

**MINERAL RESOURCE POTENTIAL OF MOUNT NAOMI ROADLESS AREA, CACHE COUNTY,
UTAH, AND FRANKLIN COUNTY, IDAHO**

By

**James H. Dover, U.S. Geological Survey
and
Philip R. Bigsby, U.S. Bureau of Mines**

STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and related acts, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, 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. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Mount Naomi Roadless Area (04758), Wasatch and Caribou National Forests, Cache County, Utah, and Franklin County, Idaho. Mount Naomi Roadless Area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

**MINERAL RESOURCE POTENTIAL
SUMMARY STATEMENT**

Geological, geophysical, and geochemical investigations have been conducted to assess the mineral resource potential of the Mount Naomi Roadless Area (hereafter referred to as "study area"), northeastern Utah and southeastern Idaho. The study area is in the Bear River Range and contains a thick section of upper Precambrian and Cambrian quartzitic and calcareous strata within a major thrust sheet known as the Willard allochthon. Tertiary sediments unconformably overlie the allochthon and are both cut by high-angle normal faults having large displacements.

Known mines and prospects are in areas containing sparse lead-zinc and copper mineralized rock. These stratabound mineralized areas form a distinct north-northeast-trending zone along the outcrop belt of Middle Cambrian limestone beds. This zone has a low potential for base metal and barite deposits, as indicated by the discontinuous and disseminated character of mineralized rock, relatively low concentrations of metals, and near lack of past production. No significant precious metal, base metal, other trace metal, or uranium anomalies are apparent in the geochemical data from the Mount Naomi Roadless Area. Potential sources of limestone and quartzite for building or agricultural purposes are present within the study area but are less accessible or farther from markets than those currently being quarried nearby.

The study area is 12 mi (19.2 km) west of the nearest oil- or gas-producing wells of the Overthrust Belt. The geology inferred for the study area allows for possible subsurface oil and gas concentrations, but this possibility cannot be evaluated without seismic or drill-hole information. However, potential targets would probably be at depths greater than the 20,000- to 30,000-ft (6,100- to 9,100-m) thickness estimated for the Willard allochthon—depths that may be prohibitive.

A phosphatic zone likely to be found within Mississippian carbonate rocks of the study area is probably too thin to be a resource.

INTRODUCTION

This report summarizes field and laboratory investigations made in 1979 and 1980 by the U.S. Geological Survey and the U.S. Bureau of Mines to evaluate the mineral resource potential of the Mount

Naomi Roadless Area ("Mount Naomi" is designated as "Naomi Peak" on current U.S. Geological Survey topographic maps). Investigations included geologic mapping (Dover, in press), geophysical studies (Mabey, in press), geochemical sampling (Dover and others, in press), and a survey and sampling of known mines and

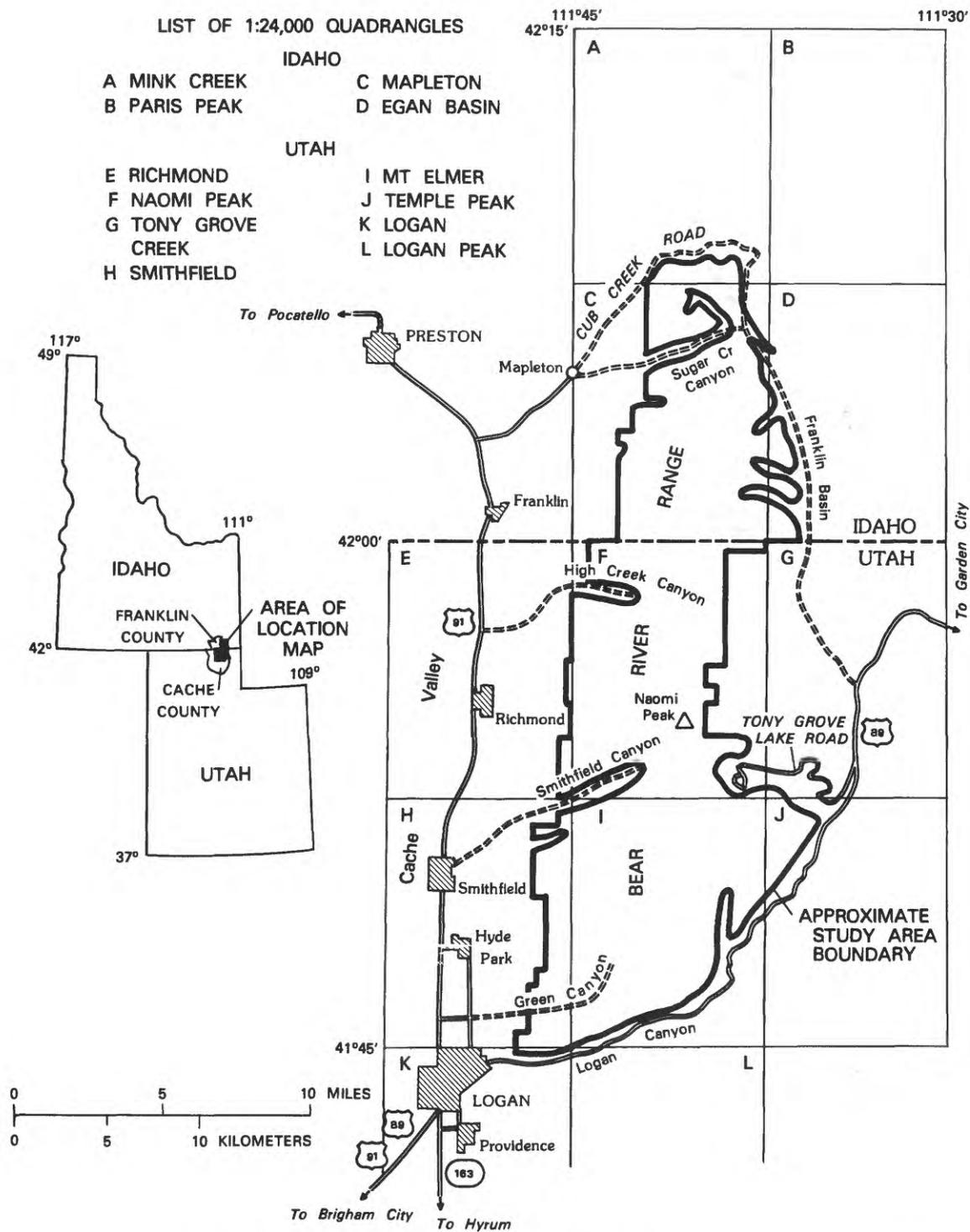
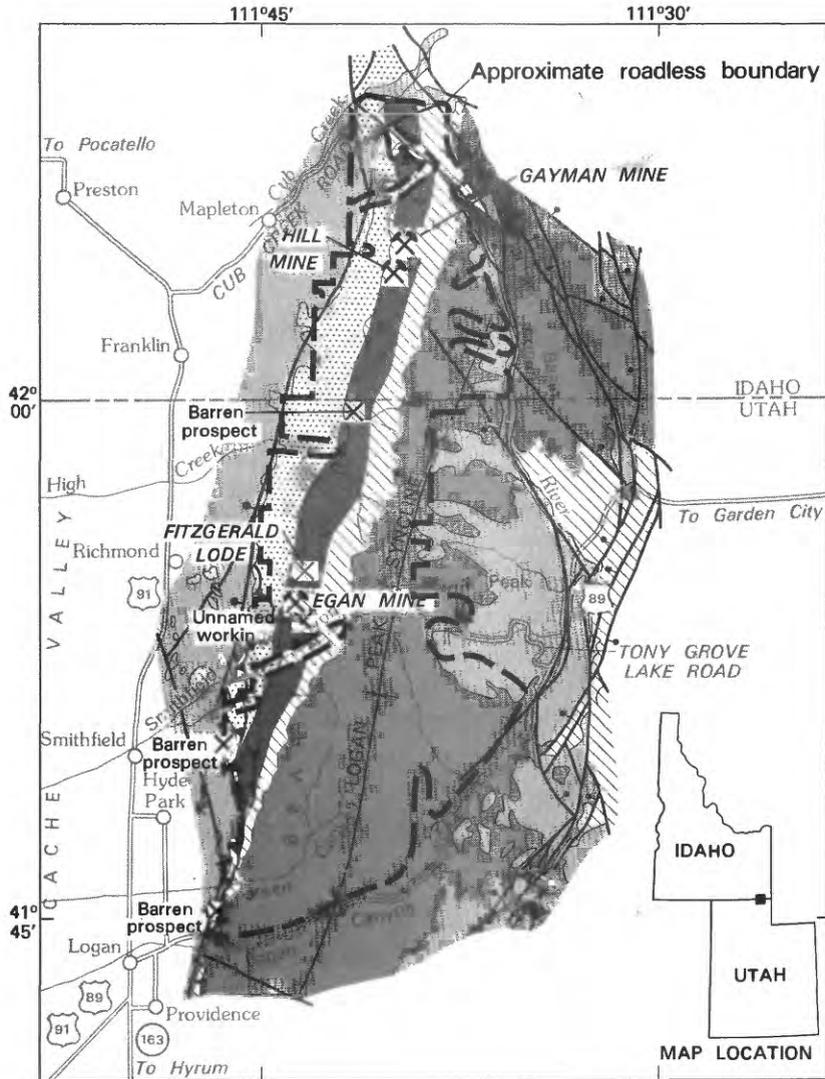


Figure 1.—Index map showing location of the Mount Naomi Roadless area (04758).



0 5
MILES

EXPLANATION

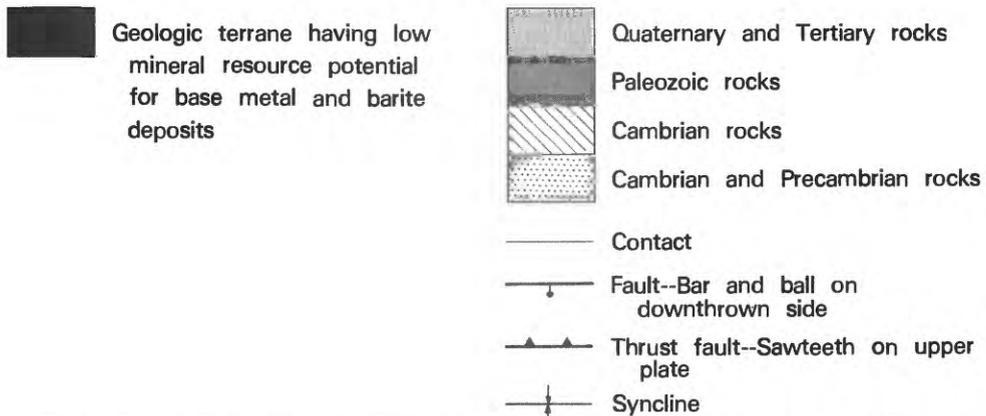


Figure 2.—Simplified geologic map of the Mount Naomi Roadless Area showing area of low mineral resource potential.

prospects (Bigsby, 1982). Data presented in the following sections are integrated in evaluating the mineral resource potential of the Mount Naomi Roadless Area.

Location, size, and geographic setting

The Mount Naomi Roadless Area (fig. 1) extends 28 mi (45 km) along the crest of the Bear River Range, from near Logan, Utah, to a point east of Preston, Idaho. Cache Valley is along the west edge of the study area and Bear Lake is about 12 mi (19 km) to the east.

The study area encompasses about 107,520 acres (43,512 ha), including 67,737 acres (27,412 ha) in Utah and 39,783 acres (16,100 ha) in Idaho.

Altitudes along the crest of the Bear River Range rise gradually from about 9,000 ft (2,745 m) in the Idaho part of the study area, to nearly 10,000 ft (3,050 m) in the Utah part. Maximum topographic relief is about 4,800 ft (1,465 m) along the steep west face of the range in Utah, which is characterized by rugged box canyons. The crest and east flank of the range have comparatively gentle slopes, except for a few small glacial cirques just east of the range crest.

U.S. Route 91 connecting Logan, Utah, and Preston, Idaho, is a few miles west of the study area. The study area is bounded on the south by U.S. 89 through Logan Canyon, and on the north and northeast by graded gravel and dirt roads connecting Routes 89 and 91 via Cub Creek and Franklin Basin. Spur roads providing limited access to the interior of the study area are shown in figure 1. A network of well-maintained horse and foot trails provides good access to most parts of the study area.

Geologic Setting

The Bear River Range is within the western part of the eastern Cordilleran fold and thrust belt commonly referred to as the Overthrust Belt. The range splays northward from the Wasatch Mountains, which form the eastern margin of the Basin and Range physiographic province.

The study area contains a thick section of quartzitic and calcareous marine sediments deposited on a continental shelf that existed along the western margin of the North American craton in late Precambrian through Paleozoic time. These rocks, representing at least 400 m.y. of nearly continuous sediment accumulation, are more than 27,500 ft (8,380 m) thick in the study area. Tertiary rocks overlap Paleozoic and older rocks on a major angular unconformity.

The rocks of the Bear River Range are exposed in a gently eastward-tilted fault block in which are preserved several broad folds. All of the pre-Tertiary rocks of the range were emplaced in their present location along a major system of deeply buried thrust faults, from an original site of deposition far to the west. The main thrust sheet, known as the Willard allochthon, extends from Cache Valley east to Bear Lake, and from Ogden, Utah, north to the Snake River Plain in Idaho. Thrusting had ceased by the time major block faulting began. Within the study area, most Tertiary rocks are preserved in structural depressions bounded by normal faults.

Mining Activity

Old mines and prospects are in eight places in the Mount Naomi Roadless Area; most appear to be more than 50 years old. No current or recent mining activity is evident in or near the roadless area, but continued interest in prospecting is indicated by courthouse records of the claim filings.

GEOLOGY

The geology of the Mount Naomi Roadless Area was extensively remapped in 1979 and 1980 during this study, but some earlier mapping by Williams (1948), Oriel and Platt (1968), Galloway (1970), and Mendenhall (1975) in areas not re-examined in detail is incorporated in the present map (fig. 2).

Pre-Tertiary stratigraphic units within the study area range in age from Late Proterozoic through Permian. Rocks of Late Proterozoic and Early Cambrian age are mainly quartzite and conglomeratic to arkosic quartzite, having minor interbeds of micaceous and hematitic siltstone, and are more than 13,000 ft (3,960 m) thick. The Middle Cambrian and younger Paleozoic section consists mostly of limestone and dolomite, but quartzite, sandstone, and siltstone interbeds, and zones of mixed lithologies form important marker horizons within the carbonate section. The thickness of Middle Cambrian and younger Paleozoic rocks is at least 14,500 ft (4,420 m).

The thrust fault inferred at the base of the Willard allochthon is estimated to be at a depth of 20,000-30,000 ft (6,100-9,100 m) below the study area, based on the exposed thickness of rocks within the allochthon and the assumption that the thrust generally parallels bedding. The Willard thrust zone is not exposed within the study area but does crop out nearby to the south and east. Eastward movement of large magnitude is indicated for the Willard thrust sheet by the sense of internal structural overturning and the degree of regional facies telescoping involved. Synorogenic conglomerates derived from the Willard allochthon and preserved east of the study area indicate a latest Jurassic to Late Cretaceous age for Willard thrusting. Above the Willard allochthon is another large thrust fault, the Providence Canyon thrust, which is exposed along the west flank of the Bear River Range and probably extends westward under Cache Valley.

The axis of the Logan Peak syncline plunges gently S. 15° W. and generally parallels the crest of the Bear River Range. The syncline is 5-10 mi (8-16 km) across and asymmetrical to the east; it probably terminates in the subsurface at the Willard thrust, just as comparable folds exposed elsewhere at the leading edge of the Willard allochthon are truncated at the sole thrust. Logan Peak syncline and related smaller folds probably formed as a result of movement along the Willard thrust, but at least some of the asymmetry and overturning of the west limb could be a result of drag beneath the overriding Providence Canyon thrust (Williams, 1948).

High-angle normal faults having moderate to large displacements flank the Bear River Range. Though steep at the surface, these faults are thought to flatten with depth and merge with the Willard and Providence Canyon thrusts in the subsurface. A

complex history of recurrent or intermittent movement at least since mid-Tertiary time is inferred for the fault zones. The fault zone along the west flank of the Bear River Range probably has at least a few thousand feet of cumulative movement, but stratigraphic control on the amount of displacement is lacking. The fault zone east of Logan Peak syncline may have as much as 7,000 ft (2,100 m) of cumulative down-to-the-west movement, sufficient to account for the 5°-15° of eastward tilting observed for the range as a whole.

GEOPHYSICS

Geophysical data show no local anomalies within the Mount Naomi Roadless Area indicative of buried intrusives or other features that might be associated with metallic mineral deposits. Most of the prominent geophysical features recognized (Mabey, in press) occur in Cache Valley, west of the study area. The study area itself is characterized by relatively featureless gravity and magnetic contour patterns of low relief. Available geophysical data do not indicate the thickness of sedimentary rocks underlying the study area, but there is no evidence of shallow metamorphic basement, and the data are consistent with a thick layer of sediments underlying one or more thrust faults.

GEOCHEMISTRY

Of the 310 samples collected for geochemical analysis in the Mount Naomi Roadless Area, 191 were stream sediments (including 16 panned concentrates), 59 were rock samples representing the major rock types and formations of the study area, and 60 were water samples from 12 surface streams and 48 springs. All rock and stream-sediment samples (including panned concentrates) were analyzed for 31 elements by semiquantitative emission spectrography (Dover and others, in press). All rock and stream-sediment samples were also analyzed for copper, lead, and zinc by atomic-absorption flame spectrometry, and were scanned by a scintillometer. Techniques used for analyzing water samples are described by McHugh (1981).

No significant concentrations of elements or element distribution patterns are evident in the analytical data from the Mount Naomi Roadless Area. Of the 31 elements determined analytically, 9 were either not detected in any rock or sediment sample or were detected in concentrations smaller than the limits of quantitative determination, and two other elements are present in measurable amounts in only a few samples. Most of the other 20 elements are present at or below average levels of abundance in sedimentary rocks or in amounts too low to warrant further consideration. Barium, beryllium, copper, lead, and zinc values defined as high or anomalous (Dover and others, in press) are only relatively so for the data set considered, and may not represent significantly anomalous concentrations. The main exception is one panned concentrate sample in which unusually high barium, lead, strontium, and zinc can be traced upstream to dumps of the City Creek mine. Two other rock samples high in barium are from altered zones of limited extent along the southern

edge of the study area; these altered zones have no obvious associated mineralized rock and are not enriched in other elements.

Most rock samples containing relatively high barium (200-1,500 ppm), beryllium (1-5 ppm), copper (20-100 ppm), and zinc (40-120 ppm) values are from upper Proterozoic and Cambrian siltstone and shale. These values may reflect concentrations of these elements established soon after deposition of the original sediments, possibly during diagenesis. Similarly, stream-sediment samples having relatively high barium (1,000 ppm), beryllium (3 ppm), lead (70-100 ppm), and zinc (110-130 ppm) contents, which are present mainly along the west side of the study area just north of the Idaho State line, have no recognized mineralized source and most likely reflect the relatively high background levels of the upper Proterozoic and Cambrian rocks drained by these streams. Stream sediments having relatively high copper values (70-100 ppm) also occur mainly in the northwest part of the study area underlain by upper Proterozoic and Cambrian rocks, near mine workings and prospects containing sparse disseminated copper-sulfide minerals. The only two samples containing detectable precious metals have comparatively low concentrations of silver (1.0-1.5 ppm) and are of questionable significance. Scintillometer readings show no significant radioactivity in any sample from the study area. No anomalous trace metal values were found in water samples collected from the study area.

MINING DISTRICTS AND MINERALIZED AREAS

Richmond mining district

The Richmond mining district, named for the town of Richmond, Utah, probably includes all workings within the Utah part of Mount Naomi Roadless Area. The district was organized in 1894 and contained 15 mines. Recorded output, which included production from the Hyrum (Paradise) mining district just south of the study area, is limited to small amounts of lead, zinc, copper, silver, and gold ores shipped from the towns of Hyrum, La Plata, Logan, Paradise, Richmond, and Smithfield (Butler and others, 1920). Production from specific properties inside the study area is not known, except for the patented Fitzgerald Lode east of Richmond (Bigsby, 1982, table 1), which shipped about 100 short tons of lead-silver ore, probably in the 1920's or 1930's. The Eagan mine on the south fork of City Creek has over 140 ft (42.7 m) of workings, but no known production. Samples from the Eagan mine contained small amounts of lead and zinc.

Other mining districts outside the roadless area

The closest mines outside the study area are 7-9 mi (11-14 km) away, in the Swan Creek (Garden City, Utah), Hyrum (Paradise, Utah), and Bear Lake (Paris, Idaho) mining districts. These districts contain lead-silver-copper replacement deposits along bedding planes and fracture zones in dolomitized limestone; these deposits are similar to mineral occurrences in the study area.

Inside the roadless area are three patented mining claims—Fitzgerald Lode (one claim) and Mine Hill (two claims)—and about 350 unpatented claims. The descriptions of most unpatented claims are vague in the location notices. Prospecting probably began in the late 1860's and early 1870's after minerals were discovered west of Salt Lake City. The earliest known claims were filed in the mid-1880's.

Mines and prospects were found in eight sites (Biggsby, 1982, table 1) in the study area: along the south and north forks of City Creek, in Smithfield Canyon, in Dry Canyon, along the North Fork of High Creek, north of Logan Canyon, and north and south of Maple Creek (fig. 2). Samples taken at the workings include chip samples across visible or suspected zones of altered or mineralized rock, and grab samples from dumps. All samples were fire-assayed for gold and silver and analyzed spectrographically for 40 elements. Of the eight sites, three are barren and five contain lead-zinc or copper minerals disseminated parallel to bedding in Middle Cambrian limestone country rock. Three sites containing lead-zinc minerals are on the south (Eagen mine) and north (Fitzgerald lode) forks of City Creek and in Smithfield Canyon, and two containing copper are south (Hill mine) and north (Gayman mine) of Maple Creek. These five workings and one of the barren prospects are along a north to north-northeast-trending belt of Middle Cambrian limestone exposures extending the length of the study area. Many of the workings show no evidence of faults or other deformational features, and where small faults or breccia zones are present, they do not appear to have confined or concentrated mineralization. Base metals are sparse and scattered at all workings examined. Although base metals, where present, are usually associated with barite, not all barite occurrences contain base metals; the total quantity of barite is probably also small, because the barite occurs as scattered and discontinuous veins.

Quarries

Mississippian Monroe Canyon Limestone is quarried in Providence Canyon, 4 mi (6.4 km) south of the roadless area, for use in sugar-refining plants; this formation also caps Beirdneau Peak in the southern part of the study area. Quartzite for road metal has been quarried from the Geertsen Canyon Quartzite in Worm Canyon, about 10 mi (16 km) north of the study area; Geertsen Canyon Quartzite is also exposed in the lower slopes along much of the Mount Naomi Roadless Area. Rounded boulders and cobbles of Geertsen Canyon Quartzite from Logan River alluvium have been used locally in precast panels for decorative building facings. Inside the roadless area in Green and Smithfield Canyons, inactive limestone quarries in the Garden City and Bloomington Formations probably supplied building stone and lime for local use. Quartzitic sandstone of the Swan Peak Formation in Green Canyon was also quarried for use in building the Logan Temple.

Nearly all the Federal land in the Mount Naomi Roadless Area has been leased for oil and gas. The study area is about 12 mi (19.2 km) west of the westernmost oil- and gas-producing wells of the Overthrust Belt. Jurassic reservoir rocks of the Overthrust Belt are not exposed in the roadless area but could be present in the subsurface below the Willard allochthon.

No leases have been issued in the study area for other leasable minerals.

A thin phosphate zone in the Mississippian Little Flat Formation is present in the Millville Canyon area about 6 mi (9.6 km) south of the study area, where samples collected by C. A. Sandberg contain 9.4 to 28.4 percent P_2O (U.S. Geological Survey unpub. computerized (RASS) data). Elsewhere in the Bear River Range, the phosphorite occurs in a few layers several inches to a few feet thick within the lower part of the Little Flat Formation. The same zone is probably present in outcrops at high elevation within the southern part of the roadless area, but is likely to be of similar thickness as well as poorly accessible.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

A low mineral resource potential for base metals and barite is assigned to a north-northeast-trending zone along the outcrop belt of Middle Cambrian limestone beds. Old workings at five places in the zone contain stratabound disseminated lead-zinc and (or) copper minerals associated with barite in limestone country rocks. A low resource potential is assigned because of the discontinuous and disseminated distribution of the minerals, the relatively low concentrations of metals, and the near lack of past production.

No significant precious metal, base metal, other trace element, or uranium anomalies are apparent in the geochemical data from the roadless area, and no new exploration targets have been detected. Slightly higher than average concentrations of barium, beryllium, copper, lead, and zinc are probably too low to be of exploration significance and appear to be derived from metals disseminated in Cambrian shales.

Potentially quarriable limestone and quartzite are present within the study area, but more accessible sources closer to markets are currently being utilized to the limit of present demand.

Thin phosphatic interbeds in Mississippian strata probably crop out at high altitude within the study area but are likely to be too thin and widely spaced to be important. Much more abundant and accessible phosphate is available in the Permian rocks of the region.

The oil and gas potential of the study area is unknown. Considering the nearby presence of potential petroleum source beds and the structure inferred for the study area, oil or gas concentrations could be present beneath the Willard allochthon. This possibility cannot be evaluated without seismic or drill-hole information. However, potential targets would probably be at depths greater than the 20,000- to 30,000-ft (6,100- to 9,100-m) thickness estimated

for the Willard allochthon—depths that may be prohibitive.

No other leasable mineral deposits are known to be in or near the Mount Naomi Roadless Area.

REFERENCES CITED

- Bigsby, P. R., 1982, Mineral investigation of the Mount Naomi RARE II Further Planning Area, Cache County, Utah, and Franklin County, Idaho: U.S. Bureau of Mines Open-File Report MLA 126-82.
- Butler, B. S., Loughlin, G. F., Heikes, V. C., and others, 1920, The ore deposits of Utah: U.S. Geological Survey Professional Paper 111, 672 p.
- Dover, J. H., in press, Geologic map of Mount Naomi Roadless Area, Cache County, Utah, and Franklin County, Idaho: U.S. Geological Survey Miscellaneous Field Studies Map MF-1566-B, scale 1:100,000.
- Dover, J. H., McGimsey, R. G., and McHugh, J. B., in press, Geochemical maps of Mount Naomi Roadless Area, Cache County, Utah, and Franklin County, Idaho: U.S. Geological Survey Miscellaneous Field Studies Map MF-1566-D, scale 1:100,000, 2 sheets.
- Galloway, C. L., 1970, Structural geology of eastern part of the Smithfield quadrangle, Utah: Logan, Utah State University M.S. thesis, 115 p.
- Mabey, D. R., in press, Geophysical maps of Mount Naomi Roadless Area, Cache County, Utah, and Franklin County, Idaho: U.S. Geological Survey Miscellaneous Field Studies Map MF-1566-C, scale 1:100,000.
- McHugh, J. B., 1981, Analytical results for 60 water samples from Mount Naomi Wilderness Study Area, Utah-Idaho: U.S. Geological Survey Open-File Report 81-196, 18 p.
- Mendenhall, A. J., 1975, Structural geology of eastern part of Richmond and western part of Naomi Peak quadrangle, Utah-Idaho: Logan, Utah State University M.S. thesis.
- Oriel, S. S., and Platt, L. B., 1968, Reconnaissance geologic map of the Preston quadrangle, southeastern Idaho: U.S. Geological Survey Open-File Report, scale 1:62,500, 2 sheets.
- Williams, J. S., 1948, Geology of the Paleozoic rocks, Logan quadrangle, Utah: Geological Society of America Bulletin, v. 59, p. 1121-1163.

