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Preliminary Report on the Mineral Resource Potential of the Scab Creek Instant Study Area, Sublette County, Wyoming

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Mineral Surveys

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Instant Study Areas

In accordance with the provisions of the Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976), the U.S. Geological Survey and the U.S. Bureau of Mines have conducted mineral surveys on certain areas, which had been formally identified as "natural" and "primitive" areas prior to November 1, 1975. This report discusses the results of a mineral survey of the Scab Creek Instant Study Area, Sublette County, Wyoming.

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INTRODUCTION

The U.S. Geological Survey and the U.S. Bureau of Mines conducted field investigations to evaluate the mineral resource potential of the Scab Creek Instant Study Area, Sublette County, Wyoming. Fieldwork was conducted by the Bureau of Mines during 1978, and by the Geological Survey during 1979 and 1980. Studies included geological reconnaissance and mapping, geochemical sampling, and examination of possible mineralized areas.

Location, size and geographic setting

The Scab Creek Instant Study Area is about 13 mi (20.8 km) east-southeast of Pinedale, in Sublette County, Wyoming (fig. 1). The study area includes the 6,680-acre (2,705-ha) Scab Creek Primitive Area, plus adjacent areas totaling about 2,700 acres (1,094 ha) on the west. North and east boundaries coincide with those of the Bridger National Forest; the Bridger Wilderness is 1/2 mi (0.8 km) north (pl. 1). The study area lies along the southwest flank of the Wind River Mountains. The crest of the Wind River Mountains lies about 10 mi (16.0 km) northeast, and the gently rolling plains of the northeast part of the Green River Basin verge on the southwest sides of the study area.

The main physiographic feature in the study area is a steep northwest-trending erosional escarpment. The escarpment has been somewhat eroded by glacial scour and meltwater erosion in the Scab Creek and Silver Creek drainages. Above the escarpment is a high-level erosion surface or subalpine pediment that occurs as patches in the eastern part of the study area. Below the escarpment are glacial moraines and outwash terraces between Scab Creek and Soda Lake in the northwest corner of the study area.

Most of the study area is the steep and rocky ground of the escarpment slope, but the part of the east side on the subalpine pediment is relatively flat and dotted with glacial lakes, and the northwest corner of the area is a

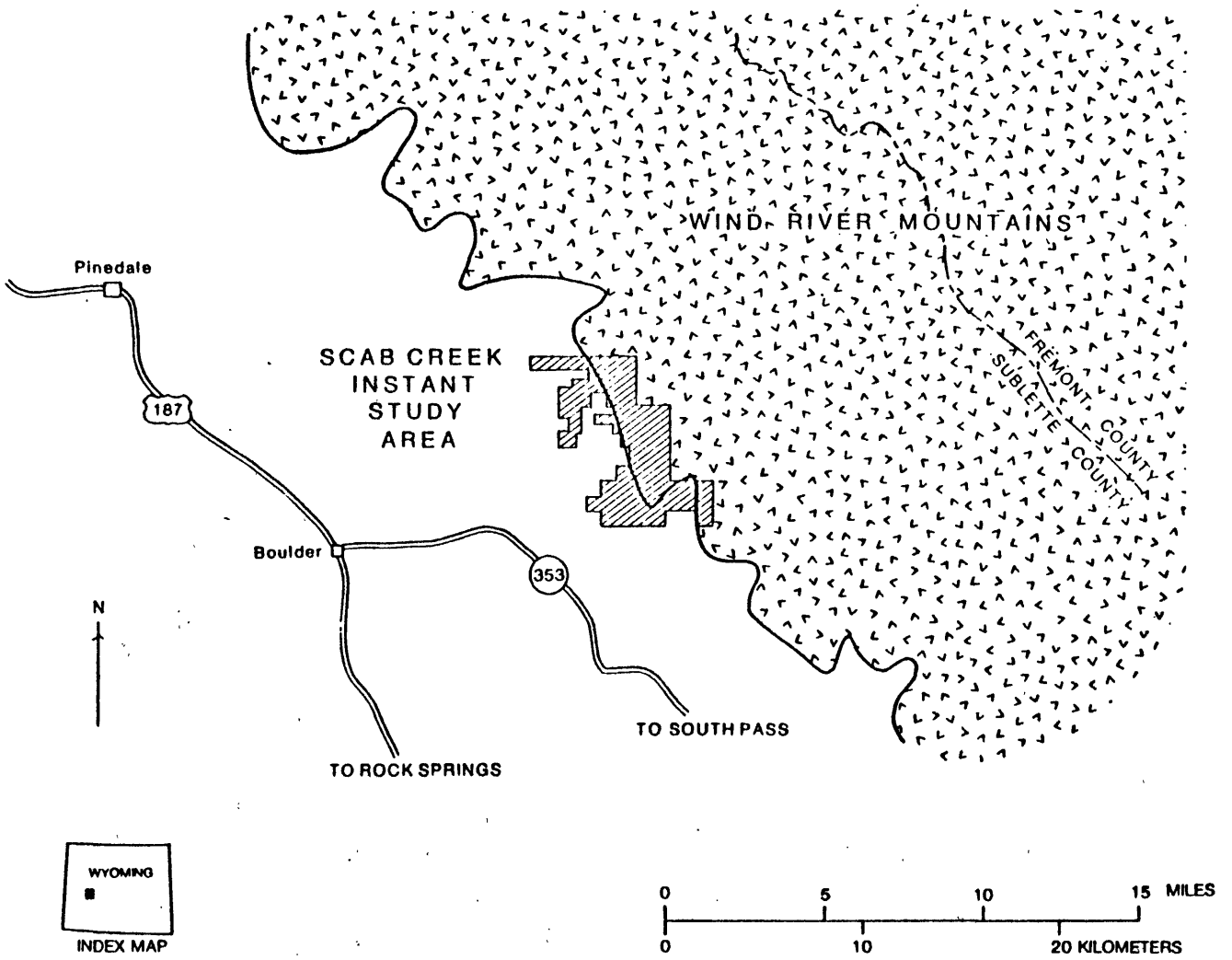

Figure 1.--Index map showing location of the Scab Creek Instant Study Area, Wyoming.

bouldery glacial moraine. Local relief is mostly rugged, with numerous large to small granite knobs on ridges and lining the base of the escarpment. Highest elevations are more than 9,600 ft (2,928 m) along the east part of the area on the subalpine pediment. The lowest elevation is about 7,300 ft (2,226 m).

Access to the area is from Wyoming Highway 353, which leads off U.S. Highway 187 at a point 12 mi (19.3 km) southeast of Pinedale. The north part of the study area is reached by going north, from Highway 353 at a point east of the north end of the Fremont Butte, over a graded road that parallels the west side of the study area and ends at trail heads near the Scab Creek Primitive Area. The south part of the study area is reached by a dirt road that leads eastward from the above-mentioned graded road, past the north end of Lovatt Butte. A few hunting trails lead toward pack trails in the Bridger National Forest.

Geologic setting

The Wind River Mountains are a broad northwest-trending asymmetrical anticline having a core of Precambrian crystalline rocks exposed over an area 125 mi (200 km) long and 25 mi (40 km) wide. The Precambrian rocks have been thrust southwestward over Paleozoic, Mesozoic and Paleocene sedimentary rocks of the Green River Basin during Paleocene and early Eocene time. Eocene and younger mountain-flank sediments covered the west side of the range and the trace of the thrust. Alpine glaciers, moving westward out of the core of the range during the Pleistocene, deposited large moraines and outwash plains along the front of the range.

The Precambrian core of the range is a complex of igneous plutonic rocks and high-grade metamorphic gneisses of dominantly felsic composition. Mafic dikes, mainly diabase, are widely scattered throughout the core. Precambrian

rocks in the very southern part of the range 45 mi (75 km) south of the study area, are low metamorphic grade metasedimentary rocks; these rocks contain the nearest areas of past or present mineral production and include banded ironstone (taconite) and gold deposits associated with quartz veins. Other areas of known mineralization within Precambrian rocks are confined to the Temple Peak area, 9 mi (15 km) southeast, where there are several molybdenite prospects in Precambrian quartz monzonite.

The nature of the Laramide fault along the west edge of the Wind River uplift is not known exactly. There is strong evidence that it is a thrust fault, but the angle of dip and whether it continues into the crust at a relatively low angle or steepens with depth are in question. The west edge of the Wind River uplift has been investigated by numerous shallow refraction profiles by the petroleum industry. Berg (1962) suggested that the fault is a fold thrust with a dip of approximately 20° northeast based upon seismic data in the Big Sandy Opening area, 15 km south of the study area. A gravity profile across the range just south of the study area supported the fold thrust theory (Berg and Romberg, 1966). The displacement along the fault was postulated by Berg to be 30,000 horizontal and 50,000 vertical feet (9,150 horizontal to 15,250 vertical m).

A recent deep seismic reflection profile, the COCORP line, was made across South Pass, 45 mi (70 km) south of the study area (Smithson and others, 1979). This study traced a major structure, presumably the Wind River thrust, to a depth of 15 mi (24 km) at a relatively consistent apparent dip of 35°. True dip of this structure may be as much as 48° (Smithson and others, 1979, p. 5969). The seismic profile contains evidence for folding of the underlying sedimentary beds against the fault with some overturning and dragging of beds upward along the fault.

Mining activity

There is no present or past mining activity in or near the study area. The nearest mineral production is that of iron and gold, about 45 mi (72 km) southeast, in the South Pass Mining District, and the nearest known mineralized area is the Temple Peak molybdenum deposit about 10 mi (15 km) east.

Mining claims have been staked over Fremont Butte, and west of and partly in the south end of the study area east of Lovatt Butte. The only evidence of prospecting activity in or near the study area is a shallow pit on a quartz vein, 1,400 ft (427.0 m) south of the primitive boundary.

GEOLOGY AND GEOCHEMISTRY PERTAINING TO MINERAL RESOURCE ASSESSMENT

Geology

The Scab Creek area is underlain by a Precambrian metamorphic complex of felsic composition, and by Pleistocene glacial deposits in the western part (pl. 1). The Precambrian rocks in the study area are granitic in character but are highly heterogeneous in detail. Three Precambrian map units are recognized; quartz monzonite, quartz diorite, which is confined to the easternmost part of the area, and a transition zone between the quartz diorite and the apparently cross-cutting quartz monzonite (pl. 1). The transition zone is characterized by numerous mafic boudins and mafic and felsic dikes. Two textural varieties of quartz monzonite were observed: one is coarse-grained and porphyritic, with 1-2-cm porphyroblasts of K-feldspar, the other is medium-grained and equigranular. These varieties are intermixed so that it is not possible to differentiate them at the map scale (1:24,000). The quartz diorite is medium grained and equigranular. Similar lithologies occur intercalated throughout the entire depth of a 10,000-ft (3.05-km)-deep drill

hole (as on map) (Ebens and Smithson, 1966) that is just outside the west boundary of the study area (pl. 1). The granitic rocks have scattered inclusions of differing mafic rock that are several inches to several feet in diameter. Locally abundant narrow dikes and pods of aplite and pegmatite, shown as discontinuous veins on the geologic map, crosscut both rock units and generally strike north, or less commonly east.

Plagioclase, K-feldspar, quartz, and biotite are the dominant minerals in all rocks. Hornblende, clinopyroxene, epidote, muscovite, and chlorite are minor to locally abundant constituents. Plagioclase is unzoned and the composition ranges from An25 to An35. The amount of quartz present is consistently from 20 to 30 percent except in some aplite dikes and pegmatites where quartz is much more abundant. Mafic minerals compose from 1 to 15 percent of the rock.

The rocks are foliated as defined by preferred orientation of feldspars and mica and by gneissic layering in the finer grained zones. Foliation generally dips moderately eastward. Several shear zones with a general north trend cut all Precambrian rocks. These are irregular zones several feet to tens of feet wide where the rock is extensively fractured and broken. Epidote and chlorite are common in and along the shear zones and some fractured zones have been silicified. Most of the zones contain mylonite and stringers of fault gouge, possibly indicative of movement during the Laramide orogeny. The Precambrian rocks are also strongly jointed along north and east trends.

No obvious mineralization is present in the study area. A few east-trending quartz veins occur in the southwest corner of the study area and immediately south of the boundary. These veins are short, narrow, and discontinuous and have no economic significance. Small pods of quartz-feldspar pegmatites occur scattered through the coarser phases of the quartz

monzonite. Most are less than 2 meters in length. There are several fine-grained felsic dikes in the westernmost and southwestern part of the study area that are similar in lithology to the dikes in Fremont Butte, 3 mi (5 km) southwest, which contain anomalous, but not economic, concentrations of thorium. The dikes in the study area are north trending, and, although commonly continuous for considerable distances, they are narrow and widely scattered.

Gravels of Tertiary age occur in a small area just west of the boundary of the Scab Creek Instant Study Area (pl. 1). These deposits are composed of deeply weathered boulders and cobbles of Precambrian crystalline rocks set in a medium- to coarse-sand matrix, and are similar to rocks of the Ogallala Formation that crop out at Halfmoon Mountain, 6 mi (10 km) north (Richmond, 1973).

Glacial deposits exposed in the study area are composed of till in terminal and lateral moraines of three Pleistocene glaciations: Sacagawea Ridge, Bull Lake, and Pinedale, from oldest to youngest. Till of the Pinedale Glaciation is most abundant (pl. 1). Just west of the study area, several undifferentiated terrace gravels (pl. 1) overlie outwash gravels of the three glaciations. The tills are all composed of an unsorted mixture of subangular to rounded boulders, cobbles, and pebbles in a gray silty to sandy matrix. Stones in the tills are of Precambrian crystalline rocks and many are striated. The topographic expression of the moraines and degree of weathering of the till is different for each glaciation. Pinedale moraines are very bouldery and hummocky and generally have steep fronts. Stones in the Pinedale Till are mostly unweathered except at the surface where they are slightly weathered. Bull Lake moraines have smooth to gently rolling surfaces with fewer projecting boulders and closed depressions than on the Pinedale

moraines. Stones in the Bull Lake Till are moderately weathered, and many at the surface are fractured and deeply pitted by weathering. Sacagawea Ridge moraines are smoother and have fewer projecting boulders than Bull Lake moraines. Stones in the Sacagawea Ridge till are mostly deeply weathered.

These terrace gravels are composed of boulders, cobbles, and pebbles of Precambrian crystalline rocks in a sand matrix. The deposits are poorly sorted and weakly bedded. There are lenses of poorly sorted arkosic sand within the gravel deposits.

Colluvium consists of a gray to yellowish-brown mixture of stones, sand, and silt, developed on moderate slopes below Precambrian outcrops or Pleistocene moraine and terrace deposits. Alluvium deposits are dark-gray-brown, humic, sandy silt and silty sand on flood plains and in depressions in till. Along Scab Creek and lower Silver Creek, the alluvial deposits include irrigated meadows on Pinedale outwash.

Geochemical sampling

Geochemical sampling was done during geologic reconnaissance. Samples for analysis were collected of stream sediment, panned concentrates of stream gravel, and of fresh and altered rock. Locations are shown on plate 1. The purpose was to discover minor quantities of metals that might be indicative of mineral deposits. A total of 75 samples were analyzed by the laboratories of the U.S. Geological Survey, but none suggest the presence of mineral deposits.

Stream-sediment samples were collected from all the active and many intermittent streams that drain the study area. The samples were chosen from the finest grained active-stream sediment available. An effort was made to collect sediment that was silty or muddy; all samples were sieved and only the 80-mesh fraction was analyzed. Each of the stream-sediment samples consisted of several ounces of material collected by hand. At 11 sample sites, 1 to 2

pounds of sand and gravel from the stream bed were panned and the resulting heavy-mineral concentrate analyzed. Two rock samples were collected from the locality; one was chemically analyzed and the other studied by petrographic microscope.

All samples were analyzed for 30 elements by semiquantitative spectrographic analysis by R. T. Hopkins, U.S. Geological Survey, Denver, Colorado. No anomalous concentrations of any element were found; the analyses indicate that rocks of the Scab Creek study area are not mineralized and only reflect the normal composition of the rock type analyzed.

MINING DISTRICTS AND MINERALIZED AREAS

The Scab Creek Instant Study Area is not within a mining district. Some 21 recorded mining claims near the southwest end of the study area, north and east of Lovatt Butte, were located by the private surface owner in 1968, avowedly to cover and protect his private surface (pl. 1). No workings or evidence of mineralization were observed on the claims.

Localities investigated for possible mineral interest were in and near two areas of reported radiometric anomalies, the area of mining claims, and an area of quartz veins. A total of 25 rock samples and specimens were taken. All were fire assayed for gold and silver, and analyzed by 6-step semiquantitative spectrographic analysis for 43 elements. The granite samples and specimens were radiometrically analyzed specifically for uranium and thorium. The results of all the analyses are not presented in this report. Although some of the samples contained anomalous silver and thorium and about half of the samples were anomalous in either titanium or barium, or both, no visible mineralization was anywhere observed. The sample locations are shown on plate 1.

One of the radiometric anomalies is reported by V. Mrak (oral commun., 1978) to have been detected, presumably by AEC airborne reconnaissance, in the Lovatt Creek headwaters area, inside the study area on the south. A gamma ray spectrometer survey was made and 12 outcrop specimens were taken during the present investigation from the granite rim above the Lovatt Creek headwaters. No mineralized rock was observed. Several above-background readings were obtained with the spectrometer, but only on broad-background reception. The specimens were analyzed for uranium and thorium; no uranium above detection limits was present, but thorium contents range from 0.002 percent (0.002 percent THO_2) to 0.009 percent (0.01 percent THO_2).

The other radiometric anomaly, reported by Love (1954), lies over Precambrian granites in the Fremont Butte vicinity 3 mi (4.8 km) southwest of the study area and consists of measurements of radioactivity that were several times background. In a geiger counter survey made during the present investigation, over Lovatt Butte, 1 mi (1.6 km) west of the study area, which is the granite outcrop nearest Fremont Butte but closest to the study area, anomalous radioactivity was not detected, but radiometric analyses of two chip samples did contain 0.004 and 0.006 percent Th (0.005 and 0.007 percent THO_2), values that are not unusual for granitic rocks of the type exposed in the Scab Creek study area.

Also at Lovatt Butte, an 18-ft (5.5-m) chip sample of a biotite schist with feldspar segregation layers contained 0.01 oz gold and 2.9 oz silver per ton. A granite sample from the butte had 2.2 oz silver per ton.

Several quartz veins occur near, but outside the southwest corner of the study area. Samples from these veins contained nil to 0.4 oz silver per ton.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Thorium

The radiometric anomalies over granitic rock, inside the study area above Lovall Creek, and outside the study area at Fremont Butte, are probably due to relatively high thorium contents, rather than to uranium. The median thorium amount shown by the radiometric assays, of the 12 specimens from above Lovatt Creek, and also of all 16 granitic rock specimens taken, is 0.004 percent. Although this amount is more than twice the average thorium found in most granites (Turekian, 1961), it is not higher than expected for higher grade metamorphic and related igneous terrains containing felsic dikes and pegmatites. The relatively high thorium content in the Scab Creek area is, therefore, probably duplicated throughout the Wind River Mountains.

Although future needs for thorium could be great, because thorium is known to be usable as a fuel for nuclear reactors, the current meager needs for thorium, for use in alloys, in gas mantles, and so on, are satisfied with byproduct thorium from uranium deposits and rare earth mineral placers. In order for thorium to be mined for its own sake, the demand would have to exceed the potential supply of byproduct thorium. Low-grade, expensive-to-mine disseminated deposits in granitic rocks will probably not be economical for many years because they would be bypassed in favor of high-grade veins, placers, and massive carbonatites (Staatz and others, 1979).

Since the thorium in the granitic rocks of the Scab Creek study area is probably no higher grade than elsewhere in the Wind River Mountains, and other types of rock contain higher grade and easier to mine deposits, the thorium in the study area does not appear to constitute a significant resource.

Oil and Gas

Although the surface exposures in the Scab Creek area are all Precambrian crystalline rocks, there is a possibility of sedimentary rocks at depth, below a faulted wedge of the crystalline rocks. There is strong evidence that the major structure along the west edge of the Wind River uplift is a low-angle thrust fault that places a wedge of Precambrian crystalline rocks onto sedimentary rocks of the Green River Basin. The sedimentary rocks present may contain natural gas, since they would probably include Paleocene (Fort Union) and Upper Cretaceous (Lance-Lewis-Almond, undifferentiated) formations, which do contain natural gas in the as-yet-untapped Pinedale anticline, the axis of which runs parallel to the study area about 15 mi (24.2 km) to the southwest.

Sedimentary rocks beneath the thrust would also probably be in drag positions, favorable for upward migration of hydrocarbons, with containment provided by fault gouge across the upturned edges. The permeability of the rocks would probably be low, however, as is the case with most reservoir rocks of Green River Basin oil and gas fields, and may be practically nonexistent, as is true of the tight sands in the Pinedale anticline.

Most Federal land in the study area, and within 2 mi (3.2 km) basinward outside the study area, is under lease. The closest known drill hole is in sec. 29, T. 31 N., R. 108 W. It is 10,694 ft (3,262 m) deep and is one of a number of shut-in gas wells on the Pinedale anticline.

The depth through the Precambrian crystalline rocks into underlying sedimentary rocks in the Scab Creek Instant Study Area is not known exactly. A 10,000-ft (3,050-m)-deep drill hole just west of this area was entirely in Precambrian rocks with no evidence of major faulting. Depending upon actual dip of the fault and where its trace lies, the depth to sedimentary rocks at the westernmost point of the Scab Creek area is 15,000-30,000 ft

(4,500-10,000 m) or more. The actual depth is probably closer to 30,000 ft (10,000 m), because the 15,000-ft (4,500-m) estimate is based upon an assumed average dip of 30° for the fault and an assumed location of the surface trace of the major thrust zone at the westernmost Precambrian exposures just west of Fremont Butte. Both assumptions are probably too optimistic. The depth to sedimentary rocks along the eastern boundary of the Scab Creek area might be in excess of 24,000 ft (7,000 m) even under most favorable conditions and possibly as much as 45,000 ft (14,000 m).

The potential for oil and gas in sedimentary rocks below the Wind River thrust is very real and will have to be considered in detail during the evaluation of the Bridger Wilderness and surrounding areas. In the Scab Creek area the potential is not high because the area is small, there are no adjacent fields or discoveries, the depth through the crystalline rocks is probably excessive, and although the nature of the underlying sedimentary rocks is unknown, they probably have very low permeability.

Other commodities

The sand and gravel of the glacial moraine and terrace deposits between Soda Lake and Scab Creek is too remote to have commercial importance. Similarly, common rock for construction purposes is too remote to be quarried economically.

No leases have been issued in the study area for any leaseable mineral other than oil and gas.

A geothermal resource might be indicated by warm springs along a probable fault zone about 3 mi (4.8 km) outside the area at Fremont Butte. However, there is no reason to suspect the presence of a shallow magma chamber, as no young volcanic rocks are nearby, and the Wind River Mountains are probably a rootless thrust feature.

Coal may occur at depths of perhaps 5,000 ft (1,525 m) in Cretaceous rocks that probably underlie the thrusted granite, but there are no known deposits.

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