

STATE OF IDAHO
Arnold Williams, Governor

IDAHO BUREAU OF MINES AND GEOLOGY

A. W. Fahrenwald, Director

SULPHUR IN IDAHO

By

W. W. Staley and Lewis S. Prater

University of Idaho

Moscow, Idaho

STATE OF IDAHO
Arnold Williams, Governor

IDAHO BUREAU OF MINES AND GEOLOGY

A. W. Fahrenwald, Director

SULPHUR IN IDAHO

By

W. W. Staley and Lewis S. Prater

University of Idaho

Moscow, Idaho

SULPHUR IN IDAHO

By

W. W. STALEY* AND LEWIS S. PRATER**

INTRODUCTION

Sulphur deposits in Idaho have been known since 1872; but a preliminary investigation was not made until 1910. In 1927 a little additional information was accumulated¹.

According to Richards and Bridges, and also Mansfield, attempts have been made to recover the sulphur from the several deposits. An inspection of the area was made during August 1945; remains of early-day equipment were still in evidence.

We wish to thank Mr. Lloyd, of Soda Springs, for his aid during the inspection of the deposits. Most of the deposits lie on his land.

LOCATION OF DEPOSITS

The deposits are located a few miles southeast of Soda Springs, Caribou County.

More specifically they are in sec. 2, 11, 13, and 14 of T 9 S, R 42 E, and sec. 14, T 10 S, R 43 E. These locations are shown on the accompanying map². The deposit south of Rattlesnake Canyon was not visited. It seems to be on the same general trend of the fault zone containing the other deposits.

The deposits in T 9 S, R 42 E are very easily accessible. Lloyd's ranch is 4½ miles from Soda Springs on a surfaced highway; the deposit in section 14 is about 1¼ miles from the ranch; that in section 13 about 2 miles from the ranch; and the large deposit in sections 2 and 11 about 2½ miles. Very little work would have to be done on any of these roads.

An inspection of the accompanying map shows that Soda Springs is located on a main highway (30N) and on one of the main branches of the Union Pacific Railroad.

GEOLOGY

The broad geological features of the area may be had by consulting Richard and Bridges or Mansfield. For the purpose of this report the following brief summary suffices³. Exposures in the area consist of Carboniferous (Pennsylvania and Mississippian) overlain by Triassic and Cretaceous sediments and Quaternary sediments and basalt. The Pennsylvanian and Mississippian formations are composed of limestone, quartzite, shales, and sandstone; the Triassic of shale; and the Cretaceous of tuff, limestone, and quartzite. There are rather extensive areas of travertine, alluvium, basalt, and lakebeds, all younger than the Cretaceous.

East of and abutting the fault zone the exposures consist of Pennsylvanian and Mississippian and later alluvium; while to the west the contact is Triassic, Cretaceous, and later travertine and alluvium.

The igneous rocks are pre-Cretaceous volcanic tuff (ash) and early Quaternary basalt.

The sulphur is associated with gypsum and cements the fault breccia which is composed of fragments of tuff, limestone, and quartzite.

DESCRIPTION OF DEPOSITS

Of the locations shown on the map, only those in the fault zone were examined.

Section 14, T 9 S, R 42 E.

There are about 40,000 sq. ft. of brecciated material exposed. The sulphur-bearing rock could be mined with a drag-line or shovel for a considerable depth. There are numerous open cuts and one rather extensive cut. Information regarding the depth of mineralization is not available. The depth could be readily found by means of churn drilling. A treatment plant of some sort had, at one time, been in operation.

* Mining Engineer

** Metallurgist

¹ Peale, A. C., Report on minerals, rocks, thermal springs, etc., U. S. Geol. Survey Terr. Fifth Ann. Rpt., p. 1931, 1872.

Richards, R. W., and Bridges, J. H., Sulphur deposits near Soda Springs, Idaho, U. S. Geol. Survey Bull. 47, pp. 499-503, 1919.

Mansfield, G. R., Geography, geology, and mineral resources of part of southeastern Idaho, U. S. Geol. Survey Prof. Paper 152, 1927.

² Base used was U. S. Forest Service map of the Caribou National Forest (1940); and for the location of the fault zone Fig. 58 from Richards and Bridges report.

³ Richards and Bridges, *Ibid.* p. 499, 502.

There were two high-grade streaks of sulphur exposed. They are each about 6 ft. wide.

Several samples were taken in the large cut or pit.

A composite grab sample across 35 ft. of pit face showed 13.1 per cent sulphur. The west side high-grade streak gave 18.2 per cent; and the east side high-grade streak showed 28.6 per cent.

Section 13, T 9 S, R 42 E.

This deposit also contains about 40,000 sq. ft. of exposure. In appearance it is very similar to that in section 14. Evidence of considerable surface excavation was apparent. The remains of an old treatment plant were scattered about.

No samples were taken of this deposit.

Section 2 and 11, T 9 S, R 42 E.

This appears to be the most extensive deposit of the three. It contains about 100,000 sq. ft. The remains of an ore bin and power plant had been left by one of the early operators. Some type of concentrator appeared to have been used. Numerous cuts had been made across the strike of the mineralized zone. No samples were taken.

Geologically the three deposits are very similar.

The one in section 14 is the most accessible. Also it appears to have more sulphur in evidence than the others. The attempt to estimate the presence of sulphur by eye will prove deceiving. The sulphur is a dirty white color; only in the high-grade streaks does it appear yellow to any great extent. A strong odor of sulphur dioxide indicates the nature of the deposit.

FUTURE OF THE SULPHUR DEPOSITS

The purpose of writing this report was because interest had recently been shown in Idaho sulphur deposits. What the future might bring forth is difficult to say. As already pointed out, previous attempts to work the deposits have failed. So far as can be determined, past operations ceased at the end of World War I. Transportation and economic conditions are somewhat different now. Movement is under way to more fully develop the resources of the Pacific Northwest. A market for sulphur is available in the Northwest area. With proper development the Soda Springs deposits may prove economically useful.

Before attempting to evaluate their worth some development will have to be done. This can be cheaply accomplished by churn drilling. Past reports have indicated 1,000,000 tons running 10 per cent sulphur. A few churn drill holes should settle the question as to tonnage and grade. The present report estimates roughly 180,000 sq. ft. exposed. To give 1,000,000 tons this area would need be but 100 ft. deep. The present physical conditions substantiate such an assumption.

The deposit in section 14, T 10 S, R 43 E seems to lie in the same general fault zone. In the vicinity of Swan Lakes there are sulphur indications. More than likely the fault zone and the sulphur deposits extend clear to Rattlesnake Canyon.

USES OF SULPHUR

Following is a list of industries and products⁴ in which sulphur is used. Many of these are not at present of importance in the economy of the northwest. Those marked with an asterisk do represent present active markets. It is proposed that many of the other industries be established.

Alcohol	*Fungicide	Petroleum products
Alum	Glass	Photography
Aniline	Glue	Plastics
*Artificial fertilizers	Glycerine	Poison
Artificial silk	Illuminant	Refrigerating reagent
Belting	Inorganic or organic acids	*Rodent exterminator
Binders	*Insecticides	Rubber hose, tires, and other
Bleaching agents	Laboratory reagents	rubber goods
Celluloid	*Leather	Shoe polish
Cements	Liquid fuels	Soap
*Chemicals	*Livestock food	Soda
Dyes	Lubricants	Solvent
Ebonite	*Matches	*Sulphuric acid

⁴Ridgeway, R. H., Sulphur—General information. U. S. Bur. of Min. Inf. Cir. 6329, p. 24, 1930.

Elastics
Explosives
Fabrics
Fire extinguishers
Fireworks
*Food preservatives
*Fumigant

Medicine
Metallurgy
Motor fuels
Moving-picture films
*Paints
*Paper
*Paper bleaching

Steel pickling and galvanizing
Storage batteries
*Sugar
*Tanning
Textiles
Water purification

In the above list sulphur is used in the form of native sulphur, sulphur dioxide, sulphuric acid, sulphites, sulphates, sulphides, etc.

METALLURGICAL EXAMINATION OF THE MATERIAL

A large sample of the material was brought to Moscow for metallurgical examination.

In general appearance this sample was a white to light gray color with the yellow crystalline sulphur uniformly distributed through it. As received at the laboratory the pieces ranged in size from fines to tabular chunks 8 to 10 inches across. The gangue was mostly a gritty, siliceous material that had been loosely consolidated with a few rounded, gray quartzitic pebbles imbedded in this matrix. Most of the lumps could be broken or crumbled by hand.

The sample was allowed to thoroughly air dry before any tests were made. In this process the sacks in which it was stored were completely rotted, indicating the presence of an appreciable amount of sulphuric acid.

The entire lot of 150 lb. was crushed to minus $\frac{1}{4}$ -in. and a head sample was cut out for assaying. The following analysis was made:

Ignition loss	31.4 per cent
Acid insoluble	60.9 per cent
R ₂ O ₃ (Iron and aluminum oxides)	3.1 per cent
CaO	2.1 per cent
MgO	trace

The sulphur assays were:

Free sulphur	28.0 per cent
Total sulphur	28.1 per cent

For the sulphur assays on all samples the total sulphur determinations were made by fusion and subsequent precipitation as barium sulfate. These results were readily checked. The free sulphur analyses were made by extraction with carbon disulphide. This method was not as exact and more difficulty was encountered in getting close checks. There were indications that something other than the sulphur in the sample was dissolved in the carbon disulphide and that these results were therefore a little high. An extraction with aniline oil checked the carbon disulphide extraction indicating that the sample did not contain any appreciable amount of amorphous sulphur.

Since the ore was very friable it was possible to grind the $\frac{1}{4}$ -in. product in the laboratory ball mill without first crushing to 10 mesh as is required on hard rock. Grinding costs on the ore should be very low. It was noted that an appreciable amount of hydrogen sulphide was given off on grinding and also that the weight lost in making the tests was more than the mechanical loss in handling, suggesting water soluble material. It would be necessary to assure adequate ventilation around the grinding circuit in a mill design.

A batch of 2000 grams was ground 15 minutes in the laboratory ball mill for the flotation test outlined below. A rougher concentrate was made and this was cleaned once giving a final concentrate, middling, and tailing.

Flotation test procedure.

I. Rougher circuit.

Ore equals 2000 grams.

Sodium silicate (40%) = 0.1 lb./ton.

Condition 2 minutes.

Methyl amyl alcohol = 0.072 lb./ton (12 drops added in stages of 6-2-2-2).

Frothing time = 15 minutes.

II. Cleaner circuit.

Methyl amyl alcohol = 1 drop added midway in frothing.

Frothing time = 3 minutes.

Metallurgical Results

Product	Weight, grams	% weight	% Free sulphur	% Free sul. recovery	% total sulphur	% Total sul. recovery
Concentrate	616	33.0	75.2	87.2	75.2	85.2
Middling	217	11.6	19.8	8.1	20.0	8.0
Tailing	1033	55.4	2.4	4.7	3.6	6.8
Composite	1866	100.0	28.5	100.0	29.1	100.0

pH of rougher tailings water = 4.6

No attempt was made to neutralize the high acid content of the pulp but it is believed that the reagent consumption would be excessive if this were tried. The sulphur can be very readily floated without modifying the pH but it would be necessary to have machinery designed to resist the corrosive action of the acid.

Rougher concentrates were floated with other reagent combinations as follows:

I. Coal tar creosote No. 4

II. Kerosene and pine oil

III. Carbon disulphide and pine oil.

Although none of the above concentrates were cleaned the grades and recoveries were about equal to the rougher concentrate made with the methyl amyl alcohol. Some choice in reagents should, therefore, be possible without hurting the metallurgy.

It was also noted that in all tests the free sulphur was equal to the total sulphur in the concentrates. The total sulphur was higher than the free sulphur in the tailings, however, indicating that the gypsum, etc., in the sample is not floated.

IDAHO BUREAU OF MINES AND GEOLOGY
 A. W. Fahrenwald, Director
SULPHUR DEPOSITS NEAR SODA SPRINGS
 Drawn by W. W. Staley

Moscow, Idaho

November 1945

X - Location of deposit

----- Fault

0 2 3 4 5 Miles

