Senator-Schwenck Area Tabb Fault System Caldwell County

By HARRY J. KLEPSER

FLUORSPAR DEPOSITS IN WESTERN KENTUCKY

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ABSTRACT

The Senator-Schwenck area is one of the minor fluorspar producing centers of the Kentucky-Illinois fluorspar field. The mapped area is located near the east end of the Tabb fault system, approximately 5 miles northwest of Princeton, Caldwell County, Ky. Mining operations began about 1903 and have continued intermittently; 15,000 to 20,000 tons of fluorspar concentrates has been produced.

Fluorspar occurs as fissure-filling and replacement type of vein deposits along normal faults that displace lower Carboniferous formations. The major fault system strikes approximately N. 60° W., but many of the ore bodies are found along cross faults and faults that diverge from the major fault system. Eighteen faults have been found in the area, and fluorspar has been mined from nine of them. The other faults have not been prospected, but some of them show surface evidence of mineralization. All of the faults are essentially vertical, normal faults with displacements ranging from a few feet to 450 feet.

The ore bodies are generally 3–5 feet wide, but a few are 10–12 feet wide; usually they are of limited horizontal and vertical extent. Fluorspar occurs in the area as veins and gravel spar, the weathered residue of veins. The ore is of two types; high-grade massive light-brown or colorless fluorspar, and lower grade fluorspar breccia. The mines are less than 150 feet deep with the exception of the Main Senator shaft, which is 300 feet deep.

Although the total production from this area is not large, a more comprehensive program of exploration and development, consisting chiefly of deeper drilling, deepening present shafts, and prospecting the hitherto little-known, unproductive faults, may increase its importance. The presence of deeper ore in the area is suggested by the recent discovery of a wide, but apparently short, ore body revealed by drilling on the Meadows property north of the Senator property.

INTRODUCTION

The Senator-Schwenck area is in the southeastern part of the Kentucky-Illinois fluorspar field, approximately 5 miles northwest of Princeton, Caldwell County, Ky. (See fig. 9.) The fluorspar mines of this area are located along the eastward extension of the Tabb fault

system, which consists of a complex system of normal faults striking approximately N. 60° W. Mining operations started about 1903 and have continued intermittently; 15,000 to 20,000 tons of fluorspar concentrate has been produced.

The mapped area is of moderate relief, in no place exceeding 200 feet, and is characterized by rounded hills and valleys. The hills, generally wooded, are capped by sandstone, and the valleys are cut in limestone and shale.

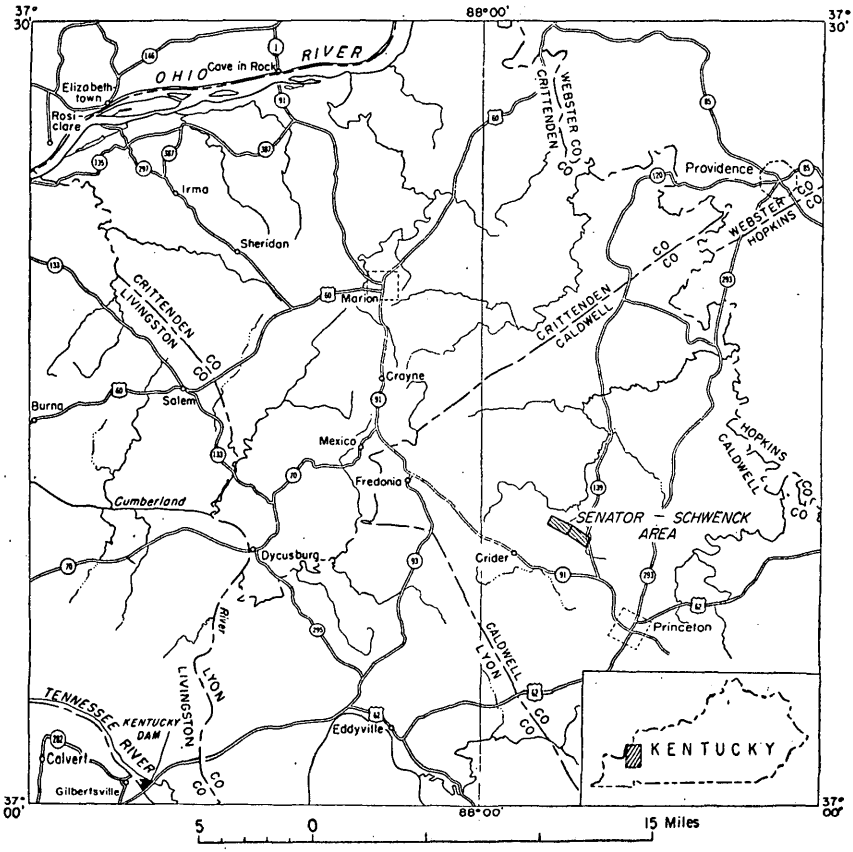

FIGURE 9.—Index map of western Kentucky showing the location of the Senator-Schwenck area, Caldwell County.

The Ohio River, the Illinois Central Railroad, and paved highways provide access to the Kentucky district. The Senator-Schwenck area can be reached by secondary roads west and northwest from Kentucky State Route 139, 1½–2 miles north of its junction with State Route 91.

The first published references to the Senator-Schwenck area were made by Ulrich (1905, p. 95–96), who discussed the Bodard fault (fault 8 of this report) on which the old Senator mine is located, and by Smith

(1905, p. 206–207), who briefly described the Senator mine. During 1921 and 1922, Weller (1923) made a geologic study of the Princeton quadrangle and mapped the main structural features. In the vicinity of the Senator mine, Weller mapped seven faults, which he named faults 3, 11, 12, 13, 14, 15, and 16. Several years later, an areal and structural geologic map of Caldwell County, Ky., was prepared by Weller, Sutton, and Crider (1927), on a scale of 1 inch to a mile. More recently Weller's interpretation of the geology of the Senator-Schwenck area is shown on the geologic map of the western Kentucky fluorspar district (Weller and Sutton, 1951).

Early in 1943 the U. S. Geological Survey began mapping the Senator mine area on a scale of 1 inch to 100 feet. The results were released in a preliminary map and report on that area.[1] Since then additional studies have been made of the Senator area, and the map area has been extended to the northwest to include the Schwenck mine. The present report includes the area from the Senator mine to the Schwenck mine. (See pl. 18.) Although it agrees in general with the above-mentioned report, several modifications have been made as a result of more detailed studies and additional information.

The writer wishes to acknowledge the cooperation of the several mine operators. The investigations were made under the general supervision of James Steele Williams and R. E. Van Alstine. Mr. A. H. Reed, Sr., of Marion, Kentucky, made available several reports and maps of this area and has orally given the writer information on the history of fluorspar mining in the area.

GEOLOGY

STRATIGRAPHY

The rocks exposed in the Senator-Schwenck area are all sedimentary. Numerous northwest-trending lamprophyre dikes are present elsewhere in the Kentucky-Illinois fluorspar field, however, and one of these dikes was reported by Weller (1923, p. 98) approximately 2½ miles northeast of the Senator mine. After the field work for this report was completed, dike rock was reported to be present in ore from a shallow shaft on the Crowder property.[2] This new shaft, recently sunk by Mr. P. L. Perkins, is on fault 14. The writer did not see any samples of the dike, but assumes that it is also lamprophyre. It is possible that other dikes may be present in the Senator-Schwenck area, but because of the ease with which they weather, no dikes were seen on the surface by the writer.

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[1] Thurston, W. R., 1943, Preliminary report on the geology of the Senator mine area, Caldwell County, Ky.: U. S. Geol. Survey, open file release.

[2] Assayed by Mr. E. Frazer, chemist for Kentucky Fluor Spar Co., Marion, Ky.

In the standard classification of the Ohio and Mississippi Valley regions, Mississippian rocks are divided into four groups; namely, Kinderhook, Osage, Meramec and Chester (Weller and others, 1948). Rocks of the two younger groups, Meramec and Chester, are present at the surface in the Senator-Schwenck area, and consist of limestones, shales, and sandstones. (See following table.) Outcrops are not abundant in this area; where present they usually consist of highly weathered rocks and represent only a small part of the total rock sequence. The bedrock, however, has been cut by several drill holes, and information from these holes and mine workings and from a few surface exposures forms the basis for a fairly complete understanding of the lithology and thickness of the sedimentary rock formations.

STRUCTURE

The Senator-Schwenck area is near the east end of the Tabb fault system. Weller, Sutton, and Crider (1927) indicated that the Main Senator mine was located on what they termed fault 3, which they then considered to be distinct from the Tabb fault system. Later, more detailed mapping has indicated that their fault 3 is the eastward continuation of the Tabb, the name used in this report.

The Tabb fault system strikes approximately N. 60° W. in this area, and consists of several subparallel faults and numerous cross faults. The faults are normal and generally dip 80°–90°. Eighteen faults mapped as a result of this study are described in the following pages. (See pl. 18.)

The rock formations are generally horizontal away from the faults, although limited data suggest that in the blocks between some of the parallel faults the beds may be dipping as much as 30°. Drag folds are most common near the faults, and the beds dip as much as 45°; the area of drag folding may extend as far as 400 feet from the fault plane.

Fault 1 is the major fault of the area and is the easterly continuation of the main fault of the Tabb fault system in Crittenden County. It strikes N. 50°–70° W. and dips approximately 85° N. Throughout most of this area the Tar Springs sandstone is exposed on the hanging wall to the north; near the eastern end, however, the Glen Dean limestone and the Hardinsburg sandstone are exposed along the hanging wall. The footwall formation in the western half of the area is either the Golconda formation or the Hardinsburg sandstone. Eastward from the zone of the cross faults on the Gilbert Williamson and Crowder properties, however, the sequence from Ste. Genevieve limestone to Hardinsburg sandstone is present at the surface on the footwall side. The displacement along fault 1 ranges from 210 to 450 feet. (See pl. 18.)

Generalized section of Carboniferous formations in the Senator-Schwenck area, Tabb fault system, Caldwell County, Ky.

System	Series	Group	Formation		Character	Thickness (feet)
Carboniferous.	Mississippian.	Chester Group.	Tar Springs sandstone.		Brownish-gray, fine- to medium-grained sandstone with gray to gray-black shales.	200
			Glen Dean limestone.		Dark to very dark gray, medium- to coarse-grained crystalline limestone with interbedded dark-gray calcareous shales.	50
			Hardinsburg sandstone.		Light- to medium-gray, fine- to medium-grained sandstone, with interbedded light- to medium-gray sandy shales.	20–40
			Golconda formation.		Medium to dark gray-brown silty shale with interbedded medium to dark gray-brown, medium- to coarsely-crystalline limestone.	80
			Cypress sandstone.		White to medium-gray, fine-grained sandstone with some gray shale; weathers yellow brown; usually not as massive as Bethel sandstone.	30–40
			Paint Creek shale.		Medium- to dark-gray, medium-grained oölitic and crystalline limestone in this area, with interbedded gray shales.	50–70
			Bethel sandstone.		White to medium-gray, fine-grained, usually massive sandstone, with some gray shale; weathers yellow brown.	40–60
			Renault formation.		Light- to medium-gray, fine- to medium-grained crystalline limestone and alternate shaly limestone and dark-gray shale; a few beds are very oölitic; sandy at base locally.	90–100
		Meramec Group.	Ste. Genevieve limestone	Levias limestone member.	White to light-gray, medium-grained oölitic limestone; few interbedded green-gray shales.	5–15
				Rosiclare sandstone member.	Green-gray, fine-grained, calcareous sandstone; locally grades laterally to sandy limestone.	5–15
				Fredonia limestone member.	White to light-gray, medium-grained, oölitic limestone and interbedded green-gray shales; some dense limestone with chert nodules in lower part.	180
			St. Louis limestone.		Medium-gray to dark-gray, dense limestone with abundant chert nodules; some more coarsely crystalline beds and a few oölitic limestone beds in upper part.	350

Fault 2 roughly parallels fault 1 and also dips north, but at a slightly smaller angle. These two faults probably merge at a depth of several hundred feet. Fault 2 is bounded on the north by the Golconda formation and the Fredonia limestone member of the Ste. Genevieve limestone and on the south by the Renault formation and Ste. Genevieve limestone. The displacement along the fault is approximately 260 feet.

Fault 3 is subparallel to fault 1 southeastward from the vicinity of the Meadows mine on the Gilbert Williamson property for several hundred feet and then joins fault 1 approximately 550 feet northwest of the Main Senator shaft. It likewise dips north, at 80°. Formations ranging in age from the Fredonia limestone member to Hardinsburg sandstone bound it on the hanging-wall side, and the Renault and Bethel formations crop out on the footwall or south side of the fault. The displacement is from 50 to 200 feet.

Fault 4 diverges from fault 1 at the Main Senator shaft and may represent a continuation of fault 3. It strikes N. 50° W. and dips 80° S. Fault 4 has Renault and Bethel formations on the north or footwall side and Bethel, Paint Creek, and Cypress formations on the hanging wall, and has a displacement of approximately 50 feet.

Throughout the western half of the area mapped, faults 5 and 6 are the bounding faults of a graben in which the Bethel sandstone and the upper beds of the Renault formation have been dropped approximately 50 feet against the upper members of the Ste. Genevieve limestone and the Renault formation. Fault 5 terminates against cross fault 15 near the middle of the area, but fault 6 continues southeastward, essentially parallel to fault 1. Southeast of fault 15, formations ranging from Renault to Cypress form the walls of fault 6 at the surface. Fault 6 here has a displacement of 30 to 50 feet. Fault 5 strikes N. 75° W. and dips approximately 85° S. West of fault 15, fault 6 is parallel to fault 5, but east of fault 15 the direction of strike changes to N. 60° W. Fault 6 dips approximately 85° N.

Fault 7 strikes N. 80° W. and dips 85° S. The Renault formation and Bethel sandstone crop out on the footwall side, and Bethel sandstone is at the surface on the hanging-wall side to the south. The displacement of this fault is from 20 to 30 feet.

Fault 8, on which the old Senator or Senator No. 1 and No. 2 mine workings are located, strikes N. 65° W. and dips 85° N. This fault is bounded by the Bethel sandstone, Paint Creek shale, and Cypress sandstone on the north and by the Levias limestone member of the Ste. Genevieve limestone, Renault formation, and Bethel sandstone on the south, and has a displacement ranging from 90 to 125 feet.

Faults 9 to 13 are a series of parallel cross faults between fault 1 and faults 2 and 3. These cross faults strike approximately N. 75° E.

Fault 9 has a displacement of about 350 feet; the Hardinsburg sandstone and the Golconda formation crop out on the hanging-wall side, and the Fredonia limestone member of the Ste. Genevieve, on the footwall side. Fault 10, a minor fault within the Fredonia, has a displacement of about 20 feet. Faults 9 and 10 dip northward approximately 85°. Fault 11, on which the Meadows shaft on the Gilbert Williamson property is located, and fault 12 are bounding faults of a graben in which the lower beds of the Renault formation have been dropped against the Fredonia limestone member. Fault 11 dips 85° S. and has a displacement of about 150 feet; fault 12 dips 85° N. and has a displacement of about 50 feet. Fault 13 dips 85° S. and has a displacement of 150 feet. The Bethel sandstone and the Fredonia limestone member of the Ste. Genevieve limestone occur at the surface on the hanging-wall and footwall sides of the fault, respectively.

Fault 14 is located almost entirely on the basis of stratigraphy. North of the Eddie Crowder shafts the block between faults 1 and 3 has Bethel sandstone, Paint Creek shale, and Cypress sandstone at the surface. Eastward, however, the Golconda formation was recognized between these two faults, indicating that a cross fault exists. The location of this cross fault is uncertain, and its position as indicated on the map is inferred from the presence of several slickensided boulders. The fault is between the Cypress on the footwall side and the Hardinsburg sandstone on the hanging-wall side, has a displacement of 125 feet, and dips approximately 85° S.

Probably other cross faults exist between fault 1 and faults 2 and 3, the main faults of the Tabb system in this area, but the above-mentioned ones (faults 9 to 14) are the only ones recognized in the present study.

Fault 15 is a cross fault between faults 3 and 6, strikes N. 70° E., and has an almost vertical fault plane. East of where this fault truncates fault 5, fault 15 has a displacement of 20 feet and the hanging wall is on the south; west of this place it has a displacement of 30 feet and the hanging wall is on the north. The Bethel sandstone crops out on the southeast wall, and limestone of the Paint Creek shale and the Bethel sandstone are at the surface on the northwest wall of the fault.

Faults 16, 17, and 18 are inferred entirely on stratigraphic evidence, and their locations are determined largely on the basis of topography. Fault 16 strikes N. 35° E., dips southeast, and has a displacement of about 90 feet; fault 17 strikes north, dips east, and has a displacement of 80 feet; and fault 18 strikes east, dips south, and has a displacement of 90 feet.

FLUORSPAR DEPOSITS

Fluorspar occurs in the Senator-Schwenck area as fissure-filling and replacement-type vein deposits along normal faults. Eighteen faults are recognized, and fluorspar has been mined from 9 of them. The ore bodies are lenticular masses that generally are 3–5 feet wide, but locally are 10–12 feet wide. In general they are small, and few exceed 200 feet in length and 100 feet in vertical extent. A relatively small percentage of silica is present in the fluorspar of this area. Calcite, galena, sphalerite, and barite are the chief gangue minerals.

Some fluorspar has been mined from the veins in place, but most of the fluorspar from this area has come from gravel-spar deposits, which are residual accumulations derived from the weathering of fluorspar veins. The vein fluorspar is of two types: high-grade, massive, light-brown or colorless fluorspar, and fluorspar cementing brecciated limestone, sandstone, and early-formed vein calcite. The former commonly is composed of 80–90 percent of CaF_2, and the latter, or "breccia ore," averages 30–40 percent of CaF_2. Recent drilling on the Meadows property, immediately northwest of the Main Senator shaft (see pl. 18), penetrated a fluorspar vein 3–12 feet wide, at vertical depths ranging from 100 to 250 feet. This discovery indicates that in the future more of the fluorspar mined in this area may come from veins rather than gravel-spar deposits.

Most of the gravel spar mined in this area after log washing contains 85 percent CaF_2, which generally had been regarded as the minimum requirement for metallurgical-grade fluorspar. Some of the selectively mined gravel spar has been sold without washing to the steel companies.

HISTORY AND DEVELOPMENT OF INDIVIDUAL PROPERTIES

Senator.—The first significant prospecting work in the Senator-Schwenck area was done in 1903, when the Senator No. 1 shaft was sunk on fault 8 to a depth of 65 feet and a few hundred tons of fluorspar containing galena and sphalerite was mined. In 1917 this shaft was rehabilitated and sunk an additional 10 feet, and approximately 100 tons of fluorspar was mined. In 1938 the Senator No. 2 shaft was sunk near the junction of faults 7 and 8 to a depth of 100 feet, but the faults were not explored at this depth. A crosscut at the 62-foot level revealed 3 to 4 feet of ore, but no fluorspar was mined.

In 1942 Mr. Hobart Crider of Mexico, Ky., sank the Crider shaft (now called the Main Senator shaft), a few feet south of fault 1 near the junction with fault 4, to a depth of 100 feet and discovered a small fluorspar body. A drilling program was initiated and 6 diamond-drill holes were bored on the Senator property (shown on pl. 18 as Senator D. D. H. 1–6). In January 1943, the Midland Minerals Corp. acquired

the property and began a program of exploration and development. The drilling was continued with eight additional holes drilled (shown as Senator D. D. H. 7–14). The Main Senator shaft was extended to a depth of 210 feet, and levels were driven southeastward along fault 4 at depths of 108, 141, 173, and 210 feet. By June 1944, most of the ore, consisting of high-grade, light-brown fluorspar and lower grade fluorspar breccia, was stoped out between these levels, and soon after the mine was closed. The Minerals Flotation Corp. of Marion, Ky. (Mr. Paul J. Bertelsen, president) acquired the Senator property and the adjacent Meadows property in 1947, drove the 210-foot level of the Main Senator shaft 300 feet northwestward onto the Meadows property, and sank the shaft to a depth of 300 feet. In 1950 Mr. C. B. Meadows, president of Glass Fluorspar Co. of Princeton, Ky., purchased the Senator property, and plans to develop the Senator and adjacent Meadows properties in the near future.

Parts of faults 6 and 16 and all of fault 17 also are on the Senator property. No mining or exploratory work has been done on faults 16 or 17, and only one shallow shaft has been sunk on fault 6.

Meadows.—Little mining has been done on the Meadows property, but several prospect pits have been dug. In 1945, Mr. C. B. Meadows drilled seven diamond-drill holes (shown as Meadows D. D. H. 1–7 on pl. 18) that cut fault 1 at depths ranging from 100 to 250 feet. One of the drill holes (no. 4) cut a 10- to 12-foot width of high-grade, light-brown fluorspar, and cores of the other holes all showed smaller widths of fluorspar. Minerals Flotation Corp. acquired the Meadows property and the Senator property in 1947 and drove the 210-foot level of the Main Senator shaft 300 feet northwestward onto the Meadows property. Mr. Paul J. Bertelsen reported finding considerable minable fluorspar of rather low grade. In 1949 the Meadows property reverted to Mr. Meadows. In 1950 Mr. Meadows purchased the Senator property, and plans to drive the 300-foot level of the Main Senator shaft northwestward onto the Meadows property under the rich ore body indicated in drill hole 4 at a depth of about 250 feet.

No prospecting has been done on faults 3 and 18, parts of which cross the Meadows property.

Perkins.—Faults 1 and 3 cross the Perkins property west of the Meadows property, and except for several shallow prospect pits near fault 3, no work has been done on the property.

Coleman.—Only fault 6 crossed the Coleman property, and no prospecting has been done there.

Crowder (Perkins).—Numerous shallow shafts and pits have been sunk on the Crowder (Perkins) property on or near fault 3 and cross faults 11, 12 and 13. (See pl. 18.) Mr. P. L. Perkins of Princeton, Ky., has the mineral rights and has done most of the prospecting and min-

ing on this property. The Eddie Crowder shafts 1 and 2 are 60 feet deep and are connected by a drift at that level. The ore is gravel spar and has been nearly mined out from several shallow drifts between the 60-foot level and the surface. This latter work was done mostly by the Cecelia Mining Co., which subleased a part of the property from Mr. Perkins between 1943 and 1945. At about the same time a small strip at the western end of this property was subleased to Mrs. S. E. Warren and Mr. Roy Cameron of Evansville, Ind., who mined a small amount of fluorspar from shallow pits and shafts. The Meadows shaft on the Crowder (Perkins) property was sunk to a depth of 150 feet and a short crosscut was driven toward fault 3, but work was stopped before the fault was reached.

Faults 1, 5, 6, 14 and 15 also cross the Crowder (Perkins) property, but no prospecting has been done on them.

Urey Williamson.—Mr. Urey Williamson has two properties (see pl. 18) in the area covered by this report, and both are leased by Mr. J. F. Wilson of Hopkinsville, Ky. A number of shallow shafts and pits were sunk on fault 6, but little work has been done on fault 5, the only other fault on the Urey Williamson properties. The fluorspar mined from these properties is entirely of the gravel-spar type, and none of the shafts has penetrated to a depth greater than 50 feet.

Gilbert Williamson.—Mr. C. B. Meadows leased the Gilbert Williamson property (see pl. 18) from 1943 to 1945, sank a 60-foot shaft, and mined a small, rich fluorspar body from several levels extending northeast and southwest from the shaft, along fault 11. A number of diamond-drill holes (shown on pl. 18 as Gilbert Williamson D. D. H. 1–20) cut faults 2, 3, 9, 10, 11, and 12 in the vicinity of the Meadows shaft on the Gilbert Williamson property but failed to show any appreciable quantity of fluorspar. Several shallow diamond-drill holes (shown as Gilbert Williamson D. D. H. 21–23) cut fault 6 at the southwestern edge of the property and were barren. Faults 1 and 5 have not been prospected extensively on the Gilbert Williamson property.

Jones.—One shallow shaft was sunk near the southwest corner of the Jones property (see pl. 18) very close to fault 2, but no fluorspar was mined.

Walker.—The part of the Walker property (see pl. 18) north of the Flynn's Ferry road is leased by Mr. Reginald Spickard of Detroit, Mich., and that part south of the same road by Mr. Johnson Byrd, who has subleased to Mr. C. E. Townsend and Mr. Howard of Princeton, Ky. During 1944 and 1945 the Cecelia Mining Co. had a lease on the Walker property north of the Flynn's Ferry road and excavated a large opencut on a deposit of gravel spar south of fault 2. The percentage of fluorspar recovered was too low for this mining method to

be profitable, and thus the attempt to mine fluorspar by opencut was abandoned. One shallow pit 25 feet north of the opencut on fault 2, sunk by Mr. P. L. Perkins in 1943, is reputed to have exposed 3 feet of fluorspar at a depth of about 20 feet. During the period between 1930 and 1935 Mr. Arthur Lynch of Marion, Ky., mined approximately 3,000 tons of fluorspar from a number of shallow shafts on fault 6 on the part of the Walker property leased by Mr. Johnson Byrd. No prospecting has been done on faults 1 and 5 on the Walker property.

Schwenck.—In 1926 the Pygmy Co. (now the Rosiclare Lead and Fluorspar Co.) of Rosiclare, Ill., is reputed to have mined about 8,000 tons of fluorspar from fault 2 on the Schwenck property. (See pl. 18.) Later the property was operated by the Princeton Spar Co. (1932–33) and by Mr. Clyde Dalton (1939–42). In 1944 the Delhi Fluorspar Co. of Marion, Ky., acquired the property, operated it until 1945, and did diamond drilling on it in 1946. At present no mining is being done on the property.

SUGGESTIONS FOR PROSPECTING

Most of the attempts at mining fluorspar in the Senator-Schwenck area have been confined to shallow workings in gravel spar. Present data suggest that this will be true for some of the future production from the area. Other gravel-spar deposits undoubtedly exist, and a well-planned program of trenching likely would uncover many of them. This program should be initiated near currently known ore bodies and extended in both directions along the strike of all mineralized faults. The numerous cross faults appear to be favorable locations for the existence of small, shallow ore bodies. Trenching should commence on the known cross faults and be continued elsewhere between fault 1 and faults 2 and 3, with the hope of discovering similar cross faults not readily visible because of surficial cover.

In view of the recent discovery of a 10- to 12-foot vein of massive, high-grade fluorspar on fault 1 at a vertical depth of 250 feet on the Meadows property (see pl. 18), minable deposits of vein fluorspar probably are present at greater depths than hitherto known in this area. Future exploration should therefore consist of systematic drilling to cut faults at vertical depths of 200 to 300 feet, or possibly at even greater depths. The writer feels that there is a greater likelihood of finding such fluorspar bodies if the drilling is confined to the main faults of the area, namely faults 1, 2, 3, and 4. No prospecting has been done along fault 1, the major fault of the area, with the exception of drilling in the vicinity of the Main Senator shaft and the above mentioned drilling on the Meadows property. It is therefore recommended that a number of holes be drilled along fault 1 at horizontal intervals of 100 to 300 feet.

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