State Department of Geology and Mineral Industries

702 Woodlark Building
Portland, Oregon

Report by N. S. Wagner
Examined-April 7-8, 1943

Name: Sodium Nitrate Deposit, Central Malheur County

Lessee: Held by Forest White, under Sodium Permit No. 031593, issued February 14, 1941, with sub-lease pending to W. M. Schmeykal and F. L. Muckensturm of Boise, Idaho.

Location: In the canyon of Crooked Creek and the Owyhee River, which is situated in sec. 4-8, T. 31 S., R. 41 E., W. M., or about 5 miles north of Rome.

Introduction:

Sodium Nitrate is one of a group of very soluble compounds, and because of this solubility, it occurs as a natural mineral deposit only under very special conditions where it is protected from moisture. Thus, most nitrate is found as incrustations, lining, or even filling, small cavities, or in caves, or in similar sheltered crevices in arid regions. Such deposits are naturally very limited in extent. Sizable deposits are scarce the world over, the most outstanding one being the Caliche deposits in Chile, and "These extraordinary accumulations——are the result of the unusual climate at the place where they are found." (H. S. Gale-p.6, U. S. G. S. Bulletin 838, Nitrate deposits of the United States, by Mansfield and Boardman.

Nitrate deposits are known to occur in the semi-arid regions of eastern Malheur County and adjacent sections of Idaho where they have been described by G. R. Mansfield (U. S. G. S. Bulletin 620-B) as being restricted to the particularly sheltered section of caves and small cavities in rhyolite. It has lately been the object of attention in central Malheur County where it occurs along with associated salts, concentrations of which appear conspicuously on the canyon walls and on the plateau adjacent to the canyon in such a manner as to suggest the possibility of an appreciable tonnage of low grade Nitrate. Since this view was widely held, the property was examined and carefully sampled by the State Department of Geology and Mineral Industries. The details and conclusions of which examination follow.

Physiography & General Geology: The area, in general, is situated in semi-desert country, has but light precipitation, and is devoid of vegetation other than sagebrush, except for poplars situated around the water holes or planted in irrigated barnyards.

The country approaching Crooked Creek from Rome is a wide valley about 3500 feet above sea level and studded with mesas composed essentially of flat-lying tuffs and loosely consolidated sediments. These are capped with basalt and are highly dissected on their flanks.

At the site of the deposit proper, the country rock is a porphyritic rhyolite. This constitutes the walls of the canyon of Crooked Creek. It first appears immerging from under the sediments on the Owyhee River a short distance upstream from the mouth of Crooked Creek and it rises gently to approximately 200 feet above river level. It constitutes the bedrock of the plateau on each side of Crooked Creek, only a thin veneer of the sediments remaining uneroded in isolated patches.

Across the Owyhee the section is complete, the overlying sediments and basalt remaining intact. From this section, and the manner in which the rhyolite rises gently from the river level to this altitude, it appears that the rhyolite is a pre-existing flow with the sediments lying unconformably on top of it.

Since the nitrate deposits occur in this rhyolite, further description of it is in order. For the most part it is a massive, dense, felsitic rock, weathering red, and exhibiting the usual banding well developed in some local areas and porphyritic textures and others. In addition there are areas in which small cavities are abundant, and particularly significant, large areas of highly porous tuffaceous material. The whole flow is traversed by a series of joints which in places are so close together as to afford easy weathering and produce a poorly developed buttress and recess effect where they strike across the canyon. A few brecciated shears were noted.

Geology of the Nitrate Occurrence:

The structural features just described control the occurrence of nitrate. Sodium Nitrate, in a fairly pure state, is to be found in specimen quantities lining cavities and as incrustations in protected places on the walls of the canyon, and distributed throughout the upper reaches of the talus slopes in

similarly sheltered spots. It also is found, as shown by analysis, with associated salts which not infrequently appear in scattered, but conspicuous concentrations both on the canyon walls and on the plateau adjacent to the canyon. These concentrations of associated salts occur primarily in the highly porous tuffaceous facies of the rhyolite, or in the major fracture zones. Since these structures penetrate the rock to a considerable depth, these salt concentrations can often be traced in the third dimension back on the surface of the plateau in addition to being seen on the canyon walls. In fact, one island of the material was found on the northern flank of the plateau 1,000 feet from the canyon. It is these bodies of associated salts, concentrated as they are in the major fracture and porous zones of the rhyolite, which led to the belief that, in contrast to other known deposits in the state, appreciable tonnages of nitrate might be found here honeycombed throughout the rhyolite mass.

Even though these concentrations of salts contain relatively small tonnages individually, were widely and erratically dispersed through the lava, and totally lacking in some areas where well developed fracturing and porosity favored deposition, so that it appeared most unlikely that many more extensive occurrences than those already visible would exist, the most direct method of evaluating the situation lay in detailed examination of a few of the most promising showings which have reportedly yielded encouraging nitrate samples.

No attempt will be made to discuss each such deposit investigated as the procedure employed and the results obtained on all of them were the same. Briefly, samples of the most likely nitrate-bearing material were taken to confirm the presence of nitrate. Then, sizable pieces of the salts were dug from depth (both back in from the canyon face, and down from the plateau surface) where they could be counted on as being free from any possible surface incrustation of nitrate. These were further cobbed down so that the final sample consisted of entirely fresh material from the center of each piece.

These samples were all subjected to the Brown Ring Nitrate test.* Without exception, all samples of the fresh material showed no nitrate content, or at best, the merest trace. Samples of the high grade varied, some few giving a strong nitrate reaction, others, of selected incrustation, showing from a trace to 2-3 percent nitrate content. No sample from the material outcropping on the surface on the plateau gave as much as a trace of nitrate. All samples, which showed any nitrate content, came from exposures on the canyon face, and here ONLY IN ISOLATED AND PROTECTED SPOTS, most samples of the "run of the mill" material there, testing nil too.

From these facts it follows that the nitrate found in these concentrations of allied salts exists there on the same basis as it does elsewhere in the canyon---in other words, in specimen quantities, preserved only by virtue of the protection from the elements afforded there by cavities, crevices, and overhanging ledges of other material; and that these occurrences are entirely superficial; and that the nitrate does not occur disseminated throughout the bulk of the deposit of other salts.

Chemical and petrographical analyses have been made by the State Department of Geology and by competent commercial analysts. On representative samples of the material which constitutes the bulk of these concentrations, they agree in finding no sodium or potassium nitrate. Mr. Lowry, of the State Department of Geology, reports that evaporation of the solute shows thenardite (Na_2SO_4) to be the predominant salt, and that the insoluble portion is largely partly kaolinized feldspar. In fact, in the field it appeared as if much of the substance of these deposits was in reality altered rock made conspicuous by relatively minor amounts of the white salt, and in all probability, samples dug from even greater depths than those obtained during this survey, would reveal the cores of these bodies to be essentially such material.

Conclusion: In conclusion, it may be said that the occurrence of nitrate here in no wise differs from that described in other parts of the state, being classified under the heading of typical cave deposits, cavity fillings, etc; that the association with allied salts which do exist in conspicuous concentrations under certain favorable conditions, is a natural and logical one, but one in which the nitrate occurs only in protected spots on the same basis as heretofore mentioned; that these allied salts in all probability are but surface phenomena themselves with the cores of the apparent bodies being in reality locally altered rhyolite; and that even if they were dominantly salts which did average as much as 10-15 percent nitrate (which they don't) their individual tonnage is so small, and their occurrence so widely separated and situated in such hazardous places throughout the canyon, that mining of them would be wholly impractical.

* The Brown Ring test given in the field is quite sensitive, showing the presence of nitrate in very small amounts. It is a qualitative test only, although experience has shown that crude quantitative observations can be made. Thus, a reaction violent enough to boil, sometimes giving off brown fumes, carries a minimum of 3 percent nitrate. A reaction producing a distinct but pale ring, reflects but a fraction of a percent. Reactions lying between these extremes reflect a nitrate content of from 1-3 percent accordingly. (U. S. G. S. Bull. 838, Nitrate deposits of the U. S., p. 11).

The method used in most of these tests in the field consisted of boiling approximately equal volumes of pulverized sample in concentrated sulfuric acid--cooling--then adding a few cubic centimeters of saturated ferrous sulphate solution. The brown ring developed immediately at the contact of the two liquids.

Respectfully submitted,

N. S. Wagner
Field Geologist

702 Woodlark Building
Portland, Oregon

Looking up Crooked Creek (west) from botton of canyon and showing one particularly conspicuous deposit on canyon wall (white spot to right of center of picture). Notice the small tributary canyon entering the main canyon at this point. A well developed fracture zone starts into the plateau here and a sizeable area of altered rhyolite and salt deposit occurs back in the recess and on the plateau surface (neither seen in this picture).

Close up of above from plateau showing part of deposit and a suggestion of the beginning of the recess.

Another view of more of same showing upper reaches of Crooked Creek Canyon in distance. This particular occurence was not accessible, but it appeared representative of similar ones in finely porous, tuffaceous-looking spots in the rhyolite. Probably nitrate can be found in the little deposit under the overhanging rock at the left of the picture.

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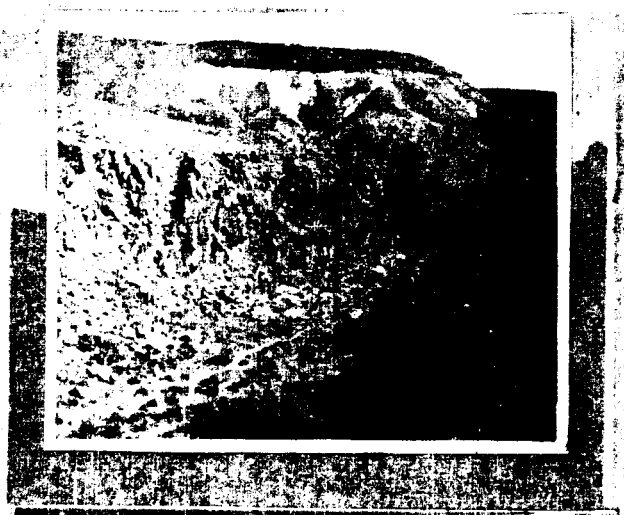
Portland, Oregon



View down Crooked Creek (east) showing canyon in which most nitrate occurs, and especially, the rhyolite and the uneroded sediments and basalt across the Owyhee River. The rhyolite drops in elevation gently to the south and can be seen disappearing beneath the sediments a few hundred feet up the canyon of the Owyhee River (just off this picture to the right).

rhyolite and salt ... occurs ... in recess and on the plateau surface (not shown in this picture).

View down Crooked Creek (east). The camera was located in the center of a strong group of fractures and the picture was taken across a swing in the canyon and along the strike of fractures showing how the creek weaves back across the fracture zone and the crude buttress and recess effect produced because of the fr... two typical concentrations of salts appear in the center of the picture-one on the crest of the largest buttress and one half way down it. Most such occurrences are found in the recesses, and when situated near the rim of the canyon, extend back onto the plateau with the fracture zone.

Close-up of a deposit occuring in a small fracture zone, showing how some deposits sometimes exist on the face of the canyon where they are exposed to the elements.

Another view of a similar deposit on the south plateau of the canyon and looking up Crooked Creek (west).

4/46

Sodium Nitrate		Nitrate	
NAME	OLD NAMES	PRINCIPAL ORE	MINOR MINERALS

31S	44E	4+8
T	R	S

PUBLISHED REFERENCES

U.S.G.S. Bull 620-B (Mansfield)

Malheur ..... COUNTY

..... AREA

..... ELEVATION

..... ROAD OR HIGHWAY

..... DISTANCE TO SHIPPING POINT

MISCELLANEOUS RECORDS

PRESENT LEGAL OWNER (S) ...Trust White..... Address Boise Idaho — Sodium Permit No. 031593 Feb-1941

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.....

.....

OPERATOR .....

Name of claims	Area	Pat.	Unpat.

Name of claims	Area	Pat.	Unpat.

EQUIPMENT ON PROPERTY

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State Department of Geology and Mineral Industries

702 Woodlark Building
Portland, Oregon

JOHN HERMAN LABORATORY
771 San Julian Street
Los Angeles, California

Certificate of SPECTROGRAPHIC QUALITATIVE ANALYSIS

Made for Adelmann Brothers Date February 19th, 1943.

"S.K. Atkinson #1"

ELEMENT	ESTIMATED QUANTITY
Silicon	10.0%
Iron	10.0%
Aluminum	10.0%
Sodium	1.0 to 10.0%
Potassium	1.0 to 10.0%
Calcium	1.0%
Magnesium	0.1 to 1.0%
Manganese	0.1%
Zirconium	0.1%
Copper	0.01 to 0.1%
Chromium	0.01 to 0.1%
Titanium	0.0[illegible]%
Lead	0.001 to 0.01%
Vanadium	0.001 to 0.01%
Nickel	0.001 to 0.01%
Strontium	0.001 to 0.01%
Tin	0.001%
Gallium	0.001%
Molybdenum	0.001%
Cobalt	0.001%
Barium	0.001%
Silver	0.0001 to 0.001%

CONFIDENTIAL

John Herman
Chemist

Certificate of Assay CHEMICAL ANALYSIS

Made for Adelmann Bros. Date April 12, 1943

S.K. Atkinson

Sodium Nitrate	None
Potassium Nitrate	None
Calcium Chloride	None
Calcium Compounds (Total CaO)	0.5%
Barium Compounds	0.01%
Magnesium	0.10%
Vanadium	0.001%
Iodine	None

$ Paid

John Herman

State Department of Geology and Mineral Industries

702 Woodlark Building
Portland, Oregon

United States
DEPARTMENT OF THE INTERIOR
Bureau of Mines

Western Region

Salt Lake City, Utah
April 6, 1943

Mr. S. K. Atkinson,
Boise, Idaho.

Dear Mr. Atkinson:

Examination of your sample indicates that it is a partially disintegrated rhyolite. Qualitative tests made on this sample confirm the presence of nitrates but the amount present appears to be relatively small. It is quite possible that the nitrate content of this type of rock may vary considerably as is the case with similar deposits that have been observed in Utah.

The possibilities of this material as a source of nitrates depend on many factors and it would be a difficult matter to advise you definitely on the commercial possibilities of such a deposit. As suggested by Mr. Zimmerely in his letter of March 30, it would be advisable to arrange with Mr. [illegible] C. Iverson for investigation of the deposit to determine its possible extent and nitrogen content.

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Very truly yours,

R. E. Head,
Microscopist,
Western Region.

Extracts from a letter from Wallace D. Lowry, Assistant Geologist, State Department of Geology and Mineral Industries, April 15, 1943.

"——Insol is largely feldspar, partly kaolinized——the solute gives a good SO_4 and Cl test. No Nitrate reaction what so ever could be present in small amount. Also no carbonate reaction to speak of. The spectroscope shows both Na and Ca. Evaporation of the solute shows thenardite (Na_2SO_4) is the predominate salt."