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White Signal uranium deposits

Elliot G. Gillerman, 1953, pp. 133-137

in:

Southwestern New Mexico, Kottlowski, F. E.; [ed.], New Mexico Geological Society 4th Annual Fall Field Conference Guidebook, 153 p.

This is one of many related papers that were included in the 1953 NMGS Fall Field Conference Guidebook.

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outer border; this extensive gravel plain slopes gently away from the Big Burro Mountains to the northeast, east, and southeast. Within the planated area, there is a panlike depression formed by the erosion of unaltered quartz monzonite porphyry.

All of the igneous rocks of the Tyrone district are intrusives. The following types have been recognized: Precambrian granite, quartz monzonite porphyry, and quartz monzonite; aplitic dikes, some of which are allied to the granite and some to the quartz monzonite; rhyolite dikes; and quartz latite porphyry of unknown age.

Semiconsolidated sand and gravel, composed of material derived from the surrounding mountains, also occurs within the district, especially in the northeast part and along the northern border in Mangas Valley.

The structural relations of all the rocks of the Tyrone district are due mostly to intrusion, faulting, and fracturing.

A main stock of quartz monzonite porphyry intrudes Precambrian granite. The stock is roughly circular in outcrop and covers an area of about 15 square miles. The northern contact of the stock dips to the south, but the attitude of the other walls is not visible. Island-like masses of granite within the stock may or may not be roof pendants. Definite evidence of large-scale stoping has not been found.

A large northwest-trending fault, forming the southwestern scarp of the Little Burro Mountains, crosses the Tyrone district. East of this fault the Precambrian rocks and overlying Cretaceous sedimentary rocks of the Little Burro Mountains are tilted eastward. No evidence of overthrusting has been found in this region; all the major breaks are considered to be normal faults.

The sequence of intrusion, folding, faulting, fracturing, and mineralization occurred in Late Cretaceous time. Movement along the fault planes in the region have persisted to a late date, and evidence for post-Pleistocene movement along some faults exists.

The Tyrone district contains a wedge-shaped zone of intense fracturing with its apex 2 miles southwest of Leopold and its northeastern boundary along the gravel-igneous rock contact between Tyrone and New Mexico Highway 180. The change from extremely fractured rock to rock that is much less broken is very abrupt along the northwestern edge of the fracture area but is very gradual along the southeastern edge.

The position of the major zone of fracturing is independent of rock type. Fracturing is directly connected with faulting; in some places the movement took place along a great number of closely spaced fractures. An analysis of the fracture systems within the mines shows that the trends are not everywhere the same, but the greatest number of fractures dip to the east at moderately high angles.

The original constituents of the rocks in the fractured zones in the Tyrone district – the feldspars, biotite, and hornblende – have been partly or entirely replaced by sericite, quartz, and pyrite, with lesser amounts of chlorite, biotite, and chalcopyrite. Superimposed upon this primary alteration have been changes involving secondary enrichment of copper minerals. Fracturing was the necessary forerunner of all alteration, for the rocks that are not fractured show no appreciable alteration, and the intensity of alteration is a direct function of the intensity of fracturing. The degree of alteration is almost independent of rock type.

The principal copper deposits of the Tyrone district are chalcocite ore bodies in quartz monzonite porphyry and granite. The deposits exhibit all the characteristics of typical porphyry copper ore bodies. Only secondarily enriched bodies have proved minable in the past. The chalcocite is either disseminated regularly throughout large masses of fractured country rock or concentrated along exceptionally strong veins or shear zones. Valuable ore bodies of both types have been found. The deposits are clearly related to zones of intense fracturing and do not occur where such fracturing is lacking. The deposits of secondary copper have been impoverished in some places by renewed oxidation and natural leaching by ground water.

WHITE SIGNAL URANIUM DEPOSITS

by

E. G. Gillerman*

The White Signal district lies just south of the Burro Mountains, about 18 miles southwest of Silver

*Publication authorized by the Director, U. S. Geological Survey.

City. The district was widely prospected for gold, silver, and copper in the first quarter of the twentieth century, but none of the deposits were extensively developed. Besides these metals, fluorspar, turquoise, bismuth, lead, zinc, and radium are known to occur in the district. The Tyrone district, which adjoins the White Signal district on the north, has produced extensive quantities of copper, fluorspar, and turquoise. Considerable reserves of the first two of these products are known to exist.

Uranium minerals were first noted in the White Signal district in 1920 by Albert A. Leach, at that time geologist for Phelps Dodge Corporation of Tyrone, New Mexico, who identified torbernite on some of the old dumps. The Radium Corporation of Colorado soon became interested in the deposits and, under Frances I. Leach, helped in the development and exploration of the district. After about a year the Radium Corporation terminated its activities, reportedly owing to lack of suitable ore for metallurgical treatment, and the short radium boom quickly ended. The Merry Widow and other properties were subsequently operated in a small way for radium during the 1920's and 1930's by Albert A. and Frances I. Leach. The product was sold for use in making radioactive water for swimming pools, drinking purposes, and as a stimulant for plant growth, for radioactive face powder, and for the extraction of radium salts for medicinal purposes.

In 1944 the area was examined by the Union Mines Development Corporation in their search for commercial uranium deposits. From about 1947 to 1950 renewed interest in the district as a possible source of uranium resulted in much prospecting and exploration. In 1949-50 the U. S. Geological Survey made preliminary studies of two of the major deposits. Results were encouraging, and a detailed study of the entire district was started in the summer of 1951 and continued through the summer 1953. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

The uranium minerals were first reported from the Merry Widow, Acme, Floyd Collins, Utah, and California claims, and from scattered occurrences elsewhere within an area of about 4 square miles centering around White Signal. Studies during the past 2 years have shown that uranium mineralization is much more widespread; and at least 74 localities scattered over an area of about 60 square miles are known to contain radioactive minerals. The White Signal uranium district outlined during the recent studies extends about 7 miles east and 7 miles west of White Signal and 3 to 4 miles north and south of this locality. Within this district most of the uranium mineralization is concentrated in an area of about 6 square miles.

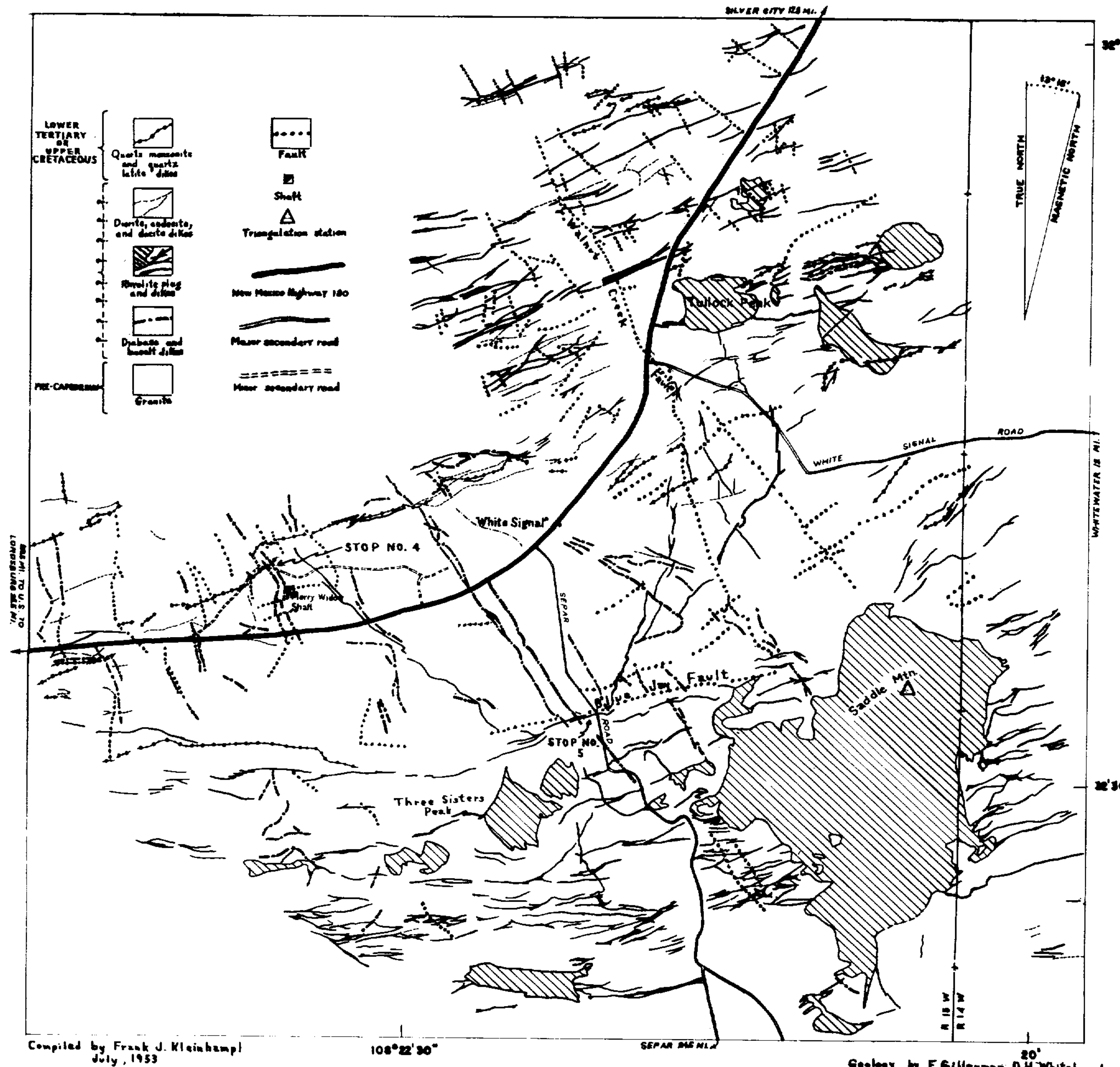
Medium-to fine-grained pink and buff-colored Precambrian granite, which varies in texture and mineralogical composition from place to place, forms the country rock in the district. The granite contains inclusions of older schists and quartzites.

Numerous rhyolite plugs intrude the granite in the White Signal district. They stand up as prominent hills and thus are in marked contrast, topographically, to the Tyrone stock of quartz monzonite, which intrudes the granite just north of the district and occupies a large topographic basin. The larger plugs form the hills known as Saddle Mountain, Tullock Peak, and the Three Sisters, lying east and south of White Signal. The plugs consist largely of gray to white fine-grained rhyolite with masses of rhyolite breccia common, particularly near the borders. Numerous dikes and apophyses of rhyolite extend out into the surrounding granite. In places, adjacent to the plugs, the granite is extremely crushed and fractured and simulates a breccia.

Dikes are very numerous and are the most distinctive features of the geology of the district. They range in age from possible Proterozoic to late Tertiary and in composition from rhyolite to diabase and basalt. Most of them trend northwest or northeast.

The oldest dikes are Precambrian (?) diabase and basalt. They pre-date the rhyolite plugs and within the central part of the district commonly trend N. 15-30° W. A few trend northeast. In the northern and western part of the district the dominant trend is northeast.

With a few minor exceptions, the dikes post-date the rhyolite plugs and trend northeast to east. Many occupy a narrow zone in the western part of the district but fan out eastward. Just north of White Signal this zone is 2 miles wide and consists of about 75 parallel and subparallel dikes, most of which are less than 30 feet wide. South and east of White Signal, in the vicinity of the rhyolite plugs the dikes form a network and in places compose more than 50 percent of the country rock. Many of these dikes twist, split, bifurcate and rejoin again, or wedge out only to reappear a few hundred yards far-



Compiled by Frank J. Kleinhampl
July, 1953

Geology by E. Gillerman, D.H. Whitebread, M.C. Swinney, and R. Crowley
1950 - 1953

GENERALIZED GEOLOGIC MAP OF A PORTION OF THE WHITE SIGNAL DISTRICT, GRANT CO., N. MEX.

1 1/2 0 1 MILE

ther along the strike. Others are en echelon, and still others can be followed as persistent dikes for 3 or 4 miles. Apparently the fractures along which the dikes occur were repeatedly reopened during the period of dike intrusion for many of the later dikes split and intrude the earlier ones.

The most prominent and persistent of the post-rhyolite plug dikes are dense to fine-grained chalky-looking white rhyolite dikes containing a few quartz phenocrysts. They commonly form the crest of the ridges and give a definite east-west lineation to the topography. Andesite, dacite, and gray rhyolite dikes are older than the prominent white rhyolite dikes; and quartz monzonite porphyry, latite, andesite, and late rhyolite dikes are younger.

Structurally the district is dominated by the dikes and by the faults and fractures in the granite. In general east-west faults and fractures, many of them occupied by dikes, are complemented by northwest-striking faults. Most of these faults appear to have small displacements. Two major faults, the Walnut Creek fault and the Blue Jay fault, trending N. 20° W. and N. 75° E., respectively, have been recognized. These may intersect southeast of White Signal within the area of concentrated uranium mineralization.

As stated above, the uranium deposits are scattered widely over an area of about 60 square miles in the White Signal district. However, most of the known deposits, are concentrated in a northwest-trending elliptical area occupying about 6 square miles in the vicinity of White Signal. All the major deposits, with one exception, are within this elliptical area. The Saddle Mountain intrusive plug lies within this area. With two doubtful exceptions, no uranium deposits are found within the rhyolite plug and thus it forms a large barren area that almost separates the southern part of the mineralized area from the northern part.

Uranium minerals identified from the district are autunite (a calcium-uranium phosphate), tobernite (a copper-uranium phosphate), meta-torbernite, and an iron-bearing torbernite-like mineral. These are all secondary minerals. No primary minerals have been definitely identified. Torbernite and meta-torbernite are the most common of the uranium minerals.

The secondary uranium phosphate deposits are most commonly found where the high phosphatic dikes of basic or intermediate composition are intersected by faults. The uranium minerals are concentrated in the dikes, along the contact of the dikes and the granite, or in the adjacent granite. Commonly the mineralized dikes are diabase, but dikes of latitic composition also seem to be important host rocks. Both these types are abnormally high in phosphate. The trend of the dikes and faults does not appear to be significant, nor does the angle of intersection. Many of the dikes and faults intersect at high angles; others intersect at very low angles. At many localities the fault forms one wall of the dike. In the larger deposits the uranium minerals occupy closely spaced fractures throughout the width of the dike and coat the surfaces of the mineral grains of the rock. In the granite adjacent to the dikes the uranium phosphates coat fracture and joint surfaces. At a few places the uranium minerals occur in northwest-trending shear zones in the granite away from any known dikes.

The uranium minerals are commonly associated with faults within which are veins of pyrite, iron oxides, gold, copper minerals, bismuth minerals, limonite, and quartz. These quartz-pyrite and quartz-specularite veins are believed to have been the source of the uranium for the supergene uranium phosphates and to contain primary uranium minerals, probably pitchblende, at depths in their unoxidized portions. Pitchblende is extremely soluble in acid waters. The oxidation of pyrite and the resultant acidity of the circulating ground waters would produce conditions conducive to the solution of pitchblende. The lowering of the acidity upon contact of the ground waters with the high phosphatic basic and intermediate rocks, and the affinity of uranium for phosphate, resulted in the precipitation of the uranium phosphates in the vicinity of the high phosphatic dikes.

The Merry Widow and Blue Jay are two of the best-known deposits of the district. At the Merry Widow mine the uranium phosphates are found at the intersection of an east-trending quartz-pyrite vein and northwest-trending diabase dikes. A latite dike is intruded along the Merry Widow vein. This latite is extremely argillized, iron-stained, and sericitized, and it locally resembles fault gouge. The granite host rock is also sericitized and iron-stained. The deposit was originally mined for gold, which occurred in commercial quantities in the upper 60 feet of the mine. Pyrite and chalcopyrite, together with magnetite and hematite, occur on the lower levels. The upper part of the mine contains oxidized copper and iron minerals. Uranium minerals are found throughout the mine but are more abundant on the upper levels near the shaft. Autunite is found only within the upper 30 feet of the deposit, and the iron-bearing torbernite-like mineral is not found within the upper 100 feet of the deposit. Uranium is also contained in a greenish-black iron-stained clay of unknown mineral composition found in the lower part of the mine.

The Blue Jay deposit lies along the Blue Jay fault zone. Numerous small subparallel faults constitute the fault zone at this locality, and the diabase basalt, and latite dikes which are present, are broken into small slivers. A white rhyolite dike has been intruded along the main fault plane. The uranium mineralization was most intense in segments of a latite dike that has been broken by the faulting and by the later rhyolite intrusion. Autunite and torbernite are both present, and pitchblende has been identified tentatively from one sample taken from the easternmost trench. The latite host rock is extremely altered (argillized). Uranium minerals also occur in the adjacent granite and in and near the diabase, which is also altered.

FLUORITE DEPOSITS OF BURRO MOUNTAINS AND VICINITY

by
Elliot Gillerman*

Although the Burro Mountains area is known primarily for its copper and turquoise deposits, fluorite was mined in the early 1880's from the Burro Chief deposit and used as a flux in the smelting of copper. Mining was carried out in a small way in the Burro Mountains and in the area immediately to the south from World War I to about 1942, when larger-scale and continuous mining started at the Shrine mine. In 1943 the Burro Chief was reopened and extensive mining began. A total of about 125,000 tons of fluorspar has been shipped from the district, the greater part of it since 1943.

The fluorspar occurs mostly as veins in the Precambrian granite. A few of the smaller deposits south and west of the Burro Mountains occur within the middle Tertiary volcanic rocks, which form a north-west-trending belt in this area; and at the Shrine mine, the vein traverses in part a mass of rhyolite that is probably a remnant of a once more-extensive flow capping the granite. At the Burro Chief the fluorspar vein follows a fault between granite and quartz monzonite porphyry.

The deposits are mostly simple fissure fillings with little or no replacement of the wall rock. The Burro Chief is along a wide shear zone, which is one of the major faults within the Big Burro Mountains; most of the other deposits are along small faults or shears adjacent to major zones of movement. Repeated movements along the shear zone of the Burro Chief have brecciated the fluorspar and resulted in an extensively altered and fractured zone.

The fluorspar is commonly associated with quartz; small amounts of pyrite, gold, turquoise, calcite, chrysocolla, malachite, and limonite may be present. No barite or base-metal sulphides have been found in the deposits. The fluorspar is mostly green or purple and is characteristically massive. Columnar and granular varieties occur. Well-developed crystals are common, particularly in the deposits south of White Signal, where cubes are modified by dodecahedrons, tetrahexahedrons, and hexoctahedrons. At least two and probably three stages of fluoritization took place, closely spaced in time. With few exceptions the violet fluorspar represents the last stage.

Several factors localized the fluorspar, but the chief factors were (1) wall-rock control, (2) irregularities in the faults along which the veins occur, and (3) the presence of small linkage faults (small faults that extend across the gap between two large faults) or similar but larger faults that split off the major faults into the footwall and are called footwall splits.

The granite is the prevalent host rock because it is more porous and because its greater competency has resulted in shattering under stress. Excellent examples of the shattered host rock are exposed at the Shrine, Spur Hill, Purple Heart, and other deposits. The irregularity of the fault surface controls the width of the ore shoots at the Shrine, Moneymaker, and smaller deposits. The effect of linkage and footwall-split faults on the localization of deposits and of ore shoots within a deposit is well shown at the Burro Chief and at the deposit south of White Signal along the Malone fault. The grosser features that determined the regional distribution of the fluorspar are the major structural features of the area and

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* Publication authorized by the Director, U. S. Geological Survey.