PAMPHLET NO. 5

July 1923.

STATE OF IDAHO
Chas. C. Moore, Governor.

BUREAU OF MINES AND GEOLOGY

Francis A. Thomson, Secretary.

==========

RECONNAISSANCE

A PRELIMINARY RECONNAISSANCE OF THE GAS AND OIL POSSIBILITIES OF SOUTHWESTERN AND SOUTH-CENTRAL IDAHO

By

John P. Buwalda

(Issued in Cooperation with U. S. Geological Survey)

PAMPHLET NO. 5 July 1923.

STATE OF IDAHO
Chas. C. Moore, Governor.

BUREAU OF MINES AND GEOLOGY

Francis A. Thomson, Secretary.

==========

RECONNAISSANCE

A PRELIMINARY RECONNAISSANCE OF THE GAS AND OIL POSSIBILITIES OF SOUTHWESTERN AND SOUTH-CENTRAL IDAHO

By

John P. Buwalda

(Issued in Cooperation with U. S. Geological Survey)

Introduction.

Because of the increase in petroleum consumption coupled with the occurrence in Snake River valley of vast areas of sedimentary beds, citizens of southern Idaho have been active in drilling and prospecting, and in inquiring for technical and geological advice concerning the area. In response to the latter a reconnaissance survey was made by the United States Geological Survey during the summer of 1920 at the request of, and in cooperation with, the Idaho Bureau of Mines and Geology. Dr. J. P. Buwalda, a geologist in the oil and gas section of the former organization, was in charge of the examination. A digest of his general findings follows:

Location of Area.

The area examined comprises that part of southwestern Idaho known as the Snake River valley and includes many of the tributary valleys from a point fifteen miles northwest of Weiser on the west to Raft River and Goose Creek valleys in South Central Idaho.

Field Work.

Most of the work was done in the summer of 1920, but studies in nearby areas by the writer during other seasons contributed to the knowledge of the region. Field work and publications by Lindgren, Russell, and Washburne of the United States Geological Survey greatly expedited the examination.

Topography of Area.

The Snake River valley over 400 miles in length, swings across southern Idaho in a great crescent varying in width from less than a mile near Wyoming to 75 miles near Oregon. So wide and flat is most of the valley that it is generally designated the Snake River Plains. This region is flanked on either side by rugged mountain ranges attaining an elevation of 9000 feet and is believed to have been caused by a huge down-warping of the crescent-shaped area for a vertical distance of several thousand feet. The mountain ranges to the south lie parallel in a north and south direction at right angles to the Snake depression. These valleys and ranges are believed to be a product of block faulting on a grand scale. Many of the tributary streams are youthful and possess gorge-like channels while a few meander across old flood plains.

General Geology.

The rocks to the north of the valley are predominantly granite and have no oil possibilities. The formations to the south of the valley are older Paleozoics also disregarded because of their generally metamorphosed condition. The formations within the Snake Valley proper and various tributaries examined are in order of age: Columbia River basalts, Payette formation, rhyolite flows, Poison Creek formation, Snake River lavas, and late river gravels.

The early basalts are dark, heavy, columnar or vesicular rocks which lie on the granite or on early phases of the Payette and intercalated with it. They appear to be continuous with the great Columbia River basalt flows of Washington, Oregon, and Central Idaho.

The Payette formation is a thick body of fresh-water and continental sediments, generally made up of ash, clay, shale, and sandstone, with an occasional lignite bed. Petrified stumps, fresh-water shells and mammalian fossils, such as ancestral horses and camels, were sufficiently prevalent to indicate that the formations were of middle or Upper Miocene age. The Columbia lavas which are generally assigned to the Miocene age, further strengthen this age assignment since they are interbedded with the Payette. A thickness of over 4000 feet was revealed in a deep well at Ontario, Oregon.

Rhyolite flows of 1000 feet in thickness overlie the Payette for a great distance on the south side of the valley.

The Poison Creek formation immediately overlying the Rhyolite is made up of ash, clays, shales, and sandstones very similar to the Payette but contains mammalian fossils indicating an age of Lower Pliocene or later.

All of the above formations dip towards the Snake Valley and indicate in many instances their former extension over the granite areas which now represent an exhumed slope with an angle identical with the dipping formations. Scattered patches of various formations in depressions protected from erosion further strengthen the belief in a wide-spread occurrence of these beds.

The Idaho formation lies in the middle and flatter part of the valley unconformably on the underlying formations. It is generally made up of cream-tinted silt and volcanic ash. Mammalian remains indicate a Pleistocene age.

The Snake River lavas either overlie or are interbedded with the Idaho formation and lie in the central part of the valley. They occur in thin sheets and in many cases appear very recent having uneroded and fresh surfaces.

No marine fossils were found in any of the formations in the valley or tributaries, and, since abundant fresh-water types and mammalian remains were found, a fresh-water and continental origin is assumed for these formations.

Structure.

Several folds were observed throughout the area. Some in the Payette attained angles of 25 degrees, others in the Idaho show not more than two or three degrees dip. No system or parallelism of folding could be observed, and no structures were worked out in detail.

Regarding the oil and gas possibilities of the various districts Dr. Buwalda's conclusions are given verbatim below.

Weiser.

Weiser, lying at the lower end of the Snake River valley, is situated on a flat area, on all sides of which hills of Tertiary sediments rise. West of Weiser, near Eaton, where the Snake enters a first short gorge or canyon, a thick series of the Payette sediments is exposed, with which lavas are

interbedded northwest of Weiser. Fine conglomerates and sandstones make up a considerable part of the Payette formation in this area as seen in surface exposures. Organic materials are present in such quantity as to stimulate the search for commercial coal deposits west of Weiser. The strata are moderately folded. Indications are that a rather thick section of Tertiary sediments underlies the city.

A well was drilled near the center of the city in 1920 by Mr. Bradshaw of Weiser and his associates. It was carried to a depth reported to be in excess of 1500 feet. Most of the material it penetrated was blue shale or clay. Although it yielded some gas at different horizons, it did not produce oil.

Since several districts to be discussed next possess the same general conditions, a treatment of their possibilities will be deferred until after these two or three additional areas have been taken up.

Payette.

Payette is also situated in the middle of the Valley, with abundant evidence of thick sections of stratified rocks on every hand. Magnificent exposures of the Tertiary Payette formation occur along the north of Payette River a short distance above the city. These strata consist of light colored materials, in part arkosic in composition, in part ashy. Somewhat east of Payette, on tributaries of Payette River, volcanic materials become more abundant in the sedimentary series. The strata seen at Payette extend westward across the Snake for long distances into Oregon. A number of wells have been drilled in these beds near Ontario and Vale, Oregon, to depths greater than 1000 feet. Throughout the whole area the strata have been gently folded, but the folds are irregular, do not parallel each other and usually cannot be followed for great distances. Some data were obtained for plotting anticlinal axes in the Payette district, but recording on a map does not seem warranted in view of the irregularity of the structure.

A well was drilled in Payette in 1907 which indicated considerable gas pressure. Washburne states regarding this well:

> "The depth of the gas sand was 740 feet, and the pressure was sufficient to blow a column of water, sand and shale to a height of 150 feet. The well was drilled through an almost continuous body of smooth, blue-gray shale, with occasional thin layers of sandy material containing smaller flows of gas. This small hole became clogged with sand and gravel and was finally plugged. A new well of

larger diameter has been started near-by for the purpose of trying to get through the gas stratum, in order to obtain oil at lower depths."

Perhaps the most interesting of all the wells drilled in the Snake River valley however is the Boyer Well, drilled in Ontario, a few miles south of Payette, on the Oregon side of the Snake, in 1902. This well was drilled to a depth of approximately 4300 feet and it yielded very notable quantities of gas. Washburne states concerning this well:

> "A small amount of gas was encountered at 640 feet, and at 986 feet a stronger flow of gas blew the water out of the well. At 1070 feet, when the hole contained 1000 feet of water giving a resistance of over 440 pounds per square inch gas was struck which blew water and mud over the top of the derrick. This operation was repeated at 2204 feet, when the hole contained about 2000 feet of water giving a resistance of over 880 pounds per square inch. These depths were all measured from the derrick floor, about 4 feet above the ground surface. Instrumental measurement of the gas pressure, made somewhat later, gave 420 pounds per square inch."

Two other wells, located in Payette, were visited. One of these, in the basement of a fruit packing plant near the railway station, had been drilled for water supply. The water obtained was not suitable for use but sufficient gas bubbled up through it to supply several lights. The second well, in the rear of a steam laundry, produced sufficient gas for the heating of one of the machines used in the laundry. The exact depth from which this gas arose was not ascertained. Gas also occurs in small quantities in other wells.

Boise-Nampa-Caldwell.

While a considerable part of this district is flat agricultural land, striking exposures of the Tertiary formations occur from Boise northwestward to Payette River and beyond, and stretch westward between the Payette and Boise rivers as far west as the Snake. The Payette formation lies directly on the granitic rocks near Boise, with little of the Columbia River lavas represented. As is the case farther north, the beds are gently flexed. The presence of later beds, presumably of Pleistocene age, and of land-laid origin, in the region southeast of Emmett has been mentioned. The Idaho formation composed of soft silts and sands, Pleistocene in age, covers considerable areas adjoining Snake River itself. No Tertiary sedimentaries are exposed south of Boise, as the Pleistocene and recent Snake River basalts overlie and conceal all older formations south and east of Boise.

Possibilities of the Region between Weiser and Boise.

It appears that of the three requisite conditions favorable to the existence of petroleum and natural gas in a region, namely, a source rock, a porous reservoir rock, and a proper structure; the last two seem to be fairly well realized in that portion of the Snake River valley between Weiser and Boise. It is quite certain that porous sandstone strata occur in sufficient abundance in the Payette beds to serve as reservoirs for gas and oil if present. Also the gently folded beds seem to satisfy the requirements for structure, even though the folds are not as large as might be desired. A satisfactory source formation is however apparently absent, as the formations are all of non-marine origin. While oil might of course originate in non-marine strata, we have no proven case so far as the writer is aware of its having done so in commercial quantities. No oil seeps have been found in the region, and while the reputed oily sandstone found 25 miles southwest of Payette might be cited as evidence, it is so very different from the ordinary type of oil seep that it does not lend much encouragement.

The presence of gas at such high pressures and in such notable quantity might be construed as evidence for the presence of oil. The gas is, however, almost entirely methane or "marsh gas," which is the characteristic type found in fresh-water deposits; and it lacks the rich ethane content commonly found in oil field gases. Methane is known to form from the decay, without oxidation, of vegetable matter buried in sediments; a considerable abundance of such material is known to be present in the Payette formation.

The question might be raised whether marine strata may not underlie the fresh-water Tertiary beds. The possibility is undeniable, but it is improbable because unmetamorphosed marine strata do not outcrop at any point, so far as known, around the margins of the valley. Their mere presence in the bottom of the basin would not of course assure an oil supply, for only a small fraction of all marine formations produce oil.

So far as the petroleum possibilities of this district are concerned the writer is forced to express an unfavorable opinion. The bases for this judgement being that marine strata are lacking, true oil seeps have not been discovered, the gas is almost entirely marsh gas, and the considerable number of wells put down have made no favorable showing for oil production.

The case for a gas supply appears slightly better. Already a well or two in the district has produced gas on a scale approaching that necessary for commercial utilization.

It is clear that if wells should encounter gas pockets of somewhat larger size and the wells were handled judiciously, they might become a commercial venture. Enough wells have been put down, however to indicate that such gas pockets do not underlie a large fraction of the territory, and it must be confessed that the chances of securing a paying gas well do not appear to be good, even if somewhat better than the chances for securing a producing oil well.

Cambridge-Council.

The areas on both sides of the Weiser River north of Weiser, surrounding Cambridge and Council, consist largely of the same formations exposed around Weiser, with this exception that as one goes northward he finds the sedimentary beds decreasing and the underlying lavas forming more and more of the surface rocks. The strata, mostly volcanic, in the Cambridge-Council district, have been considerably folded. No seeps are known from this region, sedimentary beds, even of non-marine origin, are less abundant than farther south, and the prospects for securing an oil or a large gas supply do not seem promising in any part of this area.

Long Valley.

Long Valley is part of a long north-south depression which extends southward from the Payette Lakes, situated 90 miles north of Boise, toward that city. The writer suspects it to be a fault valley, formed by the uplift and westward tilting of the mountain block lying west of Long Valley, and the dropping down with westward tilting of the block lying east of the fault. The fault would then be located along the west side of the valley. The west wall of the valley is a steep escarpment made of granitic rocks, capped by westward dipping lavas. Lavas also occur on the floor of the valley. Hence physiographic evidence, the distribution of the rocks, and the structure so far as known appear to bear out the fault hypothesis.

No part of the general district of Long Valley appears favorable to petroleum production. Sedimentary beds are scanty or wanting, no oil seeps are reported, and probable fault block structure is not well suited to oil accumulation.

Horseshoe Bend-Jerusalem Valley.

This valley is essentially the southern end of the Long Valley depression, and lies about 25 miles north of Boise. It is a valley sculptured out of Tertiary fresh-water strata, presumably the Payette formation. The beds are bounded on both east and west by granitic rocks and it is very probable that they occupy a depressed area which has been dropped down by

movement on a fault located along the west side of the valley presumably the same fault that bounds Long Valley on its west side. The strata in Jerusalem Valley dip westward in general. The beds consist of shales and sandstones, with volcanic strata interbedded. Lignites occur among the finer beds.

Considerable interest has attached to Jerusalem Valley from the standpoint of oil possibilities. Coal prospects in the neighborhood probably augmented this interest; it should be remarked, however, that the presence of coal has, of course, no bearing on the question of the chances of securing oil. Mr. S. Silen of Boise and his associates started a well in Jerusalem Valley in 1920-21. Since this well was abandoned it is presumed the results were negative.

Jerusalem Valley and the Horseshoe Bend district do not hold out promising prospects for the oil driller. As in the other areas the sedimentary beds are non-marine, the structure is faulted instead of being the more favorable folded type, and true oil seeps do not occur so far as the writer is aware.

Murphy-Oreana-Castle Creek-Grandview.

Sedimentary beds occur along an area a few miles wide parallel to Snake River, extending southeastward from the east flanks of the Silver City Range at Murphy to Grandview and the Bruneau River district. These beds are quite similar to those exposed at the north end of the Silver City Range at Poison Creek grade. The strata dip northeastward and beneath the main valley. Artesian wells have secured notable flows in the Grandview district, presumably from strata corresponding to the Poison Creek formation, which overlie the rhyolite flows. The wells are reported as emitting some gas.

The opportunities for developing an oil supply are however not to be regarded optimistically. Here again the sedimentary formations are non-marine, oil seeps of significance have not been reported, and the monoclinal structure is not particularly favorable. Wells already drilled have encountered no hydrocarbons except small gas pockets.

Mountain Home-Gooding-Twin Falls.

The vast area of relatively flat country extending eastward from Boise, including the Mountain Home, Kinghill, Gooding and Shoshone districts, and the large area south of the River usually referred to as the Twin Falls country, do not appear to include extensive exposures of sedimentary rocks. Sections

seen in the walls of the canyon through which the Snake River flows indicate that these regions are underlain by lavas mainly. The thickness of the lavas is not known to the writer, but so far as he is aware these large areas exhibit none of the favorable indications ordinarily expected in promising oil territory.

Goose Creek.

Goose Creek lies about 35 miles southeast of Twin Falls. Before conversion into a reservoir the creek drained northward through a north-south depression underlain, according to A. M. Piper, by a basement of Cretaceous or early Tertiary granite intruded into a thick series of metamorphosed sedimentary rocks. The Tertiary rocks comprise an underlying series of stratified sediments, a basal massive rhyolite, a later series of stratified beds consisting chiefly of volcanic ash and intercalated and capping sheets of rhyolite, and in a few places a capping of still later basalt.

Some drilling for oil has been done in the Goose Creek basin but the prospects of finding oil in commercial quantities at any depth are not believed to be favorable. The Paleozoic rocks are extensively faulted and crushed and have no semblance of a structure favorable for the accumulation of petroleum. Moreover, they have been intruded by granite more recently than petroleum could have originated in them or migrated into them. The conditions in the Tertiary rocks are also unfavorable. These rocks consist largely of volcanic debris stratified in fresh water, whereas all known occurrences of petroleum are from fossiliferous beds deposited in salt water. The structure of the Tertiary rocks is also unfavorable for the accumulation of oil because any folds that the rocks may have contained have been broken by normal faulting.

Raft River.

This area lies about 15 miles east of the Goose Creek area, and like it is a north-south valley between similarly trending ranges. It is drained by Raft River, which like Goose Creek flows northward to the Snake. The area of particular interest examined lies between Almo and Yost, the latter being a post office in Utah near the Idaho line. The valley, several miles wide, contains a quite thick section of Tertiary strata of the same general type as those exposed on Goose Creek, and largely of volcanic origin. The beds have been warped somewhat, and apparently have been cut by a fault along

the east side of the valley in which they lie. Another fault was observed near the west side of the valley. It is probable that the valley is essentially a graben or slice of the earth's crust several miles wide which has dropped down between faults along its margins.

At the time of visit, Mr. H. E. Wilkinson of Boise and his associates were actively drilling near the middle of the valley. This well was carried down to a reported depth of 500 feet but no petroleum was encountered.

The structure of some parts of this valley is unfavorable and it also lacks the type of marine rock which is ordinarily regarded as essential as a source of petroleum. The strata are largely volcanic ash and could scarcely be expected to generate crude oil. Older limestones occur in the range to the east, and it might be considered that they pass under the Tertiary strata and serve as a source of petroleum, but unfortunately the limestone strata are considerably metamorphosed and it is quite unlikely that they still retain petroleum, even if they ever held it. One is forced to confess that the conditions are unfavorable for expecting a producing oil well in Raft River Valley.

Conclusions.

The outcome of this investigation is regretfully an unfavorable judgement regarding the possibilities for securing a commercial supply of petroleum or natural gas in the parts of southwestern and south-central Idaho examined. Although structures occur which would presumably be satisfactory, the sedimentary formations are practically all of non-marine origin, and although it is conceivable that fresh-water formations might originate petroleum, the absence of authentic cases in which they have done so, and the lack of true oil seeps in the region under examination, reduce to rather slender proportions the hope for success in oil and gas prospecting in these areas.