STUDIES RELATED TO WILDERNESS
PRIMITIVE AREAS

GLACIER, WYOMING

GEOLOGICAL SURVEY BULLETIN 1319-F

Mineral Resources of the Glacier Primitive Area, Wyoming

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U.S. BUREAU OF MINES

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An evaluation of the mineral potential of the area

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STUDIES RELATED TO WILDERNESS

PRIMITIVE AREAS

In accordance with the provisions of the Wilderness Act (Public Law 88–577, September 3, 1964) and the Conference Report on Senate bill 4, 88th Congress, the U.S. Geological Survey and the U.S. Bureau of Mines are making 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 provides that each primitive area 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 Glacier Primitive Area and vicinity, Wyoming. The area discussed in the report includes the primitive area, as defined, and some bordering areas that may come under discussion when the area is considered for wilderness status.

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MINERAL RESOURCES OF THE GLACIER PRIMITIVE AREA, WYOMING

By H. C. GRANGER, E. J. MCKAY, and R. E. MATTICK,
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SUMMARY

A mineral survey of the Glacier Primitive Area and an adjoining area to the northwest was made in 1968 and 1969 by the U.S. Geological Survey and the U.S. Bureau of Mines. The study area was mapped geologically, an aeromagnetic survey was made, a total of 1,076 samples (593 stream-sediment and panned-concentrate samples and 483 rock samples) was collected and analyzed, and known mineral deposits and claims were appraised from both geological and mineral-potential viewpoints.

The area studied is along the northeast flank of the Wind River Range in western Wyoming and includes the Glacier Primitive Area, enclosing about 277 square miles, and an adjacent area of about 65 square miles. It contains some of the most spectacular alpine scenery in the Western United States. From the high, craggy, glacier-dominated spine of the Continental Divide, the terrain drops toward the east and north onto an intricately incised series of peneplained uplands and rounded hills. Much of the area is dotted with glacially carved lakes connected and drained by cascading mountain streams. Elevations range from 13,785 feet at the crest of Gannett Peak, the highest in Wyoming, to about 6,790 feet in the valley of Dinwoody Creek, whose source is partly in glaciers on the flanks of Gannett Peak. A large part of the area is above the tree line, but the lower elevations are partly covered with spruce, pine, grasses, and low-growing flowering plants.

The study area is largely underlain by Precambrian crystalline rocks but is flanked along the northeast edge by a sequence of Paleozoic marine sedimentary rocks which once also mantled the crystalline core of the Wind River Range. The north-central part of the study area is occupied by a north-trending granitic mass named the Middle Mountain batholith, which is about 5 miles wide and 25 miles long. This body grades outward into migmatite and agmatite which, in turn, grade outward into paragneisses that form the framework of the core of the range. These rocks terminate rather abruptly on the south at a northwest-trending zone that probably represents a very old metamorphosed fault zone. South of this zone a different migmatite unit appears to border another granitic batholith whose northern parts are represented by lobes of porphyritic granite which project only short distances into the primitive area.

The study disclosed no mineral deposits that can be mined economically, and none of the several mineralized localities appears to have possibilities for future development. A small hematitic breccia zone in Precambrian gneiss a few miles north of the primitive area reportedly yielded a few tons of uranium ore, but this zone was apparently mined out. Another small uranium prospect in the lower part of the Paleozoic sequence is of subeconomic grade. Locally, a red-shale unit in the Amsden Formation of Mississippian and Pennsylvanian age contains lenses of oolitic iron ore, but these are too small and sparse to warrant further exploration.

A few short, narrow veins in the Precambrian rocks contain sulfide minerals. These are typically oxidized at the surface, but samples of the gossan and of the sulfides show that they contain only negligible amounts of base and precious metals. A few stream-sediment samples were anomalous in metal content, and panned concentrates contained detectable amounts of gold, but no exploitable deposits were indicated by the analytical data.

INTRODUCTION

The Glacier Primitive Area (fig. 1), about 50 miles southeast of Yellowstone National Park in western Wyoming, encompasses

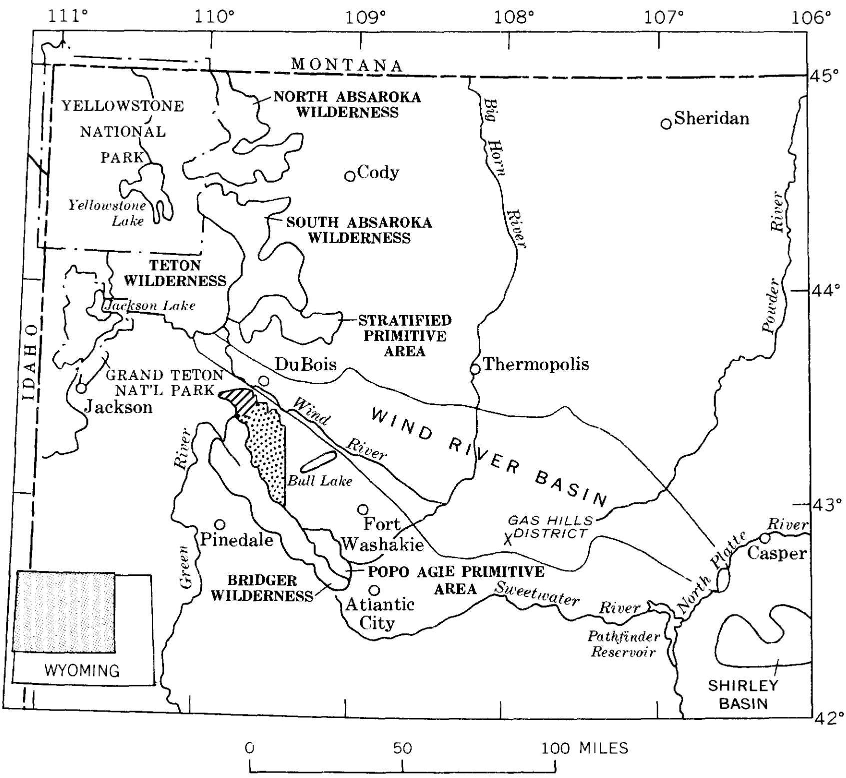

FIGURE 1.—Index map of Wyoming showing area studied: Glacier Primitive Area (stippled) and an adjacent area (hachured).

a large part of the northeast side of the Wind River Range. Its pristine beauty is typified by alpine peaks flanked by snowfields and glaciers, by cascading mountain streams, and by a myriad of scenic lakes (figs. 2, 3). The primitive area has an elongate triangular outline and includes about 277 square miles of the Shoshone National Forest. Also studied was about 65 square miles of contiguous national forest that extends northwestward from the primitive area. The area studied is bounded on the east by the Wind River Indian Reservation and on the west, beyond the Continental Divide, and south by the Bridger Wilderness. North of the area studied, part of the land is national forest, part is owned by the State, and part is privately held.

Much of the primitive area is dominated, topographically, by remnants of an uplifted peneplain cut on Precambrian crystalline rocks and sharply incised by canyons. Along the southwest border of the area the Continental Divide is characterized by a jagged alpine spine (fig. 4). A line of rounded, partly wooded peaks in the northeast part of the study area is composed of the exposed edges of resistant middle Paleozoic limestones and dolomites which dip northeastward from the flank of the crystalline core of the mountains.

Relief in the area is nearly 7,000 feet, and elevations range from 13,785 feet on Gannett Peak (fig. 5) to about 6,790 feet

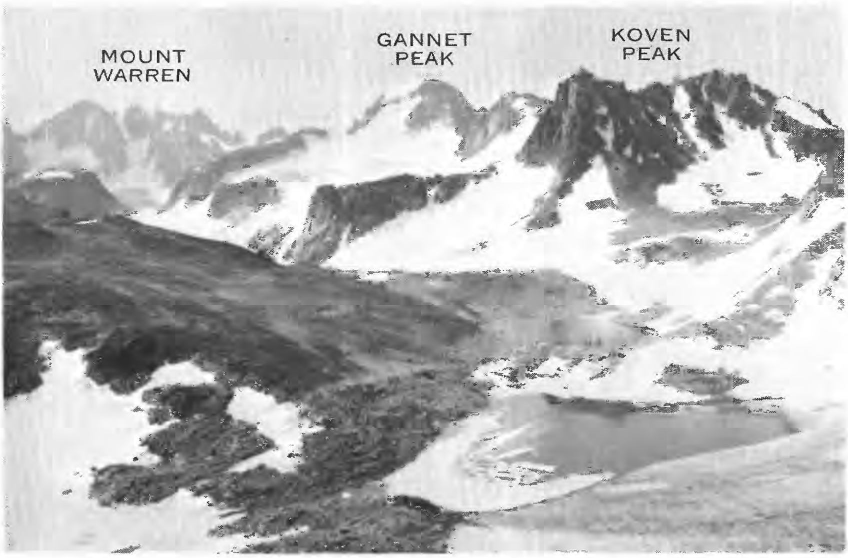

FIGURE 2.—North side of Gannett Peak as seen from the southern end of Downs Glacier.

FIGURE 3.—Two prominent physiographic features: The Fortress on the left and the Brown Cliffs on the right center; view across unnamed lake in Bull Lake Creek drainage.

where Dinwoody Creek crosses the eastern border of the area. Perhaps the most impressive relief in the area is the drop of about 3,800 feet from Gannett Peak to the base of Gannett Glacier in a horizontal distance of 2 miles. Torrey Creek, Dinwoody Creek, and Dry Creek are incised to depths of as much as 2,000 feet below the peneplain.

Travel within the primitive area is limited to foot and horseback. A sparse network of trails provides access along or near most of the major drainages, but parts of the area cannot be reached by any well-established route. An all-weather dirt road extends from U.S. Highway 287 along Torrey Creek to the primitive area, but this is the only road suitable for passenger cars that reaches the boundary and is probably the principal access route used by hikers and pack trains. Other roads that extend to, or almost to, the edges of the primitive area from Highway 287 are generally suitable only for four-wheel-drive vehicles. Several

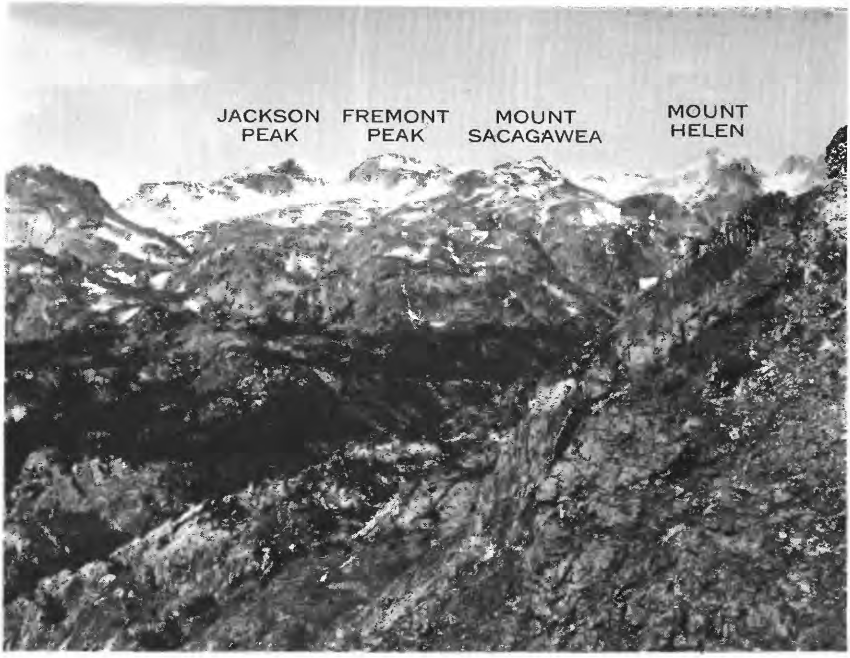

FIGURE 4.—Crest of the Wind River Range; view looking west from cliffs on the north side of Little Milky Lake. Although mapped as gneiss, the area in the foreground contains granitic and pegmatitic dikes cutting a gneissic sequence which consists principally of biotitic gneiss and includes amphibolite bodies.

of these cross the Wind River Indian Reservation, and permission to traverse them must be obtained from the Indian Agency at Fort Washakie. The northwest end of the study area can be reached by passenger car on the Union Pass dirt road (designated "Lake of the Woods Road" on pls. 1 and 2) during dry weather and by four-wheel-drive vehicles both from roads leading from the Union Pass road and from roads leading from U.S. Highway 287, although access from Highway 287 may require permission from private landowners. There is no established access to the primitive area from the west over the Continental Divide except at and near Hay Pass near the southern tip of the area. Horses reportedly can be taken through Indian Pass between Knife Point Mountain and Jackson Peak but, if this is possible, they must make a hazardous crossing of the Bull Lake Glaciers.

Grasses and sagebrush make up much of the vegetation on nonforested, soil-covered areas up to elevations of about 10,000 feet.

FIGURE 5.—Broad glaciated and alluviated part of the valley of Dinwoody Creek; snow-capped Gannett Peak (elev 13,785 ft) in the central background.

The forested areas contain mostly limber pine, locally mixed with spruce, which terminates very irregularly along a timberline at about 11,000 feet. Alpine willow and other low vegetation grows below and above the timberline particularly along stream courses and marshy meadow and tundra areas.

Independent studies of the mineral resources of the Glacier Primitive Area made by the U.S. Bureau of Mines and the U.S. Geological Survey are combined in this report. The Geological Survey's investigation consisted mainly of geologic mapping and the search for geologic, aeromagnetic, and geochemical evidence that might indicate the presence of or guide exploration for previously unknown deposits. The Bureau of Mines emphasized investigation of mining claims and known deposits.

Mapping and sampling of the study area were done by H. C. Granger and E. J. McKay of the Geological Survey during 1½ months in the summer of 1968 and 2 months in 1969. D. D. Talbot and G. A. Worf assisted in the sampling in 1968, and Christopher Henry and Duane Packer assisted in both geologic mapping and sampling in 1969. A geological reconnaissance map was prepared on the basis of aerial photographs and later compiled on a 1-inch-to-the-mile planimetric base (pl. 1) adapted from U.S. Forest Service quadrangle maps. Results of an aeromagnetic survey of the study area, made in 1969, are also shown on plate 1; the data were interpreted by R. E. Mattick of the Geological Survey.

A geochemical sampling program was conducted concurrently with the mapping. A total of 1,076 samples were collected: 483 rock samples, 470 stream-sediment samples, and 123 panned concentrates.

Fieldwork for the Bureau of Mines in 1968 was done by Paul McIlroy, who was assisted by Lowell L. Patten and, in 1969, by Patten assisted by David R. Alison. The investigation was carried out in three stages: (1) Examination of the records for claim-location notices and affidavits of annual labor, (2) discussion of mining claims with claim owners, Forest Service personnel, and others knowledgeable of mining activity in the area, and (3) on-the-ground examination and samplings of the claims, workings, and mineral deposits.

PREVIOUS WORK

Although the geology of adjacent and nearby areas has been studied and mapped, very little attention has been paid to the central part of the Glacier Primitive Area. Precambrian rocks in the southern and western parts of the Wind River Range have been much more extensively studied than those on the east flank.

St. John (1883), a member of the Hayden surveys, was among the earliest to describe the geology of parts of the Wind River Range. Much of the early work (Baker, 1912, 1946; Blackwelder, 1911, 1915; Branson and Branson, 1941; Westgate and Branson, 1913) emphasized the Paleozoic and younger rocks and the Cenozoic physiographic history, largely on the west flank of the range.

Richmond (1945) mapped and briefly described the geology of a 430-square-mile area west of the primitive area. Oftedahl (1953) commented on crystalline rocks seen during a reconnaissance of the Precambrian terrane southeast of the area studied by Richmond and west of the Continental Divide.

Graduate theses by Mooney (1951) and Gilliland (1959) described principally the geology of Paleozoic and younger sedimentary rocks that extend northwestward from Torrey Creek. Much of their mapping was within the study area.

Richmond and Murphy (1965) and Murphy and Richmond (1965) mapped the geology of two quadrangles around Bull Lake about 10 miles east of the primitive area, emphasizing the glacial deposits. Worl (1968, 1969) mapped and described the Precambrian rocks of the Three Waters area (near Triple Divide Peak) which lies largely west of the northern part of the primitive area.

Perry (1965) mapped a sequence of Precambrian metamorphic rocks in the Paradise Basin quadrangle about 4½ miles east of the southern part of the primitive area. He found that the metamorphic structures and rocks generally trend northwestward. Barrus (1968) traced these same rocks northwestward almost to the east border of the primitive area. Continuing his mapping into the primitive area in 1969 (oral and written commun., 1969), he was able to follow parts of this sequence and its structural trends to the Continental Divide. He generously provided us with some of the results of this study.

J. F. Murphy kindly permitted us to inspect the preliminary results of his mapping, largely in Paleozoic rocks, in the Blue Holes and Hayes Park quadrangles which include about a 2-mile-wide strip of the northeastern part of the primitive area along their western edges. Concurrently in 1969, R. C. Pearson and T. H. Kiilsgaard were conducting a similar mineral survey in the Popo Agie Primitive Area on the east flank of the southern part of the Wind River Range.

ACKNOWLEDGMENTS

Stimulating discussions and a great deal of useful information were contributed by other geologists who had worked or were working in the region. These include R. B. Barrus, University of Washington; R. C. Pearson, T. H. Kiilsgaard, R. G. Worl, and J. C. Antweiler, U.S. Geological Survey; and Kenneth Perry, Jr., University of Wyoming. Their contributions are greatly appreciated.

Particular thanks are given to Harold Wadley, U.S. Forest Service, and Howard Sanderson, Wyoming Game and Fish Commission, both of Dubois. Mr. Wadley very helpfully provided a fund of information, including details of accessibility to the area. Mr. Sanderson helped us choose a base-camp location (sec. 23, T. 40 N., R. 106 W.) on the Whisky Basin Winter Range from which a helicopter could be operated. Cooperation provided by the Wyoming Game and Fish Commission is deeply appreciated.

The Joint Shoshone and Arapahoe Tribal Business Council of the Wind River Indian Agency kindly granted permission to use a site on Indian land near Bull Lake as a temporary base of helicopter operations in 1969. We thank the highly competent W. L. Roberts, who owned and operated the helicopter used throughout the 1968 field season. In 1969 the pilots were Monte Johnson, Ben Merrill, and William Sears. We are especially grateful to L. O. Wilch and R. V. Mendes, U.S. Geological Survey, for their diligence and patience in transferring analytical data to computer tape.

GEOLOGY

GEOLOGIC SETTING AND HISTORY

The core of the Wind River Range is a complex assemblage of metamorphic and igneous crystalline rocks overlain, on the east side, by northeastward-dipping Paleozoic and Mesozoic sedimentary rocks that aggregate several thousand feet in thickness. These rocks dip into the Wind River Basin where they are covered by a thick succession of Tertiary continental sedimentary units that locally lap onto the flank of the range and partly cover the truncated edges of the older sedimentary sequence as well as the Precambrian rocks.

The present-day Wind River Range was initiated by a broad uplift of the northwestward-trending elongate crystalline core, evidently accompanied by westward thrust faulting (Baker, 1946; Berg, 1961) on the west flank of the range. After the earliest uplift, which occurred largely in Laramide time (Late Cretaceous and early Tertiary), erosion exposed the crystalline core of the mountains and carved a topographically rugged forerunner of the present Wind River Range. Deep canyons such as those of ancestral Jakeys Fork and Torrey Creek were cut into the flanks of the range, and the lower reaches of these canyons were filled in Paleocene(?) and Eocene time with alluvial material derived, in large part, from erosion of older rocks at higher elevations. This period of erosion was followed by mid-Tertiary or later peneplanation that must have reduced much of the range to a region of low relief. Presumably this surface is now represented by relics (figs. 13, 14) such as Goat Flat, Ram Flat, the area along Horse Ridge, and the divide between the headwaters of Dry and Bull Lake Creeks.

The angle between the mid-Tertiary peneplain and the surface on which the Cambrian Flathead Sandstone was deposited is very slight along much of the east side of the range. In fact, the presence of a rather flat-lying outlier of Flathead Sandstone on the Continental Divide just southwest of Simpson Lake suggests that some of the flat surfaces within the primitive area may be fault-displaced Lower Cambrian surfaces from which the Flathead has been stripped. West of the crest of the range, however, there seemingly is good evidence for a surface (Fremont peneplain) formed in Tertiary time as noted by Baker (1946) and earlier writers; we have assumed that it is a surface of this age which is now seen on the east side of the range even though evidence is less conclusive there.

Renewed uplift of the range then occurred during one or more episodes after peneplanation; broad arching of the peneplaned surface was accompanied by some block faulting which differentially displaced some parts of the peneplaned surface (probably not exceeding 1,000 ft) near the crest of the range relative to other parts. Pleistocene glaciers then covered most of the crest of the range and scoured much of the Tertiary filling from the old canyons that emerged from the mountain front.

Since Pinedale Glaciation, in late Pleistocene time, the glaciers have retreated to their present sites high in the cirques and alpine valleys near the crest of the range. About 30 glaciers can now be found in the primitive area; the number depends somewhat on whether merging glaciers are counted as one or several, and whether small perpetual snowfields on cliff and cirque walls are given the status of glaciers. The largest glaciers—about a dozen—originate in cirques and snowfields along the Continental Divide.

PRECAMBRIAN ROCKS

The Precambrian rocks in the area are divided into two metamorphic terranes by a structural zone that will be referred to as the Mount Helen structural belt (pl. 1). It extends from near Mount Helen on the Continental Divide southeastward toward Alpine Lake, which lies just east of the Glacier Primitive Area. North of this structural belt the central part of the study area is occupied by a north-trending granitic body referred to here as the Middle Mountain batholith. The batholith is about 5 miles wide and 25 miles long, but it continues beneath the Paleozoic sedimentary sequence to the north. The Middle Mountain batholith is gradational into the surrounding gneiss through a migmatite zone characterized in different places by lit-par-lit intrusion, partly assimilated blocks of gneiss, and a network of granitic and pegmatitic dikes.

South of the Mount Helen structural belt, a coarse-grained porphyritic granite body grades northward into migmatite which differs from the migmatite north of the belt. The structural belt is characterized by seemingly discontinuous bodies of augen gneiss, porphyritic granite, and other mafic and felsic rocks.

In summary, the crystalline rocks are divisible into two terranes, each dominated by a different granitic rock which grades outward through a migmatite zone into a thick sequence of gneissic rocks. A small area of porphyritic granite, exposed in the extreme southern part of the primitive area, is lithologically similar to rocks exposed in the Popo Agie Primitive Area 10 miles or more to the southeast.

Radiometric dates of several pegmatite dikes and bordering gneissic rocks near Simpson Lake (Bassett and Giletti, 1963) suggest that the core of the northern end of the Wind River Range underwent a metamorphic event about 2,700 million years ago. These dates, obtained by using both potassium-argon and rubidium-strontium methods, show a spread of age values in various mica and feldspar samples that was interpreted to indicate a subsequent event that considerably lowered some of the apparent ages. Because the pegmatites do not seem to have been affected by any strong metamorphic event since their emplacement, it is likely that the 2,700-million-year figure indicates the age of the pegmatites (and, perhaps, of the Middle Mountain batholith).

The following descriptions of the Precambrian rocks are necessarily brief and generalized. Greater detail and, perhaps, conflicting observations are given by Barrus (1968; unpub. data, 1969) and Perry (1965); their studies, east of the primitive area, were principally directed to the structural zone which separates the two metamorphic terranes.

Gneissic Rocks

Medium- to coarse-grained, gray gneissic rocks form the framework of the crystalline core of the northern Wind River Range. Well-foliated quartz-feldspar-biotite gneiss is the predominant rock type, although the proportions of these minerals and the compositions of the feldspars vary widely even within short distances. Fundamentally, the types of biotite-bearing gneiss are similar throughout the area, differing largely in the proportions of essential minerals and in the presence or absence of alkali feldspars. Where microcline is present in more than varietal amounts, the accompanying plagioclase is typically albite or sodic oligoclase, and there is some suggestion that these rocks are rather near one of the large granitic bodies. Where microcline is absent, the plagioclase is typically oligoclase or sodic andesine; these rocks generally seem to be farther from granitic bodies.

A typical specimen of gneiss has a quartz-diorite composition and contains about 30 percent quartz, 45 percent plagioclase, and 15 percent yellow-brown biotite. Hornblende is present locally in amounts as large as 5 percent of the rock. The accessory minerals—apatite, zircon, sphene, magnetite—and alteration (?) minerals such as epidote, clinozoisite, chlorite, and sericite make up the remainder. Gneiss of more granitic composition typically contains about 25 percent quartz, 35 percent microcline, 30 percent plagioclase, and 5 or 10 percent biotite; the accessory and alteration minerals are similar to those of the gneiss of quartz-diorite composition.

Foliation is mainly defined by streaking and alinement of biotite and hornblende, although there is also some tendency for alinement of the lighter colored minerals, particularly in rocks showing an incipient development of augen structure. Under the microscope, quartz grains typically show an undulatory extinction that indicates strain, but granulation resulting in mortar structure is much less common.

The biotitic gneiss encloses variously shaped discontinuous bodies of amphibolite, biotite schist, metadiabase, and other metamorphosed intrusive rocks, and a few scattered ultramafic bodies. Perhaps more common are lenses, blocks, and boudins of fine- to coarse-grained amphibolite that are a few inches to hundreds of feet across and contain various proportions of green hornblende, calcic plagioclase, and minor quartz. The smaller bodies form concordant lenses and boudins in the gneiss; the larger are agmatitic masses that are laced with dikes and veins of pegmatite (fig. 6) and quartz-plagioclase rock. Lenses of biotite schist are less common. Some of these lenses locally contain disseminated pyrite and are iron stained at the surface. Other elongate bodies that are abnormally rich in either hornblende or biotite are traceable for as much as a few hundred feet along the strike of foliation. All these rocks have been metamorphosed and may variously have originally been carbonate-rich graywacke in a sedimentary sequence, mafic sills and dikes, or metamorphic segregations. For the most part, these rocks occur only north of the Mount Helen structural belt and are most abundant around the southern part of the Middle Mountain batholith.

Foliation in the gneiss is commonly erratic and may be highly contorted, particularly in and near migmatite. It is most consistent in the southern part of the primitive area near the Mount Helen structural belt where it trends generally northwest and dips to the northeast. Along the east side of the Middle Mountain

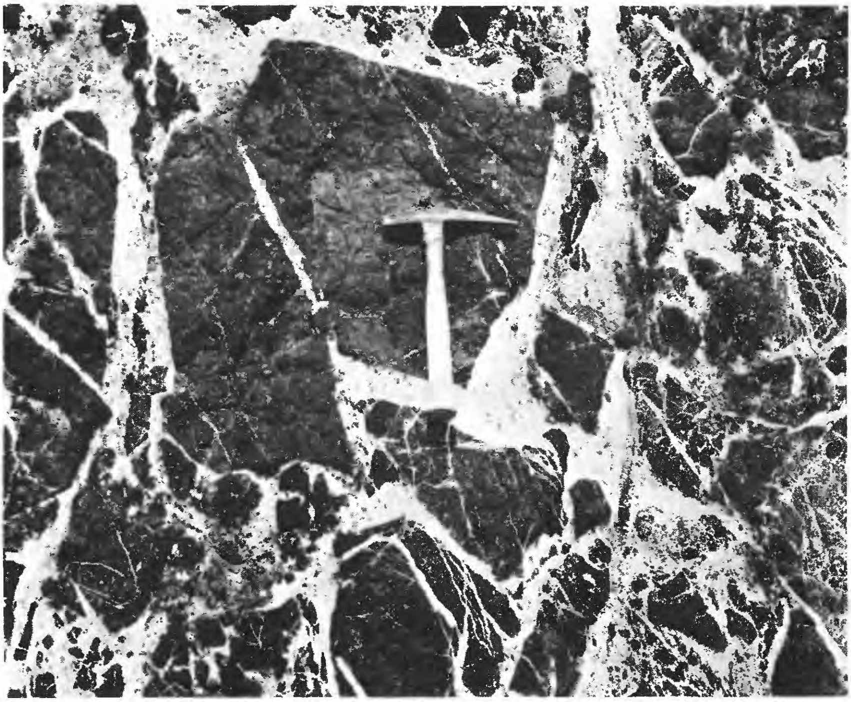

FIGURE 6.—Part of a brecciated amphibolite (agmatite) block included in migmatite, showing the intricate pattern of cementation by pegmatite. Photograph taken in sec. 32, T. 36 N., R. 106 W.

batholith, the foliation turns more northward and tends to dip steeply to the east. Near Simpson Lake there are local areas of generally consistent foliation which trends northeastward and dips west to north on the west side of the lake and strikes northwestward and dips northeast on the east side of the lake. No large folds were recognized, although small-scale drag folds of various attitudes were seen.

The gneissic masses within the study area give no good evidence of their origin, but their composition indicates that they were probably arkoses and graywackes for the most part. Metamorphosed iron-formation was identified by Worl (1969) in gneiss less than 2 miles west of Downs Peak. Perry (1965) and Barrus (1968) described sillimanitic paragneissic bodies that trend toward the primitive area from the east.

A few scattered discontinuous layers and lenses of mafic rock included in the gneiss are identified as metadiabase masses which were probably intruded as sill-like bodies prior to the last metamorphic events. They were intruded into rocks that had already been considerably metamorphosed, as is indicated by the fact that the diabasic texture is still recognizable even though the enclosing gneiss retains none of its original textures. (See also Worl, 1968.)

The gneiss in this area seems to have been uniformly metamorphosed to amphibolite facies. No convincing evidence was found for granulite-facies metamorphism as described by Perry (1965) a few miles to the east and by Worl (1968) on the west.

Ultramafic Rocks

Small semiconcordant bodies of ultramafic rock are scattered through the gneiss, particularly in the drainages of the North Fork of Bull Lake Creek and Dry Creek. A few were mapped (pl. 1), but others were too small or obscure, and some were believed to be amphibolites until their identity was shown under the microscope. The bodies are generally only a few tens to a few hundreds of feet long and a few feet wide; they are lenticular and parallel to the foliation, although some have irregular shapes and orientations. The fresh rock is dark gray, but weathered surfaces and immediately surrounding rocks are commonly iron stained. For the most part, these rocks are fine to medium grained, and fresh surfaces appear flaky or felted. Veinlike zones, particularly near the margins of the ultramafic bodies, may be much coarser grained and consist principally either of large greenish tremolite crystals parallel to the vein walls or of cross-fiber anthophyllite. The ultramafic bodies, which contain no feldspar or quartz, are lithologically distinct from the many amphibolite bodies, which are typically coarser grained and contain both plagioclase and quartz.

Under the microscope, it can be seen that the ultramafic rocks vary somewhat in composition from body to body but are typically a fine-grained hypidiomorphic granular aggregate of tremolite and various proportions of clear olivine and enstatite. A very pale brown mica, probably phlogopite, may be sparsely present, and some specimens contain scattered green spinel as inclusions in all the other minerals. Feldspars are absent from all specimens examined except for a small very coarse grained body of anorthosite associated with one of the ultramafic bodies northwest of Native Lake.

Alteration minerals are universally present and commonly replace nearly all the earlier minerals. Talc, serpentine, and chlorite are common. Magnetite and perhaps ilmenite and chromite generally accompany the other alteration minerals, although they may be in part relict minerals. Talc and chlorite are also fairly common in many fault zones within the study area, but these minerals also occur in some of the ultramafic bodies well away from the obviously faulted areas. Presumably, therefore, the alteration minerals in some of the ultramafic rocks are the result of a retrograde metamorphism unrelated to faulting.

Migmatite

The migmatite zone that surrounds the Middle Mountain batholith differs from that which occurs south of the Mount Helen structural belt and will be described separately. Migmatite marginal to the Middle Mountain batholith consists partly of mixed foliated rocks into which granitic rocks were injected while the gneiss was in a plastic state and partly of agmatite which appears to be coarse breccia into which granitic and pegmatitic phases were complexly intruded as dikes and vein networks (figs. 7, 8). Foliation is typically swirly and chaotic, and minor folds

FIGURE 7.—Chimney Rock, a landmark along the south edge of upper Horse Ridge. Note the network of granitic and pegmatitic dikes in the gneiss and amphibolite that form the cliff walls.

FIGURE 8.—Closeup of Chimney Rock from Horse Ridge. Light-colored gently dipping granitic dikes cut across the more steeply dipping gneissic foliation.

may or may not be common. Bodies of amphibolite that may be metamorphic segregations seem to be more abundant in the migmatite zone bordering the southern parts of the Middle Mountain batholith, but whether this is a characteristic of the migmatite or merely a compositional property of the preexisting gneissic sequence was not determined.

Although approximately located contacts between the migmatite and adjacent rocks are shown on plate 1, the migmatite nearly everywhere has broadly gradational margins. Ghosts and relics of almost completely assimilated or transformed gneiss can be found throughout the Middle Mountain batholith but, near the migmatite zone, these become more prevalent and less thoroughly assimilated and ultimately grade into migmatite. Amphibolite is more resistant to assimilation in granite than is the more felsic gneiss, so the abundance of amphibolite bodies may locally seem to be exaggerated along the gradational boundary between granite and migmatite. The contact between migmatite and gneiss is also gradational and was arbitrarily placed where swirly and chaotic foliation, injected gneisses, and dike networks become insignificant features of the gneissic terrane.

A large area in the upper Dinwoody and Dry Creek drainages has been mapped as gneiss and migmatite intruded by a felsic dike network. This is a poorly defined area in which large numbers of granitic and pegmatitic dikes (figs. 7, 8) form a meshlike network in the gneissic and migmatitic host rocks. The contact between these rocks and the Middle Mountain batholith is highly irregular and gradational through a broad zone containing large bodies of partly assimilated gneiss, migmatite, and amphibolite engulfed along the margins of the batholith.

North of the Jakeys Fork fault, granite grades westward into rocks that might be mapped in places as either migmatite or gneiss. Locally, the foliation is highly contorted; both granitic and pegmatitic phases were injected, while the gneisses were in a semiplastic state, as lit-par-lit bands a fraction of an inch to several feet wide and as swirly crosscutting masses. These are certainly migmatitic rocks. Much of the rock, however, appears to be well-foliated gneiss and was mapped as such, even though more detailed work would undoubtedly allow delineation of units of migmatite. Similarly, migmatite might be mapped adjacent to the granite body near Granite Lake and at several places along the Continental Divide west of Union Peak. Our work was not sufficiently detailed to define migmatite in these areas, however.

Migmatite bordering the porphyritic granite at the south end of the primitive area is distinct from the migmatite to the north. This migmatite was formed almost entirely while the gneiss was semiplastic. Granitic and pegmatite dikes occur locally throughout the migmatite but may be later than and unrelated to the porphyritic granite. The migmatite consists of typical quartz-plagioclase-biotite gneiss into which a speckled hornblende-biotite granodiorite has been complexly injected. The speckled appearance is caused by scattered discrete aggregates of hornblende, or biotite, or mixtures of the two. Scattered hornblende grains and aggregates one-eighth to three-eighths inch across are, perhaps, the most typical and diagnostic feature of this once-mobile phase of the migmatite. Large microcline phenocrysts become less abundant at the margins of the granite masses and finally disappear as the gneissic phase becomes prevalent in the migmatite. Although biotite is the most abundant mafic mineral in most of the granite, it typically gives way to hornblende or hornblende-biotite aggregates as the microcline phenocrysts decrease in abundance. The speckled phase steadily decreases, and the nonmobile gneissic phase increases proportionately with distance from the granite. Adjacent to hornblende amphibolite bodies, the speckled phase commonly contains a greater abundance of the hornblende aggregates derived, as if by attrition, from the amphibolites. Locally, the gneissic phase has been brecciated and cemented by the speckled mobile phase (fig. 9), but in most places the speckled phase was complexly and intimately injected into the gneiss (fig. 10) almost as if squirted into a sponge. Foliation of the gneissic phase is commonly contorted, although it strikes predominantly to the northwest in northern parts of the migmatite zone.

The speckled phase typically consists of about 15 percent quartz, 10–15 percent aggregates of hornblende and biotite, and

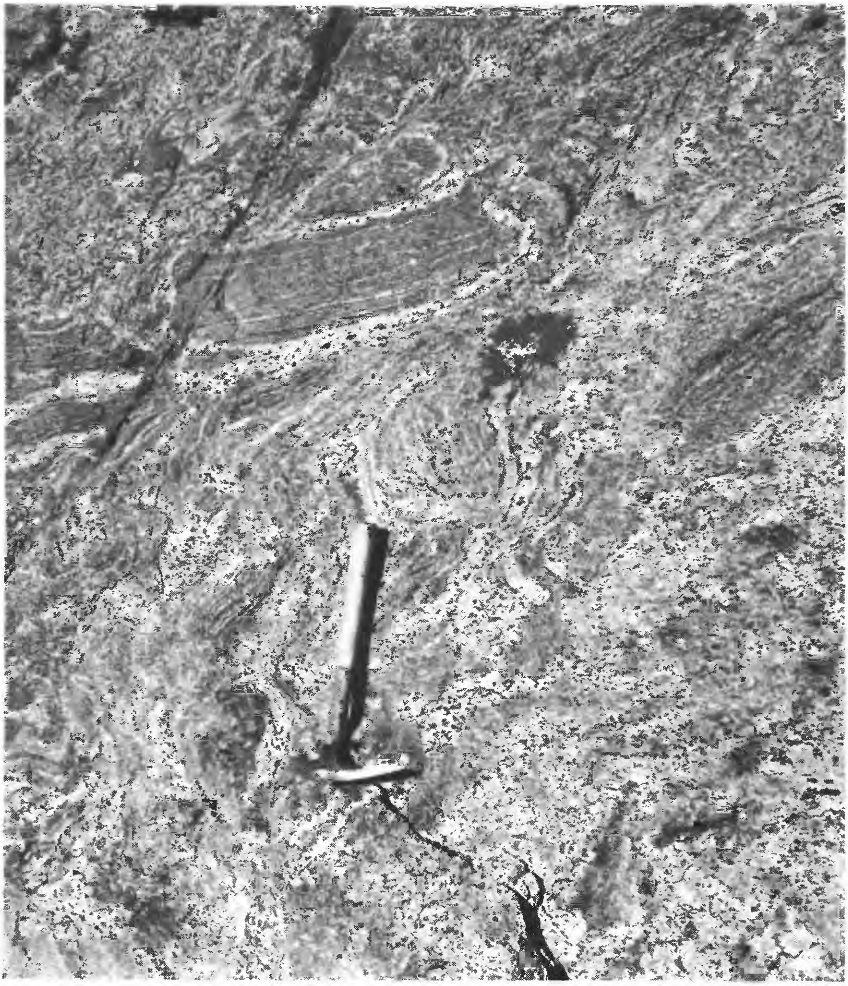

FIGURE 9.—Migmatite in sec. 3, T. 1 S., R. 6 W., showing disoriented blocks of biotite-quartz-feldspar gneiss swirled in the speckled hornblende phase of the porphyritic granite.

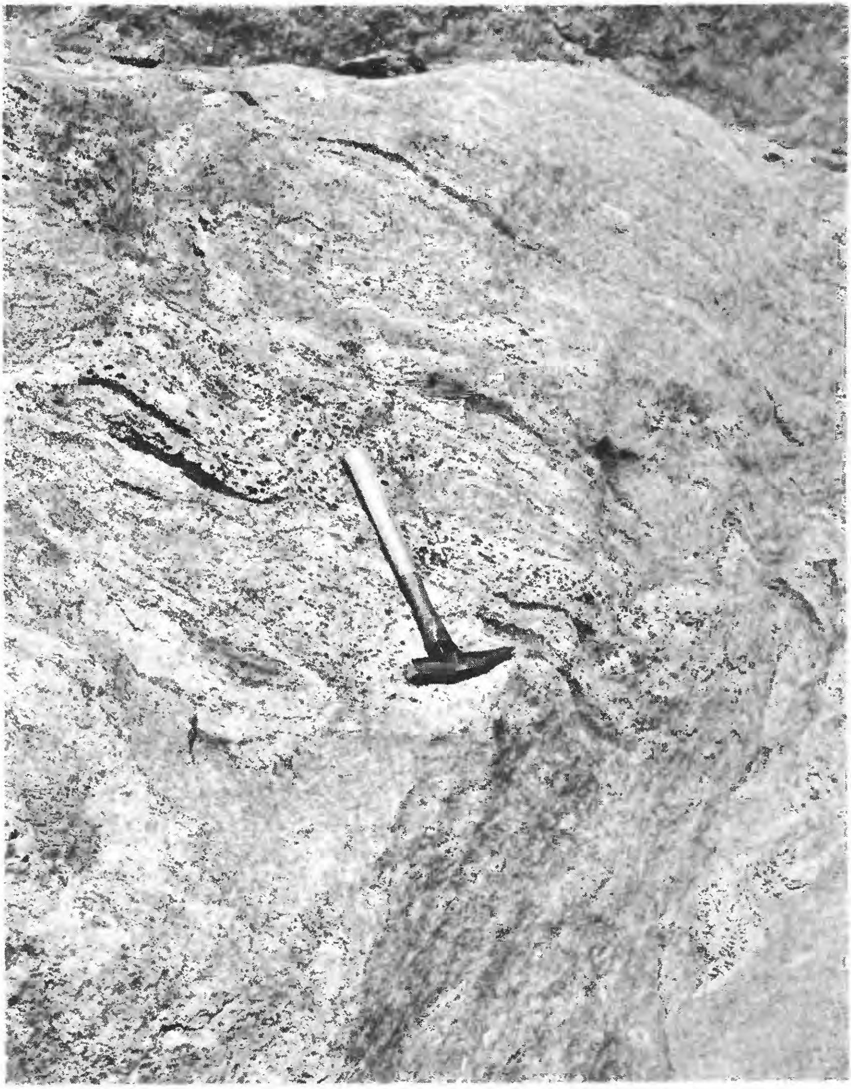

FIGURE 10.—Migmatite on Mount Quintet showing the speckled hornblende phase of the porphyritic granite injected into biotite-quartz-feldspar gneiss.

about 65–70 percent microcline and calcic oligoclase. Commonly, microcline is about 40 percent and plagioclase about 30 percent. As much as 5 percent of the rock may be sphene, apatite, magnetite, and epidote.

The gneissic phase typically contains 20 percent quartz, 15–20 percent biotite, and no hornblende. Feldspar makes up about 60 percent of the rock. The plagioclase is andesine or calcic oligoclase if microcline is virtually absent, whereas if microcline is present the plagioclase is calcic oligoclase and constitutes about 40 percent of the rock. The gneissic phase seems to be similar to the gneiss farther north and to the gneissic phase of the migmatites bordering the Middle Mountain batholith.

Mount Helen Structural Belt

The northern limit of the migmatite in the southern part of the primitive area is defined by the Mount Helen structural belt, a sinuous belt of foliated rocks containing broad bands of uniform-appearing light-colored gneisses, discontinuous(?) layers of augen gneiss, and irregular intrusive bodies of both porphyritic granite and the speckled phase of the migmatite. Within this vaguely defined band, which is about a quarter of a mile wide, the gneiss maintains a rather consistent northwest strike and northeast dip.

The belt crosses the eastern boundary of the primitive area near the junction of Bull Lake Creek and the Middle Fork of Bull Lake Creek and extends northwestward toward the headwaters of the North Fork of Bull Lake Creek where it is cut by the Alpine Lakes shear zone (the amount of displacement was not measured). The belt appears to cross the crest of the range on the north flank of Mount Helen.

The consistent foliation, the augen gneiss, and the intrusive bodies of porphyritic granite and related rocks which occur in this seemingly continuous band all suggest a structural origin for the zone. This zone is referred to herein as the Mount Helen structural belt in the belief that it represents a structurally disturbed zone predating all the faults, lineaments, and shear zones which were mapped in the area.

In an area a few miles east of the primitive area, Barrus (1968) defined a northwest-trending belt of augen gneiss paralleled by a wider belt of orthogneiss on the southwest. These belts separate gneiss on the northeast from migmatite to the southwest and project northwestward toward the Mount Helen structural belt. Reconnaissance mapping in the primitive area failed to prove the existence of such well-defined rock units as Barrus mapped, but there is little doubt that the Mount Helen structural belt represents the continuation of similar geologic features.

Barrus (1968) proposed that the augen gneiss might represent a former extensive dacite flow that formed long before the metamorphic events or, alternatively, a recrystallized shear zone bordering rocks to the south. The shear-zone concept better explains the termination of migmatite and the scattered intrusive bodies of porphyritic granite along the trend.

Granite of Middle Mountain

The Middle Mountain batholith is a northward trending body about 5 miles wide and 25 miles long in the central part of the study area. The body is composed of granitic rocks that are heterogeneous in texture but generally similar in composition. Perhaps the most characteristic rock type is gray to pale-pink biotite granite containing scattered, randomly oriented microcline phenocrysts. The phenocrysts are typically one-fourth to three-eighths inch in length; even somewhat larger phenocrysts are rather inconspicuous except under conditions where cleavage faces reflect the light. In many places—Goat Flat, for example—the porphyritic-granite phase grades into and out of a simple pegmatitic phase. Few pegmatite areas are more than a few feet across and a few tens of feet long. The pegmatites form no well-defined bodies, and obviously both phases formed contemporaneously.

A more equigranular gray granite, similar in composition to the porphyritic granite, is also abundant. No distinct separation between these phases was noted, and they are intermixed throughout much of the batholith. Most granitic dikes that intruded the surrounding migmatite seem to be similar to this equigranular phase, although they generally have a pinkish cast and have a grain size as small as aplite material, particularly in the narrower dikes.

Other granites are present locally, but it was not determined whether these represent genetically discrete intrusions or whether they are merely local variants of the batholith. An area of slightly finer grained pink granite was noted along the south side of Louise Lake, for example, but no attempt was made to map it.

In and near several fault zones, the feldspar is pink and the biotite is altered to green chlorite and epidote, making a rather colorful rock. In some places the granite also seems to contain abnormal amounts of quartz in the fault zones. We believe that these red and green hues and silicified areas are caused by alteration near the faults, although Worl (1968) reported later red granites that seem to have intruded faults west of the primitive area.

In addition, some of the granite is red owing to weathering during or after development of the peneplain surfaces. Granite underlying the Flathead Sandstone is pink or red in many places to depths of 100 feet or more, and similar colors are prevalent at least as far below some surfaces that have been called a part of the mid-Tertiary peneplain. Some of the red color may be iron stain leached from the overlying Flathead, but much of it is probably due to iron oxide from weathering of mafic minerals in the granite.

The quartz content ranges only from 20 to 30 percent in most phases in the granite of Middle Mountain, but proportions of other minerals vary more widely. Microcline is commonly perthitic and generally constitutes 20–50 percent of the rock. Albite or oligoclase commonly is clouded with sericite and makes up about 15–40 percent of the rock. Biotite is the most common mafic mineral and makes up as much as 15 percent of the rock, but locally it may be sparse or absent. Some of the biotite is variously greenish brown and yellowish brown under the microscope, but this is much less common than pleochroic green varieties. Hornblende was seen only adjacent to amphibolite inclusions. Alteration and accessory minerals, typically making up less than 5 percent of the rock, are magnetite, zircon, apatite, epidote, chlorite, and sericite. Although most of the granitic rock is equigranular or porphyritic, some of the rock exhibits mortar structure.

Porphyritic Granite

Only two lobes of porphyritic granite project into the southern part of the Glacier Primitive Area (pl. 1), but these may be parts of a much larger body or bodies of granitic rock to the south. This granite is light gray and contains large microcline crystals that are especially prominent where the cleavage faces reflect sunlight. The rock is similar to and may correlate with porphyritic quartz monzonite in the Popo Agie Primitive Area about 10 miles to the southeast (R. C. Pearson and T. H. Kiilsgaard, oral commun., 1969).

The porphyritic granite is easily recognized by the sparse to abundant microcline phenocrysts (or porphyroblasts?) which occur throughout and which may reach 1 inch across and 2 inches long and locally make up more than 50 percent of the rock. These crystals are generally randomly oriented but in some places are crudely alined, giving the rock a distinctly gneissic appearance. The border facies of the granite—and the related speckled phase in the adjacent migmatite—has mortar structure and strained quartz, which can be readily seen in thin section. Presumably, the mortar structure—finer granulated grains that form a "mortar" between the normal grains throughout the fabric—was created by semifluid movement as a crystal mush late in the cooling history of the rock.

A typical specimen of porphyritic granite contains about 20 percent quartz; 20 percent microcline, partly as phenocrysts and partly as interstitial material in the granulated or crushed areas; 40 percent sodic oligoclase or albite; and 15–20 percent combined brownish-green biotite and green hornblende, biotite generally exceeding the hornblende. As much as 5 percent combined magnetite, epidote, sphene, and apatite may be associated with the mafic minerals.

The porphyritic granite grades into migmatite, as noted above, where the phenocrysts are absent and where hornblende is typically more abundant than biotite. No bodies of porphyritic granite more than a few feet across were noted in the migmatite zone but, in the area of the Mount Helen structural belt, there are several much larger but indistinctly defined bodies of porphyritic granite. These may be similar to Barrus' (1968) orthogneiss, although he reported the large crystals, or "porphyroclasts," in the orthogneiss to be plagioclase.

Other Granitic Bodies

A body of granitic rock similar to the granite of Middle Mountain is exposed near Granite Lake west of the primitive area and southwest of Simpson Lake. Presumably the lake's earlier name, Red Granite Lake, was derived from red weathered granite beneath the Flathead Sandstone outlier nearby. At least a part of this granite body appears to be identical to porphyritic parts of the granite of Middle Mountain, and they are probably genetically related.

A body of equigranular medium-grained gray granitic rock occurs in the migmatite at the NE cor. sec. 5, T. 35 N., R. 106 W. It appears to be distinct from the mobile phase of the migmatite but was not mapped or studied during this investigation.

Two poorly defined bodies of sodic granite or albitite were noted but not mapped. One of these is near the middle of sec. 34, T. 37 N., R. 106 W., and the other is in the W½ sec. 33, T. 36 N., R. 106 W. They are equigranular, medium-grained, albite-chlorite-quartz rocks that may be small stocklike bodies only a few hundred feet across. However, because the chlorite seems to have been derived from earlier biotite and both bodies are adjacent to chloritized fault zones, they may merely represent highly altered soda-metasomatized gneiss and migmatite.

Pegmatite Bodies

Pegmatite bodies are common in the Precambrian rocks throughout the study area, but most are small, discontinuous, and randomly oriented. Only in the area near Simpson Lake and Union Peak, in the northwest part of the study area, were they considered to be of sufficient size and continuity to warrant mapping.

The pegmatites that can be mapped are all in the form of steeply dipping, parallel-walled dikes; some are as much as 50 feet wide and half a mile long, although most are only traceable for much shorter distances. For the most part, they trend eastward. No rare or valuable minerals were recognized in these simple granitic pegmatites, although Worl (1968) reported one beryl crystal in a pegmatite just west of the primitive area.

Most of the large pegmatite dikes contain abundant pale-red microcline which gives an overall pink cast to the rock. Only a few large dikes contain white feldspar, which is more common in the small dikes. Either biotite or muscovite, in books as much as a few inches across, may be present, but biotite is more common.

Smaller randomly oriented pegmatite bodies occur throughout all the Precambrian rocks with the exception of diabase and perhaps some of the ultramafic rocks. Networks of pegmatitic stringers commonly cut the larger amphibolite blocks enclosed in gneiss, and both pegmatite and granite dikes are abundant in rocks surrounding the southern end of the Middle Mountain batholith.

Most pegmatite bodies seem to have had little if any effect on the wallrocks, but several were noted in which the gneissic foliation of the country rock was dragged or contorted for a few inches from the contact. The country rock must have been semiplastic at the time of pegmatite emplacement.

Diabase

Three types of diabase were recognized within the study area. Only the oldest of these was metamorphosed. The metamorphosed diabase forms sparsely distributed small bodies that have been stretched to boudinages and altered by the metamorphism in the gneiss. (See also Worl, 1968.) Following metamorphism two lithologically distinct varieties of diabase were intruded as dikes into the metamorphic rocks: a glomeroporphyritic type and an equigranular type. The glomeroporphyritic diabase, apparently the older, forms a southwestward-trending dike that is about 25 feet wide and is traceable for at least 7 miles to where it crosses the

Continental Divide (pl. 1). A short segment of similar rock was mapped along the south edge of a lake in sec. 1, T. 38 N., R. 106 W., and, if it is a faulted segment of the same dike, the total length of the dike is more than 9 miles.

The glomeroporphyritic diabase is a dark-gray, fine-grained rock that weathers to a weakly iron stained surface speckled with nearly white to gray clusters of phenocrysts mostly less than one-fourth inch across. Under the microscope the phenocrysts are seen to be zoned labradorite laths set in a diabasic groundmass of finer plagioclase laths, pyroxene, magnetite, and alteration minerals. A few scattered altered olivine crystals are larger than most of the groundmass material but smaller than the plagioclase phenocrysts. The groundmass minerals in all specimens collected were partly altered to a variety of fine-grained minerals that were not identified.

The equigranular diabase dikes differ widely in trend and length. Several of them strike northwestward and seem to dip steeply to the southwest. The longest dike is as much as 130 feet wide where it crosses Goat Flat (fig. 11) and is traceable both northwestward and southeastward completely across and well outside the primitive area boundaries—a total distance of more than 30 miles. The few other diabase dikes are traceable for much shorter distances and are less than 50 feet wide.

The equigranular diabase differs from the glomeroporphyritic diabase in having a normal diabasic or subophitic texture grading into intersertal textures along the chilled margins and in lacking olivine. The fresh rock is composed mostly of labradorite laths, augite, and magnetite; a little brown biotite and sparse apatite are present in most specimens. All the dikes, especially the chilled margins, are partly altered. Augite is partly converted to green fibrous uralitic hornblende or chlorite or both. Labradorite is clear and fresh in many places but locally is sericitized or saussuritized(?) or both. A few aggregates of alteration minerals containing scattered magnetite grains might once have been olivine, but no fresh olivine was recognized.

Unfortunately, the projected intersection of the Goat Flat equigranular dike and the glomeroporphyritic dike is not exposed. If the short segment of glomeroporphyritic diabase in sec. 1, T. 38 N., R. 106 W., is, indeed, a faulted part of the larger glomeroporphyritic dike, the diabase of Goat Flat is the younger of the two, as it is not similarly offset by faulting in this area.

Age determinations have not been made on the diabases in the northern part of the Wind River Range, but Condie, Leech, and

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FIGURE 11.—Diabase dike viewed northwestward from Goat Flat along the strike of the dike. Note split in dike, which merges again between lake and point from which photograph was taken.

Baadsgaard (1969) reported the results of potassium-argon dating of mafic dikes (mostly tholeiitic diabases) in the southern part of the range near Atlantic City. Although these ages range from 900 to 2,060 million years those authors suggested that chloritization was responsible for the anomalously low ages of two of the samples. The remaining samples then fit into two groupings which those authors suggested may represent periods of intrusion of Precambrian mafic dikes in Wyoming: one period 1,900–2,200 and another 1,400–1,800 million years ago.

PALEOZOIC ROCKS

A broad band of sedimentary rocks of Paleozoic age dips northeastward from the flank of the crystalline core of the mountains (fig. 12) in the vicinity of the study area. These were deposited mainly in a marine environment and consist of a nearly conformable sequence of well-indurated limestone, dolomite, sandstone, and shale that is separated into nine geologic formations. The thickness of this sequence seems to vary from place to place but probably averages about 3,000 feet. Thicknesses of individual formations given in the descriptions that follow are highly generalized; measured thicknesses are shown in table 1.

FIGURE 12.—The Paleozoic sedimentary sequence, which dips northeastward from the flank of the Wind River Range; northwesterly view across the canyon of Dinwoody Creek. Flathead Sandstone (Ꞓf) forms the hump on the skyline to the far left and underlies the Gros Ventre and Gallatin Formations (Ꞓgg), which form the smooth slopes. Above is the cliff-forming Bighorn Dolomite (Ob). Darby Formation (Dd) forms the skyline to the far right. Knobby rocks in the middle foreground are gneiss of Precambrian age (pꞒgn).

TABLE 1.—*Measured thicknesses of Paleozoic sedimentary rocks in and near the Glacier Primitive Area*

[Thicknesses reported by Keefer (1957) are largely from Warm Spring Creek and Little Warm Spring Creek areas; thicknesses reported by Gilliland (1959) are largely from Jakeys Fork and Little Warm Spring Creek areas; thicknesses reported by Mooney (1951) are from Torrey Creek area; thicknesses reported by Murphy and Richmond (1965) are from near Bull Lake]

	Thickness, in feet, reported in indicated source			
	Keefer (1957)	Gilliland (1959)	Mooney (1951)	Murphy and Richmond (1965)
Phosphoria and Park City Formations	261	272	>152.5	310
Tensleep Sandstone	213	277	356	376
Amsden Formation	356	356	173.5	283
Madison Limestone	740	712	621	675
Darby Formation	193	160	54.5	178
Bighorn Dolomite	254	225	251	234
Gallatin Limestone	365	262	210	340
Gros Ventre Formation	747	655	401	~740
Flathead Sandstone	190	180	127.5	213
Total	3,319	3,099	>2,347	~3,349

The Flathead Sandstone of Middle Cambrian age rests on the remarkably smooth peneplaned surface of the Precambrian rocks. The Flathead is about 150 feet thick and composed of reddish-brown to tan, coarse-grained, quartzose sandstone. Although harder and more resistant than the immediately overlying rocks, it fractures easily and commonly forms a layer of rubble which blankets the pre-Flathead erosion surface.

The Gros Ventre Formation, also of Middle Cambrian age, conformably overlies and intertongues with the Flathead Sandstone, suggesting that the lower part of the Gros Ventre is an offshore facies of the Flathead. The Gros Ventre is about 500 feet thick and is composed of easily weathered interbedded brownish- to greenish-gray glauconitic and micaceous shales and thin limestone beds. Most of the formation weathers to a smooth slope covered with grass, but a resistant thin-bedded limestone unit in the lower middle part of the formation intermittently forms bold spines and hummocks.

The Gallatin Limestone of Late Cambrian age is gradational into the underlying Gros Ventre. This fact, plus the extremely poor exposure of the contact zone, prompted mapping of the Gallatin and Gros Ventre as a single unit (pl. 1). The Gallatin consists of about 250 feet of gray and brownish-gray limestone, dolomitic limestone, shale, and shaly limestone. The lower part of the formation is generally easily eroded, and only sporadic limestone ledges are exposed; the upper part is more resistant but is generally overshadowed by the overlying, highly resistant Bighorn Dolomite.

The 250-foot-thick Bighorn Dolomite, of Middle and Late Ordovician age, is dominantly a brownish-gray, massive, resistant, cliff-forming unit that grades from limestone at the base to dolomite in the middle and top. It is probably the most persistent cliff former in the area. The central dolomitic limestone typically weathers to a rough pitted surface that is easily recognized.

The Darby Formation, of Devonian age, is less resistant than the enclosing rocks and commonly forms slopes between prominent cliffs or saddles in ridges. The top and base of the Darby seem to have been placed at different horizons by different geologists, resulting in reported thicknesses that range from a few feet to about 190 feet in and near the study area. In general, the Darby is a brown to buff, banded unit, containing interbedded thin layers of dolomite, limestone, limy shale, and sandstone.

The Madison Limestone of Mississippian age, the thickest sedimentary unit in the area, is about 650 feet thick. It is dense, massively bedded, gray limestone and dolomitic limestone that is generally resistant to weathering and commonly stands as cliffs or bold outcrops along valley walls; it caps many of the highest hills and ridges. Not protected by resistant overlying beds, it generally has a more subdued outcrop expression than the Bighorn Dolomite.

The Amsden Formation, of Late Mississippian and Pennsylvanian age, reportedly ranges in thickness from about 175 to 350 feet. It is composed of a lower white to reddish-buff, crossbedded, medium-grained sandstone that locally forms ledges or caps small ridges and an upper sequence principally of interbedded ferruginous red and green-gray shale and dolomite beds that weather to a slope. In places the lower part of the shaly sequence consists of a few tens of feet of brick-red, hematitic claystone or shale that contains numerous lenses of oolitic iron oxides. The oolites are composed of goethite, hematite, and minor kaolinite and average a little less than one-fourth inch in diameter.

The Tensleep Sandstone, of Pennsylvanian age, is about 350 feet thick and is resistant, white to pale-buff, crossbedded, fine-grained sandstone. It forms prominent cliffs in some places and commonly caps rounded ridges and knobs.

Lithologies indicative of both the Park City and Phosphoria Formations, of Permian age, intertongue along the east side of the Wind River Range and reach a combined thickness of about 275 feet near the study area. Within the Glacier Primitive Area, however, only the lower limestone beds, which are referred to the Park City Formation, are present. These are poorly exposed in most places except for some of the more massive, gray to dark-gray, highly fossiliferous limestones. Some beds are a coquina of broken and complete brachiopod shells, crinoid stems, and bryozoa and coral fossils. Black shale, chert, and phosphorite facies, indicative of the Phosphoria Formation, were not observed.

TERTIARY ROCKS

The Wind River Range, along with most of the Rocky Mountain region, was uplifted in the Laramide orogeny at about the beginning of the Cenozoic Era. Erosion cut through the Mesozoic and Paleozoic sedimentary rocks, exposed the Precambrian crystalline core of the range, and sculptured a chain of high mountains drained by deep canyons. As the intermontane basins became filled with debris contributed by erosion and regional volcanic activity, the flanks of the mountains and the mouths of canyons were inundated by sediments. Quaternary erosion has stripped much of this cover from the mountain flanks and exhumed the early Tertiary canyons, but remnants still persist in parts of the study area.

The Wind River Formation of Eocene age is the only Tertiary formation recognized in the study area. Only small remnants of it persist in the Torrey Creek drainage; these rocks seem to be locally derived and their compositions vary accordingly. Just east of the primitive area, on the north wall of Torrey Creek canyon, easily eroded red to tan conglomeratic rocks contain many large decomposed fragments of Precambrian granite and gneiss in an arkosic matrix. North of this area, in the lower part of Whisky Creek canyon, remnants of red conglomeratic strata contain pebbles and cobbles of both Precambrian crystalline and Paleozoic sedimentary rocks.

The Tertiary rocks along the north margin of the study area contain fewer conglomeratic strata than those near Torrey Creek and consist largely of red and white to buff tuffaceous sandstones and siltstones. Farther west, near Geyser Creek and along the Union Pass road (Lake of the Woods Roads on pls. 1 and 2), much of the surface that is underlain by Tertiary strata is strewn with cobbles and pebbles of well-rounded quartzite. These are so resistant that they locally persist even on thin soil zones overlying Precambrian rocks and make reliable mapping difficult. According to Rohrer (1968; oral commun., 1968), these cobbles represent one of several coarse channel-fill deposits in the upper part of the Wind River Formation.

Some of the rocks mapped as Wind River Formation in the northwest part of the study area form gentle, featureless slopes covered with low vegetation and sporadic glacial boulders, which are most abundant near knobs of Precambrian rocks that rise above the smooth slopes. Much of this terrane was arbitrarily mapped as Wind River Formation on the basis of its characteristic topography or the occurrence of rounded quartzite cobbles, derived from the Wind River, which are scattered about the surface. Although the Wind River is definitely present in this area, its thickness and distribution are much in doubt.

QUATERNARY DEPOSITS

Glacial Deposits

Glacial deposits were separated into only two units for mapping. The younger of these consists of the neoglacial morainal material deposited largely by present-day glaciers (fig. 13). This material consists of large blocks, typically a few feet across, of Precambrian crystalline rock having very little finer grained matrix material. Much of the finer material seemingly is being washed farther downstream as glacial outwash, but some of it is

FIGURE 13.—Jackson Peak (on the left center) and the shoulder to the southeast (left) appear to be an uplifted segment of a peneplain; Fremont Peak is on the right. The terminal moraine in the central foreground has accumulated at the foot of one of the Bull Lake Glaciers. View southwestward toward Jackson Peak.

packing downward between boulders as matrix material deep beneath the surface of the moraines. Several of the terminal moraines are separated from the toe of the associated glacier by a small lake, an indication that the glaciers have recently retreated.

The older glacial deposits are mostly bouldery till related to the Pinedale Glaciation of Pleistocene age. This is the last glaciation that extended far out onto the flanks of the range and deposited the moraine in lower Torrey Creek valley (pl. 1). The veneer of glacial material in many places in the higher mountain valleys, however, may have been left during retreat of the glaciers to their present restricted positions. This glacial material is actually more common along valley walls and floors than the map suggests because, in mapping, the veneer was ignored in areas of scattered bedrock exposures.

Alluvium

Alluvium has been deposited in many places where the stream gradients are fairly gentle (fig. 5). This material varies greatly in grain size and composition, ranging from peat and fine-grained detritus through fairly cleanly winnowed arkosic sand to cobbly and bouldery accumulations of reworked glacial material. Dune sand derived from alluvial deposits and swept up onto the valley walls by the prevailing westerly winds along Dinwoody Creek in sec. 10, T. 38 N., R. 106 W., was mapped as part of the alluvium. Some of the smaller stream valleys and extensive lengths of the larger streams have been scoured clean of all but the coarsest alluvial material because of their steep gradients.

Landslide Debris

Several landslides along the walls of the major stream valleys are composed of Paleozoic sedimentary rocks. Whereas the Precambrian crystalline rocks form many talus piles at the foot of steep slopes and high cliffs, the Paleozoic rocks tend in some places to break off and flow as larger landslides. Small slumped areas (not shown on pl. 1) covering an acre or less are fairly common on exposures of the Gros Ventre and Gallatin Formations, a fact suggesting that the larger landslides were probably also initiated in these unstable rocks.

Felsenmeer

Most unglaciated surfaces above timberline are covered by felsenmeer, a jumble of broken angular blocks as much as several feet across, composed of the immediately underlying rock and formed by frost action (fig. 14). Areas of soil are common on

FIGURE 14.—Flat surfaces, now covered by felsenmeer, were beveled by peneplanation and are sharply incised by both stream- and glacier-carved canyons. View southeastward from the flank of Downs Peak.

these upland surfaces, and some of these support low-lying plants, but many areas are simply blanketed with disoriented blocks and slabs of rock. Although the frost and snow action contributes to slow creeping movement of this rock blanket, the moderately large blocks seem generally to be representative of the nearby bedrock and to have moved downslope only a few tens or a few hundreds of feet. The surfaces at Horse Ridge (fig. 15), Goat Flat, and Ram Flat consist mostly of felsenmeer.

STRUCTURE

Major structural events that affected the rocks in the northern Wind River Range seem largely to have taken place during the Precambrian and Cenozoic Eras. Extensive faulting and shearing at relatively shallow depths during the Precambrian took place in the basement rocks after they had been subjected to deep-seated metamorphic and plutonic action. The Paleozoic and Mesozoic Eras were fairly uneventful tectonically and were characterized by accumulations of marine and continental sediments, now largely removed from the primitive area by erosion. The modern Wind River Range started to grow in Laramide time (Love, 1960; Berg, 1961) and is the result of extensive faulting and uplift accompanied by erosion that has continued intermittently until the present.

FIGURE 15.—The beveling effect of peneplanation; view looking northwestward at Horse Ridge across upper Dry Creek valley. Gneissic rocks that form the cliffs are laced with granitic and pegmatitic dikes. Felsenmeer covers surface in foreground.

The earliest clearly recorded Precambrian structures in the Wind River Range are of metamorphic origin. Premetamorphism structures, such as bedding, dikes, and faults, to which we have alluded in this report, were all but obliterated by metamorphism. Although foliation of the gneissic rocks is pronounced throughout the study area, no convincing evidence for isoclinal folding or other major metamorphic structures was distinguished during this investigation even though it is assumed that the rocks were folded prior to or during metamorphism. Most of the local changes in attitudes of foliation throughout the area can be attributed either to semiplastic deformation associated with emplacement of the large granitic bodies or to later faulting. The variety in foliation attitudes seems, therefore, to be related principally to local forces or faulting rather than regional forces related to deep-seated metamorphism.

The Mount Helen structural belt separating the two metamorphic terranes may represent a major fault zone that was active prior to the last stages of regional metamorphism proposed by Barrus (1968) for rocks and features along the same zone just east of the primitive area. If so, the occurrence of porphyritic granite in places along this zone indicates that the faulting preceded granite emplacement.

The Precambrian rocks have been highly faulted since metamorphism. In places these faults are evidenced by intensely fractured and altered zones, but many faults are largely concealed by surficial rubble, and few displacements can be detected. Alinement of topographic depressions such as lakes, stream valleys, and clefts in cliff walls indicates the presence of faults not otherwise exposed. The Paleozoic rocks, in contrast, show fewer faults, and most of those faults that are present are easily discerned by marked changes in dip or displacement of strata or both. Most of the faults recognized in the Precambrian rocks originated in Precambrian time, though a few were reactivated in Cenozoic time.

Wide, steeply dipping, northward-trending shear zones dominate the fault pattern in Precambrian rocks. One of the largest zones (fig. 16) enters the primitive area from the south and extends north-northwestward through the Alpine Lakes to a point where it disappears under moraines of the Bull Lake Glaciers. It may be traceable, as a lineament largely covered by glaciers, northward past the east face of Gannett Peak, and west of Downs Peak into Soapstone Basin and past Soapstone Lake. This projection assumes a slight offset, across the Jakeys Fork fault, into Paleozoic rocks along the north edge of the study area. Parts of this zone near the Alpine Lakes are well exposed and defined by crushed and altered rock over widths exceeding 1,000 feet. Other similar subparallel shear zones, farther north, pass through the Ross Lakes and through Simpson Lake. The Simpson Lake shear zone displaces the Goat Flat diabase dike horizontally over a distance of about a mile, whereas the Ross Lakes shear zone seems to terminate abruptly before reaching the dike—it may merge with a fault that trends southeastward across Bomber Lake, Goat Flat, and the Dinwoody Lakes.

A complex network of faults, possibly related in part to movements that created the large shear zones, cuts the Precambrian terrane throughout the area. Most of these faults do not seem to have produced any noticeable displacement on either the Goat Flat dike or the glomeroporphyritic diabase dike, a fact which suggests that the earliest fault movements predate the structures along which diabase was emplaced. Also, that only a few of the faults in Precambrian rocks can be traced into the Paleozoic se-

FIGURE 16.—Topographic lineament formed along the Alpine Lakes shear zone; view northwestward from the southern part of the area.

quence indicates that they have largely been dormant since Precambrian time.

Most of the faulted rocks lack resistance to erosion and are concealed by surficial debris. Some northeastward-trending faults, however, contain a locally resistant, green-stained quartz-cemented breccia core (pl. 1) as much as 100 feet wide. Quartz fills and cements the fractured rocks and is itself weakly brecciated and cemented by films of green chlorite. These quartz-chlorite breccia zones are generally traceable for only short distances, as they commonly are covered by talus or morainal material. Scattered blocks of the quartz-chlorite breccia were seen in numerous localities where none could be seen in place. The significance of these northeastward-trending breccias was not determined, but their parallelism suggests close relation to a single structural event.

Faults that cut only Precambrian rocks may have been active in the Precambrian or the Tertiary or both. Is is assumed, however, that most of the present fault pattern was established in Precambrian time. Large thrust faults on the west flank of the Wind River Range were active during Laramide time and, presumably, some of the high-angle faults permitted adjustments in the upper plates of these thrusts even on the east side of the range. The large shear zones are characterized by pinching and swelling of broad zones of crushed and fractured rock and by silicified, chloritized, and epidotized wallrocks. In contrast, the Paleozoic rocks are abruptly upturned along narrow zones where they were dragged by high-angle normal faulting, and the associated alterations were silicification, argillization, and weak pyritization. Throw on the Ross Lakes fault where it cuts Paleozoic rocks north of Jakeys Fork is said to be about 470 feet (Gilliland, 1959), but this figure is probably minimal.

Eastward-trending faults which cut the Paleozoic rocks are typically downthrown on the north side, and north-trending faults are downthrown on the east. These movements are generally compatible with the relatively uplifted core of the Wind River Range.

Two eastward-trending normal faults—one follows parts of Jakeys Fork and the other crosses Little Warm Spring Creek about 3.5 miles to the north—may have formed entirely in Laramide time. Although both cut the Precambrian basement, there is no good evidence that they followed any preexisting structures. The Jakeys Fork fault cuts eastward through Paleozoic rocks, the north block being downthrown on the north side; the fault disappears under the glacial moraine near the lower end of Torrey Lake. It may be the same as the Twin Buttes fault east of the lake and the moraine (Gilliland, 1959), although the displacement there seems to be reversed.

The last significant tectonic event to affect the primitive area was probably a gentle arching of the Wind River Range sometime after formation of the mid-Tertiary peneplain. This may have been accompanied by greater upward movement in some of the fault blocks near the crest of the range. It is not clear whether the high peaks which form the spine of the Wind River Range were uplifted at this time or whether they are erosion remnants that resisted peneplanation. The north flank of Downs Peak and the southeast flank of Jackson Peak (fig. 13), at elevations of about 13,000 feet, both appear to be parts of the peneplain.

ALTERATION RELATED TO FAULTS

For the most part, rocks are remarkably fresh and unaltered in and near the Glacier Primitive Area. With the exception of weathering, some of which is pre-Flathead, most alteration seems to be associated with faulting. Faults that cut Paleozoic rocks locally are silicified and weakly argillized and contain minor amounts of disseminated pyrite, which is oxidized to iron stain near the surface; few other effects of alteration can be noted. Precambrian rocks, in contrast, are locally epidotized and chloritized along faults and shear zones and, in addition, contain quartz stringers, magnetite, hematite, and sulfide minerals.

Silicification is probably the commonest type of alteration along faults throughout the area. The northeastward-trending faults previously mentioned commonly contain a thick filling of quartz-chlorite breccia. The Alpine Lakes shear zone and other faults in the southern part of the primitive area are commonly bordered by a granitic-appearing rock that is apparently a silicified, chloritized part of the surrounding migmatite. Silicification and cementation of brecciated granite were noted in the Jakeys Fork fault zone. Quartz veins and silicified streaks are present in the Ross Lakes shear zone where it is exposed between the lakes. Vugs and irregular cavities lined with attractive coatings of drusy quartz crystals are found in the middle Paleozoic carbonate rocks on the southeast side of Arrow Mountain near the Blue Hole Creek fault. The calcareous tufa deposits farther downstream at Blue Holes are doubtless a result of the carbonate leaching in these silicified parts of the fault zone.

Epidote is common in the wallrocks near fault zones, generally as narrow quartz-epidote veinlets. Float fragments of quartz and epidote as much as a foot across can be found along the shear zone at Hay Pass. Although epidote is perhaps most prevalent near faults, its almost ubiquitous presence either as fracture fillings or as disseminated grains in most of the felsic rock and in some of the mafic rocks suggests more than one origin. (See also Barrus, 1968.) Chlorite, as films and fracture fillings in quartz-chlorite breccia zones and as chloritized mafic minerals in the wallrocks of fault and shear zones, is much more prevalent in the southern part of the area than in the north.

Talc and clear fibrous amphiboles, such as anthophyllite, are found locally in faults generally north of the latitude of Dinwoody Lakes. Soapstone Lake and Soapstone Basin presumably derived their names from talc-rich boulders found in the moraine south of the lake. The origin of the talc and amphiboles is not known, but the source may have been narrow sheared and altered ultramafic dikes that were intruded into some of the early Precambrian faults.

Most of the observed effects of alteration, therefore, seem to be Precambrian in age and there is no evidence of strong argillization, sericitization, or extensive mineralization by sulfur-rich solutions. In short, the types of intense alteration related to many of the metallic ore deposits of the Western United States are generally lacking in the primitive area.

MINERAL RESOURCES

HISTORY AND PRODUCTION

Intensive prospecting in the Wind River Range began in the mid-19th century with the discovery of gold in the Atlantic City district at the southeastern tip of the range. Developments at Atlantic City were disappointing, however, and activity soon subsided. Shortly after 1900, gold was discovered in the gravels of Warm Spring Creek a few miles northwest of the Glacier Primitive Area. This discovery resulted in many attempts at small-scale mining, most of which were frustrated by the fine, flaky nature of the gold.

Uranium was discovered about 100 miles to the southeast in the Gas Hills district of central Wyoming in 1954 and 1955. In the succeeding several years, prospectors with Geiger counters and scintillation meters investigated most rock outcrops in the State, including those of the Wind River Range. Many claims were located on "favorable formations" and on minor radiometric anomalies that amounted to only two or three times normal background. Improved conditions in the uranium market in the late 1960's resulted in another surge of uranium prospecting and caused renewed interest in uranium claims in the vicinity.

Small amounts of uranium have been found in shear zones in Precambrian and brecciated lower Paleozoic rocks and at weak radiometric anomalies detected near the base of the Flathead Sandstone and in Tertiary sedimentary units. Taconite-type iron deposits were discovered many years ago in Precambrian rocks near Atlantic City at the south end of the range (Spencer, 1916; Bayley, 1963), but they were not mined until recently, when economic methods for treating such low-grade remote deposits were developed.

No mineral production has been recorded from the Glacier Primitive Area. Production from within or near the contiguous area to the northwest consists of 6 tons of uranium ore, several hundred tons of facing stone, and probably several thousand dollars' worth of placer gold.

GEOCHEMICAL SAMPLING AND ANALYTICAL TECHNIQUES

A geochemical sampling program by the Geological Survey team was conducted concurrently with geologic mapping in 1968 and 1969, and 1,076 samples were collected. A total of 483 rock samples were taken both of typical rocks and of the few exposed veins, iron-stained or altered rocks, and other rocks that differed in color, texture, or apparent composition from their surroundings.

Rock samples were collected both from outcrops and from float fragments but, with few exceptions, float fragments were collected only if it seemed likely that they had moved just a short distance. Each sample consisted of two hand specimens, one of which was submitted for analysis and the other retained for reference and petrographic study. All rock samples were analyzed by semiquantitative spectrographic methods. Where additional data were desired, samples were analyzed specifically for various constituents. Analyses have been divided into petrologic categories in tables 5–11 (p. F64–F109) to facilitate comparisons.

Stream-sediment samples and panned concentrates were collected (pl. 2) at intervals from each major stream and from most of the flowing or intermittent tributary drainages. Each of the 470 stream-sediment samples consisted of approximately 4 ounces of sand- or silt-sized alluvium collected by hand at a place determined partly by the availability of fine sediment. Extensive distances along some torrential streams were traversed without finding any clastic material smaller than cobble size; other places, however, contained abundant sand and silt. After collection the samples were dried and screened and the minus-80-mesh fraction was analyzed. At 123 sample sites, about 3–5 pounds of sand or gravel was panned and the heavy-mineral concentrate analyzed. All analytical work was done in laboratories of the Geological Survey.

Nearly all the samples were analyzed for selected elements by spectrographic methods in a mobile field laboratory operated by D. J. Grimes and R. T. Hopkins, Jr., assisted by S. G. Meyers in 1968 and by W. D. Crim in 1969. Most stream-sediment samples were chemically analyzed for CxHM (citrate-soluble heavy metals) in a mobile field laboratory by A. J. Toevs. Panned heavy-mineral concentrates were analyzed for gold by atomic-absorption methods in the Denver, Colo., laboratories by A. W. Wells, J. G.

Frisken, and M. S. Rickard. A few samples were analyzed in Denver for platinum metals or for other elements by L. B. Breeden, Gordon Day, J. V. Desmond, W. H. Ficklin, J. M. Gardner, W. D. Goss, Joseph Haffty, R. L. Miller, L. B. Riley, T. A. Roemer, and Z. C. Stephenson.

It was assumed that the properties of sediments in any stream represent a function of the composition of the terrane from which the sediments were derived. The composition of the minus-80-mesh fraction of bulk stream sediment should, therefore, be a function of the gross composition of rocks upstream. The CxHM content of the same sample is largely a function of oxidized metals that have become dissolved in the stream waters and concentrated by absorption on surfaces of fine detrital grains such as clays and organic matter.

Since organic matter is known to be a particularly good absorbent of dissolved metals, the sediment samples (table 12) that were observed to contain an appreciable proportion of fine-grained organic material were distinguished from the remainder of the samples for objective comparison. No statistically significant differences were found, however, between organic-rich and organic-poor samples. All analytical data derived from the sampling program were placed on computer tape to provide greater efficiency in retrieval and organization of the information found in the various tables of this report.

RESULTS OF SAMPLING STREAM SEDIMENTS FOR BASE METALS

Stream-sediment samples found to contain at least 70 ppm (parts per million) copper, 5 ppm molybdenum, 70 ppm lead, or 200 ppm zinc by semiquantitative spectrographic analysis, or 8 ppm CxHM were arbitrarily considered to be anomalous. By these arbitrary criteria many anomalous samples were found, but none of them seems to indicate the presence of an economically usable ore deposit.

An anomalous stream-sediment sample can generally be attributed to erosion and weathering of nearby mineralized rocks; and several test samples were collected near known veins and iron-stained areas. Some sediment samples collected downstream from anomalous rock samples, however, showed no comparable anomaly and, in places, anomalous rock samples were collected a short distance downstream from an anomalous sediment sample but no mineralized rocks were noted upstream. Also, sediment samples and mineralized rocks sampled nearby are not invariably anomalous in the same elements, for reasons not readily apparent. Some anomalous samples have questionable validity because the anom-

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alies were not duplicated by resampling (table 2). This discrepancy was not explained but might be attributable to sampling error, analytical error, erratic distribution of the anomalous metal, differences in the chemistry of the stream water, or a complete exchange of the sediment at the sample site.

TABLE 2.—*Some compositional differences in sediment-sample pairs collected from the same sample site at different times*

[All values in parts per million. ----, not looked for; N, looked for but not detected; L, detected, but below determination limit. For complete analysis see tables 10 and 11]

Sample No.	Semiquantitative spectrographic analyses				CxHM analyses
	Mo	La	Pb	Y	
234	7	200	50	200	--
784	N	70	15	70	--
345	N	100	100	30	1
781	N	50	20	15	1
338	L	70	30	30	1
952	N	150	15	>200	3
284	N	1,000	100	200	--
786	N	100	10	50	--
633	5	150	20	30	3
777	N	100	15	>200	1

Sediment samples were subjected to CxHM analysis to detect anomalous amounts of oxidized base metals absorbed from stream waters by sediment particles. Several sediment samples having normal CxHM analytical results seem to contain anomalous amounts of lead or copper as determined by spectrographic analysis, a fact suggesting that the anomalous metals may be held in rock-forming minerals rather than in absorbed form (table 3). Whether such samples can form any favorable basis for further prospecting is not known.

TABLE 3.—*Some stream-sediment samples that contain anomalous lead or copper according to semiquantitative spectrographic analyses but show normal CxHM analyses*

[All values in parts per million]

Sample No.	Anomalous spectrographic analyses	CxHM analyses
210	70 Pb	1
264	100 Pb, 150 Cu	1
[illegible]45	70 Pb	1
358	70 Pb	1
381	70 Pb	1
697	100 Cu	3
740	70 Pb	1
744	70 Pb	3
745	70 Pb	1
757	70 Pb	1
772	70 Pb	1
793	70 Pb	1
1025	70 Pb	3
1034	100 Pb	3
1036	150 Pb	3

Sediment samples 317, 737, 962, 1003, and 1062 contained more than 10 ppm CxHM and were also anomalous in copper or lead or both (determined by semiquantitative spectrographic analysis). No evidence of iron stain, strong alteration, or other indication of mineralization was found near any of these samples, other than for sample 1003 which was collected in a generally iron-stained zone seemingly related to nearby gossan-filled veins of narrow width and strike length (see vein samples 861 and 862, table 9).

Many of the stream-sediment samples contained what seem to be anomalous amounts of chromium and nickel, but these elements were not found to be anomalously abundant in any of the vein or breccia zones. Most probably the stream sediments acquired chromium and nickel from amphibolites and ultramafic bodies, which commonly contain more of these elements than intermediate and felsic rocks but which are still well below ore grade. The chromium and nickel were not traced to any particular amphibolite or ultramafic body, but amphibolites are fairly common in this region and shed debris to nearly all the streams north of the Mount Helen structural belt.

Stream-sediment samples containing anomalous amounts of base metals do not seem to show any marked clustering in any part of the study area. On a broad scale anomalous samples came largely from three areas:

1. A wide area extending southeastward from the headwaters of Warm Spring Creek through Native Lake. Several samples from this zone contain anomalous CxHM, copper, lead, molybdenum, or zinc. Several quartz-, pyrite-, and gossan-filled veins were noted in the country rocks which indicates widespread but weak mineralizing activity.
2. The headwaters of Dry Creek. Several samples showing lead or CxHM anomalies were collected in this area. Gneiss in the sampled area locally contains iron-stained zones, but little other evidence of alteration or veins was noted.
3. The headwaters of Bull Lake Creek and the Middle Fork of Bull Lake Creek. Many samples were anomalous in lead and CxHM. This area is in migmatite, which field mapping and sampling showed to be uniformly unmineralized.

The vague tendency for anomalous samples to be grouped in these three areas has little obvious relationship to what is known about the lithology or structure of the study area. The Goat Flat diabase dike, because of its similar trend, may have some relationship to the first area noted above. Also, more of the anomalous samples seem to lie within aeromagnetic lows than in highs.

However, the significance of the anomalous samples is not clear and, even though they might be considered anomalous and significant in some regions known to contain minable ore deposits (Steven and others, 1969), there seems to be little likelihood that they are related to deposits in the study area that can be exploited economically.

PRECIOUS METALS

No gold deposits of economic interest were found during this study. The highest grade sample (729, table 11), containing 1.24 ppm gold, was a panned concentrate from Snowshoe Creek draining into Warm Spring Creek in the northwestern part of the study area. All other panned-concentrate samples contained less than 1 ppm gold, and most contained less than 0.1 ppm. The samples which contained more than 0.01 ppm gold were largely from drainages in or downstream from areas underlain by Tertiary sedimentary rocks in the northwestern part of the study area or from Precambrian crystalline terrane in the Dry Creek and Bull Lake Creek drainages. Several of the anomalous samples from drainages in Precambrian rocks were collected downstream from localities known to contain small weak sulfide-mineral veins. The highest grade lode sample (441, table 9) contained 0.3 ppm gold and was from a sulfide-bearing vein in the vicinity of the Ink Wells. One part per million gold is about equal to $1.00 per ton at a price of $35.00 per ounce for gold. None of the samples indicates deposits that can be worked economically at present.

Schrader (1915) reported placer gold deposits being worked in the early 1900's along Warm Spring, Bull Lake, Dry, and Dinwoody Creeks. Each of these occurrences is well outside the study area in terrane now or once underlain by lower Tertiary sedimentary rocks—similar to rocks which are known to be weakly auriferous farther to the west (Antweiler and Love, 1967). The gold in the alluvium in Warm Spring Creek, as well as the gold in the Wind River Formation, is so extremely fine-grained that it is known as "flour" gold, and there is little tendency for it to concentrate naturally in placers. Although Ketner, Keefer, Fisher, Smith, and Raabe (1966) implied that the Dinwoody Creek placers derived their gold from Precambrian rocks in the Wind River Range, just as plausible an interpretation is that the lower reaches of streams draining the primitive area derived much of their gold from the Tertiary rocks.

Persistent local rumors were heard, during this study, of a gold prospect that had been operated by Chinese prospectors in the Klondike Lake area. Whether the prospect was a lode or a placer is unclear, but the present study does not indicate any gold deposits in that area. Schrader (1915) did not mention any gold deposits within the primitive area.

Silver was detected in a few samples from sulfide-bearing veins, but all samples were well below economic limits. Samples from the Ink Wells vein contained as much as 15 ppm silver by semiquantitative spectrographic analysis but no more than 10 ppm silver by activation analyses. These were the richest samples collected.

Because platinum metals are commonly concentrated by magmatic processes in ultramafic igneous rocks, several samples (13, 21, 34, 459, 460, 507, 524, table 7) of the ultramafic rocks in the primitive area were analyzed specifically for platinum, palladium, and rhodium. None of the samples, however, contained enough of these metals to be reliably analyzed, and all indicate rocks too low in grade to evoke any economic interest.

SULFIDE-MINERAL OCCURRENCES

Most metallic-mineral deposits in the Western United States contain sulfide minerals which oxidize readily near the surface to leave reddish-brown iron-stained zones and gossan. Iron-stained rocks were therefore studied and sampled during this investigation because of the possibility that they might be surficial indications of metallic-mineral deposits at depth. In some places pyrite was found just beneath the oxidized surface. Several of the samples collected from iron-stained rocks or gossan and from rocks containing iron sulfides were found to contain anomalous amounts of base and precious metals, but none was of sufficient grade or quantity to suggest the presence of an economically exploitable deposit.

Gossan- and Pyrite-Bearing Veins

Although a few pyrite-bearing veins were found in the study area, most of them are narrow and of short strike length, are in weakly altered rock, and contain only small concentrations of base and precious metals. All the veins are partly oxidized at the surface; several consist solely of porous limonitic breccia and gouge where exposed, but they undoubtedly contain iron sulfide minerals at depth. Obviously, no strong mineralizing event has affected the area, and the diverse character and orientation of the several sulfide-bearing veins and zones suggest that they do not owe their origin to any single source.

The largest pyrite-bearing vein seen during this investigation trends northward across one of the Ink Wells Lakes (pl. 1) in sec. 11, T. 38 N., R. 106 W. The mineralized vein zone contains disseminated pyrite and perhaps other sulfide minerals, is as much as 8 feet wide, and is traceable intermittently for nearly 1,000 feet. Grab samples (39 and 40, table 9) and chip-channel samples (441–444, table 9) all contain anomalous concentrations of silver, copper, lead, and zinc, but the amounts are well below economic limits. A sediment sample (375, table 10) from the outlet of the lake crossed by the vein contained only zinc in anomalous amounts.

Several large iron-stained areas are present in the gneiss along the north side of the North Fork of Bull Lake Creek. At least some of the iron stain is related to limonitic pyritic veins. In one of the largest of these areas, a lithologically complex area northwest of Little Milky Lake, the rocks are faintly to heavily stained. The gneisses there contain large amphibolite bodies, numerous pegmatite dikes, and one or more ultramafic lenses, all of which are somewhat affected by iron stain that seems to have emanated, at least in part, from a few narrow northwestward-trending gossan veins. Samples of the gossan (861 and 862, table 9) contained a little anomalous silver, copper, and lead; sediment samples from a small stream draining the area all contained anomalous amounts of copper.

The highest copper value detected during the sampling program—2,000 ppm—was from a specimen of ultramafic rock (sample 845, table 7) containing extremely fine grained sulfide minerals disseminated along a few hairline fractures. Most of this sample, as well as nearby rocks, was barren of sulfide minerals, and no economic importance is believed to be indicated by the sample results.

Another high copper value detected in vein material during the sampling program was from a small isolated fracture in a diabase dike. The fracture was filled with a quartz-epidote-pyrite veinlet that contained a few visible flecks of chrysocolla (sample 825, table 9; 1,500 ppm copper). A gossan-rich sample of float (sample 54, table 9; 1,000 ppm copper) presumably was derived from a vein zone that crosses Goat Flat. Little, if any, economic signficance can be attached to either occurrence.

Biotite-schist lenses and boudins and biotite-rich fault zones in the study area are commonly iron stained, and some contain disseminated to massive pyrite a few inches below the weathered surfaces. Most of these are small, sporadic occurrences, but some seem to have considerable width and continuity. About a mile northeast of Klondike Lake, for example, is a 4- or 5-foot-wide biotite-quartz-pyrite vein more than 200 feet long that strikes N. 70° W. and dips 75° NE. In places the vein contains as much as an estimated 25 percent pyrite. A sample (447, table 7) contained anomalous amounts of cobalt, copper, and molybdenum, and some similar veins elsewhere also contain small but anomalous quantities of lead and zinc. Unoxidized pyrite can be found just beneath the surface of some of these deposits, which indicates that oxidation and leaching have been negligible and, therefore, that the analyses of surficial samples probably are representative of the vein at greater depths.

Disseminated Sulfide-Mineral Occurrences

Disseminated grains of sulfide minerals are rare in the country rock but were noted in a few places (samples 75 and 1109, table 6; 181 and 417, table 9; and 476 and 838, table 7). Of interest were two hand specimens that contained small crystals of molybdenite and which were collected in vastly different types of rock at widely separated localities. One of these, sample 75, apparently unaltered, was from leucocratic granite of the Middle Mountain batholith and contained 700 ppm molybdenum. The other, sample 838, contained a crystal of molybenite in a small, partly leached cavity in an ultramafic rock. The analyzed fragment of this sample contained 5 ppm molybdenum. Sample 476, containing 200 ppm copper, was taken from a diabase dike which locally contains sparsely disseminated pyrite near a northward-trending fault that displaces the diabase.

Patches of weakly iron-stained rock were noted only in the gneiss, granite, and migmatite north of the Mount Helen structural belt. These patches range from a few tens of feet to a few hundred feet across, have no continuity or trend, and are seemingly unrelated to faults or veins. Although no sulfide minerals were seen in these zones, disseminated pyrite may be associated with the mafic minerals of the rock below the weathered surfaces. These zones seem to contain, other than iron, no anomalous concentrations of metals.

MAGNETITE-HEMATITE VEINS

Narrow fracture fillings of magnetite, hematite, and quartz are present in many places in and around the Middle Mountain batholith. Hematite, perhaps mixed with some magnetite, commonly forms a dense, fine-grained gray filling in which are scattered minute octahedrons of magnetite. Generally, no other metallic minerals are associated with these veinlets. Uranium, however, may be related to hematite-magnetite mineralization in parts of the breccia of the Little Warm Spring Creek deposit.

In a few places quartz veins contain small pods and stringers of specularite, but they appear to have no economic significance. Vertical veins of this type striking N. 10° E. and as much as 18 inches wide occur near an old collapsed and abandoned cabin along a stream draining into Jakeys Fork in sec. 33, T. 41 N., R. 107 W. No prospect pits were seen in the vicinity, and the veins appear not to contain exploitable material.

Samples taken by the Bureau of Mines team from an iron-stained zone in the primitive area on the northwest side of Horse Ridge along the upper drainage of Dinwoody Creek (sec. 14, T. 38 N., R. 106 W.) contain disseminated magnetite. An exposure on the bank of Wildcat Creek (sec. 3, T. 41 N., R. 108 W.) outside the study area consists of sheared migmatite and gneiss that also contain magnetite (Harrer, 1966).

No Precambrian iron-formation was recognized in place in the study area, although Worl (1968) reported a geologically significant, but uneconomic, body of metamorphosed iron-formation (taconite) about 1.5 miles southwest of Downs Peak in the Bridger Wilderness. An angular float sample (92, table 8), found in glacial till and talus debris along the Ross Lakes fault zone between the lakes, may be a fragment of taconite. Spectrographic analysis showed it to be rich in iron but rather low in magnesium, chromium, and nickel. It consisted of a dark-gray, laminated, very fine grained granoblastic aggregate of magnetite, anthophyllite, grunerite, quartz, green biotite, and chlorite. This sample may have had a nearby source within the fault zone, but it might just as well have been transported for a considerable distance by glacial action. Regardless, it is unlikely that any significant bodies of iron-formation would have been missed during the geologic traversing. The aeromagnetic survey likewise indicated no unusual concentration of magnetite.

CHROMIUM AND NICKEL

Nearly all the samples from diabase dikes, amphibolite bodies, ultramafic rocks, and talc- or amphibolite-bearing fault zones contain greater amounts of both chromium and nickel than do samples from more felsic rocks. Ultramafic rocks in particular, however, are normally much richer in these elements (table 4) than are other rocks, and it is unlikely that any economic importance can be attached to the fact that some of the samples from the primitive area are a little richer than the worldwide average. In-

TABLE 4.—*Crustal abundance of some metallic elements compared with their abundance in rocks of the Glacier Primitive Area*

[Fe, Mg, Ca, and Ti values in percent; all other values in parts per million]

Element	Worldwide occurrence (adapted from Turekian and Wedepohl, 1961)				Occurrence in Glacier Primitive Area (median value)			
	Granitic rock							
	Low-calcium	High-calcium	Basaltic rock	Ultramafic rock	Granitic rock	Gneissic rock	Diabase	Ultramafic rock
Fe	1.42	2.96	8.65	9.43	1.17	2.72	7.50	7.85
Mg	.16	.94	4.6	20.4	.24	.70	3.17	6.68
Ca	.51	2.53	7.6	2.5	.57	1.26	3.80	2.12
Ti	.12	.34	1.38	.03	.06	.17	.38	.10
Mn	390	540	1,500	1,620	99	235	768	830
Ba	840	420	330	.4	605	515	72	120
Be	3	2	1	<1	<1	<1	<1	<1
Co	1	7	48	150	<5	8	62	74
Cr	4.1	22	170	1,600	<5	9	180	3,265
Cu	10	30	87	10	7	10	50	12
La	55	45	15	<1	24	26	<20	<20
Nb	21	20	19	16	<10	<10	<10	<10
Ni	4.5	15	130	2,000	8	14	71	935
Pb	19	15	6	1	19	14	<10	<10
Sc	7	14	30	15	<5	5	31	16
Sr	100	440	465	1	93	187	180	<100
V	44	88	250	40	10	32	152	70
Y	40	35	21	<1	10	10	21	10
Zr	175	140	140	45	76	83	47	10

deed, the median value for nickel in ultramafic rocks from the primitive area is notably less than the worldwide average. No nickel minerals were recognized even in the higher grade samples, and the nickel in these is probably contained in rock-forming silicate minerals.

NONMETALLIC MINERALS

Our studies in the area revealed no deposits of nonmetallic minerals that would encourage further economic investigation. Phosphorite occurs in the Phosphoria Formation along the east flank of the Wind River Range (Blackwelder, 1911; Condit, 1924; Sheldon, 1963), but none of these occurrences is in the Permian strata investigated in this study (pl. 1). No phosphorite was found in the primitive area nor is any likely to be found, for the Permian rocks shown on plate 1 are mostly limestone beds of the Park City Formation rather than the facies of black shale, chert, and phosphorite typical of the Phosphoria Formation.

Talc, largely in the form of soft impure soapstone, is locally common as float boulders in felsenmeer and other rubble near faults in the north-central part of the study area. Presumably, the occurrences are narrow and well fractured, but talc weathers readily, providing meager surficial evidence of its presence.

Talc apparently occurs in several fault zones near Soapstone Lake and in Soapstone Basin; a few pieces of float were found on the edge of Goat Flat overlooking the Dinwoody Lakes and at one locality south of Crater Lake in sec. 16, T. 37 N., R. 105 W. At no place did the geologic setting or the abundance and purity of the float material seem adequate to indicate the presence of an economic deposit.

Green nodules as much as 8 inches long and 4 inches across occur in sec. 34, T. 38 N., R. 106 W., on Horse Ridge in a quartz-biotite vein which also contains some red garnet elsewhere along its strike. The nodules are extremely dense and tough and look much like jade but are almost pure sericite and have a little chlorite. Possibly they were sillimanite nodules altered by potassium metasomatism. Though pretty, the larger nodules are not common and are too soft to take a durable polish. No jade was recognized in the study area. Pegmatites within the study area are of simple granitic composition, and no significant concentrations of rare earths, beryllium, or mica were found in them.

OIL AND GAS

Records of the U.S. Bureau of Land Management indicate that one oil and gas lease was issued on land within the primitive area. This lease involves the SE¼ sec. 3, NE¼ sec. 10, and E½ sec. 14, T. 36 N., R. 106 W. (fig. 17). The lease was issued November 1, 1964, and terminated November 1, 1966. There is no record of drilling or production. This locality is underlain by Precambrian gneiss, and petroleum deposits are not likely to exist there. Although westward overthrusting on the west side of the Wind River Range has placed blocks of Paleozoic sedimentary rocks beneath plates of Precambrian rock (Baker, 1946), there is no evidence that these relations exist beneath the Precambrian rocks exposed on the east side of the range.

Within the study area there is no evidence of favorable structural or stratigraphic traps within the Paleozoic formations similar to those from which oil and gas are produced in the adjacent Wind River Basin. The area underlain by Paleozoic rocks is small, and all the formations are tilted and truncated, so that oil and gas, even if formerly present there, would probably have escaped at the surface or have been flushed by ground water.

MINES AND PROSPECTS

Fremont County records show that over a period of many years several hundred mining claims have been located in or near the study area but, according to Bureau of Land Management records, none of these has been patented. The present investigation

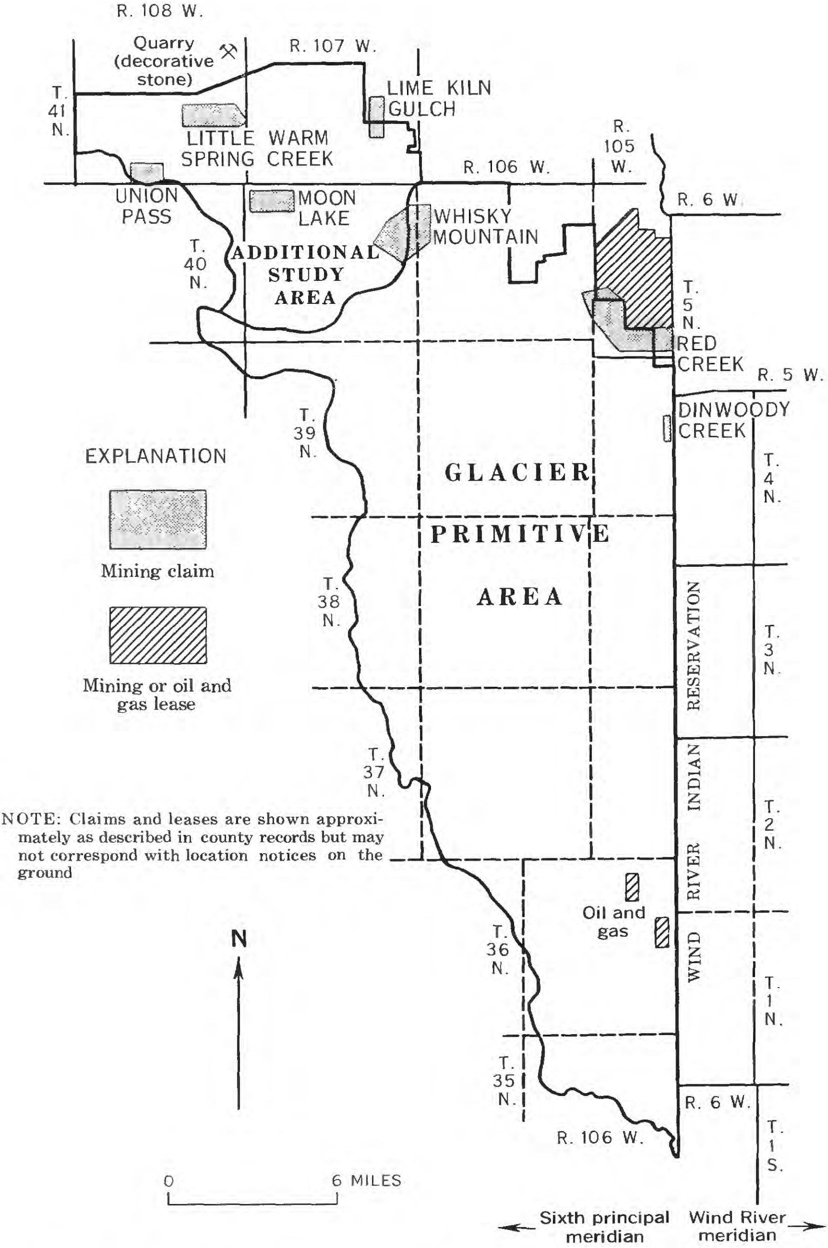

FIGURE 17.—Claims and leases in and near the Glacier Primitive Area.

was concerned mainly with abandoned mine workings and with claims that have been active in recent years as revealed by location notices and affidavits of annual labor.

Lime Kiln Gulch

Lime Kiln Gulch, which lies between Jakeys Fork and Little Warm Spring Creek, has been the site of several periods of quarrying, prospecting, and claim staking. Remains of a lime kiln which was constructed to process limestone from a talus slope of the Madison Limestone for local use can still be seen. Appearance of the ruins indicates that production was small.

Here and elsewhere along the east flank of the range, the Madison Limestone is exposed in massive cliffs several hundred feet high. It has been a source of limestone at several localities in northern Wyoming. Because of the availability of limestone at more favorable locations and the lack of railroad transportation, outcrops of the Madison in the study area have little commercial value at present.

On the opposite (north) side of the gulch from the lime kiln, and only a few hundred feet outside the national forest boundary in sec. 23, T. 41 N., R. 107 W., an adit (pl. 1) has been driven along gossan and breccia in the Ross Lakes fault zone. The adit is now caved but appears to have trended N. 5° W. for at least 75 feet (judged from the size of the dump) in Madison Limestone that strikes N. 17° W. and dips 84° NE.

Waste material on the dump consists of iron-stained claystone and limestone and a few small limonite pockets which probably represent oxidized iron sulfide minerals; a few partly oxidized grains of pyrite were noted. Two samples of rock from the dump (494 and 827, table 9) contained anomalous amounts of either arsenic, barium, and or molybdenum. Another sample contained 0.001 ounce gold and 0.02 ounce silver per ton. A panned concentrate (766, table 11) of stream sediment from Lime Kiln Gulch a short distance below the fault contained anomalous amounts of barium, lead, and tin. The tin content may be attributable to oxidizing tin cans on the property. Samples (452, 453, table 9) of iron-stained rock from the Ross Lakes shear zone within the study area and about a mile south of Lime Kiln Gulch also contained anomalous amounts of either arsenic, barium, and or molybdenum, but no metallic minerals were seen.

Chemically reactive rocks such as limestones are commonly favorable hosts for ore deposits, but the Paleozoic limestones are only weakly mineralized where cut by the Ross Lakes shear zone and are absent along those parts of the shear zone within the primitive area. The Ross Lakes shear zone, however, is a major structural feature and, although the geochemical anomalies found along it are all weak, it would be presumptuous on such scant data to rule out the zone completely as a target for further prospecting.

In 1956 a group of mining claims was located south and east of Lime Kiln Gulch (fig. 17) along a ridge that is now the site of a television relay station. Examination of this locality revealed no mineral occurrences of economic interest. Slightly anomalous radioactivity may have provided the impetus for location of the claims.

Whisky Mountain

In the mid-1950's, traces of uranium were found in the vicinity of Whisky Mountain (Theobald and King, 1954), and mining claims were staked over an area of about 2 square miles. The block of 40 claims lies partly within the primitive area (fig. 17). Affidavits of annual assessment work have been filed each year. The discovery point is on the north side of a knoll, in sec. 12, T. 40 N., R. 107 W., and 1,000 feet north of the Ross Lakes jeep road. A partly caved 6-foot-deep shaft collared in the bottom of a 5-foot-deep opencut is the principal development (pl. 1). The host rock is light-gray, brecciated, well-indurated, noncalcareous claystone interlayered with dolomite at the top of the Gallatin Limestone (or, possibly, in basal Bighorn Dolomite). To the north the same strata are thoroughly silicified to a chert breccia; dolomite occupies the same stratigraphic interval to the southeast.

The brecciated rock is iron stained and contains small rounded limonite-hematite concretions derived from oxidized iron sulfide minerals. Both white fluorite and purple fluorite occur sparingly in fractures. A few small barite concretions can be found, and carnotite was identified as a sparse fracture-surface coating.

Radioactivity in the opencut generally registers on the first scale of a Geiger counter (less than 0.2 milliroentgen per hour), although selected specimens gave second-scale readings (0.2–2.0 milliroentgens per hour). A sample (491, table 9) containing a few flecks of carnotite also contained anomalous arsenic, molybdenum, and vanadium and 0.016 percent uranium. Another selected sample (not shown in the tables) contained 0.06 percent U_3O_8. No ore has been produced from this locality. Inasmuch as this deposit and the Lime Kiln Gulch deposit each contain anomalous amounts of arsenic, barium, and molybdenum, they both may be due to weak mineralization associated with the Ross Lakes shear zone.

Little Warm Spring Creek

A small amount of high-grade uranium ore was mined in 1956 from a shallow opencut (pl. 1) along a vein on the Dubois claims in Little Warm Spring Creek valley, sec. 24, T. 41 N., R. 108 W. Additional mining increased the total production from the original group of six claims to 6 tons of ore having an average grade of about 2.0 percent U_3O_8. Later, 44 more claims were staked (fig. 17), and exploration was continued in 1958, partly under terms of a Defense Minerals Exploration Administration (DMEA) contract. Four holes were diamond drilled, and the shear zone was penetrated at depths of about 100–200 feet, but no further ore discoveries were reported.

The deposit consists of a vertical breccia zone as much as 30 feet wide that trends N. 19° W. and cuts garnet-bearing biotite gneiss into which several narrow pegmatite bodies have been injected. The breccia is cemented by quartz, hematite, and magnetite; the wallrock is chloritized. Pitchblende (R. U. King and C. M. Harrer, written commun., 1957) associated with a little pyrite occurs in late fractures that cut the breccia zone.

Nine samples (478–483 and 496–498, table 9) were collected from the mine dump and from the wall of some small workings at the collar of a 20-foot-deep shaft situated south of and about 40 feet higher than the opencut from which most of the ore was produced. Samples 497 and 498 were moderately radioactive, but only 497 contained uranium (about 0.2 percent) detectable by semiquantitative spectrographic methods; sample 497 contained a little anomalous cobalt, and nickel, and vanadium and 1,500 ppm lead; and sample 480 contained 10 ppm molybdenum.

A selected specimen (not shown in the tables) from the wall of the workings near the collar of the shaft and at about the same point as samples 497 and 498 contained 0.61 percent U_3O_8. This is ore-grade rock, and possibly a small amount of ore still remains in the deposit.

The shallow depth of the deposit and petrographic studies made during the period of active exploration suggested that the uranium deposits might not have a hydrothermal or hypogene origin (Harold Smithson, written commun., 1957). This conclusion prompts speculation that the uranium was derived by a supergene process from rocks such as the Wind River Formation which probably once overlay the area. If this is true, similar deposits might be present in the study area but would likely be small and could not be expected to extend to appreciable depth.

Red Creek

In 1952 a group of mining claims was located on a low-grade iron deposit in the Amsden Formation along the upper drainages of Red Creek and Little Red Creek, immediately inside the primitive area (Harrer, 1966, p. 44). Claims subsequently have been added, overstaked, and relocated, until the group now covers several square miles (fig. 17). Affidavits of annual labor have been filed on some of the claims each year.

Owners of the claims have also leased land underlain by the Amsden Formation east of the primitive area on the Wind River Indian Reservation. Development work on the claims and on leased land (fig. 17) consists of bulldozer trails and trenches, largely in sec. 19, T. 40 N., R. 105 W.

A red-shale unit in the middle of the Amsden Formation above the basal member (the Darwin Sandstone Member) is rich in iron in many places along the northeast flank of the Wind River Range. Exposures of this shale in the vicinity of the claims are traceable for several miles by its conspicuous red-to-orange color which contrasts with the gray of most of the formation.

The red-shale unit is about 50 feet thick on the claims; the lowest 12 feet is richer in iron than the remainder. Much of the iron in the shale is concentrated in numerous lenses which are typically a few inches thick and several tens(?) of feet across and consist almost entirely of concentrically banded oolites composed of goethite, hematite, and kaolinite interspersed with and partly included in irregular masses of hematite.

A composite sample of iron-rich material taken during a previous Bureau of Mines investigation (V. T. Dow and W. E. Young, written commun., 1957) contained 13.3 percent iron, 71.5 percent insoluble material, and low percentages of phosphorus and sulfur. The sample having the highest grade was taken from a bed 6 feet thick; it contained 19.6 percent iron. Sampling during the present study confirmed the results of the previous investigation and showed that the oolitic lenses (samples 486, 487, 488, 490, table 5) contain about 50 percent Fe_2O_3 (about 35 percent iron) in contrast to about 11 or 12 percent Fe_2O_3 (about 8 percent iron) in the dominant red-shale facies (sample 489). No direct market exists for material of this grade, and tests conducted indicate that there is no commerically feasible method of concentration. The most promising means of beneficiation—a reduction roast followed by magnetic separation—is currently too costly for treatment of such low-grade material. The iron-rich parts of the Amsden are not so well exposed elsewhere as they are at the opencuts in sec. 19, but there is no reason to believe that the iron content is substantially higher at other places along the strike of the Amsden within or near the primitive area.

Moon Lake

The Silver King group of 36 mining claims is located near Moon Lake (fig. 17) on terrane dominated by gneiss and migmatite cut by east-trending pegmatite dikes. Exploratory workings consist of a small opencut (pl. 1) in outcrops along the edge of a marshy meadow on the northeast side of a hill about half a mile east of Moon Lake (sec. 6, T. 40 N., R. 107 W.).

This occurrence, though somewhat obscure geologically, seems to represent the intersection of a northeast-trending quartz-chlorite breccia vein and an amphibolite or ultramafic body enclosed in the gneiss. The amphibolite has been largely converted to biotite and chlorite; the irregular central part of the vein zone is filled with fine-grained hematite and magnetite and has a discontinuous core of vuggy crystalline quartz. Pyrite is sparingly disseminated in the dense, nearly black chloritic material. Only chromium or nickel is anomalously high in the samples taken (463–467, table 9); amphibolites or ultramafic rocks are typically enriched in both chromium and nickel.

The samples taken for this study do not bear out local reports of anomalous amounts of silver in the deposit. However, trace amounts of silver (0.02 ounce per ton) were found in a pyrite-bearing specimen (not reported in tables) from a pegmatite dike about 2 miles east of Moon Lake, near the east edge of the claims.

Dinwoody Creek

Two mining claims (fig. 17) have been located on Dinwoody Creek (secs. 16 and 21, T. 39 N., R. 105 W.) just inside the east boundary of the primitive area. This is in an area of gneissic rocks containing several dark-colored dikes (not mapped) that generally trend east. One dike contains a serpentinized zone that is weakly radioactive. The claims apparently were staked for uranium, but radiometric analysis of samples of the rock indicated the presence of only trace amounts of radioactive material.

Union Pass

In 1965 a group of 20 mining claims (fig. 17) was located on T. 41 N., R. 108 W., east of Union Pass. Exposures there consist of gneissic rocks cut by numerous pegmatite dikes. The dikes contain scattered magnetite, but no evidence of a commercial deposit was noted during this study. Current affidavits of annual labor have been filed on the claims.

Decorative Stone

A slabby red facies of the Flathead Sandstone is being selectively removed from a large talus pile near Geyser Creek in sec. 12, T. 41 N., R. 108 W., about a mile north of the study area. The talus is on national forest land and is being worked under terms of a materials disposal sale. The stone slabs are popular as facing for buildings, largely because of the interesting surficial patterns produced by lichen. Although similar slabby quartzite and sandstone are common in many parts of Wyoming, stone from this site is currently bringing fairly high prices in the building industry.

Union Pass Uranium Claims

A large, but unknown, number of claims (not shown on fig. 17) have been staked in the area north of Union Pass on ground underlain largely by the Wind River Formation. Most of these claims are west and northwest of the study area where the Wind River Formation is much thicker than it is in the study area. Parts of the Wind River Formation are known to contain anomalous amounts of gold (Antweiler and Love, 1967), and the formation is an important host rock for uranium in the Wind River and Shirley Basins farther to the east. The claims were reportedly staked primarily for uranium. Even though the results of exploration on these claims were not available when this report was being written, the combination of thinness and weathering in the Wind River Formation probably precludes any extensive uranium deposits in these rocks within the study area.

Other Prospects

Two very old prospect cuts were noted along the diabase dike on Goat Flat (sec. 25, T. 39 N., R. 107 W.), and a pair of shallow pits was found along the diabase dike (sec. 22, T. 41 N., R. 108 W.) near the northwest corner of the study area. Although the latter dike contains a little disseminated pyrite (sample 476, table 7) near an apparent fault offset, other metallic minerals were not seen at the prospects on either dike.

INTERPRETATIONS OF AEROMAGNETIC DATA

In June and July 1969, the Geological Survey flew an aeromag-

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netic survey of the Glacier Primitive Area and adjacent areas. Thirty-nine east-west flight lines spaced about 1 mile apart were flown at a barometric elevation of 13,500 feet. The magnetic data were compiled relative to an arbitrary datum at a contour interval of 20 gammas. The magnetic contours are superimposed on the geology on plate 1. No laboratory measurements of rock magnetic properties were made.

Insofar as the geologic and geochemical data indicate, the surface rocks in the Glacier Primitive Area are apparently devoid of economic mineral deposits. The purpose of the aeromagnetic survey was to locate any magnetic anomalies that might indicate concealed or buried mineral deposits.

Magnetically, the primitive area can be divided into two parts that have different magnetic patterns: (1) The northeastern corner of the mapped area, where magnetic anomalies are almost all positive and are characterized by long wavelengths (5–10 miles) and gentle gradients, and (2) the remainder of the mapped area, where the wavelengths of the anomalies (both positive and negative) are similar and the gradients are steeper. The first area is underlain mainly by Paleozoic sedimentary rocks, and the second, by granite, migmatite, gneiss of granodioritic composition, and gneiss and migmatite intruded by granite and pegmatite dikes. Following are brief descriptions of the correlations between the magnetic data and the geology in the two areas.

In general, the area underlain by Paleozoic sedimentary rocks is typified by gentle magnetic gradients and only a few local anomalies, whereas the area underlain by Precambrian rocks generally has more anomalies having steeper gradients. If one assumes that the sedimentary rocks are essentially nonmagnetic and that all magnetic anomalies in this northeastern area are attributable to susceptibility contrasts in the underlying Precambrian basement rocks, then depth analyses based on magnetic gradients at several places (Vacquier and others, 1951) indicate the basement surface to be several thousand feet beneath the ground surface. The occurrence of predominantly positive anomalies over the Paleozoic sedimentary rocks suggests that the composition of the underlying basement rock is similar to the gneiss and migmatite exposed in the adjoining areas, rather than granite (which is characterized by relatively low magnetic intensities).

The exposed Precambian basement shown on the remainder of the magnetic map is differentiated into four lithologic units. The central part of this area is underlain by granite of the Middle

Mountain batholith and is conspicuous because of its numerous closed, negative magnetic anomalies. The low magnetic intensity of this area undoubtedly reflects a lower magnetic susceptibility for the granite than for the surrounding basement rocks. Analysis of the magnetic gradients indicates that the negative anomalies represent ground-surface or near-ground-surface effects. North of Upper Ross Lake and at the southern end of the mapped area, near Hay Pass, the granite is not characterized by magnetic lows, a fact indicating geographic variability in its magnetic properties and a lack of contrast with the surrounding areas underlain by gneiss and migmatite.

Northwest and southeast of the Middle Mountain batholith are many positive and negative anomalies having fairly steep gradients that are associated with the exposed gneiss and migmatite. However, the gneiss and migmatite do not seem to have contrasting magnetic properties, for local anomalies appear to transect the contacts between them, and neither rock type is characterized consistently by low or high magnetic intensity. The anomalies northwest and southeast of the Middle Mountain batholith are believed to represent blocks of varying susceptibility within the basement, and the steep gradients indicate that the sources of most of them are at or near the ground surface. The single exception is the high having a peak value of 6,979 gammas near Indian Pass; the source for this anomaly is calculated to be at a depth of 1,500–2,000 feet beneath the ground surface.

Of the three broad shear zones within the mapped area (pl. 1), two are associated with residual magnetic lows. The anomaly associated with the Alpine Lakes shear zone is interrupted by local anomalies, but if these anomalies were removed, a residual low of 20–60 gammas would remain. Similarly the southern part of the Simpson Lake shear zone, in the northern part of the mapped area, is marked by a residual low of about 20 gammas. These lows probably reflect altered rock in which ferromagnetic minerals have been destroyed; this alteration provides a susceptibility contrast with the adjacent, unaltered rock. The Ross Lakes shear zone has no magnetic expression. Evidently the magnetic contrast between sheared granite and unaltered granite is negligible.

A notable feature of the magnetic map is the total lack of magnetic expression of either the diabase dikes or the ultramafic bodies. Both of these rocks are more mafic than the enclosing rocks and are of types usually characterized by moderate to high magnetic susceptibilities. Apparently these dikes are too narrow in relation to their distance below the aircraft to have had any expression in the geophysical data.

None of the magnetic anomalies in the Glacier Primitive Area and contiguous areas appears to be related to potential mineral deposits. With the above-noted exception, all the anomalies seem to originate at the surface of the Precambrian crystalline rocks, whether exposed or buried, and, insofar as the geologic and geochemical data indicate, these rocks are devoid of economic mineral deposits.

CONCLUSIONS

The absence of igneous intrusive rocks of Mesozoic or Tertiary age, the scarcity of hydrothermal alteration, and the apparent weakness of sulfide-mineralizing process within the study area indicate a geological environment that differs from that which characterizes most of the metal-mining districts of the Rocky Mountain region. Nothing was found during this study that indicates the existence of economically exploitable mineral deposits in the Glacier Primitive Area. A small tonnage of uranium ore was mined from the study area, northwest of the Glacier Primitive Area, but the deposit is small and is not thought to extend to an appreciable depth.

REFERENCES CITED

Antweiler, J. C., and Love, J. D., 1967, Gold-bearing sedimentary rocks in northwest Wyoming—A preliminary report: U.S. Geol. Survey Circ. 541, 12 p.

Baker, C. L., 1912, Notes on the Cenozoic history of central Wyoming [abs.]: Geol. Soc. America Bull., v. 23, no. 1, p. 73–74.

———1946, Geology of the northwestern Wind River Mountains, Wyoming: Geol. Soc. America Bull., v. 57, no. 6, p. 565–596 [repr., 1946, as Wyoming Geol. Survey Bull. 35].

Barrus, R. B., 1968, The bedrock geology of southeastern Alpine Lake quadrangle, Wind River Mountains, Wyoming: Pullman, Wash., Washington Univ., M.S. thesis, 46 p.

Bassett, W. A., and Giletti, B. J., 1963, Precambrian ages in the Wind River Mountains, Wyoming: Geol. Soc. America Bull., v. 74, no. 2, p. 209–212.

Bayley, R. W., 1963, A preliminary report on the Precambrian iron deposits near Atlantic City, Wyoming: U.S. Geol. Survey Bull. 1142–C, 23 p.

Berg, R. R., 1961, Laramide tectonics of the Wind River Mountains, *in* Symposium on Late Cretaceous rocks, Wyoming and adjacent areas, Wyoming Geol. Assoc. 16th Ann. Field Conf., 1961: Casper, Wyo., Petroleum Inf. (sales agent), p. 70–80.

Blackwelder, Eliot, 1911, A reconnaissance of the phosphate deposits in western Wyoming: U.S. Geol. Survey Bull. 470–H, p. 452–481.

———1915, Post-Cretaceous history of the mountains of central western Wyoming: Jour. Geology, v. 23, pt. 1, no. 2, p. 97–117; pt. 2, no. 3, p. 193–217; pt. 3, no. 4, p. 307–340.

Branson, E. B., and Branson, C. C., 1941, Geology of Wind River Mountains, Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 120–151.

Condie, K. C., Leech, A. P., and Baadsgaard, H., 1969, Potassium-argon ages of Precambrian mafic dikes in Wyoming: Geol. Soc. America Bull., v. 80, no. 5, p. 899–905.

Condit, D. D., 1924, Phosphate deposits in the Wind River Mountains, near Lander, Wyoming: U.S. Geol. Survey Bull. 764, 39 p.

Gilliland, J. D., 1959, Geology of the Whisky Mountain area, Fremont County, Wyoming: Laramie, Wyo., Wyoming Univ., Unpub. M.S. thesis.

Harrer, C. M., 1966, Wyoming iron-ore deposits—Description, beneficiation processes, and economics: U.S. Bur. Mines Inf. Circ. 8315, 114 p.

Keefer, W. R., 1957, Geology of the Du Noir area, Fremont County, Wyoming: U.S. Geol. Survey Prof. Paper 294–E, p. 155–221.

Ketner, K. B., Keefer, W. R., Fisher, E. S., Smith, D. L., and Raabe, R. G., 1966, Mineral resources of the Stratified Primitive Area, Wyoming: U.S. Geol. Survey Bull. 1230–E, 56 p.

Love, J. D., 1960, Cenozoic sedimentation and crustal movement in Wyoming: Am. Jour. Sci., v. 258–A (Bradley volume), p. 204–214.

Mooney, A. R., 1951, Geology of the Torrey Creek area, Fremont County, Wyoming: Ames, Iowa, Iowa State Univ., unpub. M.S. thesis.

Murphy, J. F., and Richmond, G. M., 1965, Geologic map of the Bull Lake West quadrangle, Fremont County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ–432.

Oftedahl, Christoffer, 1953, Petrologic reconnaissance in the pre-Cambrian of the western part of the Wind River Mountains, Wyoming: Norsk Geol. Tidsskr., v. 32, no. 1, p. 1–17.

Perry, Kenneth, Jr., 1965, High-grade regional metamorphism of Precambrian gneisses and associated rocks, Paradise Basin quadrangle, Wind River Mountains, Wyoming: New Haven, Conn., Yale Univ., unpub. Ph. D. dissert.

Richmond, G. M., 1945, Geology and oil possibilities at the northwest end of the Wind River Mountains, Sublette County, Wyoming: U.S. Geol. Survey Oil and Gas Inv. Map OM–31.

Richmond, G. M., and Murphy, J. F., 1965, Geologic map of the Bull Lake East quadrangle, Fremont County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ–431.

Rohrer, W. L., 1968, Geologic map of the Fish Lake quadrangle, Fremont County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ–724.

St. John, O. H., 1883, Report on the geology of the Wind River district: U.S. Geol. and Geog. Survey Terr. (Hayden) 12th Ann. Rept., pt. 1, p. 173–269.

Schrader, F. C., 1915, Gold placers on Wind and Bighorn Rivers, Wyoming: U.S. Geol. Survey Bull. 580–G, p. 127–145.

Sheldon, R. P., 1963, Physical stratigraphy and mineral resources of Permian rocks in western Wyoming: U.S. Geol. Survey Prof. Paper 313–B, p. 49–273.

Spencer, A. C., 1916, The Atlantic gold district and the North Laramie Mountains, Fremont, Converse, and Albany Counties, Wyoming: U.S. Geol. Survey Bull. 626, 85 p.

Steven, T. A., Schmitt, L. J., Jr., Sheridan, M. J., and Williams, F. E., 1969, Mineral resources of the San Juan primitive area, Colorado: U.S. Geol. Survey Bull. 1261–F, 187 p.

Theobald, P. K., Jr., and King, R. U., 1954, Colorado-Wyoming district, *in* Geologic investigations of radioactive deposits, semiannual progress report—June 1 to November 30, 1954: U.S. Geol. Survey TEI–490, p. 223–227, issued by U.S. Atomic Energy Comm. Tech. Inf. Service, Oak Ridge, Tenn.

Turekian, K. K., and Wedepohl, K. H., 1961, Distribution of the elements in some major units of the earth's crust: Geol. Soc. America Bull., v. 72, no. 2, p. 175–191.

Vacquier, Victor, Steenland, N. C., Henderson, R. G., and Zietz, Isidore, 1951, Interpretation of aeromagnetic maps: Geol. Soc. America Mem. 47, 151 p.

Westgate, L. G., and Branson, E. B., 1913, The later Cenozoic history of the Wind River Mountains, Wyoming: Jour. Geology, v. 21, no. 2, p. 142–159.

Worl, R. C., 1968, Taconite and migmatite in the northern Wind River Mountains, Fremont, Sublette, and Teton Counties, Wyoming: Laramie, Wyo., Wyoming Univ., unpub. Ph. D. dissert.

———1969, Migmatites of the Three Waters area, northern Wind River Mountains, Wyoming, *in* Abstracts for 1968: Geol. Soc. America Spec. Paper 121, p. 647–648.

TABLES 5–11

Semiquantitative spectrographic analyses were made by D. J. Grimes and R. T. Hopkins, Jr., assisted by S. G. Meyers in 1968 and by W. D. Crim in 1969.

Spectrographic analyses are reported to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, and so forth, which represent approximate midpoints of group data on a geometric scale. The assigned group for semiquantitative results will include the quantitative value about 30 percent of the time.

Numbers in parentheses indicate lower limits of determination, in parts per million. L, element was detected but was below the determination limit; N, element was looked for but not detected; ---, element was not looked for.

The elements Ag(0.5), As(200), Au(10), Bi(10), Cd(20), Mo(5), Sb(100), Sn(10), W(50), and Zn(200) were looked for. In tables 5–8 and 11, none was detected, except as indicated in footnotes. In table 9, only Ag, As, Mo, and Zn were detected, except as noted. In table 10, only Mo was detected, except as noted.

Location: samples are located by section, township, and range.

TABLE 5.—*Analyses of sedimentary rock samples*

[Fe_2O_3 analyses, J. M. Gardner Abbreviations used· bx, brecciated; cglt, conglomerate;

Semiquantitative spectrographic analyses

Sample	(percent) Fe (.05)	Mg (.02)	Ca (.05)	Ti (.0002)	(ppm) Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Nb (10)
1	1	0.2	0.5	0.2	100	10	100	L	5	15	7	20	L
2	5	.7	.7	.2	300	70	700	1	10	30	15	30	L
3	2	.7	1.5	.10	300	15	500	1	7	10	15	20	L
4	.05	.7	>20	.01	300	N	L	N	N	L	N	N	N
5	2	3	>20	.02	500	L	50	N	N	L	N	N	N
6	.7	7	>20	.01	300	N	L	N	N	L	L	N	N
7	.05	7	15	.003	70	N	N	N	N	L	L	N	N
8	N	1	>20	.005	30	N	N	N	N	L	N	N	N
9	N	.5	>20	.005	20	N	N	N	N	L	N	N	N
10	.07	5	15	.002	200	N	L	N	N	L	7	N	N
69	.5	L	L	.15	100	L	700	N	N	5	5	30	L
70	.2	.7	>20	.03	300	N	20	N	N	N	N	N	N
73	.3	.03	.05	.2	50	L	100	L	N	7	7	30	L
137	.3	.03	.2	.05	100	N	200	L	N	L	5	L	L
141	.1	.5	>20	.01	150	N	N	N	N	N	N	N	N
142	1	.5	7	.1	200	30	300	L	N	7	5	L	N
143	.7	.7	>20	.03	150	30	70	L	N	10	L	L	N
144	1.5	.7	2	.15	100	15	150	1	15	15	15	30	L
145	.1	1	>20	.015	50	N	N	N	N	N	L	N	N
146	L	10	7	L	30	N	N	L	N	N	L	N	N
148	.2	.03	L	.05	30	N	100	N	L	L	L	L	N
173	.1	1	>20	.01	200	N	N	N	N	N	N	N	N
174	.3	.02	1	2	100	N	150	N	N	7	L	20	10
197	.15	1.5	.2	.03	100	N	L	N	N	50	N	N	N
198	.1	10	15	.007	100	N	L	N	N	L	N	N	N
199	.15	10	20	.03	20	N	L	N	N	N	N	N	N
200	L	.5	20	.005	20	N	L	N	N	5	N	N	N
454	.5	L	L	.07	L	N	L	L	N	15	N	N	N
455	1	.7	20	.07	30	20	70	L	L	30	L	N	N
456	.7	.7	>20	.05	150	L	20	L	N	30	L	L	N
477	L	10	20	L	70	N	L	N	N	L	7	N	N
484	1.5	.05	L	.5	30	N	70	N	N	15	N	20	L
486 1/	20	.07	L	.3	70	15	50	1.5	30	300	15	N	L
487 2/	20	.07	L	.3	70	15	700	1.5	30	300	15	N	L
488 3/	20	.1	L	.3	70	50	50	1.5	20	300	10	N	L
489 4/	7	.1	.05	.7	50	50	20	2	15	150	15	N	L
490 5/	>20	.07	L	.2	70	15	1,500	3	30	300	10	N	L
510	.07	.7	>20	.007	70	10	L	N	N	10	15	N	N
511	.05	.07	.5	.05	10	20	150	L	N	5	10	N	L
829	.2	.5	1	.03	20	70	50	L	N	30	20	L	N
830	.7	1.5	20	.03	300	L	30	N	N	200	15	L	N

1/ Contains 46.5 percent Fe_2O_3; Mo detected but below determination limit.

2/ Contains 51.5 percent Fe_2O_3 and 10 ppm Mo.

3/ Contains 45.5 percent Fe_2O_3 and 7 ppm Mo.

from the Glacier Primitive Area, Fremont County

dolo, dolomite; Fe st, iron stained; lms, limestone; qtzt, quartzite; ss, sandstone; sh, shale]

Semiquantitative spectrographic analyses--Continued

Sample	Ni (5)	Pb (10)	Sc (5)	Sr (100) (ppm)	V (10)	Y (10)	Zr (10)	Location Sec-Twp-Rge	Formations[6] and lithologies
1	3	N	L	L	15	L	200	21-40-106	Flathead qtzt.
2	20	10	10	L	30	30	200	21-40-106	Gros Ventre sh.
3	5	10	7	L	15	20	150	21-40-106	Gros Ventre ss.
4	N	N	N	300	L	N	N	16-40-106	Gallatin lms.
5	L	N	N	200	L	15	30	16-40-106	Do.
6	N	N	N	150	L	L	N	16-40-106	Bighorn lms.
7	N	N	N	N	L	N	N	16-40-106	Bighorn dolo.
8	N	N	N	150	L	N	N	27-40-106	Madison dolo.
9	N	N	N	150	L	N	N	27-40-106	Madison lms.
10	2	N	N	N	L	N	N	27-40-106	Darby dolo-lms.
69	2	10	L	100	10	10	200	9-38-105	Flathead ss.
70	N	N	N	500	10	L	20	33-39-105	Gros Ventre lms.
73	L	N	L	N	15	10	300	14-39-106	Flathead ss.
137	5	N	N	N	15	N	100	12-38-106	Flathead qtzt.
141	N	N	N	700	L	N	L	10-39-106	Gros Ventre lms.
142	5	10	5	L	10	20	150	11-39-106	Gallatin lms.
143	3	10	5	500	10	L	30	2-39-106	Do.
144	15	20	7	N	30	L	100	2-39-106	Gallatin red sh.
145	N	L	N	300	L	N	N	2-39-106	Gallatin lms.
146	N	N	N	N	L	N	N	2-39-106	Bighorn dolo.
148	2	N	N	N	L	N	100	19-39-105	Flathead ss.
173	N	N	N	700	L	N	N	20-40-106	Gallatin lms.
174	L	N	N	N	10	L	150	20-40-106	Flathead cglt.
197	N	N	N	700	L	N	10	7-39-105	Bighorn ss.
198	N	N	N	L	L	N	N	6-39-105	Bighorn dolo.
199	L	N	N	150	L	N	L	32-40-105	Darby dolo.
200	N	N	N	100	L	N	N	32-40-105	Madison lms.
454	L	L	N	N	L	L	200	26-41-107	Flathead ss.
455	7	15	5	200	15	10	70	23-40-106	Madison lms, Fe st, bx.
456	5	10	L	300	10	10	L	14-40-106	Do.
477	N	N	N	L	N	N	N	18-41-107	Bighorn dolo.
484	L	N	L	L	30	20	700	17-41-107	Flathead ss, Fe st, bx.
486	70	50	30	L	700	30	150	19-40-105	Amsden oolites.
487	70	30	70	L	700	30	150	19-40-105	Do.
488	70	20	50	N	700	50	300	19-40-105	Do.
489	70	20	30	N	100	30	300	19-40-105	Amsden red sh.
490	70	30	70	N	700	70	100	19-40-105	Amsden oolites.
510	L	N	N	150	L	N	N	1-39-106	Madison lms.
511	L	N	N	N	L	N	150	1-39 106	Amsden lms.
829	5	L	N	N	20	N	20	10-40-106	Park City chert nodule.
830	5	L	N	150	20	30	20	11-40-106	Park City lms, fossils.

4/ Contains 11.4 percent Fe_2O_3; Mo looked for but not detected.

5/ Contains 56.0 percent Fe_2O_3; Mo detected but below determination limit.

6/ Descriptions of formations are given in Table 1 and accompanying text.

TABLE 6.—*Analyses of felsic rock samples from*

[Samples of migmatite related to the Middle Mountain batholith listed under gneiss and migmatitic gneiss; migmatite from

Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)
	Semiquantitative spectrographic analyses (ppm)											
					Granite samples							
17	2	0.5	1	0.15	300	N	1,000	L	7	L	20	50
20	1.5	.3	.7	.07	300	N	300	3	N	5	15	20
26	.7	.15	.1	.03	70	N	150	1	10	10	7	N
28	.7	.1	.7	.03	100	N	700	1	N	N	15	N
41	.7	.1	.3	.05	70	N	500	L	N	N	7	30
44	.7	.2	.3	.05	50	N	700	L	L	N	5	30
48	.7	.2	.2	.03	100	N	700	L	L	N	L	N
49	1.5	.5	1	.15	200	N	700	1	5	L	7	30
51	.7	.07	.5	.03	50	N	300	1	N	N	5	100
52	1.5	.3	.3	.07	150	N	500	1	L	N	10	20
61	1	.3	.7	.07	100	N	700	1	L	10	L	20
63	2	.3	1	.1	150	N	700	L	L	5	5	30
74	1.5	.2	.7	.07	300	N	700	1.5	N	L	10	70
75 1/	.3	.1	1	.03	150	N	200	3	N	N	5	70
78	5	3	3	.2	500	N	1,500	2	20	70	5	200
80	1.5	.3	.7	.1	300	N	500	1	L	L	5	30
82	.7	.2	1	.05	100	N	700	1	N	N	10	100
83	.7	.1	1	.03	100	N	700	1	N	N	7	20
84	3	.7	1.5	.15	200	N	700	1	10	7	10	50
85	3	.7	1.5	.2	300	N	700	1	10	7	7	50
86	1.5	.5	.3	.1	100	N	700	L	5	N	L	70
93	1.5	.7	.3	.15	100	N	30	L	30	L	7	70
94	1.5	.5	.5	.1	70	N	700	L	N	L	5	30
95	1.5	.15	.7	.05	70	N	700	L	N	L	7	50
97	1	.15	.5	.1	70	N	700	1	N	L	5	70
98	1.5	.15	.7	.1	100	N	1,000	L	N	N	L	50
99	1.5	.2	.7	.1	70	N	700	1	N	N	7	50
100	1	.15	.7	.07	70	N	1,000	L	N	N	L	100
102	1.5	.3	.7	.15	150	N	100	1	N	L	7	20
104	1.5	.5	1	.1	150	N	700	1	5	5	5	30
109	.2	.07	.2	.02	70	N	150	1	N	N	10	N
119	.7	.2	.7	.05	70	N	300	L	N	L	7	20
121	2	.7	.7	.1	150	N	100	L	10	20	10	L
124	2	.5	1	.15	150	L	700	L	7	5	L	30
126	.1	.07	.2	.015	15	N	L	N	N	N	L	N
129	2	.5	.7	.15	200	N	100	1	5	10	7	30
130	1.5	.2	1	.1	70	N	300	L	7	7	15	20
131	1.5	.3	1	.15	100	N	700	1	5	L	L	30
156	1	.3	.2	.05	100	N	700	1	N	L	L	30
157	1	.5	.3	.07	70	N	150	L	N	L	L	50
160	1.5	.2	.3	.15	150	N	700	L	L	N	10	70
161	2	.3	.5	.15	200	N	300	L	L	L	10	20
162	1.5	.7	.3	.15	100	N	700	1	5	5	L	20
163	1	.1	.7	.05	150	N	150	1	N	L	10	30
164	3	1	2	.3	300	N	700	1	15	15	7	L
165	2	.5	1	.2	200	N	700	L	10	7	5	30
170	1.5	.5	1	.1	100	N	700	1	L	10	L	100
171	.2	.07	.7	.02	30	N	700	L	N	N	5	50
177	1	.2	.2	.05	100	N	200	1	N	N	5	50
178	3	.7	2	.2	300	N	300	1	10	N	15	20
179	.3	1	3	.15	50	L	70	1	N	7	7	50
180	2	.7	.3	.15	70	L	700	L	5	7	20	N
190	3	3	.3	.15	200	N	70	1	10	30	10	70
401	1	.3	1	.1	100	N	700	1	7	10	10	30
403	1.5	.3	.5	.1	100	N	700	1	5	L	20	100

1/ Contains 700 ppm Mo.

the Glacier Primitive Area, Fremont County

the southern part of the area listed separately. Abbreviations used: biot, biotite; Fe st, iron stained; porph, porphyritic]

	Semiquantitative spectrographic analyses--Continued (ppm)									
Sample	Nb (10)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Location Sec-Twp-Rge	Remarks
					Granite samples					
17	L	L	30	L	300	L	10	150	16-37-106	Dike.
20	15	7	30	L	150	L	15	150	33-38-106	Do.
26	L	5	30	L	N	L	L	50	34-38-106	Do.
28	L	2	30	N	200	L	10	70	34-38-106	Do.
41	N	5	20	N	L	10	10	70	11-38-107	
44	N	3	15	L	100	L	10	150	25-39-107	
48	L	7	20	N	L	L	L	50	25-39-107	
49	L	L	20	L	300	30	15	150	30-39-106	Porph phase.
51	N	L	20	N	L	15	10	70	19-39-106	Very coarse grained.
52	10	3	20	L	L	15	15	100	29-39-106	
61	L	15	15	L	100	10	10	100	32-39-106	
63	L	3	10	L	500	15	10	150	28-39-106	Porph phase.
74	L	3	70	L	L	10	15	150	32-39-106	
75	15	3	50	L	N	L	30	150	32-39-106	Molybdenite grain.
78	L	50	20	15	700	70	30	150	32-39-106	Dike in biot schist.
80	L	3	50	L	150	15	30	100	34-39-106	
82	N	L	50	L	200	L	10	200	14-39-107	
83	N	2	30	N	100	L	10	70	14-39-107	Pink.
84	N	2	30	5	100	15	15	150	13-39-107	
85	L	2	30	5	300	20	20	200	12-39-107	
86	N	L	20	L	L	10	L	150	12-39-107	Red, altered.
93	L	2	10	5	N	15	15	150	36-40-107	
94	L	7	10	5	N	15	10	150	36-40-107	
95	N	7	15	L	150	15	10	100	3-39-107	
97	L	2	30	L	L	10	10	150	3-39-107	
98	L	2	30	L	200	15	L	100	11-39-107	
99	L	3	30	L	150	20	10	150	11-39-107	
100	N	2	20	L	200	10	10	150	11-39-107	Porph phase.
102	L	2	L	7	N	50	30	150	8-37-106	Dike.
104	L	5	10	L	700	10	L	150	33-38-106	Do.
109	L	2	30	L	N	L	10	20	23-38-106	Do.
119	N	7	20	N	L	L	15	15	1-38-107	
121	N	20	L	5	100	30	10	20	7-38-106	
124	L	10	15	L	300	15	15	150	18-38-106	
126	N	3	L	N	N	L	N	N	10-38-106	Altered.
129	L	10	50	5	100	10	20	100	31-39-106	Porph phase.
130	N	7	10	L	100	10	10	100	32-39-106	Do.
131	L	2	30	L	200	10	10	150	20-39-106	
156	L	L	20	N	100	10	10	100	25-39-107	
157	L	7	15	L	L	10	L	150	24-39-107	
160	L	2	30	5	150	30	15	150	17-39-107	Porph phase.
161	L	2	20	7	L	15	15	200	17-39-106	
162	L	3	L	5	N	30	15	150	18-39-106	Porph phase.
163	10	L	70	L	N	L	30	70	18-39-106	
164	10	15	L	15	150	70	20	50	7-39-106	
165	L	L	15	5	150	20	10	150	6-39-106	Porph phase.
170	L	10	30	L	150	15	10	100	24-40-107	
171	N	L	30	N	150	L	L	20	19-40-106	
177	L	L	50	N	N	L	10	70	21-40-106	
178	L	5	15	5	300	20	15	150	27-40-107	
179	L	3	10	5	300	15	10	150	26-40-107	Leucocratic.
180	L	5	10	L	L	10	10	100	2-41-107	Red, weathered.
190	L	50	10	L	100	20	15	70	3-38-107	Chloritic.
401	L	7	20	L	150	15	10	150	25-40-107	
403	L	2	50	L	100	10	10	150	30-40-106	

TABLE 6.—*Analyses of felsic rock samples from the*

Semiquantitative spectrographic analyses

Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)
					(ppm)							
					Granite samples--Continued							
404	1	0.15	0.7	0.03	100	N	700	1.5	L	L	15	70
405	1	.3	.1	.05	100	N	500	L	N	N	20	30
407	1.5	.5	.5	.1	100	N	700	1	L	L	5	20
409	1.5	.1	.7	.07	100	N	500	1	N	N	10	70
414	2	.5	1	.15	150	N	700	1	5	7	20	30
424	1	.2	.7	.05	100	N	700	1	N	N	15	N
430	1	.15	.7	.07	100	N	700	L	N	N	5	L
434	1	.7	.3	.15	100	N	50	1	5	7	30	70
473	.15	.07	1	.01	20	N	1,500	L	N	7	10	30
485	.7	.15	.3	.05	100	N	300	L	N	N	L	L
517	1.5	.5	.7	.1	150	10	1,500	N	N	L	15	30
518	5	.07	.15	.15	70	N	1,500	L	L	N	15	L
521	3	.05	.05	.05	70	N	150	L	10	L	L	N
522	.7	.1	.15	.03	70	L	700	1	N	N	15	N
531	.7	.1	.5	.05	50	N	700	1.5	L	N	N	N
537	7	1.5	.2	.2	300	N	1,500	N	100	70	10	N
549	1.5	.3	.7	.15	100	N	1,000	L	L	N	10	50
805	.5	.15	.07	.03	20	N	700	L	N	L	20	30
807	.7	.15	.5	.07	50	N	1,500	L	N	N	L	L
808	1.5	.3	.07	.1	50	N	1,000	1	L	L	20	L
854	1	.2	1	.05	150	N	700	L	7	L	5	20
864	1.5	.2	1.5	.07	100	N	1,000	1	N	L	L	N
880	5	1	1.5	.15	300	N	1,500	L	15	7	7	100
891	3	1	1.5	.2	300	N	1,000	N	7	10	20	70
897	1	.7	1	.15	200	N	1,000	L	N	L	50	20
898	3	.7	1.5	.15	200	N	1,000	L	7	10	20	70
					Pegmatite and aplite samples							
12	0.3	0.15	0.5	0.015	150	N	100	2	N	7	10	N
14	.3	.3	1.5	.03	100	N	70	3	N	30	5	N
18 2/	.7	.07	.3	.03	70	N	L	3	N	L	L	L
27	.2	.05	.15	.01	20	N	70	L	N	L	5	N
29	1.5	.5	1	.15	150	L	300	L	10	5	10	L
33	1	.3	1	.1	300	N	700	1	L	5	5	150
50	.15	.02	.05	.003	100	N	300	N	N	N	L	N
58	1.5	.1	.5	.02	70	N	500	3	N	N	5	30
62	.7	.2	.7	.03	100	N	200	3	L	L	7	20
77	.7	.3	1	.02	50	10	150	1	N	L	5	N
81	.3	.1	.2	.007	70	N	L	1	N	N	L	N
105	1	.3	.7	.07	150	N	500	2	L	7	L	20
107	L	.02	.3	.002	30	N	70	3	N	N	7	N
113	1.5	1	.3	.1	150	N	L	1	7	L	10	L
120	.7	.2	.5	.03	50	N	500	L	N	L	N	20
123	3	1	1	.2	300	N	300	1	15	70	10	70
134	.7	.1	.2	.02	30	N	300	2	N	N	5	N
135	.7	.2	.5	.07	70	N	700	2	N	N	L	30
154	.2	.1	.1	.02	10	N	200	L	N	N	5	N
159	.15	.2	.2	.015	30	N	L	L	N	N	7	N
176	.7	.15	.7	.03	100	N	700	1	N	N	7	30
188	.7	.3	.1	.03	30	N	L	L	N	7	10	L
189	3	.07	.2	.15	30	N	700	1	N	L	15	L
412 3/	.5	.1	.1	.02	50	N	L	3	N	N	15	N
421	.7	.2	.2	.007	15	N	200	1.5	N	L	7	N
423	1.5	.1	1	.05	150	N	300	2	N	L	15	L
457	.15	.03	.07	.007	50	N	1,000	L	N	L	30	N
458	.7	.03	.15	.01	70	N	300	2	N	15	15	L
469	.7	.07	.2	.02	70	N	L	3	N	7	15	N
471	1.5	.1	.7	.02	100	N	L	1.5	N	7	10	N

2/ Contains 20 ppm Sn.

3/ Contains 100 ppm Sn.

Glacier Primitive Area, Fremont County—Continued

Sample	Nb (10)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Location Sec-Twp-Rge	Remarks
	Semiquantitative spectrographic analyses--Continued (ppm)									
					Granite samples--Continued					
404	L	2	70	L	100	10	L	100	30-40-106	
405	L	L	15	N	N	L	L	100	29-40-106	Pink.
407	L	5	L	L	100	15	N	150	21-40-106	
409	N	2	30	L	100	L	10	100	21-40-107	
414	L	7	15	5	200	30	L	150	35-41-107	Near fault.
424	L	L	30	N	L	L	L	150	35-39-107	Porph phase.
430	N	L	15	N	150	L	L	70	35-38-107	Do.
434	L	L	L	5	N	20	20	150	25-38-107	
473	N	L	15	N	300	L	N	N	31-41-108	Fine grained.
485	N	5	L	N	N	10	N	70	17-41-107	Red, oxidized.
517	L	L	20	N	150	15	10	70	26-40-107	In fault zone.
518	L	L	15	L	150	50	N	50	26-40-107	Do.
521	L	L	L	L	N	30	N	70	35-41-107	Near fault zone.
522	N	L	15	N	100	10	N	30	35-41-107	Do.
531	N	L	15	N	500	L	N	70	23-37-106	Dike.
537	L	70	L	10	N	70	10	70	7-37-105	Small body.
549	N	7	20	N	150	10	30	100	2-39-108	Porph phase.
805	N	L	15	N	N	10	L	70	33-41-107	
807	N	L	15	N	100	L	15	50	3-40-107	
808	L	L	L	N	N	10	N	100	34-41-107	
854	L	7	15	N	300	L	N	50	15-36-106	Dike.
864	N	L	50	N	300	L	N	70	9-36-106	Do.
880	L	10	50	10	500	30	10	70	33-36-106	Near shear zone.
891	L	7	10	N	500	30	15	10	5-35-106	Porph granite.
897	L	7	15	N	500	10	15	10	7-35-106	Do.
898	L	10	15	5	500	20	10	30	8-35-106	Do.
					Pegmatite and aplite samples					
12	L	3	30	N	N	L	50	30	20-40-106	Pegmatite.
14	N	15	15	L	150	L	N	30	17-37-106	Do.
18	100	2	30	15	N	L	20	N	16-37-106	Do.
27	N	3	30	N	N	L	10	15	34-38-106	Do.
29	L	7	L	L	100	30	N	N	27-38-106	Do.
33	L	2	70	L	L	L	20	100	13-38-106	Aplite.
50	N	2	20	N	N	L	N	L	30 39-106	Pegmatite.
58	15	L	70	N	100	10	15	50	32-39-106	Do.
62	10	15	50	L	100	L	15	30	28-39-106	Aplite.
77	N	7	L	N	150	L	15	N	32-39-106	Pegmatite.
81	10	2	50	L	N	L	15	15	15-39-107	Do.
105	10	7	30	L	200	L	10	100	27-38-106	Do.
107	N	2	L	N	N	L	N	N	26-38-106	Do.
113	L	15	15	5	N	50	15	20	14-38-106	Do.
120	N	5	30	N	L	L	10	30	7-38-106	Do.
123	L	30	15	7	L	30	20	150	14-38-107	Do.
134	L	5	30	N	150	L	15	N	17-39-106	Do.
135	15	3	50	L	200	L	20	70	16-39-106	Do.
154	N	2	70	N	100	L	N	N	3-38-106	Do.
159	L	L	N	N	N	L	L	70	19-39-106	Do.
176	L	L	30	N	150	10	10	70	21-40-106	Do.
188	N	L	L	L	N	10	10	70	35-39-107	Do.
189	L	5	10	N	100	30	15	N	35-39-107	Do.
412	70	2	L	70	N	L	N	N	9-40-107	Do.
421	20	L	15	L	N	L	L	20	21-39-107	Do.
423	L	3	50	N	L	15	15	100	35-39-107	Do.
457	N	5	70	N	150	L	N	N	35-40-107	Do.
458	15	L	100	L	N	15	15	50	21-40-107	Do.
469	30	L	15	N	N	L	15	30	11-40-108	Do.
471	50	L	15	15	N	L	30	N	34-41-108	Do.

TABLE 6.—*Analyses of felsic rock samples from the*

Semiquantitative spectrographic analyses

Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)
					(ppm)							
Pegmatite and aplite samples--Continued												
474	0.07	0.05	0.05	L	70	N	700	L	N	L	10	N
523 4/	1.5	.5	.3	0.02	70	N	20	3	N	N	L	N
525	.05	.03	.2	.007	15	N	150	L	N	N	7	N
527	.7	.07	.3	.007	1,500	N	30	3	N	N	7	N
532 5/	1.5	.15	L	.03	100	N	300	7	5	5	10	N
564	.5	.2	L	.007	70	N	N	N	L	N	15	N
566	1.5	1	.5	.2	100	N	700	L	10	100	L	100
804	.1	.02	L	.02	L	N	1,000	N	N	L	15	N
857	15	3	2	.3	1,500	N	150	N	30	150	15	N
879	5	2	1	.5	200	N	50	L	15	10	7	300
885	5	3	3	.07	700	N	150	L	20	300	5	30
895	5	.7	2	.5	300	N	700	L	15	15	30	100
Gneiss and migmatitic gneiss samples												
37	1	0.3	0.3	0.1	100	N	500	1	5	5	20	70
42	.7	.05	.3	.03	50	N	70	L	N	N	7	N
65	1	.15	.7	.07	150	N	700	L	N	L	7	20
67	2	.7	1	.1	200	N	700	N	15	10	5	30
68	1	.2	1	.07	70	N	700	N	L	N	7	20
71	2	1	1	.15	150	N	500	L	7	N	10	20
96	1.5	.3	1.5	.15	70	N	300	L	N	5	15	100
101	1.5	.3	.7	.15	150	N	700	1.5	L	N	L	100
103 4/	3	2	1.5	.2	300	N	700	1.5	30	70	10	L
118	3	1	1.5	.3	300	N	300	L	15	70	15	L
136	1.5	.3	1	.07	100	N	150	L	7	L	N	20
140	1.5	1.5	.15	.15	70	L	700	L	N	L	15	30
147	1.5	.3	1	.15	150	N	700	N	7	N	L	30
149	1.5	.7	.15	.07	100	L	300	N	7	10	5	20
151	1.5	.3	1	.1	150	N	700	L	7	7	7	30
152	3	.7	1.5	.15	500	N	500	1.5	15	70	7	L
153	.7	.2	.7	.05	70	N	300	1.5	N	N	7	L
168	3	1	1.5	.2	200	10	200	1	15	50	20	30
184 6/	5	.7	1.5	.05	700	L	20	N	L	50	20	N
185	2	1	.2	.15	150	N	700	L	5	15	20	30
192	3	.1	3	.07	50	N	L	N	N	L	15	300
406	3	.7	1.5	.2	300	N	200	1	15	70	15	20
408	3	1.5	2	.2	500	N	500	1	15	70	15	L
410	1	.7	.7	.1	150	N	700	L	L	15	30	20
411	3	.7	1.5	.15	200	N	700	L	10	15	7	50
425	3	.5	1	.3	150	N	1,500	L	7	L	50	100
431	3	.7	1.5	.3	300	N	300	1.5	15	15	20	100
432	3	.7	1.5	.3	300	N	300	1	15	15	30	100
451	2	.3	.7	.1	150	N	700	1	5	10	10	100
468	3	1	2	.7	500	N	700	1.5	15	30	20	50
492	2	.7	1	.2	200	N	200	1	7	10	15	L
499	1	.2	1	.07	100	N	700	N	L	N	5	N
500	1	.3	2	.15	70	N	300	L	7	N	10	N
503	3	1	1.5	.2	200	N	150	N	10	50	15	50
504	10	3	3	.3	1,000	N	100	N	70	300	150	N
505	3	.5	1	.3	500	N	700	L	L	7	50	30
512	5	2	1	.5	300	N	500	1	15	30	20	70
513	3	1	5	.3	150	N	1,000	1.5	15	50	15	30
528	.7	.15	.3	.07	70	N	700	N	5	N	L	30
530	7	1.5	2	.7	500	N	>5,000	1	20	30	15	200
535	10	1.5	.3	.3	1,500	N	70	L	15	700	15	L
540	1.5	.3	1	.2	150	N	300	N	5	L	20	N
541	5	1	1	.3	500	N	300	N	20	200	10	50
543	1	.1	.3	.05	50	N	300	N	N	N	15	L
544	5	1.5	3	.3	700	N	200	N	70	150	70	N

4/ Contains 10 ppm Sn

5/ Contains 15 ppm Sn

Glacier Primitive Area, Fremont County—Continued

Sample	Nb (10)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Location Sec-Twp-Rge	Remarks
	Semiquantitative spectrographic analyses--Continued (ppm)									
				Pegmatite and aplite samples--Continued						
474	N	L	100	N	L	L	N	N	24-40-108	Pegmatite.
523	20	L	15	L	N	10	10	50	25-40-108	Do.
525	N	L	L	N	N	L	N	10	12-37-106	Do.
527	10	L	15	N	N	L	70	20	31-38-105	Do.
532	50	30	L	5	N	20	N	N	13-37-106	Pegmatite, Fe st.
564	L	15	L	N	N	10	N	N	30-38-105	Pegmatite, chloritic.
566	L	30	15	10	L	30	30	100	20-38-105	Pegmatite.
804	N	L	20	N	N	L	N	N	23-41-108	Do.
857	10	50	10	30	L	150	15	30	20-37-105	Amphibole-rich pegmatite.
879	L	15	30	10	100	50	30	300	32-36-106	Aplite, dark gray.
885	L	100	30	15	150	70	10	N	30-37-106	Amphibole-rich pegmatite.
895	10	15	10	15	200	70	70	300	20-36-106	Aplite, dark gray.
				Gneiss and migmatitic gneiss samples						
37	L	3	30	L	N	L	10	150	7-38-105	Migmatitic.
42	N	3	20	N	N	L	30	30	7-38-106	Do.
65	L	2	10	L	L	L	L	100	7-38-105	
67	N	15	15	7	150	50	10	100	8-38-105	
68	L	3	15	N	300	20	N	100	9-38-105	
71	15	L	N	7	L	15	15	300	14-39-106	
96	L	5	15	5	100	20	50	150	3-39-107	Migmatitic.
101	L	2	15	5	150	20	15	150	8-37-106	
103	15	70	15	15	100	100	30	30	33-38-106	
118	L	20	15	10	150	70	10	150	28-40-106	Migmatitic.
136	N	7	N	L	N	20	N	70	12-38-106	
140	15	N	N	7	N	L	100	300	10-39-106	
147	N	3	30	5	100	20	15	100	19-39-105	
149	L	15	10	L	L	15	N	50	24-39-106	
151	L	7	15	L	300	10	10	150	27-39-106	
152	L	20	15	15	100	100	30	50	27-39-106	
153	L	2	30	N	100	L	10	30	34-39-106	
168	L	20	L	7	150	70	30	70	10-39-107	Migmatitic.
184	L	5	L	7	N	30	30	150	8-40-107	
185	L	15	15	5	L	15	10	150	5-40-107	
192	L	3	L	7	500	70	30	70	15-38-107	Fractured.
406	10	20	15	7	100	70	L	150	29-40-106	
408	L	30	L	10	100	70	30	150	21-40-107	
410	N	15	15	L	100	20	N	30	21-40-107	Granite(?).
411	N	10	15	5	200	50	N	150	16-40-107	
425	L	5	20	5	500	50	20	200	35-39-107	Contains garnet.
431	15	15	L	15	100	30	70	150	35-38-107	
432	10	15	10	10	300	30	30	150	35-38-107	Dark gray.
451	L	L	15	5	200	15	20	150	26-39-106	
468	30	20	10	15	100	100	150	500	11-40-108	
492	L	7	N	5	150	30	L	70	13-41-108	Migmatitic.
499	N	5	10	N	300	10	N	30	23-41-108	Do.
500	N	15	10	L	500	30	N	L	23-41-108	Do.
503	L	7	L	10	200	70	15	70	21-39-105	
504	L	70	N	20	L	150	15	50	20-39-105	Fe st.
505	L	N	10	7	100	30	10	150	20-39-105	
512	20	15	10	15	L	100	150	300	4-39-107	Migmatitic.
513	L	10	10	7	700	50	10	100	6-39-107	
528	N	L	20	N	L	15	N	30	24-37-106	
530	L	20	30	15	1,500	70	50	500	23-37-106	Fe st.
535	L	30	N	30	N	100	20	50	7-37-105	Fe st.
540	N	5	10	L	300	20	N	100	4-37-105	
541	L	70	20	15	150	100	N	100	33-38-105	
543	N	L	10	N	N	15	N	50	5-37-105	
544	L	70	10	15	200	150	L	L	5-37-105	

6/ Contains 10 ppm Mo.

TABLE 6.—*Analyses of felsic rock samples from the*

Semiquantitative spectrographic analyses

Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10) (ppm)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)
Gneiss and migmatitic gneiss samples--Continued												
545	0.7	0.15	1	0.07	100	N	15	L	N	5	20	N
548	.3	.1	.2	.02	50	N	1,000	L	N	L	5	100
551	7	2	1.5	.3	1,000	N	300	N	15	500	10	20
552	2	.7	2	.15	200	N	500	N	5	15	7	70
553	3	.7	2	.2	500	N	700	N	7	10	15	100
Gneiss samples												
554	5	1.5	2	0.3	500	N	700	N	10	20	20	20
555	2	.3	1.5	.15	300	N	1,500	L	N	L	20	L
556	5	1.5	3	.3	700	N	300	N	7	15	30	30
558	1.5	.7	1.5	.1	150	N	300	L	5	L	20	70
567	.7	.2	1	.07	100	N	500	L	N	L	5	N
568	5	3	5	.2	700	N	150	L	20	300	30	30
570	1.5	.5	.2	.1	100	N	1,000	L	5	7	5	100
801	.2	.1	1.5	.03	30	N	300	1	5	7	7	N
802	1	.3	.7	.07	50	N	3,000	L	5	L	5	N
803	2	.3	.7	.15	150	N	2,000	L	10	50	7	50
813	2	.3	1.5	.2	100	N	700	1	5	L	15	20
815	2	.3	1	.15	150	N	2,000	L	5	L	15	L
816	3	.5	1	.15	100	N	1,500	1	L	30	15	30
817 6/	10	.7	.2	.02	1,000	N	20	L	5	50	50	N
819	3	1	.7	.2	300	N	150	1	10	5	N	20
820	2	.5	1.5	.2	200	N	100	1	7	L	30	30
831	5	2	3	.3	700	N	1,000	N	20	150	5	N
833	7	3	2	.3	700	N	1,000	L	15	1,000	300	20
834	5	.7	1.5	.2	500	N	700	L	10	15	L	30
836	1.5	.5	.5	.1	150	L	300	L	L	20	5	N
846	20	3	.3	.3	1,500	N	1,000	L	15	700	70	N
847	5	1.5	3	.2	700	N	300	N	15	50	10	20
850	7	1.5	1.5	.2	500	10	300	L	15	70	5	L
855	2	.5	1.5	.15	200	N	1,000	L	10	5	5	50
856	5	1	2	.3	500	N	50	L	L	15	7	50
858 7/	10	2	.1	.7	300	N	700	L	20	1,500	20	N
863	7	1.5	2	.5	700	N	700	1	15	50	10	30
883	3	1.5	1	.15	300	N	300	L	15	70	20	70
884 8/	15	5	1	.5	300	N	300	1	100	700	1,500	L
888	2	1	1.5	.15	200	N	700	L	15	50	7	30
899	7	5	.5	.5	500	N	50	N	15	15	10	100
Migmatite samples												
559	3	1	1	0.15	200	N	300	L	10	70	10	70
562	1	.2	.7	.1	70	N	700	N	N	10	15	L
563	5	2	1	.3	500	N	30	N	10	70	15	70
569	3	.05	3	.2	200	N	300	N	N	50	5	L
571	5	1	2	.2	300	N	500	L	15	7	7	70
572	3	1	2	.15	300	N	1,000	L	10	30	7	150
573	3	1	2	.3	300	N	1,000	L	15	20	15	50
848	3	1	1	.2	200	N	150	L	10	50	10	200
849	2	.3	1	.15	150	N	500	L	7	L	7	N
852	3	.5	1.5	.2	300	L	200	1	10	20	5	30
871	3	1	1.5	.15	300	N	200	L	15	7	L	N
872	3	1.5	.7	.2	300	N	100	L	10	7	L	30
873	3	1.5	2	.2	500	N	1,000	L	15	L	15	N
874	7	3	3	.3	1,000	N	3,000	N	20	70	L	150
875	2	.7	2	.2	300	N	700	L	10	L	7	50

7/ Contains 50 ppm Mo.

8/ Contains 1.5 ppm Ag.

Glacier Primitive Area, Fremont County—Continued

Sample	Nb (10)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Location Sec-Twp-Rge	Remarks
	Semiquantitative spectrographic analyses--Continued (ppm)									
				Gneiss and migmatitic gneiss samples--Continued						
545	N	5	10	N	300	L	N	50	33-38-105	
548	L	7	20	N	100	L	15	10	28-38-105	
551	L	100	15	15	N	100	15	150	21-37-106	
552	N	10	15	L	300	30	N	70	28-37-106	
553	L	10	30	7	200	30	10	150	27-37-106	
						Gneiss samples				
554	L	20	10	10	150	100	20	N	3-2 -6	
555	N	5	30	N	200	L	15	70	3-2 -6	
556	L	15	10	15	150	100	15	20	15-37-106	
558	L	10	10	L	200	30	30	N	22-37-106	
567	N	L	15	N	200	L	N	30	34-3 -6	
568	L	100	20	15	150	70	10	10	5-36-106	
570	L	10	15	L	100	10	10	70	29-37-106	
801	N	10	N	N	300	10	N	100	25-41-108	Migmatitic.
802	N	10	15	L	300	20	N	30	26-41-108	Do.
803	L	20	15	5	300	30	N	70	27-41-108	Do.
813	L	5	N	L	500	10	N	300	19-41-108	
815	L	7	15	5	500	30	N	50	10-37-106	
816	N	L	10	5	300	30	N	70	1-37-106	Fe st.
817	L	L	N	15	N	70	70	100	1-37-106	Do.
819	L	50	N	10	L	70	10	15	36-38-106	
820	L	L	10	5	N	30	10	200	26-38-106	
831	10	30	20	20	150	100	15	30	5-36-106	
833	L	30	L	15	L	100	N	100	5-36-106	Fe st.
834	L	10	20	7	200	50	N	150	31-37-105	
836	N	15	20	N	150	10	N	100	29-37-105	
846	L	100	10	30	N	150	70	100	26-37-106	Fe st, biot-rich.
847	L	20	L	15	300	100	15	N	25-37-106	
850	L	30	L	15	100	100	20	50	19-38-105	Vague foliation.
855	L	7	15	7	300	30	10	70	11-37-106	
856	10	5	20	15	200	30	30	150	28-37-105	Very fine grained.
858	15	100	10	30	N	150	N	150	20-37-105	Fe st, biot-rich.
863	L	30	20	10	500	100	20	150	9-36-106	
883	L	30	30	10	L	50	10	150	19-37-106	
884	10	150	50	20	N	200	L	200	19-37-106	Fe st, biot-rich.
888	L	30	20	L	200	30	L	150	30-37-106	Microcline augen.
899	10	20	10	10	L	70	20	150	8-35-106	Augen in chlorite.
						Migmatite samples				
559	L	30	15	10	300	30	20	70	8-36-106	
562	N	7	15	N	150	L	N	20	28-36-106	
563	L	70	10	10	L	70	15	70	19-36-106	Amphibolitic.
569	L	L	20	5	500	70	10	100	5-36-106	Epidote-rich.
571	L	20	15	7	500	50	15	50	27-37-106	Amphibolitic.
572	N	20	20	7	500	20	20	70	23-36-105	
573	10	15	20	15	500	70	50	70	23-36-105	
848	L	20	L	10	150	70	20	100	6-36-106	
849	N	15	20	N	L	15	L	150	34-37-106	
852	L	15	10	7	300	30	L	70	32-37-106	Chloritized.
871	L	7	15	5	300	50	N	10	22-36-106	
872	L	20	10	L	150	30	L	150	22-36-106	Granitized.
873	L	15	20	15	500	50	15	70	23-36-106	Some epidote.
874	L	30	20	15	700	70	30	100	24-36-106	Mobile phase.
875	L	15	20	L	200	20	N	100	3-1S-6	

TABLE 6.—*Analyses of felsic rock samples from the*

Semiquantitative spectrographic analyses

Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)
					(ppm)							
					Migmatite samples--Continued							
876	1	0.3	1.5	0.1	70	N	1,000	L	10	L	7	70
877	3	.7	1.5	.2	300	N	500	L	10	L	5	N
878	3	.7	2	.15	200	N	200	1	10	L	7	N
882	3	.7	1.5	.3	200	N	70	L	7	L	5	30
886	5	2	2	.3	200	N	2,000	L	10	70	10	150
889	1.5	0.7	1	0.15	150	N	70	N	N	N	10	N
890	3	1.5	2	.15	700	N	70	N	5	7	7	N
892	.5	.2	.7	.05	70	N	1,000	L	N	7	15	20
893	1.5	.5	1.5	.2	200	N	700	L	10	7	20	30
894	2	.5	1.5	.15	200	N	700	L	7	15	30	20
896	3	.7	1.5	.3	200	N	700	L	10	20	20	30
900	.7	.2	.5	.05	70	N	700	L	N	N	7	50
1101	2	.7	1	.15	200	N	300	1	L	L	L	N
1102	3	.7	1.5	.2	300	N	300	L	10	5	5	N
1103	2	.5	1.5	.15	300	N	700	L	10	L	10	L
1104	2	.7	2	.05	700	N	700	L	5	5	7	100
1105	.7	.05	.3	.03	70	N	700	1	N	L	L	20
1107	3	1	2	.2	300	N	700	L	10	L	5	20
1109	2	1	1	.15	200	N	200	L	10	20	5	30
1110	2	.5	1.5	.15	200	N	300	L	10	L	L	70
1111	1	.1	1	.07	70	N	700	N	5	N	L	20

Glacier Primitive Area, Fremont County—Continued

Sample	Semiquantitative spectrographic analyses--Continued (ppm)								Location	Remarks
	Nb (10)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Sec-Twp-Rge	
				Migmatite samples--Continued						
876	N	10	20	L	300	10	N	70	12-35-106	Mobile phase.
877	L	10	15	N	200	30	N	70	1-35-106	Do.
878	L	20	30	L	300	20	L	L	32-36-106	Gneiss phase.
882	L	10	10	L	300	30	N	150	4-35-106	Altered.
886	L	20	20	10	500	50	30	150	30-37-106	Garnet-bearing.
889	L	5	L	N	150	20	N	20	4-35-106	Altered.
890	L	20	L	15	200	10	30	10	5-35-106	Mobile phase.
892	N	15	20	N	300	20	N	100	6-35-106	Gneiss phase.
893	10	15	15	7	300	20	15	100	30-36-106	Do.
894	N	10	15	7	200	30	N	70	19-36-106	
896	N	20	20	5	700	30	30	70	7-36-106	Mobile phase.
900	L	7	15	N	200	10	N	20	9-35-106	Chloritized.
1101	L	7	10	L	150	15	L	50	4-35-106	Altered.
1102	L	10	15	N	500	30	L	100	3-35-106	Gneiss phase.
1103	L	10	20	L	300	30	20	70	33-36-106	
1104	L	10	20	L	700	30	20	N	9-35-106	Altered.
1105	N	L	15	N	300	L	15	30	9-35-106	Do.
1107	L	15	20	10	500	50	30	70	2-35-106	
1109	L	20	10	L	200	15	L	100	22-1 -6	Altered.
1110	L	10	15	5	200	20	L	100	2-36-106	Gneiss phase.
1111	L	7	15	N	150	L	L	100	31-37-106	Do.

TABLE 7.—*Analyses of mafic and ultramafic rock samples*

Semiquantitative spectrographic analyses

Sample	Fe (0.5)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)
	(Percent)				(ppm)							
					Diabase and similar mafic rock samples							
24	7	5	7	0.3	700	N	70	N	70	150	70	N
32	7	5	5	.3	700	L	30	N	70	200	70	N
38	10	2	3	1	700	L	700	L	70	10	30	70
46	7	5	5	.3	700	N	30	N	70	150	70	N
47	3	5	3	.3	500	N	20	N	30	150	50	N
55	7	3	7	.2	700	N	L	N	50	300	30	N
111	5	3	3	.3	700	N	50	N	30	500	30	N
122	5	3	5	.2	700	N	L	N	50	150	50	N
125	7	1.5	3	.5	300	N	70	L	50	7	300	70
127	7	1.5	10	.3	700	L	30	L	30	100	100	N
128	7	5	5	.3	700	10	50	N	70	200	30	N
182	3	3	0.5	.7	300	N	20	L	15	30	10	30
415	15	5	3	1	1,000	N	300	N	70	5	30	100
420	7	7	3	.3	700	N	100	N	70	200	70	N
427	3	5	3	.3	300	N	5,000	2	30	100	30	300
433	7	2	1.5	.5	700	N	700	N	100	30	20	30
448	7	3	3	.7	1,000	N	500	N	30	10	15	100
472	7	5	5	.5	1,500	N	200	N	70	1,000	70	N
476	15	2	5	1	2,000	L	150	N	70	100	200	N
508	7	3	5	.2	700	N	300	N	70	300	70	N
514	7	3	10	.3	1,500	N	70	N	70	200	100	N
516	10	3	7	.7	1,500	15	70	L	70	200	100	N
529	10	1.5	3	.7	2,000	N	70	N	70	20	30	N
536	10	5	3	.5	1,500	N	70	N	150	700	30	N
546	10	3	5	.5	1,500	N	50	N	100	500	15	N
547	10	5	7	.2	100	N	50	N	30	700	70	N
557	7	3	2	.3	700	N	1,000	L	15	300	5	200
811	15	2	3	.5	1,500	N	150	N	100	300	100	N
826	10	3	5	.5	1,500	L	70	N	150	500	70	N
851	20	3	3	.5	1,500	L	150	N	30	150	50	N
					Biotite schist samples							
15	7	5	1	0.5	500	N	300	L	50	5	30	L
16	5	1	2	.2	500	N	300	L	15	30	5	20
19	3	1	2	.2	300	N	500	L	15	15	15	20
23 1/	7	1.5	0.15	.15	300	L	500	3	15	300	15	N
25 1/	7	3	.07	.15	500	L	300	L	30	500	30	N
31 1/	7	3	.3	.2	500	L	200	L	30	700	70	N
35 1/	3	.7	1	.15	200	N	200	L	10	100	30	30
45	3	1	1	.2	300	N	700	L	15	20	30	20
72	3	.7	1.5	.2	150	N	700	1	10	N	7	150
76	10	5	3	.3	700	N	150	N	70	150	50	N
114 2/	3	3	.7	.2	300	N	50	1	30	70	15	N
115	7	5	3	.2	700	N	70	L	50	L	20	L
133	1.5	5	.05	.03	200	N	150	1.5	5	5	N	30
155	7	3	1.5	.5	700	N	150	L	50	20	30	N
167	7	3	3	.5	700	L	70	L	50	70	30	N
193	15	1	3	>1	1,000	10	200	N	20	10	200	L
436	3	1.5	.5	.2	500	N	20	1.5	10	15	20	50
437 3/	7	1.5	2	.5	700	N	100	L	50	70	30	N
438 4/	2	.5	1	.15	150	N	100	1	20	30	200	30
440	7	.5	.3	.1	70	N	150	1	L	70	150	N

1/ Zn detected but below determination limit.

2/ Contains 15 ppm Sn.

from the Glacier Primitive Area, Fremont County

Semiquantitative spectrographic analyses--Continued

Sample	Nb (10)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Location Sec-Twp-Rge	Remarks
					Diabase and similar mafic rock samples					
24	L	70	N	30	100	150	15	70	13-38-106	Diabase.
32	L	70	L	30	100	150	20	50	13-38-106	Do.
38	15	20	L	20	700	100	30	100	1-38-106	Glomeroporphyritic.
46	L	70	L	30	100	150	15	30	25-39-107	Diabase.
47	N	70	L	20	100	150	15	30	25-39-107	Do.
55	N	100	L	30	L	150	15	20	29-39-106	Mafic porphyry; float.
111	L	70	10	30	100	150	15	30	13-38-106	Diabase.
122	N	100	N	20	L	150	15	30	10-38-106	Do.
125	L	50	15	20	300	70	100	150	10-38-106	Do.
127	N	70	10	20	300	150	30	20	10-38-106	Do.
128	N	100	N	30	150	150	15	30	36-39-107	Do.
182	10	15	L	15	N	50	10	300	2-41-107	Mafic dike.
415	10	20	L	20	300	100	30	100	15-38-106	Glomeroporphyritic.
420	L	70	L	30	150	150	10	30	16-39-107	Diabase.
427	L	150	70	10	3,000	30	20	200	35-39-107	Do.
433	10	30	N	15	700	100	20	50	34-38-107	Glomeroporphyritic.
448	L	7	10	15	500	70	30	70	20-38-106	Do.
472	N	300	N	70	150	300	15	50	32-41-108	Diabase.
476	L	70	N	70	200	700	70	150	21-41-108	Do.
508	L	150	15	30	L	150	20	30	6-38-106	Mafic dike.
514	L	70	N	50	150	150	15	50	12-39-108	Diabase near fault.
516	L	70	N	50	300	200	20	70	35-40-108	Diabase.
529	L	20	N	70	L	300	30	50	29-38-105	Do.
536	N	150	N	70	200	200	20	20	7-37-105	Do.
546	L	70	N	30	N	300	20	50	28-38-105	Do.
547	L	70	10	30	150	150	20	15	15-3 -6	Do.
557	L	70	15	15	300	70	70	150	14-37-106	Do.
811	L	100	N	50	100	200	20	70	35-41-107	Do.
826	L	150	N	50	150	200	15	50	19-38-105	Do.
851	L	50	L	50	L	200	50	50	20-38-105	Hornblende-rich dike.
						Biotite schist samples				
15	L	70	10	30	L	150	15	150	17-37-106	Biotite-rich gneiss.
16	L	15	L	10	200	70	15	100	16-37-106	Do.
19	L	15	15	10	150	70	15	100	4-37-106	Do.
23	N	100	L	5	N	50	N	20	34-38-106	Biotite-sericite-quartz.
25	N	100	30	15	N	100	15	70	34-38-106	Do.
31	L	150	N	20	N	150	20	70	26-38-106	Biotite in shear.
35	L	70	15	10	L	70	10	100	13-38-106	Do.
45	L	20	15	10	100	70	20	150	25-39-107	Biotite-rich gneiss.
72	10	L	15	7	100	50	30	300	14-39-106	Biotite-schist lens.
76	N	100	10	30	L	150	20	50	32-39-106	Do.
114	15	50	10	15	N	70	30	50	14-38-106	Do.
115	L	70	10	20	N	150	30	30	11-38-106	Do.
133	20	10	L	7	N	15	30	200	20-39-106	Mica schist.
155	L	20	10	20	100	150	50	200	3-38-106	Biotite-rich gneiss.
167	L	70	10	15	L	100	30	70	15-39-107	Do.
193	20	L	10	50	N	150	>200	300	1-37-107	Biotite in shear.
436	20	L	N	10	100	30	70	700	25-38-107	Biotite-schist lens.
437	L	30	L	20	L	200	50	100	25-38-107	Do.
438	L	20	15	5	100	30	30	100	25-38-107	Biotite schist and pyrite.
440	10	L	15	7	100	15	N	300	30-38-106	Biotite schist and gossan.

3/ Contains 200 ppm Zn.

4/ Contains 5 ppm Mo.

TABLE 7.—*Analyses of mafic and ultramafic rock samples from*

Semiquantitative spectrographic analyses

	(Percent)				(ppm)							
Sample	Fe (0.5)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)
					Biotite schist samples--Continued							
447 5/	15	1	0.07	0.2	200	30	70	N	700	200	700	N
533	5	2	1	.2	700	N	500	N	50	700	20	L
550 6/	5	1.5	3	.3	500	N	700	N	20	500	100	70
565	7	3	.7	.3	700	N	50	N	30	500	L	70
814	2	0.7	.1	.02	150	N	500	5	N	L	70	L
818	10	10	.7	.1	700	N	20	N	150	2,000	15	N
859	10	7	2	.3	1,000	N	500	N	50	1,500	L	N
					Amphibolite samples							
87	7	5	3	0.7	500	N	150	N	30	20	20	20
106	3	7	5	.2	700	N	50	N	50	150	5	L
110	7	5	5	.3	700	N	70	N	70	150	70	N
132	5	5	1	.5	300	N	L	L	30	150	L	70
138	7	7	5	.15	700	N	70	N	70	500	30	N
139	5	2	2	.3	700	10	150	L	30	70	15	20
158 7/	3	3	.2	.15	200	N	L	L	100	150	L	N
166	7	5	7	.5	700	L	300	N	70	300	100	N
169	7	7	5	.2	1,000	N	50	L	50	500	15	N
183	7	7	5	.5	700	N	300	N	50	300	50	30
186	5	3	.1	.2	300	N	70	1	15	150	15	30
194	7	5	5	.2	700	N	100	L	50	15	15	N
195	10	3	1	.3	700	N	700	1.5	30	3,000	70	N
422	7	7	5	.15	700	N	70	N	70	150	30	N
449	7	3	3	.2	700	N	150	N	50	300	30	N
470	7	1.5	5	1	1,500	N	150	L	30	20	50	N
506	7	2	7	.3	700	N	100	N	50	100	100	N
509	7	3	3	.15	700	N	150	N	70	500	15	N
538	7	5	5	.15	1,000	N	30	N	150	3,000	L	N
560	3	3	3	.2	1,000	N	700	N	20	500	7	100
561	3	1.5	2	.2	300	N	700	N	10	30	15	50
809	15	5	3	.7	1,500	N	70	L	150	1,500	100	N
842	15	5	5	.3	1,000	L	200	N	30	500	L	N
868 8/	20	5	1	.15	1,500	L	300	N	70	700	10	N
					Ultramafic rock samples							
13 1/	5	10	5	.05	1,500	N	30	N	50	2,000	L	N
21 1/	7	10	1.5	.05	500	N	L	N	70	3,000	15	N
34	5	7	1.5	.07	700	L	L	N	70	3,000	L	N
60	5	10	.2	.005	700	N	L	N	70	700	L	N
90	5	>10	2	.05	700	N	20	N	200	5,000	30	N
150	5	7	3	.15	700	N	70	N	70	1,000	15	N
459	20	0.7	.07	.1	100	N	50	N	30	5,000	7	N
460	7	5	2	.07	500	10	L	5	30	1,500	10	N
462	>20	1	N	.03	150	N	50	L	15	>5,000	L	N
501	7	3	5	.2	700	30	150	N	100	500	70	N
502	10	3	5	.3	1,000	L	100	N	150	300	150	N
507	7	7	2	.1	700	N	50	N	200	3,000	15	N
524	10	>10	1.5	.15	1,500	L	30	N	150	3,000	5	N
534	7	7	5	.3	1,500	N	150	N	100	3,000	50	N
539	10	7	3	.5	1,500	N	30	N	150	3,000	300	N
821	7	10	1	.1	1,000	N	N	N	150	>5,000	70	N
822	7	7	1.5	.1	700	N	N	N	150	>5,000	200	N
823	7	7	2	.2	700	N	N	N	150	3,000	30	N
835	7	7	5	.2	1,000	N	20	N	50	3,000	L	N
837	10	7	.2	.03	500	N	L	N	70	>5,000	L	N

5/ Contains 100 ppm Mo.

6/ Contains 7 ppm Mo.

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

Sample	Nb (10)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Location Sec-Twp-Rge	Remarks
	(ppm)									
Biotite schist samples--Continued										
447	10	300	15	10	N	100	50	200	20-38-106	Biotite-quartz-pyrite.
533	L	150	L	15	N	100	15	100	13-37-106	Biotite-rich inclusion.
550	L	30	50	15	200	150	15	100	21-37-106	Biotite-rich shear.
565	L	150	10	20	100	100	30	150	20-38-105	Biotite-rich shear (altered).
814	N	N	N	N	N	L	N	100	26-38-106	Biotite schist lens.
818	L	3,000	N	7	N	70	L	N	31-38-105	Do.
859	10	200	10	30	N	100	10	N	20-37-105	Do.
Amphibolite samples										
87	L	50	15	30	150	200	50	150	1-39-107	Irregular mass.
106	L	100	10	30	100	150	20	50	23-38-106	Dike(?).
110	L	70	L	30	200	150	20	70	13-38-106	Irregular mass.
132	L	100	L	10	N	70	30	150	29-39-106	Ultramafic(?).
138	L	150	N	30	N	100	15	10	12-38-106	Irregular mass.
139	L	70	N	15	100	100	20	150	15-39-106	Do.
158	L	70	L	7	N	20	10	50	19-39-106	Iron-stained.
166	L	70	L	50	100	150	20	50	15-39-107	Irregular mass.
169	L	150	L	30	N	150	30	30	14-39-107	Do.
183	L	150	10	20	300	150	20	30	18-40-107	Do.
186	10	70	L	10	N	70	15	150	5-40-107	Do.
194	N	200	10	30	N	150	15	15	1-37-107	Do.
195	N	70	15	20	N	150	15	70	1-37-107	Sheared.
422	L	100	L	20	N	150	15	15	27-39-107	Irregular mass(?).
449	L	100	L	15	100	70	15	20	21-38-106	Do.
470	L	30	10	30	100	300	50	70	12-40-108	Layer in gneiss.
506	L	50	20	15	150	200	15	100	20-39-105	Irregular mass.
509	L	150	N	30	N	150	15	15	29-39-105	Do.
538	L	500	N	30	N	150	10	10	19-37-105	Layer in gneiss.
560	L	70	30	15	300	70	20	30	7-36-106	Irregular mass.
561	L	20	10	5	300	70	N	30	2-36-105	Biotite schist(?)
809	L	700	N	30	N	300	30	70	34-41-107	Layer in granite.
842	10	200	L	30	100	200	20	10	35-37-106	With scattered plagioclase.
868	L	100	10	30	N	100	20	70	15-36-106	In fold crest.
Ultramafic rock samples										
13	N	1,000	L	10	N	30	20	N	20-40-106	Anthophyllite-chlorite.
21	N	700	L	20	N	50	10	10	33-38-106	Irregular body.
34	N	1,500	L	10	N	30	L	10	13-38-106	In fault zone.
60	L	3,000	L	5	N	L	L	N	32-39-106	Talc-chlorite.
90	L	3,000	N	7	N	50	N	N	1-39-107	Do.
150	L	150	N	30	L	150	10	15	24-39-106	Dikelike body.
459	N	200	N	15	N	200	N	20	21-40-107	Magnetite-rich body.
460	L	1,500	N	15	N	50	10	30	21-40-107	Do.
462	N	150	N	5	N	500	N	N	6-40-107	Float.
501	N	150	L	50	N	300	15	10	13-39-106	Dikelike body.
502	L	100	L	30	L	200	15	15	13-39-106	Do.
507	L	2,000	15	15	N	50	L	L	1-38-106	Do.
524	L	3,000	N	15	N	50	L	15	23-41-108	Do.
534	L	300	N	50	200	150	15	50	13-37-106	Do.
539	L	1,000	10	30	N	100	L	50	19-37-105	Tremolite-chlorite.
821	L	2,000	N	30	N	100	L	N	19-38-105	Do.
822	L	1,500	N	20	N	100	L	N	19-38-105	Do.
823	L	500	N	30	N	150	10	10	19-38-105	Do.
835	L	700	N	15	N	100	20	30	36-37-106	Dikelike body.
837	L	2,000	L	7	N	15	N	L	35-37-106	Serpentine.

7/ Contains 30 ppm Mo.

8/ Contains 300 ppm Zn.

TABLE 7.—*Analyses of mafic and ultramafic rock samples from*

Semiquantitative spectrographic analyses

	(Percent)				(ppm)							
Sample	Fe (0.5)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)
					Ultramafic rock samples--Continued							
838 4/	5	5	7	0.02	1,000	N	200	1	30	300	L	N
839	20	7	0.1	.015	500	L	50	L	70	>5,000	N	N
840	15	7	3	.1	1,500	N	N	N	70	>5,000	N	N
841	10	7	5	.1	3,000	N	100	N	20	3,000	15	N
844	20	7	1.5	.15	1,000	N	30	N	200	>5,000	200	N
845	20	5	2	.015	700	N	L	L	500	700	2,000	N
860	7	7	.7	.03	700	N	N	N	70	>5,000	L	N
866	7	7	1.5	.1	1,000	N	L	N	70	5,000	10	N
867	7	3	5	1	1,000	N	20	N	20	2,000	L	N
869	10	5	3	.15	1,000	N	100	L	50	200	15	N
870	15	5	1.5	.3	1,000	N	50	N	50	300	15	N
887 9/	20	10	3	.2	1,500	N	L	N	150	>5,000	10	N

9/ Contains 500 ppm Zn.

TABLE 8.—*Analyses of miscellaneous rock samples*

Semiquantitative spectrographic analyses

	(percent)				(ppm)								
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.0002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Nb (10)
66	10	3	5	.5	700	N	50	N	70	150	70	N	L
88	5	3	.7	.3	150	N	70	N	20	70	L	N	L
89	3	1.5	.07	.02	150	L	L	L	10	L	L	L	L
92	>20	2	.07	.07	700	10	L	N	15	150	7	N	L
191	3	1.5	3	.3	150	N	700	1	15	20	10	70	L
416	2	3	.05	.15	70	N	150	L	L	5	5	20	N
419	.7	.2	.2	.15	100	N	500	N	L	15	15	N	N
515	5	2	5	.3	1,000	N	150	1	30	50	20	20	L
526 1/	15	1.5	.3	.05	500	L	20	N	15	70	30	N	N
824	3	1.5	5	.005	1,500	N	1,500	1	30	30	20	N	N
843	5	3	.2	.2	200	N	L	N	15	50	N	L	N
881	1.5	1.5	.2	.15	70	N	N	L	10	L	L	100	L
1106	15	.3	15	.3	1,000	N	30	N	N	100	L	100	L

1/ Contains 200 ppm Zn. Matrix contains an anthophyllite-like amphibole.

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

Sample	Nb (10)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Location Sec-Twp-Rge	Remarks
	(ppm)									
				Ultramafic rock samples--Continued						
838	N	700	15	5	200	20	50	L	35-37-106	Tremolite.
839	L	1,500	L	N	N	20	N	N	35-37-106	Serpentine vein.
840	L	2,000	N	7	N	20	L	N	35-37-106	Talc-chlorite.
841	10	1,000	L	15	N	20	30	N	35-37-106	Tremolite vein.
844	L	5,000	L	15	N	70	10	15	26-37-106	Tremolite-serpentine.
845	L	5,000	10	L	N	L	N	N	26-37-106	Tremolite crystals.
860	L	700	L	10	N	50	N	N	20-37-105	Tremolite-chlorite.
866	L	700	N	20	N	70	L	10	15-36-106	Do.
867	10	50	L	50	N	500	30	10	15-36-106	Tremolite vein.
869	L	70	15	50	200	150	20	30	15-36-106	Anthophyllite vein.
870	L	100	10	50	N	150	30	150	15-36-106	Do.
887	L	2,000	L	30	N	100	10	N	30-37-106	Tremolite-serpentine body.

from the Glacier Primitive Area, Fremont County

Semiquantitative spectrographic analyses--Continued

Sample	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Location Sec-Twp-Rge	Remarks
	(ppm)								
66	70	10	30	L	200	20	15	18-38-105	Metadiabase(?).
88	70	N	10	100	70	10	150	1-39-107	Dense green rock.
89	30	L	L	N	30	N	50	1-39-107	Do.
92	50	L	10	N	50	10	15	1-39-107	Taconite float.
191	15	10	10	700	30	30	150	3-38-107	Dense green rock.
416	15	N	7	N	50	L	150	9-40-107	Do.
419	15	N	L	L	15	10	20	7-38-105	Red syenite dike.
515	50	10	30	300	100	15	30	12-39-108	Chloritic schist.
526	15	N	7	N	50	15	10	12-37-106	Rusty schist.
824	150	L	N	700	L	N	N	19-38-105	Anorthosite.
843	50	L	7	N	50	30	150	34-37-106	Albite-chlorite rock.
881	10	N	5	N	20	N	20	33-36-106	Albite-chlorite rock.
1106	L	15	30	L	300	>200	200	14-35-106	Pure andradite.

TABLE 9.—*Analyses of breccia and vein samples*

[Analyses in footnotes gold by atomic absorption spectrometry, T. A. Roemer and W. H. Ficklin; silver by atomic absorption spectrometry, 497 and 498 by semiquantitative spectrographic analysis. Abbreviations used: biot, biotite;

Semiquantitative spectrographic analyses

	(Percent)				(ppm)										
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	Ag (.5)	As (200)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)
							Breccia samples								
11	0.3	0.3	0.15	0.02	70	N	N	N	50	N	N	5	5	N	N
91	2	.3	.2	.15	50	N	N	N	100	N	L	L	10	70	N
112	.3	.3	.05	.015	50	N	N	N	L	L	N	L	L	N	N
175	.5	.07	.7	.03	50	N	N	L	700	L	N	7	5	N	N
402	1	.3	1.5	.1	70	N	N	N	700	1	L	L	10	70	N
428	.5	.2	.1	.03	20	N	N	N	30	L	N	L	5	N	N
435	1.5	1.5	.2	.02	150	N	N	N	L	1	7	15	7	N	N
439	.15	.2	.07	.03	10	N	N	N	L	L	N	10	L	N	N
450	.3	.5	.07	.01	50	N	N	N	L	1	L	7	15	N	N
461	.3	.2	.05	.015	70	N	N	N	30	N	N	10	7	N	N
463	1.5	.1	.07	L	50	N	N	L	70	L	N	150	L	N	N
464	7	1.5	.07	.07	200	N	N	10	20	L	7	2,000	15	N	N
467	10	1	L	.03	150	N	N	L	30	1	10	1,500	15	N	N
478	10	1.5	.1	.1	200	N	N	N	50	15	15	30	15	N	N
479	3	.3	L	.03	70	N	N	N	50	1.5	15	20	15	70	N
480	7	.1	.05	.007	70	N	N	N	L	L	L	L	L	N	10
481	5	2	.07	.07	300	N	N	N	70	L	30	30	5	N	N
482	10	2	.07	.1	300	N	N	N	50	L	20	70	15	N	N
483	20	1.5	.3	.07	150	N	N	10	100	L	50	70	L	N	N
491 1/	1	.07	10	.15	20	N	500	N	5,000	L	L	15	15	30	100
493	.7	.3	20	.05	500	N	N	N	150	N	N	5	L	N	N
494	3	.05	20	.015	N	N	300	N	5,000	N	N	N	L	N	N
495	.1	.3	20	.015	100	N	N	N	20	N	N	N	L	N	N
496	10	.7	.3	.1	300	N	N	L	200	L	20	100	15	N	N
497 2/	15	2	.1	.15	300	N	300	10	70	1.5	150	300	10	50	N
498 3/	3	.2	.07	.03	50	N	N	N	30	L	L	15	L	N	N
519	1	.5	.2	.1	70	N	N	N	30	1.5	N	N	10	50	N
520	.7	.03	L	.07	20	N	N	N	150	L	N	5	15	20	N
810	.5	.15	.1	.03	20	N	N	N	300	1	N	L	5	N	N
827	15	.15	.3	.1	30	N	1,500	10	5,000	L	L	20	15	L	50
828	3	.03	10	.02	10	N	L	N	100	L	N	L	10	N	N
832	1.5	1	.15	.1	100	N	N	N	N	L	10	10	N	N	N
853	.2	.15	.05	.01	15	N	N	N	L	L	N	L	5	N	N
1108	2	1	.2	.15	300	N	N	N	20	L	1	30	5	20	N
							Vein samples								
22	10	1.5	0.5	0.05	700	N	N	15	50	N	7	200	30	N	N
30	5	.03	7	.15	300	N	N	N	300	L	5	7	5	100	N
36	3	1	1	.3	300	N	N	L	300	L	15	150	300	20	N
39	5	.2	.2	.03	100	5	N	N	200	1	N	20	50	50	N
40	10	L	.05	.15	50	15	N	L	30	L	N	30	100	L	N
43	10	.7	.3	.15	100	1	N	L	100	L	N	20	70	L	N
53	20	.07	L	..005	150	N	N	10	L	L	15	7	L	L	N
54	15	.05	.07	.015	300	N	N	L	70	3	15	15	1,000	N	N
56	3	.5	.07	.003	150	N	N	N	L	L	5	L	5	N	N
57	20	.7	.05	.1	500	N	N	10	70	L	15	150	15	L	N
59	3	.5	.05	.07	100	N	N	N	300	N	N	70	50	70	N
64	7	.3	.7	.2	100	N	N	L	200	L	N	50	100	20	N
79	10	.1	L	.1	20	L	N	10	200	L	N	150	150	N	N
108	1.5	.15	.15	.03	50	0.5	N	L	70	1	N	50	30	N	5
116 4/	2	.2	.5	.2	150	5	N	N	150	L	N	5	20	30	N
172	3	L	L	.007	50	N	N	N	30	N	N	L	5	L	N
181	>20	.1	L	.03	50	N	N	30	30	L	100	5	L	N	N
187	.5	.3	10	.02	500	N	N	N	N	7	300	20	15	1,000	N
196	5	1.5	1	.7	150	N	N	N	100	1	30	300	15	L	N
413	2	.7	.07	.03	150	N	N	N	30	L	15	5	10	70	N

1/ Contains 0.016 percent U.

2/ Contains about 0.2 percent U.

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Z. C. Stephenson and J. V. Desmond; uranium of sample 491 by paper chromatography, R. L. Miller; uranium of samples bx, breccia; Fe st, iron stained; hem, hematite; mag, magnetite; py, pyrite; qtz, quartz]

Semiquantitative spectrographic analyses--Continued

Sample	Nb (10)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zn (200)	Zr (10)	Location Sec-Twp-Rge	Remarks
	(ppm)										
						Breccia samples					
11	L	2	N	N	N	L	N	N	20	21-40-106	Qtz-chlorite bx.
91	L	50	N	N	N	10	15	N	150	1-39-107	Purplish qtz bx.
112	L	5	N	L	N	L	N	N	N	14-38-106	Qtz-chlorite bx.
175	L	2	10	N	100	50	L	N	30	20-40-106	Fe st fault bx.
402	L	3	50	L	L	10	L	N	150	25-40-107	Barren granite bx.
428	N	5	N	N	N	10	L	N	50	36-39-107	Qtz-chlorite bx.
435	L	10	N	L	N	30	L	N	30	25-38-107	Do.
439	L	L	N	L	N	L	L	N	15	25-38-107	Do.
450	L	L	N	N	N	L	10	N	10	27-39-106	Do.
461	N	7	N	N	N	10	N	N	20	16-40-107	Qtz-chlorite bx; float.
463	L	L	N	N	N	15	N	N	N	7-40-107	Bx from prospect cut.
464	L	300	N	5	N	70	L	N	L	7-40-107	Do.
467	L	200	N	7	N	70	L	N	N	7-40-107	Do.
478	N	70	L	15	N	70	100	N	70	24-41-108	Bx from mine dump
479	N	20	N	L	N	30	15	N	30	24-41-108	Do.
480	L	L	N	L	N	50	N	N	N	24-41-108	Do.
481	L	70	L	30	N	50	30	N	50	24-41-108	Do.
482	L	70	N	15	N	70	10	N	50	24-41-108	Do.
483	L	70	N	10	L	50	30	N	50	24-41-108	Do.
491	L	15	30	7	100	300	30	N	100	12-40-107	Bx from prospect pit.
493	N	N	N	L	300	L	10	N	50	23-41-107	Bx in Ross Lakes fault.
494	N	L	N	L	100	L	20	N	N	22-41-107	Bx from mine dump.
495	N	N	N	N	500	10	L	N	50	14-41-107	Bx near faults.
496	L	70	N	10	N	50	15	N	30	24-41-108	Bx from mine dump.
497	N	200	1,500	20	N	300	150	N	50	24-41-108	Do.
498	N	L	15	L	N	70	15	N	L	24-41-108	Do.
519	L	L	L	5	150	30	10	N	150	36-41-107	Bx from Jakeys Fork fault.
520	L	N	N	N	L	15	10	N	300	36-41-107	Do.
810	N	7	N	N	N	L	N	N	150	34-41-107	Bx from Jakeys Fork fault.
827	L	20	N	N	L	30	L	N	30	22-41-107	Bx from Ross Lakes fault.
828	L	N	N	N	N	L	10	N	L	22-41-107	Do.
832	L	15	L	L	N	30	N	N	30	5-36-106	Qtz-chlorite bx.
853	N	7	N	N	N	L	N	N	L	1-36-106	Do.
1108	L	30	10	7	N	30	30	N	70	35-36-106	Do.
						Vein samples					
22	N	70	L	10	N	30	10	L	30	34-38-106	Fe st biot in fault.
30	L	2	10	5	700	70	20	N	30	27-38-106	Qtz-epidote vein.
36	L	70	15	15	150	70	15	N	150	13-38-106	Fe st faulted gneiss.
39	L	L	500	N	N	30	50	>10,000	150	11-38-106	Py-gossan vein.
40	L	L	150	L	N	50	L	700	150	11-38-106	Gossan vein.
43	L	L	10	7	N	70	30	N	700	7-37-106	Fe st gneiss; float.
53	L	L	10	L	N	30	15	N	N	29-39-106	Qtz-specularite float.
54	L	15	10	L	N	200	15	N	N	29-39-106	Gossan; float.
56	L	L	L	N	N	15	15	N	N	29-39-106	Qtz-specularite float.
57	L	30	10	10	L	30	30	N	50	29-39-106	Do.
59	L	20	10	5	N	30	20	N	100	32-39-106	Gossan from fault.
65	20	L	20	7	N	70	100	N	200	28-39-106	Gossan vein.
79	L	L	10	L	N	50	N	N	20	33-39-106	Do.
[illegible]	L	L	150	L	N	20	L	N	150	23-38-106	Fe st biot in fault.
116	15	L	1,500	5	N	30	70	300	300	11-38-106	Sulfide vein.
172	N	L	N	N	N	30	N	N	N	19-40-106	Qtz-specularite vein.
181	L	L	15	15	N	70	N	N	N	2-41-107	Do.
187	N	70	N	N	N	L	>200	N	30	32-41-107	Fe st zone.
196	15	15	10	15	N	150	50	N	500	7-37-106	Pyritic zone.
413	L	15	L	L	N	15	10	N	20	35-41-107	Vein qtz in fault.

3/ U looked for but not detected.

4/ Contains 15 ppm Bi.

TABLE 9.—*Analyses of breccia and vein samples from*

Semiquantitative spectrographic analyses--Continued

	(Percent)				(ppm)										
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	Ag (.5)	As (200)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)
							Vein samples--Continued								
417	20	1	0.7	0.1	500	N	N	N	150	L	30	150	15	N	N
418	2	.3	5	.02	200	N	N	N	50	L	N	N	L	30	N
426	5	.5	7	.07	150	N	N	N	300	L	70	15	15	100	N
429	15	L	L	.03	30	N	N	N	L	L	N	5	10	N	N
441[5]	10	.7	.3	.3	300	5	N	N	300	L	N	15	150	100	N
442[6]	5	.2	.2	.1	70	3	N	N	150	L	7	20	150	70	N
443[7]	10	.7	.5	.3	200	1.5	N	N	150	L	N	150	150	70	N
444[8]	7	.5	.1	.1	100	5	N	N	50	L	20	30	70	L	7
445	5	.3	.7	.15	50	N	N	N	100	L	N	7	15	150	N
446	1.5	.3	.07	.15	20	N	N	N	L	1	100	5	15	50	N
452	10	.05	.3	.03	15	N	1,500	20	>5,000	L	7	15	20	N	N
453	15	.1	.2	.03	10	N	N	50	5,000	1	L	15	15	N	10
465	7	2	.07	.05	300	N	N	L	L	L	50	3,000	7	N	N
466	>20	3	.05	.15	500	N	N	L	20	L	20	>5,000	N	N	N
475	10	3	L	.7	100	N	N	L	20	N	70	1,000	100	N	7
542	7	2	1	.3	700	N	N	N	30	N	15	700	150	N	N
806	7	.05	N	.01	30	N	N	N	30	L	N	5	15	N	N
812	3	L	L	.015	15	N	N	N	20	L	15	5	L	L	N
825	7	2	10	.3	1,000	N	N	L	N	L	50	200	1,500	N	N
861	15	.05	.15	.07	10	1	N	N	500	L	15	100	300	L	L
862	>20	.2	L	.2	30	2	N	15	30	N	N	200	300	N	N
865	15	.7	1.5	.05	300	2	N	L	30	L	N	500	500	N	N

5/ Contains 8.0 ppm Ag and 0.3 ppm Au.

6/ Contains 5.2 ppm Ag and 0.08 ppm Au.

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

Sample	Nb (10)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zn (200)	Zr (10)	Location Sec-Twp-Rge	Remarks
	(ppm)										
					Vein samples--Continued						
417	N	30	10	10	N	70	10	N	20	9-40-107	Qtz-specularite float.
418	N	10	N	5	500	70	15	N	N	4-40-107	Qtz-epidote vein.
426	L	5	15	10	700	70	15	N	100	35-39-107	Do.
429	L	L	L	L	N	100	N	N	30	36-39-107	Qtz-specularite vein
441	10	N	500	7	N	70	50	1,000	300	11-38-107	5-ft channel sample.
442	L	L	700	L	N	30	15	3,000	200	11-38-107	4-ft channel sample.
443	10	L	300	7	N	50	150	700	150	11-38-107	Do.
444	L	15	150	5	N	30	10	3,000	300	11-38-107	3-ft channel sample.
445	L	L	30	7	L	70	15	N	150	29-39-106	Mag-hem-qtz vein.
446	L	5	100	L	N	10	L	N	150	19-39-106	Py-gossan vein.
452	L	50	10	L	300	L	15	N	10	26-41-107	Gossan from fault.
453	L	15	10	L	150	L	L	N	L	26-41-107	Do.
465	L	1,000	N	5	N	50	L	N	N	7-40-107	Chlorite-py vein.
466	L	1,000	N	20	N	150	15	N	30	7-40-107	Mag vein in bx.
475	L	300	N	10	N	150	N	N	70	18-40-107	Gossan in biot schist.
542	L	70	N	30	N	150	10	N	30	7-37-105	Gossan-py vein.
806	L	N	N	N	N	70	N	N	N	33-41-107	Qtz-hem vein.
812	L	L	N	N	N	10	N	N	L	28-41-107	Qtz-specularite vein.
825	L	70	L	30	300	150	10	N	15	19-38-105	Qtz-epidote-py vein.
861	L	7	10	L	N	50	N	N	200	29-37-105	Gossan vein.
862	L	L	200	L	N	100	L	N	150	29-37-105	Do.
865	L	20	10	15	N	70	N	N	10	10-36-106	Do.

7/ Contains 2.4 ppm Ag, 0.08 ppm Au, and 15 ppm Sn.

8/ Contains 9.2 ppm Ag and 0.06 ppm Au.

TABLE 10.—*Analyses of stream-sediment and soil samples*

[CxHM analyses, A. J. Toevs. Townships marked

Semiquantitative spectrographic analyses

Sample	(percent) Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	(ppm) Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
							Soil samples								
206	3	1.5	1	0.2	200	N	150	L	15	70	15	70	N	L	70
207	2	.7	1	.2	200	L	300	1	10	30	10	50	N	L	30
216	3	.7	.5	.15	300	L	300	1	15	30	7	70	N	L	15
221	3	1.5	1.5	.2	500	L	300	1.5	15	100	30	50	N	L	50
223	2	.7	.7	.15	300	50	700	1	10	30	10	30	N	L	15
225	3	2	2	.2	500	30	700	1	10	50	15	30	N	L	15
226	1.5	2	2	.15	300	30	500	1	5	50	10	20	N	L	10
227	2	3	2	.15	300	30	500	L	7	50	10	30	N	L	10
236	1.5	.7	.5	.15	200	L	200	1	7	20	7	50	N	L	15
302	2	.7	1	.15	500	30	700	1	L	30	7	20	N	L	7
303	1.5	.3	1	.15	300	20	200	L	L	30	7	L	N	N	L
304	3	.7	1.5	.15	500	70	700	1	10	30	10	20	N	L	15
715	3	1	.5	.3	300	15	500	1	30	200	15	20	N	N	70
							Silt samples								
205	2	1.5	1	0.2	150	N	150	L	15	70	5	50	N	L	70
295	3	1.5	1.5	.5	1,000	N	150	1	15	70	15	70	N	L	30
306	5	1	1	.15	500	70	500	L	15	70	15	20	N	L	20
308	5	.7	2	.2	500	50	700	L	15	50	10	30	N	L	15
311	5	1	1.5	.2	500	30	700	L	15	70	15	50	N	L	20
312	5	1	1.5	.2	500	50	700	1	15	70	15	30	N	L	15
318	2	.7	.7	.15	150	N	300	1	L	5	15	30	N	L	5
334	3	.7	.5	.15	200	L	300	1	7	20	15	200	N	L	10
344	3	1.5	.7	.15	300	L	500	1	15	70	15	70	N	L	30
345	3	1.5	.7	.15	500	L	500	1	20	70	15	100	N	L	30
352	3	.7	.7	.2	300	L	300	1	15	70	20	50	N	L	20
767	7	3	2	.3	700	N	300	L	15	300	20	70	N	L	100
776	3	1.5	1.5	.2	300	N	300	L	15	200	7	30	N	L	70
957	3	1.5	1.5	.2	200	10	700	1	15	300	15	150	N	L	70
959	5	2	1.5	.2	700	L	500	L	20	200	30	150	N	L	50
960	10	3	1	.3	1,000	10	500	L	20	200	70	150	N	15	70
994	5	1.5	1.5	.3	1,000	L	500	L	15	150	10	70	N	L	50
1047	3	1.5	1.5	.3	300	N	300	L	15	1,000	7	L	N	L	100
1060	3	1.5	2	.15	500	L	700	L	10	70	7	150	N	L	20
1062	3	1	1	.2	500	L	700	1	15	70	10	100	N	L	30
1080	3	1	.7	.3	300	15	300	L	10	20	10	70	N	L	20
							Organic silt samples								
201	1	0.5	0.7	0.15	150	L	150	1	7	30	30	50	N	L	20
202	1	.3	.7	.15	100	L	100	L	5	20	7	30	N	L	7
203	3	2	1.5	3	300	N	150	1	15	150	10	50	N	L	150
222	1.5	.3	.5	.1	300	L	150	L	5	20	10	50	N	L	10
259	2	.5	.7	.2	150	10	300	1.5	10	30	20	30	N	L	20
273	2	.3	.5	.2	300	20	150	1	10	20	15	20	N	L	5
298	3	2	1.5	.5	1,000	N	300	1.5	15	50	30	70	N	L	20
300	1.5	.5	.5	.15	150	N	100	1	L	50	20	150	N	L	15
309	5	.7	1.5	.2	500	50	700	L	15	50	15	50	N	L	15
310	5	.7	.5	.2	500	30	700	L	10	50	10	50	N	L	15
316	3	1	1.5	.15	500	20	500	L	7	100	20	50	N	L	10
335	2	.7	.7	.15	300	L	200	1	10	30	15	20	N	L	15
336	2	.7	.7	.15	300	L	200	L	15	150	20	L	N	L	70
341	3	1	1.5	.15	300	L	300	1.5	15	70	30	70	N	L	50
354	.7	.3	.3	.07	200	L	150	L	L	30	10	50	N	N	10

from the Glacier Primitive Area, Fremont County

"S" are south of the Wind River base meridian]

Semiquantitative spectrographic analyses--Continued

Sample	(ppm) Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	(ppm) CxHM	Location Sec-Twp-Rge	Drainage basin
					Soil samples				
206	15	7	100	30	15	150	1	12-38-107	Dinwoody Cr.
207	20	7	100	30	20	200	1	18-38-106	Do.
216	30	7	L	30	20	150	3	32-39-106	Do.
221	30	15	100	70	30	200	3	3-38-106	Do.
223	50	7	N	20	15	150	1	34-40-106	Blue Hole Dr.
225	50	7	N	30	20	150	1	26-40-106	Do.
226	20	5	N	20	15	150	3	26-40-106	Do.
227	30	5	L	20	20	150	1	25-40-106	Do.
236	15	5	L	15	20	150	1	13-39-107	Torrey Cr.
302	20	L	L	15	15	150	1	13-40-107	Do.
303	15	L	L	15	10	100	3	13-40-107	Do.
304	15	5	N	20	20	150	1	18-40-106	Do.
715	10	10	100	50	15	200	3	34-41-107	Jakeys Fork.
					Silt samples				
205	10	7	100	30	15	150	1	12-38-107	Dinwoody Cr.
295	20	15	100	70	30	300	4	7-30-107	Jakeys Fork.
306	15	7	N	30	15	100	1	7-40-106	Torrey Cr.
308	15	7	N	15	20	150	1	7-40-106	Do.
311	20	10	N	50	20	150	1	8-40-106	Do.
312	20	7	100	30	20	150	1	8-40-106	Do.
318	10	L	L	10	10	150	1	6-38-106	Dinwoody Cr.
334	30	7	L	30	150	300	1	28-39-106	Do.
344	50	10	100	50	30	150	1	25-39-106	Torrey Cr.
345	100	10	100	50	30	100	1	24-39-107	Do.
352	30	10	L	50	30	300	3	12-39-107	Do.
767	30	10	100	100	20	70	5	5-36-106	Bull Lake Cr.
776	20	7	L	50	20	150	1	30-37-105	Do.
957	20	15	200	50	30	150	3	23-37-106	Do.
959	70	15	200	50	30	100	5	18-36-106	Do.
960	100	15	150	100	30	150	8	18-36-106	Do.
994	50	15	200	70	30	100	17	5-35-106	Do.
1047	20	15	100	70	15	50	3	31-38-105	Dry Cr.
1060	30	15	700	50	30	100	7	7-35-106	Bull Lake Cr.
1062	70	15	300	70	30	150	11	8-35-106	Do.
1080	30	7	150	70	20	150	5	15-35-106	Do.
					Organic silt				
201	15	7	N	30	30	150	1	11-38-106	Dinwoody Cr.
202	15	5	N	20	15	150	1	11-38-106	Do.
203	10	10	100	50	20	150	1	11-38-106	Do.
222	20	5	N	20	30	100	3	4-38-106	Do.
259	30	7	L	30	15	100	1	4-38-106	Do.
273	50	5	L	70	15	100	1	21-38-106	Do.
298	30	15	200	70	20	300	2	6-39-106	Jakeys Fork.
300	50	5	N	50	30	50	5	1-39-108	Do.
309	15	7	L	20	20	150	1	7-40-106	Torrey Cr.
310	15	7	N	30	20	150	1	7-40-106	Do.
316	20	5	100	20	15	150	1	33-41-106	Do.
335	30	7	L	30	30	150	1	28-30-106	Dinwoody Cr.
336	20	7	N	30	15	150	1	31-39-105	Do.
341	50	10	100	30	30	150	3	32-39-106	Do.
354	30	L	N	15	20	100	1	25-40-107	Torrey Cr.

TABLE 10.—*Analyses of stream-sediment and soil samples from*

Semiquantitative spectrographic analyses

	(percent)				(ppm)										
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
							Organic silt samples--Continued								
355	0.2	.07	0.2	0.03	100	L	50	L	L	10	7	30	N	N	L
375 1/	2	.5	.7	.3	300	N	150	L	15	20	15	70	N	L	7
382	1	.3	.5	.15	300	15	150	1.5	7	20	10	70	N	N	7
398	5	1.5	.7	.3	300	15	300	1	15	100	30	70	N	15	50
602	3	1	1.5	.5	500	10	300	1.5	15	150	30	30	L	L	70
607	1.5	.5	1	.2	150	N	200	1	7	70	10	30	N	L	20
611	3	1.	1.5	.5	500	N	300	1.5	15	100	10	70	N	L	50
615	3	.7	1.5	.5	500	10	300	1.5	15	150	15	150	7	L	20
618	1	.15	.7	.15	150	10	300	1.5	L	15	10	20	N	N	7
631	3	.7	.7	.3	300	15	200	1	15	70	20	70	N	L	30
652	3	.5	.3	.3	150	50	500	1.5	10	50	10	50	N	L	15
655	1.5	.5	.7	.15	200	10	150	1	10	70	15	70	N	L	20
657	2	.7	.7	.3	300	10	300	1.5	15	70	15	50	N	L	20
659	2	.7	.7	.3	300	15	200	1.5	15	150	15	70	N	10	70
660	.7	.2	.3	.07	70	L	100	2	N	20	15	150	N	L	10
663	1	.2	.5	.2	300	L	100	1	5	15	10	70	L	L	7
667	3	1.5	1.5	.3	500	L	300	1	20	200	15	50	N	L	70
669	3	.7	1	.3	700	L	500	2	15	70	15	50	N	10	20
697	5	1	1.5	.5	700	N	200	1	20	300	100	30	N	L	100
705	3	.3	.5	.3	200	15	300	1	10	200	10	70	N	L	50
709	3	.7	1	.3	500	L	500	1	10	150	15	100	N	L	30
721	1.5	.3	.7	.2	300	L	300	1	10	30	5	50	N	N	30
728	1.5	.15	.3	.2	700	10	500	L	5	20	L	20	N	N	5
739	5	2	.7	.3	1,000	10	300	1.5	15	150	20	50	N	L	70
740	2	.7	.7	.2	500	L	150	1	10	200	10	50	N	L	50
744	2	.7	.7	.2	300	L	200	1	7	150	15	70	N	N	50
745	1.5	.3	.3	.1	300	L	150	1	7	100	15	70	N	N	30
746	.7	.15	.3	.05	200	N	100	1	L	50	5	20	N	N	10
747	2	1	.5	.15	150	N	200	1	10	300	5	30	N	L	70
759	3	1.5	1	.2	700	N	200	1	30	300	10	20	N	L	150
768	7	3	1.5	.3	700	N	500	L	15	300	20	70	N	10	70
772	1.5	.7	.5	.15	300	L	200	1	10	50	20	100	N	L	30
781	3	.7	.7	.2	150	N	500	L	5	30	7	50	N	L	20
794	3	1.5	.7	.2	300	N	500	L	15	200	15	30	N	L	50
795	1	.3	.5	.15	100	L	200	L	N	50	10	50	N	N	30
796	3	.7	1	.2	500	N	200	L	15	200	15	50	N	L	70
797	.7	.15	.3	.07	150	N	100	L	N	30	7	50	N	N	15
800	1.5	.5	1	.2	150	N	150	L	5	50	5	50	N	N	30
901	3	1	.7	.5	300	15	700	1	15	200	15	70	N	10	70
903	2	1	1	.3	700	L	200	1	15	200	10	30	N	L	100
906	3	1	.7	.3	1,000	10	200	1.5	50	300	15	50	N	L	150
908	3	1	1	.3	300	N	300	1	20	200	30	20	N	L	100
912	3	1.5	1	.2	700	10	200	1	30	500	20	70	N	10	200
913	1.5	.3	.3	.07	200	10	150	1	10	150	15	30	N	L	50
914	5	1.5	2	.5	700	N	300	1	30	300	15	20	N	L	150
919	5	1.5	2	.3	700	N	150	L	20	500	5	20	N	L	100
921	3	1	1	.3	700	N	200	1	20	150	15	20	N	L	100
934	5	1.5	1.5	.3	700	L	300	L	15	100	15	50	N	L	30
965	3	1.5	1.5	.2	500	10	300	1	7	70	10	20	N	L	30
968	7	3	2	.2	700	N	300	1.5	15	500	15	150	N	L	100
985	3	.7	1.5	.3	300	L	300	L	10	70	15	70	N	L	30
988	.3	.1	.2	.1	30	N	30	L	N	5	L	50	N	L	L
996	3	.7	1	.2	300	L	200	L	10	15	7	50	N	L	20
998	5	1.5	1.5	.3	500	10	500	L	15	150	15	70	N	L	70
1003	7	2	1.5	.3	1,000	10	500	L	30	300	150	50	N	L	100
1021	2	.7	.7	.15	200	N	200	L	5	20	10	70	N	N	30
1022	3	.7	1	.2	300	N	300	L	15	70	7	50	N	L	30
1023	1.5	.3	.3	.1	150	N	300	L	L	30	5	20	N	N	15
1025	3	.7	1	.2	1,500	L	300	1	10	15	15	50	N	N	20
1036	3	1.5	1	.2	700	10	500	1	15	100	30	100	N	L	30

1/ Contains 200 ppm Zn.

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

Sample	Pb (10) (ppm)	Sc (5) (ppm)	Sr (100) (ppm)	V (10) (ppm)	Y (10) (ppm)	Zr (10) (ppm)	CxHm (ppm)	Location Sec-Twp-Rge	Drainage basin
				Organic silt samples--Continued					
355	15	L	N	10	15	30	1	30-40-106	Torrey Cr.
375	15	7	L	70	30	70	100	11-38-106	Dinwoody Cr.
382	30	L	L	30	15	200	1	13-39-107	Torrey Cr.
398	50	15	100	70	70	200	5	2-39-107	Do.
602	30	15	100	100	20	200	3	35-40-107	Do.
607	10	7	100	50	15	150	5	31-41-107	Jakeys Fork.
611	15	15	100	70	50	500	3	36-41-108	Do.
615	10	15	150	70	20	150	3	27-41-108	Warm Spg Cr.
618	10	L	100	30	15	150	10	27-41-108	Do.
631	15	10	L	70	30	150	5	24-40-108	Jakeys Fork.
652	30	10	100	30	20	300	8	36-40-108	Do.
655	15	7	100	30	30	300	8	30-40-107	Do.
657	30	15	100	70	30	200	3	23-40-107	Do.
659	20	10	100	70	30	150	1	14-40-107	Do.
660	15	5	L	30	100	70	3	14-40-107	Do.
663	20	5	L	30	30	200	3	25-40-108	Do.
667	30	15	150	70	20	150	8	31-40-107	Do.
669	20	15	300	70	30	300	1	31-41-108	Warm Spg Cr.
697	20	10	150	100	20	70	3	13-38-106	Dry Cr.
705	15	10	N	70	50	200	3	33-41-107	Jakeys Fork.
709	15	7	100	50	30	300	5	33-41-107	Do.
721	L	5	300	50	15	150	3	19-41-107	Warm Spg. Cr.
728	L	5	L	30	15	100	3	20-41-108	Do.
739	100	15	100	70	20	70	8	3-37-106	Dry Cr.
740	70	7	L	50	15	150	1	3-37-106	Do.
744	70	7	N	70	20	70	3	3-37-106	Do.
745	70	7	N	50	20	30	1	2-37-106	Do.
746	10	5	N	30	10	20	3	2-37-106	Do.
747	10	7	L	50	15	150	3	1-37-106	Do.
759	30	15	L	100	20	70	3	26-38-106	Do.
768	30	15	150	100	15	70	5	4-36-106	Bull Lake Cr.
772	70	7	L	30	30	100	1	31-37-105	Do.
781	20	7	L	30	15	100	1	24-39-107	Torrey Cr.
794	20	10	L	70	10	100	1	3-2 -106	Bob Cr.
795	15	5	N	30	10	70	1	3-2 -6	Do.
796	20	15	L	50	15	500	3	3-2 -6	Do.
797	15	5	N	20	10	500	1	35-3 -6	Do.
800	10	7	L	30	15	150	1	35-3 -6	Do.
901	30	15	300	70	20	300	N	11-37-106	Dry Cr.
903	15	7	L	70	15	200	5	12-37-106	Do.
906	20	15	L	70	20	300	3	31-38-105	Do.
908	L	15	L	70	15	100	5	30-38-105	Do.
912	15	15	N	70	30	300	3	25-38-106	Do.
913	15	5	N	50	15	150	1	25-38-106	Do.
914	L	15	100	100	30	300	3	30-38-105	Do.
919	N	15	L	70	15	150	3	31-38-105	Do.
921	15	10	N	70	15	100	3	30-38-105	Do.
934	20	10	100	100	15	100	1	26-37-106	Bull Lake Cr.
965	15	10	L	70	20	150	5	9-36-106	Do.
968	30	20	100	100	30	700	5	15-36-106	Do.
985	20	10	150	50	20	200	5	28-36-106	Do.
988	10	L	100	10	10	70	14	20-36-106	Do.
996	20	7	100	50	15	100	11	4-35-106	Do.
998	50	15	200	70	20	150	14	20-36-106	Do.
1003	70	15	L	100	30	150	14	19-37-105	Do.
1021	30	7	L	50	20	50	8	3-36-106	Do.
1022	15	10	100	70	20	100	5	1-36-106	Do.
1023	10	L	L	30	15	30	5	2-36-106	Do.
1025	70	7	100	50	20	50	3	12-35-106	Do.
1036	150	15	100	70	30	100	3	32-36-106	Do.

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TABLE 10.—*Analyses of stream-sediment and soil samples from*

	Semiquantitative spectrographic analyses														
	(percent)				(ppm)										
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
Organic silt samples--Continued															
1044	3	1	1	0.3	300	10	300	1	15	70	10	100	N	L	30
1049	5	1.5	1.5	.3	300	N	300	L	15	700	10	100	N	L	100
1051	5	1.5	1.5	.3	300	N	200	L	15	300	15	150	N	L	100
1073	2	.3	.7	.2	150	10	300	L	L	50	7	50	N	L	15
Sand samples															
117	2	1.5	0.7	0.2	300	L	200	L	15	70	15	30	N	L	30
210	2	.5	.7	.2	200	N	300	1	7	20	10	100	N	L	10
211	1.5	.3	.7	.2	150	N	300	1	L	15	15	50	N	L	10
212	1.5	.2	.7	.15	150	N	500	1	L	10	10	50	N	L	10
213	1.5	.3	.7	.15	150	N	300	L	7	10	10	50	N	L	15
214	3	1	1.5	.3	300	L	300	1	15	70	15	50	N	L	70
224	1.5	1	2	.15	300	30	500	L	7	20	7	30	N	L	10
228	.7	.3	.7	.15	50	50	150	L	L	20	5	20	N	L	5
232	2	.7	.5	.15	150	N	300	L	10	30	5	30	N	L	15
233	2	.7	.7	.15	200	N	300	L	10	50	10	30	N	L	15
240	1.5	.3	.5	.15	300	L	200	L	7	20	7	30	N	L	10
244	3	1	1	.3	500	L	300	L	15	150	10	100	N	L	20
245	3	1	1	.2	300	L	300	L	15	70	15	50	N	L	20
247	3	1.5	1.5	.3	500	N	300	1	15	200	15	200	N	20	100
253	5	1.5	.7	.3	700	L	300	1	20	150	15	70	N	L	70
254	3	.7	1.5	.3	300	L	200	1	15	N	15	50	N	L	15
255	2	.7	.7	.3	700	20	300	1	15	30	15	30	N	L	30
256	3	.7	1	.2	700	L	500	1	.5	70	10	70	N	L	20
257	3	.7	1	.2	700	L	500	1	15	70	15	50	N	L	30
258	3	.7	1	.2	300	N	200	1.5	15	70	15	50	N	L	20
260	2	.7	1.5	.2	150	N	500	1	10	30	10	100	N	L	7
262	5	1	.7	.3	300	L	500	L	20	300	15	100	N	L	15
263	3	1.5	1	.3	500	N	300	1	15	30	15	150	N	10	20
264	3	1	1	.3	500	L	300	1	20	50	150	50	N	15	30
265	1.5	.5	1	.3	150	N	500	1	5	50	15	70	N	L	5
267	2	.5	.5	.2	300	70	500	2	10	70	15	30	N	L	5
268	1.5	.7	.7	.2	150	50	700	1.5	10	20	10	30	N	L	7
269	5	1.5	2	.5	700	N	300	1	15	70	15	50	N	L	20
270	3	.7	.7	.3	300	30	300	1	10	30	20	70	10	10	15
272	2	.7	.7	.2	500	N	200	1	10	30	7	50	N	L	10
274	3	1.5	1.5	.2	500	N	300	1	15	50	15	70	N	L	15
275	1.5	.7	1	.15	200	N	300	1.5	5	30	7	50	N	L	10
276	1.5	.7	1	.15	150	N	500	1	5	150	L	70	N	N	10
277	1.5	.5	1	.3	150	N	300	1	5	70	15	70	N	10	10
278	1.5	.7	1	.15	150	N	300	1	5	50	15	50	N	L	10
279	3	.7	1.5	.3	300	N	300	1	7	70	15	150	N	L	15
280	.5	.3	.7	.07	100	50	150	1	N	20	10	L	N	N	L
281	.7	.5	.7	.15	200	N	300	L	L	15	15	30	N	N	7
283	1.5	.3	.7	.15	300	N	300	1	N	15	15	70	N	L	L
285	1.5	.7	1	.3	200	N	300	1	7	30	15	70	N	10	10
287	1	.7	1.5	.3	200	N	300	1	5	50	15	150	N	L	10
289	1.5	.5	1	.2	1,500	N	200	L	5	100	10	30	N	L	7
291	1	.5	1	.1	150	N	300	1.5	7	30	30	50	N	L	7
293	1	.3	1	.3	150	N	300	1	5	20	15	70	N	L	7
294	3	1	1.5	.7	700	N	150	1	10	70	15	70	N	15	15
296	5	2	1.5	.5	700	N	300	L	30	300	70	200	N	L	100
301	2	.7	5	.15	300	30	500	1	10	50	10	30	N	L	15
313	5	1	1.5	.15	500	30	500	L	15	70	15	30	N	L	15
315	5	1	1.5	.15	500	50	500	1	15	50	15	30	N	L	15
317	5	2	1	.3	700	L	300	1	15	200	20	100	N	10	70
319	3	.7	.7	.15	300	L	500	1.5	5	50	10	70	N	L	10
321	2	.5	1	.2	300	N	300	1	10	20	7	30	N	L	15
324	2	.7	1.5	.15	200	N	300	L	10	150	5	30	N	L	70
325	3	.5	1.5	.3	200	L	500	1	10	50	10	70	N	L	5
328	1.5	.5	1.5	.2	150	L	500	L	10	70	7	50	N	L	20

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

Sample	Pb (10) (ppm)	Sc (5) (ppm)	Sr (100) (ppm)	V (10) (ppm)	Y (10) (ppm)	Zr (10) (ppm)	CxHM (ppm)	Location Sec-Twp-Rge	Drainage basin
				Organic silt samples--Continued					
1044	30	10	150	70	70	100	7	21-36-106	Bull Lake Cr.
1049	20	15	150	70	20	100	1	30-38-105	Dry Cr.
1051	20	15	100	70	30	100	3	20-38-105	Do.
1073	15	10	150	70	15	200	3	10-35-106	Bull Lake Cr.
				Sand samples					
117	30	7	L	50	30	150	1	11-38-106	Dinwoody Cr.
210	70	7	100	30	30	200	1	8-38-106	Do.
211	15	5	100	20	30	200	3	14-38-107	Do.
212	15	L	L	15	15	150	1	14-38-107	Do.
213	30	5	100	20	20	150	3	13-38-107	Do.
214	50	10	150	70	30	150	3	13-38-107	Do.
224	15	5	N	20	20	150	1	34-40-106	Blue Hole Cr.
228	L	5	N	15	15	100	1	25-40-106	Do.
232	15	7	100	20	20	150	1	15-39-107	Torrey Cr.
233	15	7	100	20	20	150	1	14-39-107	Do.
240	30	5	N	30	20	150	1	21-40-107	Jakeys Fork.
244	50	10	100	50	70	500	1	16-40-107	Do.
245	20	10	L	50	50	300	1	10-40-107	Do.
247	50	10	100	70	150	500	1	10-40-107	Do.
253	20	10	L	70	50	300	1	33-41-107	Do.
254	15	10	100	70	15	200	1	10-40-107	Do.
255	15	10	N	70	20	150	1	31-41-107	Do.
256	15	7	100	70	30	300	1	32-41-107	Do.
257	15	10	100	70	30	300	1	32-41-107	Do.
258	20	7	150	50	15	70	1	4-38-106	Dinwoody Cr.
260	15	7	200	20	30	200	1	35-38-107	Do.
262	50	7	100	50	30	100	1	25-38-107	Do.
263	30	10	100	70	50	150	1	25-38-107	Do.
264	70	10	100	50	50	200	1	30-38-106	Do.
265	15	5	100	20	20	200	1	29-38-106	Do.
267	15	7	L	20	20	700	1	12-39-106	Red Cr.
268	15	7	L	30	30	500	1	6-39-105	Do.
269	15	10	200	100	30	70	1	20-38-106	Dinwoody Cr.
270	20	5	100	70	30	150	1	29-38-106	Do.
272	30	5	L	30	20	150	1	28-38-106	Do.
274	20	10	150	50	30	100	1	20-38-106	Do.
275	10	7	200	20	30	200	1	24-39-106	Do.
276	15	5	200	20	30	100	1	19-39-105	Do.
277	15	7	150	30	30	200	1	19-39-105	Do.
278	15	5	150	30	30	200	1	20-39-105	Do.
279	15	10	100	30	100	300	1	20-39-105	Do.
280	10	L	N	10	15	200	1	21-39-105	Do.
281	10	5	100	15	15	70	1	21-39-105	Do.
283	15	5	150	20	20	70	1	11-38-106	Do.
285	15	7	150	30	30	300	1	2-38-106	Do.
287	15	5	150	20	30	150	1	2-38-106	Do.
289	10	5	L	15	20	200	1	2-38-106	Do.
291	15	15	150	15	20	200	1	35-39-106	Do.
293	15	5	150	20	20	150	1	26-39-106	Do.
294	30	20	100	70	50	300	5	7-39-107	Roaring Fork.
296	30	20	150	150	30	300	4	12-39-108	Do.
301	50	5	100	20	15	150	3	13-40-106	Torrey Cr.
313	15	7	L	20	15	100	1	33-41-106	Do.
315	15	7	L	30	30	150	1	33-41-106	Do.
317	70	15	L	70	100	200	15	8-37-106	Dinwoody Cr.
319	30	5	100	30	15	150	1	7-38-106	Do.
321	30	7	L	20	70	150	1	8-38-106	Do.
324	10	7	150	20	15	100	1	7-37-106	Do.
325	10	7	100	30	50	700	3	6-37-106	Do.
328	10	7	150	20	20	150	1	5-37-106	Do.

TABLE 10.—*Analyses of stream-sediment and soil samples from*

Semiquantitative spectrographic analyses

	(percent)				(ppm)										
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
							Sand samples--Continued								
329	1.5	0.5	0.7	0.2	300	10	100	1	7	50	15	30	N	L	20
330	3	.7	1	.7	300	L	200	L	15	100	15	150	N	15	15
331	2	.7	1.5	.2	200	L	500	L	15	100	15	50	N	L	70
333	2	.7	1	.2	300	N	300	1	15	100	15	50	N	L	30
337	3	1	1.5	.15	500	L	200	L	15	300	20	30	N	L	70
339	3	1	1.5	.2	300	L	300	1	20	70	30	70	N	L	70
342	3	1	1	.15	300	L	200	1.5	20	70	30	70	N	L	50
343	3	.7	.7	.15	300	N	500	1	15	70	10	100	N	L	20
346	2	.7	.7	.15	200	N	300	1	15	50	20	50	N	L	20
347	2	.7	.7	.15	200	N	300	L	10	15	10	50	N	L	15
348	3	1	.5	.15	150	N	300	L	10	50	15	70	N	L	20
349	2	.7	.5	.15	300	L	300	1	10	30	20	70	N	L	15
350	3	.7	.7	.3	300	N	500	1	15	70	7	70	N	L	20
351	2	.7	.7	.2	300	L	300	1	15	70	10	50	N	L	15
353	1.5	.3	.5	.1	200	L	200	L	7	30	10	30	N	L	10
356	3	.7	.7	.5	300	10	300	1	15	70	7	150	N	10	30
357	1.5	.7	.7	.3	200	L	500	1	7	30	L	20	N	L	15
358	3	.7	1	.3	300	L	500	1	15	50	15	50	N	L	20
359	2	.7	.7	.2	300	10	300	1	15	50	15	150	N	L	15
360	1.5	.5	.3	.1	150	N	300	L	10	20	10	50	N	N	15
361	2	.7	.3	.1	200	L	500	1	10	20	15	70	N	L	15
362	3	.5	.3	.15	150	N	300	L	10	30	7	100	N	N	15
365	3	.7	.7	.2	300	L	150	L	15	50	10	30	N	L	20
366	3	.7	1	.5	500	15	200	L	15	70	15	150	N	L	15
367	2	.5	.7	.2	300	30	300	1	15	30	15	30	N	L	10
368	2	.7	.7	.3	200	N	200	1	15	30	15	50	N	L	10
369	1.5	.7	.7	.3	300	N	150	L	10	20	10	50	N	L	10
370	2	.5	.7	.2	150	N	300	1	5	15	15	70	N	L	7
372	2	1	1	.3	200	N	300	1	20	70	15	50	N	L	20
376	3	1	1	.2	300	N	150	1	20	100	10	20	N	L	30
377	3	.7	1.5	.3	500	L	200	1.5	20	70	15	20	N	L	30
378	3	1	1.5	.3	300	N	200	1	20	70	15	30	N	10	20
379	2	.7	1	.2	300	L	300	1	15	70	15	70	N	L	20
383	3	1	1	.3	700	N	300	1	20	70	20	100	N	L	50
385	1	.3	1	.15	100	N	300	L	5	15	10	30	N	L	7
387	1.5	.5	.7	.15	150	N	300	1	5	30	10	20	N	L	15
389	.7	.5	1	.15	150	N	300	1	L	30	5	30	N	L	10
391	2	.3	.5	.2	150	70	500	1.5	10	70	15	50	N	L	10
392	2	.7	3	.15	300	100	700	1	15	70	15	30	N	L	15
394	3	.7	1	.3	300	10	500	1	15	100	15	100	N	L	20
396	3	1.5	1.5	.5	700	N	200	1.5	15	100	15	100	N	20	50
399	3	1.5	1.5	.3	700	N	300	1	15	150	15	70	N	L	30
400	3	1.5	1.5	.5	1,500	N	200	1.5	15	100	15	70	N	L	50
605	3	1	1	.3	300	N	300	2	20	150	15	100	N	L	50
609	3	1.5	1.5	.5	500	N	300	1.5	20	150	15	70	7	L	70
610	3	1.5	1.5	.7	700	N	300	1.5	20	300	15	700	N	L	50
621	1.5	.5	1.5	.3	300	N	300	1	5	20	10	20	N	L	7
623	3	.7	1.5	.5	700	N	300	1	20	150	15	200	N	10	30
627	3	.7	1.5	.3	700	L	300	1.5	15	150	15	100	N	L	70
628	3	1	1.5	.5	300	N	300	1.5	15	200	15	150	N	L	70
629	3	1.5	2	.3	700	N	300	1.5	20	150	15	50	N	L	70
630	2	.5	1	.3	700	L	200	1.5	15	50	20	100	N	10	15
632	3	.7	1	.3	1,500	N	300	1	20	150	15	150	N	L	50
636	3	1.5	1.5	.5	500	L	300	1	20	200	20	100	N	10	70
637	3	1.5	1.5	.5	700	L	200	1.5	20	300	30	30	10	10	100
642	3	3	1.5	.5	700	N	300	1	30	700	20	50	N	L	200
643	3	.7	1	.2	700	N	200	1	10	70	10	300	N	L	15
645	3	.7	1.5	.5	700	N	300	1	15	100	15	700	N	L	20
646	3	1	1.5	.3	700	N	300	1	15	150	15	300	N	L	50
647	3	1.5	1.5	.2	300	10	300	1.5	15	150	15	70	N	L	70

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

	(ppm)						(ppm)		
Sample	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	CxHM	Location Sec-Twp-Rge	Drainage basin
				Sand samples--Continued					
329	20	7	N	30	20	150	5	32-38-106	Dinwoody Cr.
330	15	15	100	70	70	700	1	28-38-106	Do.
331	15	7	150	30	20	150	1	28-38-106	Do.
333	15	7	150	30	30	200	1	22-38-106	Do.
337	20	10	L	30	15	150	1	31-39-105	Do.
339	30	10	150	50	20	100	1	28-39-106	Do.
342	30	10	100	30	30	300	8	33-39-106	Do.
343	50	7	150	50	50	150	1	33-38-106	Do.
346	30	7	L	30	20	150	1	19-39-106	Torrey Cr.
347	50	5	100	20	20	100	1	19-39-106	Do.
348	30	7	L	30	20	100	1	17-39-106	Do.
349	30	7	L	30	20	150	1	8-39-106	Do.
350	30	7	100	50	20	150	---	5-39-106	Do.
351	30	7	L	50	20	150	3	32-40-106	Do.
353	30	5	L	20	15	150	3	36-40-106	Do.
356	20	10	100	50	50	150	1	28-40-106	Do.
357	15	5	L	30	20	150	1	21-40-106	Do.
358	70	10	150	50	30	150	1	26-40-107	Jakeys Fork.
359	50	7	150	50	20	150	1	23-40-107	Do.
360	15	5	L	20	10	70	1	14-40-107	Do.
361	15	5	L	30	15	150	1	11-40-107	Do.
362	20	5	N	30	15	150	1	2-40-107	Do.
365	10	7	100	50	15	150	1	9-40-107	Do.
366	30	7	L	70	70	500	1	21-40-106	Torrey Cr.
367	20	7	L	30	20	150	1	29-40-106	Do.
368	20	7	150	30	30	100	1	26-40-107	Tourist Cr.
369	30	7	L	30	15	100	1	15-38-107	Dinwoody Cr.
370	15	5	150	20	30	300	1	1-37-107	Do.
372	10	7	100	30	30	150	1	7-38-106	Do.
376	10	7	L	50	20	200	1	11-38-106	Do.
377	20	10	L	70	30	300	1	2-38-106	Do.
378	15	15	100	50	30	200	1	2-38-106	Do.
379	30	7	150	50	20	100	1	23-39-107	Torrey Cr.
383	20	10	L	70	70	200	1	27-39-106	Dinwoody Cr.
385	15	L	150	15	10	50	1	26-39-106	Do.
387	10	7	150	15	20	200	1	26-39-106	Do.
389	10	5	100	15	15	30	1	24-39-106	Do.
391	15	10	L	20	20	700	1	29-39-105	Do.
392	20	7	100	30	20	200	1	10-4 -6	Do.
394	20	10	150	50	70	200	1	33-41-107	Jakeys Fork.
396	30	15	100	100	70	300	1	3-39-107	Torrey Cr.
399	30	15	200	70	70	300	3	34-40-107	Do.
400	50	15	150	70	50	300	10	35-40-107	Do.
605	20	15	L	70	150	500	3	25-41-107	Jakeys Fork.
609	15	15	100	100	30	200	3	36-41-108	Do.
610	30	20	150	100	150	1,000	3	35-41-108	Warm Spg Cr.
621	10	7	200	50	15	300	5	28-41-108	Do.
623	30	15	200	70	30	300	3	29-41-108	Do.
627	15	15	100	70	20	200	5	29-41-108	Do.
628	15	15	300	70	20	300	3	30-41-108	Do.
629	15	20	200	70	200	300	3	24-40-108	Jakeys Fork.
630	30	10	100	50	70	1,000	13	30-40-107	Do.
632	30	15	L	70	50	300	13	24-40-108	Do.
636	20	15	100	70	150	200	5	13-40-108	Do.
637	20	15	100	70	30	500	3	7-40-107	Do.
642	20	20	100	100	30	300	3	6-40-107	Do.
643	15	10	100	50	20	300	13	26-41-108	Little Warm Spg Cr.
645	50	15	150	70	30	300	8	23-41-108	Do.
646	30	15	100	70	30	500	10	24-41-108	Do.
647	20	15	100	70	30	300	3	24-41-108	Do.

TABLE 10.—*Analyses of stream-sediment and soil samples from*

Semiquantitative spectrographic analyses

Sample	(percent) Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	(ppm) Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
							Sand samples--Continued								
648	3	1	1	0.3	300	L	300	1.5	15	150	15	70	N	L	70
649	3	1	1.5	.3	500	10	300	1	20	300	20	150	N	L	50
650	3	1	1.5	.2	700	N	300	1	15	150	20	50	N	L	70
651	3	1.5	1	.3	300	10	500	1	15	200	20	100	L	L	70
653	3	1	1.5	.3	500	N	300	1	15	70	15	70	N	L	20
654	2	.7	.5	.3	200	30	500	1	15	70	7	30	N	L	20
665	3	.7	.7	.2	200	N	100	1	10	15	15	70	N	L	15
666	3	1.5	1.5	3	700	L	200	1	15	150	15	50	N	L	70
673	3	.7	1	.5	500	N	300	1	15	100	10	50	N	L	30
674	3	1.5	1.5	.3	700	N	300	1.5	20	200	15	100	N	L	70
675	3	1.5	1.5	.3	700	L	300	1	20	200	15	200	N	L	50
677	3	1.5	1.5	.3	500	N	300	2	15	150	10	30	N	L	50
678	7	.7	1	.3	300	10	300	1.5	15	100	15	30	N	L	30
679	3	1.5	1.5	.3	700	10	300	2	15	150	15	150	N	L	50
681	2	.7	.7	.3	150	L	700	1.5	10	70	10	70	N	L	20
682	3	1	1	.3	300	30	300	1.5	15	70	15	70	N	L	30
684	3	1	1	.3	300	L	500	1	15	150	15	70	N	L	50
706	5	.7	.7	.5	700	10	300	1	20	150	15	70	N	L	70
707	7	.7	.7	.5	700	L	300	1	20	150	15	70	N	L	50
711	3	.7	.7	.3	700	L	500	1	15	150	15	100	N	L	70
712	5	.7	.7	.3	1,500	10	500	1	50	200	15	100	N	L	100
713	5	1.5	.7	.3	300	L	200	1.5	70	200	15	100	N	L	70
716	5	1.5	.7	.3	500	L	300	1	30	300	7	70	N	N	100
717	5	1.5	.7	.5	500	N	300	1	30	300	7	200	N	N	100
719	5	1	.7	.3	500	N	300	1	30	200	10	70	N	L	100
720	3	1	.7	.3	300	L	300	1	20	150	10	50	N	N	100
724	7	.7	1	.5	500	L	300	1	20	150	30	50	N	L	30
732	1.5	.1	.3	.2	300	10	300	L	7	30	7	30	N	L	20
733	3	.5	.7	.2	100	10	300	L	15	70	10	30	N	N	50
734	2	.3	.3	.2	200	15	700	1	15	30	7	50	N	L	30
735	5	2	2	.3	500	N	200	1	50	700	7	30	N	L	200
737	3	1.5	.5	.3	500	10	300	1	30	200	30	150	N	L	150
741	3	1.5	1.5	.2	500	N	300	1	15	200	7	20	N	L	70
758	3	.7	.7	.3	500	L	200	1.5	15	150	10	50	N	L	70
764	1.5	.1	.07	.2	150	15	500	1.5	10	200	L	30	N	L	7
765	3	.2	.7	.3	300	15	700	1.5	10	20	15	20	N	L	10
769	7	3	2	.3	1,000	N	300	L	20	500	10	30	N	L	70
770	5	2	2	.5	700	N	200	L	15	300	10	50	N	L	70
773	5	1.5	1	.2	700	N	500	L	15	300	15	30	N	L	50
779	7	2	2	.5	700	N	300	L	15	300	15	100	N	10	70
782	3	1	1	.2	300	N	300	L	10	70	5	100	N	L	30
783	3	1	1	.3	300	N	300	1	10	70	7	70	N	L	30
785	2	.5	1	.3	200	N	300	L	5	15	L	200	N	10	10
787	7	1	2	.3	300	N	300	L	15	70	10	50	N	10	30
788	7	1	1.5	.3	300	N	300	L	15	70	10	150	N	L	30
790	3	1	2	.3	500	N	500	L	5	30	7	150	N	L	20
792	2	.7	1	.1	300	N	300	L	10	20	10	20	N	L	20
793	7	1.5	1.5	.3	700	L	300	L	15	100	20	70	N	L	50
798	3	.7	1.5	.1	700	N	300	L	15	100	7	20	N	L	30
904	5	1.5	.7	.3	700	N	200	1	50	1,500	20	50	N	L	200
922	3	1	.5	.3	500	N	300	1	15	150	15	100	N	L	30
924	3	1.5	3	.3	700	N	700	1	7	100	7	30	N	L	30
925	5	2	1	.3	700	L	300	L	15	300	20	100	N	L	70
927	3	1.5	2	.3	500	N	300	L	15	70	7	150	N	10	30
929	5	1.5	1.5	.2	500	N	300	1	15	300	15	50	N	L	50
930	2	.7	1.5	.1	200	N	500	1	7	20	5	30	N	N	15
931	3	.7	1	.2	300	N	300	L	10	30	5	20	N	L	30
933	3	.7	1.5	.2	300	N	300	L	7	30	5	30	N	L	20
935	2	1.5	1.5	.2	300	N	300	L	10	200	5	50	N	N	70
937	3	1.5	2	.3	300	N	300	N	7	150	5	20	N	L	30

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

Sample	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	(ppm) CxHM	Location Sec-Twp-Rge	Drainage basin
					Sand samples--Continued				
648	15	15	100	70	30	700	3	19-41-107	Little Warm Spg Cr.
649	30	20	150	70	50	700	3	24-41-108	Do.
650	30	15	200	70	30	500	3	24-41-108	Do.
651	30	15	150	70	100	200	1	1-39-108	Jakeys Fork.
653	20	15	100	70	30	300	3	30-40-107	Do.
654	20	7	100	50	20	300	3	7-40-107	Do.
665	L	7	100	30	10	150	1	30-40-107	Do.
666	20	15	150	70	20	300	1	19-40-107	Do.
673	15	10	100	70	15	500	1	31-41-108	Warm Spg Cr.
674	15	20	150	100	30	700	1	24-41-108	Little Warm Spg Cr.
675	30	15	100	100	30	300	3	19-41-107	Do.
677	15	15	100	70	20	500	5	19-41-107	Do.
678	15	15	100	70	30	700	3	19-41-107	Do.
679	15	15	100	70	30	700	5	20-41-107	Do.
681	15	10	100	30	50	700	1	16-41-107	Do.
682	15	10	100	50	30	300	3	16-41-107	Do.
684	15	10	100	70	20	200	8	17-41-107	Do.
706	15	15	L	70	15	700	3	23-41-108	Canyon Cr.
707	L	15	100	70	20	300	1	22-41-108	Warm Spg Cr.
711	20	15	L	70	50	500	3	33-41-107	Jakeys Fork.
712	50	15	100	70	30	100	1	33-41-107	Do.
713	L	15	100	70	30	300	1	4-40-107	Do.
716	10	15	100	70	20	300	3	34-41-107	Do.
717	L	15	L	70	70	300	1	35-41-107	Do.
719	L	15	L	70	50	500	3	35-41-107	Do.
720	N	10	L	70	15	200	3	25-41-107	Do.
724	15	15	150	100	20	1,000	1	16-41-108	Wildcat Cr.
732	L	5	L	30	10	300	1	15-41-107	Little Warm Spg Cr.
733	10	7	N	30	10	200	3	10-41-107	Do.
734	10	7	100	30	15	300	3	6-41-107	Do.
735	10	15	200	70	30	100	3	10-37-106	Dry Cr.
737	70	10	100	70	20	50	15	10-37-106	Do.
741	30	15	200	70	15	100	1	2-37-106	Do.
758	20	15	L	70	20	300	10	25-38-106	Do.
764	15	7	L	30	20	700	3	27-41-107	Limekiln Gulch.
765	10	7	L	30	15	300	1	23-41-107	Do.
769	15	30	150	150	30	200	1	4-36-106	Bull Lake Cr.
770	20	15	100	100	30	70	1	36-37-106	Do.
773	20	10	100	70	20	150	3	31-37-105	Do.
779	20	20	100	150	50	500	1	36-41-108	Jakeys Fork.
782	20	10	L	50	30	150	1	24-39-107	Torrey Cr.
783	20	10	100	50	30	200	1	14-39-107	Do.
785	15	10	150	50	50	100	1	11-38-106	Dinwoody Cr.
787	20	15	200	70	30	300	3	34-37-106	Bull Lake Cr.
788	30	15	300	70	30	300	3	1-36-107	Do.
790	20	7	150	30	30	150	3	34-37-106	Do.
792	20	7	100	30	30	70	3	34-37-106	Do.
793	70	20	100	70	30	20	1	33-37-106	Do.
798	20	10	100	70	15	150	5	34-38- 6	Bob Cr.
904	15	15	L	70	20	200	3	6-37-105	Dry Cr.
922	10	10	L	70	30	1,000	5	30-41-106	Jakeys Fork.
924	20	15	500	70	20	100	3	5-36-106	Bull Lake Cr.
925	50	15	100	70	20	150	3	35-37-106	Do.
927	20	15	200	70	30	70	3	35-37-106	Do.
929	30	15	L	70	30	150	1	34-37-106	Do.
930	15	7	150	30	10	70	1	34-37-106	Do.
931	15	7	100	50	20	150	3	27-37-106	Do.
933	15	10	100	50	15	150	1	26-37-106	Do.
935	15	7	150	30	15	100	1	25-37-106	Do.
937	15	7	L	30	30	70	5	30-37-105	Do.

TABLE 10.—*Analyses of stream-sediment and soil samples from*

	Semiquantitative spectrographic analyses														
	(percent)				(ppm)										
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
						Sand samples--Continued									
939	5	1.5	1.5	0.3	700	N	300	L	15	150	15	20	N	L	30
941	3	1.5	2	.2	500	N	500	L	15	200	15	20	N	L	70
943	2	1.5	1.5	.2	500	N	300	L	15	300	20	30	N	L	70
945	3	2	1.5	.3	700	N	200	L	20	300	10	50	N	L	70
947	3	.7	1.5	.3	500	N	300	1	10	70	L	70	N	L	30
949	2	1.5	1	.1	300	N	300	L	15	300	5	30	N	L	70
951	5	1	1.5	.2	500	N	300	L	20	300	10	50	N	L	70
955	5	2	2	.2	700	L	700	1	15	300	10	150	N	L	70
958	3	1.5	1.5	.2	300	N	700	L	15	100	7	100	N	L	30
961	5	1.5	1.5	.3	300	N	200	1	10	50	30	70	N	L	30
962	5	1.5	2	.5	700	L	300	1	15	100	100	100	N	L	50
963	7	2	2	.3	700	L	500	L	15	150	50	100	N	L	50
964	5	1	1.5	.3	300	L	300	L	10	100	15	50	N	L	30
966	7	2	3	.3	700	N	300	L	15	300	15	200	N	L	70
972	7	2	2	.3	700	N	300	L	15	150	20	20	N	L	30
973	7	1.5	2	.3	1,000	N	500	L	15	50	30	30	N	L	20
974	5	1.5	1.5	.3	500	N	300	L	15	70	10	70	N	10	30
975	3	1	1.5	.3	500	N	300	L	10	100	15	70	N	L	30
978	5	1.5	3	.5	700	N	150	L	15	70	15	50	N	10	30
981	3	1	1.5	.2	500	N	200	L	15	150	10	30	N	L	30
984	3	.7	2	.2	300	N	300	L	15	70	15	30	N	L	30
986	3	.7	1.5	.2	300	N	700	N	7	70	L	20	N	N	20
987	5	1	1.5	.3	300	N	300	L	15	100	5	100	N	L	30
989	3	1.5	1.5	.3	500	N	300	L	10	100	5	50	N	L	50
990	3	1	2	.3	500	N	300	L	10	70	7	50	N	L	20
993	3	.7	1.5	15	500	N	500	L	10	15	7	70	N	L	20
997	2	.7	1.5	.15	200	N	500	1	5	30	L	50	N	L	15
999	5	1.5	1.5	.3	500	N	200	L	15	150	10	70	N	L	50
1001	3	1.5	1	.3	700	N	200	1	15	300	10	50	N	L	70
1004	7	3	2	.2	700	L	300	L	30	1,000	30	20	N	L	150
1007	2	1	1.5	.2	200	N	500	L	10	150	7	50	N	L	30
1009	5	2	1.5	.2	700	L	300	1	20	300	15	30	N	L	100
1010	5	1.5	1.5	.3	500	L	500	1	20	200	15	100	N	L	50
1011	5	1.5	2	.2	500	L	300	1	20	200	15	50	N	L	50
1012	5	1	2	.2	700	N	700	L	15	70	15	50	N	L	30
1013	5	1.5	1.5	.3	700	L	300	1	15	150	20	70	N	L	30
1014	5	1	1.5	.3	500	N	300	L	15	150	15	50	N	L	30
1016	5	1.5	1.5	.2	500	N	300	L	15	200	7	30	N	L	50
1020	7	2	2	.3	700	N	300	L	20	500	10	20	N	L	100
1024	5	.2	2	.2	700	N	500	1	15	150	7	30	N	L	50
1026	3	1	1.5	.2	700	N	700	L	10	30	7	L	N	L	30
1027	5	1	1.5	.2	1,000	N	300	L	15	70	10	20	N	L	30
1029	3	1	1.5	.2	300	N	300	L	15	50	5	20	N	L	30
1030	5	1.5	2	.3	700	N	300	L	15	200	15	20	N	10	50
1032	5	1.5	2	.3	700	N	500	L	15	150	7	30	N	10	30
1035	5	1.5	2	.2	500	N	300	1	15	70	10	70	N	L	30
1037	3	.7	2	.2	200	N	300	L	10	100	5	200	N	L	30
1038	2	.7	1.5	.15	300	N	300	L	10	70	5	50	N	L	30
1039	3	1.5	1.5	.2	700	N	500	L	15	150	7	20	N	L	50
1041	3	.7	1	.2	200	N	500	L	7	50	5	30	N	L	30
1042	3	1	1.5	.2	500	N	300	L	10	100	7	50	N	L	30
1045	5	1.5	1.5	.3	700	N	200	L	15	1,500	10	200	N	10	70
1052	3	1.5	1.5	.3	500	N	200	L	15	700	L	50	N	L	70
1054	3	1	1.5	.2	300	L	300	L	10	200	7	150	N	L	50
1056	5	1.5	1.5	.3	700	L	300	L	15	150	15	70	N	L	50
1057	5	2	2	.3	500	L	300	L	15	500	15	30	N	L	70
1059	3	2	2	.3	700	N	200	N	15	200	10	100	N	L	70
1061	3	1	1.5	.3	500	L	500	L	15	70	10	100	N	10	30
1063	2	.5	1	.15	300	N	700	L	5	10	L	70	N	L	7
1065	5	1	2	.3	700	N	500	L	10	70	10	100	N	L	20

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

Sample	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Z (10)	CxHM	Location Sec-Twp-Rge	Drainage basin
	(ppm)						(ppm)		
				Sand samples--Continued					
939	20	15	150	70	20	100	1	21-37-106	Bull Lake Cr.
941	15	10	100	50	10	50	1	21-37-106	Do.
943	15	10	L	30	30	100	3	22-37-106	Do.
945	30	15	L	70	30	150	3	27-37-106	Do.
947	20	10	200	50	30	150	1	26-37-106	Do.
949	15	10	L	20	10	100	3	21-37-106	Do.
951	15	15	100	70	30	20	3	20-38-105	Dry Cr.
955	30	15	200	70	30	200	5	14-37-106	Do.
958	20	15	300	50	30	70	5	7-36-106	Bull Lake Cr.
961	20	7	100	50	30	150	5	18-36-106	Do.
962	150	15	150	70	30	300	14	17-36-106	Do.
963	50	20	200	100	30	150	5	17-36-106	Do.
964	15	15	100	70	20	150	3	15-36-106	Do.
966	20	30	100	100	30	150	5	10-36-106	Do.
972	20	15	150	70	15	150	3	22-36-106	Do.
973	15	15	200	70	20	150	3	22-36-106	Do.
974	30	15	300	70	30	200	9	22-36-106	Do.
975	30	10	200	70	15	70	3	22-36-106	Do.
978	15	30	100	100	70	300	3	23-36-106	Do.
981	15	10	150	70	15	200	5	23-36-106	Do.
984	15	10	200	50	20	70	3	29-36-106	Do.
986	15	5	150	15	15	70	1	28-36-106	Do.
987	15	15	150	70	20	150	1	20-36-106	Do.
989	15	15	150	70	30	70	1	21-36-106	Do.
990	20	7	200	50	20	70	3	4-35-106	Do.
993	15	10	200	50	20	150	1	5-35-106	Bull Lake Cr.
997	15	10	300	30	10	50	5	30-36-106	Do.
999	20	15	150	70	20	50	7	21-36-106	Do.
1001	30	10	100	70	20	150	2	28-37-105	Do.
1004	30	20	L	100	20	100	7	29-37-105	Do.
1007	20	10	300	30	20	100	5	29-37-105	Do.
1009	50	20	L	70	20	300	5	8-36-106	Do.
1010	30	20	150	70	30	300	5	17-36-106	Do.
1011	50	20	200	70	20	200	5	17-36-106	Do.
1012	50	15	200	70	20	150	3	16-36-106	Do.
1013	100	15	150	70	20	100	5	16-36-106	Do.
1014	50	15	200	70	20	150	5	16-36-106	Do.
1016	20	15	100	70	20	70	3	2-36-106	Do.
1020	20	20	100	70	20	200	5	32-37-105	Do.
1024	20	15	300	70	20	200	3	3-1S-6	Do.
1026	20	7	200	50	15	50	5	12-35-106	Do.
1027	30	15	200	70	30	70	5	1-35-106	Do.
1029	15	15	200	50	30	100	5	2-35-106	Do.
1030	30	15	200	70	30	150	3	35-36-106	Do.
1032	30	15	150	70	30	50	3	32-36-106	Do.
1035	50	15	200	50	30	100	3	32-36-106	Do.
1037	15	10	150	50	20	150	3	32-36-106	Do.
1038	15	15	200	30	20	100	3	33-36-106	Do.
1039	30	15	200	30	30	100	3	33-36-106	Do.
1041	15	10	200	30	10	100	1	4-35-106	Do.
1042	30	10	150	50	30	100	3	4-35-106	Do.
1045	15	20	100	70	100	200	3	6-37-105	Dry Cr.
1052	15	15	150	70	30	150	1	20-38-105	Do.
1054	20	10	150	50	20	70	3	4-37-105	Bob Cr.
1056	15	15	150	70	20	150	9	34-3 -6	Do.
1057	30	15	200	100	30	70	3	16-37-105	Do.
1059	15	15	150	100	15	200	3	15-36-106	Bull Lake Cr.
1061	30	15	300	100	30	100	5	8-35-106	Do.
1063	15	5	500	30	30	20	1	9-35-106	Do.
1065	30	15	500	100	50	70	11	9-35-106	Do.

TABLE 10.—*Analyses of stream-sediment and soil samples from*

Semiquantitative spectrographic analyses

	(percent)				(ppm)										
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
						Sand samples--Continued									
1067	3	1	1.5	.2	500	N	300	1	20	100	7	100	N	10	50
1068	3	1	1.5	.3	500	N	300	L	10	100	7	70	N	L	30
1069	1.5	.7	1	.15	200	N	500	N	5	20	L	50	N	L	10
1072	2	.7	1	.2	150	N	300	L	5	30	L	50	N	L	15
1078	3	1	1.5	.3	500	N	300	L	10	30	7	50	N	L	30
1079	1	.5	.5	.07	150	N	300	N	N	7	N	L	N	N	7
1081	2	.5	1	.2	300	N	500	L	7	7	L	70	N	L	10
1082	5	1	1.5	.3	700	L	500	L	15	50	7	100	N	L	20
1083	3	1.5	2	.3	700	N	300	L	15	300	7	100	N	L	70
1084	2	.5	2	.1	200	N	700	L	7	15	L	L	N	L	15
1085	1	.5	2	.1	200	N	1,000	L	L	15	N	N	N	L	10
1088	1.5	.3	1	.15	1,000	L	150	1	10	30	15	100	N	L	15
1090	5	5	7	.3	1,000	N	200	L	20	500	10	150	N	L	150
1091	3	1	3	.2	700	N	700	L	15	100	7	70	N	L	30
1092	3	1	2	.2	300	N	500	L	10	70	5	150	N	L	30
						Organic sand samples									
208	3	1	1	0.2	300	L	500	L	15	70	30	70	N	L	50
209	2	.3	1	.3	100	N	300	L	5	15	10	150	N	L	7
217	3	1.5	1.5	.2	500	L	300	L	15	300	15	30	N	L	70
218	1.5	.2	.2	.2	150	70	700	1.5	10	30	15	30	N	10	7
219	1.5	.7	.7	.15	200	N	300	L	10	30	15	30	15	L	15
220	3	1	1	.2	300	L	300	1	15	70	20	50	N	L	30
229	1.5	2	2	.15	300	50	700	1	7	30	10	20	N	L	15
230	1.5	1.5	2	.1	300	30	300	L	5	20	5	20	N	L	10
231	1.5	2	2	.1	200	30	300	L	5	30	7	L	N	N	10
237	3	1.5	.7	.2	300	L	300	1	15	70	15	50	N	L	30
238	3	1	1.5	.15	300	70	700	1	15	70	10	30	N	L	20
239	3	1	1	.15	300	L	300	1	15	70	10	70	N	L	20
241	3	1.5	1	.3	500	N	300	1	15	150	10	100	N	L	30
242	.7	.3	.5	.07	200	L	100	L	L	15	10	100	N	N	7
243	1.5	.5	.7	.1	150	L	150	L	5	7	7	30	N	N	7
246	1.5	.3	.7	.15	300	N	300	L	5	50	7	70	N	L	10
248	3	1.5	1.5	.3	500	N	700	1	15	150	15	100	N	L	70
249	1.5	.3	.3	.07	300	N	100	L	5	20	5	L	N	N	5
250	3	2	1.5	.3	500	N	500	L	15	50	10	70	N	L	20
251	3	1.5	1	.15	700	N	100	L	20	200	15	50	N	L	100
252	3	1	.7	.2	300	N	200	L	10	150	15	50	L	N	50
297	3	1.5	1.5	.5	500	N	300	1.5	15	150	30	100	N	10	70
299	2	1	1	.3	200	N	300	1	10	50	15	100	N	L	15
323	1.5	.3	1	.15	300	L	150	L	5	20	7	50	N	L	7
332	3	.7	.7	.3	200	10	300	1.5	15	50	30	150	N	10	30
338	3	.7	1.5	.15	300	L	200	1	15	70	30	70	L	L	30
364	2	.7	.7	.15	300	L	200	L	15	15	5	30	N	L	15
373	3	1	1	.3	300	N	200	1	20	200	20	30	N	L	30
374	2	.7	1	.2	300	N	200	L	20	70	15	20	N	L	20
381	3	1	.7	.2	500	15	500	1.5	20	50	30	70	N	L	20
603	5	1.5	1.5	.5	300	L	300	1.5	30	200	30	50	N	L	100
613	3	1.5	1.5	.3	700	N	300	L	20	700	10	100	N	L	150
617	3	1.5	1.5	.3	500	L	300	1	30	200	15	50	N	L	70
619	1.5	.2	.7	.3	300	N	200	1	7	15	7	20	N	L	L
625	3	1	1.5	.3	500	N	300	1	15	150	30	50	N	L	70
633	3	.7	.7	.3	150	10	300	1	10	150	15	150	5	L	70
635	3	1.5	1	.5	300	15	200	1.5	20	200	20	70	N	L	70
638	3	1	1	.3	500	N	150	1	15	150	15	50	N	L	70
639	3	1	1	.5	500	L	200	1	15	150	20	50	N	10	70
640	3	1	1.5	.3	700	N	200	1	15	150	15	70	N	L	70

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

Sample	Pb (10) (ppm)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	CxHM (ppm)	Location Sec-Twp-Rge	Drainage basin
				Sand samples--Continued					
1067	30	10	300	70	50	200	11	4-35-106	Bull Lake Cr.
1068	15	15	200	70	30	150	3	4-35-106	Do.
1069	20	7	500	30	20	70	3	3-35-106	Do.
1072	15	7	200	30	20	150	3	3-35-106	Do.
1078	20	10	300	70	30	100	3	7-35-106	Do.
1079	10	5	150	15	L	20	3	14-35-106	Do.
1081	20	L	500	50	20	70	0.5	15-35-106	Do.
1082	50	10	700	70	30	150	4	10-35-106	Do.
1083	30	20	200	70	50	150	2	30-37-106	Do.
1084	15	7	500	20	15	30	5	2-35-106	Do.
1085	15	N	500	15	15	30	1	35-36-106	Do.
1088	30	7	L	50	30	150	6	35-36-106	Do.
1090	20	20	300	70	50	150	1	36-1 -106	Do.
1091	20	15	300	70	50	150	1	22-1 -106	Do.
1092	20	15	300	50	50	150	1	15-1 -106	Do.
				Organic sand samples					
208	50	7	150	70	20	100	1	17-38-106	Dinwoody Cr.
209	15	5	100	30	70	200	1	17-38-106	Do.
217	20	15	100	70	15	150	1	8-38-105	Dry Cr.
218	15	5	N	15	30	500	1	27-4 -6	Little Dry Cr.
219	30	5	L	30	30	100	3	27-39-106	Dinwoody Cr.
220	50	7	100	70	30	150	3	34-39-106	Do.
229	30	5	L	20	15	150	3	24-40-106	Blue Hole Cr.
230	10	5	N	15	15	150	1	24-40-106	Do.
231	20	5	N	10	15	100	1	18-40-105	Do.
237	30	7	L	30	30	200	1	13-39-107	Torrey Cr.
238	15	7	L	20	20	100	1	20-40-106	Do.
239	30	7	L	50	30	300	1	21-40-107	Jakeys Fork.
241	50	10	100	70	70	500	1	16-40-107	Do.
242	15	L	L	20	15	100	1	16-40-107	Do.
243	15	5	100	15	10	150	3	16-40-107	Do.
246	20	5	L	30	15	150	3	11-40-107	Do.
248	30	7	100	50	50	500	1	35-41-107	Do.
249	10	L	N	15	10	100	1	17-40-107	Do.
250	30	10	150	50	20	150	1	17-40-107	Do.
251	10	10	L	70	15	70	1	8-40-107	Do.
252	10	7	100	50	30	150	1	5-40-107	Do.
297	30	15	150	70	30	300	2	1-39-108	Do.
299	30	10	100	50	20	200	2	6-39-107	Do.
323	30	5	N	20	30	100	8	9-38-106	Dinwoody Cr.
332	30	10	100	70	50	200	1	28-38-106	Do.
338	30	7	100	30	30	150	1	22-39-106	Do.
364	15	7	100	20	15	100	1	9-40-107	Jakeys Fork.
373	20	10	L	50	30	150	1	12-38-106	Dinwoody Cr.
374	15	7	100	50	15	70	1	11-38-106	Do.
381	70	7	100	50	20	150	1	24-39-107	Torrey Cr.
603	30	20	100	150	20	700	1	29-40-107	Jakeys Fork.
613	15	15	100	70	20	150	3	34-41-108	Warm Spg Cr.
617	15	15	200	70	15	200	1	27-41-108	Do.
619	10	7	100	50	15	700	10	28-41-108	Do.
625	15	15	150	70	15	100	3	29-41-108	Do.
633	20	10	100	70	30	150	3	24-40-108	Jakeys Fork.
635	30	15	L	100	20	300	3	18-40-107	Do.
638	20	10	100	70	15	100	8	7-40-107	Do.
639	30	15	L	70	30	200	8	7-40-107	Do.
640	20	15	L	70	30	300	8	6-40-107	Do.

TABLE 10.—*Analyses of stream-sediment and soil samples from*

	Semiquantitative spectrographic analyses														
	(percent)				(ppm)										
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
							Organic sand samples--Continued								
656	1.5	0.7	0.7	0.3	300	10	300	1.5	10	70	15	70	N	L	15
661	3	.7	1.5	.3	300	15	150	1	15	70	20	20	N	L	15
662	2	.3	.7	.15	300	10	150	1	10	70	15	70	N	L	15
664	2	.7	.5	.2	1,000	10	150	1	10	100	15	70	L	L	50
668	3	.7	1.5	.5	300	L	200	1.5	10	70	15	70	N	L	15
670	3	2	2	.5	700	L	300	1.5	15	150	10	150	N	L	30
672	3	1	1.5	.5	1,000	L	300	1.5	15	70	20	70	N	10	20
685	3	1.5	2	.3	700	10	300	1	10	100	10	50	N	L	30
687	5	.7	1	.3	500	L	300	1	15	150	15	30	N	L	30
689	3	.5	.7	.3	500	L	300	1	15	100	15	30	N	L	30
691	3	.5	1	.3	500	L	300	1	15	150	10	50	N	L	30
693	5	.7	1	.5	700	N	300	1	20	200	15	70	N	L	70
695	7	1	2	.7	700	N	200	L	30	300	15	30	N	L	100
698	5	1	1.5	.5	1,000	L	300	1	30	200	20	20	N	N	70
699	5	1	1.5	.5	700	N	200	L	30	300	15	30	N	L	100
700	5	1.5	2	.7	1,000	N	200	L	30	300	15	20	N	L	100
701	3	.3	.15	.5	200	50	700	2	15	50	15	50	N	L	15
702	3	.3	.2	.3	200	30	700	1.5	10	50	15	50	N	L	15
703	3	.3	.2	.3	500	30	300	1.5	10	50	15	30	N	L	20
704	3	.3	.15	.3	1,000	30	300	1.5	15	50	15	30	N	L	30
708	3	.7	.5	.3	700	15	500	1	7	100	20	100	N	L	30
723	3	.5	.7	.3	500	L	300	1	10	50	15	20	N	L	7
726	3	.3	1	.2	700	N	300	L	10	20	7	20	N	N	10
730	2	.5	.5	.3	700	10	500	1	10	70	10	20	N	L	20
731	2	.5	.5	.3	200	10	700	1.5	10	100	7	150	N	L	70
738	1	.3	.3	.07	150	L	100	1	L	100	15	50	N	N	30
743	3	2	.7	.2	500	N	200	1	30	700	10	30	N	L	200
749	3	1	.7	.3	300	N	200	1	15	150	15	50	N	L	100
750	2	.7	.7	.3	200	N	300	1	7	200	10	50	N	L	70
751	5	1.5	1.5	.3	700	N	300	1	30	300	5	20	N	L	70
752	5	1.5	1.5	1	700	N	300	1	20	300	5	20	N	10	100
753	3	1.5	1	.3	500	N	300	L	20	200	15	50	N	L	100
754	3	.7	.7	.3	500	N	300	1.5	20	150	15	50	N	L	70
755	2	.7	.7	.3	200	N	300	1	15	150	7	50	N	L	70
756	3	1	.7	.3	1,000	10	200	1.5	20	200	15	50	N	10	70
757	3	1.5	.7	.2	1,000	10	150	1	50	500	20	30	N	L	300
760	1	.15	.3	.05	150	L	150	L	L	100	10	L	N	N	15
762	2	.5	.7	.2	300	L	150	1	7	150	5	150	N	L	30
763[1/]	3	.7	.5	.2	300	10	200	1.5	30	300	30	50	N	L	100
774	7	3	1.5	.3	700	N	300	L	20	500	50	20	N	L	100
777	5	1.5	2	.3	700	N	500	L	15	70	L	100	N	L	30
902	3	1.5	1	.3	500	N	300	1	30	700	20	50	N	10	150
905	7	1.5	1	.3	1,000	N	300	1	50	3,000	15	70	N	L	300
907	3	1.5	1	.3	500	N	300	1	30	700	15	30	N	L	200
909	3	1.5	.7	.3	300	N	300	1	30	300	30	30	N	L	150
911	7	2	2	.5	1,000	N	200	1	70	1,000	20	L	N	L	200
916	3	1	1.5	.3	500	N	200	1	15	200	15	20	N	L	70
918	3	1.5	1.5	.3	700	N	300	1.5	15	200	15	20	N	L	100
950	5	1	1.5	.3	700	N	300	L	20	200	30	50	N	10	70
952	3	.7	1.5	.7	700	N	150	L	15	30	L	150	N	L	30
954	7	3	2	.2	700	N	300	L	20	500	20	30	N	L	200
956	5	2	2	.3	500	N	700	L	15	300	15	100	N	L	100
970	7	1.5	2	.3	700	N	200	N	15	200	15	L	N	L	70
976	5	1	2	.3	700	N	300	L	15	100	20	100	N	L	50
977	3	.7	1.5	.3	300	10	500	L	10	70	10	70	N	L	20
980	3	1	1.5	.2	300	N	300	L	10	100	5	L	N	L	30
982	3	1	2	.2	500	N	300	L	15	70	30	50	N	L	20
992	3	.7	1.5	.2	300	N	300	N	10	50	5	70	N	L	20
1005	7	2	1.5	.3	700	N	200	L	20	700	50	30	N	L	150
1015	3	1	1.5	.2	300	N	500	L	7	30	L	30	N	L	20

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

Sample	Pb (10) (ppm)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	CxHM (ppm)	Location Sec-Twp-Rge	Drainage basin
				Organic sand samples--Continued					
656	50	10	150	30	20	200	3	22-40-107	Jakeys Fork.
661	20	15	100	70	15	50	5	25-40-108	Fish Cr.
662	15	7	L	70	20	100	5	25-40-108	Jakeys Fork.
664	30	10	L	70	20	500	5	24-40-108	Do.
668	15	10	200	50	30	500	8	5-40-108	Fish Cr.
670	10	15	300	70	30	300	1	30-41-108	Warm Spg Cr.
672	15	15	150	70	30	500	10	31-41-108	Do.
685	15	10	L	50	30	300	1	7-41-107	Geyser Cr.
687	15	10	100	70	20	300	N	13-41-108	Do.
689	10	10	L	70	20	200	3	13-41-108	Do.
691	10	10	200	70	20	200	3	13-41-108	Geyser Cr.
693	15	15	150	100	20	200	1	24-41-108	Little Warm Spg Cr.
695	15	20	150	150	30	300	5	13-38-106	Dry Cr.
698	10	20	150	100	30	500	3	24-38-106	Do.
699	15	15	100	100	30	150	1	19-38-105	Do.
700	10	20	150	100	30	70	3	19-38-105	Do.
701	15	10	100	30	50	700	3	27-41-107	Limekiln Gulch.
702	15	10	L	50	30	500	3	23-41-107	Do.
703	10	10	L	70	30	500	1	23-41-107	Do.
704	15	10	N	70	30	300	1	26-41-108	Little Warm Spg Cr.
708	20	10	100	70	10	150	1	23-41-108	Warm Spg Cr.
723	10	7	100	50	15	1,000	1	21-41-108	Wildcat Cr.
726	10	7	200	30	10	100	3	21-41-108	Do.
730	15	7	150	50	15	200	3	21-41-108	Do.
731	15	7	150	30	30	1,000	1	14-41-108	Little Warm Spg Cr.
738	30	L	N	30	15	50	1	3-37-106	Dry Cr.
743	30	7	N	50	15	30	1	2-37-106	Do.
749	10	15	100	70	15	300	3	29-38-105	Do.
750	10	10	100	70	20	150	1	20-38-105	Do.
751	15	15	100	100	15	200	1	21-38-105	Do.
752	10	20	150	100	30	700	8	21-38-105	Do.
753	15	15	100	70	20	150	3	21-38-105	Do.
754	15	15	100	70	15	300	5	10-3 -6	Do.
755	10	10	L	70	15	200	3	10-3 -6	Do.
756	30	15	100	70	20	300	3	26-38-106	Do.
757	70	10	N	70	20	70	1	26-38-106	Do.
760	10	L	N	30	10	70	1	3-3 -6	Do.
762	L	10	L	50	20	300	1	16-38-105	Do.
763	70	15	L	70	20	70	5	7-37-105	Do.
774	30	15	100	150	10	50	1	30-37-105	Bull Lake Cr.
777	15	15	150	70	>200	100	1	13-40-108	Jakeys Fork.
902	20	20	150	70	20	300	3	12-37-106	Dry Cr.
905	10	20	L	70	20	500	3	6-37-105	Do.
907	10	15	L	70	15	150	8	30-38-105	Do.
909	15	10	N	70	15	150	3	35-38-106	Do.
911	10	30	N	100	30	50	3	26-38-106	Do.
916	L	15	L	70	15	300	3	30-38-105	Do.
918	10	10	100	70	15	200	1	31-38-105	Do.
950	20	15	L	100	30	70	3	19-38-105	Do.
952	15	15	L	50	>200	700	3	22-39-106	Dinwoody Cr.
954	20	15	100	70	20	70	3	15-37-106	Dry Cr.
956	20	15	300	70	30	150	5	23-37-106	Bull Lake Cr.
970	20	15	100	100	20	30	3	22-36-106	Do.
976	30	15	200	100	30	150	3	22-36-106	Do.
977	20	10	200	70	30	150	5	22-36-106	Do.
980	20	7	200	50	10	50	1	23-36-106	Do.
982	15	10	200	70	20	150	5	15-1 -6	Do.
992	20	10	100	50	15	100	3	4-35-106	Do.
1005	30	15	L	100	15	100	3	29-37-105	Do.
1015	15	15	300	50	20	70	3	16-36-106	Do.

TABLE 10.—*Analyses of stream-sediment and soil samples from*

Semiquantitative spectrographic analyses

Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
	(percent)				(ppm)										
	Organic sand samples--Continued														
1017	5	1.5	2	.3	700	N	300	L	15	300	15	50	N	L	100
1018	3	1	2	.3	700	N	300	L	10	150	10	30	N	L	30
1019	7	2	1.5	.3	700	N	500	L	15	300	10	30	N	L	70
1034	5	1.5	1.5	.3	1,000	L	300	L	15	100	20	70	N	L	30
1071	2	1	1	.2	300	L	300	1	10	70	7	100	N	L	30
1074	3	1.5	1.5	.3	700	L	500	L	15	100	10	70	N	L	50
1087	2	.7	1.5	.3	300	N	300	L	7	50	L	70	N	L	15

the Glacier Primitive Area, Fremont County—Continued

Semiquantitative spectrographic analyses--Continued

Sample	(ppm) Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	(ppm) CxHM	Location Sec-Twp-Rge	Drainage basin
				Organic sand samples--Continued					
1017	30	20	150	70	20	70	3	32-37-105	Bull Lake Cr.
1018	15	15	100	70	20	100	5	32-37-105	Do.
1019	20	15	100	70	20	100	5	33-37-105	Do.
1034	100	15	150	70	30	70	3	32-36-106	Do.
1071	15	15	150	70	30	500	3	3-35-106	Do.
1074	20	15	200	70	20	200	5	16-36-106	Do.
1087	15	10	300	30	30	100	2	2-35-106	Do.

TABLE 11.—*Analyses of pan-concentrated stream-sediment*

[Gold analyses by atomic absorption analyses,

	Semiquantitative spectrographic analyses														
	(percent)				(ppm)										
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
204	3	2	1.5	0.3	300	N	100	L	15	150	7	100	N	L	70
215	3	.3	1	.3	200	N	300	1	7	15	10	150	L	10	7
234	7	1	1.5	.5	500	N	150	1.5	15	150	10	200	7	L	20
235	1	.7	.5	.15	150	L	200	L	5	20	7	30	N	L	15
261	20	.15	2	1	1,000	30	70	L	30	15	15	200	N	20	10
266	15	.3	1	>1	700	15	150	L	15	7	15	700	N	15	5
271	5	.7	1.5	.7	700	N	200	1.5	10	70	15	150	N	10	5
282	3	.7	1	.5	500	N	150	2	10	150	15	300	N	L	7
284	10	.5	1.5	1	700	N	100	1	20	100	15	1,000	N	10	L
286	10	1	3	1	1,500	N	150	1	15	150	30	300	N	30	7
288	10	.7	3	>1	700	N	150	1	15	150	15	500	N	L	7
290	5	.7	2	.5	500	N	150	2	10	100	7	300	N	L	7
292	3	.7	2	1	500	N	150	L	15	100	15	200	N	L	7
305	5	1	1.5	.2	500	100	700	1	15	70	15	30	N	L	15
307	5	.7	2	.15	500	70	1,500	1	15	15	20	30	N	L	15
314	5	1	3	.15	500	50	700	L	15	50	15	50	N	L	15
320	3	.7	1.5	.5	500	N	300	1.5	10	70	5	200	N	20	15
322	5	.3	2	1	300	N	300	1	15	70	15	300	N	20	7
326	>20	.3	1.5	>1	700	30	30	L	50	700	L	500	N	30	15
327	20	.5	1.5	>1	700	20	100	L	30	500	L	300	N	30	15
340	5	1.5	2	.5	700	N	150	1	20	150	20	150	N	L	70
363	20	.7	2	>1	1,000	L	500	L	30	700	5	300	N	L	15
371	10	.3	1.5	.7	700	L	200	L	20	300	20	300	N	L	10
380	3	1	2	.3	500	N	200	1	20	100	15	150	N	L	30
384	5	1.5	2	.5	700	N	150	L	30	200	15	50	N	L	30
386	5	.7	2	1	700	N	150	1	10	100	7	300	N	10	5
388	5	.7	2	1	700	N	150	L	15	300	15	300	N	10	20
390	3	.7	2	.3	500	N	200	L	10	100	10	150	N	10	15
393	1	.5	1.5	.2	200	N	300	1	5	50	20	200	N	L	7
395	7	.7	.7	.7	700	N	300	L	20	700	15	700	N	10	10
397	7	1.5	2	.7	1,500	L	100	1.5	20	300	15	200	N	20	30
601	5	1.5	3	.5	1,000	N	150	1.5	20	150	5	30	N	10	70
604	10	1.5	2	.7	700	N	150	2	70	500	30	500	N	L	150
606	7	1	1	.7	500	N	300	1.5	15	150	10	100	N	10	50
608	3	.7	2	.3	300	N	300	1.5	15	100	L	50	N	L	20
612	3	1.5	1.5	.3	500	N	300	1	20	300	5	300	N	L	100
614	5	.7	1.5	1	1,000	N	300	3	20	150	10	700	N	10	30
616	3	1	2	.7	700	N	300	1.5	15	150	10	100	N	L	30
620	1	.5	2	.3	300	N	300	1.5	10	20	7	30	N	L	10
622	2	.3	1	.2	500	N	200	1	7	15	10	30	N	L	L
624	3	.7	2	1	700	N	300	1.5	15	100	15	150	N	10	15
626	2	.7	1.5	.5	500	N	300	1	10	100	20	100	N	L	30
634	3	1.5	2	1	700	N	300	1	20	200	L	700	N	30	50
641	5	1.5	3	.7	700	N	150	1	15	200	7	200	N	10	70
644	10	1.5	2	.5	1,500	N	150	1.5	20	300	30	1,000	N	N	30
658	3	2	3	.7	1,500	N	150	1.5	20	500	20	200	N	L	200
671	7	1.5	2	1	2,000	N	200	1.5	15	200	15	300	N	10	30
676	5	1.5	2	.3	1,000	N	200	1.5	20	300	L	200	N	L	50
680	7	1.5	3	.7	1,500	N	200	1.5	20	300	L	300	N	L	70
683	5	.7	1	.7	500	30	700	2	15	150	10	300	N	L	20
686	10	1.5	2	.7	700	L	300	2	70	300	15	500	N	L	30
688	10	1.5	1.5	.7	700	N	200	1	30	300	15	200	N	L	30
690	1.5	.3	1	.2	300	L	500	1	10	30	L	30	N	N	7
692	5	1.5	2	.7	700	N	300	2	20	300	L	300	N	N	50
694	10	2	2	>1	1,500	N	150	L	70	700	15	150	N	10	100

samples from the Glacier Primitive Area, Fremont County

A. W. Wells, M. S. Rickard, and J. G. Frisken]

Sample	Semiquantitative spectrographic analyses--Continued (ppm) Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Atomic Absorption (ppm) Au	Location Sec-Twp-Rge	Drainage basin
204	10	15	150	30	30	150	---	11-38-107	Dinwoody Cr.
215	30	7	150	30	70	500	---	17-38-106	Do.
234	50	30	150	70	200	700	---	14-39-107	Torrey Cr.
235	20	5	L	15	15	100	---	13-39-107	Do.
261	15	20	200	200	200	>1,000	---	35-38-107	Dinwoody Cr.
266	70	15	L	100	>200	1,000	---	29-38-106	Do.
271	15	15	100	70	150	1,000	---	39-38-106	Do.
282	30	15	100	50	100	1,000	---	21-39-105	Do.
284	100	15	300	100	200	1,000	---	11-38-106	Do.
286	70	15	200	100	>200	>1,000	---	2-38-106	Do.
288	50	20	300	100	200	>1,000	---	2-38-106	Do.
290	15	15	300	70	150	1,000	---	35-39-106	Do.
292	30	15	200	70	>200	1,000	---	26-39-106	Do.
305	15	7	N	30	30	700	---	7-40-106	Torrey Cr.
307	15	5	N	15	20	150	---	7-40-106	Do.
314	10	5	L	20	20	300	---	33-41-106	Do.
320	50	15	200	30	100	1,000	---	8-38-106	Dinwoody Cr.
322	30	15	500	70	>200	700	---	8-38-106	Do.
326	20	70	L	150	>200	>1,000	---	6-37-106	Do.
327	20	50	L	100	>200	>1,000	---	5-37-106	Do.
340	20	20	200	70	150	150	---	28-39-106	Do.
363	30	100	N	70	>200	>1,000	---	15-38-106	Do.
371	30	15	150	100	200	>1,000	---	1-37-107	Do.
380	15	15	150	50	50	200	---	23-39-107	Torrey Cr.
384	15	15	100	100	70	500	---	27-39-106	Dinwoody Cr.
386	20	15	300	70	200	700	---	26-39-106	Do.
388	50	20	300	100	>200	1,000	---	26-39-106	Do.
390	20	15	300	70	100	500	---	24-39-106	Do.
393	15	7	200	20	30	150	---	10-4 -6	Do.
395	70	15	N	100	>200	500	---	33-41-107	Jakeys Fork.
397	50	50	100	150	>200	>1,000	0.10	3-39-107	Torrey Cr.
601	10	30	100	150	150	300	<.04	35-40-107	Do.
604	30	70	L	200	>200	1,000	<.02	29-40-107	Jakeys Fork.
606	20	15	100	100	50	700	<.04	25-41-107	Do.
608	10	10	300	50	30	700	<.02	31-41-107	Do.
612	15	15	150	70	30	500	<.02	34-41-108	Warm Spg Cr.
614	30	30	200	100	100	>1,000	<.02	27-41-108	Do.
616	15	15	300	70	30	700	<.02	27-41-108	Do.
620	15	7	300	70	15	300	<.02	28-41-108	Do.
622	10	7	100	30	15	700	---	28-41-108	Do.
624	10	20	300	100	50	>1,000	<.02	29-41-108	Do.
626	10	15	200	50	20	700	<.02	29-41-108	Do.
634	30	20	L	100	200	700	<.04	24-40-108	Jakeys Fork.
641	20	20	100	100	150	500	<.02	6-40-107	Do.
644	100	30	100	150	100	1,000	<.04	26-41-108	Little Warm Spg Cr.
658	20	30	100	100	>200	700	<.02	14-40-107	Jakeys Fork.
671	20	30	300	70	100	1,000	<.04	30-41-108	Warm Spg Cr.
676	15	30	150	150	50	700	<.02	19-41-107	Little Warm Spg Cr.
680	20	30	150	100	100	1,000	<.04	20-41-107	Do.
683	30	15	100	100	150	>1,000	<.05	16-41-107	Do.
686	30	30	N	150	70	>1,000	.08	7-41-107	Geyser Cr.
688	15	70	N	100	100	>1,000	.08	13-41-108	Do.
690	10	7	100	30	10	700	.20	13-41-108	Do.
692	10	30	300	100	70	>1,000	.08	13-41-108	Do.
694	L	50	L	150	100	700	.04	19-38-105	Dry Cr.

TABLE 11.—*Analyses of pan-concentrated stream-sediment samples*

Semiquantitative spectrographic analyses

Sample	Fe (.05) (percent)	Mg (.02) (percent)	Ca (.05) (percent)	Ti (.002) (percent)	Mn (10) (ppm)	B (10) (ppm)	Ba (20) (ppm)	Be (1) (ppm)	Co (5) (ppm)	Cr (5) (ppm)	Cu (5) (ppm)	La (20) (ppm)	Mo (5) (ppm)	Nb (10) (ppm)	Ni (5) (ppm)
696	7	2	2	1	1,000	N	150	1	50	500	7	100	N	L	150
710	7	1.5	1.5	>1	1,000	N	500	1	20	700	L	700	N	10	70
714	7	1.5	.7	.7	700	N	200	1	50	300	20	300	N	10	50
718	5	1.5	1	.5	300	N	300	1	20	200	L	150	N	L	70
722	15	.7	.5	>1	1,000	L	150	1	70	1,000	L	>1,000	N	10	30
725	15	.5	.5	>1	1,000	L	150	1	70	300	10	700	N	10	20
727	3	.7	1.5	.5	700	N	300	1	15	70	N	100	N	L	20
729	7	.7	.5	1	1,500	20	300	1	15	300	N	1,000	N	20	10
736	7	5	3	1	1,500	N	100	1	100	2,000	7	50	N	20	300
742	7	3	2	>1	1,500	N	70	1	100	1,000	5	150	N	20	150
748	3	1.5	1.5	.7	1,500	N	100	1	20	1,000	L	100	N	30	100
761	7	1.5	1.5	>1	1,500	N	200	L	30	300	5	500	30	L	50
766 1/	5	.3	.7	.2	200	15	>5,000	1	10	30	10	70	N	L	20
771	7	3	3	.5	1,500	N	150	1	15	500	L	100	N	L	100
775	7	3	2	.7	1,500	N	150	L	15	700	L	L	N	L	150
778	7	1.5	2	.5	700	N	300	N	15	150	10	300	N	10	50
780	7	1.5	3	.5	1,000	N	200	L	15	1,000	10	200	N	L	100
784	3	.7	1.5	.3	300	N	200	L	10	70	L	70	N	15	20
786	3	.5	1.5	.3	200	N	200	N	5	30	5	100	N	L	15
789	15	1	5	.5	500	N	150	L	15	300	10	100	N	10	20
791	15	1	1.5	.5	700	N	150	1	15	100	5	50	N	15	15
799	3	1	2	.2	500	N	300	L	15	150	5	30	N	L	30
910	7	5	3	.5	1,000	N	100	1	70	1,000	15	30	N	L	200
915	5	1.5	1.5	.7	700	N	200	1	20	500	L	30	N	10	100
917	7	1.5	1.5	>1	1,500	N	100	1	30	500	5	300	N	20	100
920	7	1.5	2	.5	1,500	N	100	1	30	500	L	100	N	10	150
923	5	.7	.5	.3	300	N	300	1.5	10	150	15	150	N	L	30
926	7	3	5	.5	1,000	N	300	L	15	1,500	L	150	N	L	100
928	5	1.5	3	.5	700	N	300	L	15	300	7	50	N	L	30
932	20	1	3	1	1,000	N	20	L	30	300	15	L	N	L	30
936	7	2	2	.5	700	N	100	L	15	700	10	70	N	L	150
938	3	2	1.5	.3	500	N	300	L	15	1,000	5	70	N	L	150
940	7	1.5	3	.5	700	N	700	L	15	150	7	100	N	L	30
942	3	1.5	2	.3	300	N	300	N	15	300	5	70	N	L	70
944	3	2	2	.5	700	N	300	L	20	1,000	5	150	N	L	100
946	7	2	2	.3	700	N	200	L	20	1,000	7	70	N	10	100
948	5	.7	1.5	.3	500	N	200	L	15	300	5	70	N	10	30
953	3	.7	1.5	.3	500	N	150	L	15	30	L	20	N	L	30
967	7	3	3	.5	1,000	N	300	L	15	300	30	30	N	L	70
969	10	3	3	.5	1,000	N	100	L	15	1,000	10	L	N	L	150
971	7	1.5	3	.2	700	N	150	L	10	200	10	L	N	L	30
979	5	1	3	.5	700	N	150	L	15	100	5	20	N	L	30
983	3	1	3	.3	500	N	300	L	15	100	7	70	N	L	30
991	5	1	2	.3	500	N	200	L	15	150	L	20	N	L	30
995	5	1.5	2	.3	700	N	200	L	15	200	L	30	N	L	70
1002	7	1.5	2	1	700	N	150	1	20	700	10	300	N	15	100
1006	7	3	2	1	1,000	N	100	L	20	1,500	7	70	N	L	150
1008	5	1.5	2	.3	700	N	200	L	15	300	10	30	N	L	50
1028	10	1.5	3	.3	700	N	300	1	15	200	10	L	N	10	30
1031	5	1.5	3	.3	700	N	300	1	15	300	L	N	N	20	30
1033	10	3	5	.3	700	N	200	L	15	300	L	150	N	10	70
1040	3	1.5	2	.2	500	N	300	L	15	200	5	20	N	15	50
1043	7	2	3	.5	700	N	200	L	15	150	5	30	N	10	70
1046	5	1.5	1.5	.3	700	N	200	L	15	3,000	7	50	N	L	70
1048	3	1.5	1	.2	300	N	300	L	15	500	7	L	N	L	70
1050	7	2	1.5	.3	700	N	150	N	15	3,000	5	150	N	L	100
1053	3	1.5	2	.5	700	N	200	L	15	300	L	100	N	L	50
1055	5	1.5	2	.7	1,000	N	150	L	15	200	7	150	N	10	70
1058	7	3	3	1	1,000	L	100	L	20	2,000	15	200	N	L	70
1064	20	.7	3	.5	500	N	100	L	30	300	7	300	N	15	30

1/ Contains 50 ppm Sn.

from the Glacier Primitive Area, Fremont County—Continued

Sample	Semiquantitative spectrographic analyses--Continued (ppm) Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Atomic Absorption (ppm) Au	Location Sec-Twp-Rge	Drainage basin
696	L	50	L	150	100	700	0.02	13-38-106	Jakeys Fork.
710	30	20	L	150	>200	>1,000	.04	33-41-107	Dry Creek.
714	20	15	100	150	100	500	.02	4-40-107	Do.
718	10	15	150	100	70	300	<.02	35-41-107	Do.
722	100	70	300	200	>200	>1,000	.04	19-41-107	Warm Spg Cr.
725	50	20	300	300	100	>1,000	<.10	16-41-108	Wildcat Cr.
727	15	20	300	70	50	1,000	<.04	21-41-108	Warm Spg Cr.
729	20	70	N	70	>200	>1,000	1.24	20-41-108	Do.
736	10	50	N	150	70	1,000	<.10	10-37-106	Dry Cr.
742	15	70	N	150	150	>1,000	.40	2-37-106	Do.
748	10	30	100	70	50	700	.04	1-37-106	Do.
761	20	70	150	150	100	>1,000	<.10	3-3 -6	Do.
766	50	5	200	50	30	700	<.04	23-41-107	Limekiln Gulch
771	20	30	100	100	70	700	.04	36-37-106	Bull Lake Cr.
775	10	30	L	100	50	1,000	<.05	30-37-105	Do.
778	20	20	L	100	100	500	<.10	13-40-108	Jakeys Fork.
780	20	30	L	100	150	1,000	<.15	36-41-108	Do.
784	15	15	200	70	70	300	<.11	14-39-107	Torrey Cr.
786	10	10	L	50	50	70	<.24	11-38-106	Dinwoody Cr.
789	30	30	500	150	70	1,000	<.027	1-36-107	Bull Lake Cr.
791	30	20	100	150	100	1,000	<.07	34-37-106	Do.
799	20	15	150	70	20	70	<.18	34-3 -6	Bob Cr.
910	10	30	L	150	70	200	<.02	35-38-106	Dry Cr.
915	L	20	L	100	30	500	<.02	30-38-105	Do.
917	15	50	L	100	150	>1,000	.02	30-38-105	Do.
920	L	30	150	100	50	500	<.02	31-38-105	Do.
923	10	10	L	70	70	1,000	.04	30-41-106	Jakeys Fork.
926	20	30	500	100	100	>1,000	<.06	35-37-106	Bull Lake Cr.
928	20	20	200	70	30	150	<.027	35-37-106	Do.
932	20	20	L	200	150	>1,000	<.022	27-37-106	Do.
936	15	20	L	100	30	1,000	.02	25-37-106	Do.
938	15	15	L	70	30	1,000	<.013	21-37-106	Do.
940	20	15	300	70	30	150	.013	21-37-106	Do.
942	15	15	100	50	20	50	<.021	21-37-106	Do.
944	20	15	L	70	50	700	<.015	22-37-106	Do.
946	15	20	L	70	50	1,000	<.074	27-37-106	Do.
948	20	15	150	70	50	200	<.092	26-37-106	Do.
953	10	15	L	30	100	300	<.031	22-39-106	Dinwoody Cr.
967	10	30	150	100	30	300	<.04	10-36-106	Bull Lake Cr.
969	10	30	100	150	30	500	<.10	15-36-106	Do.
971	10	15	150	100	15	20	.10	22-36-106	Do.
979	15	50	150	100	150	500	<.10	23-36-106	Do.
983	15	30	500	70	30	150	<.10	15-1 -6	Do.
991	15	20	200	70	70	150	---	4-35-106	Do.
995	50	15	150	70	50	300	---	5-35-106	Do.
1002	70	30	L	100	100	1,000	.10	28-37-105	Do.
1006	15	50	L	100	50	1,000	.1	29-37-105	Bull Lake Cr.
1008	15	20	300	50	30	300	<.1	29-37-105	Do.
1028	50	30	300	150	100	300	.1	1-35-106	Do.
1031	10	20	200	70	70	500	.04	35-36-106	Do.
1033	20	30	150	100	70	300	.04	32-36-106	Do.
1040	15	15	300	50	30	100	.02	33-36-106	Do.
1043	15	20	200	100	50	200	<.1	21-36-106	Do.
1046	15	20	L	70	30	150	<.04	6-37-105	Dry Cr.
1048	20	15	150	50	20	100	<.04	31-38-105	Do.
1050	15	30	L	70	70	300	<.04	30-38-105	Do.
1053	15	15	100	100	30	200	<.04	20-38-105	Do.
1055	15	15	150	70	30	500	<.1	4-37-105	Bob Cr.
1058	15	50	200	150	150	1,000	<.04	16-37-105	Do.
1064	20	15	300	300	150	1,000	<.1	9-35-106	Bull Lake Cr.

TABLE 11.—*Analyses of pan-concentrated stream-sediment samples*

Semiquantitative spectrographic analyses

	(percent)				(ppm)										
Sample	Fe (.05)	Mg (.02)	Ca (.05)	Ti (.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (5)	Cu (5)	La (20)	Mo (5)	Nb (10)	Ni (5)
1066	15	1.5	3	0.5	700	N	200	N	30	300	7	150	N	L	20
1070	7	2	5	1	700	N	500	L	10	30	L	70	L	20	10
1075	5	1.5	3	.5	500	N	200	L	15	300	L	100	N	L	50
1076	3	1	3	.3	500	N	200	L	7	70	N	30	N	L	20
1077	3	1	2	.3	500	N	300	L	10	100	5	20	N	L	30
1086	5	1.5	2	.5	700	N	300	L	15	200	L	50	N	L	30
1089	3	1	3	.3	700	N	200	L	20	150	7	70	N	L	30
1093	7	1.5	5	.5	700	N	300	L	10	200	L	100	N	20	30

from the Glacier Primitive Area, Fremont County—Continued

	Semiquantitative spectrographic analyses--Continued (ppm)						Atomic Absorption (ppm)		
Sample	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	Au	Location Sec-Twp-Rge	Drainage basin
1066	20	15	500	200	100	300	<0.1	9-35-106	Bull Lake Cr.
1070	50	20	1,000	100	70	1,000	.02	3-35-106	Do.
1075	15	30	300	100	70	300	<.04	16-36-106	Do.
1076	15	30	200	70	30	500	<.04	16-36-106	Do.
1077	15	30	200	70	30	200	<.04	16-36-106	Do.
1086	15	20	500	70	50	100	---	35-36-106	Do.
1089	20	20	300	70	50	100	---	35-36-106	Do.
1093	15	20	300	70	100	1,000	---	15-1 -6	Do.

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William T. Pecora, *Director*

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