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Fluorite Deposits in the Dry Creek District, Near Superior, Mineral County, Montana

Russell M. Corn

FLUORITE DEPOSITS IN THE DRY CREEK DISTRICT, NEAR SUPERIOR, MINERAL COUNTY, MONTANA

By

Russell M. Corn

A Thesis
Submitted to the Department of Geology
in Partial Fulfillment of the
Requirements for the Degree of
Bachelor of Science
in
Geological Engineering

Montana School of Mines
Butte, Montana
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FLUORITE DEPOSITS IN THE DRY CREEK DISTRICT, NEAR SUPERIOR, MINERAL COUNTY, MONTANA

ABSTRACT

Fluorite was discovered in the Dry Creek District, Mineral County, in 1943 and the first commercial production of this mineral in Montana was recorded from this locality.

The mineral occurrs in three separate prospects in highly folded and faulted argillites of the Wallace Formation, Pre Cambrian Belt Series.

Fluorite is found in lenses, pods, and as irregular branching replacements of quartz, carbonates, and carbonatized argillites, along zones of intense carbonate mineralization. The fluorite-carbonate relationship indicates deposition of fluorite along the same structures as the carbonate and at a later stage.

Milky quartz represents the first mineralization in the district. Along later structures, the carbonates, calcite and ankerite, and then fluorite, were deposited. Sulphide minerals, galena, chalcopyrite, tetrahedrite, and pyrite are present in minor amounts, and are later paragenically than the fluorite.

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INTRODUCTION

Fluorite was discovered in the Dry Creek District in 1943. Since that date, three prospects have been variably developed. According to their location in the district, they are the Wilson Creek, Bear Gulch, and Lime Gulch prospects, of which the Wilson Creek and Bear Gulch properties have recorded the first commercial production of fluorite in Montana.

Published literature contains only a brief description of the Bear Gulch Prospect, by C. P. Ross of the United States Geological Survey. (9-205). Mr. Ross visited the property soon after its discovery and before any comprehensive development had been undertaken.

The author has long been acquainted with the mines of the region and has been interested in the Fluorite deposits since their discovery, and has watched with interest their development. He chose their geology as a thesis subject for this reason.

The underground workings were mapped during the Christmas recess, 1952. During March and April, 1953, the surface workings were mapped and the areal geology examined. Because of the great amount of talus covered area, and the extreme alteration of the sediments exposed, the author did not attempt to map the area around the deposits.

The author wishes to thank Professors W. S. March and F. S. Robertson for their aid, advice, and guidance during research on the problem. Thanks are also due to Mr. W. E. Clark and other officers of the Superior Fluorspar Company for their permission to study the property, and to Don Cenis for his aid in the mapping and examination.

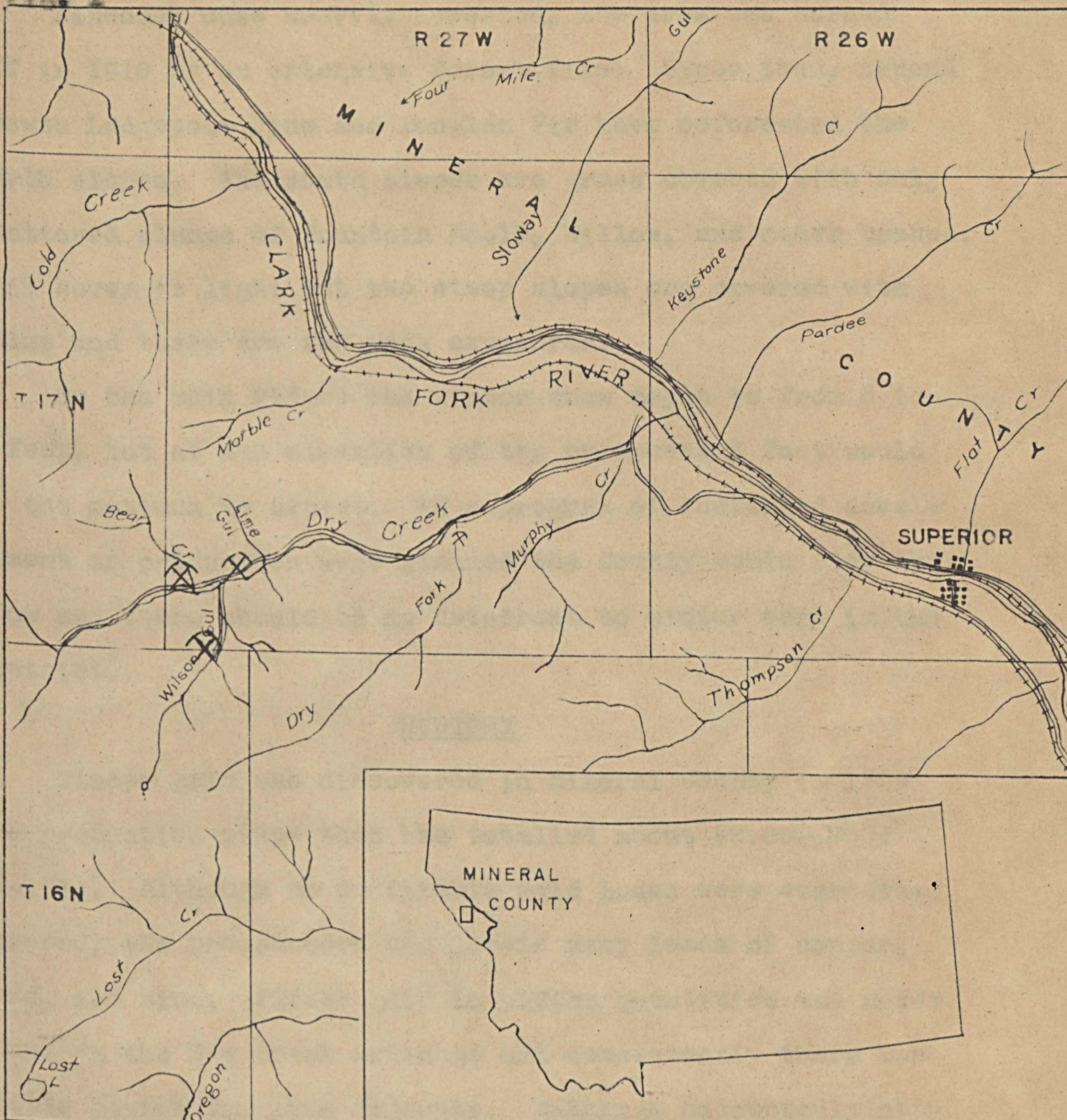
LOCATION

The Fluorite Prospects are located along the narrow valley of Dry Creek about 8 miles west of Superior, and 40 miles southeast of Wallace, Idaho. (Fig. 1). They are about 12 miles by road from Superior, the nearest shipping point at present, and can be reached by following the gravelled road south of the Clarks Fork River westward for 6 miles to Dry Creek and thence southward on the graded Forest Service road.

TOPOGRAPHY AND CLIMATE

The area is characterized by extremely rugged topography. Slopes from 30 to 40 degrees are common and the relief is from 4,000 to 5,000 feet. The prospects are close to an elevation of 4,000 feet, and they are below the heavy snowfall level. The climate is mild, with open winters and 20 to 30 inches of rainfall yearly.

Fig. 1



INDEX MAP OF PART OF MINERAL COUNTY

SHOWING THE LOCATION OF FLUORITE PROSPECTS

FLUORITE PROSPECT ⚒ 0 5 MILES

Although once heavily forested, the area was burned off in 1910 by an extensive forest fire. Since then, second growth Lodgepole Pine and Douglas Fir have reforested the north slopes. The south slopes are grass covered with only scattered clumps of Mountain Maple, Willow, and other bushes. Soil cover is light but the steep slopes are covered with talus and there are few rock exposures.

On the main ridges the winter snow depth is from 6 to 8 feet, but at the elevation of the prospects 3 feet would be the maximum to expect. If a program of sustained development or production were planned the County would plow the snow and there should be no deterrent to winter work in the district.

HISTORY

Placer gold was discovered in Mineral County in 1869 and production since then has totalled about $2,000,000. (6-193). Although no profitable gold lodes were ever discovered, the prospectors did locate many leads of copper, lead, and zinc. Placer gold in paying quantities was never found in the Dry Creek drainage and consequently there was little search for lode deposits. Although undoubtedly noticed by the early prospectors, the fluorite was not recognized as such until the early spring of 1943, when Mr. Frank Lanum staked the Fat Chance Claim at Bear Gulch. Later in 1943 the claim was taken over by Joseph Brooks, who staked several other claims in the vicinity. The Spar Mining Company was formed by Mr. Brooks and others in 1944 some surface developement was done on the claims.

Mr. Ross visited the prospect during the summer of 1944 and reported that the prospect had been trenched and that a pit had been sunk on the fluorite outcrop. (9-208). In September of that year the Coeur D'Alene Extension Mining Company acquired control of the claims, apparently to finance further developement.

In 1947 several claims were staked near the mouth of the Dry Fork, a tributary of Dry Creek, and about 2½ miles east of the other prospects. An adit 100 feet long was driven on one of the claims but no indications of fluorite mineralization were encountered. These claims are now abandoned.

Early in March, 1948, the attractive deposit on Wilson Creek was discovered and the following year the low grade occurrence near Lime Gulch was chanced upon.

The Couer D'Alene Extension Mining Company leased the Wilson Creek and Bear Gulch prospects to Mr. Bettles during 1948 and 1949. In the same period Mr. Bettles sub-leased the Bear Gulch property to the Riverside Copper Mining Company of Wallace, Idaho. The property near Lime Gulch was leased, after its discovery to the Montana Fluorspar Company.

In 1950 a change of ownership is recorded and the Couer D'Alene Extension Mining Company relinquished its holdings to the Superior Fluorspar Company. This Company leased the Wilson Creek property to William E. Clark in 1950. In 1951 Clark transferred the lease to the Howe Mining Company and apparently the company later acquired control of the property at Bear Gulch.

The author has presented this rather detailed and complex history to show that the lack of complete developement may be the result of too much promotion and not enough interest in active mining. This again, may be true in the case of exploration. Although the Bear Gulch prospect was discovered in 1943, the other two properties were not found until 1948 and 1949. New exploration using the new geological evidence may result in the discovery of other orebodies in the district.

PRODUCTION

In 1948, while under lease by Jay Bettles, the Bear Gulch and Wilson Creek properties produced 318 tons of 94.6% flourite. These few tons represent the initial production of fluorite in Montana. The following year the Riverside Copper Mining Company shipped 422 tons primarily from the claims on Bear Gulch. In 1950, the last year of recorded production, only 41 tons of fluorite were shipped, again by the Riverside Company. There has been no report of any production from the Lime Gulch prospect where hand sorting is not feasible.

The total production has been 781 tons, and assuming an average price range between $40 and $50, the value of the production would be between $30,000 and $40,000.

At the present time the Riverside Mining Company is driving 185 feet of drift from the northern branch of the major adit on Bear Gulch. They plan to follow a Diamond Drill Hole and explore favorable ground intersected by this hole beneath the fluorite outcrop. Undoubtedly, assessment work will be done on the other properties but there is no indication of any extensive developement program.

GENERAL GEOLOGY

Stratigraphy

The majority of the rocks exposed in the area are Pre-Cambrian sediments of the Belt Series. These rocks 30,000 or more feet in thickness, crop out over an extensive area in Western Montana and Northern Idaho.

The Ravalli Group, the oldest formation of the Belt Series, is an assemblage of light colored siliceous sediments. The lower part of the group is mainly interbedded argillites and impure quartzites. A fairly pure quartzite series forms the upper part of the group.

The Wallace formation, above the Ravalli Group, is made up of thin bedded dolomitic, sericitic, slate, blue and white banded argillite, and thin beds of impure ferruginous and dolomitic limestone. It is near the top of this formation that the fluorite prospects are located. Locally the rock appears to be banded argillites with some 1 to 4 foot beds of dolomite. Intense folding, faulting, and carbonate alteration and mineralization in the area has obscurred the character of these rocks.

Overlying the Wallace is the Missoula Group marked by a thick sequence of bright red green, and purple, shales and sandy shales. These sediments do not appear to have the marked structural deformation and alteration found in the Wallace.

Recent alluvium is found along the valleys of the major streams in the area. (3-675).

Igneous Rocks

Igneous rocks are very scarce in the immediate area of the Fluorite Prospects. A large diabase sill of Pre-Cambrian Age outcrops less than 10 miles away along the Idaho-Montana border. This sill has been folded and faulted during the deformation of the sediments. (7-47). (8). Later dikes and sills of Cretaceous or Tertiary Age, occur north of St. Regis. These intrusives are dioritic in character and vary from a few feet to several hundred feet in thickness. (2-50). Similar bodies have been noted by the author south of Superior, but few are more than 50 feet thick. Some stream boulders of this diorite, along Dry Creek and Wilson Creek, indicate that these intrusives are also present in the Dry Creek District.

These small intrusives may be genetically associated with the Idaho Batholith whose northern contact is along the North Fork of the Clearwater River, about 35 miles south of the prospects.

Structure

The area is complexly folded and faulted. The geologic map of the area, Figure 2, does not show this complexity because no detailed work has been done. The map does show however, a strong synclinal trend along the Clarks Fork River and paralleling the Idaho-Montana border.

The most important structural feature of the area is the Osburn Fault, a major break, with displacement estimated as greater than 5 miles. (1-324). The fault trends northwest, and movement has apparently been strike slip.

Associated with this major structure are many minor faults of varying intensities. The lead-silver, zinc deposits of Mineral County are very clearly associated as are those of the Couer D'Alene's, with the subsididary fractures of minor displacement. Faulting in the Dry Creek district is, in all probability, associated with the Osburn Fault or with the major subsidiary structures carried through from the Couer D'Alene region to the west.

FIG. 2

GEOLOGIC MAP

OF A PORTION OF NORTHEASTERN IDAHO & WESTERN MONT.

ADAPTED FROM
GEOLOGIC MAP OF IDAHO, USGS & IDAHO BUREAU OF MINES
COMPILED BY C.P. ROSS & J.D. FORRESTER, 1940
AND
GEOLOGIC MAP OF MONTANA
BY D.A. ANDREWS, G.S. LAMBERT, & G.W. STOSE, 1944

BY R.M. CORN

LEGEND

SEDIMENTARY ROCKS

QUATERNARY
Qal — ALLUVIUM

PRE-CAMBRIAN. BELT SERIES
PЄm — MISSOULA GROUP
PЄw — WALLACE FORMATION
PЄr — RAVALLI GROUP

FAULT

IGNEOUS ROCKS

TERTIARY / CRETACEOUS
TKi — INTRUSIVES UNDIFF.

CRETACEOUS
Ki — QTZ. MONZ. & GRANODIORITE

PRE-CAMBRIAN
PЄd — DIABASE

0 — 10
MILES

PLATE I

PHOTOGRAPHS OF THE BEAR GULCH PROSPECT

PLATE I

PHOTOGRAPHS OF THE BEAR GULCH PROSPECT

Fig. 1

A view of the outcrop on Bear Gulch showing the milky quartz blowout and the general topographic conditions of the region.

Fig. 2

The north wall of the outcrop pit showing the irregular veinlets and stringers of quartz and fluorite.

Fig. 3

A view of the portal of the major adit, Bear Gulch.

DESCRIPTION OF PROSPECTS

The Bear Gulch Prospect

The Bear Gulch prospect is situated in the NW. ¼, Sec. 31, T. 17 N., R. 27 W., and near the end of the ridge between Bear Gulch and Dry Creek.

The only type of rock encountered or exposed on the prospect is a banded, black and white argillite. Bands are from ¼ to 2 inches thick with the light material generally dominant. Plate 5, Figure 2 is a view of some of the contorted material of this description. These bands, representing bedding, now show considerable flowage and the rock fractures independently of the bedding.

Under the microscope this material is a very fine mass of quartz and feldspar, locally obscured by carbonate and milky quartz mineralization. The mineral grains are irregular with very sharp angular boundaries, and vary a great deal in size. These relationships are shown in Figures 1 and 2, Plate 7. Samples taken near the fluorite mineralization, show only incipient carbonates and no other alteration products present.

Mineralization

The impressive feature of the Bear Gulch prospect is the large milky quartz blowout, which forms a conspicuous landmark near the fluorite outcrop. This mass of milky quartz strikes N. 80° W., is about 150 feet long, and 20 to 30 feet wide. Similar but smaller blowouts are present in the district, but are not associated with fluorite. The quartz mass does not have vein-like features, but rather those of a replacement body, and is marked by irregular walls and appears to feature out into small veinlets. Similar milky quartz veinlets are concentrated along the crests of the larger tight folds in the area. The author believes that this mass of quartz replaced the argillites along a tight fold or a fault zone. Suggestive of this origin is the contortion of the bedding near the prospect.

As prevalent as quartz or perhaps more so, in the argillites, is carbonate alteration and mineralization. The predominant carbonate found at Bear Gulch is Ankerite, $CaCO_3$·-(Fe, Mg) CO_3. It is identified by its light gray color, nonreactivity with acid, and optic indices. The orange and red color of the soils and weathered material is due to limonite derived from this mineral. Also present are minor siderite veins, and, as evidenced by acid reactions, calcite. The ankerite reaches its greatest developement near the west end of the quartz blowout where it replaces the argillites and quartz and forms irregular pods and veins. (Plate 2 Figures 2 and 3). The sediments are so altered and veined that the bedding is, in most cases, obliterated.

It is in this zone of intense carbonate mineralization that the fluorite has formed, replacing quartz, ankerite, and the altered argillite. The fluorite is found as irregular pods and lenses from an inch to 6 feet in diameter. The apparent preference of the fluorite is for the areas of high carbonate content. Quartz replacement may have been guided by shattering since the more massive and solid quartz is not mineralized. Also the quartz, where it is being replaced is highly shattered and crumbles upon the touch. These features can be seen on the geological maps of the outcrop and adit A. (Plate 2, Figures 2 and 3).

The color of the fluorite varies, as in the other two prospects through colorless to pale blue, green, and lavender. Exposure to sunlight rapidly causes the fluorite to lose all coloring, and with weathering, it decrepitates to a mass of fine sugary grains. The mineral can be identified under the microscope by its hardness, transparancy, and isotropism. When free from enclosing rock, the fluorite is quite pure and samples of fluorite from the outcrop run 98.6% CaF_2.

This prospect is the only one in which sulphide minerals are present in megascopic amounts. Galena and tetrahedrite replace ankerite and quartz in one small spot in the outcrop. (Plate 2, Figure 2). Polished sections when examined microscopically revealed chalcopyrite replacing some of the tetrahedrite. These minerals are later than the fluorite, and although some replacement is noticed, the preference has been for carbonate and quartz. No large sulphide particles were seen in the underground workings but microscopic examination revealed particles of galena, tetrahedrite and pyrite present in the carbonates. Microscopic particles of pyrite similar to those at Wilson Creek were noticed in some of the carbonatized sediments, but nowhere in contact with fluorite or other sulphides.

Structure

The general strike of these rocks near the prospect is northwest, but the dip varies greatly due to folds and faults present. Faults have a general northwest strike and are steeply dipping. They vary in size from small seams to those with 1 foot or more gouge. Sheeted fault zones of 20 to 30 feet wide are present and locally provide areas of brecciation. Most of the faulting appears to be post mineralization and is responsible for the jointed and sheeted character of the fluorite.

Development

Two small adits were driven under the outcrop, one at a depth of 20 feet and the other at 90 feet. Production from the prospect came from these and surface working. The major workings have been near the camp at the bottom of Bear Gulch, and aggregate about 600 feet of drift. The adit branches, and neither branch has reached the area below the fluorite outcrop or intersected favorable mineralization. (Figure 5, Plate 2). At the face of the north branch there is a diamond drill hole, but unfortunately, the author could not obtain any information about it.

The only buildings on the prospects are here and consist of a bunkhouse, two tool sheds, and a compressor shed. This property has received the greatest amount of attention, although the mineralization is not as encouraging as in the Wilson Creek prospect.

PLATE II

MAPS OF THE BEAR GULCH PROSPECT

Fig. 1. Topographic Map of the Bear Gulch Prospect

Geologic Maps

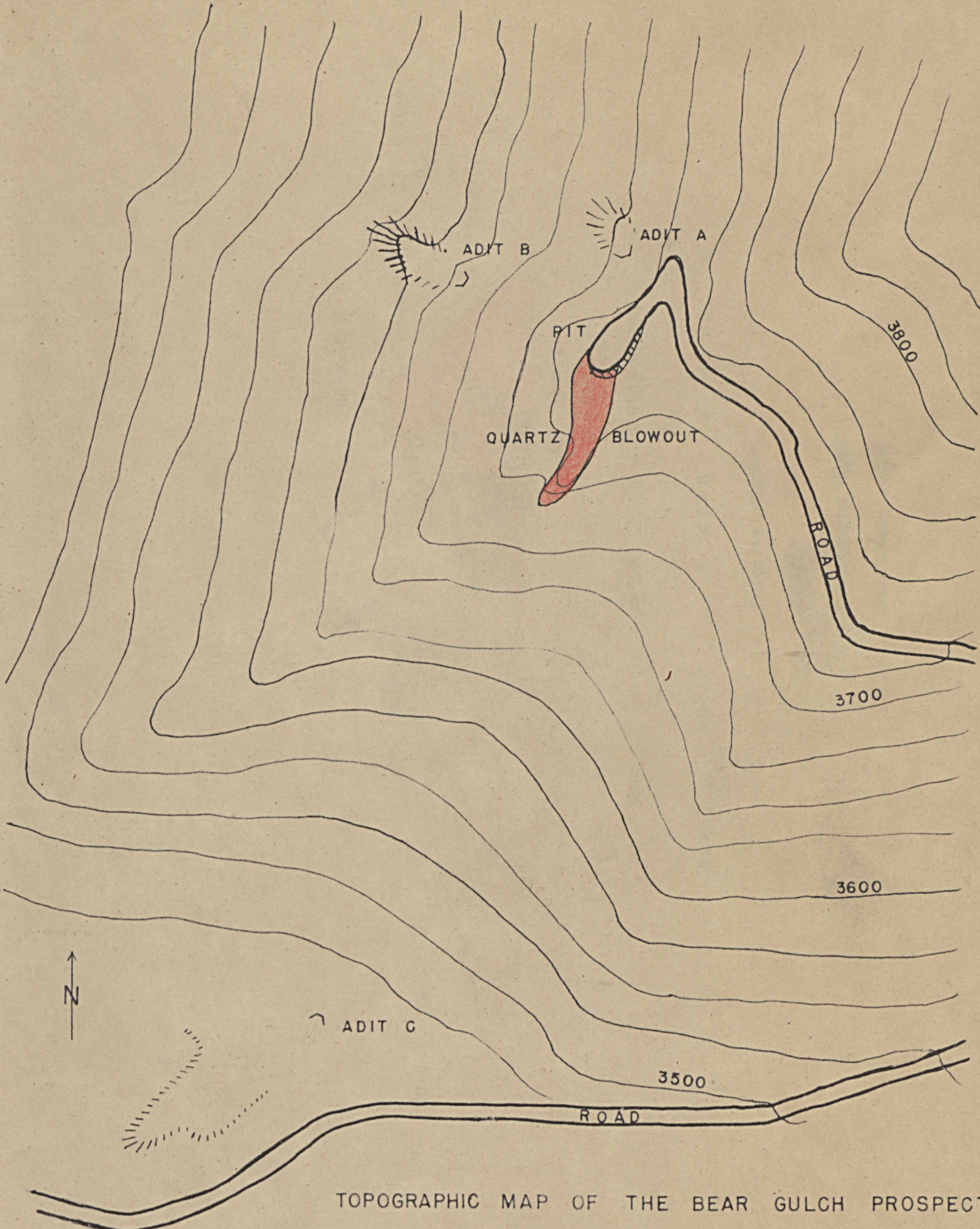
Fig. 2. Pit Walls

Fig. 3. Adit A

Fig. 4. Adit B

Fig. 5. Adit C

FIG. I

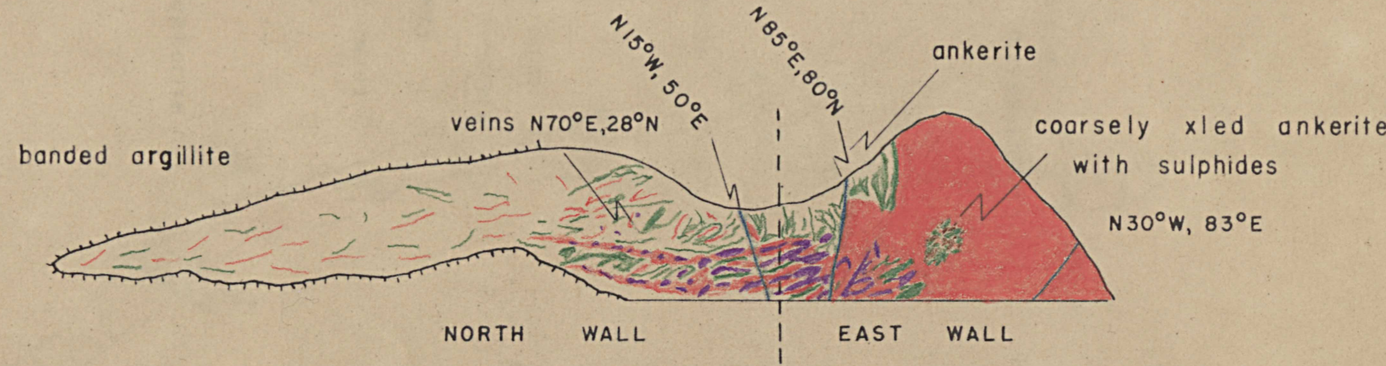


TOPOGRAPHIC MAP OF THE BEAR GULCH PROSPECT

ADAPTED FROM C. P. ROSS, U S G S, BY R. CORN

CONTOUR INTERVAL 25 FT. SCALE 0 100'

FIG. 2

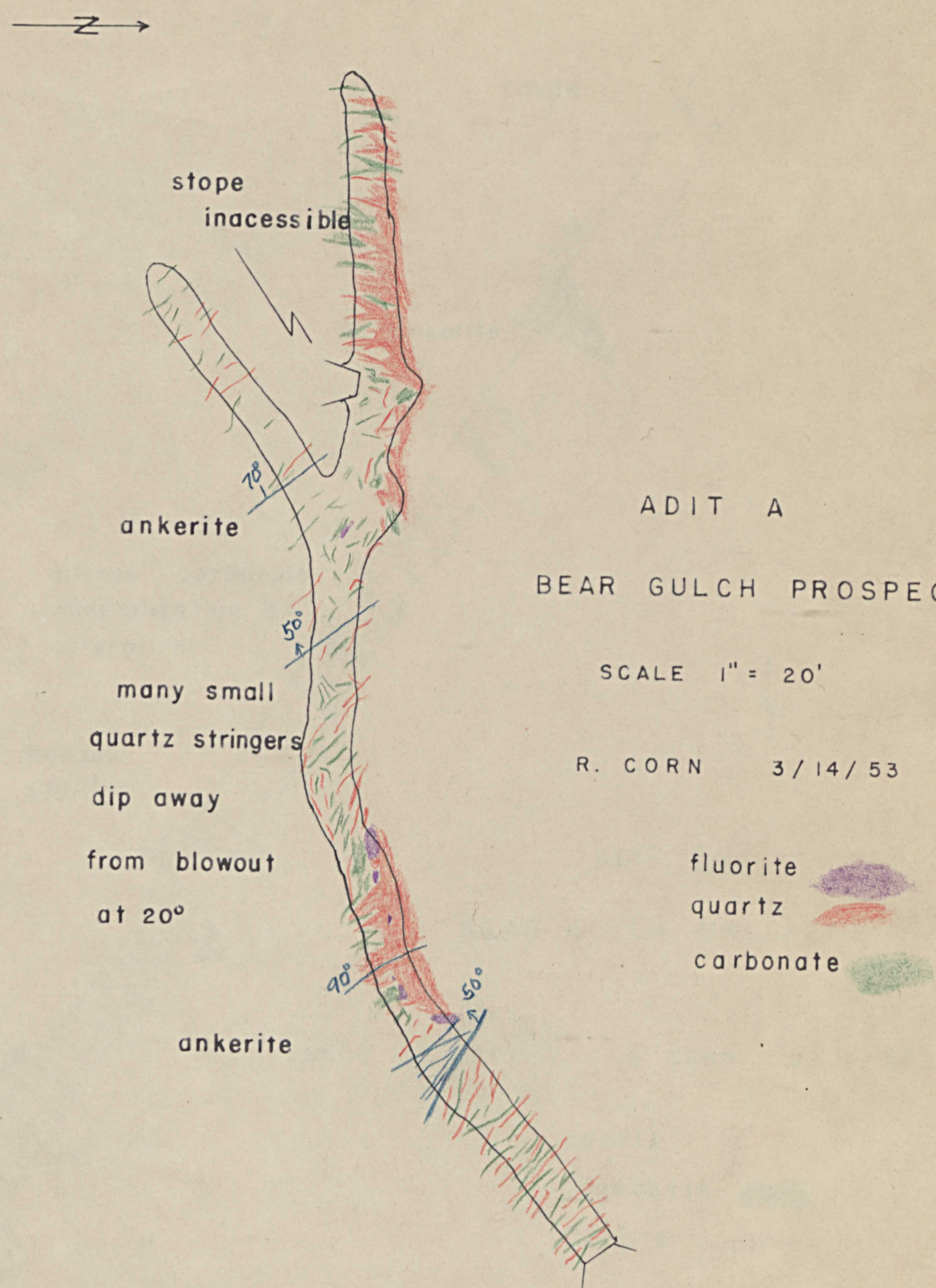


PIT WALLS BEAR GULCH PROSPECT

SCALE 1" = 20' R. CORN 3 / 16 / 53

fluorite
quartz
carbonate
sulphides

FIG. 3



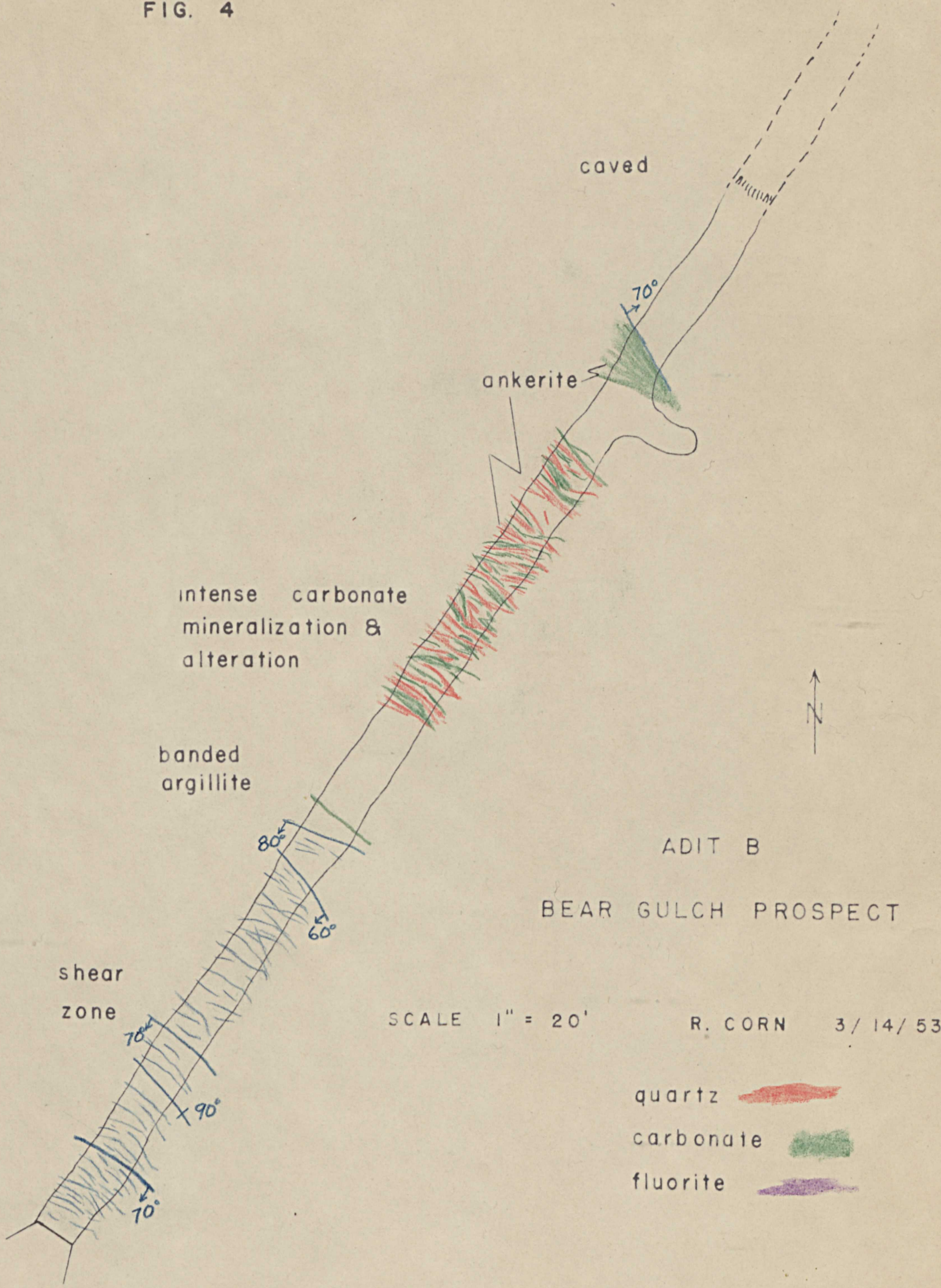
ADIT A

BEAR GULCH PROSPECT

SCALE 1" = 20'

R. CORN 3/14/53

FIG. 4

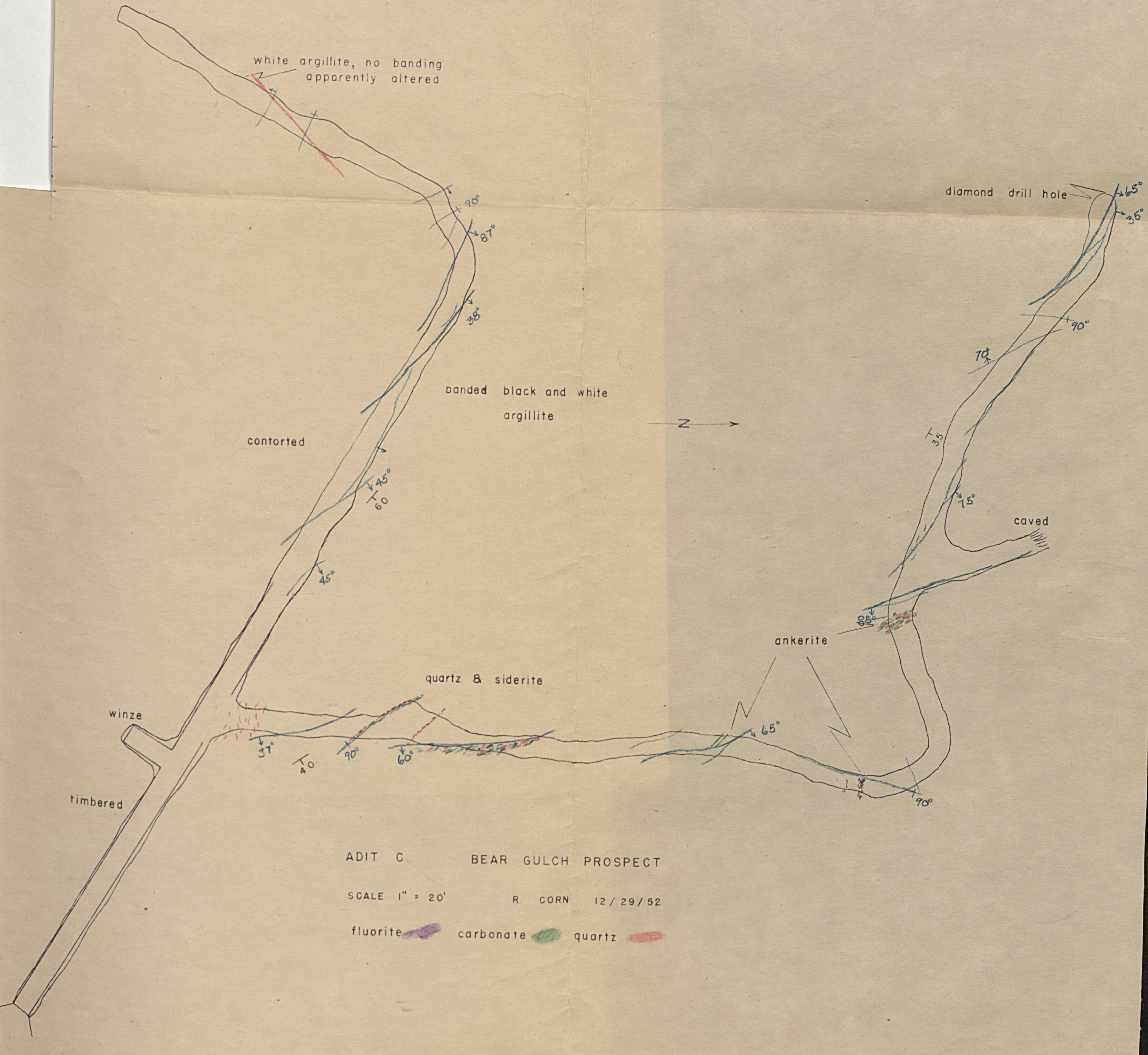


ADIT B

BEAR GULCH PROSPECT

SCALE 1" = 20'

R. CORN 3/14/53



ADIT C BEAR GULCH PROSPECT

SCALE 1" = 20' R. CORN 12/29/52

fluorite carbonate quartz

PLATE III

PHOTOGRAPHS OF THE WILSOM CREEK PROSPECT

PLATE III

PHOTOGRAPHS OF THE WILSON CREEK PROSPECT

Fig. 1

A view of the surface workings on the Wilson Creek Prospect.

Fig. 2

A view of part of Cut A.

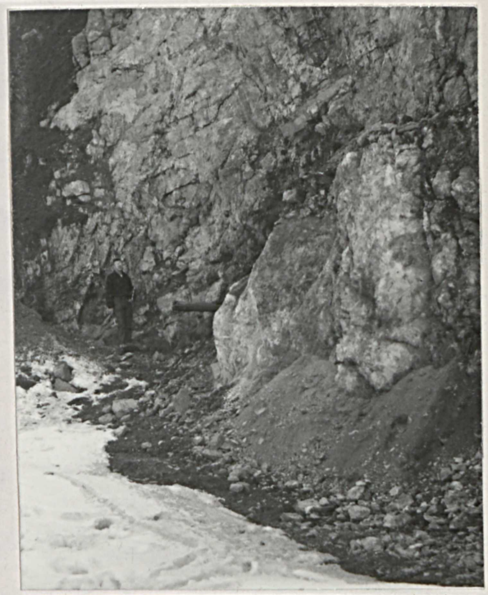


Fig. 3

A closeup of part of the face above showing the irregular replacement exhibited by the fluorite.

The Wilson Creek Prospect

The Wilson Creek prospect is about 1½ miles up Wilson Creek and in the NW. ¼, Sec. 1, T. 16 N., R. 27 W. The prospect can be reached by following an ungraded road, passable for trucks and jeeps only, which branches from the Forest Service road slightly below the mouth of Wilson Creek.

Host Rock

The sediments near the Wilson Creek prospect are banded argillites, interbedded with beds of massive, blocky, impure, dolomite, from 1 to 4 feet thick. The argillite near the fluorite zone is altered by carbonate mineralization till few of the original features are left except some banding and a thin bedded, shaly, appearance. In this respect, and under the microscope the rock is similar to the altered sediments at Bear Gulch.

The dolomitic beds are a dense, fine-grained rock, extremely homogenous in color and other characteristics. The individual beds vary in color from gray, green, and brown to black. Near the mineralized zone these beds are recrystallized, and as the argillites, are replaced by calcite and siderite. The carbonate mineralization is not widespread throughout the area but occurs only in a narrow zone near the fluorite. The alteration bleaches the country rock and is easily noticed when not obscured by siderite.

Mineralization

Quartz is present near the fluorite but only as a few thin disconnected veinlets. These are not as impressive or thick as in many other areas in the district where fluorite and carbonates do not occur.

Carbonate mineralization is intense in a zone striking about north-south and about 50 feet wide. This zone does not extend north of the major cut. The southward extension had not been delineated. Locally calcite has completely replaced the sediments and appears in masses and veins, cream colored and coarsely crystalline. Siderite, the other carbonate noticeable in this zone, is found as blotches and irregular patches in a dolomitic bed, and as small veinlets throughout the area.

Near the center of this carbonate zone the fluorite occurs as irregular stringers and blotches replacing the altered argillite, dolomite, and the coarse crystals of calcite. The greatest amount of fluorite is in Cut A, where the mineralized zone containing about 30% fluorite, is exposed for nearly 60 feet and is more than 5 feet wide. (Figure 2, Plate 4). The fluorite mineralization strikes north and appears to dip 75° to the east. Coarse crystalline calcite with some fluorite appears at the south end of Cut B. (Figure 3, Plate 4). Some small stringers of fluorite are found, but Cut A is the only one with a minable quantity exposed.

The fluorite stringers seem in many spots to widen with depth. The depth exposed can not make this conclusive but it does indicate that the fluorite mineralization may be better at depth. The relationship of fluorite and carbonate are shown in the maps of the cut faces. (Plate 4). Figure 3, Plate 3 is a photograph of the intricate and irregular branching shown by the fluorite.

Pyrite is the only sulphide present, and then only as microscopic particles replacing siderite and the altered sediments. Dark yellow, the material was partly oxidized and, although negative to all etch reactions, was slightly magnetic. The pyrite was not noticed in contact with fluorite and their relative age could not be determined. It is probable that the mineral formed contemporaneously with the sulphide at Bear Gulch and is therefore later than the fluorite.

Structure

The contorted folding and flowage noticed at Bear Gulch is not present near this deposit. The sediments do appear to be tightly folded and faults have developed along the axis of these folds. General strike of the bedding is north and the dip is steep.

Bedding plane faults and axial faults are present but do not appear to be of any large displacement. One large fault, with nearly 2 feet of gouge crosses the prospect and is clearly post mineral in age. Some minor faulting is associated with this feature.

Development

The workings on Wilson Creek consist only of surface trenches and cuts arranged in step-like fashion on the hillside. Figure 1, Plate 3 is a view of these workings. The major cut, from which several hundred tons of ore were taken is about 60 feet long, 40 feet wide and 30 feet high. The others are smaller and do not show minable ore.

PLATE IV

MAPS OF THE WILSON CREEK PROSPECT

Fig. 1. Plan View of Surface Cuts

Geologic Maps

Fig. 2. Cut A

Fig. 3. Cuts B and C

Fig. 4. Cut D

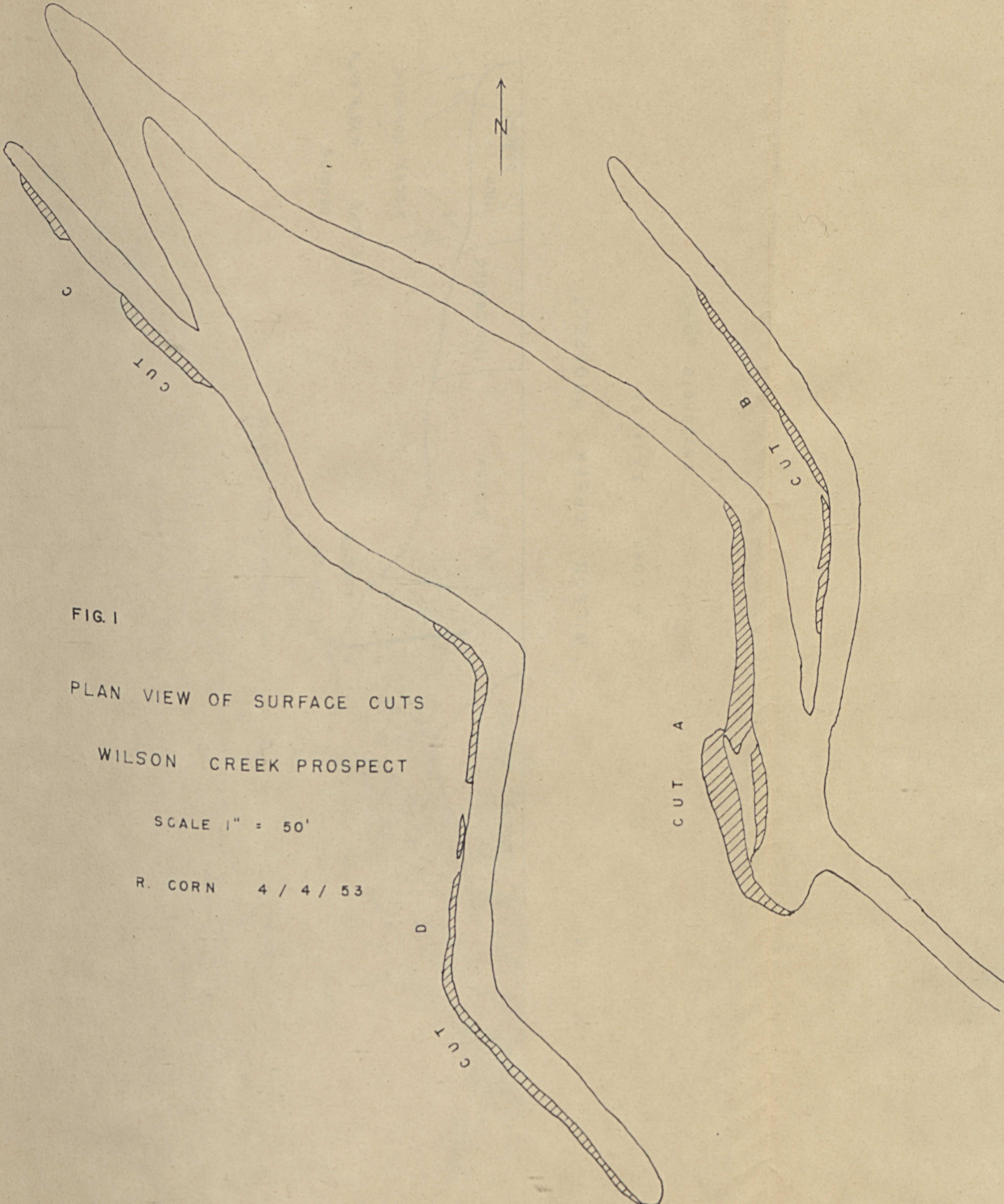


FIG. I

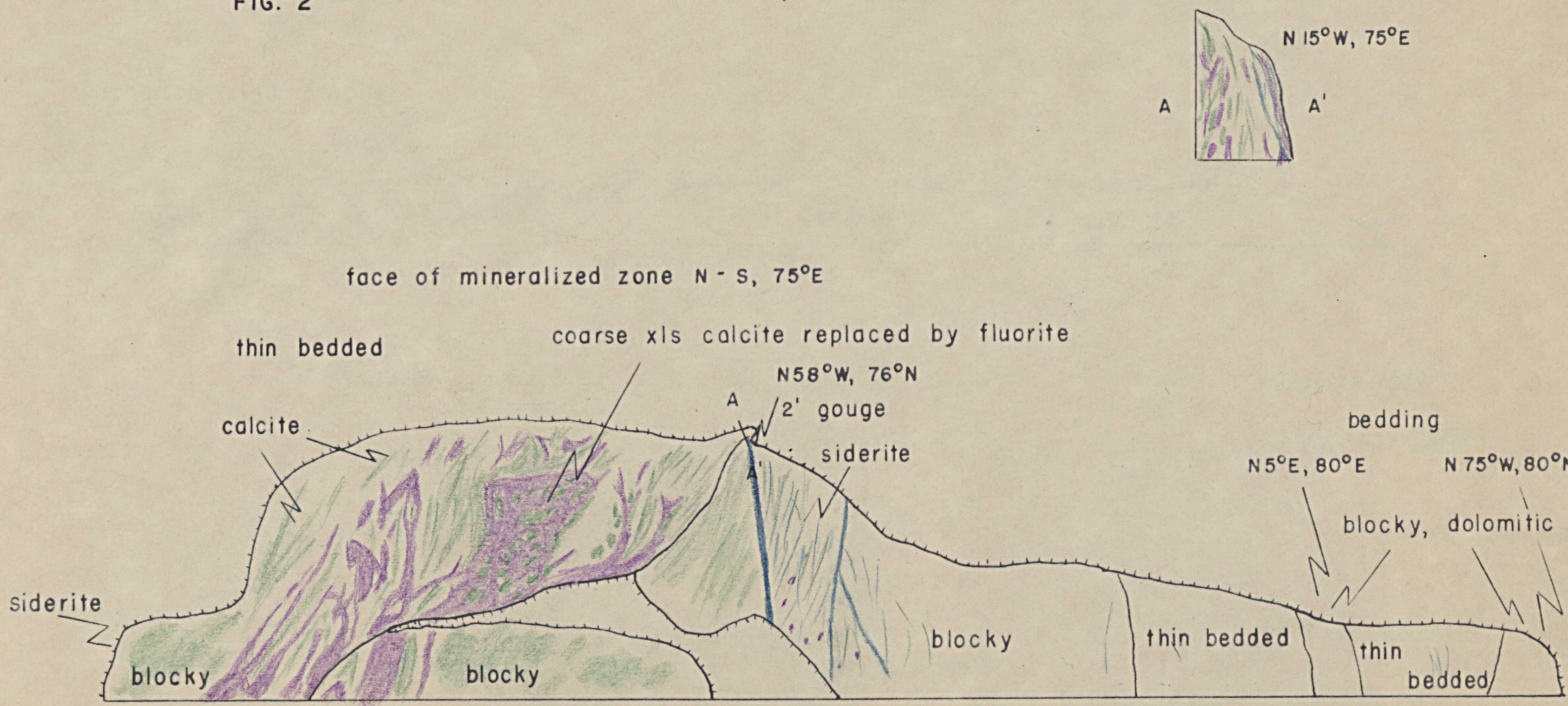
PLAN VIEW OF SURFACE CUTS

WILSON CREEK PROSPECT

SCALE 1" = 50'

R. CORN 4 / 4 / 53

FIG. 2



CUT A

WILSON CREEK PROSPECT

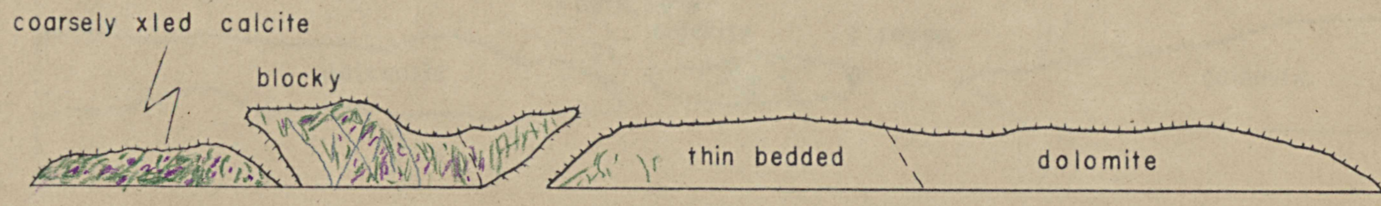
SCALE 1" = 20'

R. CORN 3/14/53

fluorite

carbonate

FIG. 3



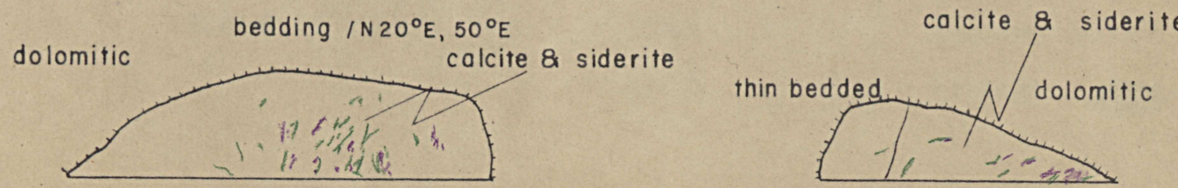
CUT B

WILSON CREEK PROSPECT

SCALE 1" = 20'   R. CORN   3 / 15 / 53

fluorite

carbonate



CUT C

FIG. 4

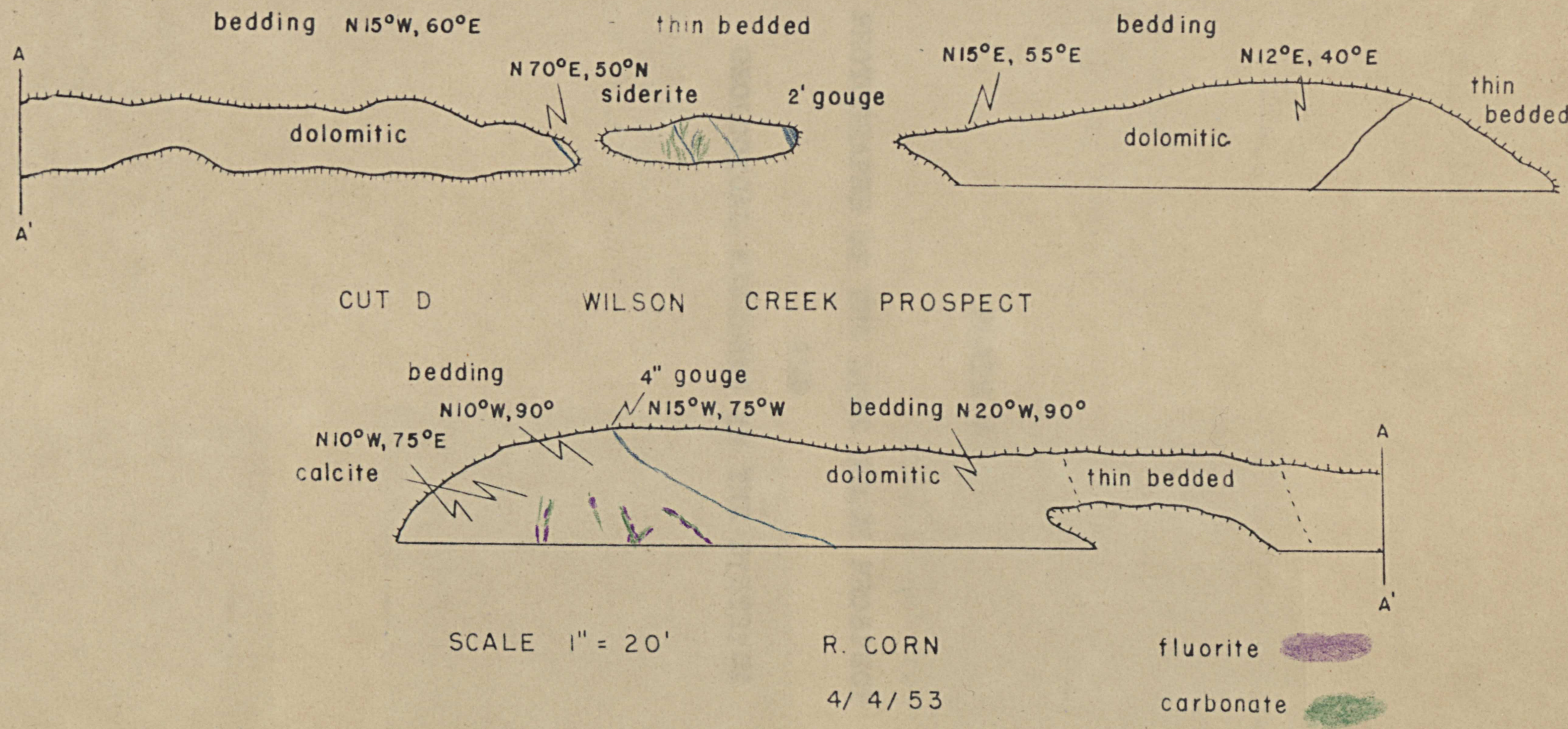

bedding N15°W, 60°E
thin bedded
bedding
A
N70°E, 50°N
siderite
2' gouge
N15°E, 55°E
N12°E, 40°E
thin bedded
dolomitic
dolomitic
A'
CUT D
WILSON CREEK PROSPECT
bedding
N10°W, 90°
4" gouge
N15°W, 75°W
bedding N20°W, 90°
N10°W, 75°E
calcite
dolomitic
thin bedded
A
A'
SCALE 1" = 20'
R. CORN
4/ 4/ 53
fluorite
carbonate

PLATE V

PHOTOGRAPHS OF THE LIME GULCH PROSPECT

AND

GEOLOGICAL FEATURES IN THE DISTRICT

PLATE V

PHOTOGRAPHS OF THE LIME GULCH PROSPECT AND GEOLOGICAL FEATURES IN THE DISTRICT

Fig. 1

A view of the Lime Gulch Prospect, looking west and up Dry Creek.

Fig. 2

A view of tight drag folds in the banded argillite Bear Gulch.

Fig. 3

Bleaching caused by alteration along a small fissure in banded argillite near the Wilson Creek prospect.

The Lime Gulch Prospect

The Lime Gulch prospect is located in the NE. $\frac{1}{4}$, Sec. 31, T. 17 N., R. 27 W., and about $\frac{1}{4}$ of a mile west of the mouth of Lime Gulch. The workings are about 300 yards above the Forest Service road and can be easily reached.

Host Rock

The host rock in the immediate area is a fine grained, highly siliceous, white to tan argillite. The rock is uniform over the areas cut by the trench and adit, and under the microscope the original fine grained texture is obscured by many small spots of carbonate and fluorite, with local enlargement of the quartz and feldspar grains.

Mineralization

The mineralization sequence is similar to that of the other deposits. First the milky quartz filled fractures and irregularly replaced the argillite in a brecciated zone. Later the carbonate minerals were deposited, in this case, the dominant ankerite and minor veins of siderite. The siderite appears to have been deposited at an earlier stage than the ankerite. The ankerite is found filling fractures in spots, but mainly as a fine grained replacement of the quartz and feldspar grains.

The fluorite, similar to that in the other deposits, replaced quartz and ankerite in the breccia zone, and is found as small spots and blotches replacing the carbonatized rock. The milky quartz that is being replaced by the fluorite is highly shattered and crumbles at the touch.

In this prospect a vug was opened and crystals of quartz, fluorite, and ankerite were present. The ankerite and fluorite crystals were around the quartz and a few crystals of ankerite were on the quartz. The fluorite seemed to have grown around and replaced the ankerite crystals present.

Sulphides were observed in the fine grained carbonate mineralization. They were tetrahedrite and chalcopyrite, occurring as very small particles in the carbonatized argillite.

<u>Structure</u>

The prospect is about 400 yards west of the contact of the Wallace formation and the overlying Missoula group. General strike of the rocks is northerly, and the Missoula rocks, competent sandstones, have a uniform dip of 60° east. The contact is not visible and is marked by a topographic low. Apparently a fault contact of some magnitude, it appears to be essentially vertical with a strike of north 20° west. The fault was nowhere exposed, although the author traced the contact to a point more than 1000 feet above the prospect. Here argillites were exposed, similar to those at the prospect, and in places suggest tight folding and an apparent dip to the west.

The mineralization is in a breccia zone probably associated with this large fault. Brecciated material is exposed along the contact and above the prospect.

Minor faults are present along the western wall of the adit. These are post mineral, and have a general northerly strike and a steep dip.

Development

The prospect near Lime Gulch has the poorest exposure of mineralization of the three, and the ore needs beneficiation to become commercial. Development work consists of a large surface trench and an adit 185 feet in length. Fluorite is encountered throughout the adit, although, the best mineralization is within 75 feet of the portal. (Fig. 2, Plate 6).

PLATE VI

MAPS OF THE LIME GULCH PROSPECT

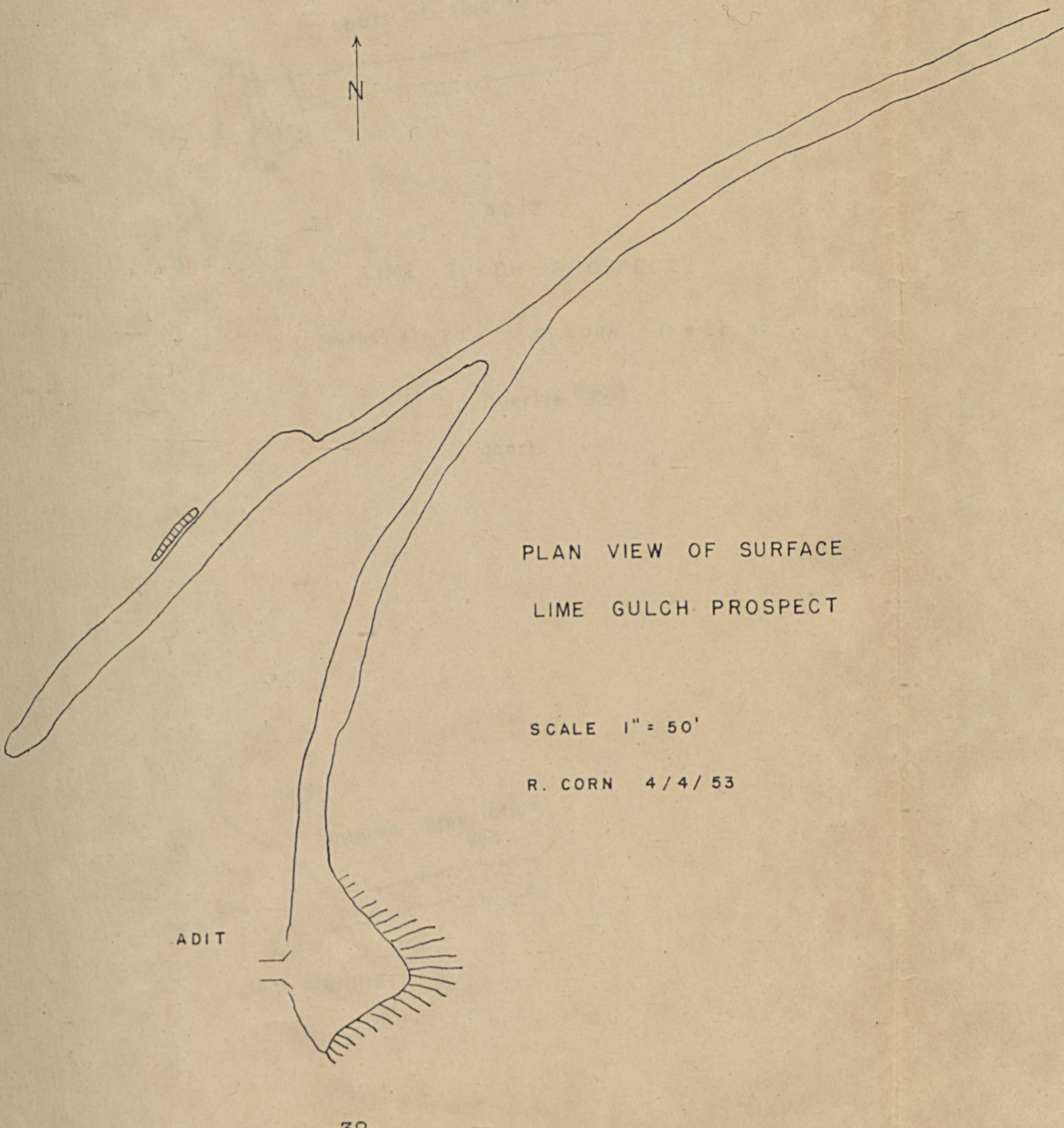
Fig. 1. Plan View of the Surface

Geologic Maps

Fig. 2. The Adit

Fig. 3. The Cut

FIG. 1



PLAN VIEW OF SURFACE

LIME GULCH PROSPECT

SCALE 1" = 50'

R. CORN 4/4/53

FIG. 2

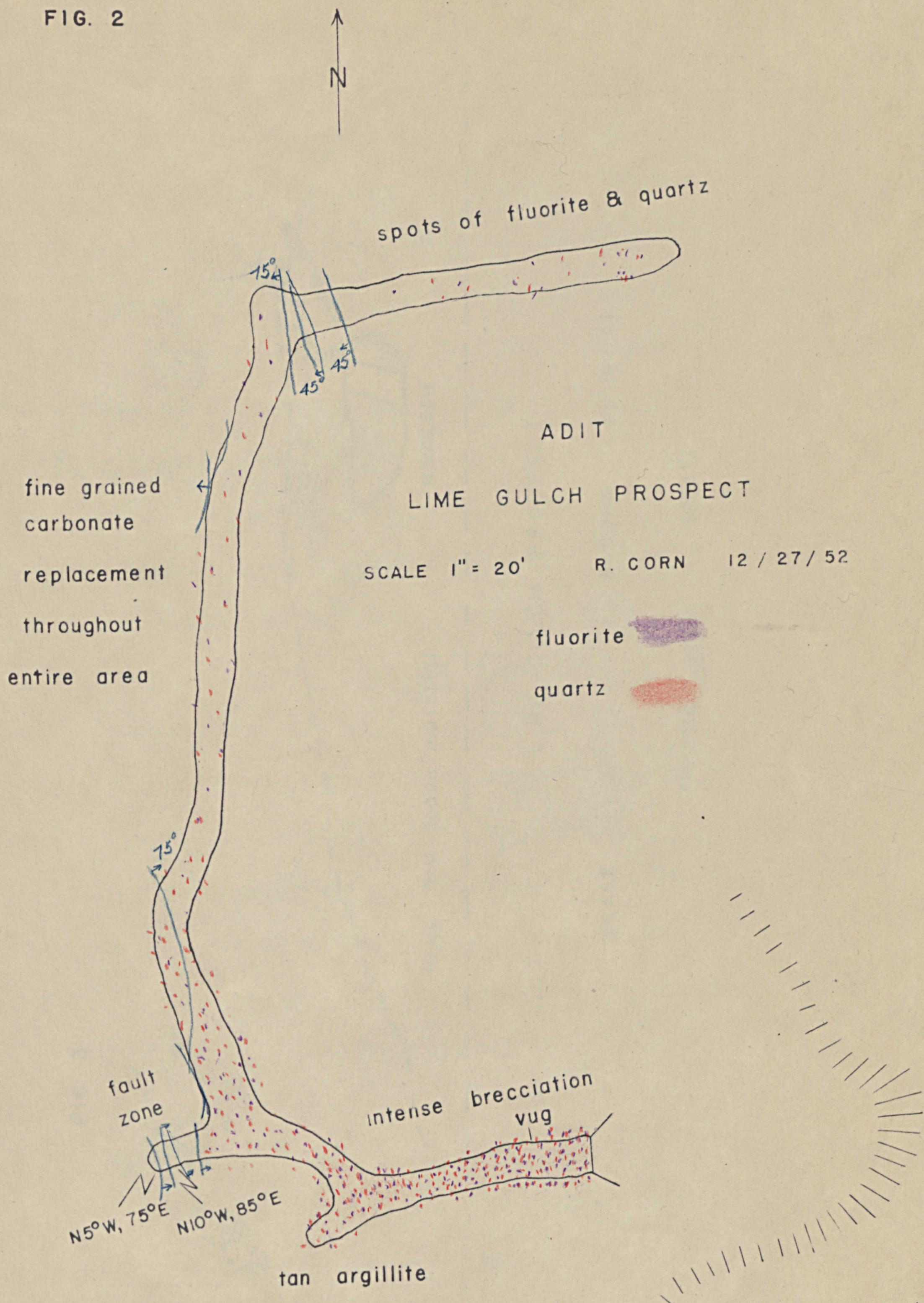
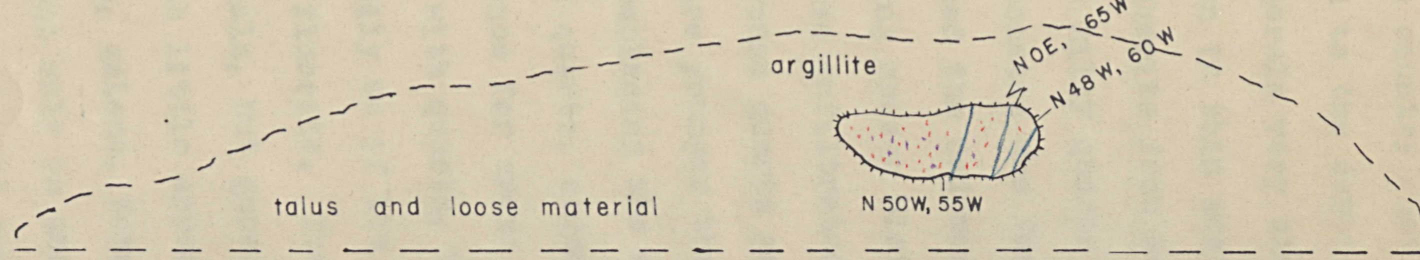

N
spots of fluorite & quartz
15°
45°
45°
ADIT
LIME GULCH PROSPECT
SCALE 1" = 20'
R. CORN
12 / 27 / 52
fluorite
quartz
fine grained
carbonate
replacement
throughout
entire area
75°
fault
zone
intense
brecciation
vug
N5°W, 75°E
N10°W, 85°E
tan argillite

FIG. 3



CUT LIME GULCH PROSPECT

SCALE 1" = 20' R. CORN 3/ 14 / 53

fluorite quartz

MINERALOGY AND PARAGENESIS

Milky quartz, the first mineral deposited, fills fissures and replaces the country rock. It does not appear to be genetically related to the deposition of the fluorite.

The carbonate minerals very clearly replace the quartz and argillites as shown in thin sections. (Plate 8, Fig. 2). Coarse, crystalline ankerite from Bear Gulch definitely invaded and replaces the milky quartz in the blowout. Major preference of the carbonates was for the sediments. The carbonates have replaced the sediments as minute crystals and as larger enveloping masses blotting out the original texture. They also have infiltrated along cracks and seem to form between and around quartz grains. (Fig. 3, Plate 7). Calcite and ankerite are younger than the siderite and are found fissurring and replacing the mineral.

Fluorite replaces quartz, carbonate, and the altered sediments with preference for areas high in carbonate. Where the fluorite is found with quartz, the quartz is extremely soft and crumbles readily as if the quartz had been shattered before replacement by fluorite. The fluorite at times fissures the other materials, but generally the contacts are slightly irregular with little apparent invasion.

Sulphide minerals, galena, tetrahedrite, pyrite and chalcopyrite are present only in small amounts, in the prospects. All are later than, and replace the carbonates, quartz, and sediments. Only in the Bear Gulch prospect were any of the sulphides in contact with the fluorite. Here galena was observed to fill cracks in the fluorite and to partially replace it.

29408

Although no areas of large contact between galena and tetrahedrite were found, the smooth boundary of tetrahedrite inclusions in galena showed simultaneous deposition. In the samples from Bear Gulch chalcopyrite was observed fissuring and replacing the tetrahedrite. Some small particles were noted in fissures in the galena.

These three minerals from direct and indirect evidence, are all later than the fluorite. No relationship could be established for the pyrite, although it seems probable that it was deposited with the other sulphides and after the fluorite.

Calcite fills post mineral fractures in the quartz, carbonates, and fluorite. Some fissures are seen in galena but none of the other sulphides exhibit this. Fluorite has been most susceptible to shattering and has the same appearance in the three prospects.

FIG. 3

PARAGENESIS

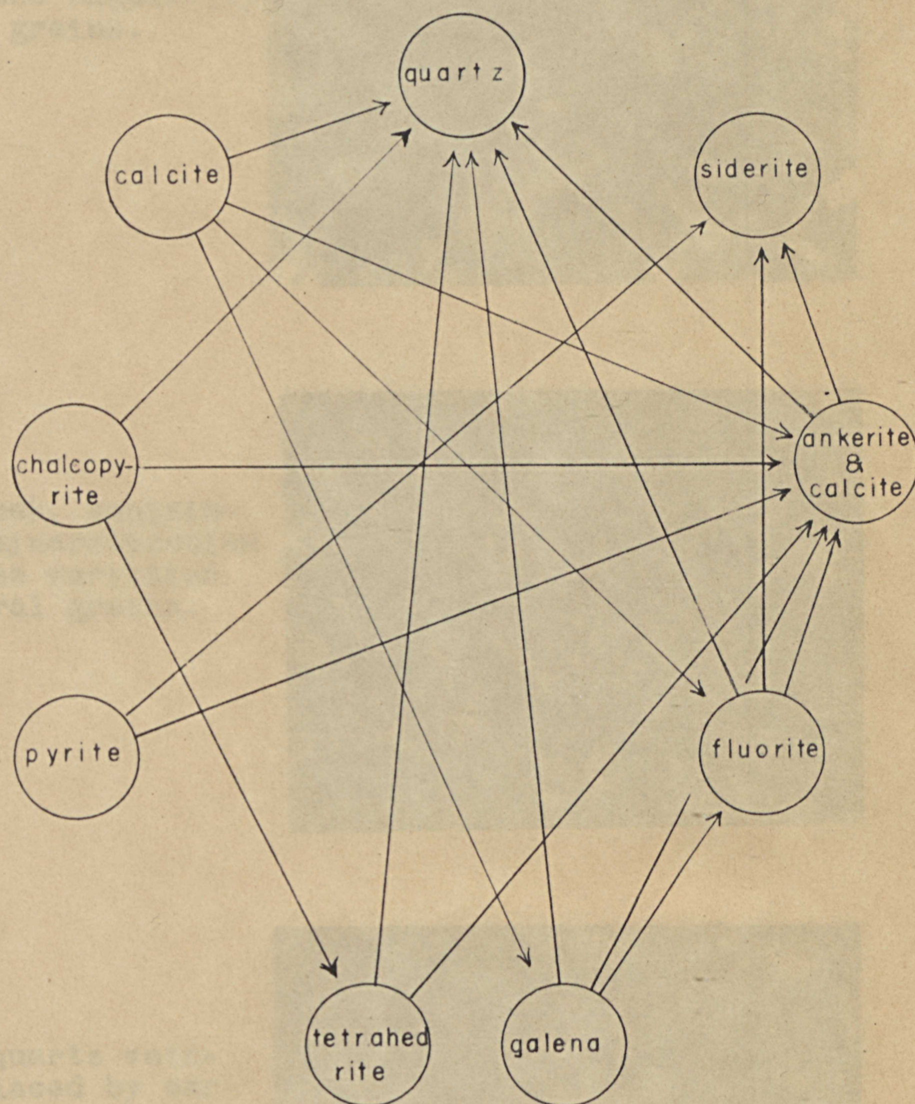


PLATE VII

PHOTOGRAPHS OF THIN SECTIONS FROM THE SEDIMENTS NEAR FLUORITE MINERALIZATION

Fig. 1

Essentially unaltered rock, showing the angularity of the mineral grains.

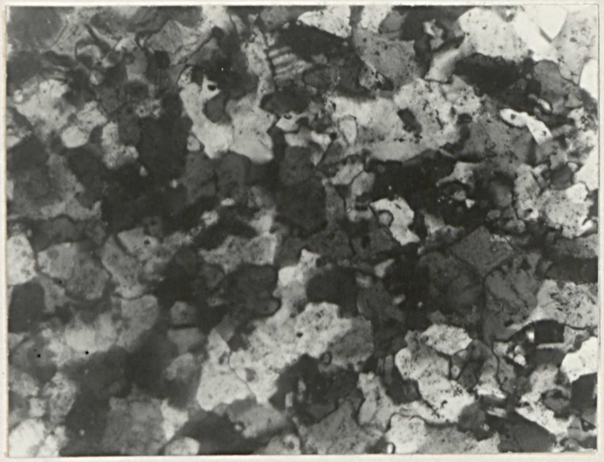


Fig. 2

Altered rock, containing carbonate mineralization and showing size variation among the mineral grains.

Fig. 3

A minute quartz veinlet partly replaced by carbonate, showing the infiltration of carbonate along crystal and grain boundaries.

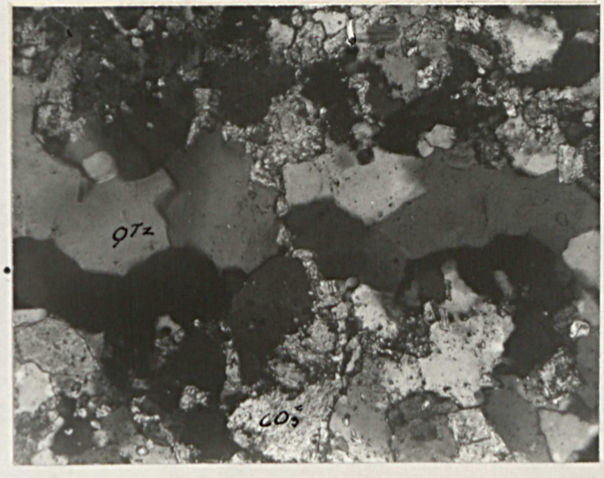


PLATE VIII

PHOTOGRAPHS OF THE CARBONATE AND FLUORITE RELATIONSHIPS

Fig. 1

Calcite replacing siderite, Wilson Creek Prospect.

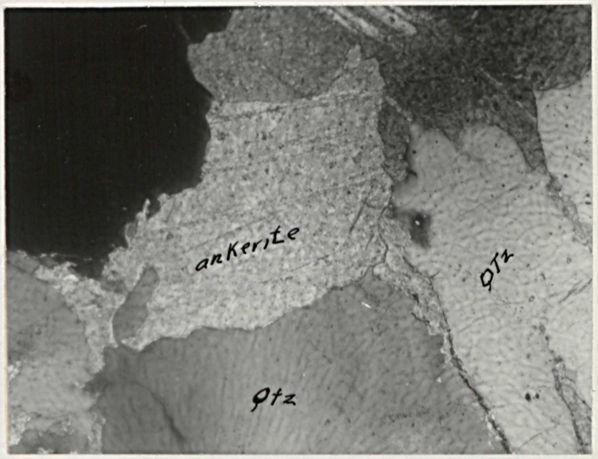


Fig. 2

Fluorite replacing ankerite, and ankerite replacing quartz, Bear Gulch Prospect.

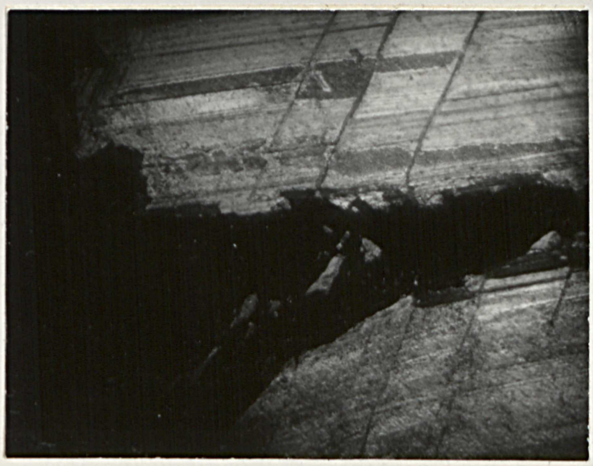


Fig. 3

Fluorite replacing coarse calcite, Wilson Creek Prospect.

PLATE IX

PHOTOGRAPHS OF POLISHED SECTIONS OF SULPHIDE MINERALS

BEAR GULCH PROSPECT

Fig. 1

Galena replacing quartz

Fig. 2

A tetrahedrite inclusion in galena, showing a smooth continuous boundary. Surface etched with $FeCl_3$.

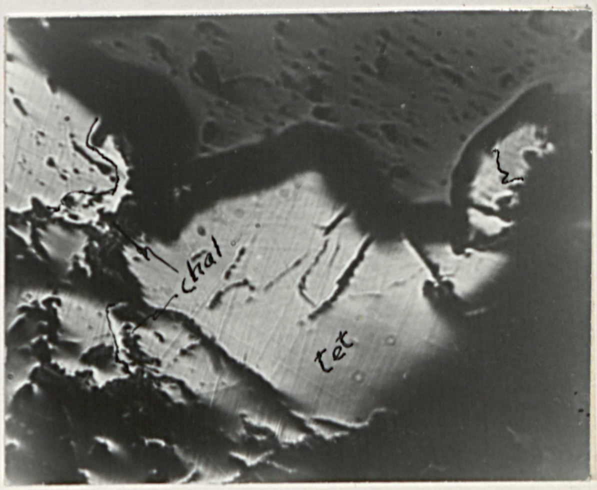


Fig. 3

Tetrahedrite replacing quartz and being replaced by chalcopyrite.

ORIGIN

The three prospects are in different structural and stratigraphic settings, and at first glance, fluorite appears to be the only similarity among them. There also is a variance in the type and amount of the carbonate, quartz, and sulphide minerals. However, if the mineralization sequence is reviewed, the minerals other than the carbonates are shown to have little or no effect upon ore deposition, and the differences can be discounted.

The depositional history in the district can be summarized as follows:

1. Intensive folding and faulting followed by extensive milky quartz mineralization.
2. The deposition of carbonates and fluorite.
3. Sulphide mineralization.
4. Late faulting which shattered the fluorite, followed by minor calcite deposition.

Carbonate mineralization in the three prospects varies from calcite to ankerite. This variation probably represents a change in depositional environment rather than an essential difference in the character of the carbonate solutions. The deposition of fluorite along the carbonate zones, and the similarity of replacement, show that the fluoritizing solutions were from the same general source, and that these and the carbonate solutions were implaced along the same structures.

There is no indication that sulphide bearing solutions were associated with those depositing fluorite. Rather, it is supposed that these are later solotions influenced by the presence of carbonate and quartz. This explains the sulphide variations in the prospects.

Few, if any other occurrences of fluorite are similar to these irregular replacements. The large deposits of the Kentucky-Illinois region are replacement veins in limestone. Here hydrothermal calcite was deposited in these veins and then replaced by fluorite, a sequence similar to that at Dry Creek. (5-83). Other deposits are fissure fillings and replacement bodies associated with granitic intrusives.

In these deposits the accessory minerals, barite, and sulphides, are associated with the fluoritizing solutions. In the Dry Creek prospects, barite was not present, and the sulphides are definitely later than the fluorite.

There is no indication of the source for the mineralizing solutions. They possibly are from the same igneous body from which the diorite dikes have been derived.

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