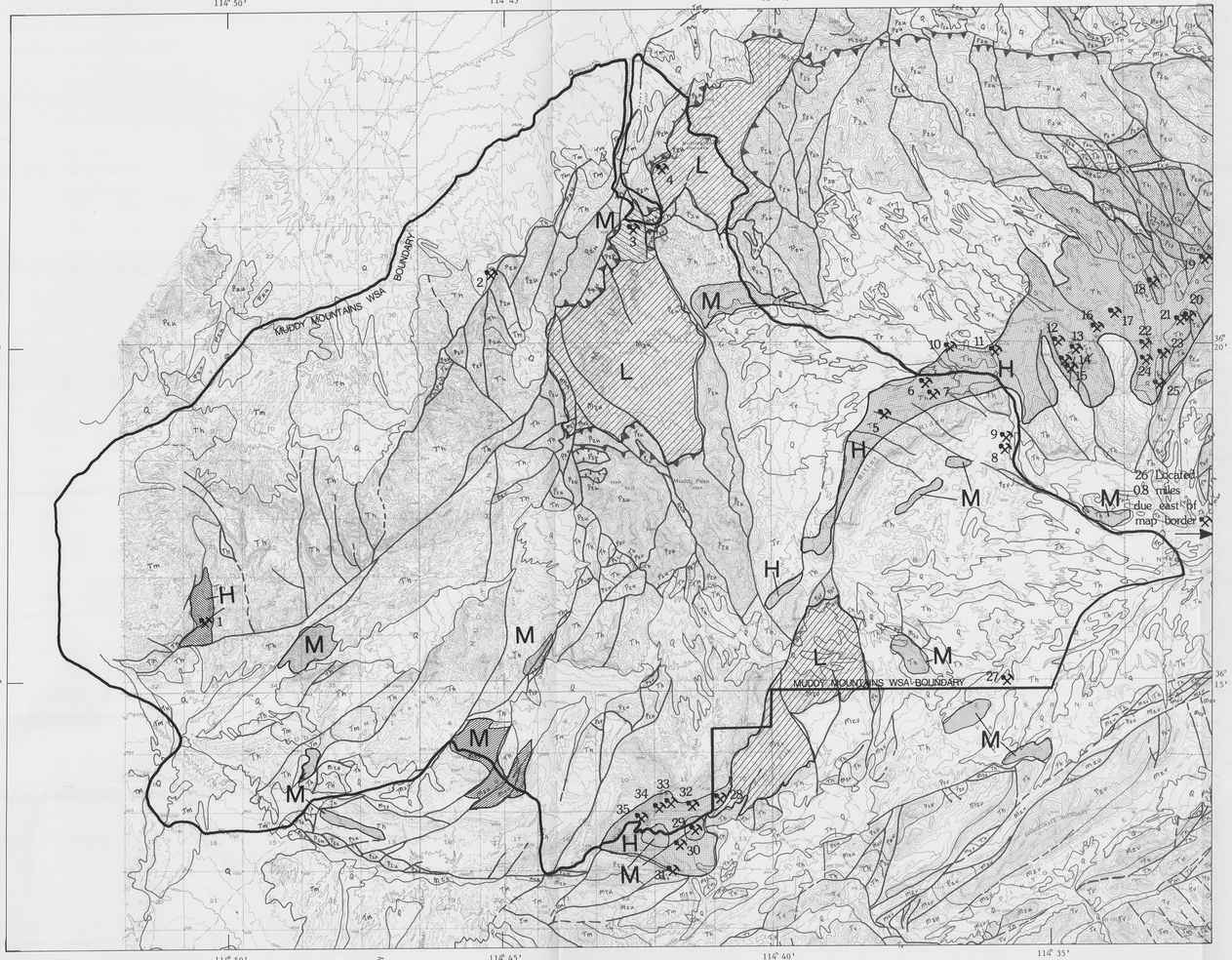
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED BY THE U.S. GEOLOGICAL SURVEY AND THE U.S. BUREAU OF MINES
FOR THE U.S. BUREAU OF LAND MANAGEMENT

MISCELLANEOUS FIELD STUDIES
MAP MF-1458-C




Base from U.S. Geological Survey,
Dry Lake, 1952; Henderson, 1953;
Hoover Dam, 1953; and Muddy Peak, 1953

Geology after Bohannon, 1981, 1982

SCALE 1:62,500
1 1 0 1 2 3 4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 .5 0 1 2 3 4 5 KILOMETERS
CONTOUR INTERVAL 80 FEET
Datum Is Mean Sea Level

APPROXIMATE MEAN DECLINATION, 1953
15° TRUE NORTH
MAGNETIC NORTH

# MINERAL RESOURCE POTENTIAL MAP OF THE MUDDY MOUNTAINS WILDERNESS STUDY AREA, CLARK COUNTY, NEVADA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EXPLANATION

- Areas having high borate mineral and lithium potential
- Areas having potential for zeolite minerals
- Areas having potential for silica sand and building stone (Aztec Sandstone)
- Areas having potential for building stone (Near quarry and roads)
- Areas having potential for silica sand (Baseline Sandstone)
- Areas having potential for clay

H High potential
M Moderate potential
L Low potential

Mines and prospects

1. Vanderbilt Mine
2. Prospect
3. Colorock Quarry
4. Prospect
5. Prospect
6. Lucky Strike Group
7. Lucky Strike Group
8. Prospect
9. Prospect
10. Patches Group
11. Prospect
12. American Borax Mine
13. American Borax Mine
14. American Borax Mine
15. American Borax Mine
16. Prospect
17. DWB Group
18. Prospect
19. North Contact Group
20. DWG Group
21. EABAEX Group
22. Prospect
23. EABAEX Group
24. Prospect
25. Prospect
26. Moby Dick
27. Prospect
28. Prospect
29. Anniversary Mine
30. Prospect
31. Prospect
32. Anniversary Mine
33. Anniversary Mine
34. Anniversary Mine
35. Anniversary Mine

(Note: The following correlation and description are for the screened geologic base map.)

CORRELATION OF MAP UNITS

| | |
|---|---|
| Q | QUATERNARY |
| Tm, Tr, Tv, Th | TERTIARY |
| Mzu | MESOZOIC |
| Pzu | PALEOZOIC |

DESCRIPTION OF MAP UNITS
for screened geologic base

Q QUATERNARY ROCKS--Includes recent alluvium, terrace deposits, and older alluvium. Mostly unconsolidated sand and gravel

Tm MUDDY CREEK FORMATION--Pink and brown siltstone and fine grained sandstone with minor amount of gypsum and gypsiferous siltstone

Tr RED SANDSTONE (MIOCENE)--Red sandstone and siltstone, white and gray tuff beds and minor amounts of gypsum

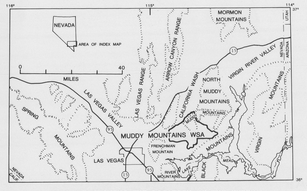
Tv VOLCANIC ROCKS (MIOCENE)--Includes andesite of the Hamblin Cleopatra volcano and basalt and andesite associated with the volcanic center at Black Mountain

Th HORSE SPRING FORMATION (MIOCENE)--Includes four members. From oldest to youngest they are the Rainbow Gardens--sandstone, limestone, dolomite, gypsum, and siltstone; Thumb--sandstone, siltstone, gypsum, conglomerate, and tuff; Bitter Ridge Limestone--limestone; and Lovell Wash--tuff, claystone, limestone, and siltstone

Mzu MESOZOIC ROCKS--Includes, from oldest to youngest, the Triassic Moenkopi, Triassic Chinle, Triassic Moenave, Triassic Kayenta, and Jurassic Aztec Formations

Pzu PALEOZOIC ROCKS--Includes, from oldest to youngest, the Cambrian Bonanza King Formation, Cambrian Dunderberg Shale, Cambrian Buffington Formation, Ordovician Monocline Valley Formation, Devonian Sultan Limestone, Mississippian Monte Cristo Limestone, Pennsylvanian and Permian Bird Spring Formation, Permian red beds, Permian Toroweap Formation, and Permian Kaibab Formation

CONTACT
FAULT--Dashed where approximately located
THRUST FAULT--Barbs on upper plate
LOW ANGLE NORMAL FAULT--Hachures on upper plate




INDEX MAP SHOWING THE LOCATION OF THE MUDDY MOUNTAINS WILDERNESS STUDY AREA

## STUDIES RELATED TO WILDERNESS

### Bureau of Land Management Wilderness Study Areas

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas 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 survey of the Muddy Mountains Wilderness Study Area, Clark County, Nevada.

### MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

The Muddy Mountains Wilderness Study Area (WSA 050-0229), Clark County, Nevada, has a high potential for mineral deposits of calcium borates and lithium. The known and potential mineral deposits are concentrated in the east-central and south-central parts of the study area. Zeolites (in particular clinoptilolite) are present in some tuff beds exposed throughout much of the study area, and this resource potential is probably moderate to high. Results of stream-sediment sampling suggest that the Muddy Mountains area has little potential for mineral deposits of metals (other than lithium). Clay minerals are mined at one location in the area (see map). Building stone and silica sand have moderate to low potential as resources in some parts of the area. Oil and gas potential within the study area appears to be low, but complete evaluation of its potential is not possible without drilling.

### INTRODUCTION

The Muddy Mountains WSA comprises about 107,000 acres (43,000 hectares) in the highest and most inaccessible part of the Muddy Mountains about 23 mi (35 km) east-northeast of Las Vegas in southeastern Nevada. Muddy Peak, which is 5,363 ft (1,635 m) in altitude, is the highest feature in the WSA and dominates its central part. Between Frenchman Mountain and the northern part of the Black Mountains the southwestern border of the WSA follows a maintained dirt road that joins the paved Northshore Road (Highway 41A) at West End Wash. East of West End Wash the southern border of the WSA is coincident with the northern border of the Lake Mead National Recreation Area, and access to this part is from the Northshore Road which is south of the border. The northeast border of the WSA follows the Borax Road, a dirt road that extends diagonally through White Basin and Buffington Pockets. The west border of the WSA is not easily accessible.

### GEOLOGIC SETTING

The study area is located in the Basin and Range structural province and is underlain by a thick section of Paleozoic, Mesozoic, and Tertiary sedimentary rocks. The late Mesozoic Muddy Mountain thrust fault juxtaposed Paleozoic marine rocks over Mesozoic nonmarine and marine rocks. Several other large faults of middle Tertiary to Quaternary age displace rocks of the WSA and exert structural control over some of the mineralized zones in the area.

### GEOCHEMISTRY

The results of spectrographic and atomic absorption analyses of stream-sediment samples (Bohannon and Vine, 1982) indicate no significant anomalies of metals in the area. Thus, the Muddy Mountains Wilderness Study Area is considered herein to offer little potential for surface enrichment of metals (other than lithium). Because subsurface and geophysical exploration techniques were not used in this study, a definitive statement regarding subsurface potential of the area cannot be made. Although the WSA is in a similar terrane to that in the nearby Goodsprings mining district, the lack of intermediate to silicic volcanic and intrusive rocks in the WSA, that are present in the mining district, it is considered unlikely that large subsurface deposits like those at Goodsprings exist in the WSA.

### MINES AND PROSPECTS

Numerous mineral claims were staked for borate minerals in and around the study area during the 1920's and 1930's. Lithium, clay, zeolites, and silica sand are all potential resources in and near the area. Claims for other types of commodities are rare, and the potential for these commodities appears to be low.

The Anniversary Mine in Lovell Wash and the American Borax Company Mine in White Basin actively produced borate minerals from 1922 to 1928. Both producing mines lie on, or outside, the WSA boundary. At the Anniversary Mine 200,000 tons (180,000 t) of 19 to 24 percent $B_2O_3$ ore was produced. No record was found of grade or tonnage of ore produced at the American Borax Mine.

The Vanderbilt Mine, owned by Western Talc Company, has produced several thousand tons of montmorillonite clay that is stockpiled at the mine and used as needed. Deposits of this type are formed in geologic environments that are not common or large. Hence, it is unlikely that similar, large, undiscovered deposits exist elsewhere in the WSA.

Aztec Sandstone from the Colorock Quarry has been used as construction stone; it underlies parts of the study area (see map). Because the quality is below that for regionally marketed sandstone and because of the inaccessibility of most exposures, its use will probably be restricted to local consumption.

Silica sand has been mined from the Cretaceous Baseline Sandstone 16 mi north of the study area by Simplot Silica Company (Smith, 1959). Ottowa Silica Company has explored for silica sand in the Baseline Sandstone adjacent to the study area in Gale Hills. Speculative silica sand resources in the study area are contained in the Aztec and Baseline Sandstones. Although tonnages are estimated to be large, both formations, especially the Aztec, are of lesser purity than that currently being mined, and their potential is considered moderate to low.

### MINERAL RESOURCE POTENTIAL

#### Mineral Potential

Borate minerals occur in the lower part of the Lovell Wash and upper part of the Bitter Ridge Limestone Members of the Horse Spring Formation. These members are exposed in the study area, and they occur in the shallow subsurface of western White Basin beneath the red sandstone unit. Although borate production took place just outside, or upon, the WSA boundary, any exposure of the Lovell Wash and upper Bitter Ridge Limestone Members is considered to have a high potential for calcium borate minerals and is shown so on the map.

Borate resources at the Anniversary Mine are an estimated 380,000 tons (345,000 t) of low-grade reserves, and about 2,000,000 tons (1,800,000 t) of resources are inferred, averaging 15-20 percent $B_2O_3$. Because underground workings are not accessible, data are insufficient to make estimates for the American Borax Mine in White Basin.

Reconnaissance sampling for lithium in the Muddy Mountains region (Bohannon and Meier, 1976; Brenner-Tourtelot and Glanzman, 1978; and Brenner-Tourtelot, 1979) and similar detailed sampling of the Lovell Wash and upper Bitter Ridge Limestone Members in the study area for this report indicate that those members are highly enriched in lithium. Lithium content of samples ranges from 78 to 2,040 ppm and is rarely below 200 ppm. Vine (1980, p. 64a, fig. 4) ranked potential lithium resources in rocks and sediments and suggested that any deposit having a thickness on the order of that of the Lovell Wash Member and average concentrations of 300-1,000 ppm lithium "warrants further search" for lithium resources. He further concluded that a deposit 30 ft thick containing concentrations between 1,000 and 3,000 ppm constitutes a "major resource potential." Because the detailed sampling program for this report indicated that beds with lithium contents greater than 1,000 ppm are abundant in the Lovell Wash and upper Bitter Ridge Limestone Members, these units are considered herein as having major lithium resource potential and they are shown so on the map.

Zeolite resources are about 4.7 million tons (4.3 million t) of inferred resources averaging 84 percent clinoptilolite with a cation exchange capacity of 1.6 milliequivalents per gram. Zeolite resources were calculated on the basis of samples from tuff beds that range from 1 ft to 60 ft thick and contain at least 75 percent zeolite minerals. Zeolite minerals have not been mined in the WSA, but technological advances have increased the number of uses for zeolite minerals as well as the demand (Sand and Mumpton, 1978). The zeolite-bearing tuffs are interbedded with sandstone, siltstone, limestone, and claystone of the Thumb and Rainbow Gardens Members of the Horse Spring Formation.

Known radioactive mineral occurrences in and near the proposed wilderness have no apparent economic potential. The potential for undiscovered deposits of radioactive minerals was not investigated in detail for this study.

The results of the geochemical survey indicate that there is little potential for deposits of metals other than lithium in the WSA.

### OIL AND GAS POTENTIAL

The Muddy Mountains WSA is located in the Cordilleran overthrust belt, an important structural province for oil production in some western states (Petroleum Information Corporation, 1981). Five exploratory oil and gas test holes have been drilled in the vicinity of the WSA (two very near its south border), but none encountered producible amounts of petroleum.

The local Tertiary stratigraphic section within the WSA is not considered to have good potential for oil exploration. These rocks are not part of the overthrust belt (they are too young) and they were deposited in closed, evaporitic basins; they contain little or no organic matter. Tertiary rocks conceal older rocks and overthrust structures throughout much of the WSA, but the high degree of structural complexity in those areas suggests that there probably are no buried overthrust-related traps that are undisturbed by Tertiary structures (Bohannon, 1982a,c). Thus, the petroleum potential of the eastern, southern, and southwestern parts of the WSA, where Tertiary rocks and structures are widespread, is considered herein to be low.

Overthrust structures are exposed in the Muddy Peak-Buffington Pockets area in the north-central part of the WSA. The Muddy Mountain thrust is exposed in a broad, eroded arch that is closed on its south end and is cut by numerous Tertiary faults. The autochthonous Mesozoic rocks in the core of the arch beneath the thrust offer good potential as reservoir rocks, but local source rocks are probably absent and a viable structural or stratigraphic trap might not be present. Local Paleozoic and Mesozoic rocks do not offer good potential as source rocks because clastic rocks of that age are red beds that lack significant amounts of organic matter. In addition, Harris and others (1980) showed high conodont color alteration indices for most of the Paleozoic rocks of the region indicating that they have been subject to high temperatures for long periods of time and that they are probably over mature with respect to oil and gas development. The Muddy Mountain thrust surface is eroded and does not provide a structural trap for petroleum. The presence of stratigraphic traps is uncertain as well. As such, the petroleum potential of the WSA is incompletely understood, but it is regarded herein as poor, chiefly because of the lack of known potential source rocks.

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