STUDIES RELATED TO WILDERNESS

DU NOIR ADDITION, WASHAKIE WILDERNESS, WYOMING

GEOLOGICAL SURVEY BULLETIN 1472

Mineral Resources of the Du Noir Addition, Washakie Wilderness, Fremont County, Wyoming

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With a section on AEROMAGNETIC SURVEY
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An evaluation of the mineral potential of the area

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STUDIES RELATED TO WILDERNESS

In accordance with the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, the U.S. Geological Survey and U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Studies and reports of all primitive areas have been completed. Areas officially designated as "wilderness," "wild," or "canoe" when the Act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The Act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. This report discusses the results of a mineral survey of some national forest lands in the Du Noir area, Wyoming, that is being considered for addition to the Washakie Wilderness. The area studied is in northern Fremont County, northwestern Wyoming.

CONTENTS

ILLUSTRATIONS

TABLES

STUDIES RELATED TO WILDERNESS

MINERAL RESOURCES OF THE DU NOIR ADDITION, WASHAKIE WILDERNESS, FREMONT COUNTY, WYOMING

By H. J. PROSTKA and J. C. ANTWEILER, U.S. Geological Survey and C. L. BIENIEWSKI, U.S. Bureau of Mines

SUMMARY

The Du Noir Addition to the Washakie Wilderness consists of 34,200 acres (13,840 hectares) of scenic mountainous terrain that adjoins the Teton Wilderness and Washakie Wilderness. The area was studied in 1973 by the U.S. Geological Survey and U.S. Bureau of Mines to evaluate its mineral, fuel, and geothermal energy potential. This evaluation is based on a search of the geologic literature, claim and production records, and fieldwork including mapping, inspection of claims and prospects, interpretation of aeromagnetic maps, and analyses of bedrock and stream-sediment samples.

Flat-lying Eocene volcaniclastic rocks of the Absaroka volcanic field are exposed in about two-thirds of the Du Noir Addition. These volcanics unconformably overlie the deeply eroded, northwest-trending Du Noir anticline in which Paleozoic marine strata of Devonian through Permian age are exposed. Of lesser importance areally are small deposits of Eocene nonvolcanic conglomerate, and basaltic intrusive and extrusive rocks of late Pliocene and possibly younger age.

The results of this study indicate that the mineral, fuel, and geothermal potential of the Du Noir Addition are minimal. Low-grade copper-molybdenum mineralization occurs outside the addition, associated with intrusive rocks, but no indications of alteration or mineralization were found within the study area. Anomalous, but not economically important, concentrations of molybdenum and uranium were found in Permian and Eocene carbonaceous shales. Phosphate rock in the Phosphoria Formation occurs in beds too thin to constitute a resource. Large amounts of very pure limestone are present in the Madison Limestone, but equally pure limestone, much closer to transportation facilities, is found throughout this part of Wyoming. That part of the Du Noir anticline in the addition is too deeply eroded to be a likely reservoir of oil and gas. Present data indicate a low potential for geothermal energy in or near the addition.

INTRODUCTION

The Du Noir Addition is an area of scenic mountainous terrain and broad forested valleys located along the precipitous southern margin of the Absaroka Range in Shoshone National Forest, Fremont County, northwestern Wyoming (fig. 1). Adjoining it on the north and

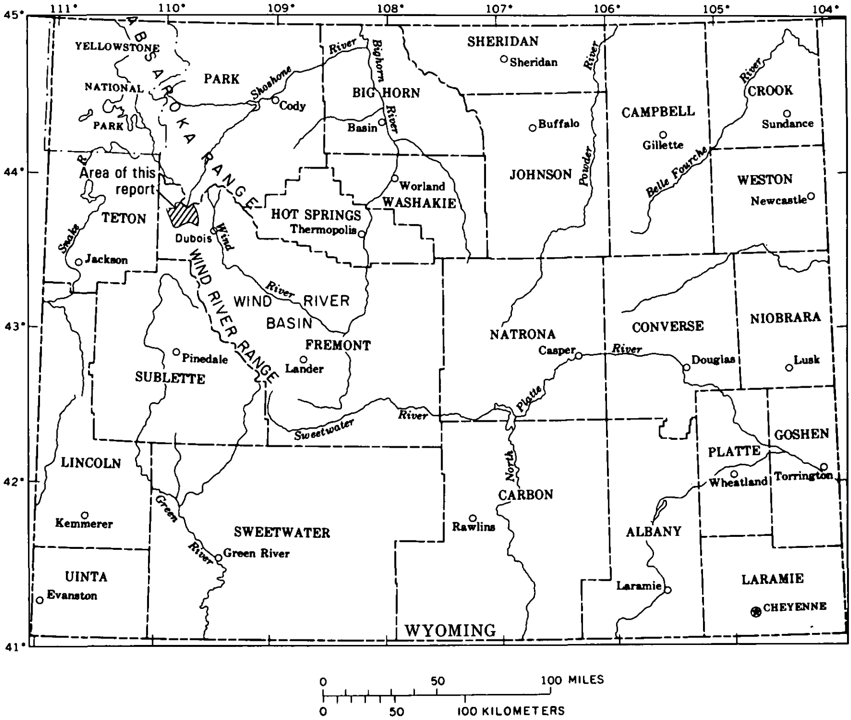


FIGURE 1.—Location of the Du Noir Addition, Washakie Wilderness, Wyoming.

northeast are the Teton and Washakie Wilderness areas. To the south, the Du Noir Addition faces the northwestern end of the Wind River Basin, and beyond it, on the distant skyline, the Wind River Range. It encompasses an area of 34,200 acres (13,840 hectares) that includes the upper drainage basin of Du Noir Creek and the encircling spectacular high divides and plateau remnants. Pinnacle Buttes (fig. 2) on the west, Du Noir Butte and Crescent Mountain to the north, and The Ramshorn (fig. 3) on the east are the principal high mountains. Elevations range from more than 11,300 feet (3,400 m) along the divide to less than 7,600 feet (2,300 m) in the valley of Du Noir Creek.[1] A small glacier, the Du Noir glacier, is on the east side of Coffin Butte. The rugged outlines of the mountains contrast markedly with the broad rolling forested valleys and their clear sparkling streams, charming meadows, and numerous small lakes.

Foot and horse trails follow the major valleys and connect with the well-used trail systems in the adjacent wilderness areas, but the

[1]Until recently this has been called Du Noir River and is so indicated on U.S. Geological Survey base maps through 1963 and on W. R. Keefer's 1955 and 1957 maps.

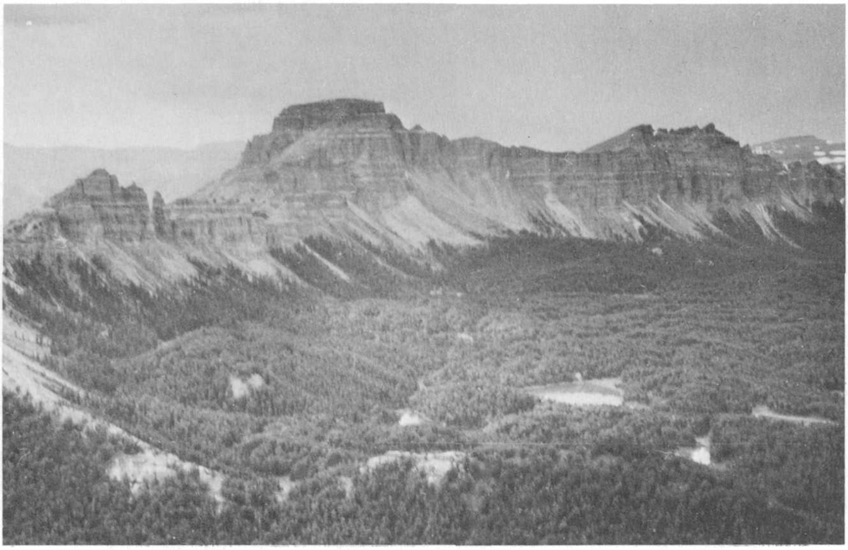


FIGURE 2.—Pinnacle Buttes and Kisinger Lakes seen from the southeast. Rugged Pinnacle Buttes are carved from flat-lying volcanic sediments of Wiggins Formation; forested ridge in foreground is underlain by Tepee Trail Formation; Kisinger Lakes are in depressions of extensive landslide deposits.

FIGURE 3.—The Ramshorn and Frozen Lake Creek seen from the southwest. Cliffs are flat-lying beds of Wiggins Formation; Tepee Trail Formation is hidden in trees near base of cliffs, and glacial-scoured rocks in foreground are Paleozoic strata in the northeast limb of the Du Noir anticline.

higher parts of the area are accessible only by mountain-climbing techniques. There are about 10 miles (16 km) of roads in the south-central part of the addition, but most of them are closed to motorized vehicles. The nearest town is Dubois, Wyo., about 15 miles (24 km) to the southeast; many guest ranches and hotels are nearby. U.S. Highway 26-287 is just to the southwest, and from it one can see many spectacular views of the study area.

Fieldwork for this study was done by the U.S. Geological Survey and U.S. Bureau of Mines during June, July, and August of 1973.

PREVIOUS STUDIES

A comprehensive study of the geology of the Du Noir area was done by Keefer (1955, 1957); it contains a summary of the earlier geologic work in the region, presents detailed descriptions and interpretations of nearly all rock units present in the Du Noir Addition, and includes a geologic map that covers the eastern half of the study area. The descriptions of the prevolcanic rocks in the present report are taken from Keefer. A report on the stratigraphy and mineral resources of Permian rocks in western Wyoming (Sheldon, 1963) includes Permian rocks in the Du Noir area. A study of the mineral potential of the Stratified Primitive Area, now part of the Washakie Wilderness (Ketner and others, 1966), gives additional information, especially on the volcanics, as does a paper on the regional stratigraphy of the Absaroka volcanic field (Smedes and Prostka, 1972). A paper by Blackstone (1966) describes the Pliocene basaltic volcano on Crescent Mountain. A map by Rohrer (1966) shows the geology of the southwestern part of the Du Noir Addition, and a paper by Rohrer and Obradovich (1969) deals with the Eocene volcanic rocks and their ages.

PRESENT INVESTIGATIONS

The purpose of the present study was to map the geology and to evaluate the mineral and geothermal-energy potential of the Du Noir Addition. These objectives were met through geologic studies that included preparation of a reconnaissance geologic map, through a geochemical sampling program, through interpretation of aeromagnetic data, and by searching for records of mineral production or mining claims. This report of our evaluation is the combined effort of the U.S. Geological Survey and U.S. Bureau of Mines. Harold J. Prostka and John C. Antweiler, U.S. Geological Survey, assisted by Gregory Lee and David Phelps, collected bedrock and stream-sediment samples and pan concentrates for the geochemical analyses. Prostka did most of the bedrock sampling and geologic mapping. The U.S. Geological Survey fieldwork was done mostly in July and August 1973, using a helicopter almost daily to facilitate access.

The published map of Keefer (1955) and that of Rohrer (1966) were incorporated in our map (fig. 4) with a minimum of remapping; however, these areas were thoroughly sampled by us. A U.S. Geological Survey mobile field laboratory, located nearby, performed the chemical and spectrographic analyses and returned the analytical results to us in a matter of days.

Fieldwork by Carl L. Bieniewski of the U.S. Bureau of Mines, conducted during June and July 1973, consisted of reconnaissance in and around the addition and sampling of bedrock units and stream sediments. Companies known to have been interested in minerals near the addition were contacted.

A search of the records of Fremont, Park, and Teton Counties was made to determine whether any mining claims had been located in the Du Noir Addition. Land-status records of the Bureau of Land Management in Cheyenne, Wyo., were examined for mineral leases and for patented mining claims. Forest Service personnel and Dan Miller, Wyoming State Geologist, were contacted for knowledge of any mineralization or prospecting activities in and near the addition.

ACKNOWLEDGMENTS

Appreciation is expressed to Forest Service and Bureau of Land Management personnel for their cooperation, and special thanks are extended to John Butruille, Dubois District Ranger for the Shoshone National Forest. Percy Yarborough permitted us to use private roads through Retlaw Enterprises ranchlands to the National Forest boundary, and Barry Horn allowed us to use the Brooks Lake Lodge as a base of operations.

U.S. Geological Survey field analyses were provided by John Viets, G. W. Day, and R. T. Hopkins. Other Geological Survey analyses were made in Denver. Computer programming and retrieval of data were handled by L. R. Wilch and Ricke Smith. Geologic field help was provided for the Geological Survey investigation by Gregory Lee, David Phelps, and John Antweiler III, and for the Bureau of Mines by John M. Hoppe.

We are particularly grateful to J. D. Love, who spent several days in the field with us and contributed to the work through his vast geological knowledge of the area, and to W. R. Keefer, who prepared a geologic map of the southern part of the area in 1955 and spent two days in the field with us at the beginning of the Geological Survey investigation.

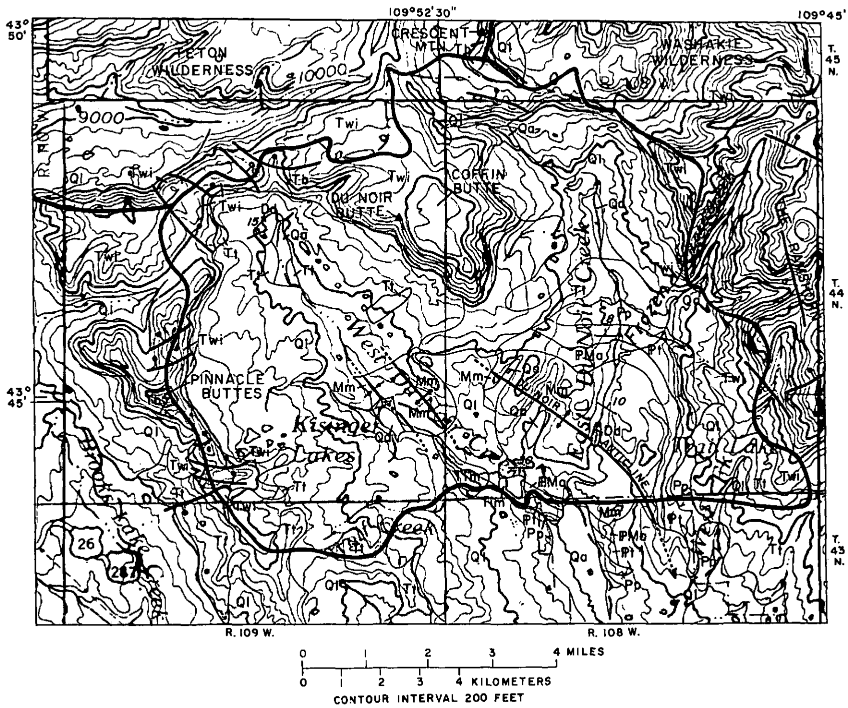


FIGURE 4.—Geologic map of the Du Noir Addition. Base from AMS 1:250,000 Thermopolis (1955).

State and county officials, local residents, and company officials of Gulf Minerals Company and Timberline Minerals cooperated with us and furnished information of value.

GEOLOGY

The Du Noir Addition (fig. 4) lies along the south margin of the Absaroka Range, a highly dissected volcanic plateau made up primarily of nearly flat-lying andesitic volcanic rocks of Eocene age. Partly exposed along the abrupt erosional edge of this plateau is the west-northwest-trending Washakie Range, consisting of Precambrian, Paleozoic, and Mesozoic rocks that were highly deformed during the Laramide orogeny and were later buried by the volcanics. Within the Du Noir Addition, middle and upper Paleozoic marine sedimentary rocks are exposed in about one-third of the area, occurring mainly in the deeply eroded northwest-trending Du Noir anticline. A small area of Devonian rocks is present on the axial part of the fold, and a larger

CORRELATION OF MAP UNITS

Map unit	Series	System
Qa, Ql	Holocene and Pleistocene	QUATERNARY
Tb	Pilocene(?) and Pliocene	TERTIARY
Unconformity		
Twi	Eocene	TERTIARY
Tt	Eocene	TERTIARY
Tim	Eocene	TERTIARY
Unconformity		
Pp		PERMIAN
IPt		PENNSYLVANIAN
IPMa		PENNSYLVANIAN / MISSISSIPPIAN
Mm		MISSISSIPPIAN
Dd		DEVONIAN

DESCRIPTION OF MAP UNITS

Qa ALLUVIUM (HOLOCENE AND PLEISTOCENE)—Unconsolidated deposits of sand, gravel, and silt along present streams

Ql LANDSLIDE AND GLACIAL DEPOSITS (HOLOCENE AND PLEISTOCENE)—Unconsolidated poorly sorted deposits of blocks and boulders, generally with hummocky surfaces; includes talus and small lacustrine deposits

Tb BASALT (PLIOCENE(?) AND PLIOCENE) — Lava flows, dikes, and a scoria-spatter cone of dark- to medium-gray aphanitic basalt and basaltic andesite

Twi WIGGINS FORMATION (EOCENE)—Light- to medium-gray and brown andesitic well-bedded coarse volcanic mudflow and fluvial breccia and conglomerate, mudstone, and airfall tuff

Tt TEPEE TRAIL FORMATION (EOCENE)—Medium-brown, green, and buff andesitic well-bedded medium- to fine-grained volcanic sandstone, siltstone, breccia, conglomerate, and tuff

Tim INDIAN MEADOWS FORMATION (EOCENE)—Red massive conglomerate consisting of clasts of Paleozoic rock in a sandy matrix

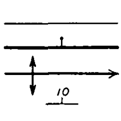
Pp PHOSPHORIA FORMATION (PERMIAN)—Tan, gray, and buff interbedded dolomite, chert, limestone, siltstone, and sandstone, and minor shale and phosphate rock

IPt TENSLEEP SANDSTONE (PENNSYLVANIAN)—Buff and white fine-grained crossbedded to massive sandstone; weathers dark brown or black

IPMa AMSDEN FORMATION (PENNSYLVANIAN AND MISSISSIPPIAN)—Red, gray, buff, and purple shale, sandstone, and dolomite

Mm MADISON LIMESTONE (MISSISSIPPIAN)—Gray massive and thin-bedded limestone, and minor chert and red shale

Dd DARBY FORMATION (DEVONIAN)—Gray, brown, and buff fetid dolomite, and greenish-gray and red siltstone and shale



Contact

Fault—Bar and ball on downthrown side

Fold axis—Showing plunge. Dotted where concealed

Strike and dip of beds

Boundary of Du Noir addition

area of gently northwest-dipping Devonian strata is near the headwaters of West Du Noir Creek. Mississippian strata are extensively exposed in the broad, complexly folded core of the anticline, and Pennsylvanian and Permian rocks compose the limbs and the southeast-plunging nose. The lithology and thickness of these strata are briefly summarized in table 1; more detailed descriptions are given in Keefer (1957). The Phosphoria Formation is the only exposed Paleozoic unit of economic interest. It is the stratigraphically lowest horizon producing oil and gas in the Dubois field, 8 miles (13 km) southeast of the addition. Regionally, the phosphatic beds contain as much as 0.10 percent uranium and are a major source of phosphate rock in western Wyoming (Sheldon, 1963). For these reasons the lithology and stratigraphy of the Phosphoria Formation will be described in more detail than those of the other Paleozoic formations.

The remaining two-thirds of the area is underlain mainly by Eocene volcaniclastic rocks, consisting of breccias, tuffs, and epiclastic volcanic conglomerates and sandstones derived from andesitic vent complexes that lie outside the study area. A variety of surficial deposits are present—mainly glacial deposits of several ages, talus, alluvium, and extensive landslide deposits—which thickly cover the bedrock in about one-half of the study area.

TABLE 1.—*Paleozoic rocks exposed in the Du Noir Addition*
[Modified from Keefer (1957) and Mallory (1967)]

Age	Formation	Approximate thickness	Description
Permian	Phosphoria	260 feet (80 m)	Dolomite, chert, limestone, siltstone, and sandstone, interbedded, tan, gray, and buff; a few thin beds of phosphate rock; a minor amount of shale.
	Tensleep Sandstone	210-245 feet (62-73 m)	Sandstone, buff and white, fine grained, thinly crossbedded to massive, cliff-forming; weathered surfaces generally dark brown to black.
Pennsylvanian	Amsden	290-310 feet (90-98 m)	Shale, sandstone, and dolomite, interbedded, red, gray, buff, white, and purple; sandstone fine to medium grained, crossbedded.
Mississippian	Madison Limestone	740 feet (225 m)	Limestone, gray, massive to thin bedded; some thin beds of chert; in places contains red shale near top.
Devonian	Darby	190-210 feet (58-64 m)	Dolomite, buff, gray, and brown, fetid; greenish-gray and red siltstone and shale.

PERMIAN PHOSPHORIA FORMATION

The Phosphoria Formation crops out along the flanks of the Du Noir anticline (fig. 4) and consists of interbedded dolomite, chert, limestone, siltstone, and sandstone and minor conglomerate, shale, and phosphatic beds. The predominant colors are light brown and gray, although the phosphatic beds are dark gray and dark brown. The dolomite and limestone occur as massive and thin bedded units. Many of the carbonate beds are cherty and contain nodules and irregular masses of chert. Fossils are common, especially brachiopods and bryozoans. The sandstones and siltstones are tan, gray, pink, and white, containing both massive and thin-bedded units; most of them are limy or cherty. The sandstones are mostly fine grained. Minor gray shale is present, as well as thin beds of dark-gray and dark-brown oolitic phosphate rock. The section described by Keefer (1957, p. 174–175), beginning just southeast of the Du Noir area, contains only a single 1-foot (0.3-m)-thick bed of phosphate rock. In the well-exposed section just east of Du Noir Creek (NE¼ sec. 9, T. 43 N., R. 108 W.), there is only an 8-inch (20-cm)-thick bed of phosphate rock and a 2-foot (0.6-m)-thick bed of phosphatic sandstone and siltstone interbedded with carbonate rocks. On the north flank of the Du Noir anticline there are local beds of dark phosphatic sandstone, siltstone, and limestone a few inches thick, but no beds of oolitic phosphate rock were found. Regional studies of the Phosphoria Formation indicate that the phosphatic members are thickest along the Wyoming-Idaho border, and that they thin and become less pure eastward and northeastward (Sheldon, 1963). Because the Du Noir Addition is near the distal edges of these phosphatic tongues, the presence of beds of phosphate rock of minable thickness beneath the volcanics is extremely unlikely.

The Phosphoria Formation was deposited on an erosion surface having a few feet of relief incised in the Tensleep Sandstone; the basal bed of the Phosphoria Formation is a conglomerate 5–15 feet(2–5 m) thick (Keefer, 1957). A complete section of the Phosphoria Formation is about 260 feet (80 m) thick in this part of Wyoming, and it is conformably overlain by the Dinwoody Formation of Triassic age. In the Du Noir Addition, however, the top of the Phosphoria Formation and the overlying Mesozoic strata are covered by volcanic rocks.

CENOZOIC ROCKS

Cenozoic rocks in the Du Noir Addition include the coarse nonvolcanic conglomerates of the Indian Meadows Formation, the extensive andesitic volcaniclastic sediments assigned to the Tepee Trail and Wiggins Formations, and two small areas of Pliocene basalt. The Cenozoic rocks rest unconformably on the deeply eroded Washakie Range, whose surface has several hundred feet of relief. The Cenozoic strata are flat-lying or dip gently north to northeastward. Because of extensive glacial and landslide deposits in the broad valley bottoms, the extent of the Indian Meadows and Tepee Trail Formations is poorly known.

INDIAN MEADOWS FORMATION

The Indian Meadows Formation was named by Love (1939) for a sequence of coarse- to fine-grained clastic sediments along the East Fork of the Wind River about 20 miles (32 km) southeast of the Du Noir Addition. Coarse massive conglomerates along West Du Noir Creek were assigned to the Indian Meadows Formation by Keefer (1957). These conglomerates consist of subrounded cobbles, boulders, and pebbles of Paleozoic sandstone, limestone, dolomite, and chert in a red and gray matrix of coarse-grained calcareous sandstone; however, they contain no Precambrian or volcanic rock fragments. The deposit is as much as 200 feet (60 m) thick. The Indian Meadows Formation is believed to have been deposited during a period of rapid erosion following folding and faulting of the Washakie Range (Keefer, 1957). These coarse conglomerates, found lapping against the south flank of the Washakie Range, grade southward into finer grained strata in the Wind River Basin. Vertebrate fossils in the type locality date the Indian Meadows Formation as early Eocene.

ABSAROKA VOLCANIC SUPERGROUP

The Absaroka Volcanic Supergroup was defined by Smedes and Prostka (1972) to include all the Eocene volcanic rocks, associated intrusives, and volcanic sediments that compose the Absaroka volcanic field. The supergroup consists of, in ascending order, the Washburn Group, the Sunlight Group, and the Thorofare Creek Group—all of middle to late Eocene age. Only rocks belonging to the Thorofare Creek Group are present in the Du Noir Addition (fig. 4)—those assigned to the Tepee Trail and Wiggins Formations. Both of these formations were first defined and described by Love (1939) in an area about 15 miles (24 km) southeast of the Du Noir Addition, but because of stratigraphic complications the type Tepee Trail may not be equivalent to the rocks called Tepee Trail in the Du Noir area.

The source vents for these volcanic sediments were andesitic stratovolcanoes located northwest, north, and northeast of the Du Noir Addition. At the time these volcanoes were being formed they were also being eroded, and the epiclastic and pyroclastic materials were redeposited as thick widespread alluvial aprons outward from the vent complexes (Smedes and Prostka, 1972). In the Du Noir area, the Tepee Trail and Wiggins Formations consist almost entirely of reworked volcanic material—mudflow breccias, fluvial breccias and conglomerates, volcanic sandstones, siltstones, and air-fall tuffs.

TEPEE TRAIL FORMATION

The Tepee Trail Formation is a sequence of well-bedded brown, green, and buff volcanic sediments and tuffs present along much of the south margin of the Absaroka volcanic field (Love, 1939; Keefer, 1957; Ketner and others, 1966; Rohrer, 1966; Rohrer and Obradovich, 1969). In the Du Noir area, the strata mapped as Tepee Trail contain a higher proportion of fine-grained beds than do those in the type section. They mostly consist of interbedded tuffaceous sandstone, mudstone, and claystone, with lesser amounts of breccia and conglomerate. The upper part of the formation is coarser grained than the lower part. A distinctive conglomerate consisting of quartzite pebbles in a green sandy matrix occurs at the base of the formation southwest of the Du Noir area, but this unit was not found exposed within the study area itself. The upper part of the formation contains several flinty beds of tuff, with abundant fossil leaves, and a few thin beds of carbonaceous shale. Northward, the formation thins and becomes coarser grained, and the carbonaceous shales pinch out. The Tepee Trail Formation unconformably overlies the Indian Meadows Formation and the Paleozoic rocks of the Du Noir anticline. Because of considerable relief beneath the Tepee Trail, the formation varies in thickness from a maximum of about 1,800 feet (550 m) near Pinnacle Buttes to less than 300 feet (90 m) west of The Ramshorn. The top of the formation is approximately located where predominantly brown and light green flintstones and claystones of the Tepee Trail are overlain by the predominantly light gray mudflow breccias and conglomerates of the Wiggins Formation. This lithologic break has been interpreted to be time-transgressive and to migrate stratigraphically upward toward the southeast, and so the top of the Tepee Trail would be somewhat younger at the eastern end of the Du Noir Addition than at the western end (Ketner and others, 1966; Rohrer and Obradovich, 1969). On the basis of recent paleontological work, however, J. D. Love (written commun., 1974) believes that the Tepee Trail of the Du Noir area is older than the type Tepee Trail and is correlative with the Aycross Formation instead. Detailed stratigraphic work, which is beyond the scope of the present study, is needed to determine lithologic continuity of the formations and their relation to time lines determined by paleontologic studies.

WIGGINS FORMATION

The Wiggins Formation is a thick sequence of dominantly light to medium gray and brownish-gray coarse volcanic mudflow and fluvial breccias and conglomerates that are spectacularly exposed in prominent cliffs throughout the southern Absaroka Range. The mudflow deposits are massively bedded units several feet to tens of feet thick. They consist of dark-gray angular to subangular clasts, as much as 6 feet (2 m) across, of hornblende- and pyroxene-bearing andesite in a light-gray to pinkish-gray tuffaceous mudstone matrix. The volcanic conglomerates and well-sorted breccias contain much less matrix than the mudflow deposits and stand out as much darker layers in the cliffs. The volcanic sandstones and mudstones are massively bedded light-gray to buff units. Several beds of biotitic air-fall tuff and pumice, each less than 6 feet (2 m) thick, are interbedded in the sequence and form prominent thin white bands. A lava flow and associated flow breccia occur in the middle part of the formation near the top of Pinnacle Buttes. Because the epiclastic volcanic sediments must have originally been deposited in beds that dipped gently away from the vent complexes north of the study area (Smedes and Prostka, 1972), the present gentle northward to northeastward dip of these beds must be tectonic. The Wiggins is 1,000 feet (300 m) to more than 2,000 feet (600 m) thick in the Du Noir area, with the thickest sections being on The Ramshorn. In the Du Noir Addition, the top of the Wiggins is an erosional surface, and so the uppermost part of the formation is not present.

PLIOCENE BASALT

Remnants of Pliocene and younger basalt are found scattered throughout the southern Absaroka Range (Ketner and others, 1966; Rohrer, 1966). Two such remnants occur in the Du Noir area (fig. 4)—a dissected volcano with associated lava flows on Crescent Mountain (Blackstone, 1966) and a patch of lava flows, possibly the remains of a small shield volcano, north of The Ramshorn. The Crescent Mountain volcano is an arcuate ridge of massive dark-gray lava flows of platy basalt about 300 feet (100 m) thick. It includes part of a red to reddish-brown scoria-spatter cone intruded by a northeast-trending dike, probably a feeder for the volcano. These basalts or basaltic andesites contain sparse small phenocrysts of plagioclase and augite. A whole rock K-Ar determination on one of the flows gave an age of 3.6 m.y. (million years) (Blackstone, 1966).

PLIOCENE(?) INTRUSIVE ROCKS

Intrusive rocks in the Absaroka volcanic field are closely associated with vent complexes and are generally not present in alluvial facies deposits. No intrusives related to Absaroka volcanism were found in the Du Noir Addition, but there are dikes of vesicular basalt on the west side of Coffin Butte that are of probable Pliocene age. These dikes are less than 5 feet (2 m) thick, dip about 10° northwest, and contain sparse small plagioclase phenocrysts. They have somewhat irregular trends, but they strike in a general way toward the Pliocene volcano on Crescent Mountain.

Rohrer (1966) mapped a thick basalt dike of similar trend on the west side of Pinnacle Buttes, but it was not found to extend northeast of there. These dikes are all believed to be part of the late Cenozoic episode of basaltic volcanism.

SURFICIAL DEPOSITS

A variety of surficial deposits are present in the Du Noir Addition, but they were not studied or mapped in detail. Alluvial and fan deposits of sand and gravel rich in volcanic clasts are discontinuously present along modern streams; these are the only surficial deposits that were sampled for geochemical analysis.

Colluvium and talus mantle the lower parts of cliffs and steep slopes; these have been included with units shown as landslide deposits on our map (fig. 4).

Glacial deposits are present mainly in high cirques and at much lower elevations along the southern border of the Du Noir Addition. Rohrer (1966) distinguished three ages of glacial till in the southwestern part of the area. None of these glacial deposits was important enough in terms of this study to be shown separately.

Landslide deposits are by far the thickest and most extensive of the surficial deposits, covering nearly one-half of the study area. Most of the landslides were a result of failure of glacially steepened slopes in the Wiggins and Tepee Trail Formations. The sliding seems to have occurred along structurally weak beds of claystone and shale that occur in the basal part of the Wiggins Formation and throughout the Tepee Trail Formation. Practically all of the steep cliffs in the Wiggins Formation are giant landslide scars modified by later rockfalls. In the valleys in the north half of the addition, thick deposits of Wiggins debris cover large areas of Tepee Trail and Paleozoic rocks. In the south half of the area, most of the landslides are in Tepee Trail Formation; some of the landslides have moved only a small amount and are only slightly out of place.

STRUCTURE

The Paleozoic rocks of the Du Noir Addition (fig. 4) have been folded into a broad northwest-trending anticline that plunges gently to the southeast; the limbs dip about 20°. A section across this fold as well as structure contours on the top of the Precambrian surface, is given by Keefer (1957).

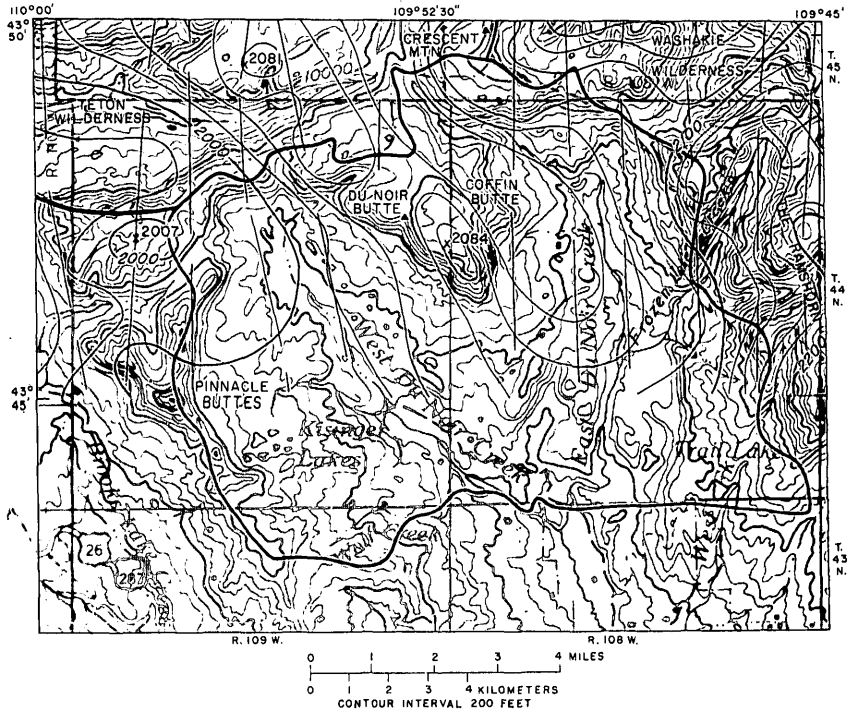
The Cenozoic rocks lie unconformably on the Du Noir anticline and dip gently, less than 5°, to the north and northeast. This dip is consistent with that observed in the Stratified Primitive Area (now part of the Washakie Wilderness) just to the east (Fisher and Ketner, 1968). The Cenozoic rocks are cut by steep faults that trend predominantly northwest and northeast and have displacements of only a few tens of feet. The age of these faults is unknown, but they are presumed to have formed in late Cenozoic time when the south margin of the volcanic field was tilted northward, as was shown by Fisher and Ketner (1968).

The basalt on Crescent Mountain and the dikes on Coffin and Du Noir Buttes and Pinnacle Buttes all lie along a zone that extends southwest to Lava Mountain, a Pleistocene basaltic volcano about 6 miles (10 km) southwest of the addition. The alinement of these young basaltic vents and intrusive rocks suggests that there is a northeast-trending line of deep crustal fracturing beneath the northwestern part of the addition that provided channelways for ascending magma.

AEROMAGNETIC SURVEY

By M. Dean Kleinkopf, U.S. Geological Survey

The aeromagnetic map (fig. 5) covers the northern half of the area and shows no evidence of buried intrusives that might be indicative of mineralization. In general, the trend of the magnetic contours is parallel to the geologic contacts. Near the center of the Du Noir area, the northwesterly trending magnetic high correlates with the thick volcanic pile that extends through the area and beyond to the northwest.



EXPLANATION

2000	Magnetic contours—Showing total intensity magnetic field of the Earth in gammas relative to arbitrary datum. Contour interval 20 gammas
x2007	Location of measured maximum or minimum intensity within closed high or closed low
— — —	Flight path—Showing location and spacing of data
———	Boundary of Du Noir addition

FIGURE 5.—Aeromagnetic map of the north half of the Du Noir Addition and vicinity. Base from AMS 1:250,000 Thermopolis (1955).

MINERAL RESOURCES

SETTING

Northwestern Wyoming contains a wide variety of earth resources of present or future potential commercial value. These resources may be grouped into five categories as follows: (1) metallic mineral deposits—some bedded and others related to igneous rocks, (2) coal, phosphate, and limestone, (3) oil and gas, (4) geothermal, and (5) surficial deposits of building stone, gravel, and sand.

Nearby areas of known metallic mineralization associated with igneous activity are Kirwin, 28 miles (45 km) northeast of the study area (Hewett, 1914; Wilson, 1964), and the Stinkingwater region, 23 miles (37 km) north (Fisher, 1972). Neither area has had significant past production, but they have future potential for low-grade disseminated deposits of copper and for molybdenum deposits.

Gold occurs in gravels along the Wind River and several of its tributaries. According to Schrader (1915), at the time of his reconnaissance in 1913, these deposits had been worked intermittently for 50 years with generally poor results.

Sedimentary rocks in the vicinity of the Du Noir Addition range in age from Cambrian to Quaternary. Regionally some of these rocks are hosts for oil and gas, and some contain bedded deposits of coal, phosphorite, gypsum, bentonite, and limestone. Many mining claims for uranium have been filed since 1950, particularly in areas having exposures of the Phosphoria Formation or the Wind River Formation.

Geothermal energy is present in the region south of the addition, where warm and hot springs occur, and in the well-known thermal areas of Yellowstone National Park.

MINING CLAIMS AND MINERAL PRODUCTION HISTORY

A search of the records of Fremont, Park, and Teton Counties was made to determine whether any unpatented mining claims had been located in the Du Noir Addition. None was found in the addition. Land-status records of the Bureau of Land Management in Cheyenne, Wyo., were examined for mineral leases and for the existence of patented mining claims. These records show no patented claims. Forest Service personnel and Dan Miller, Wyoming State Geologist, were contacted for knowledge of any mineral activity in and around the addition. They were not aware of any such activity. Companies that were known to have been interested in minerals near the addition were contacted, and they furnished the information discussed below.

No mineral production is reported from the Du Noir Addition, and the area has no record of mineral production activity. During the field investigation, no mine or prospect workings were found. However, groups of unpatented lode mining claims, presumably for uranium, called No Name, Ram, 6 M, and Skylark, were located in 1967, adjacent to and near the south boundary of the addition. A part of Ram claim No. 206, and a part of one of the 6 M claims may extend within the study area. An unidentified claim stake was found about 100 feet (30 m) inside the addition, near the jeep road between Esmond Creek and East Du Noir Creek. In 1967 and 1968, Gulf Mineral Resource Co., which acquired most of these claims, conducted an exploration program on their holdings, but none of the holes drilled by the company was on any of the claims shown in figure 6. The target for the drilling was the Wind River Formation, but no uranium mineralization was found.

The Wind River Formation probably underlies some of these claims, as it is extensively exposed farther south. This formation is the host rock for uranium ores being mined in the Gas Hills district, about 110 miles (177 km) southeast of the Du Noir Addition.

GEOCHEMICAL SAMPLING PROGRAM AND ANALYTICAL METHODS

The mineral resource appraisal was made by using geochemical sampling methods in conjunction with geological mapping and field observations. Stream-sediment samples and bedrock samples were collected (fig. 7) and analyzed. Two kinds of stream-sediment samples were collected: (1) pan concentrates for metals, such as gold, platinum, mercury, tin, tungsten, chromium, niobium, titanium, rare earths, and zirconium, that are most likely to occur in heavy detrital minerals; and (2) silt-sized stream-sediment fractions for metals, such as silver, copper, lead, zinc, molybdenum, and vanadium, that are preferentially adsorbed or precipitated on organic-rich mud, clay, or manganese oxides. A major part of the sampling program was directed toward the collection of both kinds of samples from all of the streams in the area, as well as from streams that head in the drainage divides but do not flow into the Du Noir drainage, such as tributaries of Brooks Lake Creek and Cub Creek and the South Fork of the Shoshone River.

Pan concentrates were collected at sites most likely to favor the accumulation of heavy detrital minerals—from the insides of meanders, at places protected from swift currents (beside or under boulders, below willow bushes, at the edges of gravel bars), or between the roots of streamside vegetation, particularly moss. One large pan (16 inch (40.6 cm) in diameter) of material (dry weight about 8,000 g) was taken from small streams and two such pans of material from large streams; these were panned down to a heavy mineral fraction, which ranged in weight from only 1 or 2 g to as much as 92 g. The heavy mineral concentrate thus represents as much as 92/8,000 or as little as 1/8,000 of the material sampled. In discussions of analytical results, weighting factors are considered. The concentrate was carefully examined in the pan, particularly for gold, and then was scanned for radioactivity using a scintillation counter. Splits were

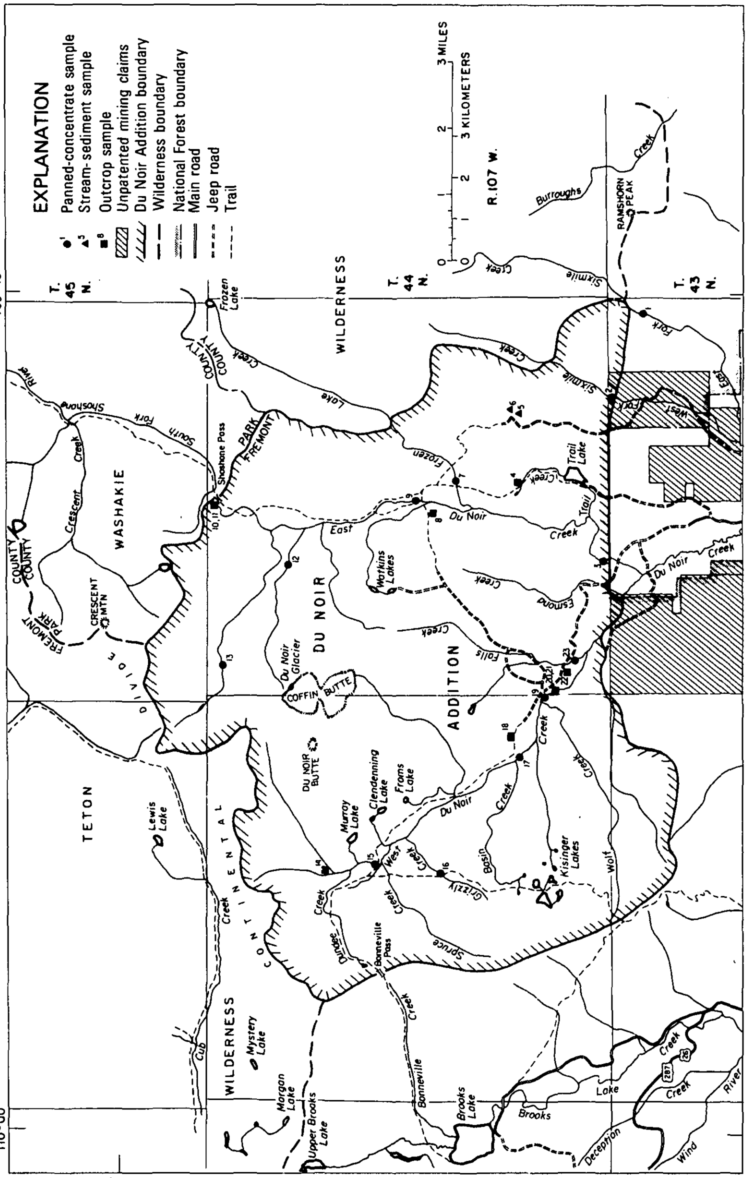
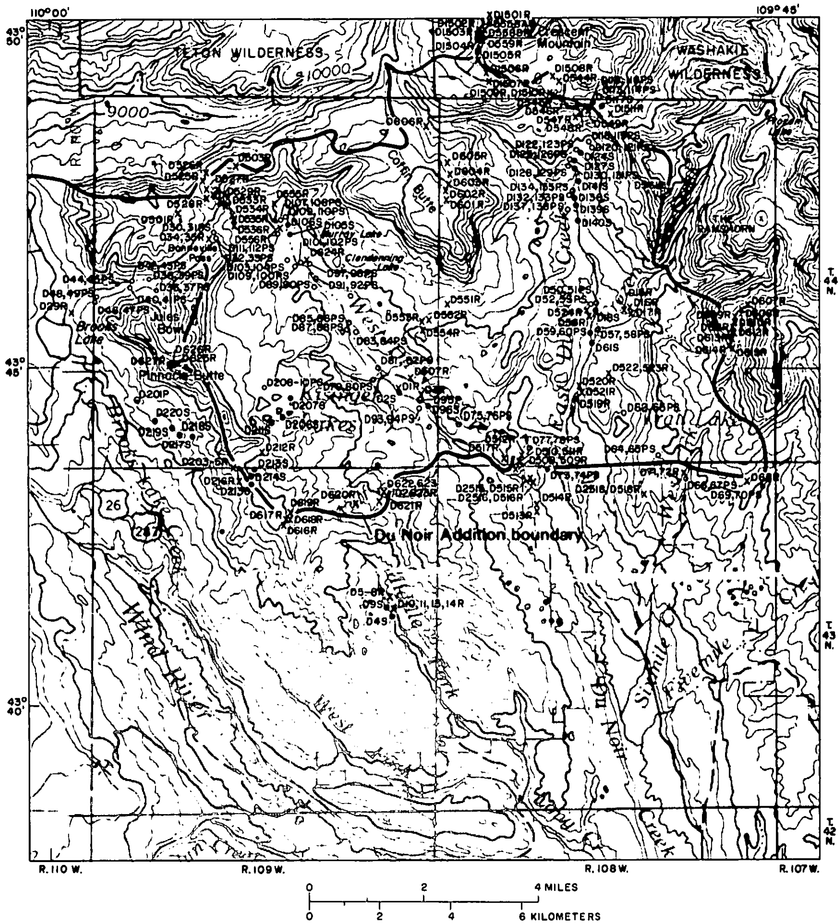


FIGURE 6.—Location of mining claims and U.S. Bureau of Mines sample localities in and near the Du Noir Addition.



EXPLANATION

× Bedrock sample

• Stream-sediment sample

○ Stream-sediment and pan-concentrate samples

⊙ Pan-concentrate sample

FIGURE 7.—U.S. Geological Survey sample localities. Base from AMS 1:250,000 Thermopolis (1955).

removed for six-step semiquantitative spectrographic analysis, mercury analysis, and cold-extractable heavy metals analysis. All the remaining material was analyzed for gold.

Silt-sized stream-sediment samples were usually collected from mud or silt at the edges of streams, below rocks and logs, in streams, or in the roots of vegetation. One to four pounds (0.5-2 kg) of material was collected at each locality. In the field laboratory the sample was dried, scanned for radioactivity, sieved to pass 80 mesh, and then analyzed for gold, mercury, and cold-extractable heavy metals and by six-step semiquantitative spectrographic analysis.

Rock samples also were collected as part of the geochemical sampling program (fig. 7). Most of the rocks of the addition are Eocene volcaniclastic rocks or Paleozoic sedimentary formations, but small Pliocene basaltic intrusives cut the volcaniclastic rocks on The Ramshorn, Coffin and Du Noir Buttes, and Crescent Mountain.

Formations consisting almost wholly of volcaniclastic material (Wiggins and Tepee Trail Formations) and the large areas of landslide debris constitute more than three-fourths of the surface area of the addition. Representative samples were collected from these rocks, with a special effort made to collect some samples that might be enriched in some metal or element of interest. Such samples came from altered areas, carbonaceous shales, lenses of well-sorted conglomerates and sandstones, or areas stained by celadonite.

The Indian Meadows Formation and the Paleozoic rocks (table 1) were examined for possible resource potential—economic concentrations of metals, and bedded deposits of coal, phosphate rock, bentonite, and building stone.

Analytical data were obtained by several methods: six-step semiquantitative spectrographic analyses for 30 elements; chemical-atomic absorption analyses for gold, mercury, and cold-extractable heavy metals; instrumental-atomic absorption analyses for mercury; the citrate-soluble heavy metals test (CxHM) for copper, lead, and zinc; and routine scanning of samples for radioactivity with a scintillation counter. Some rock samples were analyzed by gamma-ray spectrometer for equivalent uranium (eU).

The chemical and spectrographic data were stored on magnetic tape and are available from the National Technical Information Service (Prostka and Antweiler, 1974).

Analytical data indicate that the amount of each element in nearly all the samples is commonplace. Some elements (arsenic, boron, beryllium, bismuth, cadmium, lanthanum, antimony, scandium, tin, strontium, tungsten, yttrium, and zirconium) were either not detected in the analyses or were too infrequently detected to be useful in geochemical or resource studies. A list of selected analyses of samples with higher-than-ordinary values for 1 or more of 15 elements, plus the CxHM test, was retrieved via computer from the complete data stored on magnetic tape. Values of samples chosen for computer retrieval were 1½ to 14 times greater than estimates of crustal abundance. To provide perspective, crustal-abundance estimates are given in table 2 along with the values used for computer retrieval.

Listed in table 3 are the samples retrieved using the cutoff values shown in the center column of table 2.

TABLE 2.—*Estimated crustal abundance and minimum values used for computer retrieval of 15 elements*
[Titanium is given in percent; other elements in parts per million]

	Crustal abundance[1]	Minimum value
Ti	0.64	1.0
Mn	1,300	3,000
Ag	.075	1.0
Ba	390	3,000
Co	25	100
Cr	110	700
Cu	63	125
Mo	1.3	17
Nb	19	70
Ni	89	300
Pb	12	70
V	140	300
Zn	94	500
Au	.0035	.05
Hg	.089	.17
CxHM[2]	---	7

[1] Estimates were taken from Lee and Yao (1970).
[2] Cold extractable heavy metals.

As a supplement to the geochemical sampling done by the U.S. Geological Survey, the U.S. Bureau of Mines collected and analyzed 23 samples, consisting of 12 pan concentrates, 2 stream-sediment samples, and 9 bedrock samples. The bedrock samples included two samples of tuff from the Wiggins Formation, 2 samples of conglomerate from the Indian Meadows Formation, 3 samples of high-purity limestone from the Madison Limestone (discussed below), 1 sample from the Phosphoria Formation, and 1 sample from the Darby Formation, which looked as though it could have been hydrothermally altered. Analyses of these samples are shown in table 4. All samples were checked for radioactivity, with negative results.

ANALYTICAL RESULTS AND RESOURCE POTENTIAL

METALLIC MINERALS

Many of the metallic mineral deposits in the Rocky Mountains are related to igneous intrusive activity. Except for minor upper Tertiary basaltic intrusives, igneous intrusive rocks are not present in the ad-

TABLE 3.—*Selected analyses of the U.S. Geological Survey samples from the Du Noir Addition and vicinity*

[Values shown are in parts per million, except titanium, which is in percent. symbols used are: G, greater than the sensitivity limit; N, not detected at lower limit of detection; and L, an undetermined amount present below the lower limit of detection. Gold and mercury analyses were made by atomic-absorption spectrometry; cold-extractable heavy-metals test (CxHM) by colorimetric comparison; other elements by 6-step semiquantitative spectrographic analyses. These elements are reported to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, which represent approximate midpoints of group data on a geometric scale. The samples are grouped into stream-sediment samples (sample number ends in "S"), pan-concentrate samples (sample number ends in "P"), and bedrock samples (sample number ends in "R," or "M").]

SAMPLE	LATITUDE	LONGITUDE	S-TI %	S-MN	S-AG	S-BA	S-CO	S-CR	S-CU	S-MO
ANOMALOUS SAMPLES										
1/D15M	43 52 05N	109 48 18W	0.	100.	1.	150.	5.N	200.	10.	5.
1/D16M	43 52 04N	109 48 18W	0.	70.	1.N	70.	5.N	150.	7.	5.N
1/D17M	43 52 04N	109 48 19W	0.	100.	2.	200.	5.N	700.	50.	5.
D18S	43 45 52N	109 48 47W	1.	1500.	1.N	1500.	50.	500.	20.	5.N
D30P	43 47 06N	109 56 45W	1.	2000.	1.N	300.	70.	1000.	70.	5.N
D32P	43 47 05N	109 56 42W	1.	2000.	1.N	300.	70.	700.	15.	5.N
D36P	43 46 15N	109 58 11W	1.G	2000.	1.N	300.	100.	1000.	100.	5.N
D38P	43 46 18N	109 58 15W	1.	2000.	1.N	700.	70.	700.	50.	5.N
D40P	43 46 10N	109 58 48W	1.	2000.	1.N	700.	70.	700.	15.	5.N
D42P	43 46 14N	109 58 49W	1.	2000.	1.N	500.	70.	700.	20.	5.N
D44P	43 46 13N	109 59 01W	1.	2000.	1.N	1000.	70.	700.	70.	5.N
D50P	43 46 05N	109 48 47W	1.G	2000.	1.N	300.	150.	1000.	70.	5.N
D52P	43 46 04N	109 48 51W	1.	2000.	1.N	500.	100.	1000.	50.	5.N
D54P	43 46 03N	109 48 42W	1.	2000.	1.N	500.	70.	700.	20.	5.N
D57P	43 45 24N	109 46 54W	1.	2000.	1.N	1000.	70.	700.	50.	5.N
D59P	43 45 24N	109 48 56W	1.G	2000.	1.N	1000.	100.	700.	50.	5.N
D62P	43 44 14N	109 48 23W	1.G	1500.	1.N	5000.G	50.	500.	50.	5.N
D64P	43 43 45N	109 47 36W	1.	1000.	1.N	1000.	50.	500.	20.	5.N
D66P	43 43 30N	109 46 55W	1.	5000.	1.N	1000.	100.	700.	50.	5.N
D69P	43 43 19N	109 45 19W	1.	1000.	1.N	200.	70.	500.	20.	5.N
D73P	43 43 30N	109 49 52W	1.	1500.	1.N	1500.	70.	700.	20.	5.N
D75P	43 44 09N	109 51 45W	1.	1500.	1.N	2000.	70.	700.	50.	5.N
D31S	43 47 06N	109 56 44W	1.	1500.	1.N	2000.	50.	200.	50.	5.N
D45S	43 46 14N	109 59 01W	1.	1500.	1.N	1500.	30.	200.	50.	5.N
D47S	43 46 08N	109 59 19W	1.	1500.	1.N	2000.	50.	150.	50.	5.N
D78S	43 43 58N	109 50 15W	0.	1500.	1.N	500.	5.	50.	10.	5.N
D79P	43 44 47N	109 53 32W	1.	1500.	1.N	1000.	70.	1000.	30.	5.N
D81P	43 44 54N	109 53 26W	1.	2000.	1.N	5000.G	70.	1500.	50.	5.N
D83P	43 45 38N	109 54 00W	1.	1500.	1.N	500.	50.	700.	10.	5.N
D85P	43 45 39N	109 54 02W	0.	1500.	1.N	1500.	30.	700.	10.	5.N
D87P	43 45 37N	109 54 03W	1.	2000.	1.N	500.	100.	1500.	50.	5.N
D89P	43 46 17N	109 54 48W	1.	2000.	1.N	1000.	70.	1000.	70.	5.N
D91P	43 46 19N	109 54 48W	0.	1500.	1.N	1500.	50.	700.	20.	5.N
D93P	43 44 28N	109 52 25W	1.	2000.	1.N	500.	50.	1500.	50.	5.N
D95P	43 44 30N	109 52 25W	1.	1000.	1.N	1500.	50.	500.	7.	5.N
D97P	43 46 31N	109 54 55W	1.	1500.	1.N	1500.	50.	700.	20.	5.N
D99P	43 46 31N	109 55 06W	0.	1500.	1.N	1000.	20.	700.	10.	5.N

D101P	43 46 32N	109 55 05W	1.	2000.	1.N	1500.	70.	700.	50.	5.N
D103P	43 46 35N	109 55 15W	0.	1500.	1.N	1500.	50.	700.	15.	5.N
D107P	43 47 15N	109 55 23W	1.	1500.	1.N	1500.	50.	700.	20.	5.N
D109P	43 47 15N	109 55 20W	1.	1500.	1.N	1000.	50.	700.	10.	5.N
D111P	43 46 59N	109 55 22W	1.	2000.	1.N	1500.	70.	1000.	50.	5.N
D113P	43 49 00N	109 48 46W	1.	1500.	1.N	1500.	50.	500.	15.	5.N
D115P	43 48 57N	109 48 47W	1.	2000.	1.N	1500.	70.	700.	70.	5.N
D118P	43 48 29N	109 48 58W	1.	2000.	1.N	1500.	70.	1000.	50.	5.N
D120P	43 48 27N	109 48 58W	1.	1500.	1.N	1500.	30.	200.	50.	5.N
D122P	43 48 11N	109 49 15W	1.	1000.	1.N	1000.	50.	700.	10.	5.N
D125P	43 48 06N	109 49 18W	1.	2000.	1.N	1500.	70.	1000.	10.	5.N
D128P	43 48 02N	109 49 20W	1.	1500.	1.N	300.	70.	700.	50.	5.N
D134P	43 47 39N	109 49 17W	1.	1500.	1.N	700.	70.	700.	10.	5.N
D137P	43 47 22N	109 49 13W	1.	1500.	1.N	1000.	100.	1000.	50.	5.N
D201P	43 44 28N	109 58 31W	1.	2000.	1.N	1500.	70.	700.	10.	30.
D210P	43 44 32N	109 55 38W	1.	2000.	1.N	1000.	70.	700.	15.	5.N
2/D204R	43 43 37N	109 56 32W	0.	2000.	1.N	1500.	50.	200.	30.	5.L
2/D501R	43 47 15N	109 57 39W	1.	2000.	1.N	1000.	70.	1000.	150.	5.N
2/D502R	43 47 34N	109 58 22W	1.	1500.	1.N	2000.	50.	200.	70.	5.N
3/D508R	43 43 34N	109 50 31W	0.	200.	1.N	70.	5.N	20.	7.	5.N
1/D515R	43 43 10N	109 50 11W	0.	100.	2.	150.	5.N	700.	20.	10.
1/D516R	43 43 15N	109 50 11W	0.	70.	2.	100.	5.N	500.	7.	10.
1/D518R	43 43 10N	109 47 42W	0.	70.	2.	150.	5.N	500.	7.	5.N
4/D519R	43 44 31N	109 49 17W	0.	500.	1.	150.	5.N	70.	5.	5.N
2/D550P	43 47 15N	109 45 25W	0.	500.	1.N	1500.	20.	200.	20.	5.N
2/D614R	43 45 34N	109 45 56W	0.	700.	1.N	1500.	20.	100.	50.	5.N
2/D615R	43 45 33N	109 45 55W	0.	200.	1.N	700.	5.N	50.	10.	5.N
5/D553R	43 45 41N	109 52 38W	1.	2000.	1.N	1500.	15.	10.	20.	5.N
5/D616P	43 42 44N	109 35 25W	1.	2000.	1.N	5000.	50.	700.	70.	5.N
5/D617R	43 42 46N	109 55 21W	1.	150.	1.N	3000.	5.N	150.	50.	100.
5/D622R	43 43 08N	109 53 21W	0.	5000.	1.N	1500.	20.	100.	20.	5.N
5/D623R	43 43 07N	109 53 21W	0.	200.	1.N	1000.	7.	70.	7.	300.
6/D559R	43 50 03N	109 51 14W	0.	1000.	1.N	1500.	50.	700.	70.	5.N
5/D2515R	43 45 00N	109 45 00W	0.	50.	1.	70.	5.N	300.	700.	5.
5/D2516R	43 45 00N	109 45 00W	0.	50.	2.	70.	5.N	200.	7.	10.
5/D2518R	43 45 00N	109 45 00W	0.	50.	2.	100.	5.N	150.	7.	5.N
5/D2617R	43 45 00N	109 45 00W	0.	50.	1.N	1000.	5.N	70.	20.	30.
5/D2623R	43 45 00N	109 45 00W	0.	150.	1.N	700.	5.N	50.	7.	150.
6/D1503R	43 50 10N	109 51 14W	1.	1000.	1.N	2000.	20.	700.	70.	5.N
6/D1504R	43 50 07N	109 51 16W	1.	1000.	1.N	2000.	50.	700.	70.	5.N
6/D1506R	43 49 28N	109 51 07W	1.	500.	1.N	1500.	10.	150.	20.	5.N

1/ Phosphoria Formation.

2/ Wiggins Formation.

3/ Tensleep Formation.

TABLE 3.—*Selected analyses of the U.S. Geological Survey samples from the Du Noir Addition and vicinity*—Continued

SAMPLE	LATITUDE	LONGITUDE	S-NB	S-NI	S-PB	S-V	S-ZN	AA-AU-P	INST-HG	CM-CX-HM
				ANOMALOUS SAMPLES						
D15M	43 52 05N	109 48 18W	20.N	20.	150.	100.	1500.	0.05N	0.10	100.
D16M	43 52 04N	109 48 18W	20.N	5.	20.	30.	200.N	.05N	.08	30.
D17M	43 52 04N	109 48 19W	20.N	50.	200.	100.	1500.	.05N	.16	25.
D18S	43 45 52N	109 48 47W	20.N	100.	15.	300.	200.L	.05N	.04	1.L
D30P	43 47 06N	109 56 43W	20.N	200.	10.	500.	300.	.05	.02	1.L
D32P	43 47 05N	109 56 42W	20.N	200.	10.	200.	200.	.28	.04	1.L
D36P	43 46 15N	109 58 11W	20.N	500.	10.	1000.	500.	.07	.02	1.L
D38P	43 46 18N	109 58 15W	20.N	200.	10.	200.	200.	.04	.02L	1.L
D40P	43 46 10N	109 58 48W	20.N	200.	10.	200.	200.	.07	.02	1.L
D42P	43 46 14N	109 58 49W	20.N	200.	10.	300.	300.	.08	.02L	1.L
D44P	43 46 13N	109 59 01W	20.N	200.	10.	300.	200.	.04	.02	1.L
D50P	43 46 05N	109 48 47W	20.N	300.	10.	1000.	300.	.04	.02L	1.L
D52P	43 46 04N	109 48 51W	20.N	200.	15.	300.	200.	.02L	.02L	1.L
D54P	43 46 03N	109 48 42W	20.N	200.	10.	300.	200.	.02L	.02	1.L
D57P	43 45 24N	109 48 54W	20.N	150.	10.	300.	200.	.01	.02L	1.L
D59P	43 45 24N	109 48 56W	20.N	200.	10.	500.	300.	.02	.02L	1.L
D62P	43 44 14N	109 48 23W	20.L	150.	15.	500.	200.	.02L	.02L	1.L
D64P	43 43 45N	109 47 36W	20.N	150.	20.	300.	200.L	.05	.02L	1.L
D66P	43 43 30N	109 46 55W	20.N	200.	20.	300.	200.	.02L	.02L	1.L
D69P	43 43 19N	109 45 19W	20.N	150.	10.N	300.	200.N	.02L	.02L	1.L
D73P	43 43 30N	109 49 52W	20.N	150.	10.N	500.	200.N	.02L	.02L	1.L
D75P	43 44 09N	109 51 45W	20.N	150.	15.	300.	200.	.02L	.02L	1.L
D31S	43 47 06N	109 56 44W	20.N	200.	20.	200.	200.N	.05N	.02	1.L
D45S	43 46 14N	109 59 01W	20.N	150.	50.	200.	200.N	.05N	.02L	1.L
D47S	43 46 08N	109 59 19W	20.N	70.	50.	200.	200.N	.05N	.04	1.L
D78S	43 43 58N	109 50 15W	20.N	50.	15.	100.	200.N	.05N	.40H	5.
D79P	43 44 47N	109 53 32W	20.N	150.	10.N	500.	200.	.03N	.02L	1.L
D81P	43 44 54N	109 53 26W	20.N	200.	10.N	500.	500.	.03N	.02	1.L
D83P	43 45 38N	109 54 00W	20.N	150.	10.N	300.	200.L	.03N	.02	1.L
D85P	43 45 39N	109 54 02W	20.N	100.	10.	200.	200.L	.03N	.02L	1.L
D87P	43 45 37N	109 54 03W	20.N	500.	10.N	300.	200.	.03N	.02	1.L
D89P	43 46 17N	109 54 48W	20.N	200.	10.N	300.	200.	.03N	.02L	1.L
D91P	43 46 19N	109 54 48W	20.N	150.	15.	200.	200.	.04L	.02L	1.L
D93P	43 44 28N	109 52 25W	20.N	150.	10.N	300.	200.	.03N	.02L	1.L
D95P	43 44 30N	109 52 25W	20.N	150.	10.N	300.	200.N	.05	.02L	1.L
D97P	43 46 31N	109 54 55W	20.N	150.	10.	300.	200.N	.03L	.02L	1.L
D99P	43 46 31N	109 55 06W	20.N	150.	10.N	100.	200.N	.05N	.02L	1.L

D101P	43 46 32N	109 55 05W	20.N	200.	10.N	300.	200.	.04N	.02L	1.L
D103P	43 46 35N	109 55 15W	20.N	150.	15.	150.	200.L	.03N	.02L	1.L
D107P	43 47 15N	109 55 23W	20.N	150.	15.	300.	200.L	.03N	.02L	1.L
D109P	43 47 15N	109 55 20W	20.N	100.	10.	200.	200.L	.03N	.02L	1.L
D111P	43 46 59N	109 55 22W	20.N	200.	10.	300.	200.L	.03N	.02L	1.L
D113P	43 49 00N	109 48 46W	20.N	100.	15.	300.	200.L	.03N	.02L	1.L
D115P	43 48 57N	109 48 47W	20.N	100.	15.	500.	200.	.04N	.02L	1.L
D118P	43 48 29N	109 48 58W	20.N	200.	15.	300.	200.L	.03N	.02L	1.L
D120P	43 48 27N	109 48 58W	20.N	100.	15.	300.	200.N	.05	.02L	1.L
D122P	43 48 11N	109 49 15W	20.N	150.	10.	200.	200.L	.03L	.02L	1.L
D125P	43 48 06N	109 49 18W	20.N	150.	15.	300.	200.L	.03L	.02	1.L
D128P	43 48 02N	109 49 20W	20.N	200.	10.N	500.	200.L	.05L	.02L	1.L
D134P	43 47 39N	109 49 17W	20.N	150.	10.	300.	200.L	.10	.02	1.L
D137P	43 47 22N	109 49 13W	20.N	150.	10.N	300.	200.	.02N	.02L	1.L
D201P	43 44 28N	109 58 31W	20.N	200.	15.	200.	200.N	.05L	.02L	1.L
D210P	43 44 32N	109 55 38W	20.N	200.	15.	200.	200.N	.07N	.02L	1.L
D204R	43 43 37N	109 56 32W	20.N	150.	70.	200.	200.N	.05L	.04	1.L
D501R	43 47 15N	109 57 39W	20.N	300.	10.	300.	200.N	.05N	.02L	1.L
D502R	43 47 34N	109 58 22W	20.N	150.	50.	300.	200.N	.05N	.02L	1.L
D508R	43 43 34N	109 50 31W	20.	5.	15.	30.	200.N	.10	.02L	1.L
D515R	43 43 10N	109 50 11W	20.N	50.	150.	200.	1500.	.05N	.04	70.
D516R	43 43 15N	109 50 11W	20.N	50.	150.	100.	1500.	.05N	.24	50.
D518R	43 43 10N	109 47 42W	20.N	15.	50.	100.	200.	.05L	.02	7.
D519R	43 44 31N	109 49 17W	20.N	20.	10.	100.	200.N	.05L	.02	1.L
D550R	43 47 15N	109 45 25W	20.N	150.	70.	150.	200.N	.05N	.02L	1.L
D614R	43 45 34N	109 45 56W	20.N	100.	70.	200.	200.N	.05N	.02	1.L
D615R	43 45 33N	109 45 55W	30.	30.	70.	100.	200.N	.05N	.02L	1.L
D553R	43 45 41N	109 52 38W	20.N	10.	10.N	500.	200.N	.05N	.02	1.L
D616R	43 42 44N	109 35 25W	20.N	150.	10.	300.	200.N	.05N	.02L	1.L
D617R	43 42 46N	109 55 21W	20.N	7.	15.	200.	200.N	.05N	.04	1.L
D622R	43 43 08N	109 53 21W	20.L	50.	50.	150.	200.N	.05L	.04	4.
D623R	43 43 07N	109 53 21W	70.	7.	10.	500.	200.N	.05N	.08	2.L
D559R	43 50 03N	109 51 14W	20.N	150.	20.	100.	200.N	.05N	.02L	1.L
D2515K	43 45 00N	109 45 00W	20.N	20.	100.	50.	500.	.05N	.04	35.
D2516K	43 45 00N	109 45 00W	20.N	50.	150.	50.	500.	.05N	.20	35.
D2518K	43 45 00N	109 45 00W	20.N	10.	50.	30.	200.	.05N	.02	5.
D2617K	43 45 00N	109 45 00W	20.N	5.L	15.	100.	200.N	.05N	.02	1.L
D2623K	43 45 00N	109 45 00W	20.N	5.L	10.	300.	200.N	.05N	.08	1.L
D1503K	43 50 10N	109 51 14W	20.N	200.	20.	200.	200.N	.05N	.02L	1.L
D1504K	43 50 07N	109 51 16W	20.N	200.	30.	200.	200.N	.05N	.02L	1.L
D1506K	43 49 28N	109 51 07W	20.N	70.	20.	100.	200.N	.05N	.02	7.

4/ Darby Formation.

5/ Tepee Trail Formation.

6/ Tertiary igneous intrusive.

TABLE 4.—*Analyses of U.S. Bureau of Mines samples from the Du Noir Addition and vicinity*

[Sample localities are given below by T. (township), R. (range), and S. (section) north and west of the 6th Principal Meridian; thus T. 44 N., R. 108 W., sec. 22, is shown as 44-108-22. Samples were analyzed by semiquantitative spectrographic and fire assay methods at the U.S. Bureau of Mines laboratories in Reno, Nev. Spectrographic analyses were made using a 3.4-m Wadsworth spectrograph with 30-inch (76 cm) plateholder. Estimates of concentrations were made by comparing intensity of lines in sample spectra with intensity of lines in spectra of a graded series of standards. The numbers in parentheses beneath the element symbols represent the estimated lower limit of detection for that element. An error of plus 100 percent, minus 50 percent of the reported concentration is assumed. Symbols used are: M, more than 10 percent; >, more than the amount shown; <, less than the amount shown; NA, no analyses; Tr, trace; --, looked for but not found and hence may occur only in amounts below the lower detection limit. The following elements were looked for spectrographically but were not detected: As, Au, Be, Bi, Cd, Ga, Hf, In, La, Li, Nb, Pt, Re, Sb, Ta, Te, Tl, W, and Zn. The following elements were detected in some samples and the results reported at the bottom of the table as footnoted: Ag, B, Mo, Sn, Sr, and Y. Ca, Na, and Si were detected in most samples but were found in amounts normal for the rocks samples]

		Assay (oz/ton)		Semiquantitative spectrographic analyses														
				(ppm)										(percent)				
Sample	Location T. R. S.	Au	Ag	Ba (1,000)	Co (40)	Cr (30)	Cu (20)	Mn (30)	Ni (20)	Pb (100)	Sc (50)	V (60)	Zr (70)	Al (0.003)	Fe (0.004)	Mg (0.0004)	Ti (0.001)	Remarks
[1]1	43-108- 1	--	0.1	--	100	1,000	40	2,000	300	100	--	500	--	1.0	M	6.0	0.8	Stream-panned concentrate.
[2]2	43-108- 2	--	.1	40,000	40	4,000	40	4,000	300	100	--	400	300	3.0	M	M	.8	Do.
3	44-108-33	--	.4	--	40	500	40	2,000	200	--	--	100	300	3.0	4.0	M	.2	Do.
4	44-108-27	NA	NA	--	--	--	<20	10	--	<100	--	60	--	.04	.05	.02	--	Madison Formation outcrop.
[3]5	44-108-26	NA	NA	2,000	40	1,000	60	2,000	200	200	--	100	100	M	4.0	5.0	.4	Stream sediments.
[4]6	44-108-26	NA	NA	2,000	40	1,000	60	2,000	200	200	--	100	300	M	4.0	5.0	.4	Do.
[5]7	44-108-22	--	--	--	--	1,000	40	2,000	200	--	<50	200	--	4.0	7.0	>6.0	.4	Stream-panned concentrate.
[6]8	44-108-21	Tr	Tr	<1,000	--	300	80	200	--	--	--	--	--	.7	2.0	.4	.02	Phosphoria Formation outcrop.
9	44-108-22	--	.1	--	100	1,000	40	2,000	600	200	<50	500	<70	3.0	M	M	1.5	Stream-panned concentrate.
10	44-108- 4	--	.1	--	--	--	40	1,000	--	--	--	--	100	5.0	1.0	1.0	.05	Wiggins Formation outcrop.
11	44-108- 4	--	--	--	--	60	40	1,000	--	200	--	--	--	1.0	1.0	.6	.05	Do.
12	44-108- 8	--	.1	--	50	500	40	4,000	200	100	<50	60	<70	M	6.0	6.0	.4	Stream-panned concentrate.
13	44-108- 6	--	.1	1,000	50	500	40	1,000	200	100	<50	500	<70	M	M	M	.8	Do.
14	44-109-10	--	--	--	--	--	40	100	--	<100	--	--	--	1.0	.4	.4	.05	Darby Formation outcrop.
15	44-109-15	--	.1	--	50	500	40	1,000	300	100	<50	100	<70	3.0	6.0	M	.8	Stream-panned concentrate.
16	44-109-22	--	.2	--	50	500	40	2,000	300	200	--	100	<70	2.0	M	M	.4	Do.
17	44-109-25	--	--	1,000	100	1,000	30	2,000	600	--	50	500	<70	M	M	M	1.5	Do.
18	44-109-25	NA	NA	--	--	--	<20	60	--	--	--	--	--	.01	.05	.02	--	Madison Formation outcrop.
19	44-109-25	--	Tr	--	40	1,000	30	2,000	300	<100	<50	100	100	4.0	M	M	1.0	Stream-panned concentrate.
20	44-108-31	--	.1	--	--	200	40	300	--	--	--	<60	200	2.0	.4	2.0	.05	Indian Meadows Formation outcrop.
21	44-108-31	--	.2	--	--	200	40	300	--	--	--	<60	200	1.0	.4	3.0	.02	Do.
22	44-108-31	NA	NA	--	--	--	20	100	--	--	--	--	--	.02	.1	M	--	Madison Formation outcrop.
23	44-108-31	--	.1	--	--	500	20	1,000	200	100	50	60	<70	5.0	5.0	.2	.2	Stream-panned concentrate.

[1]Sample 1 contains 50 ppm Ag [3]Sample 5 contains 1,000 ppm Sr [5]Sample 7 contains 20 ppm Ag
[2]Sample 2 contains 80 ppm Sn [4]Sample 6 contains 2,000 ppm Sr [6]Sample 8 contains 20,000 ppm P, and 30 ppm Y

dition. Geologic mapping and field examination do not suggest the presence of mineralization associated with these upper Tertiary basaltic intrusive rocks. Bedrock samples D1501R–D1510R, D558R, D559R, and D544R–D546R were collected on and near Crescent Mountain from the intrusive and the intruded rocks. Only samples D559R, D1503R, and D1504R were sufficiently anomalous to be included in table 2; the "anomalous" element was chromium—700 ppm—which is only slightly enriched (if enriched at all) in comparison to other mafic rocks in the Earth's crust. The basalt on The Ramshorn is outside the addition and was not sampled, but it showed no evidence of mineralization. Stream-sediment samples from Frozen Lake Creek (D57P and D58S), which drains that area, show no enriched metal values except for titanium and chromium, and these are too small to be of value.

The possibility of any economic mineral resources in the addition is slight. Gold was observed in a few pan concentrates and one rock sample (D508R). The most likely source of gold in pan concentrates is quartzite gravel lenses that occur near the base of the Tepee Trail Formation. These lenses were apparently derived from the Pinyon Conglomerate and Harebell Formation of Paleocene and latest Cretaceous age, which occur extensively to the west and northwest (Antweiler and Love, 1967). The small amount of gold found, plus the very small volume of quartzite gravels in the addition, precludes the possibility of a gold resource. The one bedrock sample in which gold was detected (D508R) was sandstone from the Tensleep Sandstone. Other analyses from this sandstone failed to show any gold.

Silver, copper, lead, and zinc, although found in amounts exceeding normal background values in a few samples, are not present in sufficient quantity to be of any resource interest. The cold extractable heavy metals test is particularly useful in detecting zinc; the four samples that showed high values for the CxHM test had enough zinc to be detected by spectrographic analysis as well.

Many of the samples in table 3 appear to be high in titanium and chromium. However, most of the high values are in pan concentrates and result from concentration of ilmenite and chromite by panning. If the values shown are divided by the concentration factor (which is usually about 100) to obtain the actual concentrations present in alluvium prior to panning, it is doubtful that either element is present in an amount great enough to be of importance. The amounts of chromium and titanium found in bedrock samples are within the ranges expected for the kinds of rock analyzed. There are no naturally concentrated ilmenite or chromite deposits in the stream gravels large enough to be of any economic importance.

Carbonaceous shale is present along the southern margin of the outcrop belt of the Tepee Trail Formation. It contains abundant leaves and freshwater invertebrates indicative of swamplike conditions. Organic-rich muds in these areas evidently provided favorable conditions for precipitation or sorption of several metals including molybdenum (samples D617R, D2617R, D623R, and D2623R). Volumetrically, the carbonaceous shales constitute only a small fraction of the formation, but in the aggregate they could amount to a substantial tonnage. However, because of their thin lenslike character they would be extremely expensive and difficult to mine, even if they were rich in metals. To further evaluate their resource potential, 45 additional samples of similar shales were obtained from the region, and a summary of pertinent analytical results is presented in table 5.

Table 5 shows a greater enrichment in molybdenum than in any other element, but even its concentration is considerably below that required for molybdenum to be a potential resource. Of geochemical, but not economic, interest is the fact that two of the samples had sufficient tungsten to be detected spectrographically.

The geology of the area virtually precludes the possibility of exposed primary uranium deposits. The best possibilities for uranium concentrations are the black shales of the Tepee Trail and Phosphoria Formations. Radiometric eU determinations were made on all carbonaceous shale samples, and fluorimetric determinations for uranium were made on those that registered 90 ppm eU or more.

Of the samples collected within the addition, only one had sufficient uranium to justify a chemical-fluorimetric determination; that sample, which came from the Phosphoria, contained 80 ppm uranium. The samples of Eocene shale referred to in table 3 all contain less than 50 ppm eU and, therefore, do not appear to constitute a resource.

The uranium content of the Phosphoria Formation has been studied regionally by Sheldon (1963), who stated (p. 157), "The rocks in the western part of the report area [that is, western Wyoming–eastern Idaho] are more uraniferous than in the eastern part. In fact, in the Wind River Range in the eastern part of the area, no minable phosphorites contain as much as 0.005 percent uranium [50 ppm] * * *. Thus, most phosphate rock mined in westernmost Wyoming and adjacent parts of Idaho will contain maximum quantitites of uranium; whereas, rock mined in most of western Wyoming will contribute smaller quantities of uranium as a byproduct." The Du Noir Addition is in the eastern part of the region studied by Sheldon, and therefore is a less likely area for high uranium concentrations in the Phosphoria Formation than are areas farther west.

TABLE 5.—*Summary of analyses for selected elements in Eocene carbonaceous shales near the Du Noir Addition*

[Figures are in parts per million. N, not detected; <, less than; ND, not determined. Number of samples are given in parentheses. Localities are given in degrees, north latitude and west longitude]

Element	Crustal 2/ abundance	Location, formation, and average								
		Holmes Cave (10) 3/ 43°49'45" 110°5'20"	Barbers Point Tepee Trail (7) 43°43'59" 110°0'38"	Pinnacle Buttes Tepee Trail (6) 43°42'28" 110°56'3"	Esmond Park quadrangle Tepee Trail (12) 43°37'51" 109"52'16"	Esmond Park quadrangle Ay Cross 4/ (8) 43°36'22" 109°38'25"	Wind River (2) 43°37'55" 110°51'56"	Range	Average	Number of samples above crustal abundance
Manganese	1,300	1,535	54	255	37	114	85	<10 - 5,000	467	5
Chromium	110	65	67	63	66	28	85	<10 - 300	43	1
Copper	63	18	170	21	43	8	8	5 - 300	45	8
Molybdenum	1.3	5	53	40	4	11	N	<5 - 150	18	24
Vanadium	140	119	436	83	129	78	70	70 - 700	153	16
Tungsten	1.1	N	<50	N	N	N	N	<50 - 70	<50	2
Zinc	94	54	17	36	73	36	45	10 - 400	47	1
Equivalent uranium	ND	<30	76	40	48	40	55	<30 - 130	39	ND

1/ These 45 samples were collected from the formations of Eocene age indicated from the Togwotee Pass, Lava Mountain, and Esmond Park quadrangles by J. D. Love and from the Kisinger Lakes quadrangle by W. L. Rohrer, all from outside the Du Noir Addition.

2/ Estimates from Lee and Yao, 1970.

3/ Samples taken from unnamed formation.

4/ Type section, Love, 1939.

As a further check, J. D. Love collected samples, using a scintillation counter to find material with maximum radioactivity, from the Phosphoria at Stony Point (not on map, but located at 43°32'30" N., 109°43'7" W.; 14 miles (22.5 km) south of the addition). The analytical results are listed in table 6, together with those from the Phosphoria collected in the addition.

These analyses indicate that the Phosphoria in this vicinity is a possible low-grade source of several metals, as it is elsewhere (Service and Popoff, 1964, p. 7). However, none of the trace elements (including vanadium, fluorine, and molybdenum) that occurs in the Phosphoria is being recovered at the large phosphate-mining and -processing plants in southeastern Idaho. Even though it is technologically feasible to recover uranium from this source, it is not now profitable or competitive with uranium from other sources. Even though individual values are high enough to indicate potential resources, the beds are so thin that there is little possibility of a minable resource of any of these elements in the Du Noir Addition.

COAL, PHOSPHATE, AND LIMESTONE

Mineral leasing records of the Bureau of Land Management show Federal coal withdrawals in 1910 for all of T. 43 N., R. 108 W., and T. 43 N., R. 109 W., and phosphate withdrawals in 1912 for parts of the area included within the addition. In 1914, the coal withdrawal was revoked for most of T. 43 N., R. 108 W., including those parts of the township in the addition. At the same time, the land was opened to mineral entry for phosphate in all the withdrawn lands. No phosphate or coal leases have been issued in the Du Noir Addition since the Mineral Leasing Act of 1920, which established phosphate and coal as leasable minerals. In 1966, the U.S. Geological Survey classified T. 43 N., R. 109 W., as coal land, meaning that it may have potential for coal. Thin coal seams occur in the Wind River Formation about 6 miles (10 km) south of the addition. If any of this formation exists in the addition, it would be beneath the Wiggins and Tepee Trail Formations. Consequently, exploration costs would be expensive and the possibility of finding coal seams is slight.

Thin beds of phosphate rock occur in the Phosphoria Formation, as mentioned in the uranium discussion. Thicker, more accessible beds with a higher phosphate content occur throughout western Wyoming and southeastern Idaho (Sheldon, 1963). The phosphate beds in the addition are not of resource value at the present time.

The Madison Limestone was sampled at three localities (fig. 6) to determine the chemical composition of the limestone (table 7). The results suggest that high-quality lime from this area could be a

TABLE 6.—*Selected analyses of bedrock samples from the Phosphoria Formation, Du Noir region, Wyoming*

[eU was determined radiometrically; U, fluorimetrically; Hg, by instrumental atomic absorption; CxHM, colorimetrically; P_2O_5, volumetrically; and other elements by six-step semiquantitative spectrographic analysis. All values are in parts per million except P_2O_5, which is in percent. nd, not determined; <, less than]

Sample	North latitude	West longitude	eU	U	Ag	Cr	Cu	Mo	Pb	Zn	Hg	CxHM	P_2O_5
Areas in or near Du Noir Addition													
D15M	43°45'53"	109°48'18"	30	nd	1	200	10	5	150	1,500	0.10	100	7.5
D16M	43°45'52"	109°48'18"	<30	nd	<.5	150	7	<5	20	<200	.08	30	3.5
D17M	43°45'53"	109°48'19"	50	nd	2	700	50	5	200	1,500	.16	25	13.7
D513R	43°42'58"	109°50'08"	30	nd	<.5	70	20	<5	10	<200	.02	<1	2.7
D514R	43°43'01"	109°50'08"	50	nd	<.5	500	20	<5	20	<200	.02	<1	2.5
D515R	43°43'17"	109°50'09"	60	nd	1.5	700	20	<5	150	1,500	.04	70	10.9
D2515R	43°43'17"	109°50'09"	60	nd	1	300	700	5	100	500	.04	35	9.8
D516R	43°40'15"	109°50'10"	50	nd	2	500	7	<5	150	1,500	.24	50	6.8
D2516R	43°43'15"	109°50'10"	50	nd	2	200	7	10	150	500	.20	35	8.5
D518R	43°43'12"	109°47'41"	30	nd	2	500	7	<5	50	200	.02	7	9.0
D2518R	43°43'12"	109°47'41"	30	nd	2	150	7	<5	50	200	.02	5	9.3
D524	43°45'57"	109°48'57"	<30	nd	<.5	100	50	<5	15	<200	<.02	5	7.0
Stony Point area													
D20M	43°32'30"	109°43'07"	60	nd	10	700	150	5	150	<200	0.16	2	14.0
D21M	43°32'30"	109°43'07"	<30	nd	3	700	5	70	200	1,500	.14	7	17.9
D22M	43°32'30"	109°43'07"	<30	nd	2	700	50	50	200	<200	.12	11	13.9
D23M	43°32'30"	109°43'07"	80	nd	.7	500	20	10	100	1,500	.12	60	20.1
D24M	43°32'30"	109°43'07"	40	nd	3	700	100	5	50	1,500	.50	30	3.6
D25M	43°32'30"	109°43'07"	40	nd	1.5	700	70	<5	50	<200	.22	100	2.2
D26M	43°32'30"	109°43'07"	60	nd	2	700	70	<5	50	1,000	.45	7	1.7
D27M	43°32'30"	109°43'07"	50	nd	1	700	15	<5	15	<200	.22	1	17.5
L73-279A	43°32'30"	109°43'07"	100	80	.5	500	10	<5	15	<200	.10	5	14.7
L73-279B	43°32'30"	109°43'07"	290	310	3	150	20	10	30	<200	.14	5	31.8
L73-279C	43°32'30"	109°43'07"	80	nd	.5	300	5	30	20	1,000	.18	40	14.8

TABLE 7.—*Chemical analyses of limestone from the Madison Limestone*
[Figures are in weight percent; <, less than]

	Sample 4	Sample 18	Sample 22
Major constituents:			
Lime (CaO)	57(±1)	56(±1)	49(±1)
Volatile matter	44(±1)	44(±1)	45(±1)
Calculated calcium carbonate[1/]	101(±1)	100(±1)	94(±1)
Other constituents:			
Silica (SiO_2)	.30	.22	4.6
Iron oxide (Fe_2O_3)	.057	.057	.094
Alumina (MgO)	.062	.042	.062
Titanium oxide (TiO_2)	<.025	<.025	<.025
Moisture	.045	.055	.020

[1/] Calculated by adding lime and volatile matter, which is here considered as carbon dioxide (CO_2).

resource; however, the Madison Limestone is exposed and readily accessible over large areas of western Wyoming and adjacent parts of Montana and Idaho, and the demand for lime in this region is small. High-calcium lime has many industrial and agricultural uses (Hubbard and Ericksen, 1973), but high shipping costs limit mining to areas near its market.

OIL AND GAS

The area southeast of the Du Noir Addition has a history of oil and gas leasing that began in 1946 (fig. 8). The first lease issued for land actually within the addition was in 1955, but by 1972 all of these leases were terminated. No drilling for oil and gas has been done in the addition; the nearest test is a dry hole drilled in 1965 in about the SW¼ sec. 21 (unsurveyed), T. 43 N., R. 107 W. The Dubois oil field in sec. 11, T. 42 N., R. 108 W., is the nearest oil field; it is about 8 miles (13 km) southeast of the addition. This oil field was discovered in 1946, and through 1972 it had produced approximately 98,000 barrels of oil from the Phosphoria Formation.

The Du Noir anticline (fig. 4) is on strike with the Dubois anticlinal complex in which the Dubois oil field is located. However, it is not a good target for oil and gas exploration because it has been deeply eroded into the Devonian rocks and largely stripped of favorable pro-

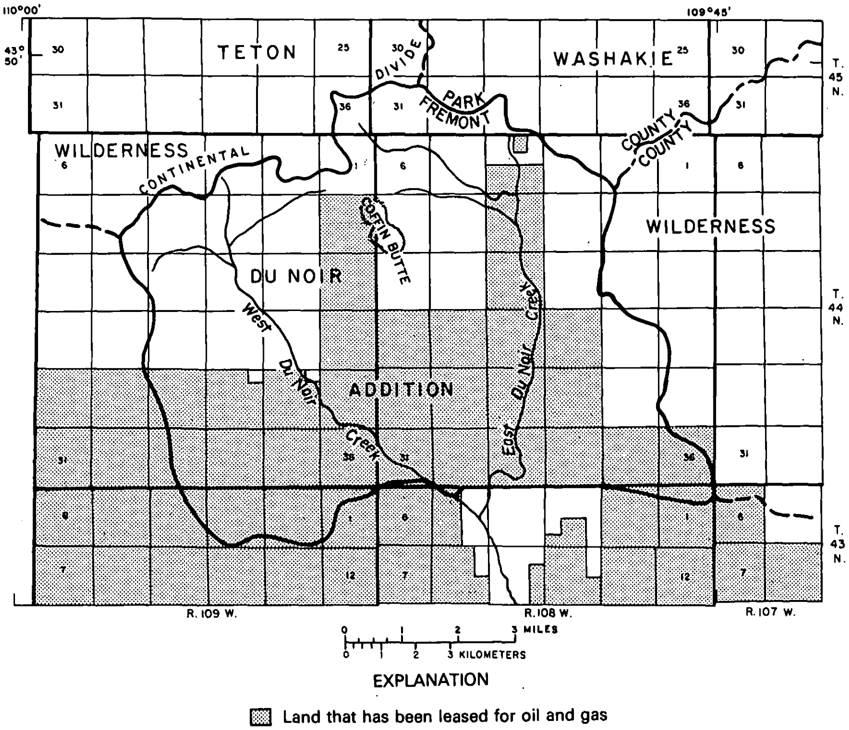


FIGURE 8.—Location of oil and gas leases in and near the Du Noir Addition. Section lines shown are only approximately located. Except for T. 43 N., R. 108 W., which has been surveyed, the townships have not been surveyed or have been only partially surveyed.

ducing horizons. Because the axis of the Du Noir anticline plunges to the southeast, the possibilities for finding oil and gas beneath the volcanics in the addition are considered to be negligible.

BUILDING STONE, GRAVEL, AND SAND

Quantities of good building stone, gravel, and sand are very limited within the addition. The Madison Limestone would be a satisfactory source of building stone; however, stone of equal or better quality can be obtained much more easily near established transportation routes. Deposits of sand and gravel tend to be poorly sorted and of limited extent within the addition; they contain a high proportion of soft volcanic fragments generally unsuitable for concrete aggregate and road metal.

GEOTHERMAL RESOURCE POTENTIAL

The geothermal resource potential within the Du Noir Addition is small. The closest warm or hot spring is an inactive geyser between Geyser Creek and Warm Spring Creek, in the northeast quarter of sec. 32, T. 42 N., R. 107 W., about 11 miles (18 km) south of the Du Noir Addition.

The basaltic rocks on Crescent Mountain, Du Noir Butte, Pinnacle Buttes, and Lava Mountain are late Pliocene and younger and occur along a northeast-trending line, suggesting the presence of a deep-fracture zone along which the magmas rose. A radiometric date (K-Ar, whole rock) that W. L. Rohrer and J. D. Obradovich determined on the basalt at Lava Mountain, which is outside of the study area, gave an age of only 500,000 years (U.S. Geological Survey, 1968, p. 27). Although there are no recognized geothermal anomalies along this zone, it may be a possible target for geothermal energy investigations.

CONCLUSIONS

The results of the present investigation of the Du Noir Addition by the U.S. Geological Survey and U.S. Bureau of Mines show no evidence of significant mineral, fuel, or geothermal potential within the area. Neither the geochemical study nor the geologic mapping revealed any areas of alteration or mineralization, although minor anomalous concentrations of molybdenum and uranium were found in some Permian and Eocene carbonaceous shales. Phosphate rock in the Phosphoria Formation occurs in beds too thin to constitute an economic resource either at present or in the foreseeable future. There are large amounts of very pure limestone in the Madison Limestone within the addition, but equally pure limestone, much closer to transportation facilities, is found throughout this part of Wyoming. Coal was not found in any of the exposed formations. Sand and gravel deposits are all of low quality. The part of the Du Noir anticline within the addition is too deeply eroded to be a likely reservoir of oil and gas, and the absence of warm or hot springs in or near the addition does not favor its geothermal energy potential.

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