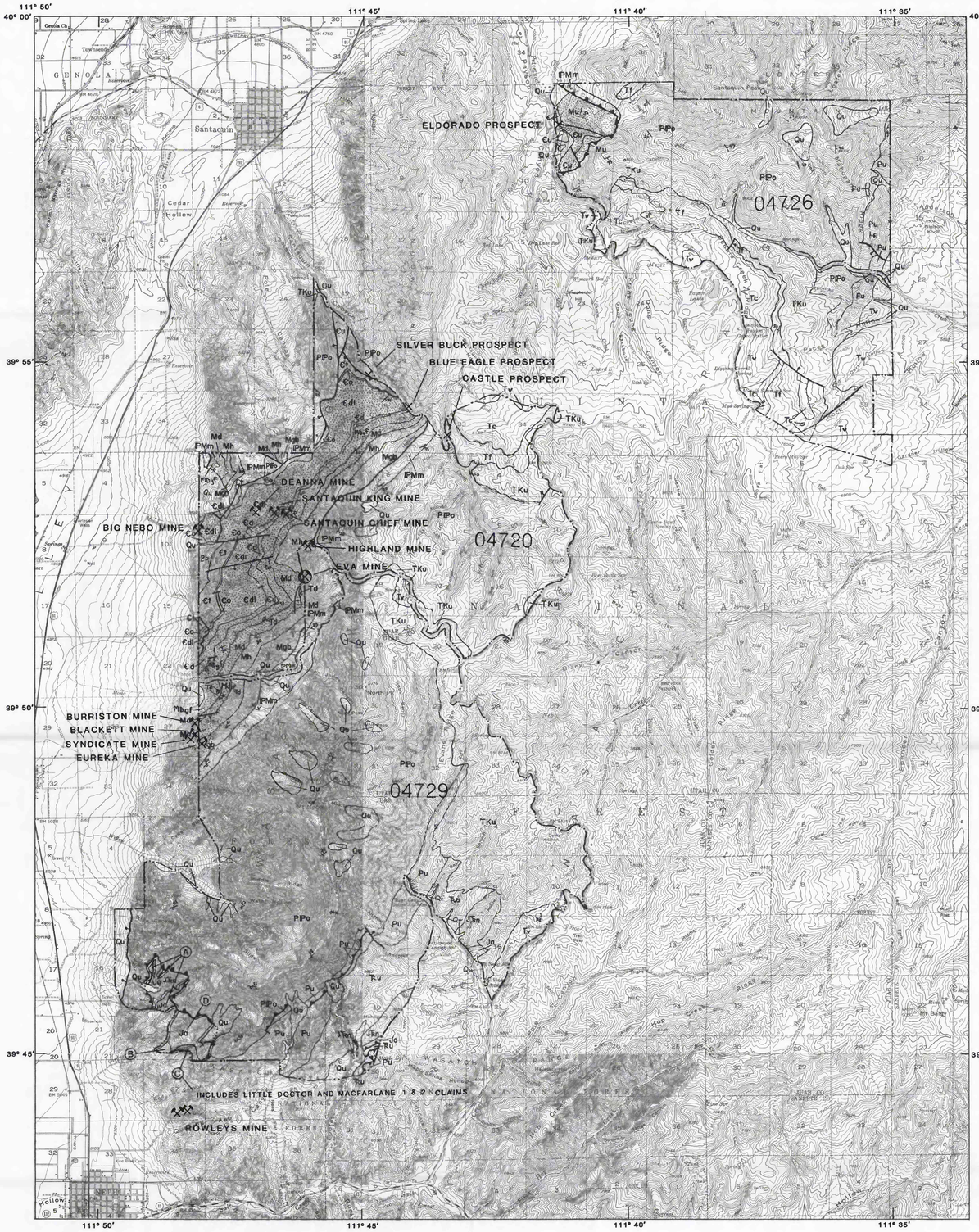
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1574



Base from U.S. Geological Survey
Santaquin, 1951; Moroni, 1951; Nephi, 1951; Santaquin Peak, 1952

Geology generalized from Hintze (1962), Black (1965), and Brady (1965)

MINERAL RESOURCE POTENTIAL MAP OF THE BIRDSEYE, NEPHI, AND SANTAQUIN ROADLESS AREAS, JUAB AND UTAH COUNTIES, UTAH

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EXPLANATION

- Locality (Eva mine) with high potential for small (1,000 ton) deposit of lead-zinc-silver ore
- Area with moderate potential for lead-zinc-silver deposits and high potential for smelter-grade limestone and dolomite
- A — Area with low potential for uranium deposits and moderate to high potential for gypsum deposits
- B — Area with high potential for cement-grade limestone
- C — Area with high potential for gypsum deposits
- D — Area with moderate to high potential for gypsum deposits
- The entire study area has a moderate to low potential for oil and gas deposits

CORRELATION OF MAP UNITS

Qu		QUATERNARY
Unconformity		
Tv		TERTIARY
Unconformity		
Tc		TERTIARY
Tf		TERTIARY
Td		TERTIARY(?)
TKu		TERTIARY AND CRETACEOUS
Ja		JURASSIC
JRn		JURASSIC(?) AND TRIASSIC(?)
Ru		TRIASSIC
Unconformity		
Pu		PERMIAN
PPo		PERMIAN AND PENNSYLVANIAN
PMm		PENNSYLVANIAN AND MISSISSIPPIAN
Mgb	Mu	MISSISSIPPIAN
Mh		MISSISSIPPIAN
Md		MISSISSIPPIAN
MDgf		MISSISSIPPIAN AND DEVONIAN
Unconformity		
€d		CAMBRIAN
€dl		CAMBRIAN
€u		CAMBRIAN
€o		CAMBRIAN
€t		CAMBRIAN
Unconformity		
Xb		PROTEROZOIC

DESCRIPTION OF MAP UNITS

Qu — SURFICIAL DEPOSITS, UNDIVIDED (QUATERNARY)—Alluvial, fan, glacial, landslide, and talus deposits

Tv — VOLCANIC ROCKS, UNDIVIDED (TERTIARY)—Consists of: Moroni Formation (Schoff, 1938) - tuff and volcaniclastic sedimentary rocks; and, Goldens Ranch Formation (Muessig, 1953) - andesitic agglomerate and flow rocks, tuffs, and volcaniclastic sedimentary rocks

Tc — COLTON FORMATION (TERTIARY)—Conglomerate, sandstone, and shale

Tf — FLAGSTAFF LIMESTONE (TERTIARY)—Freshwater limestone with minor interbedded shale and sandstone

Td — DIKE ROCKS (TERTIARY?)—Lamprophyre dikes and sills

TKu — SEDIMENTARY ROCKS, UNDIVIDED (TERTIARY AND CRETACEOUS)—Comprises, in descending order: North Horn Formation (Tertiary and Cretaceous)—conglomerate, sandstone, and shale; and, Price River Formation (Cretaceous)—conglomerate and minor sandstone

Ja — ARAPIEN SHALE (JURASSIC)—Siltstone and sandstone in upper part; lower part consists of sandstone, siltstone, and sandy limestone, and commonly includes lenses and beds of gypsum, halite, and other evaporite minerals; oolitic limestone at base

JRn — NUGGET SANDSTONE (JURASSIC? AND TRIASSIC?)—Sandstone

Ru — SEDIMENTARY ROCKS, UNDIVIDED (TRIASSIC)—Comprises, in descending order: Ankareh Shale - shale, sandstone, and conglomerate; Thaynes Limestone - limestone and shale; and Woodside Formation - siltstone, shale, and sandstone

Pu — SEDIMENTARY ROCKS, UNDIVIDED (PERMIAN)—Comprises, in descending order: Park City Formation - limestone, dolomite, and phosphatic or siliceous shale; Diamond Creek Sandstone - sandstone and sandy dolomite; and, Kirkman Limestone - limestone

PPo — OQUIRRH FORMATION (PERMIAN AND PENNSYLVANIAN)—Quartzite, sandstone, limestone, and siltstone

PMm — MANNING CANYON SHALE (PENNSYLVANIAN AND MISSISSIPPIAN)—Shale with interbedded quartzitic sandstone

Mgb — GREAT BLUE LIMESTONE (MISSISSIPPIAN)—Limestone

Mh — HUMBUG FORMATION (MISSISSIPPIAN)—Quartzitic sandstone and sandy limestone

Md — DESERET LIMESTONE (MISSISSIPPIAN)—Limestone and dolomite, commonly with lenses of chert; phosphatic shale or oolite commonly at base of unit

Mu — LIMESTONE AND DOLOMITE, UNDIVIDED (MISSISSIPPIAN)—Includes limestone and dolomite, commonly with lenses of chert, quartzitic sandstone, and sparse shale

MDgf — GARDISON LIMESTONE, FITCHVILLE FORMATION, AND PINYON PEAK(?) FORMATION (MISSISSIPPIAN AND DEVONIAN)—Comprises, in descending order: Gardison Limestone (Mississippian)—limestone and dolomite; Fitchville Formation (Mississippian and Devonian)—dolomite; and Pinyon Peak(?) Formation (Devonian)—medium to dark gray dolomite and discontinuous exposures of buff to tan thin-bedded quartzite

€d — DOLOMITIC ROCKS, UNDIVIDED (CAMBRIAN)—Comprises in descending order: Ajax Dolomite - dolomite, cherty dolomite, and limestone; and Opex Formation - interbedded dolomite and shale

€dl — DOLOMITE AND LIMESTONE, UNDIVIDED (CAMBRIAN)—Comprises, in descending order: Cole Canyon Dolomite - dolomite; Bluebird Dolomite - dolomite; Herkimer Limestone - limestone with interbedded shale and conglomerate; Dagmar Dolomite - dolomitic limestone; and, Teutonic Limestone - limestone

€o — OPHIR FORMATION (CAMBRIAN)—Phyllitic shale with interbedded quartzite and limestone

€t — TINTIC QUARTZITE (CAMBRIAN)—Quartzite and conglomeratic quartzite

€u — SEDIMENTARY ROCKS, UNDIVIDED (CAMBRIAN)—Quartzite, shale, limestone, and dolomite

Xb — BIG COTTONWOOD FORMATION (PROTEROZOIC)—Quartzite, quartzite conglomerate, and shale

- CONTACT
- FAULT—Bar and ball on downthrown side
- THRUST FAULT—Dotted where concealed; sawteeth on upper plate
- STRIKE AND DIP OF BEDDING
  - 30 — Inclined
  - 70 — Overturned
- BOUNDARY OF ROADLESS AREA
- ADIT
- PROSPECT PIT
- MINE

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral resource potential survey of the Birdseye, Nephi, and Santaquin Roadless Areas in the Uinta National Forest, Juab and Utah Counties, Utah. Birdseye (4726), Nephi (4729), and Santaquin (4720) Roadless Areas were classified as further planning areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

The U.S. Geological Survey and the U.S. Bureau of Mines have conducted a survey to determine the mineral resource potential of the Birdseye, Nephi, and Santaquin Roadless Areas, Juab and Utah Counties, Utah. The results of this survey indicate several areas with mineral resource potential. A high potential for a small lead-zinc-silver deposit is recognized in the Santaquin Roadless Area at the Eva (Privateer) mine. A moderate potential for other lead-zinc-silver deposits exists at the Eva mine and elsewhere in the roadless areas in tracts underlain by Cambrian and Mississippian carbonate rocks. A high potential for gypsum is recognized at a gypsum deposit on three patented claims in the southwest corner of the Nephi Roadless Area. The potential for undiscovered gypsum deposits in other areas underlain by the Arapien Shale is moderate to high. There is a high potential for limestone and dolomite for use in cement and as smelter flux. The potential for uranium is low. The potential for oil and gas deposits is probably moderate to low throughout the three roadless areas. There are no indications of coal or geothermal resources in the study area.

GEOLOGY

The Wasatch Mountains in the area of this report are underlain by approximately 26,000 ft of sedimentary rocks that range in age from Proterozoic to Tertiary and by scattered outcrops of Tertiary volcanic rocks. Quaternary surficial deposits within the study area include alluvial, fan, glacial, landslide, and talus deposits. Surface geology is generally uncomplicated in the study area. Rocks in the Birdseye and Santaquin Roadless Areas dip homoclinally to the east at moderate angles, but steepen southward and are near vertical to overturned throughout the southern part of the Nephi Roadless Area. The Birdseye, Nephi, and Santaquin Roadless Areas occupy part of the Charleston-Nebo block (Roberts and others, 1965, p. 1946) and are underlain, with the exception of a few square miles of the Nephi Roadless Area, by the Nebo thrust fault. Other faults exposed in Santaquin Canyon and in the northeast part of the Birdseye Roadless Area are probably imbricate thrusts rising from an unexposed northern extension of the Nebo thrust fault.

Several geologic environments with potential for mineral resource occurrence were delineated during the current study.

Arapien Shale

The Arapien Shale has long been known to contain gypsum, anhydrite, halite, and other evaporite minerals (Stone and Lupton, 1920, p. 265). Gypsum was mined from deposits in the Arapien Shale east of Nephi until approximately 1925. The Arapien Shale is exposed over slightly less than 1 mi² and may be present in the subsurface beneath the Nebo thrust in the southern part of the Nephi Roadless Area. Wherever present, the Arapien Shale is a potential host for gypsum and other evaporite minerals.

Paleozoic rocks

Small lead-zinc-silver deposits occur in Paleozoic limestone and dolomite in the Mount Nebo and Santaquin mining districts. Most deposits appear to be associated with faulting in coarsely crystalline carbonate rocks (Bullock, 1962, p. 88-91) and may be spatially associated with Tertiary(?) lamprophyre dikes and sills (Phillips, 1940).

Rocks beneath the Charleston-Nebo thrust fault

The lower plate of the Nebo thrust includes exposures of rocks assigned to the Nugget Sandstone, a unit that is an important petroleum reservoir rock elsewhere in Utah. The Nugget Sandstone or other potential reservoir rocks may be present in the subsurface beneath the Nebo thrust, but this cannot be determined without extensive geophysical exploration.

GEOCHEMISTRY

A total of 27 altered or mineralized rocks, 173 stream-sediment samples, and 147 panned concentrates of stream-sediment samples were analyzed for 31 elements by semiquantitative spectrographic analysis. Results of the analyses are reported by Sorensen and others (1983).

Many of the rocks analyzed contained visible galena and were collected from mine or prospect pit dumps along the west edge of the Nephi and Santaquin Roadless Areas. Seven samples contain high values for lead (>20,000 ppm, parts per million) and (or) zinc (>10,000 ppm). Moderately high values for silver (up to 300 ppm) occur in some of the high lead-zinc samples.

Analysis of stream sediments indicates three areas with locally high concentrations of several elements. Samples collected from the northwest corner of the Birdseye Roadless Area, the northwest corner of the Santaquin Roadless Area, and from the west edge of the Nephi and Santaquin Roadless Areas contain slightly anomalous amounts of copper (>50 ppm), lead (>500 ppm), silver (>1 ppm), and zinc (>300 ppm). Stream sediment samples yielding these values were collected in areas that include numerous prospect pits and small mines and reflect local low-grade mineralization.

MINING DISTRICTS AND MINERALIZED AREAS

The Birdseye and northeast half of the Santaquin Roadless Area are in the Santaquin mining district. The Santaquin district was organized in 1871 (Heikes, 1920, p. 148) and during 1910-1917 had a reported production of 208 lb of copper, 206,522 lb of lead, and 3,499 oz of silver (Bullock, 1962, p. 90). The Nephi and southwest half of the Santaquin Roadless Areas are in the Mount Nebo mining district. The Mount Nebo district was organized in 1870 (Heikes, 1920, p. 147) and during 1870-1917 had a reported production of 15.29 oz of gold, 37,226 oz of silver, 1,526 lb of copper, 1,932,683 lb of lead, and 788,679 lb of zinc (Heikes, 1920, p. 336).

Samples were collected from mineralized or altered areas and from mine dumps during a study of the mines and prospects in and near the roadless areas. All samples were analyzed for gold and silver by fire-assay methods, and most were analyzed for 40 elements by semiquantitative spectrographic methods.

Lead-zinc-silver deposits

Lead-zinc-silver ore has been produced from mines in the Nephi and Santaquin Roadless Areas. Most of the larger ore bodies occur near the top of the Deseret Limestone, in coarsely crystalline limestone that is intruded by lamprophyre dikes. Smaller mineral deposits occur in other carbonate rocks with similar coarse textures elsewhere in the three roadless areas. The lead and zinc minerals in the ore bodies are mostly secondary.

Selected prospects

The Eldorado prospect is a replacement deposit in brecciated Cambrian limestone and is located in the northwest corner of the Birdseye Roadless Area. A U.S. Forest Service examination made when the workings were still open reported assay values of 13 percent zinc, 5 percent lead, and 1.4 oz/ton silver. Portal and dump samples collected during the present study had assay values of 0.05 percent lead and 0.10 percent zinc.

The Blue Eagle, Castle, and Silver Buck prospects are in and near Santaquin Canyon within and adjacent to the Santaquin Roadless Area; the workings are small and production is unknown. The Big Nebo, Deanna, Santaquin Chief, and Santaquin King mines are in Mendenhall Canyon within and adjacent to the Santaquin Roadless Area. The workings are more extensive than those in Santaquin Canyon; production is recorded only for the Santaquin Chief.

Eva mine

The Eva mine, also known as the Privateer mine, is on the north wall of North Creek. The boundary of the Santaquin Roadless Area apparently cuts the workings of the Eva. Production during 1912-13 was 809 tons of ore that averaged 38 percent lead, 19.2 percent zinc, and 15.9 oz/ton silver. Total production apparently is 10,000 tons (Defense Minerals Agency Docket 234, 1951). Samples collected during the present study have average assay values of 3.6 oz/ton silver, 2.83 percent lead, and 1.97 percent zinc; approximately 1,000 tons of ore of this average grade are estimated to be present in the Eva mine.

Highland mines

The Highland mine is 3,000 ft north of the Eva mine and is outside of, but immediately adjacent to, the Santaquin Roadless Area. Most samples collected at the Highland contain less than 0.2 oz/ton silver, less than 0.5 percent lead, and less than 0.5 percent zinc.

Mines and prospects near Bear Canyon

Numerous mines and prospects are present along the west boundary of the Nephi Roadless Area near Bear Canyon. Although most samples from these workings had assay values of less than 0.2 oz/ton silver, less than 0.5 percent lead, and less than 0.5 percent zinc, values as high as 8.3 oz/ton silver, 7.45 percent lead, and 19.5 percent zinc are present in some samples. Mines with the highest values are the Syndicate tunnel, Blackett tunnel, Burriston mine, and Eureka mine. Only the Eureka mine is within the roadless area.

Uranium

Uranium mineralization is present in a series of 10 pits on a block of claims in the southwest corner of the Nephi Roadless Area. The uranium mineral tyuyamunite occurs as a secondary replacement in a bed of oolitic limestone at the base of the Arapien Shale. Maximum values of 0.004 percent U_3O_8 and 0.05 percent vanadium were determined for four chip samples from the deposit.

In 1970, Cerro Corporation drilled 12 inclined holes 300 ft from the area of known mineralization. Evans (1978) reported that four of the drill holes contained no uranium or vanadium, and that mineralized intercepts in the eight other drill holes ranged from 2 to 6 ft. Uranium content ranged from 0.012 to 0.662 percent U_3O_8 and averaged 0.063 percent. Vanadium content ranged from 0.013 to 0.5 percent V_2O_5 and averaged 0.104 percent.

In 1976, Montoc, Inc. drilled 8 inclined holes 200 and 100 ft from the area of known mineralization. The results of this drilling are not known.

Limestone and dolomite

An exploration program conducted by Monroc, Inc. near Gardner Creek in the southwest corner of the Nephi Roadless Area resulted in the assessment of limestone at the base of the Arapien Shale as having potential for use in cement (Allen Flandro, oral commun., 1981). Monroc, Inc. later located an area elsewhere that was more practical for the location of a cement plant.

Rocks composed predominantly of limestone and dolomite (industrial minerals that are used as fluxes in smelter operations) underlie approximately 9 mi² in the northwestern corner of the combined Nephi-Santaquin Roadless Areas. Rocks older than Humbug Formation (Upper Mississippian) and younger than Ophir Formation (Middle Cambrian) are mostly limestone and dolomite and are exposed in a southwest-trending belt south of Santaquin Canyon.

Gypsum

A gypsum deposit is present on three patented claims, the Little Doctor and MacFarlane 1 and 2, in the southwest corner of the Nephi Roadless Area. The deposit, a lens of 80 percent pure gypsum in the Arapien Shale, is estimated to total 270,000 tons.

Oil and gas

Oil and gas leases and lease applications cover the entire study area. Four oil companies, Amoco, Exxon, Gulf, and Quasar, ran seismic surveys through and near the three roadless areas in the summer of 1981, but the results of the surveys have not been released. Exploration efforts have probably evaluated formations in the subsurface to determine their suitability as source and reservoir rocks for oil and gas.

CRITERIA USED IN MINERAL RESOURCE EVALUATION

The mineral resource potential of the roadless areas is classified as high, moderate, or low, on the basis of geologic and geochemical investigations conducted for this study and on the history of mining and mineral exploration in the area. A high potential exists in an area where all or nearly all conditions for a geologic environment favorable for ore deposits are met. Such areas may include known mining districts and other areas where geologic, geochemical, geophysical, and other data demonstrate a high probability for the presence of mineralized rock. A moderate potential exists where a geologic environment favorable for ore deposits has been identified or may reasonably be inferred but where the evidence for mineralization is less definite or has not yet been found. Areas lacking either a high or moderate mineral resource potential are considered to have very little probability for mineral resources and are classified as having a low mineral resource potential.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Lead-zinc-silver

A high potential for a small lead-zinc-silver deposit is recognized in North Canyon at the Eva mine, where approximately 1,000 tons of ore remain from earlier mining activities. A moderate potential for other lead-zinc-silver deposits exists at the Eva mine and elsewhere in the study area in tracts underlain by Cambrian and Mississippian limestone and dolomite. Any newly discovered deposits will probably be small, localized by faulting or intense folding, and spatially associated with lamprophyre dikes or sills. The upper part of the Deseret Limestone is the most favorable host rock, although mineralization may occur in any of the Middle Cambrian through Upper Mississippian limestones or dolomites.

Uranium

The mineral resource potential for uranium is low. The only known occurrence in the study area is in the southwest corner of the Nephi Roadless Area, where drilling and sample data reveal mineralization to be generally low grade and confined to a narrow zone. Due to the insolubility of the ore mineral, it is unlikely that enriched deposits will occur downdip from the mineralized occurrence.

Limestone and dolomite

Monroc, Inc. conducted an investigation of limestone near Gardner Creek (Allen Flandro, oral commun., 1981) in the southwest corner of the Nephi Roadless Area. It is concluded from their drilling data and analyses that a high potential for cement-grade limestone exists near Gardner Creek.

There is a high potential in the study area for limestone and dolomite for use as smelter flux. Rocks mostly of this composition underlie 9 mi² south of Santaquin Canyon, in the Nephi and Santaquin Roadless Areas. The value of these rocks as industrial minerals is diminished by their inaccessibility and by limestone and dolomite quarries already in operation at West Mountain, approximately 4 mi northwest of Santaquin Canyon.

Gypsum

A high potential for gypsum is recognized at three patented claims underlain by the Arapien Shale at the southwest corner of the Nephi Roadless Area, where approximately 270,000 tons of 80 percent gypsum are estimated to be present. The potential for undiscovered gypsum deposits elsewhere within the study area in tracts underlain by the Arapien Shale is moderate to high.

Oil and gas

Recent leasing and exploration activities suggest the possibility of oil and gas deposits in or near the roadless areas, but the surface geology within the roadless areas does not suggest the presence of such deposits. The oil and gas potential of the three roadless areas cannot be determined without the data derived from subsurface exploration. Drilling has not taken place in or near the roadless areas and it is assumed that the potential for oil and gas is moderate to low.

Other resources

There are no indications of coal or geothermal resources in the study area.

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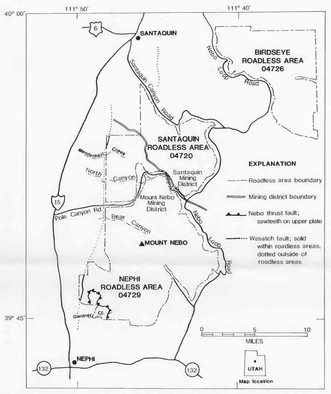

Index map showing location of Birdseye (04726), Nephi (04729), and Santaquin (04720) Roadless Areas, Juab and Utah Counties, Utah.

Explanatory pamphlet accompanies map

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For sale by Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225