RED LAKE SALT MASS

by
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INTRODUCTION

Surface to near surface halite occurrences in the Nevada portion of the Lake Mead region have been known for many years. In 1958, thirty miles south of Lake Mead near a playa known as Red Lake, the Kerr-McGee Red Lake No. 1 evaporite test cored 1190 feet of relatively pure, coarsely crystalline halite. The site of this encounter is in Hualapai Valley north of Kingman, in Mohave County, Arizona (Fig. 1). A short time later the Kerr-McGee Red Lake No. 2 was drilled about two miles NE of the No. 1. The No. 2 test cut 635 feet of similar halite, the top in both cases being on the order of 1500 feet below the relatively flat valley surface. Both tests terminated in salt. Then, in July 1970, the El Paso Natural Gas Company Red Lake No. 1, drilling within one-half mile NE of the No. 2 Kerr-McGee test, cut slightly in excess of 4,000 feet of apparently similar halite. This test also bottomed in salt.

SHAPE AND SIZE

The approximate elevations of the salt tops in the three holes are: KM-1 – 1382, KM-2 – 1310, and EP-1 – 1004 feet above sea level. All were drilled from a surface elevation near 2800 feet. The inferred relief on the top of the salt approximates 380 feet over a lateral distance of about 12,000 feet.

Geophysical work, principally gravity data, suggest that the salt mass might be on the order of 12 miles long paralleling the length of Hualapai Valley, 5 miles wide perpendicular to the sides of the valley, and as much as 2 miles (10,000 feet) thick (Davis, 1972). If these data represent good approximations, the salt mass in gross aspect is tabular in shape. The long and intermediate axes occupy a horizontal plane oriented along and across the valley, respectively. The shortest dimension is the vertical axis or thickness factor.

BASIN FORM

A plan view of the valley suggests the possibility that a closed basin existed in the geologic past (Fig. 1). Outcrops of Precambrian crystalline rocks appear to restrict the basin to the south. North of Red Lake there is a constriction that narrows the valley width from about eleven to five miles. A seismic profile included in Gillespie and Bentley (1971) crosses the valley near this neck. The elevation of "bedrock" in the center of the valley is shown by them to be just slightly below sea level whereas the

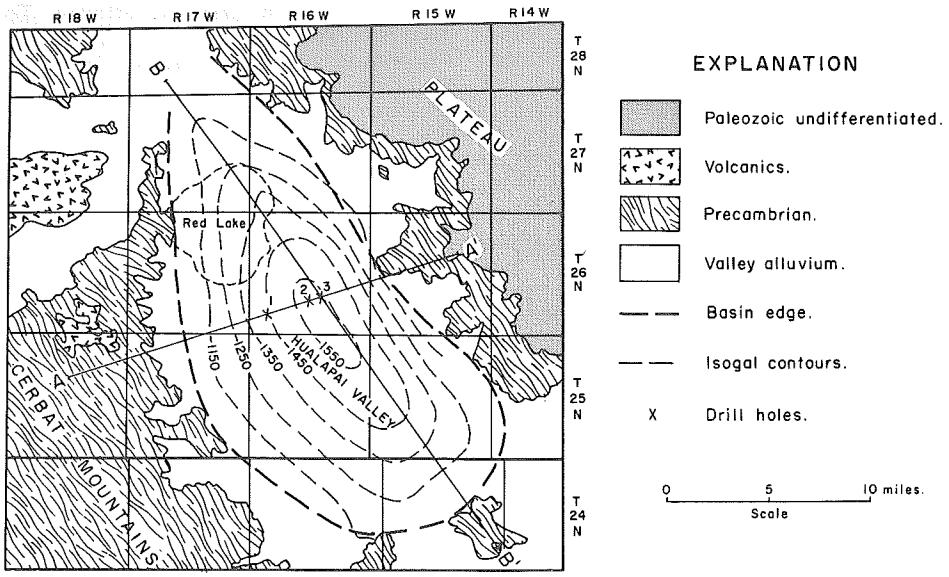

Figure 1. General geologic map, Red Lake-Hualapai Valley area, Mohave County, Arizona.

elevation of the bottom of the El Paso test (still in salt) is near 3,000 feet below sea level (Fig. 2). The inferred depth to "bedrock" in the El Paso test area is no less than 9,000 feet below sea level. The gravity pattern itself suggests a closed basin (Fig. 1) and the amount of closure in the basin seems to be at least 9,000 feet.

STRUCTURAL POSITION

Hualapai Valley occupies a unique position in that it lies between the relatively stable Colorado Plateau to the northeast and the first range in the Basin and Range country to the southwest, the Cerbat Mountains. Also, the valley, which is elongated northwesterly, is immediately south of the point where the edge of the Plateau swings from east of north to a northwesterly trend. The Hualapai basin-plateau boundary is usually considered to be a buried normal fault. The Grand Wash fault, which bounds the Plateau further north, has a postulated stratigraphic throw of 16,000 feet (Longwell, 1936). Whether or not the suspected fault that forms the northeastern limit of Hualapai basin is an actual continuation of the Grand Wash fault is not known. The basin margin on the Cerbat side may or may not be significantly faulted. Remnants of probable Tertiary volcanics that rest unconformably on the Precambrian terrane of the Cerbats dip toward the Hualapai Valley as much as twenty degrees (Wilson and Moore, 1959). If this attitude is tectonically derived then it is reasonable to suspect that the Cerbat block has been rotated to the northeast. The asymmetry of the gravity contours is suggestive of a one-major-fault valley. The longitudinal basining suggests differential movements amounting to several thousands of feet over a lateral distance of about twenty miles (Fig. 2).

AGE

The age of the salt in the Hualapai Valley is subject to interpretation. The exposed regional geologic habit strongly indicates that Mesozoic and Paleozoic strata were removed from the Cerbat-Hualapai Valley region before detachment from the Plateau, by subsidence, took place in Tertiary time. South of Lake Mead probable pre-salt Tertiary volcanics characteristically overlie a stripped surface cut on Precambrian crystallines. Longwell (1963) observes that an estimated 17,000 feet of Mesozoic-Paleozoic strata present in the Frenchman Mountains near Las Vegas are not represented in northern Mohave County south of Lake Mead. This regional stratigraphic setting places constraints on the age possibilities of the salt. The basining event clearly appears to be a Tertiary feature and the salt in the basin, regardless of origin, is likely to be Tertiary in age. The El Paso Natural Gas Company has attempted to obtain an idea as to the age of the salt. Pollen work was done on a piece of core (supplied by the Arizona Bureau of Mines) that was taken from above the evaporite sequence and potassium-argon techniques were applied to water insolubles contained in the salt (Spitler, 1971). Data obtained from these two studies suggest a Triassic-Jurassic age for the materials dated, namely pollen above and mineralogic contaminants in salt. It seems possible, however, that these determinations are dating transported materials derived from Triassic-Jurassic source rocks, and not the salt.

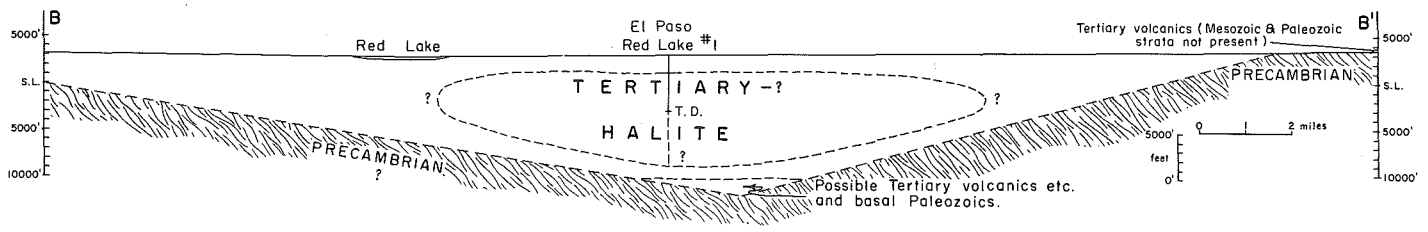

Figure 2. Longitudinal generalized geologic section B-B' along Hualapai Valley.

Evaporites including halite, gypsum, and carbonate (Hualapai Limestone) are associated with the largely Pliocene Muddy Creek Formation in the Lake Mead region to the north. It appears reasonable to consider that the salt in Hualapai Valley may be Pliocene in age but not necessarily the precise time equivalent of halite previously recognized in the Muddy Creek Formation.

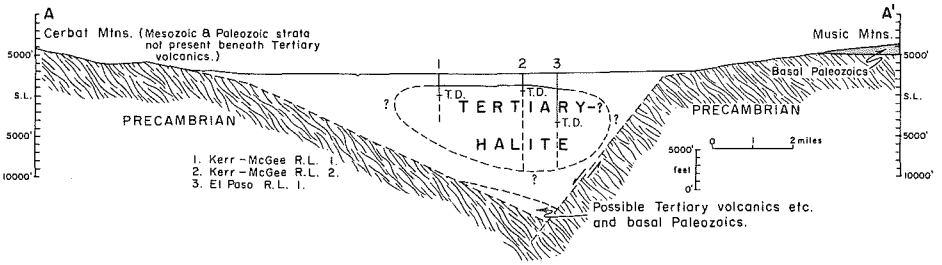

Figure 3. Generalized geologic cross section A-A' across Hualapai Valley.

MODELS

The model presented here is that of rapidly accumulating non-marine halite in a likewise rapidly subsiding closed basin in late Tertiary time. It is believed that this interpretation is a logical extension of the basic geologic data presently in hand. The geologic framework envisioned is perhaps quite different from that involving marine waters and unstable continental margins. It might well be that subsidence rates of some basins during Basin and Range tectonism were sufficient to accommodate the relatively rapid depositional rates normally credited to halite.

Koester (1971 and in McCaslin, 1972) has presented a different model in that he considers the Red Lake salt mass to be a salt dome. His "reasons for considering the Red Lake salt as a salt dome are the great thickness of relatively pure salt, the presence of caprock-like material above the salt, the dip between the Kerr-McGee No. 2 well and the El Paso well, the proximity to the salt dome in the Overton Beach area of Clark County, Nevada, and the geophysical and palynological data."

COMMENT AND CONCLUSIONS

The present salt mass might contain as much as 100 cubic miles of halite. If this mass is to be considered intrusive then there is an additional room requirement for the source material. If the basin walls are converging with depth, a constraint is placed upon the amount of available room. The fact that the inferred vertical dimension of the salt mass is less than width and length is not suggestive of large magnitude extension in a vertical dimension as is commonly associated with salt dome intrusion. The so-called "caprock" might well represent a normal accumulation of sulfate associated with salinity decrease as is implied by encroaching fine-grained clastics that eventually covered the evaporite materials. The Overton Beach area in Nevada appears to be within a complex tectonic region. On the other hand, the Hualapai salt mass, though probably internally rearranged to some extent, might be in a more stable tectonic setting against the Plateau.

The geologic history of thick halite deposits being discovered in Arizona valleys is of much interest. Although the final story of their genesis is not yet available, it is suggested that "thickness" be placed in the perspective of Basin and Range history and possibilities. When this is done perhaps we will be able to encourage a multiple hypothesis approach to this relatively new problem in Arizona geology.

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GRADUATE MINING CONSERVATION SEMINAR

A graduate-level seminar on "Conservation of Mineral Resources" was offered during the spring semester by the University of Arizona College of Mines.

Co-sponsored by the UA Division of Continuing Education and the Summer Session, the seminar presented an overview of conservation objectives and practices in the fields of exploration, mining and resource management.

Meeting 13 times during the semester beginning Jan. 31, the series offered two units of graduate credit upon successful completion.

Topics included in the schedule were: estimation of resources; trends in mineral demand; innovations in mining; the energy crunch; minerals and the physical environment; waste management and surface restoration; multiple use and economic analysis; international aspects of conservation, and guidelines for mineral planning.