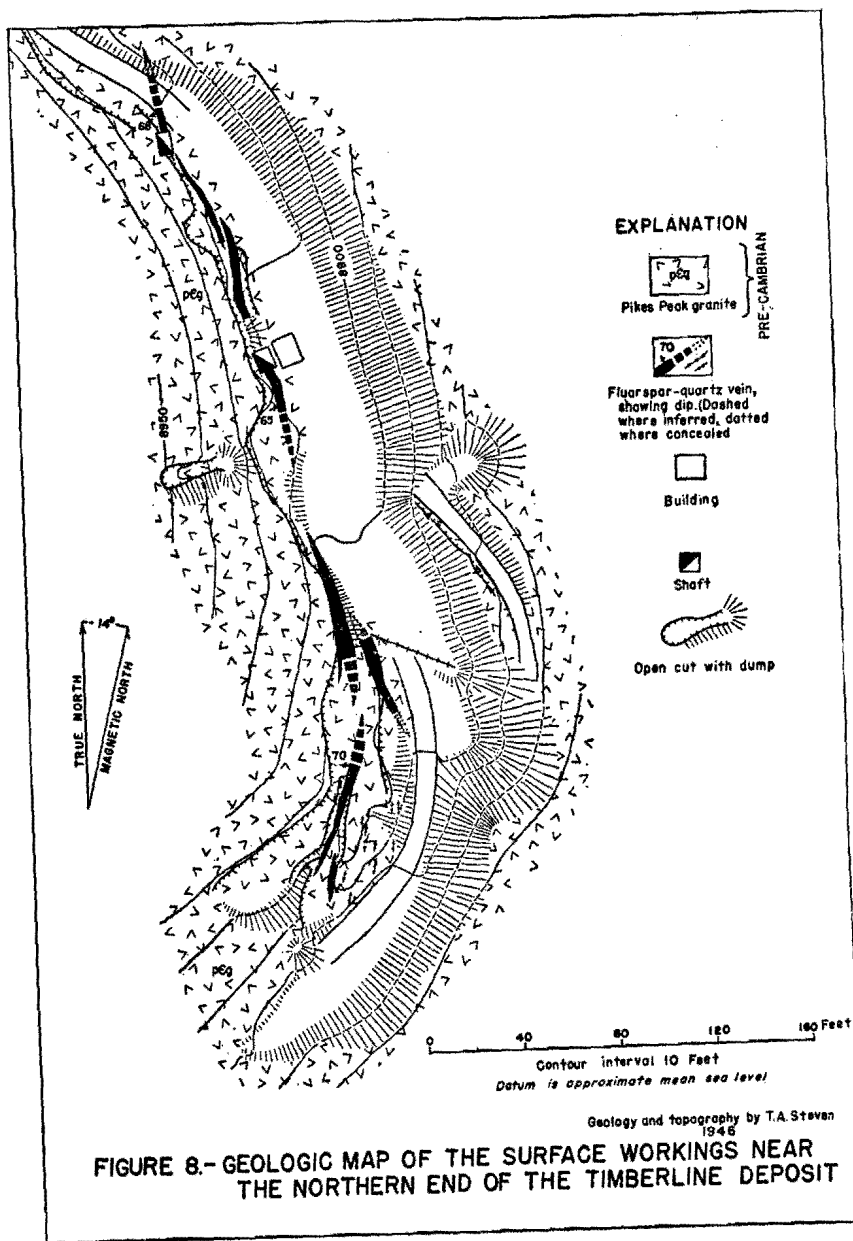
The veins of the Timberline deposit are in subparallel fractures of narrow shear zone. Displacement on faults in this zone appears to be small, and the gouge is rarely more than an inch or two thick. The veins are exposed through a vertical range of 380 feet, and appear to be as discontinuous vertically as they are along the strike. The individual veins are as much as 7 feet thick and 200 feet long. Locally, as in the Timberline tunnel, brecciated zones between subparallel fissures are mineralized.

The tenor of the ore varies considerably. The fluorite-quartz veins that formed largely during the first stage of the second period of vein formation tend to be of higher grade but narrower than the more siliceous veins formed by repeated brecciation and deposition. Galena and sphalerite are more abundant in the Timberline deposit than in the other deposits, and pyrite and chalcopyrite were observed only in the Timberline tunnel. Small quantities of barite are distributed widely.

OUTLOOK AND RESERVES

The discovery of new deposits of fluorspar in the St. Peters Dome district probably will depend upon exploration at depth within the area of known deposits. Detailed mapping north of the Mattie B. deposit and reconnaissance south of the Timberline deposit did not disclose significant fracturing related to the second stage of Tertiary (?) shearing, and the fluorspar deposits in these areas are unimportant. The fluorspar deposits are known to occur through a vertical range of more than 600 feet, and as the deposits are discontinuous vertically as well as horizontally, fluorspar bodies probably exist that do not crop out.

Very little ore in the district can be classed as measured or blocked out. However, exposures at the three main deposits are considered to indicate at least 65,000 tons of ore



containing 35 percent or more CaF_2 within 100 feet beneath the present workings. Another 80,000 tons of comparable ore reasonably can be inferred. These estimates are conservative as they take into account no ore deeper than 250 feet beneath the surface at the Timberline deposit, 200 feet beneath the surface at the Duffields deposit, or 50 feet beneath the surface at the Mattie B. deposit.