

State Department of Geology and Mineral Industries

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Portland, Oregon

SODIUM CHLORIDE BRINE OCCURRENCE FROM NEAR VALE, OREGON

MALHEUR COUNTY

Introduction

Forward:

Sodium chloride brine with a concentration of 58,000 parts per million was reported² to have been obtained from a well situated in T.18 S⁸, R.45 E⁸ ~~SE~~, which is near Vale, Malheur County. An investigation made by this department during the Fall of 1946 disclosed no known brine well in this location. Numerous reports, however, were heard about early-day attempts to commercialize a sodium chloride brine occurrence near Alkali Springs. Subsequent investigation, an account of which follows, led to the confirmation of these reports.

Location:

Alkali Springs is situated in T.17 S⁸, R.45 E⁸ ~~SE~~. This is the same range and section as given in the above reported location, but the adjoining township. It would thus appear that this is the same occurrence as referred to in the report and that the location given ~~therein~~ is in error with regard to the township. Access to the springs is by 6.5 miles of road which turns off to the north of U. S. Highway 28 at a point 6.4 miles ^{NORTH} west of Vale. A small portion of the side road is lightly gravelled but the bulk of it is an unimproved, dry-weather, stockmen's access road.

History:

The circumstances surrounding the original discovery of the brine ~~is~~ ^{ARE} not

1 U. S. Geological Survey--- News Release, 1931.

3 Informants include: Messrs. V. E. Johnson, C. E.; Irwin Troxell, County Commissioner; Homer King & O. E. Clark, ranchers.

JUDGE ~~County Judge, now~~ Better check this with an up to date Blue Book as I suspect he rates as How about an up to date Blue Book?

known, but the discovery was presumably made by some homesteader or rancher who was attempting to develop water. The attempted commercialization of the brine is more fully known. This was done by a Mr. Johnson of Vale during the early 1920's. Johnson's work consisted of the drilling (auger) of numerous but shallow holes, and also the sinking of a few pits. A 50 x 50 ^{ft.} concrete evaporating tank was constructed adjacent to one of these pits. It is also reported that attempts ^{To effect} ~~at~~ evaporation were made, utilizing metal tanks and sagebrush fuel. Although the experimental production made by this work did serve to focus local attention upon the occurrence, no ^{Further} ~~more~~ comprehensive development of the occurrence ever materialized, ~~nor did the discovery command widespread notoriety.~~

Area:

Alkali Springs ^{is} ~~are~~ a group of springs controlled by the U. S. Grazing Service. They occur in a relatively flat valley which lies to the west, and southwest of a pronounced range of hills. Elevation of the Springs is about 2500 feet. Drainage by an unnamed and ^{usually} ~~essentially~~ dry creek is to Willow Creek to the south.

The precise location of the Johnson wells is not known excepting ^{that there are} ~~for~~ two pits found close ^{To} ~~by~~ the remains of the concrete evaporating tank. This tank is adjacent to the access road about 2000 feet to the southwest of the Springs, and in the west half of the section (8). This half section is owned by Otto Broweleit, Rt. #3, Kearney, Nebraska.

As the above mentioned pits are themselves just sluffed in "relics", and as no other means of sampling existed, ^{the} ~~this~~ department drilled ^{several} ~~several~~ holes to confirm the occurrence. The area covered by this drilling is set forth on the map accompanying this report (Plate-1.). The first hole was drilled within a few feet of the concrete tank on the presumption that this tank was

13. Permission for drilling granted by Mr. Broweleit.

located on one of Johnson's most promising test hole sites. Likewise the second departmental hole was located to the east of the first on the strength of the other Johnson shaft situated nearby. For want of additional knowledge concerning the extent of the brine area the remaining departmental holes were located arbitrarily on a grid pattern. Grid intervals used approximated 500 and 1000 feet but these distances were "adjusted" with respect to favorable topographic and drilling conditions.

Procedures followed in the field:

Drilling was done by hand auger supplemented in the case of the deeper #1 hole by a tripod. Three inch augers were used for the most part, although on occasion difficult drilling made the use of a 2" auger expedient. The nature of the strata encountered frequently necessitated a "preconditioning" of the ground before the conventional auger would function efficiently. This was accomplished by the use of a chopping ^{BIT} bar or by a coal auger. Drilling was supervised by R. S. Mason, *Department engineer.*

A total of nine holes were sunk for an aggregate depth of 148 feet 4 inches. Excepting for one dry hole which was abandoned because of excessively difficult drilling conditions, water was encountered at depths ranging between 8 feet 9 inches and 14 feet.

The first hole ~~was~~ was sunk to a depth of 31 feet. This gave a penetration of 19 feet 4 inches below the horizon at which water was first encountered. ~~The~~ ^{the} sinking of this hole to this depth was done ^{to} (by way of) determining ^{if} ~~if~~ ^{there was} any significant increase in flow or salinity (would be disclosed by) ^{at} depth. A slight increase in flow was noted as was to be expected, but no positive or significant increase in salinity was observed in this distance. Since appreciably deeper drilling was indicated for a test of these factors,

and since the objective of this project was merely to confirm the reported existence of the sodium chloride brines here at this time, it was ~~deemed~~^{thought} best to sink as many holes as possible within the time available in order to give some idea of the extent of the area underlain by brine. Therefore subsequent holes were sunk only a sufficient distance below the water horizon to permit ~~the taking~~^{of} a sample.

Large samples were taken and allowed to settle before bottling. The clear solution was siphoned off. ~~Outings~~^{samples} were saved from only a few of the holes as the material encountered in all holes proved to be ~~very~~ similar.

The sodium chloride content of the brine for each hole appears on the map, (Plate 1). A more complete record of the analyses showing associated compounds, etc., is set forth in (chart form in) Table I.

Geology:

The northeastern portion of Malheur County is occupied largely by lacustrine and fluviatile sediments of the Fayette formation. These sediments have been classified as being of fresh water origin. ^(Lindgren, 1898) The composition of the formation varies widely and includes the extensive diatomite deposits in the Harper and other Harney County areas to the west. The clastic portion of the formation is composed chiefly of clays, sands and conglomerates. In the Harper, and other more western areas where the formation has been mapped, Moore ⁽¹⁹³⁷⁾ describes the clastics as being primarily water reworked materials of volcanic origin such as tuffs, ashes, etc. In the Vale to Fayette (Idaho) area Washburne ⁷ points out that while the coarser water-rounded

⁴ Moore - Non-Metallic Mineral Resources of Eastern Oregon. U.S.G.S. Bulletin 875.

⁷ Washburne - Gas & Oil Near Vale, Oregon & Payette, Idaho - U.S.G.S. Bulletin 431, Part II.

Lindgren, Waldman, U.S.G.S. Boise Folio 45.

pebbles appear abundant on the surface, deep well logs show the formation to be composed predominately of clays. ⁽¹⁹¹¹⁾ Euwalda expresses the opinion that these beds are not true lakebeds, but, instead, largely river flood-plain and waste-slope deposits laid down only in part in lakes. While strata of Pliocene (and possibly ~~Pliocene~~^{Pleistocene}) age have been recognized and included in the Payette, the bulk of the formation is generally regarded as being of Miocene age.

Basalt and vitrophyre flows of a younger, or Pliocene and possibly ~~Pliocene~~^{Pleistocene} age, according to Moore, and Washburne, constitute the next most abundant formation to be seen in the area.

So thoroughly do the Payette ~~sediments~~ blanket the area in general, that little is known concerning the identity of the underlying formations over a wide area. In his report on ~~Gas and Oil Near Vale, Oregon and Payette, Idaho,~~ Washburne goes into this aspect of the geology to a considerable extent. Established formations of pre-Miocene age include ~~such formations as~~ the Cretaceous granitics ~~of the mountains~~ exposed 20 miles east of Payette; other igneous rocks and Paleozoic-Triassic metamorphics (shists, limestones, and slates) in the Burnt River and ~~Moran~~^{Moran} Basin areas 20 to 25 miles or so to the north and northwest of Vale; ~~and~~^{and} rhyolitic and other igneous rocks in the ~~Wyhee Range,~~^{Wyhee Range,} 23 miles south of Nyssa. The foregoing ~~sentence is~~^{only} a rough and incomplete summary of Washburne's observations, but it is sufficient to give the picture---especially so since no geologic mapping having a direct bearing on the subject has been published covering this portion of Oregon since Washburne's report.

~~Insufficient~~^{Insufficient} ~~little~~^{little} data exists at this time on which to base conclusive statements

⁵ Euwalda, Report on Oil & Gas Possibilities of Eastern Oregon - Oregon Bureau of Mines & Geology, Vol. 3, No. 2. (1911)

* Op. cit.

concerning the origin of the salt brine found. Accordingly, only a discussion of such observations and data as seem pertinent to the subject, will be given here.

Saline waters are not uncommon. They range in age from present day saline lakes to brines associated with formations of almost all geologic ages. ~~Various opinions exist~~ ^{Various theories have been advanced} concerning origin, especially in the case of the older brines. Some of these saline waters are regarded as connate, or original sea water trapped in sedimentary formations of marine origin. Others clearly originate from the solution of salt deposits contained in sedimentary formations. Still other saline waters associated with igneous and volcanic rocks, are believed to originate from volcanic sources.

Saline beds of the type normally associated with the evaporation of saline lakes have not been described as being integral to the Payette sedimentaries, nor is a connate origin compatible with the fresh water classification of the formation.

Washburne mentions reported finds of rock salt (small fragments from unspecified depths) in two different oil well ~~holes~~ ^{tests}, and even states that one core near Vale "bears some resemblance to those in other oil fields that have cores of salt, gypsum, dolomite, or basalt". This ~~necessitates~~ ^{brings up} consideration of the possibility that the underlying formations may contain rock salt deposits. None of the underlying formations ~~are~~ ^{is} known to contain such deposits although the Triassic sedimentaries could possibly be regarded as a potential host formation.

One horizon of this formation is known as the "Gypsum formation" because of contained gypsum deposits.

8 Livingstone - A Geologic Reconnaissance of the Mineral & Cuddy Mountain Mining District, Washington & Adams Counties, Idaho, Pamphlet No. 13, Bureau of Mines and Geology, Idaho.

This horizon is characterized by red and green shales and conglomerates. If the contained gypsum of this formation is of sedimentary origin, it would not be unwarranted to suspect that the formation might also contain beds of salt as the two minerals are commonly found together. In this respect, however, and from an examination of the old gypsum mine, near Huntington, Oregon⁹ it is the writer's belief that the gypsum (of this particular deposit, at least) is of secondary origin and the result of the reaction of sulphur-bearing waters on contained limestone lenses ~~the~~^{because} gypsum is closely associated with an area of sulphide mineralization and faults ~~and~~^{and} the gypsum gives way progressively to limestone with distance from the faults ~~as~~^{whereas} other nearby limestone lenses in the formation show no alteration. Whether this origin for this deposit is an exception ~~or the rule~~, would necessitate study of the formation at large and of the other known gypsum occurrences ~~therein~~^{in the formation} in Idaho. Of interest is the fact that the writer has traced this "Gypsum Formation" in Oregon to a point on Durbin Creek about 18 miles to the north or north-northwest of the Vale salt brine area under discussion. At this point the "Gypsum Formation" is exposed as a "window" of only a few acres in area in a region occupied predominantly by lake beds and basalts. The occurrence of this formation here shows its trend to be towards the salt area in general. Whether or not it continues its trend in this direction, and whether or not it does contain rock salt beds in that area is something that cannot be answered with the data at hand. ~~The question of~~ whether or not the brine ~~could~~ originate^s from the solution of salt beds thus remains problematical.

A volcanic origin for the brine is also a possibility, as an association of saline waters of various types with volcanic rocks and volcanic activity, has been noted the world over. Such waters are believed to have been con-

⁹ Wagner, C.S. Gypsum Mine of the Snake River Below Huntington, unpublished report, 1911

tributed from primary volcanic sources in some ^{instances} ~~cases~~, while, in other ^s ~~cases~~, their mineral content has undoubtedly been derived in a secondary manner by widespread leaching or dissolving of soluble salts from such volcanic materials as contain them. Very likely the mineral content of saline waters found in volcanic areas includes components derived from both primary and secondary sources.

In considering the origin of the brines under discussion here, it must be noted that thermal waters are common in the Vale area. Washburne makes special comment on the wide variations prevailing in both physical and chemical properties of some of the waters to be encountered there. Likewise, it must be noted that volcanic rocks of both acid and basic types, and ranging from early Tertiary to recent in age, are widespread in southeastern Oregon (at large). Further, a study of nitrate occurrences in this part of the state has shown that other salts, ^{such as} ~~namely~~ sulphates and chlorides of magnesium, potassium, sodium, and calcium, are not uncommon. ^{Although} ~~While~~ neither the nitrates nor the other salts occur in commercial amounts, their study has led to several observations which may prove pertinent to any consideration of the origin of the Vale brines.

The salts have been established as accumulations resulting from the evaporation of underground waters where such are exposed to the surface climatic conditions ^{because of} ~~by virtue of~~ erosion or structural agency. They are to be found only in selected places where they are protected from being re-dissolved by rainfall or other surface waters. Furthermore, Williams ^{10. (171)} reports that they are associated almost exclusively with rhyolitic rocks.

¹⁰ Williams - Report on Nitrate Deposits of Southeastern Oregon, Oregon Bureau of Mines & Geology, 1918.

~~while~~ ^{although several} various of the "nitrate" occurrences are many miles distant from the Vale brine area, some of them ~~are~~ situated near Vale. Their origin is of significance, as from a geologic standpoint, the Vale brine area is an integral part ~~of~~ the same geologic province as a whole. ~~while~~ ^{no} direct evidence is at hand to ~~conclusively support any contention that~~ ^{from} the Vale brines represent concentrations of salts derived either directly or indirectly from volcanic sources, ^{but} the weight of available evidence strongly suggests such an origin ~~to these brines~~ ^{for these brines}.

Discussion of drill hole data:

While the drilling done has confirmed the reported occurrence of sodium chloride brine here, neither the nature ^{not} or scope of this drilling permits ~~an~~ ^{an} ~~the making of any~~ ^{economic} specific evaluation of the occurrence ~~along economic~~ lines at this time. Such conclusions as can be made follow.

An examination of Table I shows that two types of brines were encountered. Both contain NaCl as the chief constituent. The significant difference is that in one brine the associated compounds are ^A predominantly sulphates as compared to the other in which the associated compounds are ^A predominantly chlorides. This will be more clearly seen if only the average of the fractional samples for hole # 1 be considered in comparison with the brines from the other holes. Predominancy, as ^{estimated} ~~reasoned~~ by the writer, consisted of comparing the sum of the parts per million of sulphate compounds ^{against} ~~against~~ the sum of the chloride figures with only the associated compounds (not NaCl) being considered. ^A Whichever was greater was considered as predominant.

A distinct segregation or zoning of these sulphate and chloride brines is apparent when they are entered on the map. The sulphate bearing brines occupy the northwest portion of the map, ⁱⁿ or holes numbered 1, 6, 7, 8, 9, and include also ^A Alkali Springs. The brines in which chlorides predominate

originated from holes (numbered) 2, 3, and 4. A marked decrease in NaCl content is to be noted as existing with the sulphate brines. The brine from hole # 1 is the only exception.

The value of saline brines depends not only on a high concentration of a marketable compound, but also upon the nature of associated brines and the ability to effect a separation within commercial cost limits. Since a variation in brine types to be had here is indicated, it is possible that a more extensive ~~prospect~~ ^{prospect} development program might disclose not only areas of higher grade NaCl brine, but also areas in which some of the present associated compounds may occur in significantly greater amounts. ~~In regard to the~~ ~~presence of~~ ~~these~~ ~~brines,~~ ~~it is also to be noted that minor constituents such as bromine and iodine sometimes occur in commercially important concentrations. ~~These~~ ~~should not be overlooked.~~~~

From the foregoing it is apparent that any prospect development program would have to be extensive, not alone for the purpose of proving a large area to be underlain by brine, but also for the purpose of determining the ~~existent~~ type and grade of brine.

Flow encountered in the holes sunk was negligible from a commercial standpoint. Drilling at depth will be necessary to reveal the amount of flow that may be had.

Conclusions:

The brines recovered from the holes drilled confirm the reported occurrence of such brine in the area, ^{and this} ~~which~~ confirmation was the objective of the drilling project described. The geologic nature of the brine occurrence from the standpoint of origin is uncertain but probably represents concentrations of soluble salts derived from volcanic agencies, although a possibility exists that the brine could be derived from the solution of saline deposits

contained in Triassic sedimentary rocks buried beneath the Fayette formation. Additional drilling, so conducted as to increase present knowledge concerning the area underlain by brines, the nature and grade of the brines, ^{quantity available} ~~and the distance of a potential flow of same~~, will have to be ^{done} ~~made~~ before any consideration of commercial value for the occurrence is warranted.

Report By:

N. S. Wagner, September 18, 1947

TABLE I - TABULATION BY COMPOUNDS - VALE BRINE SAMPLES

(All results given in parts per million)

HOLE	WATER-BEARING SECTION SAMPLED	TOTAL SOLIDS	SULPHATE COMPOUNDS			CHLORIDE COMPOUNDS			
			CaSO ₄	MgSO ₄	Na ₂ SO ₄	CaCl ₂	MgCl ₂	KCL	NaCl
# 1	11'8" to 14'0"	55,300	5,110	1,540	1,160			205	44,600
# 1	11'8" to 19'0"	57,100	4,750	1,440	2,475			565	45,900
# 1	11'8" to 27'4"	55,100	4,900	1,480	1,950			325	44,000
# 1	11'8" to 31'0"	55,500	5,510	1,530	1,380			420	44,500
# 1	Average of above fractional samples	55,750	5,067	1,497	1,741			379	44,750
# 2	14'0" to 17'4"	70,100	5,525			5,900	2,990	290	51,500
# 3	14'0" to 17'0"	65,600	2,960			7,390	3,150	520	46,000
# 4	14'0" to 17'6"	65,600	3,500			3,990	2,870	290	47,800
# 6	10'0" to 14'0"	43,000	2,540	770	11,400			140	26,000
# 7	13'0" to 17'0"	44,200	4,850	1,860			580	210	34,600
# 8	11'3" to 15'3"	25,800	1,940	590	1,470			160	20,150
# 9	8'9" to 13'4"	49,400	690	600	8,880			250	36,200
Alkali Springs		1,200	22	20	120			14	910

No bromine or iodine was found in the samples.