LARGE-SCALE GEOLOGIC GUIDES
TO CARNOTITE DEPOSITS IN THE
URAVAN AND GATEWAY DISTRICTS,
MONTROSE AND MESA COUNTIES,
COLORADO

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LARGE-SCALE GEOLOGIC GUIDES TO CARNOTITE DEPOSITS IN THE URAVAN
AND GATEWAY DISTRICTS, MONTROSE AND MESA
COUNTIES, COLORADO

By

E. J. McKay

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LARGE-SCALE GEOLOGIC GUIDES TO CARNOTITE DEPOSITS IN THE URAVAN AND GATEWAY DISTRICTS, MONTROSE AND MESA COUNTIES, COLORADO

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ABSTRACT

Results of detailed mapping of the Salt Wash sandstone member of the Morrison formation in the Uravan and Gateway districts, Montrose and Mesa Counties, Colo., suggest that large areas containing both lenticular bedding in the ore-bearing sandstone and persistently altered mudstone beneath the sandstone are generally favorable for carnotite deposits. If this is true, the distribution of these two geologic features shows that part of the ground in Montrose and Mesa Counties now being drilled by the Geological Survey probably is favorable for deposits whereas other parts probably are not especially favorable.

INTRODUCTION

Several geologic features associated with the carnotite deposits on the Colorado Plateau have been recognized as guides in exploration. Some of these are readily observed in diamond-drill core and have been used by the Geological Survey in guiding diamond-drill exploration in southwestern Colorado, as described by Blackman (1951). Other features can be observed better at the outcrop.

In 1950 a special detailed study was undertaken in the Uravan and Gateway districts, Montrose and Mesa Counties, Colo., to map some of these features that can be observed at the outcrop, and to appraise their possible value as ore guides, in order to aid the planning of exploration in parts of these districts. This preliminary report describes the results of this study.
Counties, Colo., where exploration is now being undertaken by the Geological Survey, appears favorable for large ore deposits. The results of this study might also necessitate modifying the concept of the Uravan mineral belt, as presented by Fischer and Hilpert (1951).

**GEOLOGY**

In the Uravan and Gateway districts, most of the known carnotite deposits are in the Salt Wash sandstone member of the Morrison formation. The Salt Wash member is about 300 feet thick and is composed of alternating sandstone and mudstone strata in about equal proportions. On fresh exposures, the sandstone ranges from white to grayish, yellowish, or reddish brown. The light-colored sandstone is speckled with limonite stain in places. The sandstone is composed dominantly of fine- to medium-sized quartz grains with minor amounts of interstitial clay and grains of white and pink chert and feldspar. Carbonized plant remains, consisting of logs, leaves, and fragments of woody material, are present in places. Calcite is the principal cementing material. In general, the sandstone strata are broadly lenticular, but near the top and base of the Salt Wash these lenses are numerous enough to give the gross appearance of persistent sandstone layers. Carnotite deposits are localized almost wholly in the group of strata that form the uppermost sandstone layer. This layer is commonly called "the ore-bearing sandstone."

The mudstone in the Salt Wash is interbedded with sandstone strata and also occurs as thin lenses, films, and pebbles in the sandstone strata. The mudstone is composed of argillaceous material mixed with varied amounts of grains of quartz and other minerals of silt-size or slightly larger. The mudstone is dominantly red, but in the vicinity of carnotite deposits the mudstone in the ore-bearing sandstone, as well as the upper part of the
mudstone lying beneath the ore-bearing sandstone, is altered to gray.

The ore-bearing sandstone ranges from 15 to 80 feet in thickness. In places it is rather thinly and evenly bedded, comprising beds ranging from 1 foot to several feet in thickness. More commonly the sandstone is broadly lenticular and irregularly bedded, occurring as individual strata or depositional units that range in thickness from a feather-edge to 60 feet, and in horizontal extent from several hundred to several thousand feet. Scour and fill bedding is present in many places, particularly in the lenticular sandstone. It is present in a few places in sandstone that is evenly bedded. The scour and fill bedding forms thick narrow lenses that are composed of sandstone containing thin discontinuous lenses of mudstone, thin beds of mudstone pebble conglomerate, and abundant fragments and masses of carbonized wood. Ore deposits are commonly localized in or near the scour and fill bedding.

ORE GUIDES AND THEIR DISTRIBUTION

The following four geologic features are observable in drill core and have been shown by Blackman (1951) to be useful ore guides in diamond-drill exploration: 1) the ore-bearing sandstone is 40 feet thick or more in the vicinity of ore deposits; 2) the ore-bearing sandstone near ore deposits is dominantly light brown, whereas away from ore deposits much of the sandstone has a reddish cast; 3) gray (altered) mudstone is more abundant in and immediately below the ore-bearing sandstone in the vicinity of ore deposits than away from ore deposits; 4) carbonized woody material is more abundant in the sandstone near ore deposits than away from deposits. In addition to these features which can be observed in diamond-drill core, general observation has suggested that the ore deposits occur mainly in sandstone strata that are lenticular.
Of these several features, only the character of the sandstone bedding, and the persistency of altered mudstone immediately beneath the ore-bearing sandstone, could be adequately observed on the outcrop and accurately shown on the map (fig. 1). Symbols show general areas where the sandstone is dominantly lenticular or dominantly nonlenticular and are overlapped by symbols representing the persistency of alteration (fig. 1).

Sandstone bedding

In the area extending from Long Park through Spring Creek, Atkinson, Blue, Outlaw, and Calamity Mesas to Beaver Mesa, the ore-bearing sandstone is dominantly lenticular (fig. 1). East of Long Park, on Tenderfoot Mesa, and at the north end of Calamity Mesa, the sandstone is dominantly non-lenticular. This distribution suggests an area of nonlenticular sandstone lying east and north of the area of dominantly lenticular sandstone, but the continuity of this nonlenticular characteristic cannot be proved because exposures are either lacking or poor.

Mudstone alteration

The upper few inches to few feet of mudstone beneath the ore-bearing sandstone is persistently altered in the areas around Long Park and Uravan, on the north ends of Outlaw and Calamity Mesas, and on Tenderfoot Mesa (fig. 1). On the basis of this distribution, it is assumed that a continuous belt of persistent alteration extends from Long Park through Spring Creek Mesa and the north ends of Outlaw and Calamity Mesas to Tenderfoot Mesa. Exposures in the central part of the belt are inadequate to prove its continuity.

Exposures on the west side of Atkinson Mesa, at the north end of Blue Mesa, and in the central parts of Outlaw Mesa and Calamity Mesa show that only part of the top of the mudstone is altered. These areas of partial alteration are assumed to border the belt of more intense alteration and to form a relatively narrow western margin to it.
Figure 1.—Map of the Unravan and Gateway districts, Montrose and Mesa Counties, Colorado, showing the distribution of geologic features useful as guides to carnitite deposits and areas most favorable for exploration.
Little or no altered mudstone was observed in the vicinity of the lower part of Mesa Creek and its tributaries, on Blue Mesa (except its northern tip), and on the south ends of Outlaw and Calamity Mesas. On Flattop and Beaver Mesas, the mudstone is unaltered except in the immediate vicinity of ore deposits. The patches of altered mudstone near ore deposits on Beaver Mesa are too small to show on the map (fig. 1).

The apparent absence of persistently altered mudstone in the areas immediately east of Mesa Creek suggests that the Uravan mineral belt, as conceived by Fischer and Hilpert (1951), either does not project through this area or that it is poorly developed here.

**DISTRIBUTION OF KNOWN DEPOSITS**

The largest and richest known deposits in the Uravan and Gateway districts are in the vicinity of Long Park and Uravan, in the northeastern part of Outlaw Mesa, and in the central part of Calamity Mesa. In these areas, the top of the mudstone is persistently altered and the ore-bearing sandstone is dominantly lenticular (fig. 1). Smaller and more scattered deposits, some of which are rich, though others are lower than average grade, are present in areas where only one of these two geologic features is well developed; for example, on Beaver and Flattop Mesas, the sandstone is dominantly lenticular, but altered mudstone is restricted only to the immediate vicinity of carnotite deposits, whereas on Tenderfoot Mesa alteration is persistent at the top of the mudstone, but the sandstone is dominantly non-lenticular. In the transition zone between the belt of persistent alteration and the areas of little or no alteration, as for example at the north end of Blue Mesa, on the east side of Mesa Creek in Mesa County, and on the west side of Atkinson Mesa, the deposits also appear to be small and scattered, even though the sandstone is dominantly lenticular.
CONCLUSIONS

In the Uravan and Gateway districts, the largest known deposits of carnitite ore are in areas where the ore-bearing sandstone is dominantly lenticular and the upper part of the underlying mudstone is persistently altered. This association suggests that these geologic features can be used as large-scale guides in recognizing areas generally favorable for ore deposits.

The observed distribution of these geologic features focuses attention on ground that appears to be especially favorable for exploration on Spring Creek Mesa and the southeastern part of Atkinson Mesa (see fig. 1), where the Geological Survey began drilling in July 1951. In contrast, because of the absence of persistently altered mudstone in outcrops along the west side of Atkinson Mesa and Mesa Creek, it is predicted that not much favorable ground will be found in the north side of Atkinson Mesa and in T. 47 N., R. 17 W., where the Survey has also begun drilling. This prediction, however, and the evidence on which it is based, is not firmly enough established at present to justify a modification of plans for these drilling operations. Rather, this ground should be drilled with wide-spaced holes, as is planned, in order to obtain a still better geologic appraisal of the ground, and especially to establish the northwestern limit of the expected favorable ground on Spring Creek Mesa and the southern part of Atkinson Mesa.

Small patches of favorable ground will be found on Beaver Mesa, particularly in the vicinity of the Corvusite mine and the Lumsden group, as well as elsewhere in the Uravan and Gateway districts. These patches can be recognized, either at the outcrop or in drill holes, by the presence locally of the geologic features that serve as ore guides.
