# Mineral Resources of the High Uintas Primitive Area Utah

GEOLOGICAL SURVEY BULLETIN 1230-I

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*By* MAX D. CRITTENDEN, JR., *and* CHESTER A. WALLACE, U.S. GEOLOGICAL SURVEY, *and* M. J. SHERIDAN, U.S. BUREAU OF MINES

STUDIES RELATED TO WILDERNESS

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*An evaluation of the mineral potential of the area*

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# STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, Sept. 3, 1964) and the Conference Report on Senate bill 4, 88th Congress, direct the U.S. Geological Survey and the U.S. Bureau of Mines to make mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe," when the act was passed, were incorporated into the National Wilderness Preservation System. Areas classed as "primitive" were not included in the Wilderness System, but the act provided that each primitive area should be studied for its suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. This bulletin reports the results of a mineral survey in the High Uintas primitive area, Utah. The area discussed in the report corresponds to the area under consideration for wilderness status. It is not identical with the original High Uintas Primitive Area as defined because modifications of the boundary have been proposed for the area to be considered for wilderness status. The area that was studied is referred to in this report as the High Uintas primitive area.

This bulletin is one of a series of similar reports on primitive areas.

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By MAX D. CRITTENDEN, JR., and CHESTER A. WALLACE, U.S. Geological Survey ,and M. J. SHERIDAN, U.S. Bureau of Mines

## SUMMARY

The High Uintas ~~primitive area~~—High Uintas Primtive Area and the additional area that has been proposed for inclusion into the National Wilderness System—occupies approximately 500 square miles along the crest of the Uinta Mountains in northeastern Utah. A survey of its mineral resources was carried out by the U.S. Geological Survey and the U.S. Bureau of Mines during August 1965 and by the U.S. Geological Survey during July 1966.

The area that was studied contains no known mines or mineral deposits. Geological studies extending from 1876 to 1963, reviewed and supplemented by reconnaissance and sampling in 1965 and 1966, have yielded no evidence of undiscovered or potential mineral resources of commercial significance. Neither the surface geology nor geophysical studies made in connection with this examination have revealed any element of the geologic environment favorable for the existence of ore deposits at depth.

Bedrock within the primitive area consists entirely of sedimentary rocks assigned to the Uinta Mountain Group and classed as younger Precambrian in age. These rocks are mainly quartzite and arkose but include some shale. Despite their great age, they show remarkably little evidence of regional metamorphism. About 10,000 feet of such rocks is exposed within the area, and from evidence in nearby areas, an additional 15,000 feet is inferred to lie between the exposed sequence and the underlying crystalline Precambrian basement.

The primitive area lies astride the crest of the Uinta Mountains, which structurally is a great elongate east-trending fold bordered on its north and south flanks by nearly vertical faults. The area lies entirely within the uplifted structural core of the range and thus does not contain the sequences of younger rocks that flank the range beyond the bordering faults. In most places the north boundary of the area is 3 to 4 miles south of the North Flank fault, and the south boundary is 1 to 3 miles north of the South Flank fault.

Small iron deposits occur in places along the boundary faults, 1 to 5 miles from the primitive area. Small faults are numerous within the boundary zones, but none contain mineral deposits or show any physical or chemical evidence of the passage of mineralizing solutions.

Aeromagnetic and gravity studies also give no indication of mineralized areas within the primitive area, nor do they indicate any shallow igneous bodies similar to those assocated with mineralized deposits in the Park City and Cottonwood mining districts, 30 to 40 miles to the west.

The area could provide a source for ornamental stone or quarrystone, but the abundance of similar materials in and near the populous areas of Utah makes their exploitation both unlikely and unnecessary. Record was found of one unpatented claim in the area, located in 1954; it was staked on a small deposit of specular hematite that has no economic significance. No mineral deposits have been found in the area, and no mineral potential is indicated.

# GEOLOGY AND MINERAL RESOURCES

By MAX D. CRITTENDEN, JR., and CHESTER A. WALLACE, U.S. Geological Survey

## INTRODUCTION

### PURPOSE AND SCOPE OF REPORT

The U.S. Geological Survey and the U.S. Bureau of Mines conducted a mineral survey of the High Uintas primitive area, Utah, during August 1965 and July 1966 to verify existing reports on the rocks and structures of this area and to determine whether there may be undiscovered or potential mineral resources. The examination was done by making a geological reconnaissance of the area, mapping the faults of measurable displacement as far as they could be traced, and sampling the fault zones for their mineral content. The present report primarily concerns the mineral potential and hence only summarizes the geology.

### LOCATION AND ACCESS

The High Uintas primitive area—High Uintas Primitive Area and the additional area that was studied (fig. 1)—is in the west part of the Uinta Mountains, Utah, and extends from near Mirror Lake on the west to the vicinity of Fox Lake on the east, a distance of 41 miles, and from the vicinity of Grandaddy Lake on the south to a point 2 miles north of North Burro Peak on the north, a distance of 20 miles. The total area of 505 square miles includes the highest point in Utah, Kings Peak (revised alt, 13,528 ft), and the headwaters of the Provo, Weber, Duchesne, Uinta, and Bear Rivers, the sources of most of the surface water used in Utah.

Roads reach within half a mile of the west edge of the area at Mirror Lake, within 2 miles at Rock Creek on the southwest edge, within 6 miles at Moon Lake near the center of the south edge, and within 3 miles at the Uinta River at the southeast edge. At many other places the primitive area, at distances of 3 to 10 miles from the road end, may be reached by trail. Trails suitable for horses reach most parts of the area, though many are extremely rough and travel is slowed by fallen timber at the beginning of each season. In years of late or heavy snows, such as 1965, certain passes over the crest of the range (for example, Dead Horse Pass, fig. 2) cannot be traversed by horse throughout the summer. Certain passes between drainages (for

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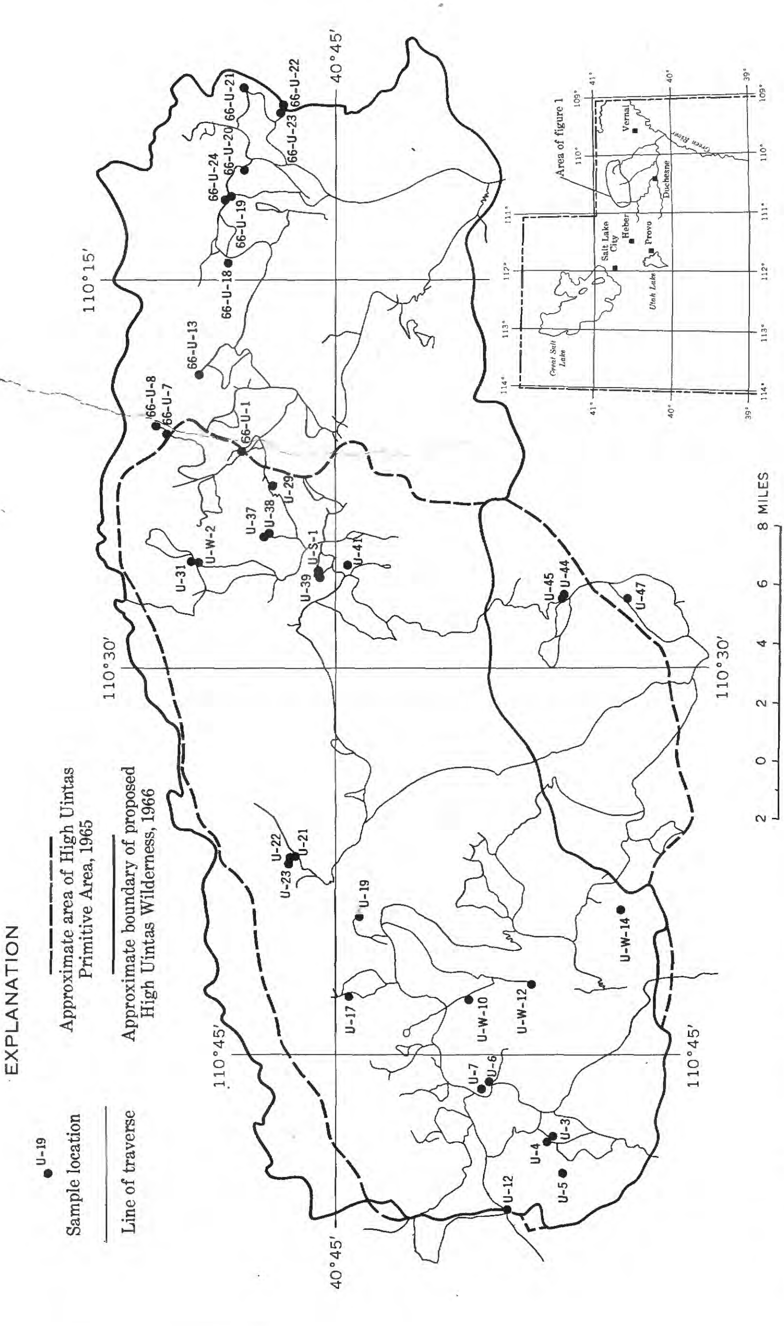


FIGURE 1.—Location of the High Uintas primitive area (proposed High Uintas Wilderness), geologic traverses, and samples.


FIGURE 2.—Cirque basin at head of the Blacks Fork of the Green River.

example, Rocky Sea Pass) may not open until mid-August. Areas below about 11,000 feet are wooded and moraine covered, and except on established trails travel in them is difficult because of the fallen timber and the jumbled masses of coarse rock debris. Above 11,000 feet, there is much open meadowland, and travel is unimpeded except locally by ledges or cliffs.

## PHYSICAL FEATURES

The High Uintas primitive area straddles the main divide of the Uinta Mountains, near the western end of the range. As a result, streams arising in this area extend almost radially in all directions except east. In the mountainous area each stream canyon consists of a lower segment, which is 5 to 7 miles long and ranges in depth from 1,000 to 2,500 feet, and an upper segment commonly with several branches that head in semicircular steep-walled basins, or cirques. As a result of glaciation, the lower segment of most stream valleys has a characteristic U-shaped profile, and the canyon walls are steep and rugged. The upper segment of each canyon, particularly south of the divide, opens out into broad meadowland commonly near or above timberline. Glaciation here produced extensive areas of rock pavement and hundreds of rock-rimmed lakes. The gently sloping basins or cirques are separated from each other and from similar areas at the heads of adjoining canyons by steep-walled narrow ridges. These narrow ridges commonly meet in higher peaks, many of which range in altitude from 11,000 to 13,000 feet.

The forest cover between 7,000 and 10,000 feet is extremely dense in much of the area, and the dominant species are lodgepole pine and aspen. Above about 10,000 feet, spruce and fir predominate; these in general form more open forest and give way to scattered clumps of stunted trees as timberline, averaging 11,500 feet, is approached.

Near the crest of the range, the ridges or aretes are commonly narrow with little or no flat area on their crests. Near the flanks of the range, however, many smoothly rounded elevated surfaces and flat ridge crests are preserved. Such areas are commonly covered by a mantle of broken rock—ranging from a few inches to a foot or two in size—which results from severe and long-continued frost action. Where vast areas are covered by these rocks (fig. 3), travel by horseback is limited.

Rock exposures are nearly continuous along many of the stream canyons and along most of the narrow interstream ridges. In the intervening benchlands, rock exposures are intermittent and depend on the extent of the glacial moraine and forest cover.

Innumerable lakes dot the upper reaches of most of the canyons in the primitive area and are among its most characteristic and attractive


FIGURE 3.—Kings Peak, highest point in Utah, overlooking head of Yellowstone Creek; expanses of broken rock in foreground mantle many rounded ridge crests.

features. Virtually all the takes of glacial origin formed where the ice scooped shallow basins out of solid bedrock. Most are entirely natural; a few have been deepened artificially to increase their storage capacity. Their presence contributes a large measure of the value of this area as a natural resource, both for recreation and water supply.

## INVESTIGATIONS

### PREVIOUS STUDIES

The earliest geological work in the Uinta Mountains was that of the territorial surveys begun along the Green River in 1869 by Powell (1876), and in the west end of the range by Emmons with Hague (1877). Several papers on the stratigraphy and structure appeared between that time and the turn of the century (see Berkey, 1905), but little work was done in the center of the range. Emmons (1907) and Weeks (1907) recognized the rocks in the core of the Uinta Mountains as Precambrian and correlated them with similar rocks of the Grand Canyon Series in Arizona. The glacial geology of the range was early described by Atwood (1909) and has had little attention since that time. A geological map of the Uinta Mountains published by Forrester in 1937 shows the major structural features of the primitive area, including the Uinta Crest fault. Detailed maps of a strip along the southernmost boundary of the primitive area were published by Huddle and McCann (1947) and by Huddle, Mapel, and McCann (1951). Although the principal objective of this latter work was the study of strata that might be possible source rocks for oil and gas in the adjoining Uinta Basin, the maps leave no doubt that iron prospects along the south flank of the range are associated with the South Flank fault rather than with structures that extend into the primitive area. A generalization of the geology of the Uinta Mountains also appears as part of the "Geologic Map of Utah, Northeast Quarter" (Stokes and Madsen, 1961). The map includes the unpublished work of a number of university students together with reconnaissance carried out on behalf of the University of Utah specifically for this map. The results of ground-based gravity and magnetometer surveys were reported by Behrendt and Thiel (1963).

### PRESENT INVESTIGATION

A mineral survey of the original High Uintas Primitive Area extending from Mirror Lake to Gilbert Peak was made during August 1965; the survey party consisted of a geologist and an assistant, supported by a packer. The party was joined by an engineer of the U.S. Bureau of Mines during the second 2 weeks. A total of 508 traverse miles were covered by the party at that time. The area between Gilbert

Peak and the eastern boundary of the proposed wilderness was examined by the U.S. Geological Survey between July 10 and 24, 1966. An additional 330 traverse miles were covered at that time.

Geological mapping was done on aerial photographs, and the data were transferred to topographic base maps at a scale of 1:125,000.

## GEOLOGY

### STRATIGRAPHY

All the rocks exposed in the High Uintas primitive area are younger Precambrian in age. Sedimentary rocks of Cambrian and Mississippian age occupy a narrow strip near the boundary of the area south of Brown Duck Lake. The total thickness of sedimentary rocks represented is approximately 12,000 feet, of which about 10,000 feet is Precambrian. Rocks of Ordovician, Silurian, and Devonian age are absent. Rocks of Pennsylvanian and Permian age and most of the Mesozoic stratas are exposed both north and south of the primitive area but are not present within it. The consolidated rocks are overlain throughout the entire area by Quaternary deposits—largely moraine, talus, and rock pavement—but these younger rocks are omitted from the geologic map (pl. 1).

#### UINTA MOUNTAIN GROUP

Precambrian rocks of the Uinta Mountain Group underlie the entire area of the High Uintas primitive area. These rocks consist largely of quartzite or sandstone and contain smaller amounts of interbedded shale, siltstone, or argillite (fig. 4). The predominant color of rocks throughout the entire area is grayish red grading locally into brick red, pale lavender gray, or less commonly pale buff or white. The predominant color of the interbedded shales and argillites is grayish red, dark gray, or olive drab.

The base of the Uinta Mountain Group is nowhere exposed in the area. To the west in the Wasatch Range, its probable equivalent, the Big Cottonwood Formation, rests on a metamorphic terrain consisting of schistose quartzite and amphibolite, there termed the Little Willow Formation (Crittenden and others, 1952; Crittenden, 1965). To the east near Flaming Gorge, rocks of the Uinta Mountain Group rest on a still more highly metamorphosed terrain consisting of garnet-bearing gneisses and quartzites called the Red Creek Quartzite by Powell (1876); this terrain is exposed along the Green River east of Flaming Gorge Reservoir (Hansen, 1965). The total thickness of the Uinta Mountain Group in the primitive area is probably intermediate between that in the Wasatch Range (15,000 ft) and that along the Green River (26,000 ft). The maximum thickness exposed, however, is approximately 10,000 feet.

FIGURE 4.—Flat-lying rocks of the Precambrian Uinta Mountain Group in cirque wall above Red Castle Lake.

To determine the extent and significance of faulting in the High Uintas primitive area, the Uinta Mountain Group was divided into several informal members; these units were traced across as much of the area as possible. Six major units were established (pl. 1). Beginning at the base these are as follows:

Unit 6 (+1,700 ft), best exposed near Red Castle, consists of very poorly sorted pebbly arkose (microcline dominant) intercalated with fine-grained arenaceous shale, shaly siltite, and very fine grained thin-bedded quartzite. All are brick-red to dark-grayish-red. Arenites are predominant in the Red Castle area, whereas shale dominates in Henrys Fork.

Unit 6 is believed to grade southwestward into the lower part of unit 5, which consists of thick beds of quartzite with intercalated argillites (subunits 5c through 5a). These become thick and well defined enough to map from approximately the crest of the range southward. The quartzite of unit 5 is grayish red to lavender gray, dense, and medium to fine grained—the lower parts becoming more coarse grained and feldspathic to the north. Subunit 5c (400 ft) is exposed in the area above the intersection of the Duschene River with the boundary of the original High Uintas Primitive Area. It is dominantly dark- to brick-red or dark-olive-black shale and siltite with beds of grayish-red coarse-grained arkosic sandstone that are 6 inches to 4 feet thick. Subunit 5b (200 ft) consists of thin-bedded finely laminated dark-grayish-red to brick-red siltite and fine-grained quartzite; locally the basal part is dark olive gray. Subunit 5a (200 to 600 ft) consists of finely laminated thinly bedded dark-red to brick-red shale, siltite, and fine-grained quartzite, with minor intercalations of dark-olive rocks of the same lithology. The top of unit 5 is locally white to buff and thus contrasts strongly with the overlying beds.

Unit 4 (200 to 600 ft) is a lenticular thin-bedded laminated sequence of micaceous shale, siltite, and quartzite which is brick red at the bottom and light-olive-gray to blackish-gray at the top. To the northeast, unit 4 contains a medial grayish-white to buff quartzite which ranges in thickness from 20 to +100 feet.

West of Swift and Yellowstone Creeks, unit 4 is overlain by unit 3 (1,000 to 1,200 ft), which is a sequence of fine- to medium-grained moderate-grayish-red dense quartzites. The bleached variety of unit 3 is mapped as subunit 3w but, aside from its color, maintains the same lithologic characteristics as subunit 3r. Unit 2 (5,000 to 6,000 ft) overlies subunits 3r and 3w in the southwestern part of the area; however, east of the Yellowstone-Swift Creek area, the two subunits are indistinguishable and unit 2 directly overlies unit 4. Unit 2 is a dark-brick-red to dusky-red locally poorly sorted medium- to coarse-grained quartzite that generally contains distinctive quartz granules and pebble lenses. This unit is commonly friable and contains abundant primary bedding features. Some horizons contain thin intercalations of siltstone and fine-grained quartzite that are locally dark grayish red or moderate grayish olive.

The youngest rocks in the Uinta Mountain Group, here designated unit 1 but called the Red Pine Shale by Williams (1953), consist principally of brown, gray, or olive-drab shale intercalated with thin-bedded rusty-weathering quartzite and siltstone. This unit ranges from 0 to about 3,000 feet in thickness depending on the position of the South Flank fault and the amount of erosion beneath the unconformity at the base of the overlying Cambrian rocks. The rocks of unit 1 were formerly assigned to the Cambrian (Huddle and others, 1951) but have more recently been shown to be Precambrian by Williams (1953) and Stokes and Madsen (1961). The Precambrian age of this unit was confirmed during this study by relations observed on the ridge crest between Lake Fork and Rock Creek about 5 miles west of Moon Lake.

### TINTIC QUARTZITE AND YOUNGER SHALE AND LIMESTONE

The oldest Cambrian rocks in the area consist of gray to buff-weathering coarse-grained quartzite assigned to the Tintic Quartzite. This unit is less than 100 feet thick just south of the dam at the south end of Moon Lake but may be as much as 300 feet thick on the divide about 5 miles west of Moon Lake. It is characterized by an abundance of coarse well-rounded granules of frosted quartz ranging in size from about $1/8$ to $1/2$ inch. The granules weather out of the matrix and accumulate as distinctive rounded grains throughout the soil. Near the dam at Moon Lake, this unit rests with apparent conformity on shale of unit 1 of the Uinta Mountain Group. On the divide west of Moon Lake, however, the unconformity at the base of this unit has an angular discordance of about 20° and has cut down across the entire thickness of the shale to rest unconformably on coarse-grained red quartzite in the upper part of unit 2. The upper part of the Tintic Quartzite at this locality consists of buff-weathering fine-grained uniformly bedded quartzites that show abundant *Scolithus* and fucoidal markings. These are overlain with gradational contact by shale, limy sandstone, and limestones that are probably equivalent to part of the Ophir Formation of central Utah. They show the wavy bedding characteristic of Cambrian rocks throughout the Rocky Mountains. The youngest rocks of Cambrian age at this locality are about 300 feet of light- to dark-gray thin-bedded impure limestones that are tentatively correlated with the Maxfield Limestone of the Wasatch Mountains (Calkins and Butler, 1943, p. 14). The total thickness of beds assigned to the Cambrian in the area is less than 600 feet.

### MISSISSIPPIAN ROCKS UNDIVIDED

Thin- to medium-bedded light- to dark-gray limestones assigned to the Madison Limestone of Mississippian age overlie the Cambrian rocks without apparent unconformity on the divide west of Lake Fork. Locally, this unit may include rocks younger than the Madison Limestone. Although a total thickness of nearly 1,000 feet of these rocks is present to the south, only a few hundred feet is exposed along the southern boundary of the original primitive area (pl. 1). Nowhere else do Paleozoic rocks come closer to the boundary than a few miles.

## STRUCTURE

The Uinta Mountains have long been recognized to consist of a broad gentle east-trending arch with nearly flat-lying older rocks in the center and more steeply dipping younger rocks along the margins. This structure extends from Kamas on the west to the Colorado border on the east, a distance of more than 100 miles. The area described in this report is near the west end of the arch (fig. 5). The north and south flanks of the range are approximately parallel and about 28 miles apart. They are marked by fracture zones or faults designated, respectively, the North Flank and South Flank faults. Movement along these faults has elevated the older rocks of the central part of the range with respect to the younger rocks to the north and south. For the most part, these are normal faults that dip outward from the range; locally they may be steep reverse faults.

The general attitude of the sedimentary rocks reflects the archlike structure of the range; dips are nearly flat near the center, average 10° or less over very large areas particularly to the south, and increase to 30° near the boundary faults. Around the west end of the range, the dips swing concentrically to form a westward-plunging nose or closure of the anticlinal fold. This structural arch is illustrated on the map and sections (pl. 1).

Aside from the Uinta arch itself, the largest and most significant structural feature anywhere close to the primitive area is in the South Flank fault. This is a steep normal or reverse fault system that extends almost the full length of the range, along which Paleozoic rocks are faulted against the Precambrian rocks. Breccia zones along the fault are the sites of most of the small iron deposits known on the south side of the range.

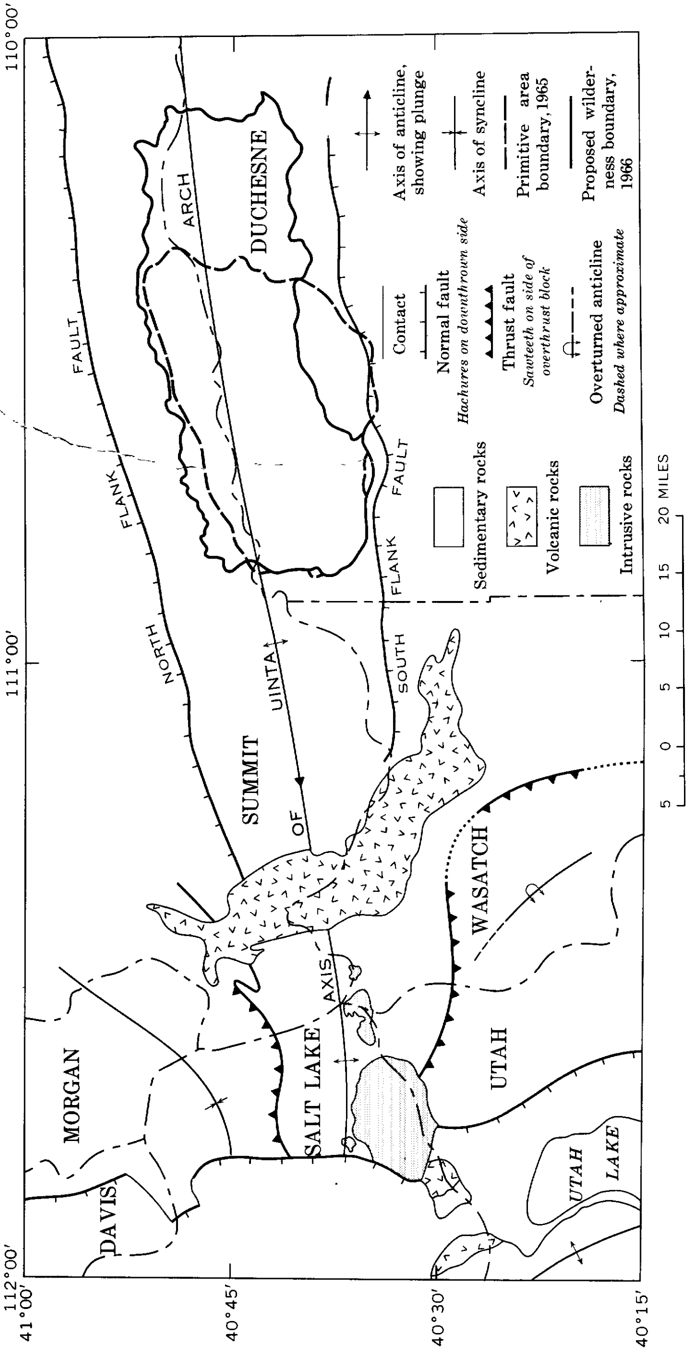


FIGURE 5.—Structural setting of the High Uintas primitive area.

The Uinta Crest fault (Forrester, 1937, p. 645; fig. 6) is a system of high-angle branching and braided faults that extends across the primitive area approximately from Hayden Peak on the west to a point a mile north of Gilbert Peak on the east. The average strike of the zone is N. 70° E., but individual faults range in strike from N. 50° E. to approximately east; they dip either north or south at angles of 60°. Neither the total displacement nor the direction of movement on the Uinta Crest fault is known with certainty, although it is probable that the north side is downthrown about 2,000 feet.

A number of smaller faults mainly striking east or northeast have been mapped in other parts of the area (pl. 1). The displacement along these faults is small, generally 200 feet or less. In the basin of Yellowstone Creek, a series of north-northwest-trending faults were noted. So far as is known the faults of this system do not cross either the Crest fault or the South Flank fault.

Near the east end of the primitive area between Rainbow and Fox Lakes is an intricate system of small faults and grabens. They form an intersecting set whose elements strike approximately N. 60° W. and N. 60° E., respectively. The displacements are generally a few hundred feet or less. Topographic lows, formed along the fault zones, delineate each of the passes leading from Fox Lake north across the crest of the range and east into the basin of Whiterocks Creek.

Although most of the faults within the primitive area can be traced with certainty for several miles because of their consistent offset of stratigraphic units, actual exposures of the fault surface or the surrounding breccia zone can be seen in detail only in ridge crests or streambeds. In these places they range from comparatively simple fractures marked by slickensided surfaces to zones of crushed rock a few feet to as much as 20 or 30 feet wide.

## MINERAL RESOURCES

### KNOWN MINERAL DEPOSITS

No mineral deposits are known to occur within the High Uintas primitive area. The nearest mining district is at Park City, some 30 miles to the west, and although that district and others farther west are alined along the extension of the Uinta structural axis, neither the intrusive nor the volcanic rocks associated with those districts extend into the Uinta Mountains.

A few small deposits of iron oxide have been found within the Uinta Mountains outside the boundaries of the primitive area, but none of these have yielded significant production. Probably the best known of these iron oxide deposits is on the Rhodes Plateau in Wasatch County, west of the Duchesne River, about 7 miles southwest from the


FIGURE 6.—Uinta Crest fault, crossing ridge at head of the Blacks Fork of the Green River.

edge of the area that was mapped. This deposit is reported to have yielded 500 tons of iron ore for paint pigment in 1879. It was worked as recently as 1953, but there is no record of further shipments.

A similar deposit, the "Paint mine," is on the South Flank fault about 2½ miles west of Moon Lake and about half a mile south of the primitive area. Although Huddle, Mapel, and McCann (1951) reported that pods of hematite in the breccia zone along the fault were being worked during the summers of 1947 and 1948, no shipments are on record. Present conditions at this property are described on pages I24–I25.

The only prospect within the primitive area is about 250 feet northwest of the trail leading from Tungsten Pass into the upper basin of Yellowstone Creek and is assumed to be on the Red Castle claim. It consists of a cut 30 feet long and at most 12 feet deep extending S. 30° E. into the north slope of a low bedrock ridge at the south rim of the small lake just east of Tungsten Pass. The face of the pit and last few feet expose a breccia zone 4 to 6 feet wide that strikes N. 60° E. and dips 65° NW., cutting grayish-red crossbedded quartzite near the top of unit 5 of the Uinta Mountain Group. The breccia is cemented by layers and crusts of specular hematite, but at most this mineral constitutes only 10 to 20 percent of the rock. A sample of the better part of the breccia zone contained a few tens percent iron and trace amounts of other metals (U–41, table 1). Traces of hematite can be followed along strike for a maximum of 120 feet from the cut. Neither the conditions at the outcrop nor the analysis suggests that this material has any economic potential.

A small deposit of manganese oxides occurs in the SW¼ sec. 33, T. 3 N., R. 5 W., about 5 miles outside the primitive area. Indications of prospecting at this locality consist of pits at the outcrop. Neither the date nor the origin of the work is known. Mineralization extends over an area 100 feet or so in diameter. The best material contains 10 to perhaps 30 percent maganese, 10 percent barium, 2 percent iron, and traces of other metals (U–47, table 1), but the average grade does not exceed a few percent manganese.

### "TUNGSTEN" PROSPECT

Because of the persistent reference to tungsten (Tungsten Lake and Tungsten Pass) on maps prepared by the U.S. Forest Service, the area on the divide near the headwaters of the Yellowstone River was examined closely to determine the reason for this designation. Except for the previously mentioned fault-controlled occurrence of specular hematite on the Red Castle claim and a few scattered occurrencies of similar materials to the west, no evidence was found to indicate that tungsten is present in this area. The total absence of igneous rock or of any of the alteration and metamorphic minerals commonly associated with the tungsten mineral scheelite virtually eliminates the possibility of the occurrence of this mineral. It seems most likely that the names originated because the specular hematite that does occur here was mistaken for wolframite or hubnerite—tungsten minerals that are somewhat smiliar to specular hematite in appearance.

## OIL AND GAS

Early in 1966, a major oil field was discovered by Phillips Petroleum Co. in sec. 25, T. 3 N., R. 14 E., 6½ miles north of the boundary of the proposed wilderness and 1½ miles north of the North Flank fault. On December 1, 1966, oil and gas leases around the fringes of this discovery covered part of the following sections along the northern edge of the proposed wilderness: Sec. 6, T. 1 N., R. 13 E.; secs. 5 and 6, T. 1 N., R. 14 E.; secs. 34, 35, and 36, T. 2 N.; R. 13 E.; secs. 31–36, T. 2 N., R. 14 E.; secs. 31, 33, 35, and 36, T. 2 N., R. 15 E.; and sec. 31, T. 2 N., R. 16 E. These leases are in areas of Precambrian rocks 5 to 6 miles south of the North Flank fault. There is no evidence that this fault is a flat thrust of the type that would be required to permit petroleum-bearing rocks to extend beneath the proposed wilderness.

## SAMPLING AND RESULTS

A number of samples were collected to evaluate further the possibility that deposits of useful or potentially useful minerals might exist in this area. The locations from which these samples were taken are indicated in figure 1. The description of the samples and the resulting analyses are contained in table 1.

Because rocks of the Uinta Mountain Group, which underlie the entire High Uintas primitive area, are widely exposed both here and in the adjoining Wasatch Mountains to the west, and nowhere have been found to contain any suggestion of bedded deposits of value, no attempt was made to sample these stratigraphic units systematically. On the other hand, because most of the ore deposits of western Utah are associated with faulting, fracturing, and brecciation, samples were obtained from several of the larger faults and fracture zones within the primitive area.

To screen the samples effectively for mineral values, all were subjected to routine semiquantitative spectrographic analysis. Samples from the area contain silicon, aluminum, and iron, and the alkalies, sodium, potassium, and magnesium, in amounts that are normal for the rocks that were sampled—feldspathic or arkosic quartzite of the Uinta Mountain Group. A single sample, that from the manganese

TABLE 1.—*Semiquantitative spectrographic analyses of*

[For sample locations see fig. 1. M, major constituent

| Sample No. | Parts per million | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B | Ba | Be | Cr | Cu | Ga | La | Mn | Ni | Pb | Sc | Sr | Ti | V |
| U-3 | 20 | 70 | 0 | 7 | 10 | 0 | 0 | 100 | 0 | 0 | 0 | 5 | 300 | 10 |
| U-4 | 70 | 70 | 0 | 7 | 30 | 0 | 0 | 20 | 7 | 30 | 0 | 10 | 500 | 150 |
| U-6 | 30 | 150 | 0 | 700 | 10 | 3 | 0 | 15 | 7 | 30 | 0 | 10 | 700 | 100 |
| U-7 | 50 | 200 | 0 | 70 | 15 | 5 | 0 | 10 | 3 | 30 | 0 | 15 | 1,000 | 70 |
| U-12 | 10 | 50 | 0 | 7 | 30 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 150 | 0 |
| U-17 | 10 | 100 | 0 | 20 | 15 | 0 | 0 | 20 | 5 | 0 | 0 | 0 | 700 | 50 |
| U-19 | 30 | 300 | 0 | 20 | 20 | 10 | 0 | 70 | 15 | 0 | 0 | 20 | 500 | 50 |
| U-21 | 70 | 500 | 1.5 | 70 | 7 | 10 | 0 | 50 | 15 | 0 | 0 | 30 | 3,000 | 70 |
| U-22 | 100 | 2,000 | 1 | 70 | 50 | 15 | 30 | 70 | 20 | 15 | 0 | 70 | 5,000 | 70 |
| U-23 | 7 | 300 | 0 | 50 | 50 | 3 | 0 | 50 | 7 | 0 | 0 | 15 | 3,000 | 30 |
| U-29 | 30 | 200 | 0 | 50 | 20 | 3 | 30 | 20 | 3 | 0 | 0 | 7 | 700 | 15 |
| U-31 | 20 | 70 | 0 | 5 | 15 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 300 | 70 |
| U-37 | 30 | 700 | 1.5 | 100 | 20 | 50 | 15 | 300 | 30 | 30 | 0 | 70 | 500 | 100 |
| U-38 | 30 | 700 | 3 | 100 | 20 | 30 | 100 | 300 | 70 | 50 | 0 | 100 | 10,000 | 150 |
| U-39 | 30 | 700 | 2 | 70 | 15 | 20 | 70 | 300 | 50 | 30 | 0 | 70 | 7,000 | 100 |
| U-41 | 0 | 50 | 0 | 7 | 10 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 700 | 700 |
| U-44 | 150 | 100 | 0 | 10 | 10 | 0 | 0 | 70 | 0 | 0 | 0 | 7 | 300 | 0 |
| U-45 | 20 | 7,000 | 0 | 15 | 30 | 0 | 0 | 150 | 0 | 0 | 0 | 20 | 500 | 30 |
| U-47 | 10 | 100,000 | 1.5 | 5 | 70 | 0 | 0 | M | 50 | 0 | 0 | 150 | 500 | 700 |
| U-W-10 | 50 | 150 | 0 | 50 | 30 | 0 | 0 | 200 | 0 | 0 | 0 | 10 | 1,500 | 50 |
| U-W-12 | 20 | 70 | 0 | 10 | 10 | 0 | 0 | 70 | 0 | 0 | 0 | 7 | 500 | 20 |
| U-W-14 | 50 | 70 | 0 | 10 | 15 | 0 | 0 | 50 | 10 | 0 | 0 | 70 | 1,500 | 30 |
| U-S-1 | 50 | 700 | 2 | 100 | 30 | 0 | 50 | 300 | 50 | 30 | 0 | 100 | 7,000 | 150 |
| U-S-2 | 30 | 1,000 | 1.5 | 30 | 20 | 0 | 30 | 200 | 15 | 15 | 15 | 100 | 3,000 | 50 |
| 66-U-1 | 50 | 500 | 150 | 70 | 70 | 15 | 30 | 200 | 30 | 100 | 15 | 50 | 7,000 | 150 |
| 66-U-7a | 0 | 70 | 0 | 5 | 5 | 0 | 0 | 10 | 50 | 0 | 0 | 0 | 200 | 10 |
| 66-U-7b | 10 | 20 | 0 | 5 | 5 | 0 | 0 | 15 | 50 | 0 | 0 | 0 | 200 | 0 |
| 66-U-7c | 10 | 20 | 0 | 5 | 3 | 0 | 0 | 7 | 50 | 0 | 0 | 0 | 300 | 0 |
| 66-U-8 | 15 | 70 | 0 | 7 | 7 | 0 | 0 | 30 | 1.5 | 0 | 0 | 0 | 300 | 30 |
| 66-U-13 | 30 | 700 | 1 | 70 | 20 | 20 | 70 | 150 | 50 | 0 | 15 | 50 | 5,000 | 100 |
| 66-U-18 | 15 | 30 | 0 | 7 | 30 | 0 | 0 | 70 | 0 | 0 | 0 | 7 | 300 | 0 |
| 66-U-19 | 10 | 30 | 0 | 7 | 3 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 150 | 0 |
| 66-U-20 | 7 | 70 | 0 | 5 | 3 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 300 | 0 |
| 66-U-21 | 15 | 30 | 0 | 7 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 7 | 700 | 0 |
| 66-U-22 | 10 | 20 | 0 | 5 | 5 | 0 | 0 | 10 | 1.5 | 0 | 0 | 5 | 300 | 0 |
| 66-U-23 | 20 | 100 | 0 | 5 | 3 | 0 | 0 | 10 | 1.5 | 0 | 0 | 5 | 200 | 0 |
| 66-U-24 | 15 | 30 | 0 | 7 | 7 | 0 | 0 | 7 | 2 | 0 | 0 | 5 | 150 | 30 |
| Abundance in sandstone (Green, 1953) | 9 | 170 | 0 | 68 | 10 | 7 | 17 | 620 | 3 | 20 | | 26 | 960 | 20 |
| Abundance in iron deposits of hydrothermal replacement type (Radtke, 1965) | 98 | 18 | .0001 | 31 | 132 | <30 | -- | 1,281 | 122 | 98 | | <15 | 650 | 600 |

prospect east of Moon Lake, outside of the primitive area, contained more than 10 percent manganese and approximately 10 percent barium. Minute amounts of a number of other elements present in the samples are shown in table 1. To make these sample figures more meaningful, the abundance of elements in sandstone and in iron-ore deposits (formed by hydrothermal replacement) is shown for comparison.

Of the elements most commonly involved in ore deposits in the Western States, silver, gold, and zinc are below the limits of detectability in all samples. This is not particularly meaningful for gold because the *samples from the High Uintas primitive area, Utah*

greater than 10 percent. Analyses in percent by Chris Heropoulos]

| Sample No. | Percent | | | | | Sample description |
|---|---|---|---|---|---|---|
| | Si | Al | Fe | Mg | Ca | |
| U-3 | M | 0.7 | 0.2 | 0.03 | 0.015 | Fault slickensides. |
| U-4 | M | 1. | M | .05 | .02 | Hematite veinlets. |
| U-6 | M | 1.5 | 1.5 | .10 | .03 | Do. |
| U-7 | M | 2. | 1.0 | .15 | .03 | Hematite-stained quartzite. |
| U-12 | M | .7 | .05 | .03 | .015 | Bleached quartzite. |
| U-17 | M | 1. | 5. | .15 | .02 | Hematite veins. |
| U-19 | M | 5. | 1.5 | .70 | .15 | Fault gouge. |
| U-21 | M | 5. | 1.0 | .50 | .10 | Fault breccia. |
| U-22 | M | 7. | 2.0 | 1.0 | .20 | Do. |
| U-23 | M | 2. | .7 | .30 | .05 | Do. |
| U-29 | M | 1.5 | 2. | .20 | .03 | Do. |
| U-31 | M | .7 | .15 | .10 | .02 | Brecciated quartzite. |
| U-37 | M | 10. | 3. | 1.0 | .30 | Fault breccia. |
| U-38 | M | M | 7. | 1.5 | .30 | Do. |
| U-39 | M | 10. | 3. | 1.0 | .30 | Do. |
| U-41 | M | 5. | M | .03 | .01 | Hematite vein. |
| U-44 | M | .5 | .3 | .02 | .01 | Do. |
| U-45 | M | .7 | .1 | .03 | .05 | Vein of jasperoid. |
| U-47 | M | 1.5 | 2. | .10 | .15 | Manganese-bearing sandstone breccia. |
| U-W-10 | M | 1.5 | .2 | .15 | .02 | Bleached quartzite near fault. |
| U-W-12 | M | .7 | .3 | .07 | .02 | Bleached slickensided quartzite. |
| U-W-14 | M | 1.5 | .3 | .07 | .02 | Fault breccia. |
| U-S-1 | M | 10. | 5. | 1.0 | .30 | Do. |
| U-S-2 | M | 7. | .2 | .70 | .50 | Stream sediment along fault zone. |
| 66-U-1 | M | 5. | 3. | .7 | .5 | Fault breccia and gouge. |
| 66-U-7a | M | .5 | .2 | .015 | .015 | Breccia on Uinta Crest fault. |
| 66-U-7b | M | 1. | .2 | .015 | .015 | Do. |
| 66-U-7c | M | .7 | .2 | .015 | .015 | Do. |
| 66-U-8 | M | 1. | .2 | .01 | .01 | Fault gouge. |
| 66-U-13 | M | 10. | 5. | .2 | .2 | Hornfels adjoining dike. |
| 66-U-18 | M | .7 | .1 | .01 | .01 | Fault breccia cutting quartzite. |
| 66-U-19 | M | .5 | .15 | .02 | .01 | Fault breccia and jasperoid. |
| 66-U-20 | M | .7 | .1 | .02 | .01 | Fault breccia. |
| 66-U-21 | M | .5 | .1 | .02 | .007 | Fault breccia and gouge. |
| 66-U-22 | M | .7 | .15 | .02 | .007 | Fault breccia. |
| 66-U-23 | M | .7 | .15 | .05 | .015 | Fault breccia and jasperoid. |
| 66-U-24 | M | 1. | .3 | .05 | .01 | Silicified fault breccia. |

limits of detectability are approximately 20 parts per million, which is roughly equivalent to a value of $20 per ton. For silver, however, this means that the content is less than 0.00007 percent, which represents a value of a little under 3 cents per ton. For zinc the limit of detectability is 0.02 percent. Copper, whose limit of detectability is 0.0001 percent, is present in the range of 0.0003 to 0.0050 percent in most samples. This range is normal for ordinary sandstone and is well below the level that would be expected in mineralized areas.

Of the remaining elements, titanium is particularly interesting in that it sheds some light on the possible origin of the iron minerals that are present in this area. The titanium content of most specimens ranges from 0.02 to about 1 percent and averages 0.17 percent. This figure is higher than the value (0.0960 percent) normally expected in an average sandstone according to Green (1953) and is appreciably higher than that expected in iron-ore deposits—either magmatic segregations or deposits of placer origin. Inasmuch as the magmatic-segregation type can be eliminated because of the complete absence of igneous rocks in the area, the titanium content suggests that the iron in these deposits was originally of sedimentary origin.

Of the trace elements present in still smaller quantities, most of those in samples representing fault breccia or gouge fall within the range for typical sandstone. Neither the major-element nor the trace-element content suggests significant addition of material of hydrothermal origin.

In summary, neither the physical appearance of the crushed rocks along the fault zones in the High Uintas primitive area nor the composition gives any indication that solutions from deep-seated sources like those characteristically associated with typical ore deposits have ever permeated these rocks.

## GEOPHYSICAL STUDIES

Airborne magnetometer surveys and ground-based gravity studies also were used to evaluate the mineral potential of the High Uintas primitive area. Together these two geophysical methods provide a means of testing the possible presence at depth of concealed igneous rocks like those exposed at the surface and believed to be associated with ore deposits in many mining districts of western Utah.

### AIRBORNE MAGNETOMETER SURVEY AND INTERPRETATION

During October 1965 the U.S. Geological Survey flew an aerial magnetic survey of that part of the Uinta Mountains between lat 40°31′ and 41° N. and long 110°15′ and 111°35′ W. The results of this survey constitute the eastern two-thirds of figure 7. The western third of that map is taken from a similar aerial magnetic survey published earlier (Mabey and others, 1964).

Geophysical results on the aerial magnetic map may be correlated with the regional geology shown in figure 5. Extending southwest from the center of the western half of the illustration is a group of intrusive stocks that underlie the Park City and Cottonwood mining districts. These igneous rocks are clearly indicated in a corresponding position on the magnetic map (fig. 7) by a series of southwest-trending magnetic anomalies, with closures ranging from 300 to 650 gammas.

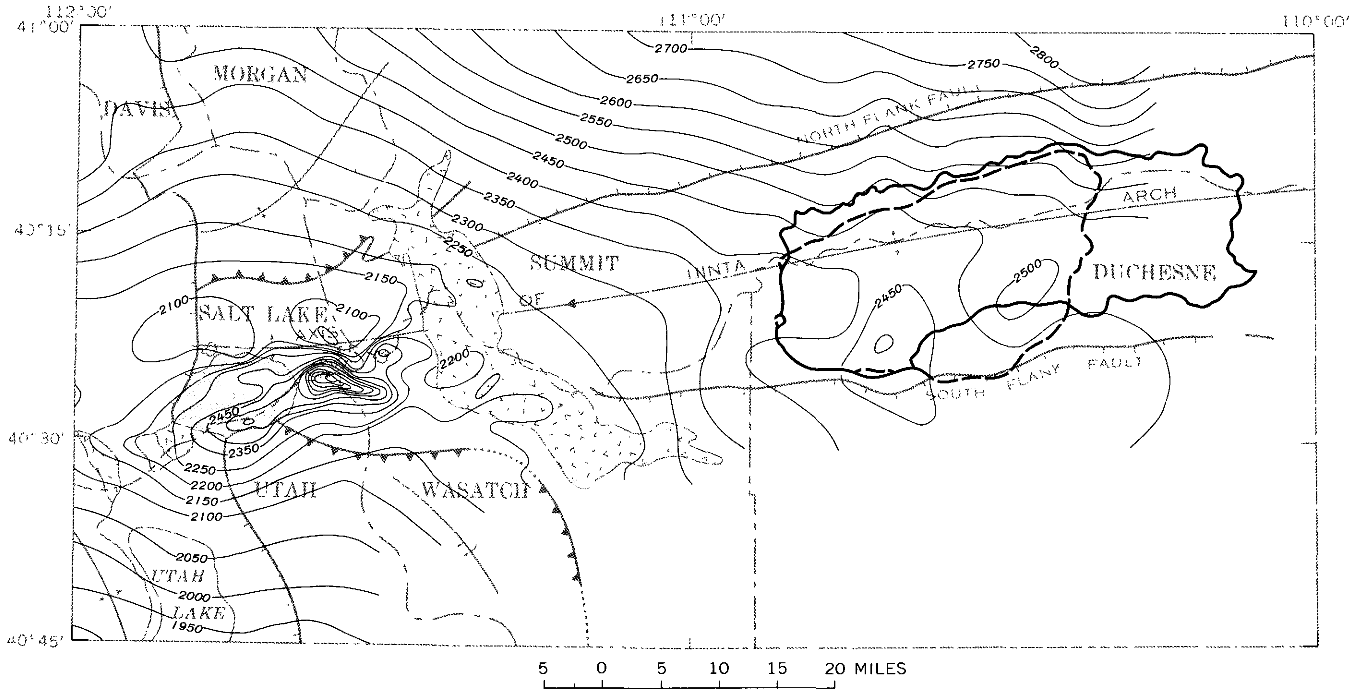


FIGURE 7.—Vertical magnetic intensity (west of 111°30' after Mabey and others, 1964). Contour interval 50 gammas except 100 gammas in closures northeast of Utah Lake. Dashed line shows boundary of original primitive area (1965); solid line is boundary of proposed wilderness (1966). For other symbols see figure 5.

Similar closures are evident on aeromagnetic maps over igneous rocks in the West Mountain (Bingham) and Tintic mining districts still farther west. In strong contrast to the features in the western part of the illustration are those in the eastern part, which is approximately centered over the High Uintas primitive area. Here one finds broad gentle magnetic anomalies of approximately 100 gammas closure. Analyses of these anomalies by Andrew Griscom of the U.S. Geological Survey (oral commun., 1966) indicates that they are associated with buried bodies of magnetic rocks, the tops of which are at least 10,000 feet below the surface, or approximately at sea level. Combining this information with that derived from geologic mapping suggests that these anomalies are associated with variations in the crystalline Precambrian rocks that underlie rocks of the Uinta Mountain Group rather than with intrusive rocks like those to the west.

It is evident also that the two positive anomalies shown in figure 7 lie well to the south of the axis of the Uinta Arch and that the axis itself more nearly coincides with a magnetic trough. Comparison of this negative feature to the pronounced positive anomalies over the stocks in western Utah further emphasizes the contrast between the two areas. The magnetic trough was recognized earlier during reconnaissance magnetic surveys on the ground by Behrendt and Thiel (1963), who pointed out that the existence of a granitic body beneath the Uinta Mountains is not compatible with the gravity data available.

### GRAVITY SURVEY AND INTERPRETATION

A small-scale gravity map based on several ground traverses across the Uinta Mountains was also published by Behrendt and Thiel (1963) at the same time as their preliminary magnetic results. This map (fig. 8) indicates a broad gravity high that coincides with the axis of the Uinta Arch. The result is entirely consistent with the structural interpretation of plate 1 (sections *A–A′* and *B–B′*). The anomaly is appreciably greater than would be expected from a buried granitic body, which suggests that dense rocks of the crystalline Precambrian basement are closer to the surface near the core of the range.

## ECONOMIC APPRAISAL

By M. J. SHERIDAN, U.S. Bureau of Mines

### INTRODUCTION

This section of the report describes the U.S. Bureau of Mines investigation of the High Uintas primitive area in Ashley and Wasatch National Forests, northeastern Utah.

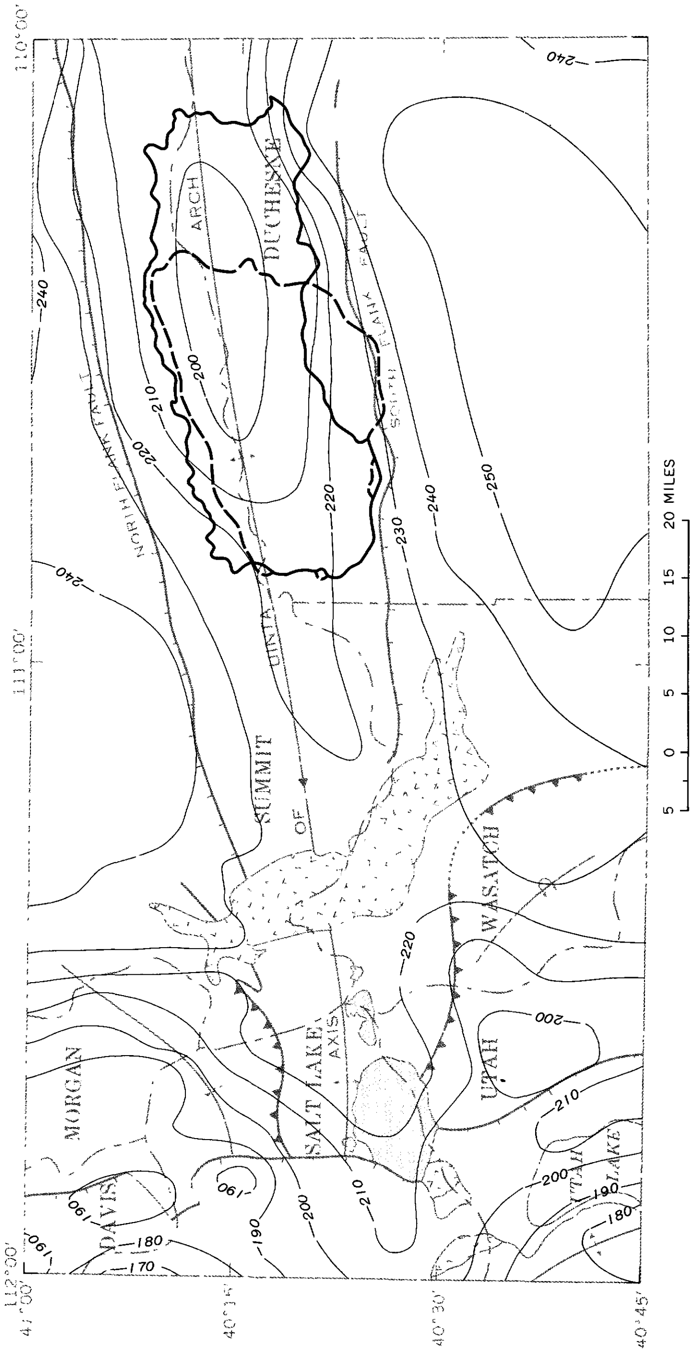


FIGURE 8.—Bouguer gravity anomaly map (after Behrendt and Thiel, 1963; Woolard and Joesting, 1964). Contour interval 10 milligal. Dashed line shows boundary of original primitive area (1965); solid line is boundary of proposed wilderness (1964). For other symbols see figure 5.

In May 1965, valuation engineers of the U.S. Forest Service, Ogden, were consulted relative to locations of mining claims within the High Uintas primitive area. Forest Service officials advised that, in compliance with the Multiple Use Act, they had conducted a records and field search of unpatented claims staked in Ashley and Wasatch National Forests prior to July 1955. Only one claim, identified as Red Castle, was found within the area. Several claims located just outside the original primitive area boundary were generally grouped in an area south from Brown Duck Lake and 2 to 6 miles west from Moon Lake (pl. 1). Forest Service plat maps showed no patented claims within the area shown on plate 1.

Forest Service personnel at Vernal, Roosevelt, and Duchesne, Utah, advised that mineral activity in the vicinity of the primitive area had, to the best of their knowledge, been limited to prospecting for iron west of Moon Lake and south of the boundary of the primitive area.

Courthouse records in Coalville, Summit County, and in Duchesne, Duchesne County, were examined to determine the presence of claims staked subsequent to 1955. Summit County records indicated no locations in the original primitive area nor within 2 to 3 miles of its boundary. Duchesne County records contained 1957–58 filings of claims located south from Brown Duck Lake and west from Moon Lake. All these locations would lie 3 to 5 miles outside the south boundary of the proposed wilderness, and geologic conditions strongly suggest that they fall in the same area as those noted during the previous Forest Service search.

U.S. Bureau of Land Management plat maps in Salt Lake City show phosphate withdrawals north and south of the High Unitas primitive area but none within the boundary. Oil and gas leases were filed along the north edge of the proposed wilderness area in 1965 and 1966 (see p. I17).

Jim Birn, a resident of Moon Lake, was asked about mineral activity in the Moon Lake area and subsequently accompanied the author to the Paint mine, in which Birn holds an interest (pl. 1).

## DESCRIPTION OF MINERAL DEPOSITS

### "PAINT MINE"

Although the "Paint mine" lies about 4½ miles south of the proposed wilderness, its proximity to the boundary of the original primitive area justifies a brief description of findings.

The property is about 3 miles west of Moon Lake in sec. 15, T. 2 N., R. 6 W., and, according to Birn, is the only mineral development of significance in the area. The deposit is developed by two adits about 20 feet apart and reportedly 20 to 40 feet in length. Both are now completely caved. Because of talus and slump cover and inaccessibility of the workings, the deposit could not be observed in place; however, float and dump rock together with Birn's description of the operation indicate the character of the mineralization.

The name "Paint mine" derives from pigment-type hematite which occurs in breccia fractures and as pods in a fault zone in the Mississippian Madison Limestone. According to Birn, a small lot—possibly 20 tons—of pod hematite having acceptable pigment properties was shipped from the property several years ago, but subsequent lots totaling possibly 75 tons were rejected because of contained impurities. This limited production was lowered about 200 feet from the mine to a truck-loading point via a makeshift aerial tram.

The extent of hematite-bearing float in the vicinity of the "Paint mine" adits is extremely limited, and the deposit may be assumed to be small and incapable of sustained production. No iron-ore potential is indicated, and past pigment production was doubtless unprofitable. It is reasonable to conclude that other claims in the area west of Moon Lake and south of Brown Duck Lake were staked on comparable or inferior deposits. It is concluded from the results of U.S. Geological Survey investigations that the presence of similar deposits within the proposed wilderness is unlikely because: (1) the controlling structure at the "Paint mine," being roughly parallel to the primitive area and from one to several miles south of it, cannot be projected into the proposed wilderness, and (2) the deposit occurs in Paleozoic limestone, and the bedrock in the primitive area is entirely Precambrian quartzite and argillite.

### RED CASTLE CLAIM

An unidentified location monument in Tungsten Pass (pl. 1) presumably marks the discovery point of the Red Castle claim, which was staked in 1954 by Allen Odegaro, Lemmie Swearengin, and Woodrow Swearengin, addresses unknown, and recorded at the Duchesne County courthouse.

The deposit is well exposed in a hillside cut. Specular hematite occupies fractures and surrounds breccia fragments in a 5-foot-wide fault zone that strikes N. 60° E. and dips 65° NW. Host rock is red-brown quartzite of Precambrian age. About 3 feet of the better mineralized part of the zone may contain 10 to 20 percent specularite. The workings completely crosscut the deposit exposing barren quartzite on both sides of the zone. There is no evidence of wallrock alteration. The fault zone, with discontinuous spots of specularite, is traceable for about 100 feet southwest and 20 feet northeast from the cut. Inasmuch as bedrock exposures are excellent throughout the immediate area, there is no likelihood that the occurrence extends beyond the indicated dimensions. This deposit has no economic significance.

## MINERAL POTENTIAL

The High Uintas primitive area contains no known mineral deposits of economic interest. The area is geologically unfavorable for the occurrence of metallic mineral deposits, and no metallic potential is indicated.

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