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DETAILED DESCRIPTIONS OF URANIUM-BEARING DEPOSITS IN THE DRIPPING SPRING QUARTZITE, GILA COUNTY, ARIZONA

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INTRODUCTION

During a study of uranium deposits in the Dripping Spring Quartzite of younger Precambrian age in southeast central Arizona, detailed information was acquired about many individual deposits. The descriptions that directly bear on the origin and occurrence of the uranium appear in U.S. Geological Survey Professional Paper 595 by Granger and Raup (1969). The remainder, included here, are supplemental to Professional Paper 595. Fieldwork was done on behalf of the Division of Raw Materials of the U.S. Atomic Energy Commission.

SUMMARY OF GEOLOGY OF THE URANIUM DEPOSITS

Uranium deposits in the Dripping Spring, a formation in the Apache Group, occur largely as disseminated veins in carbon- and potassium-rich siltstone of the upper member near diabase intrusive bodies, also of younger Precambrian age. The deposits, mostly in the northern part of Gila County, Arizona (fig. 1), have been extensively explored and developed, but production has been small.

The upper member of the Dripping Spring is composed largely of siltstone and very fine grained sandstone. Effects of regional metamorphism are negligible in these rocks, but siltstone adjacent to large diabase bodies is locally metamorphosed to varieties of hornfels.

The area that contains most of the uranium deposits is crossed by several north-trending monoclines of prediabase age. Faults and joints subparallel to the monoclines and in various other directions provided feeder channels for the diabase magma. Two varieties of nearly superposed sets of high-angle joints that trend north-northeast and west-northwest cut the uranium deposits. We call the earlier of these joints tension joints; the north-northeast-trending group, in particular, seems to have controlled the shapes of the uranium deposits. We call the later sets shear joints; these are postore and generally cross the uranium deposits at a low angle although they may locally follow the trends of uranium veins for short distances.

Most of the uranium deposits occur in the gray unit of the upper member of the Dripping Spring (see fig. 2 in Granger and Raup, 1969), either above or below a thin quartzite stratum called the barren quartzite. The largest veins are several hundred feet long and a few feet wide, and extend several tens of feet vertically. All larger veins occur near diabase and many of these occur in hornfels. Structural relations indicate that ore minerals were deposited after the hornfels had formed, but the association of high-temperature minerals in the vein zones nearest diabase suggests that they were deposited prior to complete cooling of the diabase.

The vein minerals are disseminated largely in the wallrock adjacent to a poorly defined central joint or fractured zone. Locally, uraninite forms a few small lenticular fissure fillings. Close to diabase the vein minerals consist principally of uraninite of two stages; these uraninites are associated with pyrrhotite, pyrite, chalcopyrite, galena, and sparse molybdenite, cubanite, and iron-rich sphalerite. Farther from diabase the minerals are poorly crystallized uraninite, pyrite, chalcopyrite, galena, and sparse sphalerite. Fluorite, ankerite, calcite, and phlogopite are variably associated with the deposits. The most common alteration and gangue mineral consists of chlorite that locally may range from chlorite to a nontronite clay.

Isotope ages, determined for the uraninite, are about 1,050 million years. Because of the close genetic association between the diabase and the uranium deposits, as shown by this study, the diabase is considered to be of the same age.

Our conclusion is that the uranium-bearing solutions originated within the cooling diabase and were fed to the vein zones at the time of formation of late-stage, femic deuteric veinlets. Chemical analyses of the deuteric veinlets and the presence in them, locally, of abundant zircon grains surrounded by pleochroic halos show that uranium was concentrated in the deuteric fluids.

Aerial radiometric exploration guided by geologic considerations, and followed by ground checking is the most efficient exploration procedure. Drilling is of limited value because of the small target presented by the deposits.

DESCRIPTIONS OF INDIVIDUAL DEPOSITS

Alta Vista

The Alta Vista and other claims in the same block, located by A. J. Kelton and R. H. Van Marel, of Globe, are in secs. 4, 5, 8, and 9, T. 4 N., R. 14 E. (unsurveyed), in the Rockinstraw Mountain quadrangle They cover an area of short, sharply incised, southwest-trending canyons that drain from a Mescal Limestone-capped mesa and discharge into the alluvium-filled Roosevelt basin. The claims are accessible by about 5 miles of ungraded dirt road that connects with the Globe-Young road at the Red Bluff deposit.

Only one deposit, in the north-central part of sec. 9, was visited; it is about 200 feet north of the north end of the Alta Vista No. 16 claim. The deposit sometimes is called the Little Sis No. 1.

Exploration work consisted of three bulldozed benches on the north-facing canyon wall. The deposit is best exposed in the lower bench, but weak anomalous radioactivity is traceable across the upper benches.

The canyon rim overlooking the deposit is approximately on the contact between the upper member of the Dripping Spring and the Mescal. The floor of the canyon is cut into the middle member of the Dripping Spring. The strata are nearly flat lying.

The stratigraphic position of the deposit is in doubt because the block containing the deposit apparently has slumped a few tens of feet below the surrounding rocks. Probably it is in the black facies just above the barren quartzite. No diabase was seen in the vicinity of the deposit.

About 700 feet east of the deposit is a minor north-trending fault, downthrown on the west; it is probably related to large northwest-trending Tertiary(?) faults about half a mile to the west which mark the edge of the Roosevelt basin.

Anomalous radioactivity at the Alta Vista deposit is traceable along and adjacent to an irregular limonite-stained fracture that trends about N. 20° E. Although nearly vertical for most of its length, the fracture locally rolls and almost merges with the stratification. Both the fracture and the radioactivity can be traced for about 35 feet along the steep canyon wall.

Only secondary minerals are present in the explored parts of the deposit and include malachite, chrysocolla, azurite, and limonite localized in random fractures. These minerals are most abundant within 2-3 feet of the lowest exposed part of the fracture in coarse- to medium-grained quartzite.

The highest radioactivity is near the most abundant copper stain, where it ranges from 0.1 to 0.4 mr per hour. Radioactivity in one small area on the fracture surface near the top of the coarse-grained strata is as high as 0.75 mr per hour. Generally the rock along exposed parts of the fracture emits about 0.1-0.2 mr per hour.

A selected sample of copper-stained rock from the surface contained 0.056 percent eU_3O_8 (R. J. Schwartz, written commun., 1957).

Andy Gump

The Andy Gump deposit is in the NE 1/4 sec. 34, T. 7 N., R. 14 E. (unsurveyed), in the McFadden Peak quadrangle. It is on the east wall of Cherry Creek Canyon about 20 feet above the stream bed and about 0.7 mile south of the confluence of Cherry Creek and China Spring Creek. The claim is accessible to 4-wheel-drive vehicles from the Cherry Creek access road.

The deposit is on a block of at least two claims located by Alfred Haught and others of Young, Ariz. A 42-foot adit and 17-foot crosscut (see fig. 25 in Granger and Raup, 1969) were driven by the Pacific Uranium Co., who held the claim from late 1954 to early 1956. We did not examine additional development work done by Twentieth Century Fuels, Inc., in mid-1956. No ore has been produced from the deposit.

The Andy Gump adit is in the black facies about 12 feet above the barren quartzite, which here is a fine-grained stratum. The host rock is largely flaggy siltstone to very fine grained sandstone with a few crumpled shrinkage cracks. Near the surface it is bleached and limonite stained. It appears not to have been metamorphosed.

The deposit is within a half mile east of the Cherry Creek monocline. Although it is on the upthrown side of the monocline, an intervening fault has dropped the host rocks several hundred feet relative to the same rocks within the monocline.

The nearest diabase is in a dike about 200 feet south of the deposit. The dike is 20-25 feet wide, strikes N. 80°-90° W., and dips 75° S. It intruded along a fault on which there has been 30-35 feet of normal displacement.

The adit is dug in such a way that it is nearly parallel to the steep outcrop and nowhere is much more than 10 feet from the surface. Radioacti is moderately strong and is largely confined to an approximately 2-foot-th stratigraphic interval which is traceable both in the adit and along the outcrop. Within this interval and extending a few feet both above and below It is a veinlike zone of even higher radioactivity that trends about N. 12° E., largely within the west wall of the adit and between the adit and outcrop. The vein zone is exposed at the portal, then is largely parallel to the adit within the west wall for about 35 feet, and is expose again on the west wall for the last 5 feet of adit at the face. Several strong limonite-filled joints transect this radioactive vein zone at a very low angle. These are very radioactive where they cross the vein zone in the favorable stratigraphic interval.

The favorable stratigraphic interval is darker, more fine grained, and more thinly stratified than the enclosing rocks, but these differences are slight. Efflorescent white sulfates that have formed on the mine wall in this interval suggest a higher concentration of sulfide minerals, probably mostly pyrite.

With the exception of sparsely disseminated pyrite in the host rock, no primary minerals were recognized. A little metatorbernite in the weathered rock is the only uranium mineral present. Sparse malachite near the surface suggests the presence of copper sulfide minerals in the fresh rock.

A marked increase in radioactivity is found near the end of the crosscut, particularly in the favorable stratigraphic interval. This increase may indicate the presence of a second parallel vein zone a few feet beyond the face.

Three samples were collected and analyzed by the U.S. Atomic Energy Commission (R. J. Schwartz, written commun., 1957). The first was a 3-foot channel sample cut in the vein zone within the favorable interval at the adit portal but before the adit was driven; this sample contained 0.17 percent U_3O_8. A second sample, 6 feet long, which was taken vertical from the west wall about 15 feet into the adit, contained 0.13 percent U_3O_8. A third sample was cut on a fracture in the vein zone at the face of the adit and contained 0.72 percent U_3O_8. Schwartz believed that the high grade of this sample was due to an abnormal concentration of secondar minerals on the fracture surface.

Big Buck

The Big Buck deposit is in the south-central part of sec. 25, T. 6 N. R. 14 E., about half a mile south of Gold Spring Canyon in the McFadden Peak quadrangle. It is at an altitude of about 4,400 feet, nearly 1,200 feet above Cherry Creek, and is on the rugged west wall of the canyon. The deposit is accessible to 4-wheel-drive vehicles from the Cherry Creek access road.

The deposit is on a block which consists of three Big Buck claims and other claims owned by Nathan and Donald Ellison and others, of Globe, and held by option by the Metbel Mining and Exploration Co.

The Big Buck vein is developed (see fig.21 in Granger and Raup, 1969) for about 145 feet by an adit that trends S. 20° W. for 100 feet and by an opencut that extends to the north of the adit portal for about 45 feet. The vein is developed vertically for a maximum of about 20 feet.

Two shipments of ore were made from the Big Buck adit. The first, made late in 1956, consisted of 22.45 tons that contained 0.19 percent U_3O_8. The second, made during April 1957, consisted of 179.03 tons that contained 0.14 percent U_3O_8.

The lowest exposed part of the Big Buck vein is in the black facies about 20 feet above the barren quartzite. The host rock is largely siltstone and very fine grained sandstone that contains a few fine- to medium-grained sandstone lenses, located principally near the barren quartzite. Adjacent to the vein the rock is bleached but has limonite-coated fracture surfaces. Nearly unaltered host rock a few feet from the vein is medium gray to dark gray. Within the adit much of the rock is dense and tough and may be hornfels. Crumpled shrinkage cracks are common. Stylolites contain very finely divided carbon and many of the bedding planes contain abundant mica flakes.

The strata strike about N. 20° E. and dip 5° W. at the deposit, but within 100 feet to the northeast they are abruptly tilted on the west edge of the Cherry Creek monocline. Here they strike N. 20° W. and dip 65° SW. Small drag folds were noted near the deposit.

About 350 feet southeast of the adit portal is a diabase dike nearly 75 feet wide that strikes N. 30° E. and dips 65° SE. Another diabase dike less than 500 feet west of the deposit is poorly exposed but is estimated to be 200-300 feet wide; it strikes north-northeast and dips to the west at a low angle.

The deposit is veinlike and occurs along limonite-filled irregularly walled fractures which are about 1/4-1 inch wide. The opencut and the first 40 feet of the adit develop a vein that strikes N. 18° E. and dips 80°-86° E. South of the 40-foot point the adit follows a parallel en echelon vein which is about 3-4 feet to the west. The uranium originally may have been deposited in a tight fracture zone as much as 2 feet wide; later movements may have been largely relieved along the central fractures of this zone with a consequent opening of the fractures which are now filled with limonite near the surface.

In spite of relatively high radioactivity in the vein zone, uranium minerals are scarce. A few fracture surfaces are sparsely coated with a platy yellow mineral identified by X-ray as mixed saleeite and bassetite (minor). Pyrite, largely oxidized, is common in thin veinlets and on bedding planes, and is disseminated in the host rock. A few minor calcite-filled veinlets and local, thin, discontinuous purple fluorite veinlets are in the uranium vein zone. Limonite is abundant and is locally massive in the radioactive vein. It extends outward from the central fracture into bedding planes and minor fractures. Nearly all fracture surfaces are limonite coated.

At the northernmost exposure of the vein, where it is about 20 feet above the barren quartzite and is nearest the Cherry Creek monocline, the radioactivity in the vein zone is about 0.5 mr per hour in contrast to 0.15 mr per hour a few feet away on either side of the vein. At the adit portal, before the adit was started, the radioactivity generally exceeded 3 mr per hour and locally was greater than 5.0 mr per hour. After the vein had been mined to the length of the adit, the radioactivity of the vein zone in the back and face of the adit remained between 2 and 4.5 mr per hour, but the width of the vein in that area is 2 feet or less.

Big Six

The Big Six claims are in the W 1/2 sec. 4, T. 6 N., R. 14 E., in the McFadden Peak quadrangle. The deposits are at an altitude of about 5,500 feet, nearly 1,500 feet above Cherry Creek on the rugged west wall of the canyon. The property is accessible to vehicles with 4-wheel drive by about 2 miles of road that connects with the Cherry Creek access road.

The deposits are on a group of seven claims, the Citation Nos. 1 through 5 and the Sorrel Horse Nos. 1 and 2. All but Citation No. 5 were held in 1957 by Big Six Explorations, Inc., Odessa, Tex., under a lease agreement with the owners, Alfred and Homer Haught and others, of Gila County, Ariz. The Citation No. 5 claim is owned by location by Big Six Explorations, Inc.

By mid-1956, exploratory workings on the claims consisted of a north-trending adit (No. 1) 43 feet long near the south end of the Sorrel Horse 2 claim and another north-trending adit (No. 2) of unknown length about 700 feet to the north of the No. 1 adit and on the same claim. By May 1957, the company had completed an access road, driven a 250-foot adit (No. 3), and drilled 12 percussion drill holes within the adit for a total of 627 feet, all in compliance with the agreements of a Defense Minerals Exploration Adm. contract.

No ore has been produced from the property.

The deposits are in nearly flat lying rocks about a mile east of the Cherry Creek monocline. On the property the Sierra Ancha diabase sheet intrudes the upper member of the Dripping Spring at a horizon approximately 80 feet below the barren quartzite. The syenite facies forms generally small, irregularly shaped, coarse-grained bodies in the diabase. It does not form continuous sheetlike masses as in the Workman Creek area nor is it so abundant. Black deuteric veinlets are common but not abundant. They form irregularly spaced and randomly oriented stringers some of which cut through the upper chilled contact of the diabase but do not seem to penetrate the overlying rocks. The deposits occur in the gray facies in a stratigraphic interval from 10 to 35 feet above the diabase. This favorable interval is therefore from 35 to 70 feet below the barren quartzite; the interval is stratigraphically similar to one of the favorable intervals at the Red Bluff deposit but different from the stratigraphic position of the nearby Black Brush deposit and all other productive deposits. From 5 to 10 feet above the diabase is a layer that consists of highly brecciated hornfels intruded and cemented by aplite; locally this layer is almost entirely aplite. Hornfels extends well up into the favorable interval and in some places a lit-par-lit relation between hornfels and siltstone is apparent.

Adit No. 1 is in light- to very light-gray hornfels about 14 feet above the diabase sheet. A few aplite stringers less than 1/2 inch thick cut the hornfels and are generally parallel to the relict stratification. Fractures, even near the surface, contain very little limonite stain. Very little pyrite or other sulfide minerals are disseminated in the rock.

The deposit in adit No. 1 apparently parallels an obscure fracture that trends about N. 5° E. near the east rib. The strongest radioactivity is in a stratigraphic interval between the floor of the adit and from 4 to 5 feet above the floor. The trend of the "vein" projects into the east wall of the adit at about 15 feet from the face but is too weak to be recognized there.

The most radioactive part of the vein is about 15 feet from the portal of the adit; radioactivity decreases sharply to both the north and south. No uranium-bearing minerals were recognized in the vein zone, and disseminated sulfide minerals were extremely scarce. A sparse efflorescent coating of white sulfate minerals had begun to form on the mine walls by mid-1956.

A sample selected by the owners from the point of highest radioactivity contained 2.36 percent U_3O_8. Samples collected by the U.S. Atomic Energy Commission at points 10 and 18 feet south of the locality of the selected sample contained 0.12 and 0.16 percent U_3O_8, respectively.

Adit No. 2 was not examined, but it is believed to be short and to probably contain very little radioactive material.

We did not examine adit No. 3 but according to data in the D.M.E.A. report by Emerick and Romslo (1957b) the portal is 400 feet N. 35° W. of the portal of adit No. 2 and is about 5-10 feet lower stratigraphically. The adit trends S. 19° W. for 250 feet and cuts rock similar to that in adit No. 1. Abnormally radioactive rock was encountered by Emerick and Romslo at points 35, 50, 75, 140, 150, and 250 feet from the portal. Each of these was tested by percussion drilling, and the radioactive material was found to be confined to a single bed of "altered coarse-grained arkosic quartzite" about 3-12 inches thick in the back of the adit. Selected samples cut at these places ranged in grade from 0.12 to 0.43 percent U_3O_8; the average grade of the bed, however, may be less than 0.1 percent U_3O_8.

Black Brush

The Black Brush deposits are in the SE 1/4 sec. 4, T. 6 N., R. 14 E., in the McFadden Peak quadrangle just southeast of the Sorrel Horse and Citation claims. The main deposit is at an altitude of about 5,600 feet on the south slope of a ridge between two northeast-trending canyons that are tributaries to Cherry Creek. The vicinity of the claims is rugged and brush covered. Access is by about 2 miles of steep unimproved road from the road in Cherry Creek canyon.

The Black Brush property is composed of a group of 10 claims, 7 of which were located by T. E. Ellison and others, and 3 by C. A. Saylor. In 1957, at least eight of the claims were held with lease and option agreement by Western Mining and Exploration Co., Phoenix, Ariz.

Exploration work consisted, by 1955, of several prospect pits, a 70-foot adit (No. 1) that trends N. 17° E., and a 35-foot crosscut that extends N. 50° W. and intersects the adit about 25 feet from the portal. Additional exploration was conducted in 1956 and 1957 under terms of a Defense Minerals Exploration Adm. contract. This work consisted of the extension of the previously mentioned crosscut for an additional 101 1/2 feet, of the driving of a second adit (No. 2) 100 feet N. 80° W., of rim stripping 682 feet at the horizon of the deposit, of percussion drilling to depth of 30 feet, and of the construction of an access road. The portal of adit No. 2 is 555 feet N. 35° E. of the portal of adit No. 1.

Host rock for the deposit on adit No. 1 is a thin stratum of dark-gray siltstone which overlies the barren quartzite. The barren quartzite is pinkish white, medium to coarse grained, and 1.0-1.5 feet thick. Scattered light-colored pebbles at the base of the quartzite bed are commonly blade shaped and appear to be sericitized. Much of the gray unit is bleached and iron stained at the surface. This condition persists for at least several feet below the surface in the gray facies, but most of the black facies is medium to dark gray within a few inches of the surface. The upper surface of the Sierra Ancha diabase sheet is in nearly concordant contact with the gray facies about 80 feet below the barren quartzite, and the Mescal Limestone overlies the Dripping Spring about 195 feet above the barren quartzite.

The Dripping Spring is nearly flat lying in the deposit vicinity, but dips steeply on the flank of the Cherry Creek monocline about 1/2 mile east of the claims. The strongest joints there trend N. 70°-80° W. and about N. 20° E.; joints in another set trend about N. 55° E. Nearly all are filled with limonite near the surface.

Just above the diabase the Dripping Spring is locally converted to hornfels, but no evidence of contact metamorphism is seen at the ore horizon. A few narrow stringers of aplite or mobilized hornfels cut the hornfels but not nearly in the quantity present on the Sorrel Horse and Citation claims where a breccia zone several feet thick above the diabase sill is cemented by aplite.

The Black Brush deposits are within about 1/4 mile of the Citation and Sorrel Horse deposits yet occupy a different stratigraphic position. The Black Brush deposits are just above the barren quartzite, whereas the Citation and Sorrel Horse deposits range from 35 to 70 feet below the quartzite.

Adit No. 1 (see fig.40 in Granger and Raup, 1969) was started along a N. 20° E. fracture that was strongly radioactive at the surface. This fracture had previously been traced and explored for about 60 feet south of the adit portal, but exploration had been discontinued; the Dripping Spring had been eroded approximately down to the horizon of the barren quartzite so that very little radioactive rock remained.

About 40 feet into adit No. 1 the fracture diverges to the east from the zone of highest radioactivity. Beyond this point the zone of highest radioactivity follows no particular fracture, but continues along an obscure vertical zone that is much easier to drill than the adjacent rock. This zone is shown on figure 40 in Granger and Raup (1969) as shattered rock.

The ore body is localized almost entirely in a stratigraphic interval, less than 2 feet thick, which is adjacent to the central fracture and between 15 and 50 feet into the adit. The ore was somewhat thicker adjacen to the central fracture than in the walls of the adit only 2-3 feet away. D.M.E.A. investigations (Emerick and Romslo, 1957a) subsequently disclosed that a 2- to 4-inch-thick siltstone stratum immediately above(?) the barren quartzite was abnormally radioactive along several hundred feet of stripped outcrop. Apparently the ore body was localized at the intersection of a fracture with the favorable siltstone stratum.

The mineralogy of the ore body is similar to that of deposits in the Workman Creek area. Uraninite occurs as small irregularly shaped blebs which are chiefly in the black siltstone but are also in the upper part of the barren quartzite. Both uraninite I and II are present, but uraninite I is much less common. Small amounts of pyrrhotite, chalcopyrite marcasite, galena, and pyrite are associated with the uraninite, but most of the sulfide minerals occur in the barren quartzite and are separated from most of the uraninite. At least some of the marcasite has developed from the decomposition of pyrrhotite. The galena occurs both as minute grains dispersed in the uraninite II and as blebs disseminated in the barren quartzite. Near the surface, torbernite is common in the iron-stained rock.

During 1955, about 25 tons of radioactive rock from adit No. 1 was stockpiled near the portal. Late in 1955, 7.94 tons of this rock was trucked to the Cutter buying depot. It contained 0.11 percent U_3O_8. In mid-1956, a second shipment of 11.23 tons contained only 0.07 percent U_3O_8 and no further shipments were made. Select samples that contained more than 1.5 percent U_3O_8 and several samples that contained more than 0.2 percent U_3O_8 were cut from the ore zone (R. J. Schwartz, written commun., 1957).

During extension of the crosscut from adit No. 1 under D.M.E.A. agreements, a radioactive fracture was crossed that was approximately parallel to and 84 feet from the central fracture in the adit (Emerick and Romslo, 1957a). Radioactivity in the fracture apparently was not associated with the pyrite disseminated in the fracture zone but rather with small localized spots in the fractured siltstone. A sample of this material, only 1.5 inches across, in the fracture zone was found to contain 0.65 percent U_3O_8, but adjacent 1-foot-long samples on either side were found to contain only 0.08 and 0.05 percent U_3O_8, respectively.

Adit No. 2 was driven along a vertical N. 80° W. fracture that was abnormally radioactive at the surface (Emerick and Romslo, 1957a). At the portal the fracture is about 4 inches wide and contains limonite-stained material, but it pinches out completely about 60 feet into the adit. The adit was continued on the trend of the fracture for about 40 feet more, but radioactivity at the face was found to decrease to about twice the normal background. No ore has been produced from this adit.

Black Diamond

The Black Diamond claims are in the E 1/2 sec. 32, T. 5 N., R. 14 E., in the Rockinstraw Mountain quadrangle. The uranium deposit is at the head of a box canyon that drains southward into Roosevelt Basin. It is accessible by about 2 miles of dirt road and a few hundred feet of trail. The road joins the Globe-Young road at the Red Bluff claims.

The claims, which are owned by Roger Kyle and others, of Globe, were originally located for asbestos. Several old adits are in the Mescal Limestone about 1/4 mile northwest of the 8-foot adit that was driven on the uranium deposit. No uranium has been produced from the deposit.

The adit is in the black facies of the Dripping Spring Quartzite about 60 feet above the barren quartzite. The host rock is nearly flat lying and, except for considerable near-surface iron stain, is gray siltstone and very fine grained sandstone typical of the black facies.

The deposit is about 1,000 feet northeast of a large discordant diabase body whose northwest-trending contact cuts the black facies. The Rainbow adit is about midway between the Black Diamond adit and the diabase.

In 1954, prior to exploration, surface exposures indicated that a 2-foot-thick bed of siltstone was abnormally radioactive where cut by several N. 73° W. vertical fractures. Even though this relation is not so evident at the face of the northwest-trending adit, the abnormal radioactivity is nonetheless confined to a narrow stratigraphic range near the fracture zone.

We saw no uranium minerals, but R. J. Schwartz (written commun., 1957) noted metatorbernite and bassetite(?). A little pyrite is present, and limonite stain is abundant on fracture surfaces. White efflorescent sulfates locally coat adit walls and nearby protected cliff faces at the stratigraphic position of the adit.

At the surface, before the adit was driven, the radioactivity of the fractures was as high as 1.0 mr per hour. At the face of the adit the radioactivity is no greater than 1.0 mr per hour, and averages about 0.4 mr per hour. Background radioactivity is about 0.1 mr per hour.

Blevins Canyon

The Blevins Canyon deposit is on the north wall of Blevins Canyon about midway between Lauffer Mountain and Lookout Mountain in the Roosevelt quadrangle. In the vicinity of the deposit, Blevins Canyon drains southeastward and is about 250 feet deep; its rim is at an altitude of about 5,500 feet. Lauffer Mountain, about 0.8 mile to the north, rises to 6,100 feet, and Lookout Mountain, about 1.0 mile to the south, rises to 6,500 feet. The deposit may be reached from Tonto Basin and from the Globe-Young road by an ungraded dirt road suitable for 4-wheel-drive vehicles.

The deposit is on a group of claims held by the Bridger-Jack Mining Co. Thirty-six of the claims were leased from Tom Russel of Tonto Basin in 1954 (R. J. Schwartz, written commun., 1957), and the rest were located by Ralph Smith for the Bridger-Jack Mining Co.

In the spring of 1955, the lessees started an adit at the most radioactive outcrop on the north wall of the canyon. Shortly thereafter, the U.S. Bureau of Mines, on behalf of the U.S. Atomic Energy Commission, drilled three exploratory diamond drill holes a few hundred feet north of the rim. Work on the claims was terminated by early 1956 and the claims were returned to the owners (R. J. Schwartz, written commun., 1957). No production has been reported from the deposit.

The deposit was explored by an adit, three diamond drill holes, and several prospect pits. The adit was started in a small reentrant on the northeast wall of the canyon about 75 feet below the canyon rim and was driven N. 82° E. for about 110 feet. At about 20 feet from the portal, a branch working was directed N. 43° E. for about 40 feet.

The diamond drill holes are approximately 150, 275, and 370 feet north of the canyon rim overlooking the adit. All the holes cut a radioactive zone at about the same stratigraphic position as does the adit. The third hole cut a few inches of rock that contained metatorbernite on a fracture surface but penetrated no ore-grade rock (R. J. Schwartz, written commun., 1957).

The Dripping Spring Quartzite is nearly flat lying in the Blevins Canyon area. The north canyon rim is in dark-gray, bleached, and limonite-stained siltstone strata of the gray facies of the upper member; the rim is about 75 feet above the middle member, and the deposit is at the base of a paleochannel cut in the upper part of the middle member. The channel as exposed on the canyon wall is about 700 feet wide and 50 feet deep; exposures are insufficient to determine its length or trend.

A discordant diabase body probably once intruded the Dripping Spring above the level of the present land surface. Lauffer Mountain is composed of diabase from this body, and Lookout Mountain to the south has on its flanks a sill-like mass of diabase which may represent the same body. A few hundred yards north of the deposit the lower contact of the diabase is sharply discordant and cuts across strata at the stratigraphic position of the deposit. Although not investigated in the field, the lower contact of this diabase body probably plunges discordantly to the east about 3/4 mile east of the deposit. This contact would correspond to discordant diabase contacts projected from the May claims about 1 mile northeast and from the Fairview claims about 1 1/2 miles south of the Blevins Canyon deposit.

About 100 yards north of the rim is abundant float of quartz vein material. Copper-bearing quartz veins as much as 10 feet wide a few hundred yards N. 70° W. of the deposit trend toward the deposit, and the float probably reflects the eastern extension of these veins. No copper minerals were noted in the float, but the canyon walls near the deposit were locally stained bright green by malachite.

Joints are abundant near the deposit and strike predominantly N. 25°-50° E. and N. 40°-70° W.

The deposit is blanket shaped and is localized in the basal beds of the paleochannel which are cut in the middle member and filled with arkosic sandstone, quartzite, and several thin shaly splits. At outcrop the lowermost strata in the channel filling are radioactive for about 200 feet along the canyon wall. The most radioactive zone is in a very fine grained to fine-grained, clayey arkosic sandstone just above a 1- to 3-inch-thick micaceous shale bed on the contact with the middle member. Locally, this shale rests on a thin subangular conglomerate. The arkosic sandstone and shale splits in the overlying rocks are only locally radioactive.

Metatorbernite is the only uranium mineral that was noted. It is most prevalent on bedding planes in the basal micaceous shale but is present sparingly on small fractures in the immediately overlying rocks. Metatorbernite was identified by R. J. Schwartz (written commun., 1957) in a fracture at about the same stratigraphic position as that of the radioactive outcrop at a depth of 60 feet in the core drilled about

370 feet north of the canyon rim.

Malachite is locally abundant as a coating on cliff faces and in fractures near the portal of the adit. It was not observed in the adit or in the drill cores.

Limonite is common on nearly all surfaces, and jarosite(?) is found on fracture planes near the adit walls.

Abnormal radioactivity at the outcrop is traceable for more than 200 feet horizontally and less than 15 feet vertically. Only locally does the radioactivity exceed 1.0 mr per hour. The most radioactive spot, which has an activity of about 5 mr per hour, is a few feet northwest of the portal. A specimen from this point contained 0.351 percent eU_3O_8, and a 3-foot vertical channel sample contained 0.032 percent eU_3O_8 (R. J. Schwartz, written commun., 1957).

Radioactivity within the adit decreases from the portal toward the face. Near the base of the channel the radioactivity ranges from 1.0 to 3.5 mr per hour for 40 feet into the workings, but beyond 40 feet it is less than 1.0 mr per hour.

The radioactive zone was detected in all three diamond drill holes, but the radioactivity is much less than at outcrop (R. J. Schwartz, written commun., 1957).

Blue Rock

The Blue Rock deposit is in sec. 36, T. 6 N., R. 14 E., about 0.3 mil south-southeast of the Big Buck deposit in Cherry Creek Canyon. The deposit is exposed on an east-facing, steep, rubble-covered slope below vertical cliffs of Troy Quartzite. Cherry Creek is about 1,300 feet below the deposit, which is at an altitude of approximately 4,500 feet. Access to the deposit is by road traversable by 4-wheel-drive vehicle and by a trail from the access road in Cherry Creek canyon.

The Blue Rock deposit is in the Devil's Chasm group of claims owned by F. D. Meadows (R. J. Schwartz, written commun., 1957). Since the claims were located there has been a little exploration work but no ore has been produced.

The property has been explored by several small and shallow pits dug through the rubble that covers most of the slope. Some of the pits are merely location holes, but most were dug to investigate local radioactivity anomalies detected at the surface. The three most radioactive pits are rudely alined in a N. 11° E. direction. These pits, from bottom to top, are 25 and 18 feet apart stratigraphically.

The host rock for the deposit is very dark gray to black siltstone, typical of black facies of the gray unit, and is locally bleached by weathering to lighter gray. In this area, the black facies consists of approximately 110 feet of nearly flat lying strata underlain by fine- to coarse-grained barren quartzite. Thin lenses of very fine grained quartzite are intercalated with the siltstone laminae in the strata just above the barren quartzite. These lenses abruptly decrease in number upward, and most of the black facies comprises silt- and clay-size detritus and includes a colorless micaceous mineral, probably muscovite. Stylolites are abundant in the finer grained strata.

Thermal metamorphism probably has affected the host rock to a slight degree, but not to the extent that would account for the recrystallization in the Workman Creek area. A few small flakes of biotite(?) were noted in one specimen of siltstone from the Blue Rock deposit.

The exploration pits that expose anomalously radioactive rock are all in strata of the black facies. The stratigraphically lowest pit which shows significant radioactivity is 25 feet above the barren quartzite, and the highest pit is 68 feet above the barren quartzite. Most of the anomalies, however, are between 40 and 60 feet above the bottom of the black facies.

A diabase dike projected to the Blue Rock area from exposures between the Blue Rock and Big Buck deposits indicates that a substantial body of diabase is not more than 500 feet into the hill behind the deposit. This dike, which is about 50-75 feet wide, strikes N. 30° E. and dips 60°-70° SE. No diabase sills were noted in the immediate vicinity of the deposit. Diabase may have intruded closely to the east of the deposit along structures associated with the Cherry Creek monocline, which is, at most, about 1/2 mile to the east. Evidence to substantiate this possibility, however, is lacking, because the diabase has been removed by erosion.

The uranium deposits on the Blue Rock property consist of secondary minerals that coat fractures and bedding planes. Because the few exposures of mineralized rock are so small, an estimate of the size of these deposits is impossible. In outcrop, the deposits apparently are veins, but local favorable strata are mineralized for various short distances from the veins. As suggested by the alined pits mentioned earlier, the vertical extent of the deposits may be as much as 45 feet.

The most radioactive fractures, those that seem to have controlled the emplacement of uranium, trend N. 15°-40° E. The alinement of the pits, however, is N. 11° E. Furthermore, one of two radioactive fractures in one of the pits dies out in the face. These facts suggest an en echelon arrangement of the host fractures. These fractures are typical of tension-type fractures, inasmuch as the strike and dip are irregular in detail.

The radioactive fractures are commonly weathered so that the fracture filling is largely iron oxides and clay. Bordering the fracture is a bleached zone about a quarter of an inch wide. Determinations as to whether the bleaching is an effect of mineralization or of weathering could not be made.

The lowest of the three most radioactive pits contains secondary uranium minerals coating bedding planes and joints in relatively unbleached siltstone. The greatest concentration of minerals in this pit is above and below a 2- to 6-foot-thick unit of very fine grained quartzite, which, judged from the pulverulent and boxwork limonite that fills vugs in the rock, apparently was sulfide rich. The upper pit is in relatively unbleached siltstone in which secondary uranium minerals have been concentrated along a north-northeast-trending fracture.

Bassetite and metatorbernite are the principal uranium-bearing minerals in the Blue Rock deposit. Kaolinite was identified by X-ray methods as the clay mineral present in the mineralized fractures; iron oxides are abundant. Gypsum in minute flakes, as well as white and very pale yellow efflorescent minerals, probably sulfates, is abundant on surfaces in the pits.

Maximum radioactivity detected in the deposit was 3.5 mr per hour, but only in the three pits described was radioactivity detected in excess of 0.5 mr per hour. Background radioactivity is 0.1 mr per hour. The lowest of the three pits has a 1.5-mr-per-hour maximum and the highest has a 2.0-mr-per-hour maximum. The radioactivity of the middle pit is the highest.

Brushy Basin Trap

The Brushy Basin Trap deposits are in the N 1/2 sec. 27, T. 7 N., R. 14 E., in the McFadden Peak quadrangle. Both deposits are within 25 feet of the floor of a southeast-trending canyon tributary to Cherry Creek and are about 600 feet from the confluence of the canyon and Cherry Creek. The canyon walls are steep, ledgy slopes, and the deposits are on opposite walls approximately across from one another. The deposit area is accessible to 4-wheel-drive vehicles by a road from the access road in Cherry Creek Canyon.

The Brushy Basin Trap property was located by Alfred Haught and others, of Young. W. T. Graham had leased the claims and had completed all the exploration work that had been done by the time of our examination. The lease was dropped by Graham and a new lease was taken in June 1956 by the Cherry Creek Uranium Co. No ore had been produced from the mine by the end of 1956.

Mine workings on the property consist of two adits and a crosscut from the larger of the two adits. The larger adit, which is on the northeast side of the canyon, is 145 feet long and trends approximately N. 8° E. The course of the adit, however, is very irregular. At 65 feet from the portal is a 65-foot crosscut that trends N. 27° W. The second adit, which is on the southwest side of the canyon, is 60 feet long and trends S. 30° W. We have no information from at least four long holes drilled from the larger adit, but lack of further work suggests that the results were negative.

The host strata for the deposits are, where unbleached, alternating layers of dark-gray and light-gray siltstone typical of the black facies. In the smaller adit the rock is shattered and iron stained but is still for the most part unbleached. Weathering has had more effect on the rocks in the larger adit and crosscut and the degree of bleaching is greater. In both adits are lenses and groups of laminae of pink fine-grained sandstone and arkosic sandstone. No evidence of thermal metamorphic effects was noted. The strike of the host rocks is approximately N. 20° W. and the dip is 6° SW.

The deposits are within a few feet of being at the same stratigraphic level. The distance of the adits above the barren quartzite could not be determined, because the quartzite is poorly developed in this area or because it is below the level of the canyon floor. The deposits are probably in the upper 50 feet of the black facies, which means that they are higher in the section than most of the deposits in the Dripping Spring Quartzite.

The nearest known exposures of diabase are across Cherry Creek to the east-southeast where a discordant body apparently has intruded along a fault. This diabase is nearly 0.3 mile from the Brushy Basin Trap deposits and is the same body of diabase that is just to the east of the Navajo adit (described later in this report). The Navajo adit, which is about 0.2 mile to the southeast, and the Brushy Basin Trap adits are at approximately the same stratigraphic level. The Brushy Basin Trap deposits are about 1 mile east of the axis of the Cherry Creek monocline.

The deposit exposed in the northern adit on the Brushy Basin Trap property is small, discontinuous, and follows no obvious trend. Abnormally high radioactivity is spotty and commonly can be traced to local concentrations of secondary minerals on joint surfaces. Two sets of joints are prominent, trends of which are: N. 32° W., 65°-70° NE. and N. 62° E., 60°-65° SW. No main fracture was followed during exploration drifting.

The deposit exposed in the southern adit is also small and, in detail, does not seem to be controlled by structural or stratigraphic features. Joints that trend N. 65° W. and dip 50° E. have no apparent effect on the deposit. The most radioactive part of the adit is 25 feet in from the portal; however, the cause for this increase in radioactivity is not visible.

No primary uranium-bearing minerals were noted, but pyrite is sparsely disseminated in the host rock and is locally present as a thin coating on fracture planes. Graphite is present in the abundant stylolites.

Secondary minerals occur as fine-grained coatings on fracture and joint planes. These are metatorbernite, which was observed megascopically, and bassetite, which was identified by X-ray methods, an extremely fine grained yellow coating identified as saléeite by X-ray methods, and, occurring with these minerals, nontronite(?) and kaolinite as well as abundant hydrous iron oxides. In addition, white to very pale yellow and very pale blue efflorescent minerals coat recently exposed surfaces and are probably sulfate minerals.

Radioactivity and uranium content of the deposits are fairly low. The radioactivity as measured with a scintillation meter is, in the northern adit, less than 0.5 mr per hour except near the portal and in the first few feet of the crosscut where very local areas gave readings of slightly more than 1.0 mr per hour. Background radioactivity is 0.06 mr per hour. In the southern adit, the highest radioactivity is 0.5 mr per hour, and the average reading is approximately 0.3 mr per hour. Uranium content of several samples taken from the northern adit by U.S. Atomic Energy Commission personnel ranged from 0.01 percent eU_3O_8 to 0.17 percent eU_3O_8. The highest assay came from a 3-foot channel sample taken from the roof of the crosscut within 5 feet of the start of the crosscut and represents a local "hot spot." Most of the samples contain much less than 0.1 percent eU_3O_8.

Cataract

The Cataract deposit is in the SW 1/4 sec. 19, T. 7 N., R. 13 E. (unsurveyed), in the Roosevelt quadrangle about 2 miles east of Copper Mountain and about 2 miles north of Lauffer Mountain. A rugged canyon trends southeastward across the property. The deposit is about halfway up the steep and ledgy northeast wall of the canyon. Access to the property is by a rough dirt road that connects the Roosevelt-Payson road and the Globe-Young road. In several places the access road is extremely rough and may require 4-wheel-drive vehicles.

The Cataract property comprises seven claims located by S. L. Bennet and W. Haywood. The Cataract Uranium Mining and Exploration Corp. leased the property and explored the deposit by an adit and some minor benches. No ore had been produced from the property up to the end of 1956.

The exploration adit (see fig. 39 in Granger and Raup, 1969) extends N. 29° W. for 198 feet. Two short crosscuts branch from the adit: 50 feet from the portal a 36-foot crosscut trends S. 76° W. and at the end of the adit a 12-foot crosscut trends N. 58° E.

The host rocks for the deposit are fine-grained to shaly, thinly and very thinly laminated strata that are buff to white where not stained by iron minerals. Thin, irregularly shaped lenses of fine-grained sandstone and quartzite are common. Flakes of mica on stratification planes suggest that the rocks are in the lower part of the upper member of the Dripping Spring Quartzite. Even though the rocks just below these strata are typical of the middle member, the basal, or red unit, of the upper member is not typical. Instead, this unit is partly composed of detritus similar to that in the middle member. These facts, plus the irregular nature of the contact between the upper and middle members, suggest that the host strata are channel-fill material. Apparently, channeling was very subdued, inasmuch as the relief of the contact is only about 4 feet. Thus, rather than being a thick sequence of channel-fill material in a single channel, the clastics at the Cataract property are probably in a group of relatively thin lenses on an irregular surface cut into the middle member. The strata apparently are unmetamorphosed.

The Cataract adit was driven on the contact between the upper and middle members. Above the adit level are strata that resemble the gray facies, the barren quartzite, the black facies, and the buff unit. All the rocks, however, have been bleached buff to white.

Diabase has not been noted in the immediate vicinity of the mine but may occur in a canyon which is less than half a mile to the east. A large body of diabase sharply transects Dripping Spring strata near the May deposit, which is on the northeast flank of Lauffer Mountain about 1 mile south of the Cataract deposit. We saw this same discordant contact at several places farther south, and the projection of the trend of the structure would pass within 1/2 mile east of the Cataract adit.

The uranium deposit exposed in the Cataract adit apparently is controlled by stratigraphic features related to the channels previously described. Measurements of the radioactivity in the adit and crosscuts suggest that the deposit is of the blanket type. The exact overall size and shape of the deposit is not known because of inadequate exposure, but the deposit probably is contained in the lenses of more permeable channel-fill strata that overlie relatively less permeable strata of the middle member. A vertical shattered zone that can be traced in the roof of the adit for 165 feet from the portal apparently has no controling effect on the deposit.

Primary metallic minerals noted at the deposit include pyrite and possibly chalcopyrite, but no uranium-bearing minerals. The sulfide minerals occur as minute grains disseminated in very small and thin lenses of fine-grained sandstone and quartzite near the base of the upper member.

Secondary minerals are more common, and include metatorbernite, malachite, and chrysocolla, as well as abundant limonite. Metatorbernite and secondary copper minerals occur as thin coatings on short random fracture surfaces. The copper-stained fractures are commonly more irregular than are those coated with metatorbernite. Limonite and clay minerals occur together on fracture surfaces, but both, particularly the limonite, also occur independently. In the Cataract adit, copper-stained rock is most abundant between 60 and 85 feet from the portal. Metatorbernite is most common near the portal where it coats randomly oriented fractures.

In general, the secondary copper minerals are commonest at the contact in medium-grained sandstone, whereas the highest radioactivity and the most abundant torbernite are in strongly bleached claystone about a foot above the contact.

Local differences in the radioactivity of the deposit indicate that the favorable strata were not uniformly mineralized. Inasmuch as the uranium-bearing minerals are secondary, the favorable strata probably were channelways for supergene uranium-bearing solutions, and the amount of uranium deposited depended on the porosity and permeability of the strata and the favorability of the rock for deposition. These factors would not be consistent in a channel fill and could explain the local differences in radioactivity.

The maximum radioactivity in the adit is 1.90 mr per hour, and the lowest reading in favorable rock is 0.21 mr per hour. In general, the radioactivity increases abruptly at the middle-upper member contact and is highest about a foot above the contact. From 1 foot to about 5 feet above the contact, the radioactivity gradually tapers and returns approximately to the level typical of the underlying strata in the mine. The average radioactivity in the adit of strata of the middle member is about 0.20 mr per hour; the average of the favorable zone approximately 1 foot above the contact is 0.52 mr per hour, and the average at the roof (2-4 ft above the contact) is 0.38 mr per hour.

Selected samples of radioactive rock were collected from the surface and the mine by U.S. Atomic Energy Commission personnel. The sample from the surface contained 0.21 percent eU_3O_8, and the sample from the mine contained 0.18 percent eU_3O_8. These samples were selected specimens that probably represent the most radioactive rock available.

Donna Lee

The Donna Lee deposits are in the SE 1/4 sec. 13, T. 5 N., R. 14 E., in the McFadden Peak quadrangle. Both adits are at an altitude of about 4,750 feet and are just beneath the rim of the west wall of Deep Creek canyon, which drains southward into Bull Canyon. Deep Creek canyon is sharply incised to a depth of several hundred feet in the vicinity of the claims. Access is by about 2 miles of unimproved road from a road junction just west of the Sue mine.

The property comprises a group of 15 claims located by the Miami Copper Co. to cover a radioactivity anomaly that was publicly announced by the U.S. Atomic Energy Commission in 1954.

No ore is known to have been shipped from the claims, although in 1956 R. J. Schwartz (written commun., 1957) noted a small ore stockpile near the portal of adit No. 2.

Mine workings (fig. 2) on the claims consist of two adits. Adit No. 1

is directed S. 22° W. for 90 feet, from which point a crosscut extends S. 78° E. for 50 feet. Adit No. 2 is about 1,700 feet south of adit No. 1 and trends S. 10° W. for 85 feet.

Exploratory drilling resulted in a series of short, nearly horizontal probes in both walls of adit No. 2, which indicate the presence of local ore that extends sporadically for 1-3 feet into the walls of the adit. Drilling in adit No. 1 consists of several holes as much as 50 feet long collared near the end of the adit and in the crosscut. Some of these are horizontal and others are inclined upward at a very low angle. They intersect at least three radioactive zones west of the adit and prove the upward extension of the radioactive zones encountered in the workings.

The deposits are in strongly weathered and oxidized gray siltstone and very fine grained sandstone of the black facies. The fresh rock ranges from a uniform gray to very light gray flaggy and lenticular strata and shows no evidence of metamorphism. Crumpled shrinkage cracks are common in adit No. 2.

The floor of adit No. 1 is 10 feet stratigraphically above the barren quartzite, and adit No. 2 is about 5 feet higher. During earlier work (Granger and Raup, 1959), a sandstone layer in the black facies above adit No. 1 was identified as the barren quartzite, but it now seems more probable that both deposits are at a stratigraphic position similar to that of the Sue mine (described later in this report), about 6,000 feet to the south.

A north-trending prediabase fault extends downstream from the deposits along the east wall of Deep Creek canyon. East of adit No. 2, the creek extends upstream to the northwest, departing from the fault zone. The deposits are in the block west of the fault, which is downthrown 300-350 fe with respect to the east block. Thin diabase sills intrude the Pioneer Formation below the deposits at different stratigraphic positions on opposite sides of the fault, and dikelike bodies of diabase are sporadicall distributed in the fault zone. The nearest large body of diabase was probably a sill in the overlying Mescal Limestone, but the sill has since been removed by erosion.

Adits 1 and 2 apparently follow different sets of fractures and, although adit No. 2 seems to follow the same vein throughout, adit No. 1 seems to branch from the vein that is exposed at the portal. Adit No. 2 follows two strong N. 10° E.-trending fractures which join about 60 feet from the portal and continue as one fracture to the face. The main fracture trend is intersected by several fractures which trend N. 22° E. and N. 80° W. but which do not seem to be related to the main ore trend. The dominant fractures in adit No. 1 trend N. 20°-27° E., but it is not certain that this is the dominant direction of the ore zones. The vein zone on which the adit was started seems to enter the east wall at about 25 feet and, if it continues on this trend, may connect with the radioactive zone intersected about 20 feet into the crosscut. The anomalous radioactivity of the adit throughout may be due to redistribution of uranium under weathering conditions.

In adit No. 2, some of the strongest radioactivity is localized between the main fractures, but the limonitic fracture filling and the immediately adjacent rock are much less radioactive. Several 1- to 3-inch-thick lenticular beds in the walls of both adits are locally more radioactive than the enclosing rocks. Whether this radioactivity was caused by primary or by redistributed uranium could not be determined. Anomalous radioactivity can be traced on the surface for about 20 feet above the portal of adit No. 2.

Pyrite was the only unoxidized epigenetic mineral identified, although chalcopyrite is probably present inasmuch as secondary copper minerals are abundant. Metatorbernite is abundant along joints and is disseminated in clay-rich strata in near-surface parts of the deposits. Limonite is common in nearly all fractures and is accompanied by sparse calcite near the ends of the adits. Gypsum and malachite are sporadically present along some fracture surfaces. Efflorescent white sulfates are abundant on the adit walls and are associated with considerable chalcanthite near the portal of adit No. 1.

Radioactivity in the vein zones in adit No. 1 ranges from

3 to 5 mr per hour. Radioactivity in the adjacent wallrocks is typically between 1.5 and 3 mr per hour except near the east end of the crosscut, where it drops well below 1 mr per hour. Background radioactivity in the area is about 0.1 mr per hour.

In adit No. 2, radioactivity in the vein zone ranges from 2 to 7 mr per hour, and in the walls of the adit between 20 and 40 feet from the portal is generally more than 1 mr per hour. Beyond this interval the vein narrows and the radioactivity in the wallrocks is generally below 1 mr per hour.

Two chip samples from the west wall of adit No. 2 and one grab sample from the dump contained 0.24-0.29 percent eU_3O_8 (R. J. Schwartz, written commun., 1957).

Easy

The Easy deposit is in the SE 1/4 sec. 35, T. 7 N., R. 13 E. (unsurveyed), about 1 1/4 miles west-southwest of McFadden Peak in the McFadden Peak quadrangle. The deposit is in somewhat subdued terrain on the gently sloping southwestern flank of McFadden Peak. Bedrock is largely covered by soil and timber. Access to the property is by 4-wheel-drive vehicle from the McFadden Peak lookout.

A. D. Williams and J. Carter located the 12 Easy claims and leased the property to the Blue Bonnet Uranium Corp. The lessee explored the property by bulldozing and blasting an opencut and by wagon-drilling several holes behind the radioactive outcrop. No ore had been produced from the deposit to the end of 1956.

The opencut exposes the radioactive stratigraphic interval for approximately 70 feet. The drill holes are mostly to the north of the opencut and are reported (R. J. Schwartz, oral commun., 1955) to have penetrated the radioactive interval. The number of holes drilled and the data obtained are not known to us.

The host rock for the Easy deposit is interlayered strata, less than 2 inches thick, of gray silty rock and pink fine-grained to silty rock. Locally present are lenses, less than 1 1/2 inches thick, of granule and small-pebble conglomerate that commonly consists of flattened clay galls. Conglomeratic lenses are most common near the base of the host strata which directly overlie principally medium grained feldspathic orthoquartzitic to orthoquartzitic strata typical of middle member rocks.

The stratigraphic position of the deposit seems to be just above the contact of upper member and middle member strata; the stratigraphic section in the vicinity of the deposit, however, is not typical and is poorly exposed. The rocks underlying the deposit are typical of the upper part of the middle member, but the overlying host rocks are not similar to the red unit at the base of the upper member; the host rocks and the next overlying strata are more typical of the gray facies, inasmuch as the color and grain size are similar and pseudochannels are present. The pseudochannels are poorly developed and look somewhat like flexures, but they all trend approximately N. 20° E. The presence of conglomeratic lenses directly overlying the middle member rocks suggests that the red unit may have been removed by erosion prior to deposition of gray facies strata. Exposures of the contact are poor, except where seen in the opencut, so that further evidence of an erosion surface between middle and upper members is lacking.

The host rocks do not appear to have been affected by thermal metamorphism due to diabase. Furthermore, diabase is not exposed near the deposit. The nearest known diabase is in the McFadden Peak monocline, which intersects a major cross structure about 1 1/2 miles east of the Easy deposit. The sill that is exposed on the west side of the McFadden Peak monocline in the Workman Creek area may also underlie the Easy deposit area, but its depth below the present surface would be on the order of 300-350 feet if the sill were concordant.

The Easy deposit is blanket type and has secondary uranium minerals coating fracture and bedding planes through a fairly thin stratigraphic interval. A suggestion of a northeast trend for the most radioactive rock was noted by R. J. Schwartz (written commun., 1957). His interpretation was based on the results of probing the drill holes for radioactivity. The host strata and thus the deposit are nearly flat lying. Abnormally high radioactivity is sparse and not uniformly distributed in the host strata exposed in the opencut, but "hot spots" were noted at many places in the cut. The width of the deposit seems to be at least 70 feet; much of the rock, however, contains very little uranium. The thickness of the deposit is commonly only 2-3 inches but uranium minerals locally coat fractures through a stratigraphic interval of as much as 2 1/2 feet. We do not know the depth of the deposit under the hill behind the face of the opencut, but R. J. Schwartz detected abnormal radioactivity in drill holes at least 30 feet behind the opencut.

Primary minerals noted include chalcopyrite and pyrite which occur as fine grains disseminated in the pink host strata and particularly in the conglomeratic lenses. No primary uranium minerals were identified.

The uranium at the Easy deposit is largely contained in secondary minerals that coat fracture and stratification planes. Metatorbernite and uraniferous opal were tentatively identified in the field, and saleeite, bassetite, and metazeunerite were identified by X-ray methods. Covellite was noted in association with the primary sulfide minerals. The opal occurs largely on stratification planes. Limonite occurs with the secondary minerals as well as on exposed surfaces throughout the deposit area.

Radioactivity at the deposit is not high. Scintillation-meter readings from the 2- to 3-inch most favorable interval are most commonly in the 0.20-0.25 mr per hour range; background radioactivity is approximately 0.05 mr per hour.

Two samples taken from the deposit were reported (R. J. Schwartz, written commun., 1957) to contain 0.02 and 0.08 percent eU_3O_8. The richer sample was a grab sample, whereas the poorer was a chip sample. In addition, a select specimen contained 0.42 percent eU_3O_8.

Fairview

The Fairview deposit is in the NW 1/4 sec. 12, T. 6 N., R. 12 E. (unsurveyed), about 3/4 mile south of Lookout Mountain, in the Roosevelt quadrangle. The deposit is on the southwest side and near the top of a ridge that extends south-southeast from Lookout Mountain. Steep slopes broken by ledges and cliffs form the side of the ridge below the deposit level, but from the deposit to the crest of the ridge the slope is fairly gentle and the bedrock is largely covered with a thin mantle of soil and rubble. The deposit overlooks Greenback Valley, Chubb Mountain, and part of the Salome Creek drainage area. Access to the property is by road southward past the west side of Lookout Mountain from a road that connects the Roosevelt-Payson road in Tonto Basin with the Globe-Young road north of McFadden Peak.

The 16 Fairview claims were located by E. C. Conway and others, who used a bulldozer to clear the surficial debris from the most radioactive area on the claims. They continued exploration of the cleared area by digging several small opencuts, pits, and trenches. The Boxwell and Frates Corp. leased the property from the owners and wagon-drilled numerous holes. By the end of 1956 no uranium ore had been produced from the property.

The principal exploration workings are two opencuts and 80 feet of trenches or shallow, elongate pits. The larger of the two cuts is approximately 17 feet long and 7 feet wide; R. J. Schwartz (written commun., 1957) reported that the Boxwell and Frates Corp. wagon-drilled more than 100 vertical holes which totaled about 8,000 feet. Many of these holes were collared near the surface workings. Two holes were drilled by the U.S. Atomic Energy Commission, one of which was collared near the principal opencut and the other about 300 feet farther up the hill and 50 feet higher in elevation (R. J. Schwartz, written commun., 1957).

The host rocks for the deposit are thinly and very thinly laminated argillaceous siltstone that strikes approximately N. 65° W. and dips 5° SW. At the surface the siltstone is strongly weathered to buff and tan; limonite stain is everywhere dominant, especially on fracture and stratification planes. Below the weathered surface, the host rocks are gray, thinly laminated siltstone (U.S. Atomic Energy Comm. drill core, R. J. Schwartz, written commun., 1957). No evidence of metamorphic effects can be seen except for the "spotted" rocks which are prevalent at the surface. The host rocks are broken by numerous fractures and joints that are randomly oriented except for one vertical set that trends N. 60°-65° E.

The exploration workings are about 60-70 feet above the base of the upper member, which suggests that the deposit is in the gray facies. The barren quartzite was not noted above the deposit but could be present under the almost entirely rubble covered surface.

A body of diabase is in discordant contact with the Dripping Spring Quartzite near the crest of the ridge above the deposit. The contact has a roughly northward trend and is probably related to the structure that also lies to the east of the Cataract, May, and Blevins Canyon deposits. The diabase is less than a quarter of a mile from the Fairview deposit, and may have been within 75 feet above the deposit prior to erosion.

The deposit consists of three blanket-type ore bodies. Two of these bodies are exposed in the opencuts and trenches, but weathering has obscured whatever structural features may have controlled mineralization. The exposed zones range in thickness from 1 to 2 feet, but inasmuch as the radioactivity of the zones is not uniform, owing to weathering or unequal mineralization, the size and shape of the zones cannot be further evaluated from surface data. R. J. Schwartz (written commun., 1957) stated that data obtained from the drill holes suggest the presence of three ore bodies, or zones 51, 61, and 73, above the base of the upper member. Furthermore, the data indicated that the upper two zones are about 160 feet long and 20-30 feet wide, whereas the lower zone is only 80 feet long and 20 feet wide. All three are less than 1 1/2 feet thick. Drill data also were used by Schwartz to show that the zones are elongated northward.

All the identified minerals from the property are secondary, although pyrite was probably disseminated in the unweathered host rock, as evidenced by the abundant limonite that coats all surfaces. The secondary uranium-bearing minerals also occur as surface coatings. Metatorbernite and bassetite were identified in the field, and uraniferous hyalite and uranophane were identified by X-ray methods.

Local concentrations of high radioactivity are related to concentration of secondary minerals, particularly uraniferous hyalite. Thus, the radioactivity in the workings is irregular. Scintillation-meter readings range from less than 1.0 mr per hour to a maximum of nearly 4.5 mr per hour. In places where uranium minerals are not concentrated in the workings, readings of about 0.5 mr per hour are common. Two U.S. Atomic Energy Commission grab samples of stockpiled rock contained 0.56 and 0.08 percent eU_3O_8, whereas a chip sample of a selected "bed" contained 0.18 percent eU_3O_8.

First Chance

The First Chance deposits are in the E 1/2 sec. 1, T. 5 N., R. 13 E., about 0.4 mile north of the Parker Creek Experiment Station in the McFadden Peak quadrangle. The deposits are at an altitude of about 5,600 feet on a ridge that plunges steeply to the south. The surrounding topography is rugged, and altitudes within 1 mile of the deposit differ by as much as 3,000 feet. The deposit may be reached by a steep ungraded dirt road that joins the Globe-Young road about 1/4 mile northwest of the Experiment Station.

The deposits are on a block of claims that consist of the First Chance Nos. 1-4, the Minnie Nos. 1 and 2, and the Beulah Nos. 1-5. They were located early in 1954 by Wm. W. and Bessie K. Cline and Van V. Baker, of Globe. Later that year the claims were leased to Arizona Continental Uranium, Inc., who in 1955 and 1956 built an access road, benched the outcrop, and drove three adits. Late in 1956, the claims were not worked but were still held by the lessees.

The claims have been explored by a discovery pit and three adits (see fig. 26 in Granger and Raup, 1969), two of which develop the same deposit. Adit 3 is about 620 feet S. 80° E. of adits 1 and 2. It is a drift about 60 feet long that trends N. 23° E. Adits 1 and 2 are driven along a vein that trends N. 19° E. Adit 1 is filled with rubble about 70 feet from the portal but reportedly is 110 feet long (R. J. Schwartz, written commun., 1957). Adit 2 is about 16 feet above adit 1 and is 75 feet long with 10-foot crosscuts to the northwest and southeast about 50 feet from the portal. At about 35 feet in adit 2 is a winze that connects with adit 1. The rubble blocking adit 1 was presumably dumped into the winze during the driving of adit 2. The discovery pit is about 10 feet above adit 2.

In the vicinity of the deposits, the Apache Group is exposed from the middle of the middle member of the Dripping Spring Quartzite through the lower parts of the Troy Quartzite. Strata have a general northeast dip, and at adit 3 the Dripping Spring strikes N. 18° W. and dips 8° NE. All the workings are in the black facies. Adit 3 is about 13 feet above the barren quartzite at its portal; in adit 1 the barren quartzite is 6-8 inches thick and is about 3 feet above the floor at the portal but dips beneath the floor about 28 feet into the adit.

The claims are in a structurally complex area. About 3/4 mile to the east the strata turn up steeply on the east flank of the Sierra Ancha monocline. A thick body of diabase, part of the Sierra Ancha sheet overlying Red Bluff and underlying the Workman Creek deposits, intruded the middle member of the Dripping Spring at the monocline. About 1,000 feet south of the deposits the upper contact of this sill has been largely removed by erosion but was discordant, and rose abruptly from the middle of the middle member to well into the gray unit of the upper member. This discordant contact apparently strikes slightly north of west and dips steeply north.

Sparse diabase float near adit 1 and for several hundred feet to the east suggests the possible existence of a narrow east-trending dike that should terminate within 100 feet north of adit 3. No outcrop was seen, however.

Adit 3 follows a poorly defined radioactive zone along a nearly vertical fracture that trends N. 21° E. Transverse fractures are only locally more radioactive than the host rock. The host rock is light- to dark-gray, laminated, and very thinly bedded siltstone. Fracture surfaces are limonite stained, and walls of the workings, particularly near the portal, are sparsely coated with white to yellow efflorescent sulfate minerals.

Radioactivity in the vein zone within 4 inches of the central fracture ranges from 0.8 to 1.2 mr per hour; that in the wallrocks ranges from 0.3 to 0.9 mr per hour within 5 feet of the vein. Locally, individual beds are abnormally radioactive for short distances, particularly in the upper half of the adit.

Prior to adits 1 and 2 being driven, the outcrop was benched to depths not exceeding 10 feet from the surface. Within this weathered zone the rocks were found to be strongly bleached and fractures limonite stained. Metatorbernite, malachite, and azurite were common on fracture surfaces, especially near the radioactive vein. Radioactivity was strongest adjacent to a conspicuous limonite-filled fracture, which locally contained as much as 2 inches of gouge and breccia but which showed no evidence of vertical displacement. Abnormal radioactivity was traceable along the fracture for a vertical distance of 30 feet.

Adit 1 was driven along the lowest exposed part of the radioactive vein--the level of the barren quartzite; adit 2 was driven 16 feet above adit 1. Both are largely in dark-gray siltstone of the black facies. Adit 1 was driven along a vertical fracture for about 70 feet to the pile of rubble which blocks the adit. From the portal to about 30 feet, the fracture is no more radioactive than the adjacent rock. At about 8 feet, however, a radioactive zone can be detected about 2 feet east of the fracture. This zone is parallel to the east wall of the adit to about 20 feet, then changes strike slightly and merges with the fracture at about 30 feet from the portal. At 40 feet the fracture splits into two closely spaced parallel fractures with the most radioactive rock between them. R. J. Schwartz (written commun., 1957) examined the adit while it was completely accessible and stated that at about 75 feet a series of faults seem to displace the ore zone 7 feet to the northwest.

Many surfaces in the opencut at the portal of adit 1 are coated with metatorbernite, minor malachite, and sparse azurite. These minerals are rare within the adit. The walls of the adit, particularly near the portal, are coated with chalcanthite and abundant white efflorescent sulfates.

Radioactivity of rock in the walls of adit 1 ranges from about 0.8 to 1.2 mr per hour. Radioactivity of the vein ranges from 1.0 to 3.5 mr per hour, an average of about 50 percent higher than that of the walls.

Adit 2 follows the same vein as adit 1. The N. 19° E.-trending fracture and the radioactive zone are coincident for nearly 50 feet. At this point, a N. 30° W. limonitic breccia and gouge-filled shear zone apparently displaces the vein about 7 feet to the northwest. A 10-foot crosscut to the southeast and an irregular extension of the adit beyond the shear intersected another parallel but erratic radioactive vein. This vein apparently is not related to any visible fracture. In the crosscut the back and both walls are abnormally radioactive, but at the end of the adit radioactivity is largely confined to a series of strata in the lower half of the drift.

Pyrite, disseminated on bedding planes and in fractures, is common where not oxidized to limonite. Disseminated chalcopyrite was identified in gouge in the main fracture at the portal of adit 2 and in adjacent random fractures. Near the surface the chalcopyrite is largely oxidized to malachite and azurite. Between the malachite zone and the nearly unweathered rock, much of the chalcopyrite is rimmed by chalcocite and covellite. The walls of the adit, particularly near the portal, are locally coated with chalcanthite and white efflorescent sulfate minerals.

Metatorbernite was the only uranium mineral identified, although R. J. Schwartz (written commun., 1957) noted bassetite and uraniferous hyalite.

Radioactivity of the walls of adit 2 south of the crosscuts ranges from 1.5 to 2.6 mr per hour. Radioactivity in the vein ranges from 1.7 to 4.2 mr per hour in the back of the drift. The first 5 feet of the vein south of the N. 30° W.-trending shear emits less than 1.7 mr per hour, probably because of the ready access to oxidizing and leaching meteoric water provided by the shear zone. The offset part of the vein in the northwest crosscut emits about 2 mr per hour in contrast to about 1 mr per hour from the wallrock on either side of the vein. The parallel vein intersected by the southeast crosscut and the end of the adit is strongly radioactive only in certain strata. Radioactivity in these ranges from about 1.3 to 3.2 mr per hour.

Before underground development began, personnel of the U.S. Atomic

Energy Commission took three samples of near-surface oxidized rock from the radioactive vein zone (R. J. Schwartz, written commun., 1957). Two of these samples were out of equilibrium, as follows:

Description	eU_3O_8 (Percent)	U_3O_8 (Percent)
6-foot vertical channel in discovery pit---------	0.02	0.025
8-foot vertical channel near portal, adit 2------	.12	.091
Select sample from discovery pit-----------------	.12	.086

Shipments totaling 35.53 tons of rock were delivered to the Cutter buying depot in the second quarter of 1957, but the average grade was only 0.08 percent U_3O_8. Selective mining could no doubt have resulted in several tons of ore-grade material.

Grand View

The Grand View claims are in the E 1/2 sec. 18, T. 5 N., R. 14 E., in the McFadden Peak quadrangle. The deposit is at creek level in the northwest-trending canyon of Pocket Creek and about 200 feet downstream from BM 5266. Access to the property is by about 1 mile of good graded road from the Globe-Young road.

The Grand View claims are owned by Wm. Kline and others, of Globe. In 1954 the claims were leased for a short period to Wm. Brunson, of Globe. Brunson drove a 60-foot drift, the only workings on the property, but no uranium ore was produced.

The adit is near the top of the gray facies of the upper member and about 15 feet above the Sierra Ancha diabase sheet. The barren quartzite is about 25 feet above the adit. Strata in the vicinity dip gently to the east.

Nearly all the gray unit is metamorphosed to hornfels above the diabase. At adit level the hornfels is locally cut by a network of narrow aplitic and pegmatitic dikelets less than 1 inch thick. This material most commonly is concordant, but many of the dikelets are transverse to the bedding. At adit level much of the rock is light gray, but, in the black facies above, the dominant color is medium gray to dark gray, and limonite stain is prevalent on exposed surfaces.

The underlying diabase is apparently concordant, but the contact is not well exposed in the immediate vicinity. The diabase is fairly light colored near the contact, but it is not syenitic. Very little syenitic rock is present in the area.

Rocks between the diabase and barren quartzite are cut by many closely spaced vertical fractures that trend N. 20° W. Locally these are so abundant as to suggest minor shearing.

The adit trends N. 80° E. for about 60 feet but follows no particular structure or radioactive zone. The radioactivity in the adit ranges from 0.1 to 0.15 mr per hour. Near the portal and for 100 feet upstream there are local areas in which the radioactivity ranges from 0.5 to 0.7 mr per hour. In general, these more radioactive areas are confined to a 5- to 10-foot stratigraphic interval a few feet below the barren quartzite, but they have no particular trend. Background radioactivity in the area is about 0.05 mr per hour, but in much of the rock it is as much as 0.1 mr per hour.

Great Gain

The Great Gain deposit is in the S 1/2 sec. 30, T. 7 N., R. 13 E., a little less than 1 mile northeast of Lauffer Mountain in the Roosevelt quadrangle. The deposit is exposed about 50 feet below the rim of a very irregularly shaped east-trending promontory overlooking two intersecting canyons. The property may be reached by 4-wheel-drive vehicle, north from the road that connects the Roosevelt-Payson road in Tonto Basin with the Globe-Young road north of McFadden Peak.

The five Great Gain claims were located in 1954 by Wm. Minarek. In 1955 the claims were leased to the Desert Queen Uranium Co., of Whittier, Calif. By 1957 the lessee had completed the exploration work that the owner had begun. The U.S. Atomic Energy Commission core-drilled three holes on the property to determine the extent of the mineralized rock and the geologic relations between the host rock and adjacent rocks. No ore had been produced from the property by the end of 1956.

Exploration workings on the property consist of many pits and a long bench that served also as an access road along the favorable stratigraphic interval. A 30-foot adit is the only underground working. The U.S. Atomic Energy Commission drill holes were collared on the promontory behind the outcrops of radioactive rock. All the exploratory work has been superficial.

Host rocks for the deposit are nearly flat lying strata composed of very fine grained to silty material generally occurring as thin laminae. The color of the rock on a freshly broken surface ranges from moderate pink to moderate orange pink; the light color may be due to near-surface weathering effects. Above the light-colored strata is a series of dark-gray platy and flaggy siltstones that constitute the rim of the promontory. About 20-30 feet above the host rocks are some pseudochannels that trend approximately N. 10° E. Immediately below the host rocks is a series of fine- to medium-grained, well-cemented, gray quartzite and sandstone strata that are typical of the upper part of the middle member. The host strata thus seem to directly overlie the middle member and underlie the gray facies rock. The red unit is not present in this area. These factors suggest the possibility of an erosional interval between the deposition of middle member rocks and of upper member rocks, and the possibility seems to be substantiated by conglomeratic lenses seen by R. J. Schwartz (written commun., 1957) in the drill core from just above middle member strata. Evidence of paleochannels in the Great Gain vicinity is not conclusive.

Two sets of steeply dipping fractures are particularly common in the deposit area. They strike N. 25°-30° E. and N. 50°-60° W. Neither set is more closely related to the uranium deposits than the numerous randomly oriented joints and fractures that are also present in the deposit area.

The Great Gain deposit is within half a mile of the projection of a major discordant body of diabase that is well exposed east of the May deposit, which is 1/2 mile south of the Great Gain. If the same relations hold true, the diabase once formed a sill above the Great Gain deposit and was discordant across strata at the horizon of the deposit within half a mile east of the deposit. No effects of thermal metamorphism caused by diabase intrusion, however, were noted at the Great Gain deposit.

The Great Gain deposit is a blanket-type deposit that shows little evidence of structural control. All the uranium-bearing minerals occur in or very near the first 3 feet of strata above the contact between the middle and upper member rocks. This thin stratigraphic interval is abnormally radioactive, although not uniformly so, along more than 750 feet of the outcrop around the irregularly shaped promontory; the strike length of the deposit, however, is more nearly 300 feet. At the time of our most recent examination of the deposit, exploration work was insufficient to determine the third dimension of the deposit.

After the bench, adit, and drill holes were completed, it became apparent that radioactivity dropped abruptly behind the outcrop (R. J. Schwartz, written commun., 1957). The bench along the deposit interval removed much of the more radioactive rock and left only a few spots where the radioactivity was as high as at the outcrop. Examination of the drill core also suggested that radioactivity decreased behind the outcrop, inasmuch as only very weak radioactivity was detected (R. J. Schwartz, written commun., 1957). In at least one hole, however, three thin, weakly radioactive zones were noted near the base of the upper member.

All the uranium-bearing minerals observed at the Great Gain deposit are secondary and occur principally as thin and spotty coatings on fracture and stratification planes, although some minerals are very sparsely disseminated in the host strata. Most commonly, the minerals are in the lowest foot or two of the upper member, but rarely minerals occur in fractures as much as 5 feet above the contact. Metatorbernite is the most prevalent mineral, and uraniferous hyalite is moderately abundant. An unidentified yellowish mineral, perhaps meta-autunite, also is present. Limonite occurs with or without the uranium-bearing minerals.

Radioactivity in the more radioactive parts of the deposit ranges from 0.25 mr per hour to about 1.0 mr per hour. Two U.S. Atomic Energy Commission samples from the Great Gain deposit contained 0.03 and 0.04 percent eU_3O_8; a sample of stockpiled rock contained

0.06 percent eU_3O_8.

Grindstone

The Grindstone deposit is in sec. 25, T. 6 N., R. 14 E., about 0.6 mile north of the Big Buck deposit on the west wall of Cherry Creek canyon. Exploration pits are on a small bench on the north side of the canyon of Cold Spring, which is an east-flowing tributary of Cherry Creek. Above the deposit are steep slopes and vertical cliffs of Troy Quartzite, whereas below the deposit the cliffs are composed of Dripping Spring Quartzite. The property is at an altitude of about 4,250 feet, about 1,000 feet above Cherry Creek. Access to the deposit is by more than 1 mile of road, traversable by 4-wheel-drive vehicle, from the access road in Cherry Creek canyon.

Travis Ellison and Joseph Comutt located the Grindstone claims early in 1954 and then leased the property to the Western Mining and Exploration Co., of Phoenix. In 1955 the lessee began exploration work, but by the fall of 1956 no uranium ore had been produced.

The exploration workings consist of two small pits dug in two radioactive zones that are exposed on the rim of the bench. At the time of our examination, neither pit had been cleared of blasted rock. At least one hole has been drilled, probably by wagon drill; the hole is close to the eastern pit and is nearly vertical. We do not know results of the drilling.

The host rock for the deposit is dark-gray to light, commonly pinkish gray, siltstone of the black facies of the Dripping Spring. Pyrite is abundantly disseminated in the rock. The rock appears to have been moderately recrystallized by thermal metamorphism. The strata dip gently to the northwest at the deposit but increase in dip to the east.

About 10 feet below the pits are strata of the barren quartzite which form the rim of high vertical cliffs. Just above the pits a fine- to medium-grained ledge-forming unit forms the rim of the bench. A narrow ledge commonly separates the bench from the high cliffs below.

About 10 feet stratigraphically above the pits is the poorly exposed lower contact of a sill-like body of diabase. A large, northeast-trending diabase dike that is well exposed along the road in Cold Spring canyon passes the deposit within 450 feet to the northwest. Just east of the deposit, the strata are sharply upturned on the west flank of the Cherry Creek monocline.

The uranium deposits exposed in the Grindstone pits are related to fractures that trend N. 77° W. and about N. 20° E. Because of the small amount of exploration and the broken rock in the pits, the size and shape of the deposits could not be determined accurately; they seem, however, to be veinlike and not bedded. The N. 77° W. fracture is filled with 1-1.5 inches of limonitic gouge. The northeast-trending fracture is in more weathered rock than the northwest-trending fracture.

Pyrite is the only metallic mineral identified, although a small amount of pyrrhotite may be present. No uranium-bearing minerals were identified, but a faintly fluorescent surface coating probably is uraniferous opal. The pyrite not disseminated in the host rock occurs most commonly on bedding planes, but some occurs in minute randomly oriented veinlets. Crystals are well-developed cubes and rarely octahedra, ranging in size from extremely minute to as much as 2 mm. Pulverulent and boxwork limonite are commonly associated with the pyrite, and limonite occurs as a hard or powdery coating on most of the rocks in the vicinity. The pyrite apparently is not more concentrated near the uranium deposits.

Maximum radioactivity detected in the pits was 2.0 mr per hour; background radioactivity was 0.07 mr per hour. The highest readings were from the northwest-trending fracture in the eastern pit. The western pit barely exposes the northeast-trending fracture, so the 1.0 mr per hour maximum measured radioactivity is not a reliable figure. A chip sample from the most radioactive spot in the eastern pit contained 0.26 percent eU_3O_8 (R. J. Schwartz, written commun., 1957).

Hope

The Hope deposits are in the NE 1/4 sec. 30, T. 6 N., R. 14 E., on a steep, timbered slope that forms the northeast valley wall of Workman Creek (see plate 2 in Granger and Raup, 1969). The workings are easily accessible by a short mine road that connects with the road along Workman Creek about 1.5 miles from its junction with the Globe-Young road.

The Hope deposits are on 16 claims, all of which we believe were staked by Charles Nichols, Maurice Sharp, and Carrel Wilbanks. In 1954, the property was acquired by Arizona Continental Uranium, Inc., who conducted all the exploration and development of the deposits and mined most of the ore that was produced. The company terminated mining in early 1957 and turned the property over to a contract miner by mid-1957. The ore was derived from three veins.

Approximately 6,300 tons of ore which had an average grade of 0.24 percent U_3O_8 was trucked to the uranium buying depot at Cutter prior to its closing. How disposal was made of later production by the contract miners is not known to us. Production from adit 1 prior to July 1956 was 1,380 tons with an average grade of 0.18 percent U_3O_8. Only 448 tons averaged more than 0.20 percent. Production from adit 2 prior to September 1956 was 188 tons with an average grade of 0.13 percent U_3O_8. Greatest production prior to June 1957 was from adit 3, where 4,742 tons of ore which had an average grade of 0.26 percent U_3O_8 was produced. Only 1,475 tons of this ore was below 0.2 percent.

Mine workings on the property consist of three adits from which ore was produced, 1 short adit on a nonproductive vein, a haulage adit below the level of two of the producing adits, and several prospect pits. All the adits are between 5,960 and 6,000 feet in altitude with the exception of the haulage adit, which is collared at about 5,900 feet.

Arizona Continental Uranium, Inc., is not known to have done any exploratory drilling on the property with the exception of short probe holes in the walls of the drifts and several holes of unknown length that fan out radially near the face of adit 1. Those near the face were directed like the spokes of a vertical wheel oriented normal to the trend of the adit, but they did not intersect any ore.

The U.S. Bureau of Mines collared two diamond drill holes between the portals of adits 2 and 3 under the auspices of the U.S. Atomic Energy Commission during April and May of 1956. The first of these was a vertical hole 106.5 feet deep. It intersected no ore but cut the chilled selvage of diabase at 90.8 feet. The second hole was horizontal and was directed southeastward. It intersected the vein in adit 3 at 95-96 feet, but no other ore was cut. From 331 feet to its termination at 353 feet the hole was interpreted as being in a fault zone.

The Sierra Ancha diabase sheet on the Hope claims was intruded discordantly into the gray unit of the Dripping Spring Quartzite (see fig. 3 in Granger and Raup, 1969). Near and to the south of adit 1 the intrusive horizon is just above the barren quartzite. To the north the diabase cuts discordantly down across the strata to a horizon in the gray facies. Near the face of the haulage adit a discordant diabase contact is exposed that strikes N. 35° E. and dips 37° NW. If these two exposures are on the same discordant structure, they define a discordance in the upper diabase contact that strikes about N. 40° E. and near which all the uranium deposits on the Hope property are located.

Within 350 feet southeast of adit 1, several narrow aplite dikes cut the Dripping Spring. They trend generally in a north-northeast direction but are irregular in detail. These probably connect with a 5- to 20-foot-thick aplite sill which intruded between the diabase and Dripping Spring and which extends from the discordance about 40 feet east of the portal of adit 1 to south of the area shown in figure 3 in Granger and Raup (1969).

Two sill-like syenite bodies 10 to 20 feet thick in the diabase sheet south of adit 1 were not traceable to the north. One of these is at the top of the diabase, and no chilled zone could be seen in the diabase. The other body is about 60 feet below the top of the diabase.

Black deuteric veinlets are plentiful in the diabase exposed along the bed of Workman Creek below the deposits. The diabase is too weathered and too poorly exposed to determine the abundance of deuteric veinlets nearer the deposits.

All the ore on the Hope property occurs in steeply dipping vein zones of north-northeast trend. These veins generally can not be readily defined except by detailed examination with a geiger counter or scintillation meter. In detail, the vein zones seem to be offset horizontally so that they form steps down the dip. In adit 3 these steps are so pronounced and bedding-plane fractures so common that the miners assumed that the vein was displaced by low-angle faults. Careful examination of many of these steps has shown, however, that the radioactive zone is continuous, and rolls, without disruption, across the step. At no place, apparently, are the veins actually offset by a fault.

Adit 1 was driven between August 1954 and July 1955, but most of the stoping on the ore body was done in early 1956 after the adit had lain idle for several months. The adit (pl. 3 in Granger and Raup, 1969) trends N. 26° E. for about 360 feet and follows a uranium-bearing vein for nearly its entire length. The back is stoped from 12 to 37 feet above the floor for a distance of about 137 feet in the central part of the adit, and the floor is stoped downward near the face.

Adit 1 is in medium- to light-gray hornfels and gray to red coarse-grained hornfels that directly overlies the chilled zone at the top of the diabase sheet of the Sierra Ancha. The radioactive vein follows a zone of brecciation that is filled and cemented by pale-red mobilized hornfels. The degree of metamorphism decreases upward in the stoped areas. In the tops of the stopes the host rock is largely hornfels; at adit level the vein zone contains a great deal of coarse-grained and mobilized hornfels. The chilled zone of the diabase directly below the vein is not abnormally radioactive, and no evidence can be found that the fracture or brecciation of the vein zone penetrates the diabase.

The stratigraphic position at the adit level is about 10 feet above the barren quartzite, which is cut out by diabase 300 feet northwest of the portal. Strata dip eastward as much as 5° except for local warps, probably related to brecciation, in which dips of as much as 30° occur.

For the first 170 feet in from the portal of adit 1, the radioactive vein dips vertically or eastward. From 170 to about 290 feet it dips steeply to the west. Beyond 290 feet it is curved in cross section so that it is nearly vertical at the floor of the drift but curves out of the drift in the east wall. The top of the ore plunges north at a low angle; it extends about 40 feet above the floor of the drift at 100 feet from the portal but drops below the floor of the drift about 15 feet from the face.

Uraninite II is the most abundant ore mineral. Probably most of it is disseminated in the gray hornfels wallrock and the fragments in and adjacent to the breccia zone. It is also common as visible blebs, stringers, and veinlets. The stringers consist of narrow replacement aggregates that are parallel to the stratification in hornfels. Numerous specimens were noted in which the uraninite stringer extends upward to a contact with mobilized hornfels where the stringer abruptly terminates. The stringer projects slightly into the mobilized hornfels, and claylike or chloritelike alteration minerals associated with the uraninite affect the mobilized hornfels for a few millimeters away from the uraninite. Uraninite II also occurs in short veinlets within the mobilized hornfels, but veinlets in normal hornfels are much more common. Most of the uraninite II contains minute inclusions of galena, and the veinlets are ordinarily bordered by a narrow zone that contains disseminated galena; more rarely, uraninite II occurs without associated galena.

Uraninite I is less abundant than Uraninite II, and generally occurs as disseminated inclusions in it.

Pyrrhotite is disseminated in the host rocks. Grain size is varied but is ordinarily smaller than that of the rock which contains it. It also occurs disseminated in uraninite II, locally as minute hexagons about 0.05 mm across and 0.005 mm thick. In some specimens, pyrrhotite, found as masses as much as 10 mm across, contains narrow irregular subparallel polysynthetic twin lamellae. Pyrrhotite also occurs in vugs in the mobilized hornfels.

Nearly all the molybdenite seen in Hope adit 1 occurs in vugs in mobilized hornfels as minute well-crystallized flakes and rosettes perched on silicate minerals. A little molybdenite was seen in a segmented veinlet associated with pyrite, pyrrhotite, and ilmenite(?). The paragenetic relations are not clear.

Sphalerite is rare in adit 1, but where seen it occurs as rounded blebs 0.1-0.5 mm in diameter in the wallrock at the margins of uraninite-filled veinlets. Some of the blebs are cut by minute veinlets of marcasite, but the sphalerite seems to have boundaries mutual with those of galena. The internal reflection in polished sections of fractured blebs is dark red brown, indicating a high iron content.

Chalcopyrite is sparsely disseminated in the wallrock and in uraninite II and locally replaces the margins of pyrrhotite blebs. A little chalcopyrite occurs on the surfaces of random fractures that are filled with a dark-green chloritelike mineral.

Pyrite and marcasite are abundant and occur disseminated and as veinlets which cut the host rock and the uraninite II concentrations. In general, the pyrite is more closely associated with pyrrhotite and the marcasite with galena. Both marcasite and pyrite, however, have been locally formed from the decomposition of pyrrhotite.

Some of the marcasite that borders uraninite II veinlets has a lacy appearance. It occurs in some places as a mesh of interlocking veinlets and in others as irregularly shaped blebs consisting of an intersertal mosaic of individual grains or having a flamboyant appearance. Some veinlets that contain marcasite seem to be segmented--galena alternating with marcasite. Possibly this galena is composed predominantl of common lead in contrast to the radiogenic lead in the galena closely associated with uraninite II.

Some of the fractures that cut across the ore zone near the end of adit 1 are filled with calcite and a small amount of pyrite. In places brecciated zones in the fractures are as much as 8 inches wide and are thoroughly cemented with calcite. Narrow veinlets of calcite have also been noted in polished and thin sections. These all cut and seem to be later than uraninite and most of the related sulfide minerals.

At least two types of clay or chlorite occur in association with uraninite. One variety observed is pleochroic from yellow green to dark green and the other from yellow to yellow brown. They fill narrow fractures, envelop uraninite, and extend outward from uraninite into the wallrock by forming interstitial fillings and grain-boundary replacements.

A later variety of clay, probably nontronitic, fills numerous random fractures that are later than the uraninite. It is dark green and becomes slippery when wet. The indices of refraction are all between 1.53 and 1.55. Pleochroism ranges from brownish green parallel to the flakes to greenish yellow and yellowish green perpendicular to the flakes.

At the outcrop some secondary minerals were present in the vein zone prior to mining. The most prevalent uranium mineral was β-uranophane, which was accompanied by minor amounts of metatorbernite. Abundant limonite and a little gypsum were also present on fracture and bedding-plane surfaces.

Adit 2 is in a reentrant gully about 860 feet north of the portal of adit 1. It was driven largely in the last half of 1955. Stoping below the adit level was done largely in the last half of 1956 after the workings had been idle for several months. It was driven for about 70 feet along a vein that trends N. 5° E. and is stoped to as much as 20 feet above and below the adit level (see plate 3 in Granger and Raup, 1969).

Adit 2 is in medium- to dark-gray partly recrystallized siltstone about 25 feet above the barren quartzite and 90 feet above diabase. The strata dip 2°-5° to the east. Presumably the deposit bottoms on the barren quartzite and extends at least 45 feet above it.

The vein in adit 2 is weak and obscure. It was defined, during mining, entirely by its radioactivity because it was rarely visible. Evidently it has a steep, generally eastward dip.

The shape of the ore body in adit 2 is poorly known. Possibly the top of the ore plunges northward as in the other Hope deposits, but this plunge was not proved. Adit 4 is on the line of strike and about 500 feet south of the vein at the portal of adit 2. If the vein in adit 4 is the same vein as that in adit 2 the total strike length probably exceeds 600 feet. Ore, however, is not present throughout this distance.

The mineralogy of adit 2 is similar to that in adit 3.

The portal of adit 3 is 60 feet southeast of adit 2 and 800 feet north of adit 1. It was driven and stoped both above and below adit level in the period between mid-1955 and early 1957. We did not observe the work that was performed after this date by a contract miner.

About 50 feet east of its portal, adit 3 intersects the uranium-bearing vein. From this point a drift extends along the vein about 230 feet to the north and 65 feet to the south. A considerable part of the vein is stoped to as much as 40 feet above the adit level; near the north end of the drift the vein is extensively stoped below the drift level and in sublevels which have been developed off a winze that connects with the underlying haulage adit.

The vein developed by adit 3 is about 120 feet east of adit 2 and subparallel to it. Host rocks are similar to those in adit 2. The deposit probably bottoms on the barren quartzite and extends upward for at least 85 feet. The top of the ore plunges both north and south from a high point near the middle of the mine. This suggests that the vein may have a somewhat fanlike shape in longitudinal section.

The vein in adit 3 was much richer in uranium than that in adit 2 and was much more extensively mined. The vein zone was distinguishable by eye in many places in adit 3, where it was characterized by a zone of subparallel discontinuous uraninite-filled fractures.

The vein has a steep eastward dip throughout the mine. Near the north end the vein forks upward, then separates into two en echelon segments. The upper segment fades out to the north, but the lower continues to the north.

Near the north end of adit 3, a narrow discontinuous pink aplite dike, which has a strike of N. 45° E., cuts obliquely across the uranium vein. It wedges out upward in the mine, and is neither traceable in the underlying haulage adit nor visible at the surface or in adit 2. Analyses of the aplite where it crosses the vein zone disclosed a uranium content of only 5.74 ppm, the content which is normal for aplite found elsewhere. This and the visible relations show that the dike is later than the uranium vein.

Joints in adit 3 trend primarily N. 80° W. and N. 25° E. Joints of the northeastward set locally so nearly parallel the vein zone that only detailed examination shows that they are unrelated to the trend of the vein.

The mineral assemblages of adits 2 and 3 are similar. The host rocks are only mildly metamorphosed and contain no mobilized hornfels; this lack of extensive metamorphism seems to have resulted in less varied mineralogic relations than in adit 1.

Both uraninites I and II are common in adits 2 and 3. Uraninite I is ordinarily fractured and corroded, but, where it is enclosed and protected by pyrrhotite, much of it has well-developed crystal outlines that suggest dodecahedral shape. Uraninite II seems to have been preceded by pyrrhotite, and perhaps by some of the pyrite and marcasite, although these two minerals have locally developed by decomposition of pyrrhotite. Galena, pyrrhotite, marcasite, and pyrite all form minute veinlets that cut uraninite I. Pyrrhotite is partly replaced by uraninite II and is cut by veinlets of galena. Galena also cuts uraninite II in places, but the relations among uraninite II, pyrite, and marcasite are not clear.

Pyrite associated with carbonate minerals in fractures seems to be later than much of the pyrite disseminated in the host rock. The fine-grained pyrite that adheres to fracture walls is octahedral, or a combination of octahedral and cubic. Pyrite enclosed by calcite or perched on calcite in vug fillings is ordinarily cubic in form.

A suite of thin sections, selected at intervals across the vein under adit 3, was made from the core of the horizontal diamond drill hole which was drilled under the auspices of the U.S. Atomic Energy Commission and loaned to us by R. J. Schwartz. Of particular interest is the presence in the core of purple fluorite in veinlets as much as 2 mm wide. Grain size of the fluorite ranges from about 0.005 mm to 0.09 mm. The mineral is more abundant in the wider parts of the veinlets. Where calcite is present the fluorite is most abundant near th center of the veinlet, but it also occurs as minute inclusions along zone boundaries that seem to represent growth stages in the calcite crystals. Some fluorite includes minute grains of pyrite.

Within this suite of thin sections pleochroic green and pleochric brown clays or chlorites are abundant and occur in the host rock as disseminated aggregates associated with uraninite and as veinlet fillings. Distinction in thin sections among the types and occurrences of these claylike minerals was not successful. The greenish variety, however, is at least in part later than fluorite; it partly replaces the fluorite by penetration along grain boundaries and along the veinlet walls.

Adit 4, about 400 feet north-northwest of adit 1 and 500 feet south-southwest of adit 2, is little more than a prospect pit. The vein is explored for about 7 feet underground from the north end of an 18-foot-long opencut.

Rock in adit 4 is bleached, partly recrystallized siltstone of the black facies, and is about 35 feet above the barren quartzite. The strike of the vein is on a line with the southward extension of adit 2, and probably both adits are on the same structure.

At the face of adit 4 the vein rolls sharply down toward the east just below a bedding-plane fracture. Careful tracing of the vein by its radioactivity, however, shows that the vein is continuous and that the roll occurs several inches below the fracture.

The haulage adit was driven in early 1957 to provide easier mining by making access from below to most of the ore in adits 2 and 3 and, perhaps, to test the possibility of intersecting the veins at greater depth. It is about 65 feet below adit 2 and 80 feet below adit 3. The main haulageway is approximately 460 feet long and has a 120-foot-long crosscut near the end which connects with an ore chute leading to the second sublevel of adit 3. A raise to adit 2 was not completed at the time of our mapping in May 1957.

The portal of the haulage adit is in gray facies rocks about 35 feet below the barren quartzite and 10 feet above diabase. At the face of the main haulage adit diabase is exposed in discordant contact with the Dripping Spring. No abnormal radioactivity is present in the haulage adit, even below the veins in adits 2 and 3.

Horse Shoe

The Horse Shoe deposit is in the SW cor. sec. 11, T. 6 N., R. 14 E., in the McFadden Peak quadrangle in the canyon of a tributary to Cherry Creek that is known locally as Gold Creek. The adit is on the north side of the canyon at an altitude of about 4,300 feet in a rugged topographic setting. It is accessible by about a quarter of a mile of road that extends westward from the Cherry Creek access road; this short road is traversable by 4-wheel-drive vehicle only.

The deposit is on a block of four claims located by Alfred Haught and others, of Young, in 1954. In 1956 the property was leased to the Longhorn Exploration Co., of Odessa, Tex., who drove the only workings on the property--an adit about 130 feet long that trends generally N. 5° E. (see fig. 48 in Granger and Raup, 1969).

The deposit is in nearly flat lying strata on the downthrown, west, side of the Cherry Creek monocline and is only a few hundred yards from the axis of the monocline. About 200 feet to the west the dip is about 5° W., whereas only a few hundred feet to the east it is steep.

The nearest diabase is a sheet in discordant contact with the Mescal Limestone west of the deposit. Only 1 1/2 miles to the northwest, at the Black Brush claims, this same diabase sheet intruded the gray unit of the Dripping Spring. Apparently the east margin of the diabase sheet of the Sierra Ancha is determined by a prediabase fault, downdropped on the east side, between the Black Brush and Horse Shoe deposits. As a result, the diabase intruded the Dripping Spring more or less concordantly to the west of the Horse Shoe deposit but did not intrude any part of the Apache Group exposed in the vicinity of the monocline. This north-trending prediabase fault is about 1,000-1,500 feet west of the deposit and cuts the Dripping Spring at depth.

Near the deposit the rocks are locally shattered, and low-angle west-dipping reverse faults of small displacement are common, as might be expected at this position in a monoclinal flexure. The adit is driven in the footwall of such a fault.

The stratigraphic position of the deposit is in the gray facies about 30 feet above the base of the upper member. No red unit is present in this section.

The host rock is gray siltstone, particularly dark for the gray facies. The strongest radioactivity is confined to a 1- to 2-foot-thick interval in which the rock is highly shattered. Locally this interval is broken into many small blocks, as much as a few inches on a side, by a myriad of random fractures, which have dark-green to black slickensided surfaces.

The radioactive zone follows this thin shattered unit in the footwall within 1-4 feet of a low-angle reverse fault. Drag along the fault has resulted locally in a reversal of the generally westward dip and in some places the strata are markedly contorted into small-scale flexures. The most radioactive areas are confined to the most shattered and most contorted rocks.

A stratigraphic interval from 2 to 8 feet thick is abnormally radioactive at the outcrop for more than 100 feet to the west of the fault, but this radioactivity is far less than in the adit. If this interval and the ore zone are stratigraphically identical, the fault displacement is only a few feet.

The structural resemblance between this deposit and the deposit on the Ancient claims in carbonaceous shale of the Mescal Limestone is striking.

In spite of the intense radioactivity of some specimens, no uranium minerals were recognized at the Horse Shoe deposit. Very likely uraninite is finely disseminated in the host rock but possibly much of the uranium is held by chlorite or nontronite.

Sulfide minerals are common in the deposit as disseminated grains and as fillings of the myriad hairline fractures in the ore zone. Pyrite, marcasite, chalcopyrite, sphalerite, and galena are present.

Pyrite is present in many of the fine fractures and locally forms larger masses in dilatant zones near the axis of sharply flexed strata. A polished section of one of these masses disclosed what has the appearance of a nearly homogeneous bleb of pyrite with a few grains of polysynthetically twinned marcasite near the edges. Some of these marcasite grains are completely enclosed by the pyrite. Etching of the apparently homogeneous mass with HNO_3 brought out an obvious granularity on a scale of 0.05-0.8 mm. Prolonged etching (5 minutes) brought into relief veins 0.1 to 0.2 mm wide that cut the pyrite mass. The veins are more strongly etched than the enclosing pyrite, and locally they enclose breccia fragments of less readily etched pyrite. Obviously at least two generations of iron sulfide exist; perhaps the twinned marcasite represents a third.

The thin random veinlets are commonly monomineralic and can consis exclusively of pyrite, of sphalerite, or of galena. Sphalerite veinlets are abundant in some places in the mine. Gangue minerals are sparse, but both quartz and calcite are present either together or separately in some of the veinlets. At swells in the veins two or more sulfide minerals commonly occur together. For example, in one polished section the veinlet is normally less than 1 mm wide and is filled with pyrite and quartz. Locally it swells to 3-4 mm in width and is filled with quartz, marcasite, chalcopyrite, and sphalerite. The marcasite apparently is pseudomorphous after early pyrite in the places where the other sulfide minerals are deposited. Quartz, pyrite, and marcasite are paragenetically early, and are followed by chalcopyrite, then sphalerite. No cubanite is present in the chalcopyrite, and no exsolved chalcopyrite is present in the sphalerite.

Sphalerite in these rocks is generally dark yellowish brown in contrast to the nearly black color of the sphalerite seen in the other deposits. Galena, chalcopyrite, and pyrite also occur disseminated in the host rock, but all the sphalerite seen is confined to the veinlets. Sometime after mining ceased, lacy efflorescent accumulations of goslarite formed locally on the mine walls.

Some movements may have occurred in the fractured rock after mineralization. Locally pyrite appears to be smeared. A specimen of the dark-green shiny material from a slickensided surface was found by X-ray methods to consist of antigorite, galena, and a clay.

In some veinlets antigorite(?) forms a coating on the vein walls and is earlier than quartz and other vein minerals.

Stylolites are not offset by the quartz-filled veinlets. Some veinlets, however, are cut by stylolites. Sulfide minerals are present in both veinlets and stylolites. Evidence, nevertheless, that the stylolites may have formed after quartz deposition and before sulfide mineral deposition is inconclusive.

Two shipments were made to the Cutter buying depot during the last quarter of 1956. The first of these consisted of 6.55 tons of selected ore that contained 0.17 percent U_3O_8. The second consisted of 7.34 tons of average rock taken from the drift; it contained 0.02 percent U_3O_8.

Iris

The Iris deposit is in sec. 3, T. 4 N., R. 14 E. (unsurveyed), about 1/4 mile west of Oak Creek canyon near the bottom of a rugged tributary canyon. Near the deposit, Oak Creek canyon and its tributaries incise the Dripping Spring Quartzite, but their rims are largely in the lower part of the Mescal Limestone. Relief ranges from about 400 to 1,000 feet. The deposit is accessible by about 5 miles of ungraded dirt road that branches northward from the Cherry Creek access road nearly 8 miles northeast of its junction with the Globe-Young road.

The Iris group consists of an unknown number of claims located in 1954 and owned by Globe Uranium, Inc. Exploration workings consist of several prospect pits and a short adit driven in 1955. No production has been reported, and the property was abandoned prior to mid-1956.

The Iris deposit is explored by a south-trending adit (fig. 3) about 95 feet long, and two prospect pits. One of the prospect pits is about 40 feet southeast of the portal of the adit; the other is about 200 feet northeast of the adit on the north wall of the canyon.

The deposit is in the gray facies about 40 feet below the barren quartzite. The gray facies is laminated siltstone, which is light to dark gray except near the surface and adjacent to fractures at shallow depth, where it is bleached and oxidized. The strata strike generally north-northwest and dip about 4°-5° ENE.

No diabase was seen nearby, although a sill of diabase may have intruded the overlying Mescal Limestone prior to erosion.

The deposit explored by the adit is veinlike and trends N. 8° E. At the portal the highest radioactivity occurs along a strong tension fracture which has smooth undulating walls and which dips about 80° W. near the floor at the adit and about 75° W. at the roof. The fracture surface is sparsely limonite stained. The wallrock is bleached light brown to pale reddish brown for at least 1/2 inch away from the fracture, and locally, in certain beds for 15 inches away from the fracture. Beyond this bleached limonite-stained zone the rock is the normal gray facies. Similar bleaching was not noted adjacent to subparallel nonradioactive fractures.

At about 5 feet and again at about 20 feet into the adit the fracture is en echelon to the left for about 4-6 inches (not shown on map, fig. 3). The fracture also has a tendency to be strongest near the floor of the adit and to break up against transverse fractures near the roof.

About 25 feet from the portal the adit swings to the southwest, away from the vein. Then at 45 feet it turns to the southeast, and crosses the vein at about 55 feet. At this point the strongest radioactivity is near a fracture that dips about 84° W. and contains 1/8 inch of gouge. Disseminated pyrite, largely oxidized to limonite, was noted in the workings and waste rock.

Near the portal, a few small rosettes of metatorbernite were seen on fracture surfaces. Associated locally with the metatorbernite is a yellow, acicular to powdery mineral which may be uranophane.

Radioactivity of the vein within 5 feet of the portal ranges from 1.05 to 1.35 mr per hour. From 5 to 20 feet the radioactivity immediately adjacent to the fracture is less than 0.70 mr per hour--less than that of the walls of the adit. Where the vein enters the east wall of the adit, at about 25 feet, the radioactivity ranges from 0.85 to 1.35 mr per hour. At about 55 feet, where the adit recrosses the vein, the radioactivity is 0.35-0.40 mr per hour and in local spots as much as 0.8 mr per hour, in contrast to the 0.15-0.25 mr per hour a few feet away from the vein.

In the pit 40 feet southeast of the adit portal radioactivity is about 0.1-0.2 mr per hour, except at the surface of a fracture in the southwest corner, where it is 0.4 mr per hour. The fracture strikes N. 15° E. and dips 75° W. Its extension would have been intersected by the adit had the adit been extended another 15-20 feet.

The pit on the north wall of the canyon contains only small isolated areas of slightly abnormal radioactivity. These areas are seemingly controlled by stratification.

A grab sample of selected ore from near the portal of the adit contained 0.24 percent U_3O_8 and 0.29 percent eU_3O_8.

Jim

The Jim deposit is in secs. 30 and 31, T. 5 N., R. 13 E., in First Water Canyon about 300 feet south of the Globe-Young road. First Water Canyon breaches a northeast-sloping erosional terrace cut into the lower part of the Sierra Ancha diabase sheet that in this area intruded the upper member of the Dripping Spring. To the northeast are steep rolling slopes of the Sierra Ancha. A few hundred yards to the southwest is a fault scarp marking the structural edge of Roosevelt Basin.

The deposit is on the Jim 1 claim located by Ned Saban and James M. Everett of Miami early in 1954 and leased to John Bustamonte, of Globe, later that year. Late in 1954, Bustamonte drove an adit 17 feet S. 78° E., which penetrated no ore. The property was abandoned.

The deposit is in light-gray, bleached-appearing siltstone in the lower 20 feet of the gray facies and about 50 feet above the base of the upper member. The rocks strike about N. 30° W. and dip 6°-8° eastward. Limonite stains nearly all fracture and bedding surfaces.

The contact at the base of the thick diabase sill that overlies the Red Bluff deposit is exposed near the Globe-Young road just north of the Jim deposit. The contact was no more than 50 feet above the Jim deposit prior to erosion.

First Water Canyon follows a northeast-trending fault along which displacement is less than 10 feet for most of its length south of the deposit. The fault was not observed opposite the deposit, indicating that it may die out just to the south.

About 1/3 mile southwest of the deposit, along the northeast margin of Roosevelt Basin, is a zone of northwest-trending Tertiary(?) faults.

The Jim deposit is about 1 mile northwest of the Red Bluff deposit. The fundamental differences in their geologic setting apparently are the presence of the diabase dike at Red Bluff and the abrupt change of the horizon of sill intrusion, also at Red Bluff.

The radioactive zone is apparently veinlike but is very inconstant. Abnormally radioactive zones that are present in the back and face of the drift trend generally N. 85° W. A group of narrow, nearly vertical limonite-filled joints that are approximately parallel to and within the radioactive zone have the appearance of shear rather than tension joints.

No uranium-bearing minerals were noted at the deposit. A little pyrite is present, but the abundance of limonite attests to the presence of considerable pyrite before weathering. The walls of the adit are locally coated with a white efflorescent sulfate mineral.

Radioactivity of the deposit ranges from 0.15 mr per hour at the portal of the adit to 0.7 mr per hour at the face. The radioactivity throughout the adit is very spotty and does not appear to extend more than 10 feet vertically.

A chip sample from a 1-foot-square area at the face of the adit assayed 0.045 percent eU_3O_8 (R. J. Schwartz, written commun., 1957).

Jon

The Jon deposit is in sec. 29, T. 6 N., R. 14 E., on the northeast side of the valley of Workman Creek at an altitude of about 6,000 feet. The valley walls are steep, pine-covered slopes with few outcrops below the Troy Quartzite in the vicinity of the deposit. The mine is readily accessible from the Globe-Young road by the graded road that extends up the valley. The mine is on the northeast side of this road, and the waste dump and mine buildings are on the southwest side.

The Jon group consists of several claims located early in 1954 by Larry Snow, Alice B. Moore, and others, of Globe. In August 1954 the owners bulldozed the surface rubble from an area of abnormal radioactivity in the bottom of a gully tributary to Workman Creek. This work was done preparatory to exploratory drilling and adit driving. Early in 1955 the property was leased to the Regent Mining and Development Co., which later became known as the Regent Uranium and Oil Co. By mid-1955 an opencut had been driven to the area of abnormal radioactivity which had been located, in part, by drilling. An adit was started from this point and driven north-northeastward for 180 feet (see fig. 27 in Granger and Raup, 1969). Mining continued until August 1956, when the workings were abandoned.

A few truckloads of ore were shipped from the property, but the production was meager relative to the total amount of rock removed from the workings.

In August 1956 the workings on the Jon deposit consisted of a 140-foot opencut, a 180-foot adit with about 15 feet of crosscuts, and a 10-foot stub adit. Approximately 85 feet of the adit is stoped for as much as 30 feet above the floor. Several wagon drill holes were collared at the surface prior to adit driving; one of these was intersected by the adit about 90 feet from the portal and 62 feet below the collar of the hole. We were told by the owners that this hole was in abnormally radioactive rock throughout its length.

A horizontal diamond drill hole extending 165 feet southeastward from its collar in the workings intersected no abnormal radioactivity. Core recovery was only 40 percent, but the hole was probed to 79 feet with a gamma-ray detector; results were negative. Beyond 79 feet the hole was blocked. Drilling was done by the U.S. Bureau of Mines under the auspices of the U.S. Atomic Energy Commission (R. J. Schwartz, written commun., 1957).

The Jon deposit is in hornfels derived from the gray facies. Adit level is about 65 feet below the buff unit and approximately 12 feet above the diabase of the Sierra Ancha sheet. To the east and southeast of the adit a sill-like body of pink aplite is intruded at or just above the contact between diabase and hornfels. At about the position of the adit the aplite either terminates or thins abruptly along a generally north trending line. The thinning takes place along a zone of intertonguing aplite and hornfels, and is accompanied by brecciation in the hornfels and cementation by the aplite. A nearly horizontal fault marked by 1-6 inches of gouge delineates the upper contact of the aplite with the hornfels; it continues as a bedding-plane fault into the hornfels to the west of the adit. This fault is about 2.5-3 feet above the floor of the adit at the portal and merges with the floor of the adit at about 85 feet from the portal. Movement on the fault has displaced the upper block about 6 feet to the east, as indicated by an apparent offset in the radioactive veins above and below the fault.

The ore developed by the Jon adit is in a veinlike body that strikes N. 19° E. and dips about 80° W. At the portal, two veins are exposed in the back of the adit, but these join about 8 feet into the adit. The veins are detectable only with radiation meters and do not seem to follow any particular fracture. Beyond their junction, the vein widens to include the entire width of the drift. At about 28 feet, however, the radioactivity drops off abruptly at a vertical N. 81° E. fracture. South of this point the strongest radioactivity is not associated with any particular structure, but to the north the radioactive zone generally is parallel to one or more calcite- and pyrite-filled fractures. At about 118 feet, the vein aplits once more. The west branch continues northward for about 25 feet as a vertical zone of steadily decreasing radioactivity. Beyond 25 feet, the vein loses its definition. The east branch forms a cymoid curve or chatterlike link (McKinstry, p. 314); it has a somewhat flatter westward dip for a few feet, then resumes the N. 19° E. trend and the steeper dip to the face of the adit.

The lack of continuity of radioactivity below the low-angle fault and in the aplite makes it difficult to trace the veins south of the adit portal. It seems, however, that the west branch of the vein at the portal can be detected in the east wall of the opencut about 50 feet south of the portal; the east branch of the vein is very weak or not detectable in the opencut. Strongest radioactivity on the wall of the opencut is in a zone marked by blocks of hornfels included in aplite and apparently defines the zone of abrupt thinning of the aplite. The flat fault was not traceable this far south.

A 10-foot stub drift and shallow downstope a few feet west of the portal of the adit was developed on the offset part of the vein below the low-angle fault. According to the operators, the ore body here was small but fairly rich. Inasmuch as the stope filled with water soon after mining, we could not learn why the ore cut off to the north.

The offset lower part of the east vein at the portal apparently lies in hornfels-aplite breccia in and below the "septum" between the short drift and the main adit. It was not mined, either because it was low grade or because it was not recognized by the operators.

We identified no uranium minerals at the Jon deposit. The strong radioactivity of the black brittle rock in parts of the vein zone suggests that the ore contains very finely disseminated uraninite similar to that in other deposits in the Workman Creek area.

Pyrite is the most abundant metallic mineral. It fills fractures as thin sheets and thin elliptical rosettes; it is disseminated in the wallrocks and in the gouge of the flat fault, and it occurs in pyrite-calcite veins. Much of the pyrite seems to be contemporaneous with calcite--crystals of pyrite as much as 8 mm on a side are intergrown with coarse calcite in such a manner as to suggest simultaneous emplacement. Small amounts of pyrite, as minute well-crystallized cubes and cubes modified by octahedra, are later than drusy calcite, and also coat it, in some of the open fractures. Myriad hair-thin random veinlets in much of the rock are filled almost exclusively with pyrite which partly replaces the wallrock.

Galena is common but not abundant in parts of the Jon adit. Much of it occurs in lensing parts of pyrite veinlets that are normally about 0.02 mm thick. The lenses are as much as 2.0 mm thick and 2-3 cm long. The principal lens filling is galena; the selvagelike discontinuous margins are of pyrite. Locally, although relations are not conclusive, the pyrite seems to cut the galena. Blebs of galena a few hundredths of a millimeter across also occur in the thin pyrite veinlets near the lenses. In some places small amounts of galena occur associated with calcite in vuggy parts of veins. They appear to be intergrown and of approximately contemporaneous deposition.

Sphalerite is common only as disseminated blebs less than 5 mm across in the gouge of the flat fault. Abundant fine-grained disseminated pyrite is associated with it, and some of the sphalerite blebs are cut by thin veinlets of pyrite and calcite. The sphalerite is reddish brown and is embedded in a feldspar and green clay matrix that is locally rich in calcite, particularly near abundant pyrite.

Pyrrhotite is common at the Jon deposit, but only as very fine disseminated blebs a few hundredths of a millimeter across. They are so small as to be inconspicuous and easily mistaken for pyrite in hand specimens. Much of the pyrrhotite as well as the galena and some of the pyrite is in a very fine grained, pink, biotitic lit-par-lit hornfels that may be closely related to the aplite.

No chalcopyrite was noted at the Jon deposit, although the mineralogy of this deposit so closely resembles that of others in the Workman Creek area that the presence of chalcopyrite is strongly suspected.

Calcite and a little quartz are the only gangue minerals noted. The calcite occurs in veinlets as much as 1 inch thick and is associated largely with pyrite and more rarely with minor galena. Locally, the calcite-bearing veins are brecciated, and the calcite cements rock fragments. Most of the calcite is milky white but near the surface it locally may be weakly iron stained.

The only alteration mineral noted in the veins is green nontronite. Many pyrite-filled fractures are coated with a clay that is black megascopically and is slick when wet. Microscopically, this material has a pleochroic green, flaky appearance and has indices of less than 1.60. The X-ray powder pattern matches that of nontronite. Green chlorite that is very similar in appearance to the nontronite is abundant in the gouge of the low-angle fault. It is biaxial negative, with very small optic angle and indices near 1.60, which characteristics suggest that it may be a variety of clinochlore. Associated with the chlorite is a green fibrous variety of hornblende.

Radioactivity and ore tenor are very inconsistent in the Jon adit. Near the portal the vein ranges from about 3.0 to more than 5.0 mr per hou The width of the vein, however, ranges from about a foot to the entire width of the adit. Between 50 and 140 feet from the portal of the adit the radioactivity of the vein is generally above 2 mr per hour, but in that area the vein is less than 2 feet wide. Beyond 140 feet the radioactivity is from 1.0 to 2.0 mr per hour along a very narrow vein zone.

Two samples were selected from rock typical of or better than the average of that mined in July 1956. These contained 0.11 and 0.066 percent U and 0.084 and 0.058 percent eU. These samples are out of equilibrium in the same direction as all samples we took of nearly unoxidized rock from mines in the Workman Creek area.

Little Joe

The Little Joe deposits are in sec. 19, T. 6 N., R. 14 E., on the north side of Workman Creek (see plate 1 in Granger and Raup, 1969) along southwest-facing slopes largely covered by soil and vegetation. Above the deposits the slopes steepen to cliffs in the Troy Quartzite, and below the deposits the slopes become more gentle in diabase. The deposits are all at an altitude of about 6,000 feet, nearly 600 feet above the level of Workman Creek where it is crossed by the Globe-Young road. Access to the property is by ungraded dirt roads either from the Globe-Young road a little less than 1 mile north of Workman Creek or from the road that parallels Workman Creek up the creek valley.

The Little Joe deposits are on a group of 11 claims owned by M. Sharp, C. Wilbanks, and C. Nichols, of Globe, and located by these owners in early 1954. Later the same year the claims were taken over by Thornburg interests (R. J. Schwartz, written commun., 1957). By mid-1956, the claims reverted to the original owners, whose exploration works on the claims consisted of numerous roads, benches, and prospect pits, as well as about 170 feet of underground workings divided among five adits. During the exploration operations about 300 tons of rock was stockpiled as ore, but no shipments were made. Subsequent mining operations extended the level workings to about 450 feet, and about 1,553 tons of rock was trucked to the ore buying depot at Cutter in late 1956 and to the middle of 1957. The average grade of this rock was from 0.19 to 0.20 percent U_3O_8.

The principal exploration workings on the Little Joe claims are the five adits which are here numbered 1 through 5 from south to north for convenience of description (see plate 1 in Granger and Raup, 1969). Adit 1 is near the south edge of the Little Joe group of claims and is only 105 feet N. 12° E. of Workman adit 2. Adit 1 (fig. 4) trends about N. 22° E. at the portal, but this trend changes to slightly northwest near the face. The length of the adit is about 31 feet; a 10-foot-long opencut exposes the vein south of the portal.

Adits 2 and 3 (fig. 5) are within a few feet of each other in the same zone of radioactivity. Adit 2, the lower and larger of the two, is 125 feet N. 76° W. of adit 1, and is 3 feet higher in altitude; the adit trends N. 6° E. for 34 feet and has a 15-foot opencut outside the portal. A 70-foot-long drift that develops a vein about 15 feet east of the adit is connected to the adit by two short crosscuts. Adit 3 is 22 feet N. 31° E. of adit 2, and is 21 feet higher. Its floor has been mostly removed by stopes that extend upward from the back of adit 2.

Adit 5 (fig. 4) is 170 feet N. 66° W. of adit 4, and is 15 feet higher. A 25-foot opencut leads to the portal of adit 5, and the adit itself trends N. 6° E. for 49 feet. Approximately 70 feet of lateral workings attach to the adit underground.

Several pits and benches on the property expose zones of abnormally high radioactivity; other radioactive zones have been detected at the surface but have not been explored. Other pits and benches are only location holes, holes to augment the flow of spring waters, and cuts left by bulldozers on road-building jobs. In many places soil and rubble cover are thicker than the roadcuts.

Two core holes were drilled on the Little Joe claims under the auspices of the U.S. Atomic Energy Commission and were examined by U.S. Atomic Energy Commission personnel (R. J. Schwartz, written commun., 1957). Hole 1 was collared at an altitude of 6,170 feet about 300 feet east-southeast of adit 4. The hole, which is 220 feet deep, is in siltstone and hornfels for 171 feet and in diabase beneath. Abnormally high radioactivity was encountered in the 11 feet just above the diabase, particularly in the top 2 feet. Maximum radioactivity was 0.45 mr per hour. The radioactive rocks are largely coarse-grained hornfels with abundant disseminated sulfide minerals.

Hole 2 is about 2,300 feet north-northwest of adit 5. The depth of the hole is 50.5 feet, but only the upper 20 feet are in Dripping Spring strata. The lower 30.5 feet are in diabase except for a 0.7-foot unit of coarse-grained hornfels that is about 1 foot below the Dripping Spring-diabase contact. All the Dripping Spring is metamorphosed, mostly to coarse-grained hornfels, and is abnormally radioactive. Whereas the radioactivity of the diabase in the hole was 0.2 mr per hour, the Dripping Spring is at least 6 times more radioactive and locally is as much as 12.5 times. The best sample from the core assayed 0.08 percent eU_3O_8.

The host rocks for the deposits are largely hornfels and coarse-grained hornfels locally cut by aplite dikes. As at most of the deposits on the north side of Workman Creek, the siltstones above the diabase sheet have been converted in part to hornfels. The hornfels is very dark gray and extremely fine grained where fresh and is commonly dark to light gray where exposed at the surface. Close to the contact with diabase, coarse-grained hornfels is more common than the normal hornfels. The contact between these varieties is irregular and in places is gradational. Coarse-grained hornfels rarely occurs more than 20-25 feet above the diabase contact and is most common within 10 feet of the contact. It ranges from a finely crystalline to a very coarsely crystalline light-tan rock which is very light gray where fresh. Relict stratification is commonly visible, and locally this stratification is broken, indicating minor brecciation of the rock. The breccia is cemented by mobilized hornfels(?). Inasmuch as the rock showing relict stratification has been largely converted to coarse-grained hornfels and the breccia cement has similar grain size and texture, brecciated host rocks are difficult to distinguish without close study of a cleanly broken rock surface. Because the brecciated rock contains primary uranium minerals in adit 2, however, discovery of brecciated rock may be an important factor in finding the minerals, particularly as mobilized hornfels-cemented breccia is also uraniferous in other deposits in the Workman Creek area.

In general, the host rocks are not highly oxidized, but many surfaces are coated with a thin layer of hydrous iron oxides. The coarse-grained hornfels apparently oxidizes more readily than does the normal hornfels; this oxidation is most evident in the profusely shattered rock just northwest of adits 2 and 3.

The host strata at the deposits dip gently eastward, but their dip steepens to the west toward the Sierra Ancha monocline. Most dips on the claims range from 5° to 9° eastward, but less than 300 feet west of adit 4 the dip is nearly 20° eastward.

Dikes of aplitic rock locally cut hornfels along north-northeast and west-northwest trends. Because of poor exposures and the similarity in appearance of the dike rocks and coarse-grained hornfels, more dikes than the four we noted are probably present. The most prominent aplite dike we noted is shown on plate 1 in Granger and Raup (1969). This dike trends northward for at least 350 feet through a vertical distance of more than 80 feet. At its lowest exposures, it is 2-4 feet thick and its borders are irregular. At the highest exposures it is only about 6 inches wide and looks like a narrow silicified zone in the siltstone.

Other aplite dikes noted were exposed on the bench of adit 4 and in the opencut of adit 5. The dike near adit 4 (fig. 4) trends about N. 65° W. and is vertical; apparently this dike is a local feature, inasmuch as it cannot be traced for more than a few feet. Poor exposures, however, hampered study of the dike. The dike exposed in the opencut of adit 5 (fig. 4) trends N. 73° W. and dips about 84° SW. The width of this dike varies, but averages about 18 inches. The dike abruptly terminates upward approximately 10 feet above the floor of the cut and about 20 feet above diabase. Its length could not be determined.

The fourth aplitic dike is exposed at the portal of adit 4. It trends about N. 81° W., is 1-2 inches wide, and can be traced only a few feet into the adit. Possibly the dike rock is coarse-grained mobilized hornfels rather than aplite; this dikelet is similar in many respects to dikelets, presumably of mobilized hornfels, that parallel the zone of highest radioactivity in Workman adit 1.

Fractures in the host strata are common. The two predominant sets trend N. 5°-15° E. and N. 75°-85° W. and are nearly vertical. Other fractures are randomly oriented. Many contain a limonitic gougelike filling which ranges in width from 1/16 inch to as much as 8 inches but which is most commonly from 1/4 to 3/4 inch. Mica, identified by X-ray methods as phlogopite, occurs sparsely in the N. 81° W. fracture along which adit 4 was driven.

Very low angle faults - bedding-plane faults in part - are locally present in the strata nearer the McFadden Peak monocline. We noted two such faults in adit 4; others probably exist on the property. Displacement along these faults could not be determined. In adit 4, the faults contain as much as 2 inches of gouge and breccia, and they dip a little more steeply to the east than does the stratification.

The stratigraphic positions of the deposits can only be determined in a general way, inasmuch as contacts between units of the upper member of the Dripping Spring are poorly exposed and the area has been only moderately disturbed structurally. Furthermore, the diabase intruded above the barren quartzite, which is commonly the datum most useful for determination of the stratigraphic position of an ore body. Adits 1, 2, and 3 are in a fault(?) block of black facies rocks that has apparently been displaced downward relative to the rocks east of the deposits. By extrapolation from outcrops southeast of these adits, the deposits would be below the barren quartzite. The barren quartzite, however, is not above these deposits. The required movement probably took place along a fault that is now filled by the aplite dike exposed about 80 feet east of the portal of adit 1.

By somewhat similar extrapolation, the stratigraphic positions of adits 4 and 5 were determined to be almost exactly the same. The deposits in both adits are in the black facies of the upper member appromimately 30 feet stratigraphically above the barren quartzite.

The diabase body that intruded the upper member just below the deposits is sill-like in general, but in detail the contact between diabase and Dripping Spring is locally irregular, as is apparent from the several local discordances noted in the Workman Creek area. Because of poor exposures of the contact in much of the Little Joe area and because of the complications presented by the diabase- and aplite-filled fault(?) just east of the southernmost adits, the relations between deposits and diabase can only be determined at the portals of the adits. The approximate distances to diabase from the floors of the adit portals are: adit 1, 20 feet; adit 2, 15 feet; adit 3, 36 feet; adit 4, 7 feet; and adit 5, 10 feet. Taking into account the dip of the host strata and the altitude of the diabase contact as shown on plate 1 in Granger and Raup (1969), it is apparent that the diabase did not intrude at a single horizon but rather gently crosscuts the stratification.

Adit 1 was started along the east side of a vertically tabular zone of high radioactivity and was turned to cross the zone near the face. Although the strike of the zone is not uniform, the average is about N. 13° E. The zone is traceable on the surface for about 125 feet south of the portal. The height of the zone is not accurately known but it is at least 6 feet and probably is more. The width of the minable ore in the zone is considerably less than 5 feet.

Adits 2 and 3 are on the same zone of high radioactivity. The zone is tabular and has an irregular dip, which averages about 65° E. Abnormally high radioactivity is detectable at the surface more than 50 feet above the floor of adit 2. The length of the deposit in this zone is at least 50 feet. The width of the deposit in adit 2 is less than 5 feet, and apparently narrows upward. The lowest exposure of the deposit is in adit 2, where the host rock is highly fractured coarse-grained hornfels. Adit 3, which is 21 feet higher than adit 2, is in normal hornfels. The radioactivity in adit 3 coincides with an obscure limonite-filled fracture along which the hornfels is slightly bleached. The relation between the fracture and the deposit is not well defined, however, and in adit 2 there is seemingly no fracture control. Primary uranium minerals noted in adit 2 are commonly in coarse-grained hornfels that has been obscurely brecciated and cemented by rock that may be mobilized hornfels. Possibly, therefore, the deposit is controlled in part by a brecciated zone. Because the rock types involved in the breccia are so similar in appearance, however, any tabular-shaped zone that might exist is too poorly developed or too poorly exposed to be traced. Even a slight coating of hydrous iron oxides or the presence of a few postbreccia fractures would be sufficient to mask the obscurely brecciated rock.

Radioactivity in adit 4 and on the bench south of the portal is spotty and not easily definable. A N. 81° W. fracture at the portal of the adit coincides with a zone of high radioactivity, but only for about 5 feet into the adit. Adjacent to this fracture is a narrow dikelet of aplitic rock, possibly mobilized hornfels. The dikelet also is not traceable more than a few feet into the adit. About 30 feet into the adit, which is in mildly weathered hornfels, radioactivity increases at floor level. No structural or lithologic reason for the increase was found.

Before the bench south of adit 4 was bulldozed, an aplitic dike, possibly part of the same one shown on figure 4, was noted adjacent to a radioactive fracture. The dike was 8 inches wide and the strike was about west-northwest. On one side of the dike, a parallel fracture was abnormally radioactive; the dike itself was not abnormally radioactive. The aplitic dike exposed after the bench was bulldozed is not paralleled by a radioactive fracture. A vertical fracture which trends N. 85° W. and which is about 14 feet south of this dike is radioactive, however, where exposed on the face of the bench.

Adit 5 follows a poorly defined zone of radioactivity that is presumably veinlike. The zone strikes about N. 5° E. and is not controlled by any obvious structural feature. Radioactivity tends to be slightly higher just below waist level in the adit, and at the face is even lower, which suggests a northward rake of the top of the deposit. The vein zone in the adit is crossed nearly at right angle by several other radioactive veins. The best defined of these are about 30 and 40 feet from the adit portal, respectively, and are parallel to east-trending fractures in some places. Mining along these veins disclosed another north-trending vein about 18 feet west of the adit. This vein, developed for about 45 feet, is subparallel to a group of fractures for about 20 feet, but is seemingly uncontrolled by any obvious structural feature for the northernmost 25 feet of the drift.

The host strata in adit 5 are coarse-grained and normal hornfels; coarse-grained hornfels is more common lower in the adit. The contact between the two rock types is gradational and irregular. Although the host strata in adit 5 are not highly oxidized, the rocks are coated with hydrous iron oxides, particularly on fracture surfaces. Locally these surfaces are abnormally radioactive, commonly where limonite is most abundant. Limonite-filled, near-surface fractures also are locally radioactive. Efflorescent minerals that occur locally on the oxidized surfaces do not seem to be related to the concentration of radioactive material. The local "hot" spots in the adit are probably due to concentrations of secondary uranium-bearing minerals.

Several other zones of radioactivity were detected at the surface (see pl. 1 in Granger and Raup, 1969). All these zones strike north-northeastward. One of these, which is 2,150 feet northwest of adit 5, is exposed in a small pit, but the exposure is inadequate for the determination of the characteristics of the deposit.

Uraninite is the only primary uranium mineral that has been found in the Little Joe deposits. It has been seen only in coarse-grained hornfels, where it occurs as small streaks oriented parallel to relict stratification planes and as megascopic blebs in feldspar crystals in brecciated coarse-grained hornfels that has been cemented by mobilized hornfels.

Uranophane and metatorbernite are the dominant secondary uranium minerals, but even these are sparsely present. Uranophane was identified by X-ray methods from a specimen of coarse-grained hornfels that also contained uraninite. Metatorbernite was noted in several pits, benches, and other near-surface workings on the property, but always in very small amounts.

Several other minerals were identified, mainly by X-ray methods, in specimens from the Little Joe deposits. Primary sulfide minerals are not abundant in the deposits, although pyrite is locally disseminated in the host rocks and marcasite is seen in some specimens of coarse-grained hornfels that contains uraninite and jarosite. Gypsum occurs fairly commonly as a thin coating on fracture planes in hornfels. Phlogopite occurs sparsely in a weathered, limonite-filled vein at the portal of adit 4. In adit 5, chalcanthite occurs as a pale-blue efflorescent coating on the walls, commonly with limonite and where the limonite is particularly abundant.

The tenors of the different deposits on the Little Joe property are best compared by radioactivity measurements, inasmuch as the available sample data are sparse and there have been no assays of bulk samples such as ore shipments. The deposit exposed in adits 2 and 3 and the deposit exposed in adit 5 are the most radioactive; scintillation-meter readings range from about 2.5 mr per hour to more than 5.0 mr per hour. The deposit exposed in adit 1 is less radioactive, but still the meter readings are locally more than 4.0 mr per hour and rarely less than 2.5 mr per hour in the radioactive zone. Adit 4 exposes the least radioactive deposit; meter readings are mainly less than 1.5 mr per hour--rarely more than 2.0 mr per hour--at the many local zones of abnormal radioactivity that have not been more than superficially explored on the property.

Samples from the deposits (R. J. Schwartz, written commun., 1957) range from 0.14 to 0.86 percent eU_3O_8. The average eU_3O_8 content of the samples, many of which are selected specimens, is about 0.30 percent.

Lost Dog

The Lost Dog deposits are in sec. 30, T. 6 N., R. 14 E., on the south side of Workman Creek (see plate 2 in Granger and Raup, 1969). The deposits are exposed in a shallow reentrant at the end of a northeast-trending ridge that is covered by timber and, particularly at lower elevations, by soil and rubble. Altitude of the workings ranges from about 5,900 to about 6,000 feet; the principal ore body is in the upper 25 feet of this interval. Access to the property is by ungraded dirt road from the road in the valley of Workman Creek.

The property was located by D. W. Wilbanks, H. M. Shaw, and Pat Morgan. In 1954, C. W. Via leased the property from the owners and began exploration and mining. After the lease expired, the Blue Bonnet Uranium Corp. of Houston, Tex., took over the property on lease and continued development and mining activities until April 1956. Via bulldozed a wide bench on the deposit and dug two short adits and an opencut. The Blue Bonnet Uranium Corp. drove an underground continuation of the opencut and started two additional short adits. A vertical hole and a horizontal hole were diamond drilled on the property under the auspices of the AEC. Approximately 1,400 tons of rock was mined and shipped, but only about half of this was of ore grade.

The original bench, which is about 300 feet long and 30-50 feet wide, trends north-northeast along a fairly steep west-facing slope. Bedrock is exposed along the length of the face of the bench and commonly constitutes its bottom. Two of the adits start from the bench, a third adit and a trench are near bench level but are on the south-southwest projection of the bench, and a fourth adit is below bench level on the north-northeastern projection of the bench. The fifth adit starts below bench level and penetrates beneath the southern end of the bench.

For descriptive purposes we have numbered the adits from north to south as 1 through 5 (see figs. 18 and 28 in Granger and Raup, 1969). Adit 1, which is 47 feet long and trends S. 15° W., is about 150 feet north-northeast of the bench and is at an altitude of 5,902 feet. Adit 2, which is a 56-foot crosscut that trends S. 78° E., enters the east face of the bench about 300 feet south of adit 1 and is at an altitude of

5,977 feet. From the crosscut is a drift which starts 42 feet from the portal. It extends N. 16° E. for 46 feet and S. 25° W. for 42 feet.

Adit 3 is above adit 4; they are about 200 feet south-southwest of adit 2. Adit 3 is at an altitude of 5,984 feet and trends S. 62° W. for about 12 feet where it enters a low stope that at one place is connected to the surface by a short raise. From the stope are two main drifts; one trends N. 24° E. for about 26 feet, and the other trends about S. 11° W. for about 54 feet. Two stub workings were driven for short distances from the stope and another from the southern drift. A winze in the stope connects with adit 4, about 50 feet from its portal. Adit 4, which was intended as a haulage level for adit 3, is at an altitude of 5,963 feet, trends S. 88° E., and is 64 feet long.

Adit 5 and the trench are roughly alined south-southwest of the bench. The trench starts 40 feet south of adit 3 and trends S. 13° W. for 93 feet. It is rarely more than 6 feet deep and is 4-8 feet wide. About 30 feet beyond the south end of the trench and at an altitude of 5,990 feet is the start of the opencut at the portal of adit 5. The opencut trends S. 13° W. for 62 feet and then goes underground for an additional 55 feet. The adit trends S. 20° W., or slightly more to the west than does the opencut. The adit has been stoped both above and below and a little on the west side. For the length of the adit the back has been stoped to a height of 20 feet above sill level. The underhand stope, which starts in the opencut and goes into the adit for less than 40 feet, is only about 5 feet deep. At the south end of the adit a small opening connects with workings on the Lucky Stop property.

Two diamond-drill holes on the property were cored by the U.S. Bureau of Mines under auspices of the AEC. Hole 1 (see fig. 18 in Granger and Raup, 1969) was collared 45 feet S. 40° W. of the portal of adit 3. It was directed N. 70° W. at -83° and was drilled to 115 feet, intersecting diabase at 96 feet. Radioactivity is erratic but abnormally high for the first 30 feet, below which it does not exceed 0.10 mr per hour; maximum radioactivity of 3.0 mr per hour was found at 18 feet. The barren quartzite was probably penetrated within 5-10 feet of the collar, which would have indicated that abnormally high radioactivity is present in the underlying gray sandstone or gray facies.

Hole 2 is collared in the wall of the bench a few feet east of hole 1. It was driven horizontally at approximately S. 65° E. for 390 feet and is entirely in silty and very fine grained strata. Abnormally high radioactivity was detected only near the collar (0.8 mr per hour) and at 49-51 feet (1.5 mr per hour). The latter radioactive zone corresponds with the vein explored by adit 2.

The host rocks for the deposit are dark-gray siltstone strata of the upper member of the Dripping Spring Quartzite, which dip gently east-southeast. For the most part the host strata are oxidized and bleached. Relatively unoxidized siltstone from the claims contains fine disseminated grains of pyrite and sparse chalcopyrite. A speciman of the relatively unoxidized rock was dissolved in hydrofluoric acid, and an insoluble residue was identified by X-ray methods as graphite. Metamorphism of the rock has not formed hornfels but has caused partial recrystallization. Numerous fractures cut the host strata, the strongest set of which strikes about N. 20° E. and a subordinate set north-northwest.

Just underlying the deposit is a unit composed largely of very fine- to fine-grained sandstone and quartzite topped by a 1-foot-thick bed largely composed of fine- to medium-grained quartzite. The top quartzite which locally contains white plates of altered mudstone is the barren quartzite and thus the overlying host strata are black-facies rocks.

The structural setting of the deposit and its relation to diabase are obscured by the abundant soil, rubble, and vegetation cover, particularly below the deposit level. A diabase sheet underlies the deposit area, but the nature of the upper contact of the diabase is not well known. The nearest exposure of the contact is about 600 feet north-northwest of the deposit at an altitude of 5,888 feet. The vertical diamond-drill hole, however, intersected diabase beneath the deposit at an altitude of about 5,889 feet, which indicates a slight discordance inasmuch as the rocks dip 3°-5° SSE. Further evidence that the sill is locally discordant can be seen on the geologic map of the Workman Creek area (see pl. 2 in Granger and Raup, 1969).

The Lost Dog deposit is in general about 600 feet long in a N. 18° E. direction, but in detail it consists of four known north-northeast-trending zones of radioactivity that are subparallel and locally intersecting, probably en echelon in part. They are (1) a zone which is traceable in the drift of adit 2, and which has an irregular trend apparently unrelated to visible fractures. This zone was intersected by the horizontal diamond-drill hole but it was not noted elsewhere on the claims; (2) a zone which is exposed in adit 3. Although a shear fracture is nearly coincident with it, the slight divergence suggests that the shear fracture postdates the mineralization; (3) in the southern part of the workings in adit 3, a zone which seems to trend nearly parallel to the other zone of adit 3 and is possibly connected as shown on figure 28 in Granger and Raup (1969). The eastern of these two zones in adit 3 is not traceable elsewhere in the deposit but it is possible that the western zone continues southward and intersects the fourth zone between the trench and the opencut; (4) the fourth and principal zone of radioactivity, which is exposed in the trench, in the opencut, and in adit 5. Ore production has come largely from this zone. Two areas of concentrations of secondary minerals were detected during benching and we suggest that these areas represent the northward extensions of zones (2) and (4).

Inasmuch as the deposit has been oxidized and secondary uranium minerals are abundant, the sites of original uranium deposition are obscured by local concentrations of secondary minerals on randomly oriented fracture and stratification surfaces. The persistent zones of radioactivity described, however, may represent sites of original deposition. In general the zones seem to predate the fractures and seem to have irregular trends suggesting a relation to tension fractures. The principal zone where exposed in the opencut and adit 5, however, is largely on the footwall of a conspicuous fracture which strikes about N. 17° E. and dips 82° W and which is filled with as much as 1 foot of gouge.

The size and shape of the ore body exposed in adit 5 are fairly well known. For the most part the ore zone is 4-6 feet wide with assay walls, but in some beds ore-grade rock may be as much as 10 feet wide.

The height of the ore body may have been reduced by near-surface oxidation but the deposit is at least 20 feet high. The barren quartzite limits the downward extension of the radioactive zone, and ore-grade rock is not consistently present in the first 5 feet above the quartzite. The total length of the ore body in its original state cannot be determined, because the northward projection of the ore body has been eroded and oxidized. The southward limit, however, is sharp; the ore body abruptly drops in grade and size to almost nil barely 30 feet beyond the end of adit 5.

Metatorbernite, which is abundant, and uraniferous hyalite are the only uranium-bearing minerals that were identified. The metatorbernite coats fractures and bedding planes and locally impregnates some thin strata. Limonite, gypsum, and a small amount of malachite are associated with the ore minerals.

Pyrite occurs sparsely as a thin coating on fracture surfaces but is fairly common disseminated in the less oxidized host rock. A little chalcopyrite occurs disseminated in the host rock. Extremely sparse galena was noted only in adit 1, where it was disseminated locally in very fine grained quartzite.

Lucky Boy

The Lucky Boy deposit is in secs. 31 and 32, T. 2 S., R. 15 E., among a series of sharply dissected cuestas on the southern slope of the Mescal Mountains. Vegetation is largely grass and low-growing desert plants except in the draws, where mesquite and other woody plants are plentiful. Access to the deposit is by a short mine road that trends west from the Pioneer Stage Station road about 1/2 mile south of the old stage station.

The deposit is on a group of 50 claims that were staked in 1953(?) by G. A. Stacey and others of Clifton, Ariz. The property was drilled in 1953 and 1954 under a lease agreement with the Phelps-Dodge Corp. Under a subsequent lease by Tulsa Minerals Corp. the deposit was more extensively drilled and mined from early 1956 to mid-1957.

During the period from March 1956 to June 1957 about 2,430 tons of rock was shipped that contained from 0.1 to 0.2 percent U_3O_8. Average grade of these shipments was 0.18 percent U_3O_8.

The main workings (see fig. 38 in Granger and Raup, 1969) on the Lucky Boy claims consist of a 200-foot adit that connects to a 65-foot incline from which about 130 feet of levels and stopes have been developed. There are also about 130 feet of workings on the adit level surrounding the top of the incline.

Updip from the main workings along the shear zone that influenced mineralization is an adit about 60 feet long. Near the end of the adit is a northward-inclined upstope about 20 feet long.

Farther updip at the outcrop of the shear zone is an opencut about 30 feet long and 10 feet wide. Forty feet northwest of this opencut is another shallow opencut which is also on the same structure along the east wall of a gully. In addition there are several other shallow opencuts and prospect pits on the claims but these are not on the structur that defines the radioactive zone.

The claims have been extensively drilled near the deposit (fig. 6 of this report and fig. 23 in Granger and Raup, 1969). Phelps-Dodge Corp. originally drilled 13 shallow wagon-drill holes and 3 deeper diamond-drill holes. All the wagon-drill holes were less than 25 feet deep, and were collared along the outcrop of the radioactive structure.

The first diamond-drill hole (DDH 1 on fig. 23 in Granger and Raup, 1969) is a vertical hole collared on a ridge to the west of the radioactiv outcrops (E. E. Maillott, Phelps-Dodge Corp., written commun., January 195 The hole was drilled through 145 feet of Dripping Spring siltstone, and then through diabase to a total depth of 521 feet. The second diamond-drill hole (DDH 2, exact location not known) was collared at or near DDH 1. From the first 105 feet to the bottom, the hole penetrated diabase except for an interval of Dripping Spring from 121 to 138 feet. Diamond-drill hole 3 was collared vertically about 1,000 feet southwest of DDH 1. It penetrated Mescal Limestone from the surface to 178 feet where it entered the Dripping Spring. At 293 feet it penetrated diabase which it cut to the bottom at 771 feet.

Late in 1956 or early in 1957, Tulsa Minerals Corp. drilled an unknown number of wagon-drill holes on the Lucky Boy claims. At least

60 were drilled on or near the ore body. These holes succeeded in outlining the general area of the ore body and led to the subsequent mining.

The host rock for the Lucky Boy deposit is siltstone of the black facies and lies about 40-45 feet above the barren quartzite. At the surface the rocks are bleached and somewhat iron stained. In the main workings they are much darker but still lighter colored than much of the black facies elsewhere--within a mile or so both east and west of the deposit the facies is dark gray.

The uranium deposit is about 170 feet stratigraphically below the Mescal Limestone. The contact of the Mescal and Dripping Spring is disconformable and may have several tens of feet of stratigraphic relief near the deposit.

Rocks in the immediate vicinity of the deposit are tilted into a cuesta in which the strata strike generally N. 50° W. and dip 25° SW. Fractures are abundant and trend in several directions, but the dominant ones trend northeastward and dip steeply to the northwest.

Diabase intruded the Dripping Spring discordantly below the deposit, but this discordance is probably a local irregularity in a generally concordant sill. By projection from the surface and the intercepts of DDH 1 and 2 we estimate that the diabase is 70 feet vertically below the outcrop of the deposit shown in the cross section on figure 23 in Granger and Raup (1969) and is about 400 feet downdip. In the lowest part of the workings, therefore, distance vertically downward to diabase would probably be 20-25 feet, or distance along the stratification another 100 feet.

There are no other known uranium deposits in the nearby area although at least one abnormally radioactive outcrop is along Pioneer Wash about 1/2 mile southeast of the Lucky Boy deposit.

The ore body is controlled primarily by a bedding-plane shear zone (fig. 6). The shear is characterized by broken rock and a stratigraphic interval of from a few inches to several feet in which the rock is altered and spotted. The spots are a few millimeters in diameter and contain minerals not determined during this study although phlogopite probably is one of them. At outcrop, the spots are generally altered in large part to limonite, and the shear zone is hardened and slightly more resistant to erosion than are the adjoining rocks.

Near the bottom of the workings the shear zone contains a dark core as much as 8 inches thick that is composed of micaceous and radioactive minerals in a highly altered, somewhat friable matrix. The micaceous minerals have refractive indices from 1.58 to 1.60; they are biaxial (-) and have a very small 2V, near or less than 5°. X-ray diffractometer patterns of the micaceous minerals indicate that a mica, probably phlogopite, and a chlorite are present. Perhaps the aggregate contains phlogopite partly altered to delessite. The uranium mineral was not identified but is probably finely divided uraninite.

Ore also extends upward from the shear zone on and near curved fractures. These fractures strike about N. 30° W. and are steeply dipping except where they merge with the shear zone. They appear to form the hanging wall for the stoped area in the Lucky Boy mine.

The ore body appears to be generally elongate in a northeastward direction between N. 20° E. and N. 35° E. Its total length is at least 250 feet and its width about 70 feet; much of the rock in this area, however, would be below ore grade.

The primary control of ore was probably the intersection of the shear zone and some more nearly vertical structure which trends northeastward but which is now obscure. The alteration accompanying the ore is of a mafic type similar to that in the uranium deposits of the Sierra Ancha, and not siliceous as in most base-metal ore deposits in southern Gila County. The close association of the ore with a discordant diabase contact also suggests a similarity to the Sierra Ancha deposits.

The mineralogy and paragenetic relations in the Lucky Boy deposit have not been studied in any detail. In the primary parts of the deposit, pyrite and, tentatively, pyrrhotite have been identified megascopically; and the presence of chalcopyrite is suspected because of the high copper content (more than 1.0 percent in the mica-chlorite-rich shear). If uraninite is the primary uranium mineral, it is disseminated in the alteration minerals and host rock; no uraninite was seen in fractures or as masses in the ore.

Near the surface on fracture surfaces and bedding planes the deposit contains the secondary uranium minerals metatorbernite and bassetite, which were identified by X-ray powder pattern. Also present are minor amounts of fluorescent opal and a yellow uranium mineral tentatively identified as uranophane.

Associated with the secondary uranium minerals are various amounts of limonite (goethite), jarosite, and gypsum. All of these were identified visually with the exception of goethite, which was identified by X-ray powder pattern.

Near the surface in parts of the bulldozed areas north of adits 1, 2, and 3, abundant metatorbernite and small amounts of β-uranophane, as well as limonite and sparse barite (G. Weathers, written commun., 1956), are present. These secondary minerals generally occur to depths of only a few feet as coatings on bedding planes and narrow random joints; on stronger joints they extend to greater depth.

Lucky Stop

The Lucky Stop deposits are in the N 1/2 sec. 30, T. 6 N., R. 14 E., on pine-wooded, steep to gentle slopes along the southwest side of Workman Creek valley. Access to the property is by a steep unimproved mine road that connects with the Workman Creek road about 1 1/4 miles from the Globe-Young road (see pl. 2 in Granger and Raup, 1969).

The deposits are on a group of 17 claims owned by the Lucky Stop Mining Co. These claims were staked in 1954 by J. O. Brunson and others, Payson, Ariz., during the period in which the AEC was making airborne radiometric surveys of the Dripping Spring outcrops. Brunson (oral commun., 1954) staked the Lucky Stop claims after observing the Commission plane making repeated passes over the Workman Creek area.

Shipments were made from this property from mid-1955 to June 1957. No production after this date is known to us, nor is the breakdown of output from individual workings.

Total shipment from the property was 2,383 tons that contained from 0.15 to 0.20 percent U_3O_8, or an average of 0.16 percent. The best ore, 95 tons containing 0.22 percent U_3O_8, was recovered from an underhand stope in adit 1 during the second quarter of 1957.

Workings on the claims consist of five adits, several claim location pits, at least five opencuts on radioactive veins, and a large benched and bulldozed area. Adit 1 (see figs. 18 and 20 in Granger and Raup, 1969) trends S. 12° W. for about 80 feet on one vein zone. Adit 2 is about 155 feet long and develops two en echelon veins that also trend approximately S. 12° W. The vein exposed at the portal is developed for about 100 feet at which point it fades out. The second vein is developed for about 60 feet. Adit 3 trends S. 12° W. for 60 feet but does not seem to follow any continuous zone of radioactivity. No ore was produced from this adit. Adit 4 is about 230 feet long but follows a continuous vein only in its last 120 feet. Adit 5 is about 650 feet long with an additional 185 feet of lateral workings that develop en echelon and parallel veins all of which trend about S. 17° W.

Two core holes were drilled on the Lucky Stop claims by the U.S. Bureau of Mines to obtain geologic information for the U.S. AEC. Diamond drill hole 1 was collared in the vein zone near the portal of adit 1 and drilled vertically. A lithologic log prepared by R. J. Schwartz (written commun., 1957) indicates that the hole is in the gray unit to a depth of from 80 to 93 feet; is in the red unit to 95 feet; and is in chilled diabase to hole depth of 106 feet. Radioactivity abruptly decreases at about 5 feet, the depth of the top of the barren quartzite.

Diamond-drill hole 2 was collared southeast of adits 1, 2, and 3 and directed horizontally for 295 feet. Five radioactive zones were encountered, the most radioactive at 276 to 278 feet. At 282 feet drilling entered a fault zone which was not completely penetrated at 295 feet, the bottom of the hole.

The Lucky Stop deposits are in the lower 20 feet of the black facies and are generally richest just above the barren quartzite. The strata dip 1°-5° eastward in the immediate vicinity of the deposits but steepen markedly to the southwest along the flank of the Sierra Ancha monocline. About 2,000 feet southwest of the deposits, eastward dips of as much as 20° have been noted.

Although all the host rocks show some evidence of minor recrystallization, hornfels was seen only in adits 1 and 2. In parts of adit 1, metamorphic effects are strongest near the floor; these areas are also the areas of best ore. In adit 2 metamorphism is strongest near the cymoid link between the en echelon veins and decreases gradually to a point about 55 feet from the portal; certain strata are more strongly affected than others.

Some of the samples from adit 1 show evidence of strong soda-metasomatism in which large ragged albite porphyroblasts have developed in and replaced the normal potassic hornfels.

All the adits are within 10-15 feet above the barren quartzite, and most of the prospect pits have a similar stratigraphic position. Because dip is fairly uniform eastward, adits 4 and 5 should be several tens of feet lower than adits 1, 2, and 3. As the prospect pits near DDH 2 are at the same stratigraphic position as adits 1 and 2, a structural break is indicated in the valley between DDH 2 and adit 4. No evidence of any significant fault, however, was observed at the surface during field mapping. The fault zone exposed at the face of adit 4 may be related to the offset. If the offset is caused by faults it may have preceded diabase intrusion, as there is no evidence of a break in the upper contact of the diabase sheet. The diabase contact on the adjacent Lost Dog claims, however, is largely covered, and there is a possibility that a postdiabase fault may be present and may trend southward up the valley.

Diabase intruded the Dripping Spring about 95 feet below adit 1 (DDH 1, Lucky Stop property) and about 96 feet below adit 5 (DDH 1 on the Lost Dog property). It seems, therefore, that if no prediabase faults are present the upper contact of the Sierra Ancha diabase sheet is approximately concordant and cuts the red unit of the Dripping Spring under most of the area of the Lucky Stop deposits.

To the east and southwest of the deposits, the diabase is involved in the flexure of the Sierra Ancha monocline and, although the steepest dips recorded on the stratification are about 20°, the diabase is locally discordant along contacts that dip much more steeply.

The upper contact of the diabase to the north and east of the deposits is marked at the outcrop by a layer of syenite. To the west and southwest of the deposits there is little or no syenite at the upper contact nor at the top of the diabase cut by DDH 1.

Joints near the deposits are predominantly of two sets, one that trends N. 70°-80° W. and the other that trends N. 15°-45° E.

The veins developed in adit 5 are part of an interconnected network that extends onto the Lost Dog property (see fig. 18 in Granger and Raup, 1969). One of the veins, in fact, crosses the property line and has been mined on both properties. These deposits seem to have almost the same spatial relation to the Sierra Ancha monocline as do the Workman and Little Joe deposits on the north side of Workman Creek. The degree of metamorphism, as evidenced by the abundance of hornfels, however, is much less on the Lucky Stop property.

All the deposits on the Lucky Stop claims are similar. All are veins and apparently terminate downward on the barren quartzite. They seem, in part, to be interconnected and form branching, en echelon, and cymoid relations. The ones that are en echelon in plan may branch vertically, as does the vein in adit 2; this type of branching is also present elsewhere, as in the Hope 3 and Jon adits.

The veins are vertical to steeply dipping. Abnormal radioactivity in any of the veins is probably traceable throughout a vertical distance of no more than 40 feet above the barren quartzite. The vertical extent of the veins in adits 1 and 2 seems to be no more than 20 feet and in adits 4 and 5, 30 feet or less in most places. The horizontal extent of the veins and vein zones is much greater than the vertical. The vein in adit 1 is traceable underground and on the surface north of the portal for at least 120 feet. The vein system in adit 2 is traceable for at least 180 feet. In adit 4 the main vein is traceable for only about 110 feet, but it may persist on the southwest side of a fault that was encountered at the face of the adit. In adit 5 the vein that extends onto the Lost Dog claims is probably traceable for at least 600 feet and has been exposed by mining and exploration for much of this distance. Other veins in adit 5 are generally not individually traceable for more than 180 feet but are en echelon or branching so that the total vein zone, including that part on the Lost Dog claims, is traceable for about 1,200 feet.

The ore minerals are not obvious in any of the veins. With the exception of a few narrow stringers and blebs and one small vug, all the ore minerals studied occur as disseminated replacements of the wallrock. In adits 1 and 2 uraninite, identified by X-ray powder pattern, occurs accompanied by pyrite and galena; it is probably present in the other veins also. The first massive vein uraninite found in the district was given to us by J. O. Brunson in October 1954, and was identified by X-ray powder method. At about the same time, other specimens of uraninite were found in the Workman adit 1 by geologists of Arizona Continental Uranium Inc.

A vug in coarse-grained hornfels from adit 2 contains pyrrhotite, chalcopyrite, sphalerite, marcasite, sphene, diopside, albite, and calcite. Euhedral sphene is partly to completely enclosed by pyrrhotite, albite, sphalerite and by aggregates of diopside. The diopside is enclosed, in part, by albite, but although the albite is restricted to the margins of the vug, the sphene and diopside are scattered throughout. Pyrrhotite encloses albite. Some of the pyrrhotite is euhedral and the interstices are filled with sphalerite; some of the pyrrhotite is decomposed to marcasite. The sphalerite is nearly black and, along with pyrrhotite, is cut by chalcopyrite veinlets.

A green chlorite(?) is associated with the ore minerals in all the specimens studied.

No polished sections were made of the ore but we assume that the paragenetic sequence generally corresponds to that of the minerals of the vug filling and is similar to the paragenetic relations found at other deposits.

Major Hoople

The Major Hoople deposit is in sec. 6, T. 7 N., R. 14 E., about 1 mile west of the confluence of Cherry Creek and China Spring Creek (fig. 1). Exploration work has been done on the steep slopes of a tributary of China Spring Creek. Access to the property is by a little more than 2 miles of steep road from the access road in Cherry Creek canyon.

Homer Haught and others from Young located the 10 Major Hoople claims early in 1955 and then leased the property to Frank Mathews. The lessee built the access road, benched several areas of anomalously high radioactivity, and drove a short adit before withdrawing from the property in the summer of 1956. Further exploration was contemplated on other parts of the claims according to R. J. Schwartz (written commun., 1957), but by the end of 1956, no uranium ore had been produced from any of the claims.

Principal exploration workings are three benches or pits and an adit. Small concentrations of radioactive rock are exposed at three localities. The general aspects of these localities are quite different even though they are adjacent.

Nearly flat-lying strata of the upper member of the Dripping Spring constitute most of the bedrock in the deposit area. Major faults, however, have displaced rocks of the Apache Group within half a mile north and west of the property; and a discordant body of diabase is reported by R. J. Schwartz (written commun., 1957) to have intruded upper member strata farther up the canyon to the east. No diabase is exposed in the immediate vicinity of the deposits and the host rocks show no evidence of thermal metamorphism.

The character of some of the basal strata of the upper member in the area is somewhat unusual and is suggestive of some of the channel-fill strata noted elsewhere in Gila County. In general, rocks of the red unit are underlain by pock-marked feldspathic quartzite typical of the middle member; but locally the red rocks either are not recognizable or are absent, and gray flaggy strata constitute the basal part of the upper member. Whereas one pit, about 12 feet above the pock-marked quartzite, is just above red rocks, the adit appears to be stratigraphically lower and is in gray siltstone strata. Evidence of disconformity at the base of the gray siltstones, if present, is obscured because of inadequate outcrops.

Of the three pits, one apparently is at the base of the gray facies whereas the other two are in the black facies. The pit in the gray facies is shallow and exposes principally weathered siltstones that are gray to light gray. Locally on the dump are pieces of black siltstone, which suggests that the rock was not uniformly bleached. The host strata are very irregularly laminated and pseudochannels are abundant. The trends of the pseudochannels range from north to north-northeast and average approximately N. 13° E. Immediately below the pit are pale- to dark-red, flaggy to blocky, more regularly laminated siltstones that contain abundant hematite and limonite.

No uranium minerals were noted in the pit at the lower stratigraphic level and the radioactivity did not seem to be controlled by bedding planes or fractures. Pyrite was sparsely disseminated in the unbleached specimens of siltstone. The black siltstone on the dump also was the most radioactive but the radioactivity was low. Maximum radioactivity detected on the dump was 0.4 mr per hour; average in the pit was less than 0.2 mr per hour. Background radioactivity was 0.04 mr per hour.

The pits or benches in the black facies are a little more than 1/8 mile north and across the canyon from the lower pit. These pits, which are near the bottom of southeast-facing, partly overhanging cliffs, are within a few feet of one another in a sheltered area that contains ruins of Indian dwellings. The cliffs are composed of partly bleached black facies rock, but the barren quartzite is hidden beneath slope rubble. Judging by the height of the cliffs and the most common thickness of the black facies, the pits are within 10-20 feet above the barren quartzite. This relation is further suggested by the lenses of fine-grained sandstone and quartzite that occur abundantly at the base of the black facies.

The greatest concentrations of radioactivity are from nearly vertical shear fractures that trend N. 69°-76° W. Although no primary uranium minerals were observed, metatorbernite liberally coats fractures and bedding planes. Gypsum locally coats fracture surfaces and a white efflorescent sulfate(?) mineral has formed on the more recently broken surfaces. Maximum radioactivity detected was 1.65 mr per hour.

A calcite-filled fracture is exposed in the upper of the two benches in the black facies, but no relation seems to exist between the calcite and the uranium. The fracture strikes N. 47° W. and dips approximately 75° NE. The width of the calcite filling is irregular; it is as much as 4 inches wide locally but most commonly is from 1 1/2 to 2 inches wide. Apparently the fracture was filled with calcite and then was reopened and filled again at least once, and probably several times. Most likely formation of the calcite postdates the uranium mineralization; the calcite was probably deposited from ground water that had become lime rich from percolating through the overlying Mescal Limestone.

The adit is in the bottom of the canyon upstream from the pits. It trends S. 51° E. for 28 feet in thinly laminated but blocky to flaggy gray to dark-gray siltstone. The laminae are less irregular than is typical of the gray unit and no pseudochannels were noted. Some of the rock in the adit has a distinct reddish hue but the color is not as dark or pervasive as that of the red strata below the lower pit. Above the adit the strata are more typical of the gray facies of the gray unit.

No uranium minerals were seen in the adit or on the dump. Pyrite is very sparsely disseminated in some of the darker gray host rocks.

A fracture exposed in the roof of the adit is not abnormally radioactive but one series of laminae is very locally more radioactive than the surrounding rocks. Maximum radioactivity in the drift is 0.34 mr per hour but readings most commonly range from 0.2 to 0.3 mr per hour.

About 4 1/2 feet to the right of the portal is a small "hot spot" that seems to be localized on and just above a bedding plane. The host rock is mostly fine grained rather than silty as elsewhere. Below the bedding plane, box-work limonite suggests the former presence of a cubic mineral, probably pyrite. Although no uranium minerals were observed in the "hot spot," radioactivity was as high as 1.5 mr per hour.

May

The May deposit is in the NW 1/4 sec. 31, T. 7 N., R. 13 E. about 1/2 mile northeast of the top of Lauffer Mountain in the Roosevelt quadrangle (fig. 1). The deposit is on the moderately sloping northeast flank of Lauffer Mountain. Outcrops are largely in the bed of dry streams and in ledges; slope wash, soil, and vegetation cover much of the bedrock. Access to the property is by steep, unimproved road north from the road that connects the Roosevelt-Payson road in Tonto Basin with the Globe-Young road north of McFadden Peak.

C. B. Cox and others located and own the May claims, Nos. 1, 3, and 4. The owners also did the surface exploration work which includes two small prospect pits, only one of which contains visible uranium bearing minerals. The barren pit is about 600 feet westward from and about 125 feet stratigraphically above the lower pit. A hole, diamond-drilled by the AEC is near the barren pit.

The host rocks for the May deposit, which is exposed in the lower pit, are metamorphosed strata of the red unit in which much of the moderate pink color remains. Recrystallization of the unit has obscured all but the most prominent stratification planes and has changed the grain size of the rock. Inasmuch as the effects of metamorphism are different in different strata as well as laterally in the same strata, the grain size of the host rock ranges from silty or microcrystalline (hornfels) to medium grained and, rarely, coarsely crystalline. Very thin and discontinuous lenses of fine- to medium-grained sandstone and quartzite are fairly common. The rock is locally "spotted" and cavities several millimeters across along stratification planes are the sites of particularly coarsely crystalline minerals developed during metamorphism. These minerals are dark-green to black fibrous and prismatic hornblende, potassium feldspar, well-terminated prisms of quartz, and a clear micaceous mineral, possibly phlogopite. In addition, there are several green claylike or chloritelike minerals that were not identified.

Below the deposit are rocks similar to those in the upper part of the middle member, and above it are metamorphosed gray facies rocks.

The strata of the middle member are fine- to medium-grained predominantly light gray quartzite. The rocks of the gray facies are in part recrystallized and are cut by irregularly shaped dikelike bodies. The dikelike bodies are narrow, short, and lenticular but trend approximately N. 60° E. They could be solution channels guided by joints, along which the gray facies rocks are especially recrystallized, or they could be dikes of aplitic material. The texture of the dikelike rock is very similar to that of many of the aplite dikes that intruded the Dripping Spring elsewhere. The rock is primarily potassium feldspar and quartz with locally large amounts of a yellow to brown pleochroic micaceous mineral, possibly biotite. Clear sphene(?) is sparse.

The stratigraphic position of the deposit is approximately 1 foot from the bottom of the red unit and thus 1 foot above the contact between middle and upper member rocks.

Less than 100 feet east of the deposit is the contact between the Dripping Spring Quartzite and a discordant body of diabase. The contact, which trends approximately north and dips about 50° E, apparently reflects an old fault along which the diabase abruptly changed the horizon of intrusion; to the east of the structure diabase intruded the middle member of the Dripping Spring and to the west of the structure the diabase intruded the Mescal Limestone. The structure noted at the May deposit is the same one that we believe passes closely to the east of the Cataract, Great Gain, Blevins Canyon, and Fairview deposits, all of which are within 4 1/2 miles of one another in the Roosevelt quadrangle.

The deposit exposed in the lower pit on the May claims is small and spotty. A 1-foot stratigraphic interval is locally radioactive; secondary uranium-bearing minerals are present as thin and discontinuous coatings on randomly oriented fracture planes and locally on bedding planes.

The minerals present at the deposit include uraniferous hyalite and sparse metatorbernite. Pyrite is sparsely disseminated in the host strata as it is elsewhere in the section, but is seemingly more abundant in the very small lenses of medium-grained sandstone and quartzite. Limonite is abundant as a surface coating.

Maximum radioactivity detected at the deposit with a scintillation meter was 0.7 mr per hour; background radioactivity was 0.03 mr per hour. A sample selected by AEC personnel from a narrow stratigraphic interval contained 0.08 percent eU_3O_8.

Navajo

The Navajo deposit is in the N 1/2 sec. 27, T. 7 N., R. 14 E., about 1/2 mile north of the confluence of Cherry Creek and China Spring Creek (fig. 1). It is a few tens of feet above the level of Cherry Creek and is at the base of steep, west-facing cliffs that form the lower east wall of Cherry Creek canyon. Access to the property is by rough road from the Cherry Creek access road.

Alfred Haught and others of Young located the property and then leased it to W. T. Graham of Payson. Graham's exploration of the deposit consisted of digging a short adit from which no ore had been produced through 1956.

The host rock is predominantly siltstone and claystone in thin to very thin laminae; strata of very fine- to fine-grained sandstone are present in lesser amounts. Where relatively fresh, the rock is dark gray, but where leached, as it is for the most part, its dominant color is very pale reddish tan. The strata are nearly flat-lying. In the vicinity of the deposit bodies of diabase intruded the host rock discordantly, possibly as dikes in faults, although no evidence was found of thermal metamorphism.

The deposit is in the black facies, approximately 55-60 feet below the top of the unit. The barren quartzite was not noted at the deposit because it is below the level of alluvial fill on the canyon floor. Lenses of fine-grained sandstone are sparse at the adit and in the few feet of exposures below the adit level, which suggests that the deposit is more than 15 feet above the barren quartzite.

The adit is 30 feet long and trends S. 48° E. Radioactivity in the adit is above background, but no particular fracture or stratum is exceptionally radioactive. At the portal, however, a tension(?) fracture that trends N. 13° E. is significantly more radioactive than the surrounding rock. The fracture is thoroughly leached for the most part so that the original position of uranium in the fracture cannot be determined. In any event, the presently existing deposit is small and probably is vein type and almost completely leached.

Metatorbernite, the only uranium mineral noted, is sparse. Limonite is abundant and gypsum, which occurs as a flaky coating, is common. Voids, most commonly oriented parallel to the stratification, contain pulverulent and box-work limonite, suggestive of the former presence of pyrite. White efflorescent minerals coat recently broken surfaces.

Radioactivity in the adit ranges from 0.2 to 0.4 mr per hour, whereas background radioactivity is about 0.06 mr per hour. On local surfaces at the portal it is as much as 0.9 mr per hour, but the highest readings were from the fracture at the portal where the maximum radioactivity detected is 1.2 mr per hour.

North Star

The North Star deposit is in the NW 1/4 sec. 6, T. 7 N., R. 12 E., in the headwaters of Gun Creek about 5 miles northwest of Copper Mountain in the Roosevelt quadrangle (fig. 1). The deposit is at the bottom of a shallow valley, which has moderately sloping walls. Rubble, soil, and vegetation obscure much of the rock in the area except locally in the stream valley and in ledges. Access to the property is by road, traversable only by 4-wheel-drive vehicle, either from Tonto Basin or from the Globe-Young road.

North Star claim 6, which includes the deposit, is owned by H. Stockman and others. C. S. Keating leased the property and explored the deposit by means of an adit that trends S. 22° W. for about 40 feet. Three holes were diamond-drilled in the Gun Creek headwaters under the auspices of the AEC. The hole closest to the deposit is about 600 feet away and none intersects abnormally radioactive rocks (R. J. Schwartz, written commun., 1957). No uranium ore has been produced from the deposit.

Host rocks for the deposit are principally platy to flaggy siltstone strata that dip very gently northeastward. The rock at the surface is very light gray to buff and appears bleached; within 4-5 feet below the surface it is predominantly light gray. Hematite and limonite stain fracture and stratification planes.

Pseudochannels and fractures are abundant in the host rocks. The pseudochannels trend generally northward from N. 10° W. to N. 15° E. At the adit the dominant trend is about N. 10° W. The fractures have random orientation except for two main sets, the stronger of which strikes N. 60°-70° W., and the other about N. 15° E.

The deposit apparently is in the gray facies of the upper member, because the barren quartzite is 55 feet above the deposit and abundant pseudochannels are at the adit level. The base of the upper member is not exposed in the vicinity of the deposit. About 20 feet above the deposit, but not well exposed, is a ledge forming group of sandstone strata that may be a part of the gray sandstone.

Diabase is present in the headwaters of Gun Creek but not in the vicinity of the North Star deposit. A diabase sill noted near the deposit would have been about 100 feet above it prior to erosion. Also, a poorly exposed northeast-trending diabase dike that intruded a fault has been noted near the drill site, 600 feet north-northeast of the deposit. R. J. Schwartz (written commun., 1957) reported that the sulfide mineral content of the drill core seems to be directly related to the nearness to the dike.

The North Star deposit consists of secondary minerals related to a dominant north-northeast-trending fracture. Uranium minerals are not uniformly distributed in the deposit but are commonly found in random fractures that cross the main fracture. The size and shape of the deposit was not determined because of inadequate exposure and because of the effects of weathering. Apparently some of the strata in the adit were more favorable for the deposition of secondary uranium minerals inasmuch as the radioactivity in the adit is different at different stratigraphic levels. The greatest concentration of minerals is at the portal of the adit where, on the west wall nearly at floor level, minerals are visible on fracture surfaces.

Metatorbernite is the dominant uranium mineral, but saléeite is also present and is apparently associated with minor bassetite in a mixed crystal relation. The saléeite and bassetite were identified by X-ray methods. Pyrite and gypsum occur sparsely in random fractures. Limonite, however, is common.

Radioactivity at the deposit is fairly low and irregular. Maximum radioactivity was detected at the portal where readings as high as 2.0 mr per hour were obtained from the lower part of the west wall. In the adit readings taken in the first 20 feet of the east wall averaged about 1.0 mr per hour near the floor; readings along the west wall averaged about 0.5 mr per hour. Other pits in the area have readings of less than 0.3 mr per hour and local spots in the creek bottom had readings of about 0.2 mr per hour. These local "hot spots" were detected throughout a 15-foot stratigraphic interval.

Peacock

The Peacock deposit is 15,600 feet N. 56 1/2° W. from U.S. Highway 60 bridge across the Salt River and is 1,700 feet south of the Salt River (fig. 1). The sparse exploration workings are about 400 feet above river level on the steep south wall of the Salt River canyon. Above the deposit the canyon wall rises for nearly 2,000 feet as cliffs, steep slopes, and ledges composed of pre-Devonian sedimentary rocks and diabase. Access to the property is by rough road north from the road that connects the Regal asbestos mine and Highway 60 in the Blue House Mountain quadrangle.

C. T. Davis and others located and own the Peacock claims Nos. 1-10. On claim No. 8 the owners did exploration work that consists of two small opencuts about 30 feet apart on the east side of a steep reentrant in the south wall of the main canyon. Through 1956 no uranium ore had been produced from the deposit.

The host rock for the deposit is thinly laminated siltstone that contains many small lenses of fine- to coarse-grained sandstone and quartzite. Locally some pyrite is present, but the rocks are so badly oxidized and leached that most of the iron-bearing primary minerals have been altered to limonite which abundantly coats fracture and stratification planes. One or two pink seams about half an inch thick and parallel to the stratification appear to be hornfels.

The deposit is in the black facies of the upper member of the Dripping Spring. About 15-20 feet below the pits is the barren quartzite but the lenses of quartzite in the host rocks indicate that the top of the barren quartzite is somewhat gradational in the vicinity of the deposit.

A diabase sill(?) intruded the Dripping Spring below the deposit level, probably at or near the contact between the middle and upper members. Although exposures are poor because of abundant talus cover, sparse outcrops of diabase in the headwall of the reentrant suggest that a diabase dike may trend north-northeast down the valley less than 500 feet west of the deposit.

The Peacock deposit is so little explored and so badly oxidized that accurate determinations of its size and shape are not feasible. Maximum radioactivity is concentrated near the exposed face of a N. 18° E. fracture in the southern of the two pits. High radioactivity can be detected for about 12 feet along this fracture, but any anomalous radioactivity beyond 12 feet is masked by talus cover. A projection of the radioactive fracture toward the northern pit indicates that the fracture must pass to the west of the pit. In the pit radioactivity is not particularly high.

Uraniferous opal is the only uranium-bearing mineral that was noted at the deposit. The opal occurs as a colorless to milky white, botryoidal coating on stratification planes.

Maximum radioactivity detected at the deposit was 0.5 mr per hour; background radioactivity was about 0.04 mr per hour. Most readings from the N. 18° E. fracture were less than 0.25 mr per hour. Samples from the deposit, as reported by the AEC, (R. J. Schwartz, written commun., 1957) contained from 0.042 percent eU_3O_8 to 0.082 percent eU_3O_8, except for a specimen of selected rock that contained 0.237 percent eU_3O_8.

Quartzite

The Quartzite deposit is in the NW 1/4 sec. 12, T. 5 N., R. 14 E., high on the east wall of Cherry Creek canyon about 1 mile north of the confluence of Horse Camp Creek and Cherry Creek (fig. 1). The workings are at an altitude of about 4,600 feet in a reentrant in the steep canyon wall. Access to the deposit is by very steep road which joins the access road in Cherry Creek canyon and crosses Cherry Creek just north of Horse Camp Creek.

The Quartzite claims were located by W. Hunsaker and leased in 1955 to the Jontex Corp. of Reno, Nev. The lessee built an access road to the claims and benched the area that was most radioactive. Exploration work was scant and no ore was produced.

The most radioactive area of the bench is more than 150 feet long but most of the exposed rock is not abnormally radioactive. A small opencut was dug to further explore the only radioactive rock exposed in the bench; and another small pit was dug on radioactive material about 15 feet beyond the end of the bench.

The host rock is mainly bleached strata composed of fine-grained to clay-sized detritus typical of the lower part of the black facies. Some relatively unbleached rock is still present and is very dark gray to nearly black. There is no evidence of recrystallization of the host rock. About 2-3 feet below the workings is a group of strata that resembles the barren quartzite, but apparently the unit is not well developed in this area. The grain size of the quartzite is relatively smaller--fine to medium--and the unit is thinner and more lenticular than it is elsewhere.

No diabase was noted in the vicinity although there are several faults in the area which may have predated the intrusion of diabase. The most prominent of the faults is exposed to the northwest of the workings and trends northwestward, thus it should cross the steep slope below the deposit. R. J. Schwartz (oral commun.) was unable to trace the fault on the slope because of talus cover. Displacement on this fault is about 200-250 feet with the west block downdropped.

Another fault, which trends north-northeast, is less than 500 feet southeast of the deposit.

The uranium deposit explored on the Quartzite claims has been extensively weathered where exposed so that control of the primary ore minerals is obscured. At both pits the highest radioactivity is from iron-stained bedding planes and joints that have no visible coating of uranium minerals. In the opencut on the bench, malachite has stained the rock locally and an irregularly shaped fracture contains kaolinite and an unidentified soft black mineral having a metallic luster. The shiny black mineral, which is nonradioactive, occurs as an onionskin-like coating on a less shiny black material; both contain iron and to a lesser extent copper. Abnormally high radioactivity is not associated with either the copper stain or the black mineral.

R. J. Schwartz (written commun., 1957) reports metatorbernite and an unidentified yellow uranium mineral. Pyrite is sparingly smeared on some fracture surfaces. Pulverulent and box-work limonite on some bedding planes suggest the former presence of a cubic mineral, probably pyrite. A white efflorescent mineral, probably a sulfate, has developed on recently exposed surfaces.

Radioactivity at the deposit is not very high. At the opencut on the bench, the highest reading obtainable with a scintillation meter was less than 0.5 mr per hour, and the maximum reading from the pit beyond the bench was 0.75 mr per hour. Two chip samples, taken by R. J. Schwartz, contained 0.06 and 0.11 percent eU_3O_8 (written commun., 1957).

Rainbow

The Rainbow deposit is in the SE 1/4 sec. 32, T. 5 N., R. 14 E., nearly 1 mile east of the Red Bluff mine in the Rockinstraw Mountain quadrangle (fig. 1). Steep cliffs and barren slopes rise abruptly above the deposit to the west. The area is typified by rugged topography with local relief of about 600-800 feet within 1/2 mile of the deposit. A dirt ranch road that joins the Globe-Young road on the Red Bluff claims passes along the rim of the cliffs above the deposit about 2 miles from the Red Bluff deposit.

Rainbow claims 1 and 2 were located by Mrs. Ethel S. Larsen of Globe. The location pit on claim No. 1 is about 100 feet northeast of the portal of the adit. The location pit on claim No. 2 is 1,700 feet to the southeast of the portal. In early 1954, the Rainbow and Red Bluff claims were purchased by the Sierra Ancha Mining Co. under a deferred payment contract. Late in 1954 and early 1955, the deposit on claim No. 1 was explored by a bench about 45 feet long and 10 feet wide and by a 70-foot adit. No ore was shipped or stockpiled, largely because the workings were poorly accessible. The property was returned to the original owner in early 1955 prior to completion of the purchasin contract.

In the spring of 1955, the Uranium Corp. of America acquired the property on an option and exploration agreement but dropped the option in late 1955 after drilling one diamond drill hole on the claims. Since that time the property has been idle.

The Rainbow adit is in the black facies of the Dripping Spring abou 5 feet above the barren quartzite. The host rock consists of dark-gray siltstone with lighter gray interlaminae, crumpled mud cracks, and numerous stylolites--typical of the black facies. A few thin beds of medium-grained quartzite are in the lower part of the adit and bench. Near the surface much of the rock is strongly limonite stained, and locally bleached. The siltstone is partly recrystallized but does not form hornfels. In the vicinity of the deposit the strata strike north-northwest and dip 3°-5° to the east-northeast.

A discordant contact between diabase and the Dripping Spring, about 400 feet southwest of the adit, marks the eastern boundary of the large, sill-like diabase body that intruded the Dripping Spring at Workman Creel and the Red Bluff deposit. The contact trends about N. 20° W. and dips steeply to the east. It probably cut across the entire Dripping Spring section prior to erosion.

The northwest-trending Tertiary(?) fault zone that forms the fault scarp called "Red Bluff" is about 4,000 feet to the southwest.

Fractures in the area are largely of the N. 70° W. set and are commonly filled with as much as half an inch of limonite near the surface. Fractures of N. 20° E. trend are less common and much narrower.

The radioactive vein (see fig. 29 in Granger and Raup, 1969) trends about N. 15° E. and is nearly vertical. The total length of the vein has not been determined but it has been explored for about 80 feet (60 feet in the adit and 20 feet on the bench). It ranges in width from about 1 foot to more than 3 feet in favorable strata. The strongest radioactivity in the vein zone is at about waist height at the portal and plunges slightly to about knee height where the vein passes out of the adit near the face. At the portal the abnormal radioactivity is at least 6 feet high. No stoping was done in the adit even though the back and floor are locally radioactive.

At the portal a strong limonite-filled fracture marks the center of the vein. This fracture is so tight and indistinct, however, as to be unmappable beyond about 30 feet from the portal. The radioactive vein continues at least 30 feet beyond the mappable limit of the fracture and passes into the east wall of the adit about 8 feet from the face.

Primary uranium in the deposit is associated with carbon and clays. Efforts to separate any discrete uranium mineral were unsuccessful.

A fine-grained black material that gave a weak X-ray powder pattern for graphite was separated from strongly radioactive rock from the adit. Radioactivity measurements and qualitative fluorescent flux tests for uranium indicated a high uranium content for the graphite.

Another fine-grained black separate, obtained from similar rock by use of a superpanner and heavy liquids, gave an X-ray pattern for pyrite only. Semiquantitative measurements of alpha radioactivity on small quantities of the material showed that it contained several percent uranium. The total amount of this material separated was too small to permit further work, but the black material may be a polymerized hydrocarbon.

A small fragment of strongly radioactive rock from the adit was ground and the fragments were dispersed on a gelatin-coated glass slide. The slide was then covered with stripping film. After a 4-week exposure the film was developed and examined for alpha tracks. Several black opaque grains were noted that had emitted alpha particles but fully as many alpha tracks were derived from green clay or chlorite aggregates. Apparently much of the uranium in the deposit is adsorbed by the green clay or chlorite.

Pyrite is common in the host rock. Much of it occurs very finely disseminated in the siltstone. Pyrite, or limonite pseudomorphous after pyrite, occurs in most fractures. Many of the fractures probably also contained calcite before weathering; calcite was noted in a west-northwest-trending fracture near the face of the adit.

Metatorbernite is the only secondary uranium mineral identified. It sparsely coats a few fracture surfaces in the near-surface rock.

Some strata near the portal of the adit are cut by myriad random interconnected hairline fractures, possibly a result, in part, of blasting. At the surface these fractures are defined by lines of a white efflorescent sulfate mineral.

Gypsum is sparsely present, associated with limonite and metatorbernite, as a fracture and bedding-plane coating.

Radioactivity of the vein zone where it crosses the favorable strata ranges from about 2 to 7 mr per hour, as measured with a β-γ meter. Throughout most of the adit the radioactive vein zone is traceable by its abnormal radioactivity in the back. However, from 45 to 55 feet the vein zone in the back is no more radioactive than are the walls, which are less than 1.0 mr per hour.

Samples taken by personnel of the U.S. Atomic Energy Commission from the vein zone (R. J. Schwartz, written commun., 1957) range from 0.11 to 0.50 percent U_3O_8. The higher values are from samples taken in the richest part of the vein, the lowest is a grab sample of rock representing the full width of the adit.

A series of samples taken at known distances from the central fracture in the vein at the portal indicate that the uranium content drops abruptly in the first foot away from the center of the vein to a value below the limits of detection (0.05 percent U) by semiquantitative spectrographic analysis.

Red Bluff

The Red Bluff deposits are in the SE 1/4 sec. 31, T. 5 N., R. 14 E., about 750 feet E. of the Globe-Young road in the Rockinstraw Mountain quadrangle (fig. 1). The deposits are exposed on the steep walls of Warm Creek Canyon, which has been incised into Dripping Spring rocks near the cliffs that mark the southwest edge of the Sierra Ancha. South of the cliffs, which are less than 1/4 mile south-southwest of the deposits, is the broad, gravel-filled basin that contains Theodore Roosevelt Lake. All the Red Bluff mine workings are at altitudes between 3,580 and 3,780 feet. Access to the property is by a short dirt road from the Globe-Young road.

The first discovery of uranium in the Dripping Spring Quartzite was made by Carl Larsen on the Red Bluff claims in February 1950. The original property was expanded and now comprises 15 claims owned by Carl and Ethel Larsen. In early 1954 the claims were leased to the Sierra Ancha Mining Co. which held the lease until early 1955. A short exploration agreement was made with the Uranium Corp. of America in the middle of 1956, but the corporation's option was not exercised.

Larsen's early work on the property consisted of the excavation of several pits and two narrow opencuts high on the west side of Warm Creek Canyon. From these workings he mined and shipped several hundred tons of ore to the buying depot at Bluewater, N. Mex. The Sierra Ancha Uranium Co. explored the deposits by means of many feet of underground workings, both high on the west side of Warm Creek Canyon and at creek level on the east side of the canyon. From these workings more than 2,000 tons of ore was shipped and more rock of lower grade was stockpiled. Part of the stockpiled rock was later shipped as ore by the Uranium Corp. of America but the principal work done by that company was exploration drilling. In June 1956, a hole was diamond drilled under the auspices of the U.S. Atomic Energy Commission.

There are about 1,400 feet of mine workings on the claims (see fig. 17 in Granger and Raup, 1969) which are divided among five adits, a narrow opencut, and several prospect pits on the west side of Warm Creek Canyon and two adits on the east side of the canyon. Drill holes on the property (see pl. 4 in Granger and Raup, 1969) comprise 11 wagon-drill holes and 37 diamond-drill holes totaling more than 4,000 feet.

Mine workings on the west side of Warm Creek Canyon are in a 25-foot stratigraphic interval about 200 feet above the bottom of the canyon. The principal workings, from north to south, are (1) an opencut that trends N. 70° W. for 90 feet, (2) an opencut and adit that trends N. 66° W. for 90 feet and is closely paralleled by a 30-foot stub drift, (3) an opencut and adit that trends about N. 79° W. for 150 feet and from which raises lead to a subparalled 80-foot upper level drift and stope and surface pits and from which a 180-foot crosscut trends about S. 30° W., (4) an adit that trends N. 77° W. for 68 feet, (5) an opencut and adit that trends N. 72° W. for 43 feet and from which a 10-foot crosscut trends southward, and (6) an adit that trends N. 78° W. for 107 feet and from the end of which a raise extends to the surface.

The two adits on the east side of the canyon are in nearly the same stratigraphic position close to the bottom of the canyon. Adit 7 trends S. 74° E. for 200 feet. About 100 feet from the portal a crosscut extends 70 feet N. 18° E. and 70 feet S. 18° W. from the adit. Since we mapped the adit, several short raises have been driven from both the drift and the crosscuts. Adit 8, which is 155 feet S. 15° W. of adit 7 trends S. 76° E. for 111 feet. About 100 feet from the portal a crosscut trends 16 feet N. 15° E. and 26 feet S. 5 1/2° E.

Most of the drilling was done on the east side of the canyon. All but one of the 11 wagon-drill holes are on the east side of Warm Creek at creek level. They are at approximately 30-foot intervals upstream or north of adit 7. We do not know the position of the eleventh wagon-drill hole. At least 26 of the 37 diamond-drill holes are also in or near the deposit on the east side of the canyon. Five holes were drilled from the canyon bottom including the hole drilled under the auspices of the U.S. Atomic Energy Commission, and 21 were drilled from adit 7 and crosscuts. The other 11 diamond-drill holes were collared at several locations on the Red Bluff and Rainbow claims.

The general geologic setting of the Red Bluff deposits is shown on figures 16 and 17 in Granger and Raup (1969). The deposits are on opposite sides of a large diabase dike that occupies a steeply dipping reverse fault; the east side of the northeast-trending fault is down-dropped about 250 feet in relation to the west side. Warm Creek Canyon has formed by erosion of the dike. The main mass of diabase in the area, however, is the Sierra Ancha diabase sheet that intrudes the upper member of the Dripping Spring Quartzite northwest of the deposits and intrudes the Mescal Limestone east and northeast of the deposits. The bottom of the diabase sheet is discordant to the northeast and terminates to the east against east-dipping, diabase-filled faults.

The syenite facies of the diabase forms a layer (not mapped) several feet thick within the diabase sill on the east side of Warm Creek Canyon. This layer is resistant to weathering and forms the rim of part of the east wall of the canyon. It may be a little less sodic than most of the other syenitic rocks, inasmuch as the dominant feldspar is oligoclase in some of the specimens studied.

An albite aplite dike (not mapped) cuts the diabase sheet several tens of feet west of the diabase dike in Warm Creek. These dikes are roughly parallel. The albite aplite dike is traceable northward for several hundred feet from its southernmost outcrop about 1,000 feet north-northeast of the mine workings. This is a coarse-textured rock and in hand specimen looks much like the syenite facies. The allotriomorphic granular texture and high albite content recognizable in thin section, however, establish it as aplite. A few narrow aplite dikes are also present in the diabase dike in Warm Creek Canyon.

Black deuteric veinlets are abundant in the diabase dike along Warm Creek Canyon. Near the mine workings most of these veinlets trend parallel to the walls of the diabase dike and have very short horizontal continuity, commonly less than 2 feet. Farther north there appear to be two preferred orientations plus many random veinlets; these are N. 40°-80° W. and N. 20°-40° E., and generally are accompanied by steep dips. These veinlets are more continuous here and can commonly be traced for up to a maximum of about 40 feet.

South of the deposits a high-angle N. 56°-59° W., postdiabase fault separates the Precambrian rocks from Gila-like conglomerate. This fault and others of similar trend that form the southwest border of the Sierra Ancha tilted the older rocks toward the northeast. Movement on the faults continued after deposition of the conglomerate. Sparse galena has been found in the fault zone south of the deposits but this lead mineralization probably took place in Tertiary time (Granger and Raup, 1969) and thus much later than the proposed age of the uranium in the deposits.

The deposit on the west side of the canyon extends about 35 feet below the barren quartzite in gray facies rocks. The exposed part of the deposit on the east side of the canyon is in the black facies a few feet above the barren quartzite. Thus the eastern deposit, although about 200 feet lower in altitude than the western, is several feet higher stratigraphically. Data from the drill holes on the east side of the canyon suggest that the deposits may also extend below the barren quartzite into the stratigraphic interval in which the deposits occur on the west side of the canyon.

The host rocks on the west side of the canyon are bleached and iron-stained laminae of siltstone and, less commonly, very fine grained quartzite. Bedding planes, joints, and a network of fine fractures are filled with thin stringers of pyrite. Near the surface the pyrite is largely oxidized. Ripple marks and pseudochannels are locally present in these rocks which dip approximately 4°-9° southeast near the fault and the diabase dike.

The host rocks for the deposit on the east side of the canyon are dark-gray laminated siltstone and very fine grained quartzite strata. The rocks are only weakly bleached because they are protected from weathering near the canyon floor. Pyrite is also present in these rocks but occurs most commonly as fine grains disseminated in the rocks rather than as fracture fillings. The rock is partly recrystallized and locally seems to be hornfels adjacent to the dike.

Adjacent to the diabase dike the strata abruptly change dip. The host strata east of the dike dip gently northeastward to within a few feet of the dike, where they reverse dip to as much as 15° to the west. Locally, at the contact, there is a sharp warping so that beds adjacent to the contact are tilted abruptly upward to a vertical or overturned position. At one such place the strata are overturned and dip 85° W. adjacent to the diabase, are right side up but dip westward for 2-6 feet from the diabase, and thence dip gently northeastward at greater distances east of the diabase. A possible explanation is that the strata were originally warped downward on the footwall of a normal prediabase fault only to be sharply dragged by a later reversal of movement, probably also before or during deposition of the diabase.

Fractures of the N. 20° E.-N. 70° W. set are prevalent in the area and are commonly limonite filled near the surface. Locally on the west side of the canyon a little vein quartz occurs in the larger fractures. Where the strata dip about 6° to the northeast near the deposits, fractures of the N. 70° W. set dip steeply southwest. Where the strata are nearly horizontal, however, the fractures are nearly vertical. This suggests that the fractures were formed prior to local tilting of the rocks by post-Gila faults.

Inasmuch as the explored deposits on the two sides of the dike occur in slightly different stratigraphic intervals and are in rocks that have been affected quite differently by erosion, the deposits are described separately.

The deposits on the west side consist principally of veinlike ore bodies that trend about N. 70° W. in the lower of the two main favorable stratigraphic intervals. The upper interval on the west side of the canyon has been largely removed by erosion so that no ore-grade rock is left. Most of the ore mined from the west-northwest-trending ore bodies is adjacent to strong, limonite-filled fractures that are nearly vertical and, very locally, contain as much as 3/4 inch of vein quartz.

Ore-grade rock borders several fractures of the N. 20° E. set in a few places and relatively large ore bodies have been mined from the intersection of N. 70° W. and N. 20° E. fractures.

The widths of the ore bodies range from a few inches to several feet in more favorable strata. The longest ore body is less than 150 feet. Because of the irregular effects of leaching and weathering which have emphasized the spotty occurrence of ore along the fractures, the vertical extent of individual ore bodies is difficult to determine. Maximum height is about 30 feet but most of the ore bodies mined were considerably less than that. Several of the stopes indicate that some of the ore bodies in favorable strata were wider than they were high.

Adjacent to the N. 70° W. fractures and in abnormally radioactive strata, a distinctive light-red alteration is commonly associated with high radioactivity. The altered zone is rarely more than 1 foot wide on either side of a fracture and beyond the altered zone the rock is less radioactive and considerably more bleached. The red-gray strata are locally radioactive and seem most commonly to be 2- to 12-inch blocky, very fine grained quartzite strata rather than flaggy siltstone strata. The most radioactive rock from the western deposit is characteristically nearly black with a faint reddish tinge that becomes more conspicuous away from the "hottest" spots.

The adits on the east side of the dike were started at abnormally radioactive localities on the outcrop; secondary uranium minerals were found at the portal of adit 7. Each of the adits was driven east-southeastward parallel to the trends of the ore bodies on the west side of the diabase dike. It was found, however, that the radioactivity at the surface was not due to the outcrop of a primary vein but rather was due to a near-surface concentration of secondary minerals that were no doubt transported to this position by ground waters percolating along west-northwest-trending joints. No ore body was intersected by adit 8 but two ore bodies were intersected by adit 7, one at 60-70 feet from the portal and the other at about 100-110 feet from the portal (fig. 7). The crosscut 100 feet from the portal diverged to the east of the ore body on the north side of the adit and to the west of the ore body on the south side of the adit.

These ore bodies plus another probable concealed ore body were further delineated by the drill programs conducted in part by the Uranium Corp. of America and in part by the U.S. Atomic Energy Commission. Drill data are shown on plate 4 in Granger and Raup (1969). As the drill holes were probed by several different operators who used a variety of instruments it was not possible to get a reliable calibration correlation among the various data. We therefore assumed that the lowest radioactivity recorded in each hole was background radioactivity for the gray unit and this represented approximately 0.007 percent equivalent uranium. Probe data were then converted to this common denominator with the results shown on the figure. According to our interpretation of these results there are three veinlike north-northeast-trending ore bodies in and beneath adit 7. These bodies cut through the barren quartzite which generally shows up as a zone of lower radioactivity in the drill holes. Certain strata are mineralized between the veins and probe data show these to be apparently anomalous radioactive zones in some places.

The radioactive zones below the barren quartzite are at about the same stratigraphic position as the ore bodies on the west side of the diabase dike, but they apparently do not have the same trend. Perhaps further exploration would disclose that ore bodies both of the west-northwest and of the north-northeast trend are present below the adit level.

Others who have also studied these drill data (R. J. Schwartz, oral commun., 1956) tend to believe that the ore below the barren quartzite on the east side of the dike occurs as a discontinuous blanket deposit. This idea, however, does not seem to be in keeping with either the findings of the drill data or the mode of occurrence of uranium ores elsewhere in the Dripping Spring.

Primary metallic minerals in the Red Bluff deposits are uraninite, pyrite, chalcopyrite, and galena. The uraninite is disseminated in the host rock for the most part although some was tentatively identified along stratification planes; no uraninite was noted in fractures. Pyrite is prevalent in fine fractures on the west side of the canyon and is disseminated throughout the host rock and occupies fractures on the east side of the canyon. Chalcopyrite is not abundant but is locally associated with pyrite, particularly in the vein zones on the west side of the diabase dike. Galena is sparse and generally is finely disseminated along fracture and stratification planes.

Uranium in weathered parts of the deposits occurs in the secondary minerals metatorbernite, bassetite, meta-autunite, beta-uranophane, saleeite, kasolite, and uraniferous opal. All the uranium-bearing minerals have been identified by X-ray methods. Bassetite was orginally identified by Howard Evans of the U.S. Geological Survey (Gordon Gastil, written commun., 1954), kasolite was identified by Muriel Mathez of the U.S. Atomic Energy Commission (R. J. Schwartz, written commun., 1954), and the others were identified by us. The secondary uranium-bearing minerals are associated with gypsum, limonite, and minor amounts of malachite. A pleochroic green chlorite is common particularly in the deposits on the west side of the dike and locally is closely associated with the strongest radioactivity. The dark color of small, highly radioactive parts of the deposit is largely due to the abundance of this chlorite. Kaolinite and illite have also been identified by X-ray methods from rocks from the deposits. A white to pale-yellowish-white efflorescent coating that commonly occurs on the walls of the mine workings in pyritiferous parts of the deposits was identified by X-ray methods as a magnesium-rich mineral of the melanterite group.

Some assay data from samples taken in the mine workings on the west side of the canyon are reported by R. J. Schwartz (written commun., 1957). The U_3O_8 content of these samples ranges from 0.04 percent to 0.70 percent; the average content is a little less than 0.25 percent. Radioactivity in the mine working ranges from about 0.2 mr per hour to more than 5.0 mr per hour as measured with a portable scintillation meter. Background radioactivity is about 0.05 mr per hour, and the radioactivity of ore-grade rock is generally more than 3.0 mr per hour.

Rock Canyon

The Rock Canyon deposit is at the bottom of Rock Canyon about 0.4 mile north of the confluence of the canyon with the Salt River in the Blue House Mountain quadrangle (fig. 1). The area is rugged and typified by deep canyons and high bluffs. Relief is more than 1,200 feet within 0.5 mile of the deposit. From the U.S. Highway 60 bridge across Salt River a dirt road extends westward along the north side of the river. From the end of this road, about 6 miles airline northwest of the Highway 60 bridge, a nearly 2-mile-long obscure trail leads westward into Rock Canyon to the deposit.

The deposit is in the Fort Apache Indian Reservation. In early 1956, Atomic Ores, Inc., of Globe, held a concession granted by the Fort Apache Tribal Council that permitted sole prospecting rights with option to lease (R. J. Schwartz, written commun., 1957). In late 1955 or early 1956, one opencut and two shallow, shaftlike prospect pits were dug. Less than 5 tons of selected ore was stockpiled but none was shipped because of the inaccessibility of the deposit. The concession was dropped early in 1956.

The deposit is explored by 2 pits. Pit A is 4X6 feet X about 12 feet deep. Pit B is 20 feet S. 19° W. of pit A and is on the same vein as A. It has about the same horizontal dimensions, but because it was filled with water in the summer of 1956, depth could not be determined. It, however, is believed to be about 7 feet deep (R. J. Schwartz, written commun., 1957). The shallow opencut is about 200 feet S. 15° E. of pit A.

The deposit is in rock of the black facies 15-25 feet above the barren quartzite, which is in this area poorly developed. The host rock is laminated to very thin bedded siltstone with alternating light and dark-gray layers. The rock is partly recrystallized but is not metamorphosed to hornfels.

The deposit is on the east side of the Rock Canyon monocline in strata that strike about N. 15° E. and dip 12-13° SE. Within a few hundred feet to the west the strata dip 30°-50° eastward; and 600-900 feet north at the bottom of Rock Canyon the strata are locally vertical along the axis of the monocline.

A diabase sill several hundred feet thick intruded the middle member of the Dripping Spring on the west side of the monocline. The upper part of this sill is exposed along both sides of Salt River west of the mouth of Rock Canyon. Whether the sill is concordant across the monocline is not known as its intrusive horizon is below the surface to the east of Rock Canyon.

About 300 feet north of the deposit a small diabase body cuts the upper member of the Dripping Spring on the east side of Rock Canyon. Exposures were too poor on the rubble-covered slope to allow determination of size, shape, or attitude of this body, but it is probably dikelike and of westward trend. It is very likely an offshoot from the underlying diabase sill and possibly was intruded along a transverse fault formed at the time of monoclinal folding.

The only other uranium deposit in the area is the Tomato Juice, about 0.9 mile to the southeast.

The deposit explored by pits A and B is veinlike and is best developed at pit A. Strongest radioactivity borders a narrow, less than 0.2-inch-thick, ankerite-filled fissure. This fissure strikes N. 19° E. and is generally vertical although in detail the dip is very irregular. The walls of the fissure are undulatory in contrast to the planar nature of most other fractures in the area. Vertical displacement of about 0.3 inch can be seen on the fissure.

The wallrock for 0.2-0.8 inch adjacent to the fissure is bleached to a pale reddish brown; the original light-gray laminae in the wallrock are altered farther from the fissure than are the dark-gray laminae. Within the bleached zone is abundant fine-grained pyrite. The pyrite adjacent to the fissure forms aggregates that feather outward along bedding planes.

The mineralogy of the deposit can be summarized in part by descriptions of thin and polished sections cut across the central ankerite-filled fissure. Such a thin section discloses a vein coated on both sides by about 0.2 mm of drusy comb ankerite. Where the vein is wider than about 0.5 mm the center is filled with a clearer equigranular mosaic of ankerite. The drusy ankerite is yellow and locally brown stained. Perhaps for this reason it appears to have higher relief than the equigranular variety. Ankerite is also abundant in the wallrock for 1 cm or more from the vein. Here it forms cloudy, yellow, rounded masses and radiating spherules. Locally ankerite is deposited on the surface of pyrite at the vein walls and in some places it fills fractures in brecciated pyrite.

Adjacent to the vein are stylolites marked by a filling of ankerite, pyrite, and other unidentified minerals. The ankerite in the stylolites is later than the pyrite and in some places the masses and radiating spherulites of ankerite cut indiscriminately across the stylolites.

The original host was spotted rock, the spots delineating concentrations of feldspar aggregates. The veins, stylolites, and ankerite cut indiscriminately across the feldspar. The feldspars near areas known to contain uraninite are affected by a brown cloudy alteration mineral.

A polished section cut across the ankerite-pyrite part of the vein contains both pyrite and uraninite in the host rock. The uraninite occurs as round or elongate and irregularly shaped blebs with generally rounded outlines and is disseminated in the host rock but not directly in the veins or stylolites. The blebs are ordinarily less than 0.1 mm in length or diameter although one was 0.2 mm long and about 0.05 mm across. The uraninite has a pale-brown cast in plane polarized light. Most of the blebs have a border zone that contains a myriad of tiny decussately arranged yellow, highly anisotropic blades. These blades are less than 1 micron in length and just within the resolving power of a microscope set at 1,500 X magnification. They are more reflective than the uraninite and have a yellow tint much lighter than that of pyrite. The centers of all but the smaller uraninite blebs are free of the bladed mineral. As nearly as can be determined from such small grains the mineral is as hard as the uraninite and is negative to all the reagents commonly used in stain tests.

Possibly the mineral is cassiterite as the optical and stain-reaction properties match those of cassiterite and the specimen from which it came is known to contain about 0.007 percent tin by semi-quantitative spectrographic analysis. This tin content is the highest for any sample taken from the deposits in the Dripping Spring.

In addition to the tentatively identified cassiterite, some of the uraninite blebs also contain a few minute pyrite cubes. Average size of the pyrite cubes is about 3 microns on a side.

Efforts to make a heavy mineral separate containing uraninite, both with a superpanner and with heavy liquids, met with failure. Autoradiographs of slabs of rock across the vein showed a concentration of small radioactive loci in the wallrock at the margin of the ankerite-coated vein and along certain stylolitic bedding planes for several centimeters from the vein. The film was also lightly clouded throughout suggesting an overall dissemination of radioactive material as well as the local concentrations.

Pyrite forms lenses as much as 3 inches long and 1/4 inch thick parallel to the bedding in hand specimen, in addition to its occurrence in and near the ankerite vein. Disseminated pyrite throughout the rock is sparse but not uncommon. In polished section the fine-grained, cubic pyrite adjacent to the ankerite vein shows weak steel-blue to reddish-brown anistropism, but X-ray powder patterns of the mineral prove its identity as pyrite.

The ankerite in the central fissure was identified both in thin section and by X-ray powder pattern.

Limonite and white sulfate minerals were the only secondary minerals noted. The limonite is common near the surface and has resulted from the weathering of pyrite. The white sulfates are efflorescent coatings on freshly broken rock and exposed fractures.

Radioactivity in the vein at pit A ranges from 1.0 to 1.5 mr per hour. Radioactivity of rock on the select ore pile was as much as 5.0 mr per hour. At pit B the radioactivity is generally lower and only locally exceeds 1.0 mr per hour. Radioactivity at the opencut is about 0.25 mr per hour in shattered rocks. No trend to the radioactivity in the opencut could be detected.

A selected sample submitted by Atomic Ores, Inc., contained 0.45 percent eU_3O_8 and a grab sample from the ore stockpile collected by personnel of the U.S. Atomic Energy Commission contained 0.28 percent eU_3O_8 (R. J. Schwartz, written commun., 1957). These samples are undoubtedly much richer than can be expected from normal mining procedure.

Roxy

The Roxy deposit is in the canyon of Gentry Creek 9.2 miles S. 82 1/2° E. from the school in Young (fig. 1). The deposit is on a southwest-trending ridge delineated by sharp bends in Gentry Creek, a stream which has cut a moderately steep walled canyon into the high plateaulike terrain. The uranium deposits are on the east side of the creek. Access to the deposit is by foot and crude road from a graded road that runs south from the Young-Holbrook road.

The Roxy claims, 14 in all, were located in 1954 by the Miami Copper Co. The company explored the deposit that we examined by a trench and several opencuts. No uranium ore had been produced from the property by the end of 1956.

The exploration workings consist of a shallow trench that trends a little south of east, and four opencuts. Three of the opencuts and the trench are rudely alined in an eastward direction down the southeastern flank of the ridge; the trench is on the ridge crest. The distance between the trench and the farthest opencut is less than 150 feet. The fourth opencut is about 100 feet northeast from the lowest opencut. Of the five exploration workings, only the trench and the lower two opencuts in the alined group contain visible concentrations of uranium minerals.

The host rocks for the deposit are interstratified siltstone, silty and very fine grained sandstone, and medium-grained quartzite that is flaggy to blocky. The coarser grained rocks occur principally in thin lenses. In many of the exposures, the rock has been bleached and oxidized so that the original dark-gray color is only occasionally visible. Most of the siltstone contains abundant mica, largely oriented parallel to stratification. The rocks in the vicinity of the deposit dip gently eastward.

The stratigraphic position of the deposit is in the black facies of the upper member. Lenses of medium-grained quartzite suggest that the barren quartzite is not far below the lowest pit.

No diabase was noted in the vicinity of the deposit.

In spite of generally eastward alinement of all but one of the exploration workings the concentrations of uranium minerals seem to be randomly oriented and distributed. Differences in the permeability of the siltstone and of the quartzite lenses as well as the probable differences in chemical composition of the host strata may have influenced deposition. In any event, the major concentrations of uranium minerals seem to be related to stratification and to small, randomly oriented fractures that are adjacent to mineralized strata.

All the uranium-bearing minerals are secondary and occur as coatings on stratification and fracture planes. Metatorbernite, which is the dominant uranium-bearing mineral, uraniferous opal, and saleeite were identified in the field and laboratory. Nonuraniferous minerals that occur in barren rock as well as in the deposits are gypsum and abundant limonite.

Radioactivity in the opencuts ranges from 0.1 mr per hour to 4.6 mr per hour. Maximum readings of 4.0 mr per hour were noted at the trench and the lower two opencuts of the alined workings. The upper opencut of the alined workings is considerably less radioactive with 0.25 mr per hour the maximum; the cut north of the alined working is even less radioactive with only 0.10 mr per hour the maximum. Background radioactivity is 0.04-0.06 mr per hour.

Shepp

The Shepp deposit is in sec. 31, T. 8 N., R. 15 E., and sec. 36, T. 8 N., R. 14 E. about 17 miles by ungraded dirt road southeast of Young (fig. 1). The deposit is exposed at the base of nearly vertical walls of a narrow canyon cut by Wilson Creek, a southwest-flowing tributary to Cherry Creek.

The Shepp claims Nos. 1-5 were located early in 1953 by O. H. Shepp and M. Stockman. Later the property was acquired by the American Asbestos and Uranium Co. which began underground exploration of the deposit after constructing a 300-foot inclined tramway from the end of the access road to the canyon floor. Underground exploration and development at the Shepp No. 2 mine consists of four adits that total about 610 feet of workings (see fig. 24 in Granger and Raup, 1969).

Work on this property stopped in the fall of 1954. A few tons of uranium-bearing rock were stockpiled; however, no ore had been shipped prior to 1957.

The adits are within a foot or so of the bottom of the canyon and are very nearly in the same stratigraphic interval. Two adits trend north-northeast into the north wall of the canyon whereas the other two trend south-southwestward into the south wall. The two adits on the north side of the canyon are about 185 feet apart; the two on the south side are about 180 feet apart. A line drawn down the middle of the northeastern adit would, when projected, very nearly form the center line of the southeastern adit. The western adits, however, are not so alined.

The northwestern adit is about 118 feet long and trends N. 25° E. At 36 feet from the portal a N. 26° W.-trending crosscut extends for 34 feet. The northeastern adit is 128 feet long and trends N. 12° E. Several rounds have been blasted in the walls of this adit but none of the holes is large enough to constitute a crosscut. The southwestern adit starts as a crosscut and extends for about 60 feet in a S. 45° E. direction. About 18 feet from the portal is a drift that trends approximately S. 16° W. for 108 feet. The back of the drift has been stoped from 48 to 94 feet from the crosscut; the height of this narrow stope is about 6-7 feet at the ends and is nearly 20 feet in the middle. The southeastern adit is about 162 feet long, trends S. 13° W. and has a small "dog-hole" in the west wall about halfway between the portal and face of the adit.

The host rock for the deposit is dark-gray, flaggy, indurated siltstone. At the surface and adjacent to shear zones exposed in the adits the rock is locally bleached and commonly stained by iron oxides. The rock exposed in the vicinity of the deposit is nearly flat lying. No evidence was noted of recrystallization caused by thermal metamorphism related to diabase.

The strongest fractures in the area trend N. 70°-80° W. They are generally limonite filled near the surface but may contain calcite where unweathered in the adits. Minor movement has occurred along these fractures; displacement of nearly 2 feet has been noted. Zones of breccia and gouge along these fractures are as much as 10 feet wide. Fractures that trend N. 10°-15° E. are also prominent in the area, but no displacement along them has been noted. The north-northeast-trending fractures also contain limonite but are not as wide as the N. 70°-80° W. set. Pseudochannels are common in the host strata and also trend north-northeastward.

The adits are about 40 feet stratigraphically above the barren quartzite. In Wilson Creek canyon the barren quartzite is a 1/2- to 2-foot-thick bed of medium-grained quartzite only 16 feet above the middle member. The red unit and most of the lower part of the gray facies seem to be missing.

A diabase sill that intruded just below the top of the lower member of the Mescal Limestone is exposed about half a mile north of the deposit. About 3/5 mile south of the deposit a steeply discordant body of diabase cuts both Mescal and Dripping Spring strata.

No distinct or continuous ore body has been found in the adits, but experience has shown that more radioactive rock could be removed by following N. 10°-15° E. trends than by crosscutting. Thus it seems that the deposits are elongate north-northeastward. Fractures of the N. 10°-15° E. set, however, are not abnormally radioactive underground although they are loci for secondary mineral deposition near the surface. Furthermore, the most radioactive material underground is bedded; commonly a bed near the roof of an adit is radioactive, but in other places in the adit the strongest radioactivity is near the floor. The sporadic changes in stratigraphic position apparently are independent of visible fractures. All the fractures, where comparatively unweathered, are no more radioactive than the wallrock. All the wallrock exposed in the adits show radioactivity that is slightly higher than normal.

No individual zone of high radioactivity is continuous for more than a few feet in any direction. Zones are rarely more than 10-20 feet long, 2 feet high, and 10-12 feet wide. At the surface there are several smaller areas of abnormal radioactivity exposed on the canyon walls.

Primary metallic minerals identified at the Shepp deposit include pyrite and chalcopyrite but not uraninite or any other primary uranium mineral. The pyrite and the less abundant chalcopyrite are finely disseminated in the host rock, and locally the pyrite is associated with calcite in fractures. Studies of heavy mineral separates, air elutriation separates, and autoradiographs suggest that some of the uranium may be in a colloidal form, perhaps adsorbed on clay minerals. Alpha particle tracks emitted from clay minerals were noted in some of the autoradiographs.

Metatorbernite, the only secondary uranium mineral identified (X-ray methods), is abundant in fractures near the surface. This mineral is commonly associated with limonite and less commonly with gypsum, malachite, and azurite.

Radioactivity in the deposit ranges from 0.1 mr per hour to nearly 5.0 mr per hour; background radioactivity is about 0.05 mr per hour. The highest radioactivity is on metatorbernite-coated surfaces and in locally uraniferous strata. The lowest radioactivity is on weathered surfaces, in crosscuts, and in oxidized shear and breccia zones in the adits.

Samples from the deposit were taken from surface exposures prior to exploration and development work. A chip sample across a 1.7-foot-thick zone that was 10-12 feet wide at the surface contained 0.11 percent eU and 0.17 percent U. A composite sample, consisting of several 1 1/2- to 2-foot chip channel samples cut 8 feet apart across radioactive strata, contained 0.12 percent eU_3O_8 (R. L. Wells and W. E. Mead, written commun., 1957).

Sky

The Sky deposit is 2.2 miles N. 88° W. of the peak of El Capitan Mountain and 4.3 miles S. 42° E. of Pioneer Mountain in the Ray quadrangle (fig. 1). The deposit is on the southwestern flank of the Mescal Mountains and on the northwestern flank of the ridge that constitutes El Capitan Mountain, the high point of the Mescal range. Most of the exploration workings are high on the south wall of a moderately steep sided, southwest-trending canyon. Access to the property is by 4-wheel-drive vehicle road from Arizona Highway 77 which is about half a mile west of the deposit.

The deposit is in a block of about 20 claims located and owned by G. K. Angus and others. The owners located the claims in mid-1954 and in 1955 leased them to O. C. Swain of the Interstate Uranium Co. of California. Prior to stopping work in early 1956, the lessee developed the deposit by several prospect pits and eight diamond drill holes.

The prospect pits are principally on the outcrop of a thin stratigraphic unit exposed along the south wall of the canyon. One of these workings, a small opencut, contains the best exposures of uranium minerals in the area and is the source of most of the mineralogic data presented here. The diamond drill holes, however, are near the top of a cuesta stratigraphically above the explored outcrop. They range in depth from 36 feet to 225 feet (R. J. Schwartz, written commun., 1957).

The host rocks for the deposit are 2-4 feet of shale and platy siltstone strata that may be the basal beds of a broad, shallow paleochannel cut into well-cemented quartzite strata that immediately underlie the host rocks. Dark-gray platy and flaggy siltstone strata stratigraphically higher than the deposit are locally radioactive. The rocks in the area dip 20°-30° to the south.

The host rocks apparently are the lowest strata of the upper member, because well-cemented quartzite below the deposit is typical of the upper part of the middle member. Local radioactivity in strata above the deposit is probably in gray unit rocks.

A discordant body of diabase south of the deposit cuts strata of the upper member but no evidence of thermal metamorphism caused by the diabase was noted near the deposit.

The deposit as exposed at and near the surface is of the blanket type. Moderately strong radioactivity is continuous for less than 200 feet along the outcrop of the base of the upper member, but high radioactivity was noted locally along more than 400 feet of the outcrop. Radioactivity data from the drill holes (R. J. Schwartz, written commun., 1957) do not indicate that the deposit continues very far behind the outcrop suggesting that the outcrop has been enriched by secondary uranium minerals.

Metatorbernite is the only uranium mineral that has been identified at the deposit. It occurs as a thin coating on stratification and small fracture planes in the 2- to 4-foot favorable interval. Associated with the metatorbernite are malachite, limonite, and gypsum. Also occurring as a thin coating on fracture and stratification planes is a pale-yellow platy mineral that was identified by X-ray methods as barite. The only primary metallic mineral noted was pyrite.

Radioactivity at the deposit is everywhere less than 1.0 mr per hour and is commonly not even as much as 0.5 mr per hour along the outcrop of the favorable interval. Background radioactivity is about 0.04 mr per hour.

Snakebit

The Snakebit deposit is 4 3/4 miles N. 73° W. from Seneca on U.S. Highway 60 in the southern part of the Blue House Mountain quadrangle (fig. 1). The deposit, which is high on the steep north wall of the southwest-trending canyon of a tributary to Ash Creek, is about 450 feet above the canyon floor and is about 400 feet below the rim of the canyon; its altitude is approximately 4,450 feet. Access to the property is by 4-wheel-drive vehicle road south from the graded road that goes northwest from Highway 60 just north of Seneca.

C. S. Black located nine Snakebit claims in 1954. Lessees, however, have done the exploration work. The first lessee cleared off a bench at the deposit and the second built an access road from the canyon rim and drove an adit. No ore has been produced from the deposit.

The bench is 30 feet long and about 15 feet wide. From the bench, the adit trends west-northwestward for about 80 feet. The adit does not follow the deposit and is almost barren of uranium.

The host rocks for the deposit are nearly flat lying iron-stained strata, composed largely of fine-grained quartzite just below dark-gray siltstone strata and about 2 feet above a 4-inch bed of medium- to coarse-grained quartzite. The siltstone strata above the deposit contain abundant crumpled shrinkage cracks and pyrite-filled stylolites. The medium to coarse-grained strata just below the deposit contain abundant sulfide minerals. Fractures in the host rock are nearly vertical and are principally in two sets: N. 75°-85° W. and N. 5°-15° E; they are commonly filled with as much as a quarter of an inch of limonite near the surface and in less weathered parts of the adit are filled with pyrite and calcite.

The deposit is in the black facies of the upper member about 130 feet above the contact between the middle and upper members. The 4-inch bed of medium- to coarse-grained quartzite 2 feet below the deposit may possibly here represent the barren quartzite.

A thick diabase sill intruded the middle member below the deposit, but about a quarter of a mile to the west the upper contact of the diabase cuts across strata of the upper member. The relation of this discordance to the Rock Canyon monocline was not established, but it seems unlikely that the two can be joined inasmuch as the trend of such a connection would not be compatible with the most common trends of the monoclines.

The deposit is exposed in such a way that it appears to be blanket type. There is, however, a definite trend to the deposit roughly parallel with the long dimension of the bench. Both the radioactivity and sulfide minerals are concentrated along this trend which is marked by a prominent N. 10° E. limonite-filled fracture. The adit trends nearly at a right angle to the trend of the deposit. In the face of the opencut, the most radioactivity is along a 5- to 10-inch zone exposed at about waist height in iron-stained very fine-grained quartzite; the zone is nearly parallel to the stratification.

The only uranium mineral noted is metatorbernite which occurs in weathered parts of the deposit in association with limonite. Metatorbernite was noted not only in the 5- to 10-inch zone parallel to the stratification but also locally in the 4-inch bed of medium- to coarse-grained quartzite about 2 feet below the radioactive zone.

The sulfide minerals, which include abundant pyrite and chalcopyrite, galena, and sparse sphalerite, occur disseminated in the coarser grained lenses, particularly concentrated near the N. 10° E. fracture.

Radioactivity in the radioactive zone parallel to the stratification and near the N. 10° E. fracture ranges from about 0.2 mr per hour to 1.0 mr per hour. Radioactivity in the adit is very much lower. Samples from the opencut are reported to contain as much as 0.16 percent U_3O_8, but the best sample from the adit contained only 0.05 percent U_3O_8 (R. J. Schwartz, written commun., 1957).

Sorrel Horse

The Sorrel Horse deposits are in the south-central part of sec. 4, T. 6 N., R. 14 E., between the Black Brush and Big Six deposits in the McFadden Peak quadrangle (fig. 1). They are at an altitude of about 5,440 feet on the rugged walls of a northeast-trending canyon that is on the west side of and is tributary to Cherry Creek. The deposits are accessible by about 2 miles of unimproved road from the Cherry Creek access road.

The property consists of the Sorrel Horse claims 3 and 4 and of two other claims held by Frank Mathews of Young, Ariz.

Four small deposits on these claims are explored by three short adits and a prospect pit. Adit 1 is on the north wall of the tributary canyon approximately 400 feet south of the Big Six adit 1. It is 25 feet long and trends N. 80° W. Adit 2 is a few hundred feet east of adit 1, about 5-10 feet higher stratigraphically and on the south wall of the canyon. It is 45 feet long and trends S. 80° E. Adit 3 is about 100 feet southwest of adit 2 and several feet stratigraphically higher. In August 1956, adit 3 had just been started on a trend of about S. 70° E. It, however, was driven only a few feet. The prospect pit is west-southwest of adit 3 at about the same stratigraphic position.

All the deposits are in nearly flat lying strata less than 1 mile west of the Cherry Creek monocline. The Sierra Ancha diabase sheet intruded the upper member of the Dripping Spring about 60-70 feet below the barren quartzite. The diabase on the Sorrel Horse property contains a few small irregularly shaped bodies of the syenite facies. These appear for the most part to be widely scattered segregations.

Black deuteric veinlets are common but they are widely spaced and seem to have a random distribution and trend. An effort was made to trace some of the veinlets from the diabase sheet into the overlying Dripping Spring. It was found that a few of the veins cut the chilled upper border of the diabase sheet but here they appeared to terminate abruptly or turn and follow the contact for a short distance.

Aplite is locally abundant in the lower 10 feet of the Dripping Spring above the chilled contact of the diabase. The aplite forms many short irregular dikes and commonly cements breccia fragments of Dripping Spring in this interval. The aplite was fed from numerous dikes that can be traced for several feet into the underlying diabase. All the aplite examined is composed largely of potassium feldspar and it is possible that this material may be mobilized hornfels. All of this aplite was from the breccia zone, however; none was from the dikes in the diabase. If the material is actually mobilized hornfels the dikes in the diabase are not feeders but are apophyses extending from the breccia zone.

The host rock at both adits 1 and 2 is light-gray hornfels that contains meager disseminated mica flakes, pyrite, and sparse chalcopyrite. The fresh unweathered rock is a much lighter gray than is the host rock of any other known uranium deposit in the Dripping Spring with the exception of that at the Big Six.

Adit 1 is 10-20 feet above the diabase and about 65 feet below the barren quartzite. Several joints that trend N. 75°-80° E. are parallel to the adit but apparently have no relation to the radioactivity. Limonite is unusually sparse in these joints near the surface. All the radioactivity within the adit is less than 0.25 mr per hour with the exception of that of one small area on the north wall near the floor and a few inches from the face; in that area the radioactivity is about 0.7 mr per hour. No radioactive vein or zone could be delineated in the adit and no uranium-bearing minerals were noted. A very sparse coating of white efflorescent sulfate minerals is present on the mine walls near the portal.

Adit 2 is 20 feet above the diabase sheet and 60-70 feet below the barren quartzite which is difficult to recognize at this point. At the portal of the adit is a 1/8-inch-wide limonite-filled fracture that trends S. 83° E. The radioactivity on the fracture is about 0.2 mr per hour, which is about twice the average background radioactivity in the adit. At 25 feet from the portal the fracture turns S. 88° E. and continues on this trend to the face at 45 feet. At the face the radioactivity of the fracture is about 1.1 mr per hour near the roof of the adit. The floor of the adit is not abnormally radioactive except in one small area near the face where the radioactivity is about 0.8 mr per hour. The fracture apparently marks the center of a very weak uranium vein localized only within 3- to 5-foot stratigraphic interval. No uranium minerals were identified; disseminated pyrite is locally abundant but chalcopyrite is rare.

Adit 3 was started in medium- to dark-gray siltstone at the top of the gray facies and just below the gray sandstone. The siltstone is cut by a random system of fine veinlets that may possibly be localized along a N. 75° W. zone. These veinlets are rarely more than 2 mm wide and locally the opposing walls have been displaced as much as 4 mm parallel to the fracture surface. The vein filling varies from veinlet to veinlet with no apparent systematic relation. Vein minerals are quartz, siderite, fluorite, pyrite, chalcopyrite, sphalerite, and galena.

Quartz appears to be one of the earliest minerals to have formed and occurs as minute prisms perpendicular to the veinlet walls. Purple fluorite was both preceded and succeeded by pyrite but is evidently of about the same age as chalcopyrite. A colorless to milky variety of fluorite was noted in one specimen. It occurs as a crudely botryoidal coating similar in appearance to hyalite and undoubtedly much later in the paragenetic sequence than the purple fluorite.

Siderite forms an olive-green to greenish-amber drusy veinlet filling which is later than quartz. The occurrence is similar to that of ankerite in the Tomato Juice, Rock Creek, and Horse Shoe deposits. The siderite is earlier than any of the pyrite with which it is associated but its relation to other sulfide minerals and fluorite was not observed.

Pyrite, chalcopyrite, galena, and sphalerite occur both as vein fillings and as minute disseminated grains in the host rock. The pyrite commonly occurs separately from other sulfide minerals but in association with quartz and fluorite. The reason for this is not known as it seems to occupy the same type veinlets that the other sulfide minerals occupy. Chalcopyrite and sphalerite are of nearly the same age but the chalcopyrite may be in part both earlier and later than the sphalerite. Areas in the sphalerite adjacent to chalcopyrite contain a myriad of tiny exsolved chalcopyrite blebs. Galena appears to be later than both the sphalerite and chalcopyrite.

In addition to these vein minerals a dark-olive-green claylike mineral occurs on some of the numerous stylolite surfaces. This mineral was not identified by X-ray but it is probably a nontronite clay.

Although some of the rock in adit 3 is abnormally radioactive, no uranium minerals were identified. The radioactive rock is cut by the described veinlets but there is no evidence that the radioactivity derives from these veinlets. Rather it seems to be disseminated in the host rock.

The prospect pit is a very shallow excavation from which about 1 cubic yard of rock has been removed. It is about 25 feet above the diabase sheet and 35 feet below the top of the gray facies in light-gray dense siltstone and hornfels. The host rock appears to be selectively metamorphosed along several very thin beds in a stratigraphic interval of less than 2 feet. Within this interval are spotted rocks, lenses of hornfels, and one thin bed about 2 inches thick that contains little knots of biotite. Pyrite occurs in narrow veinlets and small masses less than 1/4 inch on a side, as well as in thin lenses along bedding planes. A few quartz veins parallel to the bedding and less than 1/8 inch thick contain a little pyrite, chalcopyrite, and a gray metallic mineral that was not identified. Meager purple fluorite was noted on two steeply dipping joints that trend N. 40° E. and N. 16° W.

Radioactivity of about 2 mr per hour was noted at two small areas less than 1 foot across; these areas are in the pit at about the horizon of the biotite-rich layer. These spots are alined in a N. 7° E. direction but there is no evidence of continuity between them. No relation is apparent between the abnormal radioactivity and either the sulfide minerals or the fluorite, although a small elongate bleb of pyrrhotite was noted in one strongly radioactive specimen. No uranium minerals were identified.

Suckerite

The Suckerite deposit is in sec. 24, T. 6 N., R. 13 E. (unsurveyed), about 300 feet south of Workman Creek and about a quarter of a mile west of the Globe-Young road (see pl. 2 in Granger and Raup, 1969). The deposit is at an altitude of approximately 5,375 feet on the wooded western flank of a north-trending ridge that is breached by Workman Creek. Access to the deposit is by less than 1/2 mile of mine road from the Rose Creek road.

In May 1957, a lease and option on the claims was held by Tulsa Minerals, Inc. The Suckerite property comprises 16 claims located early in 1954 by D. Gerovich, C. T. Collopy, R. J. Fernandez, and others. Later in 1954, the property was leased under option to the Sierra Ancha Uranium Corp., which constructed an access road and explored the deposit by a bulldozer bench and a few short wagon drill holes. About 3 tons of radioactive rock was stockpiled but not shipped. In early 1955, the lease and option was acquired by the Uranium Corp. of America who subleased the property to the Standard Mining Co., subsidiary of Standard Ores and Alloys Co. Several diamond drill holes were cored at the deposit and in nearby rocks with discouraging results (A. Gordon, geologist, Standard Mining Co., oral commun., 1955). Early in 1956, both leases had been dropped and the property returned to the owners. In the summer of 1956, Ross Burke of Houston, Tex., leased the claims, enlarged the bench, and trucked about 10 tons of selected ore to the buying depot at Cutter (R. J. Schwartz, oral commun., 1956). Late in 1956, the lease was acquired by Tulsa Minerals, Inc.

All the undergound workings on the deposit have been driven by Tulsa Minerals, Inc. These consisted, in May 1957, of two levels (see fig. 37 in Granger and Raup, 1969). The upper level was about 200 feet long, trended S. 20° W., and connected with the surface at the bench that marks the original discovery. The lower level was 55 feet below the upper level and consisted of a drift about 250 feet long connected with the surface by a crosscut adit. The lower level was driven after it was found that ore extended below the upper level.

There are several other workings on the Suckerite property but all were driven at or near the contact between the Mescal Limestone and Dripping Spring Quartzite in magnetite- and serpentine-rich rock. These consist of two short drifts, an adit estimated to be 150 feet long, an inclined shaft about 100 feet deep parallel to the stratification, and a prospect pit. These workings are much older than the uranium mine and were driven in normally radioactive rock.

The Suckerite deposit is a tilted elongate xenolith of sedimentary rock enclosed by diabase. The position of the xenolith is near the axis of the Sierra Ancha monocline and it probably is a segment of rock torn from the main mass during the formation of the monocline and the intrusion of diabase. Its position is not consistent, stratigraphically, with rocks on either side of the monocline so it is very likely an unattached block engulfed by the injected diabase magma.

The xenolith is twisted so that the strata dip about 55° E. at its north end and 15° E. at its south end. At the uranium deposit they dip 40°-45° E. Diabase is in contact with the black facies of the Dripping Spring on the underside of the xenolith. At the uranium deposit this contact is 55 feet below the buff unit.

In contact with the basal Mescal on the upper side of the xenolith is a sheet of syenite facies about 200-300 feet thick. Composition and texture are inconstant within the sheet but, in general, it is a pink medium- to coarse-grained differentiate from the diabase. It is locally cut by narrow, irregularly walled pegmatitic and aphanitic mafic dikes.

A separate exposure of the Dripping Spring that extends along Workman Creek for 800-2,300 feet west of the deposit forms a gentle anticline with north-trending axis. The upper surface of this block, prior to erosion, was in concordant contact with the diabase about 35 feet above the barren quartzite. It seems likely that this block of rock and the xenolith were split away from each other during diabase intrusion at a stratigraphic horizon 35 feet above the barren quartzite and 55 feet below the buff unit. The positions of these two blocks of sedimentary rock suggest that they may be joined at considerable depth in the diabase.

The uranium deposit is in a bedding-plane fracture zone about 10-15 feet above the diabase contact and 45 feet below the buff unit. The host rock at the surface of the zone is highly shattered and bleached. All but the tightest joints are filled with limonite. Within 15 feet below the surface the rocks are less strongly weathered and the color is olive gray. Below this depth the host rock is uniformly medium gray to dark gray. Sulfide minerals are present within 10 feet of the zone surface.

The host rock appears to be mildly recrystallized but not metamorphosed to hornfels. This is strange in view of the intense heat that must have been present in the diabase magma that enclosed the xenolith. A little hornfels was noted, however, near the diabase contact with the block of Dripping Spring exposed farther west.

The ore body is confined to a narrow 3- to 5-foot stratigraphic interval that was evidently shattered by a bedding-plane fault of negligible displacement. No fault surfaces or continuous fractures can be seen. This vein has been developed for more than 200 feet along strike and at least 120 feet downdip. Although the vein zone is nearly everywhere abnormally radioactive, the positions of the stopes furnish some evidence that the ore lies largely in shoots which rake northwest.

The mineralogy of the Suckerite deposit is similar to that of other deposits in the Workman Creek area: Uraninite, pyrite, pyrrhotite, molybdenite, chalcopyrite, and galena are distributed in the vein zone in short irregular veinlets and as disseminated grains. A few rare flakes of molybdenite include tiny unfractured grains of uraninite I. Pyrite locally replaces the margins of the molybdenite and uraninite II appears to have encroached along cleavages in the molybdenite. Grains of uraninite II in excellent cubic form occur at the margins of the minute veinlets. The uraninite II is cut by a fine vein network of pyrite. In the wallrock away from the veinlets, pyrite forms small disseminated cubes.

Near the surface chalcopyrite is altered in part to covellite. In the more strongly weathered limonite-stained rock, torbernite and fluorescent hyalite occur sparingly with gypsum on fracture surfaces.

By selective mining a total of 2,443.70 tons of ore which contained more than 0.1 percent U_3O_8 has been produced. Most of this ore contained more than 0.2 percent U_3O_8 and the total average grade was 0.2341 percent U_3O_8.

Sue

The Sue deposit is in the SE 1/4 sec. 19, T. 5 N., R. 15 E., and the SE 1/4 sec. 24, T. 5 N., R. 14 E., near the south edge of the McFadden Peak quadrangle (fig. 1). The deposit is exposed at an altitude of approximately 4,700 feet on a steep north-facing slope about 500 feet above the floor of Bull Canyon. Bull Canyon is a deep, steep slope- and cliff-walled canyon cut by an east-flowing tributary to Cherry Creek. The rolling uplands above the deposit are a small remnant of plateaulike terrain that remains after profound erosion by stream systems to both the east and west. Relief within a few miles of the deposit is nearly 4,000 feet.

Access to the deposit is by 5.4 miles of dirt road from the Coon Creek road. The first 4.8 miles are on a graded access road. The remaining 0.6 mile is on an ungraded mine access road to the portal of the easternmost adit.

The 18 Sue claims are among 57 unpatented claims located by K. C. Heron in the vicinity of the deposit. These claims are owned by Globe Uranium, Inc. Late in 1954, the owners began exploration of the deposit by bulldozing two connecting benches (fig. 8), that exposed about 1,800 feet of bedrock along a stratigraphic interval that was abnormally radioactive at the surface. From these benches three adits were started in a southward direction. The westernmost adit was continued for only about 30 feet but the other two adits, which are at approximately the same altitude and are 118 feet apart, were extended southward into the hill. In June 1955, the underground workings entered by the two active adits consisted of nearly 800 feet of interconnected drifts and crosscuts on two levels.

In August 1955, work began on a project partly financed by a DMEA (U.S. Defense Minerals Exploration Administration) loan. Under the contract the underground workings were augmented by more than 500 feet of drifts and 250 feet of crosscuts. Also long hole drilling from the workings explored the rock adjacent to the drifts. Work under the contract terminated in July 1956.

Ore mined from the Sue mine was shipped to the ore-buying depot at Cutter; total production prior to 1957 was less than 500 tons.

The mine workings (fig. 8) that develop and explore the Sue deposit include 1,130 feet of drifts and stopes and 536 feet of crosscuts entered by two adits. The western adit trends S. 10° W. for 104 feet and the eastern adit approximately S. 13° W. for 681 feet. These two drifts and the 354 feet of crosscuts from them constitute the lower level. There are five lower level crosscuts, all of which were started from the eastern drift. To facilitate description we have numbered the lower level crosscuts 1 through 5. Crosscut 1 is 90 feet from the portal and trends N. 82° W. for 84 feet; number 2 is 180 feet from the portal and trends N. 83° W. for 14 feet; number 3 is 316 feet from the portal and trends generally N. 65° W. for 124 feet; number 4 is 512 feet from the portal and trends N. 82° W. for 57 feet; and number 5 is 585 feet from the portal and trends S. 74° E. for 75 feet.

The upper level is about 7-9 feet above the lower level and consists of 345 feet of drifts and stopes between the lower level adits and 182 feet of crosscuts. There are four parts of the upper level which are here called the northern, middle, southwestern, and southeastern parts. The northern part of the upper level consists of a 219-foot drift and stope which trends generally N. 13° E. and of four crosscuts which total 182 feet. Access to the drift is by an inclined raise from the western adit to an upper level crosscut, by raises from lower level crosscuts 1 and 2, and by two raises from the eastern adit to upper level crosscuts. The middle part of the upper level consists of a 99-foot drift, with stopes, that trends N. 13 ° E. and which is accessible only by a raise from crosscut 3. The southwestern and southeastern parts of the upper level are merely small stopes, which are elongate northward and neither of which is more than 15 feet long. The southwestern part is accessible by a raise from crosscut 4 and the southeastern part is above the end of crosscut 5.

A large number of short holes were drilled by the owners into the top of the workings and 17 long holes were drilled under the terms of the DMEA contract. The long holes ranged in length from 40 to 57 1/2 feet and in inclination from horizontal to vertical upward.

Strata correlated with the barren quartzite are exposed throughout the length of the eastern adit. They are typically moderately well sorted fine- to coarse-grained orthoquartzite. The barren quartzite and adjoining underlying strata are interlensing, laminated to thin-bedded rocks that are very light gray to moderate orange pink where fresh. In most of the eastern adit the rock is weathered and bleached to pale yellowish orange. Moderate-red to dusky-red layers along stratification planes are common where the rock is strongly oxidized.

The top of the barren quartzite maintains a position at about shoulder height in the eastern adit but is about 14 feet above the floor of the western adit.

Overlying the barren quartzite are siltstone and very fine grained feldspathic orthoquartzite interstratified with lenses of medium-grained orthoquartzite. These rocks are similar to the basal parts of the black facies elsewhere and consist of flaggy, laminated, dark to light gray strata. Where oxidized, the color ranges from very pale orange to light brown. Stratification is commonly wavy owing to pseudochannels and the lenticularity of the bedding.

Minable parts of the deposit are almost entirely in the first 6-8 feet of strata above the barren quartzite although local concentrations of secondary uranium minerals and abnormal radioactivity are present in and below the barren quartzite. All workings on the upper level are above the barren quartzite and we believe that all the ore shipped was from the upper level.

The host strata dip southeastward about 5°-7°; the strike is slightly more northeast than the general trend of the drifts. Thus, whereas the base of the black facies in the mine is for the most part exposed in the eastern adit, it is above the western adit and is largely near the floor level of upper level workings.

Evidence of metamorphism of the host rocks is sparse. A few hundred feet west of the deposit specimens of dark-gray siltstone were found that contain small lath-shaped porphyroblasts composed of alteration minerals presumably after feldspar. The porphyroblasts, which are randomly oriented in the rock, suggest that some recrystallization possibly caused by hydrothermal metamorphism has taken place.

Fractures in the host rock are common, particularly in the flaggy siltstone strata above the coarser rocks. The most prominent of the fractures is N. 60°-85° W. set and the next most prominent is the N. 5°-15° E. set. Many of the fractures nearer the surface contain about a quarter of an inch of earthy limonite but, where less oxidized, fractures are commonly filled with calcite and kaolinite as well as with limonite. Locally the fracture fillings are as much as 2 inches wide and contain gouge and breccia as well. In general there seems to have been no significant movement along the fractures. Movement along the several narrow shear zones also was negligible. Sheeted and shattered zones are locally present in the mine; shattered rock is common in the stopes. These structural features are all discontinuous both laterally and vertically.

Roughly parallel to the north-northeast set of fractures are pseudochannels that are common in the flaggy siltstones. Most of the pseudochannels trend N. 15°-20° E., although trends that range from N. 5° E. to N. 25° E. are not uncommon. The rocks in which the pseudochannels occur are principally grayish siltstone and very fine-grained quartzite. The cores of the pseudochannels are generally light in color--dominantly of pale-orange and brownish hue--but the grain size of the cores is not unlike the surrounding rock. Apparently the cores are composed of cleaner, more thoroughly winnowed detritus. Lenticular stratification, which locally produces a wavy effect in the bedding similar in appearance to pseudochannels, does not produce all the characteristics typical of pseudochannels, particularly the subparallel alinement and the presence of warped and truncated laminae of the surrounding strata.

The effects of oxidation were noted in all the rocks in the mine but the effects are not constant throughout the mine. Oxidized rock is most easily detected by the significant change in color from the grayish hues of fresh rock to the lighter, more orange and brown hues of the oxidized rock. Limonitic stains are common, the rock is softer, and less calcite is present in fractures in oxidized rock. In general, rocks in the deeper part of the mine are less oxidized than the rocks nearer the portals; the more highly fractured and shattered rocks are more oxidized, and the coarser grained rocks are more thoroughly oxidized than the siltstone. It is common to see a narrow zone of thoroughly oxidized rock adjacent to a fracture, which suggests a close relation between the two.

The distribution of oxidized rock in the mine is dependent on a combination of controls so the pattern is irregular. A general pattern of distribution, however, can be seen. At the portals of the two adits the rock is strongly bleached and oxidized. Effects of oxidation decrease inward but less so in the western adit. In the eastern adit, the degree of oxidation of the rocks decreases for the first 20 feet and then becomes stronger again largely because of an abundance of fractures. Beyond about 500 feet in this adit, evidence of oxidation again decreases although all the rocks in the adit, even at the face, are iron stained and partly bleached.

The relations of the Sue deposit to diabase and regional structure are similar to those of the Donna Lee deposits about 1 mile to the north. A north-trending fault about 2,000 feet east of the Sue deposit has about 300 feet of vertical displacement with the upthrown side on the east. A map included in the final report by the DMEA field team indicates that a sill of diabase that intruded the Pioneer Formation east of the fault terminated against the fault rather than being cut by it. An unpublished map shown to the writers by R. J. Schwartz shows a small body of diabase in the fault zone in Deep Creek about 1/2 mile north of the Sue deposit. The fault could not be traced into the diabase body but was mapped as though it cut the diabase. Thus the age relation between the fault and diabase intrusion is not yet well understood; the possibility that diabase may have locally intruded the fault near the Sue deposit is dependent on the fault predating the diabase.

Diabase may also have intruded the Mescal Limestone above the deposit. If any such sill ever existed, however, it has been removed from the deposit by erosion. Several miles to the north of the mine such a sill is exposed.

The Sue deposit comprises a group of discontinuous zones of radioactive rock that trend N. 5°-20° E. and numerous small, randomly distributed concentrations of secondary uranium minerals. All the north-northeast trending zones are in the upper level of the mine and it has been from these zones that nearly all of the ore has been produced. The zones, particularly in the middle part of the upper level, seem to have an en echelon relation to one another but they do not seem to be related to visible fractures. In the few places where fractures and radioactive zones coincide, the relation apparently is fortuitous, the presently visible fractures having postdated mineralization. Locally the radioactive zones are shattered and are coincident with extremely tight, nearly invisible breaks in the rock. These features may also postdate mineralization.

The shape of the radioactive zones is in general vertically tabular. The length of the longest zone is about 50 feet but most of the zones are considerably shorter. Heights of zones are commonly 6-8 feet and locally a little more. The trends of the zones are irregular, which suggests a possible relation to now-healed tension fractures. Where the radioactive zones were wider or more closely spaced, they constituted minable ore bodies.

Generally the radioactivity in the mine is greater near the back of the lower level workings and near the floor of the upper level workings, suggesting that uranium has been concentrated at the contact between the flaggy siltstones and the coarser grained barren quartzite strata. The abundance of secondary uranium minerals near the contact offers further evidence of such a concentration.

The mineralogy of the vertically tabular zones is poorly understood inasmuch as no primary uranium minerals could be separated and identified. It may be that uraninite is present in an extremely finely divided state; however, attempts to concentrate uraninite from a specimen of highly radioactive rock crushed to -200 mesh failed. Attempts to isolate hydrocarbons which might contain uranium also failed. Inasmuch as all the fractions of the crushed rock were radioactive, it is possible that much of the uranium is adsorbed by clay minerals.

Randomly distributed concentrations of secondary uranium minerals that occur as thin coatings on stratification and fracture surfaces occur throughout the mine, but for the most part they are too small and weakly radioactive to be considered significant. Most of these small concentrations are in the upper level although several are exposed in the lower level workings generally above the barren quartzite.

Secondary uranium minerals in the deposit are principally metatorbernite and bassetite. Metaautunite is sparse and is associated with bassetite. A specimen of a yellow powdery mineral that coats bassetite gave an X-ray powder pattern of sodium-zippeite. A rare pale-yellowish-green mineral that forms rims on bassetite flakes yielded an X-ray powder pattern of metanovacekite. The secondary uranium minerals commonly occur on fracture surfaces that also are coated with limonite and gypsum.

Pyrite and illite were identified in highly radioactive rock by X-ray methods but pyrite, at least, also occurs in nonuraniferous rock from the mine vicinity.

Calcite associated with kaolinite occurs as a fracture filling in the less oxidized parts of the deposit. Crystals of calcite are commonly oriented normal to the walls of the fractures except in the center of the fracture where the crystals are randomly oriented. Some of the calcite is banded and resembles travertine. The kaolinite occurs as masses in the fractures.

White to pale-yellow efflorescent minerals, most likely sulfate minerals, occur on recently exposed rock surfaces.

The radioactivity in the mine workings ranges from 0.2 mr per hour to slightly more than 5.0 mr per hour; background radioactivity is about 0.04 mr per hour. The vertically tabular radioactive zones and the local concentrations of secondary minerals were delineated on the mine map (fig. 8) on the basis of radioactivity measurements of more than 1.0 mr per hour.

Assays of 65 channel samples from the Sue mine range from 0.01 percent

eU_3O_8 to 3.47 percent eU_3O_8 (J. H. Faick, written commun., 1957). Several samples were analyzed chemically and the results suggest that the uranium in the deposit is not quite in equilibrium with its daughter products; the chemical analyses show that U_3O_8 content averages slightly more than eU_3O_8 determinations.

Tomato Juice

The Tomato Juice deposit is in Regal Canyon about 900 feet southeast of its confluence with the Salt River and about 300 feet east of the junction of Regal and Walnut Canyons in the Blue House Mountain quadrangle (fig. 1). The deposit is in the bottom of Regal Canyon at an altitude of about 3,200 feet and about 175 feet above the Salt River. Steep walls rise abruptly for more than 200 feet on both sides of the canyon. Topography along the south wall of the Salt River canyon is rugged, and relief within 1 mile of the deposit is more than 1,800 feet.

In the Blue House Mountain quadrangle, as shown on the topographic sheet, is a road that passes about half a mile east of VABM 4910. Near the end of this road an unimproved mine road turns northeastward on the west side of Walnut Canyon and leads to the tramway overlooking the workings. The roads are passable by passenger car throughout most of the year.

The Tomato Juice deposit is on a group of 24 claims that include the Tomato Juice claims 1-12. They were located and are owned by Frank Lewis, J. B. and W. R. Williamson, and Grady B. Gulledge of Globe. During 1955 and the first half of 1956 the claims were held under lease and option by Uranium Enterprises, Inc. The lessees built a 360-foot tramway from the canyon rim to the deposit and explored the deposit by two adits totaling 275 feet of drifts and crosscuts. Ore mined during late 1955 and stockpiled near the portals of the adits was washed down the canyon by a flash flood. Later about 140 tons of rock that contained about 0.16 percent U_3O_8 was trucked to the ore-buying depot at Cutter. In mid-1956 the lease was relinquished.

Workings consist of two adits that develop the same vein on opposite sides of Regal Canyon (see fig. 19 in Granger and Raup, 1969). The northern adit trends generally N. 22° E. for about 110 feet and has a 15-foot crosscut to the east at about 30 feet from the portal. For the first 60 feet from the portal the adit is a few feet west of the vein; it then continues as a drift to the face. The southern adit is 135 feet long and trends S. 20° W. A 10-foot crosscut to the east about 25 feet from the portal intersects the vein. From the portal to 50 feet the adit is generally a few feet west of the vein then it drifts along the vein to the face.

Strata are nearly flat lying in the vicinity of the Tomato Juice deposit. A well-exposed section of the upper member of the Dripping Spring is exposed in Regal Canyon. The red unit is about 40 feet thick and is overlain by 62 feet of gray facies. The ledge-forming gray sandstone above the gray facies is 38 feet thick and is capped by a fine-grained sandstone which contains coarse-grained lenses and which probably represents the barren quartzite. Above the sandstone is 27 feet of strata that belongs to the black facies but contains numerous coarse-grained sandstone lenses. The Tomato Juice adits are cut into normal black facies just above this 27-foot "transition" unit. The normal black facies is 80 feet thick and is overlain by 60 feet of the buff unit which is capped by 6 feet of green poorly sorted sandstone at the base of the Mescal.

The host rock for the deposit is medium- to dark-gray micaceous siltstone. In some places the rock is spotted by what appear in hand specimen to be aggregates of dark mica. Possibly much of the mica in the rock is the result of metamorphism. Some of the rock is partly recrystallized to a hornfels in an incipient stage of development. Stylolites in the host rock, some of which are transverse to the stratification, are largely filled with a carbon-rich aggregate and lesser amounts of pyrite. A few crumpled shrinkage cracks were noted.

Geologic structure near the deposit is complex. A few hundred feet southeast of the mine is a northeast-striking low-angle reverse fault that dips southeast. The fault is intruded by about 200 feet of diabase. The dip of this diabase dike is so low that the lower contact is nearly concordant where it enters the lower part of the Mescal Limestone on the bluffs overlooking the deposit.

The Rock Canyon monocline is about 2,000 feet west of the deposit. It has a northward trend and an average dip on the limb of about 30° E. Approximately 3,000 feet southwest of the deposit the monocline is cut by the low-angle diabase dike.

About 600 feet north of the deposit is a fault that strikes just north of east and drops down on the north side with respect to the south. Displacement probably does not exceed 100 feet. In the north block, about 700-800 feet due north of the deposit, a 50-foot diabase dike is exposed that dips 20° E. and strikes about N. 30° W. almost in alinement with Regal Canyon. The north end of the deposit is near and trends directly toward the junction of the east-trending fault and diabase dike.

The Tomato Juice deposit and the Rock Canyon deposit about 4,000 feet to the northwest are unique among uranium deposits in the Dripping Spring Quartzite in that a well-defined fissure vein occupies the central part of the ore body. Radioactivity is strong adjacent to the fissure and abnormally high for several feet on either side.

The radioactive vein has been explored for 285 feet which includes the section of the vein crossing the canyon floor. Abnormal radioactivity is traceable vertically for as much as 20 feet throughout which distance the vein is exposed on the canyon walls; stopes extend as much as 11 feet above the floor in radioactive rock near the face of the southern adit.

Strong radioactivity in the vein zone apparently plunges northward in the northern adit and decreases toward the face of the southern adit. The ore body may have the shape of a fan, more than 300 feet long and more than 20 feet high at the apex of its arch. The presence of two radioactive veins at the face of the southern adit suggests the possibility of a deposit to the south in en echelon relation to the main vein.

The central fissure vein within the deposit consists of a narrow ankerite-filled fracture that locally contains a little pyrite, chalcopyrite, and dark-purple fluorite. The fissure is rarely more than 3 mm wide and has irregular undulating walls. In some places it branches and forms two or more subparallel and interconnected fissures in a zone less than 2 inches wide. In unweathered rock a halo of bleached pale-reddish-brown rock about 1 inch wide borders the fissures; this halo grades outward within 3 inches from the fissure into normal medium- to dark-gray siltstone. The fissure and bleached halo are best displayed near the portals of the adits and are less conspicuous near the faces.

The ankerite vein filling is clear to transluscent white for the most part but is locally tinted yellow to brown. The crystals of ankerite are oriented at right angle to the vein walls and terminate as a comb structure near the center of the vein. Where these crystals do not touch, the center is filled with a pyrite-ankerite aggregate. A little calcite is mixed with the ankerite in some places and this effervesces in HCl. Most of the carbonate, however, is nearly unreactive to cold HCl.

Purple fluorite is sparse and is largely in veinlets that branch from the central fissure; it also is disseminated in the wallrock as much as 4-5 inches from the central fissure. It apparently is about the same age as the ankerite.

Pyrite occurs in the veins as cubes, octahedra, and cubes modified by octahedra; it is also disseminated in the wallrock as grains generally less than 0.05 mm across but with a maximum size of 0.25 mm. Ankerite in some places is deposited against euhedral crystals of pyrite and more rarely fills fractures in pyrite that locally lines the vein walls. Some of the pyrite forms a thin layer of grains at the edges of stylolites. Disseminated pyrite occurs as nuclei for chalcopyrite which forms complete and partial rims around it in some places. More rarely pyrite forms what appears to be a thin coating on uraninite blebs disseminated in the wallrock.

Chalcopyrite is present in minute amounts in the ankerite-pyrite veins but is more commonly disseminated in the host rock. Near the surface some of the chalcopyrite is oxidized in part to covellite.

Uraninite is disseminated in the host rock but not in the fissure veins. It is most abundant near the central fissure and grades into insignificance within a few inches. In polished section the uraninite appears as minute rounded blebs and elongate irregular masses about 0.1 mm across. The blebs and masses are a brownish gray with low reflectivity. There seems to be neither an idiomorphic tendency nor a banding in most of the material although three tiny semicircular forms were noted to have the concentric banding and botryoidal forms typical of pitchblende. Some of the uraninite blebs are partly coated with a film of pyrite but no pyrite was noted inside any of the uraninite masses.

Secondary minerals other than limonite are scarce. A yellow radioactive mineral identified visually as uranophane is sparingly present near the surface. Elongate rectangular plates of gypsum form a film on some fracture and bedding planes.

Workman

The Workman deposits are in sec. 19, T. 6 N., R. 14 E. on the north side of Workman Creek (see pl. 2 in Granger and Raup, 1969). Timber and brush cover the steep, southwest-facing slopes on the Workman claims and soil and rubble further obscure bedrock in the area. All the deposits are at an altitude of approximately 6,000 feet, about 400 feet above Workman Creek. Access to the deposits is by many good to poor dirt roads on the north side of Workman Creek. This network of roads and trails is connected to the Globe-Young road about 1 1/2 miles north of Workman Creek and also to the road that parallels Workman Creek.

C. Nichols and others located 16 Workman claims early in 1954. Shortly afterward the Workman group was leased to Arizona Continental Uranium, Inc., which held the lease until May 1956. All the exploration and development work on the property was done by the lessee and consists of the roads, and of location pits, bulldozed benches, and three adits. The underground workings total about 360 feet. Less than 200 tons of ore was shipped from the property; this tonnage represents all production from the Workman mine and came from adit 1.

The three adits are the only significant workings on the property; for ease of description these adits are numbered 1, 2, and 3 in the order that they were dug. Adit 1 is at an altitude of 6,006 feet between the other two adits. Adit 2 is 500 feet N. 72° W. of adit 1 and is at an altitude of 5,985 feet. Adit 3 is 610 feet S. 12° E. of adit 1 and is at an altitude of 5,954 feet.

Adit 1 (see fig. 13 in Granger and Raup, 1969) as we mapped it in June 1955, was about 120 feet long in a N. 17° E. direction. Subsequent work, however, extended the adit to a length of about 155 feet (R. J. Schwartz, written commun., 1957). Beyond about 30-40 feet from the portal nearly the entire length of the adit has been stoped, both above and below. The stopes are irregularly shaped but do not exceed 12 feet above the roof or 6 feet below the floor. In the fall of 1956, the underhand stopes were water filled, blocking access to the most recent workings.

Adit 2 (fig. 9) is a crosscut inasmuch as all the radioactive zones in the area trend north-northeast and the adit trends S. 69° E. for 118 feet. At the end of the adit, the floor slopes upward at a 30° angle for about 25 feet to form an inclined raise.

Adit 3 (fig. 9) is also a crosscut. It trends S. 83 1/2° E. for 85 feet. About 50 feet from the portal an irregularly shaped 6-foot raise has been driven.

The host rock for the deposits is largely hornfels that is dark gray to medium gray where unoxidized. Pyrite or pyrrhotite is locally disseminated in the hornfels as minute grains. In general the rocks strike northward and dip 2°-11° eastward away from the Sierra Ancha monocline. Crumpled shrinkage cracks are locally common. Aplite dikes which are randomly oriented locally cut the hornfels. Some of the hornfels near the contact with the underlying sill-like body of diabase is coarse grained. In adit 1 is a zone of north-northeast-trending dikelets about half an inch wide that are composed of a pink to grayish-pink aplitic rock, possibly mobilized hornfels. Also in the zone are hornfels breccia blocks cemented by the same aplitic rock.

The hornfels and associated metamorphic rocks are metamorphosed black facies rocks. At adit 3, however, the diabase contact is stratigraphically lower and the barren quartzite is exposed. The barren quartzite here consists of about 1 foot of fine- to coarse-grained poorly sorted quartzite. Underlying the quartzite are platy and slabby strata of quartzite and siltstone which are oxidized and bleached where exposed. Pyrite-rich pockets occur just above the barren quartzite in adit 3; the pyrite is oxidized in part to pulverulent and boxwork limonite.

The most prominent fractures in the deposits trend N. 60°-80° W. Minor sets trend N. 10°-20° E. and N. 60°-80° E. Fractures of the N. 60°-80° E. set dip 35°-65° SE., whereas fractures of the other sets are vertical or nearly vertical. Many of the more prominent fractures are filled with as much as 5 inches of gouge, although most of the fillings range from 1/4 to 1 inch in width. The zone of breccia and dikelets in adit 1 is also somewhat shattered. The rock exposed in adit 2 is also partly shattered and is cut by several north-trending shear zones probably related to a nearby discordance in the contact between the diabase and the Dripping Spring.

The stratigraphic position of adit 3 is the only one precisely known. In this adit the barren quartzite is exposed in the roof 20 feet from the portal and dips below muck at 75 feet. Adit 1 is in black facies rock and by calculation, is about 25 feet stratigraphically above the barren quartzite. Adit 2, although apparently in black facies rock, is by calculation stratigraphically below the barren quartzite. This would suggest that adit 2 is in a fault block that has been relatively down-dropped at least 25 feet. This movement probably took place along a fault that was intruded by diabase and now is a north-trending discordant body of diabase about 100 feet east of the portal of adit 2. The west side of the discordant diabase is steep where it is exposed near the face of adit 2 and is defined by a thin aplite dike.

The upper contact of the diabase that underlies the property is slightly discordant east and south of the abrupt discordance. Near the portal of adit 1 the contact between the diabase and the Dripping Spring dips as much as 45° NE., whereas the strata dip only about 11° NE.; in the adit the contact where exposed is moderately irregular. Further evidence of discordance is the considerable difference in the stratigraphic horizon along which the diabase intruded at adits 1 and 3. The intruded horizon at adit 1 is about 70 feet higher than that at adit 3, indicating an average discordance of about 5°.

The principal deposit on the Workman claims is exposed in adit 1. For the first 60 feet in the adit the deposit is in and adjacent to a N. 17° E. trending poorly defined zone of mobilized hornfels dikelets and breccia cemented by the same type of rock. Beyond 60 feet the radioactivity decreases but abnormally high radioactivity can be traced to the end of the drift, as we mapped it in June 1955. The radioactive zone, which is nearly vertical throughout the adit, is more continuous than any other mappable feature in the adit. Beyond about 80 feet from the portal it can be traced only on the basis of abnormally high radioactivity; no continuous structural feature can be noted that is related to the radioactivity. A face examined in minute detail during mining showed that the stratification crossed the radioactive zone with no apparent break. The only thing different about the radioactive zone was a local slight increase in the degree of oxidation which caused an irregular sodic aplite dike in the zone to be locally slightly more iron stained than the rest of the rock in the face. Weak fractures in the face seemed to be totally unrelated to the radioactivity and therefore may postdate mineralization.

The ore body mined from the first 70 feet of adit 1 was 2-3 feet wide and about 10-15 feet high. The ore bottomed on the underlying diabase. In a stope 70 feet from the portal, the top of the ore-grade rock plunges steeply to the north and the radioactive zone from there on to the face becomes progressively weaker. Long holes drilled laterally from the drift failed to intersect a continuation or an offset of the radioactive zone.

Uraninite and coffinite are the primary uranium minerals in the deposit in adit 1. Coffinite has been identified in only one specimen by X-ray methods (L. R. Stieff, written commun., 1955). The uraninite, however, forms visible irregularly shaped veinlets and small blebs in the hornfels in and adjacent to the zone of dikelets and breccia; it is associated with pyrrhotite and less abundant chalcopyrite, marcasite, and molybdenite. The marcasite occurs as a concentric banded replacement of partly decomposed pyrrhotite. The sulfide minerals are disseminated throughout the host rock, but they are especially abundant in and near the dikelets. At the surface the secondary uranium minerals uranophane and metatorbernite are associated with limonite and gypsum in fractures. Uraniferous hyalite is locally present as a coating on stratification planes.

Adit 2 crosscuts the most common trend for radioactive zones in the Workman vicinity and intersects, at 25 feet from the portal, a zone of radioactivity that trends N. 14° E., which may be the same zone that is exposed at the surface above the adit. The intersected zone is only about 1 foot wide and is only moderately radioactive. No structural control or uranium-bearing minerals were noted. Aside from this one weak zone the radioactivity in the adit is very low, possibly caused in part by the highly broken and oxidized condition of the host rock.

Adit 3 exposes moderately radioactive rock that is locallized just above the barren quartzite. Although the deposit seems to be of the blanket type there is a considerable increase in radioactivity between 50 and 60 feet from the portal, which area is directly below a N. 17° E. trending zone of radioactivity noted on the surface. Thus, it appears that the deposit is vertically tabular for the most part but spreads out in the strata just above the barren quartzite. The highest radioactivity noted underground was in a pyrite-rich bed just above the quartzite. The character of the vertical part of the deposit could not be checked because of the lack of exploration workings. In any event, the tenor of the deposit is fairly low, perhaps caused in part by the moderately high degree of oxidation that has affected the host rocks. No uranium-bearing minerals were noted in the workings but sparse metatorbernite was found in the dump.

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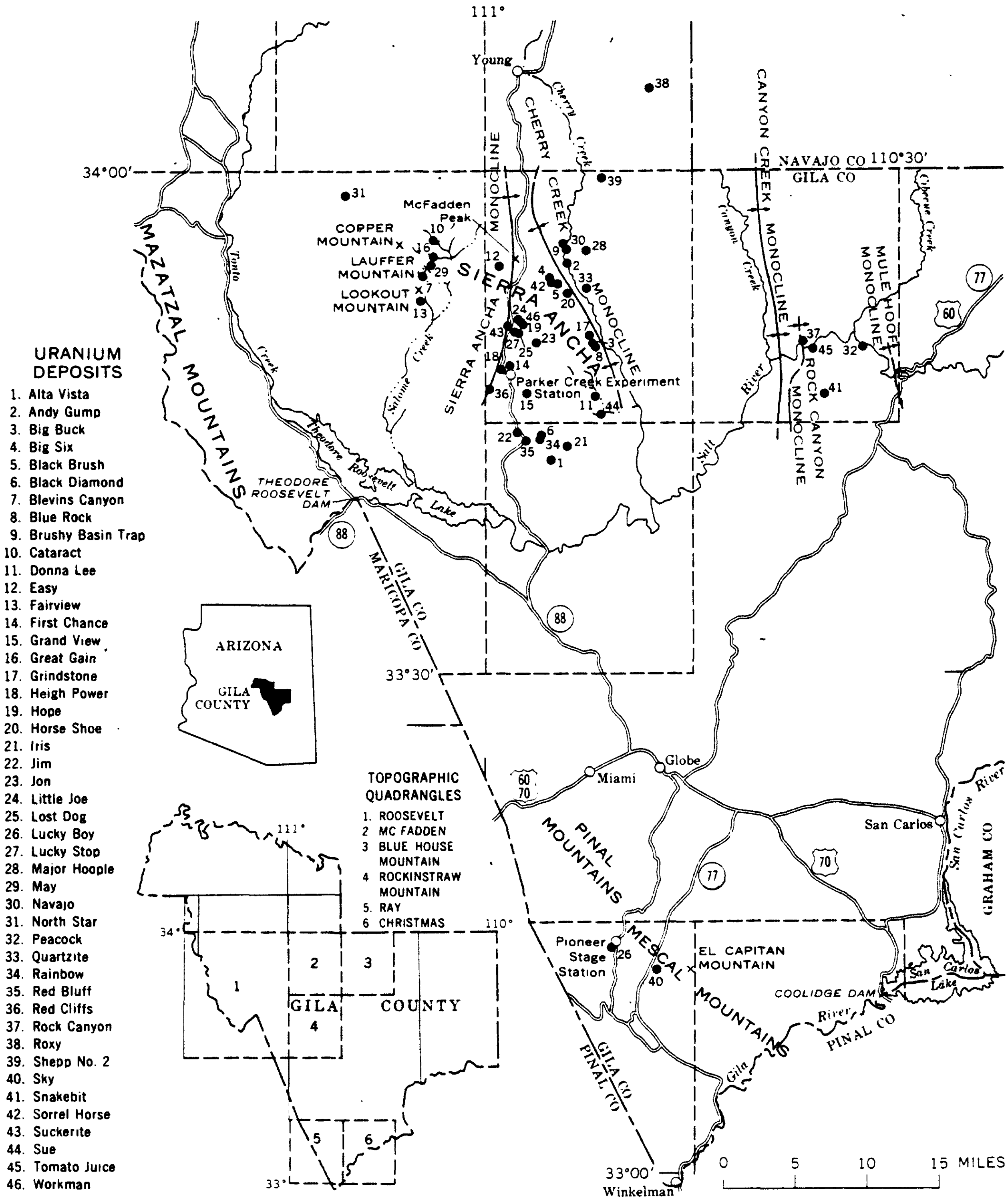

Figure 1.--Index map showing uranium deposits in Gila County, Arizona

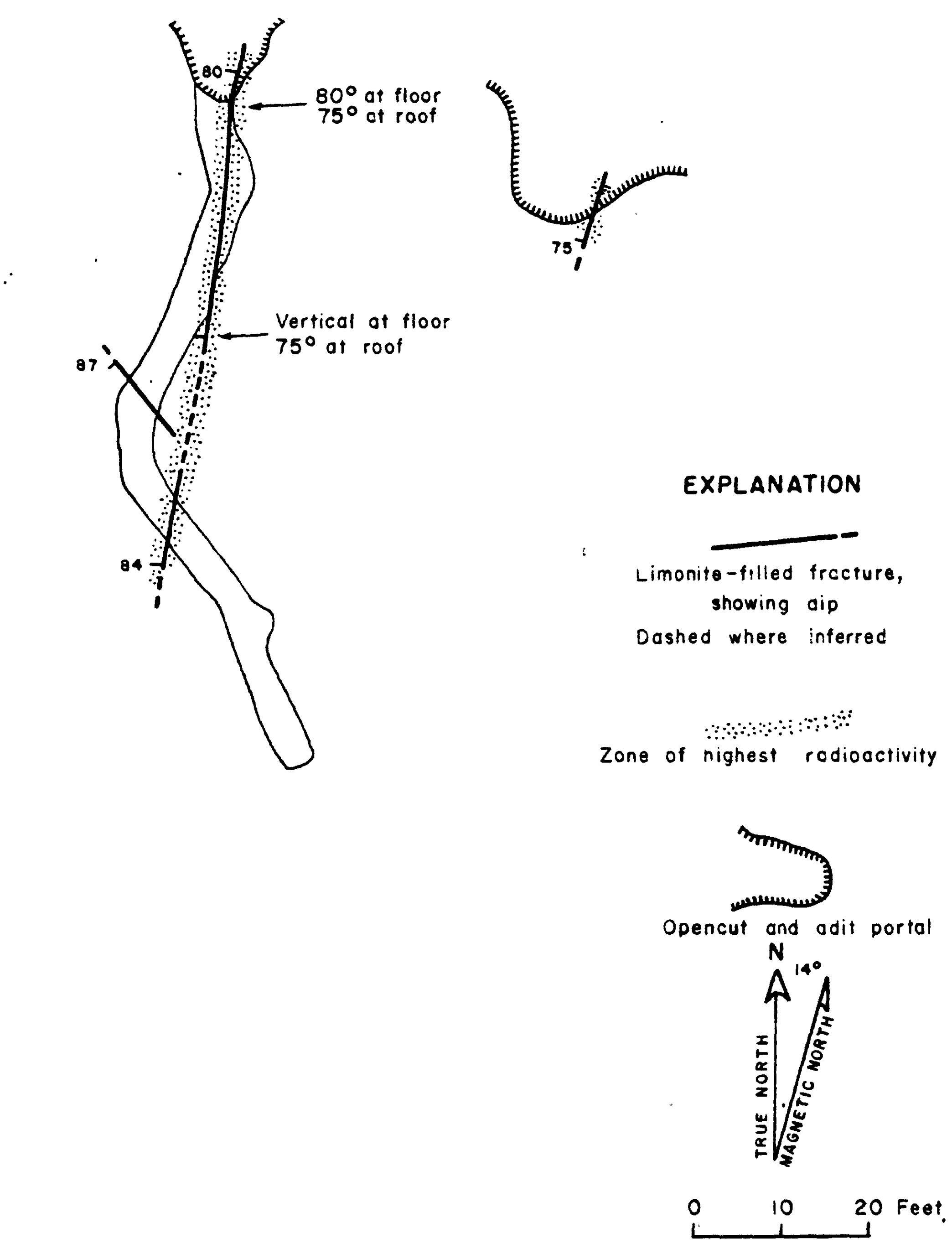

FIGURE 3.--GEOLOGIC MAP OF ADIT AND PROSPECT PIT, IRIS DEPOSIT