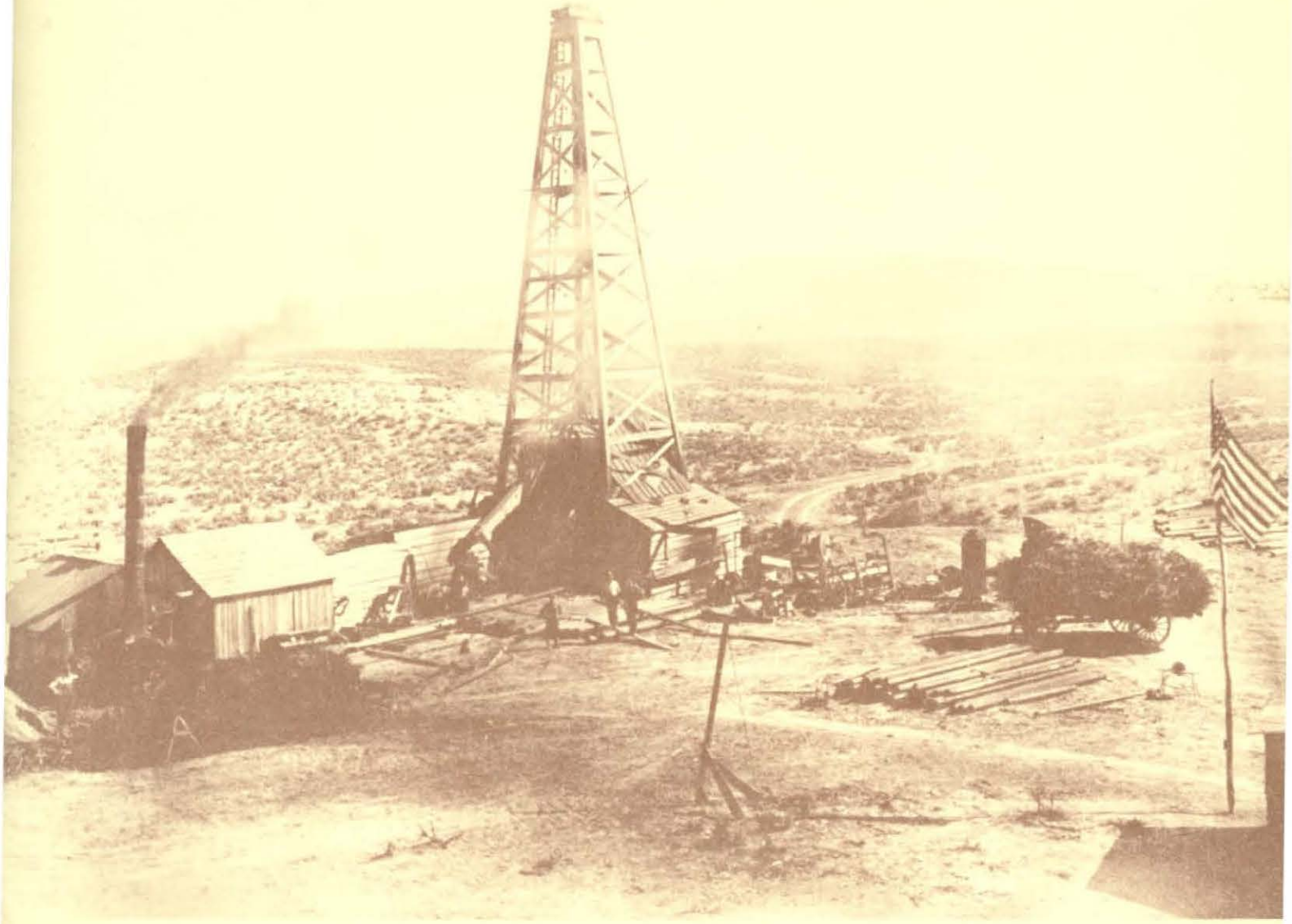
PETROLEUM GEOLOGY OF THE WESTERN SNAKE RIVER BASIN

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES



Oil and Gas Investigations No. 1

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STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
1069 State Office Building
Portland Oregon - 97201

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by V. C. Newton
and
R. E. Corcoran

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Hollis M. Dole
State Geologist

FOREWORD

This is the first of what is planned as a series of publications presenting geologic and drilling data on sedimentary basins that might warrant further oil and gas exploration. The Snake River Basin was chosen for study because of the availability of well records and the existence of general geologic information. As more drilling is done in the other regions of the state, enabling subsurface correlations to be made, and as knowledge of the surface geology expands, other studies of this nature will be undertaken.

Within the last 10 years a considerable amount of oil and gas exploration has taken place in the Western Snake River Basin of Oregon and Idaho. Interesting gas shows developed by an independent operator in 1954 brought major firms to the Western Snake River Plains to explore for commercial production. Because of this interest and of lack of material published since the 1920's, it was decided that a study by the department would be of considerable value. Besides giving geological details of the basin region, this report is intended to be a catalog of exploration data covering activity from its beginning in 1902 through the present.

The department is indebted to the Idaho Bureau of Mines, El Paso Natural Gas Co., Sinclair Oil & Gas Co., and the Pan American Oil Corp. for supplying valuable well data. A large part of the historical account of oil and gas exploration during 1954-58 was obtained from Northwest Scouting Service bulletin, published by the late J. R. McCusker. Staff members of the Idaho Bureau of Mines were also most helpful in reviewing this report and offering many useful suggestions. As a result of the cooperation from the various organizations complete formation test data, gas analyses, and core analyses are available.

Hollis M. Dole
State Geologist

September 13, 1963

Cover: The Ontario Cooperative Gas & Oil Co. well at Ontario, Oregon, 1910. Drilled to a depth of 4,000 feet. (Photo courtesy Oregon Historical Society)

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PETROLEUM GEOLOGY OF THE WESTERN SNAKE RIVER BASIN

By V. C. Newton* and R. E. Corcoran**

Abstract

The western Snake River basin is near the western edge of a much larger area usually referred to as the "Snake River Plain." The basin has an area of about 2,000 square miles and an average elevation of 2,300 feet. The Snake River is the controlling stream in this region and, in this western area, it marks the border between Idaho and Oregon.

The basin is underlain by a thick nonmarine Cenozoic section of sediments and lavas ranging in age from middle or late Miocene to early Quaternary. The high mountains that surround the area on three sides are composed of slightly metamorphosed Permian to Jurassic sediments and volcanics and Jurassic-Cretaceous plutonic rocks of the Idaho batholith.

The oldest known Tertiary rocks, Payette-Sucker Creek, Owyhee Basalt, and Deer Butte-Poison Creek Formations (Miocene), crop out along the flanks of the downwarp. The central plain consists of Pliocene lake and stream deposits of the Idaho Group which are at least 5,000 feet thick. None of the test holes in the central part of the basin penetrated the entire Pliocene section.

The first exploration for petroleum in the region began in 1902, and sporadic but unsuccessful drilling has continued up to the present time. The major incentive for these activities was the fact that varying quantities of gas have been encountered in many of the test wells. None of these drillings have produced commercial amounts for sustained periods, but several shallow wells provide gas for a few ranches in this area.

Possibilities for entrapment of oil or gas appear to be in up-dip pinch-outs of sand horizons in the Idaho Group. Unfortunately, there are few surface indications of subsurface stratigraphic traps, so that the location of potential reservoirs of this type may have to depend on detailed geophysical studies.

The similarity in rock types and depositional environment of the western Snake River basin to other well-known nonmarine basins in the world that now produce commercial amounts of oil and gas indicate that conditions suitable for the formation of hydrocarbons apparently existed in this region during late Miocene and early Pliocene time. The constantly increasing demand for gas in the Pacific Northwest and its nearness to the El Paso-Four Corners pipeline make the western Snake River basin an attractive area for continued exploration.

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Introduction

Location and general geography

The western Snake River basin is part of a much larger area usually referred to as the "Snake River Plain" (Malde and Powers, 1962), a broad relatively flat plain forming a belt across southern Idaho and extending into southeastern Oregon (see index map, figure 1). The western portion, having an area of about 2,000 square miles and an average elevation of about 2,300 feet, is roughly triangular in shape, with the base south of Boise and Nampa in Idaho and the apex north of Vale and Ontario in Oregon. The Snake River is the controlling stream in this region. Its main tributaries are the Boise and Payette Rivers on the Idaho side and the Owyhee and Malheur Rivers on the Oregon side. The principal towns are Boise, Nampa, and Caldwell in Idaho and Nyssa, Vale, and Ontario in Oregon.

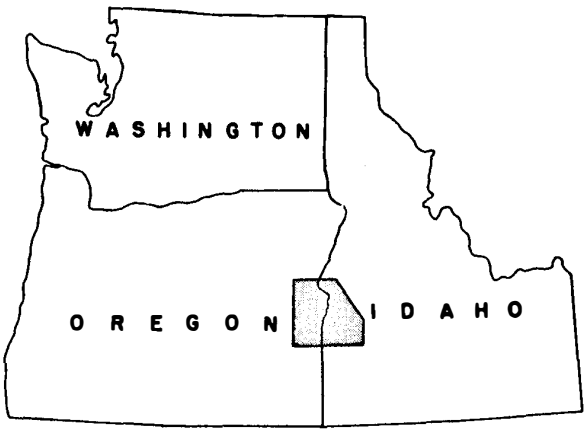

Figure 1. Index map showing location of the Western Snake River basin.

Most of the area is semi-arid with an average temperature of 52 degrees and rainfall of 10 inches. The principal vegetation is sagebrush and cheat grass with some wild buckwheat, antelope brush, and rabbit brush. Much of the western Snake River basin is under irrigation. The bulk of the crop is potatoes and sugar beets. It is bordered on the west by the Owyhee Plateau, on the north by the Blue Mountains, and on the east by the Rocky Mountains.

Purpose of investigation

Since the early 1900's, this region has been the site of sporadic oil and gas explorations by both the large petroleum producing companies and local "wildcatters." Although no commercial quantities have yet been discovered in the basin, gas from several wells has been utilized for heat and light by ranchers.

The western basin is one of the few areas in the Pacific Northwest where enough exploratory wells have been drilled to give some information on the lithologic character and lateral continuity of the subsurface stratigraphic section. The well density actually is very low when compared with oil-producing areas elsewhere in this country and, because only those tests having reliable data can be used, the interpretations are subject to change when more subsurface information becomes available. In addition to the sparsity of data, stratigraphic correlation in a nonmarine basin such as this is unusually difficult because of (1) lenticularity of the sediments, (2) angular and erosional unconformities that separate the various lithologic units, and (3) complex faulting along the borders and within the central part of the basin.

This report presents a summary of the history of drilling in the basin and assembles the available surface and subsurface information. It is hoped that by compiling this information and presenting our interpretation of the data obtained, we can show that the western Snake River Plain is a potential commercial gas-producing area.

Methods and scope of investigation

The region in and bordering the Snake River Plain has had a considerable amount of geologic investigation, both reconnaissance and detailed, since King first visited the area in 1869. The generalized geologic map (Plate 1, in pocket) was compiled largely from Corcoran and others (1962), Savage (1958, 1961), and unpublished graduate theses from the University of Oregon (see Schlicker, 1959).

Twenty exploratory wells (Plate 2 in pocket) from a total of 61, chosen on the basis of depth and available subsurface information, were used to compile the cross-sections (Plates 3a and 3b in pocket).

Although this report is primarily concerned with the late Tertiary sediments occurring in the basin proper, the older rock units cropping out around the margins have been included in the map and will be discussed in the report because they may also represent possible deeper petroleum-bearing horizons or source rocks.

Acknowledgments

The authors would like to take this opportunity to acknowledge the generous help and cooperation of Prof. E. F. Cook and Mr. C. N. Savage of the Idaho Bureau of Mines and Geology. The work of Mr. Savage on the Idaho side of the Snake River Plain was particularly useful in compiling the general geologic map of that region, and his suggestions and comments concerning the present study have been incorporated into the body of the report. Members of the Oregon Department of Geology and Mineral Industries also reviewed the manuscript and made many valuable comments and suggestions.

History of Drilling in the Western Snake River Basin

The search for oil and gas within the western portion of the Snake River basin commenced in 1902 and continued until 1910; then interest cooled. Wildcatters drilled 12 holes in this period without finding any oil or significant quantities of gas. The oil workers with their strange jargon left the scene as quickly as they had arrived. Only 5 holes were drilled from 1910 to 1919.

It is interesting to speculate on reasons for early exploration in the Snake River area. By the year 1900, production in the Appalachian oilfields had declined to the extent that the young industry turned to other regions to expand operations. The introduction of mass-produced motor cars by Henry Ford at this time provided a prospective market for petroleum products. Oil explorers had amazing success in California, Kansas, and Texas after leaving the eastern fields, and a fever burned in the adventurer as in the gold rush of 1849. No doubt stories of the numerous occurrences of gas in springs and water wells in the Snake River region had been circulated to eager listeners. C. W. Washburne described such an occurrence called Mud Spring in his report of 1909. The spring was said to be located in sec. 29, T. 20 S., R. 45 E., Malheur County, and from it an ebullition of inflammable gas issued constantly "and was at times extremely vigorous."

It is understandable, then, that oil men surged enthusiastically into the Snake River Plain region, where natural gas seeped out at the surface in numerous places. Activity in the Vale-Ontario region led one writer to report in the September 11, 1907 issue of the Engineering and Mining Journal: "The Malheur oilfields of Oregon are being developed as rapidly as machinery will put down wells." Drilling did not always proceed without encouraging signs. Various drillers saw oil "colors" on water in the bailer as cuttings were cleaned out of the hole, and small shows of gas were encountered in most of the wells. R.N. Bell of the Idaho Bureau of Mines (1907) described a gas gusher near Payette, Idaho, and accompanied his report with a picture of the well blowing "gas, water, sand, and shale 150 feet into the air." Work in the Snake River area ended rather abruptly, however, mostly because no oil was found. It must be remembered that a market for natural gas did not exist to any extent in the early 1900's. Gas applicances and refinements in distribution were to come later.

After World War I the United States was much concerned about its petroleum reserves, so oil activity

revived again in the region. In 1920 the federal government enlarged the staff of the U.S. Geological Survey in order to make oil and gas investigations in unexplored regions of the country. About this same time, Congress passed laws opening the public domain to oil exploration and established the depletion allowance as the equitable method of taxation. This recognition by the government of the value of hydrocarbons encouraged widespread exploration, some of which took place in the western Snake River basin of Oregon and Idaho. Between World Wars I and II, a total of 22 wells was drilled in the western Snake River basin.

Following World War II, oil exploration in the United States greatly increased, but it was not until 1950 that drilling resumed in the Snake River area. At this time, gas was the prospective resource, since marketing facilities were expanding at a rapid rate. Plans for building the El Paso-Four Corners pipeline into the Northwest gave hope of marketing commercial amounts of gas found along its route. Also, discoveries in the Tertiary nonmarine basins of Utah and Wyoming and in the Basin and Range province of southeastern Nevada in the early 1950's focused attention on the Snake River region. Between 1950 and 1961, 22 holes were drilled in this portion of the basin.

Idaho-Oregon Production Co., a local organization, drilled two holes in 1950: one near Vale, Oregon, and the other a short distance north of Payette, Idaho. A small amount of gas was encountered in the second well, but sands were thin and permeability low. Shut-in gas pressure was recorded to be 60 psi. No further work was done until R. A. Stamey & Assoc. drilled "Russell 1" at Vale in 1954. Stamey's work attracted several firms to the area: Sinclair Oil & Gas Co., El Paso Natural Gas Co., H. K. Riddle (later organized as Oroco Oil & Gas Co.), R. N. Ranger & Assoc., and Pan American Petroleum Corp.

H. K. Riddle was instrumental in the drilling of 12 tests in the western Snake River basin. Before drilling his first well in 1955, Riddle arranged to pool his leases with those of R. A. Stamey (Sta Tex Oil Co.), a combined amount totalling more than 200,000 acres. Stamey had just finished drilling a dry hole near Vale, Oregon. El Paso Natural Gas Co. drilled "V. Johnson 2, Asmussen 1, and Webber-State 1" for an operating interest in Oroco's holdings in the area. J. R. Simplot Co. of Boise was joint operator with Oroco in the drilling of "Richardson 1, Bolles 1, B. Carpenter 1, and V. Johnson 1," and E. W. Pauley, California Independent, participated in drilling Oroco "T. B. Carr 1."

Sinclair Oil & Gas Co. "farmed out" portions of its holdings in Oregon to El Paso Natural Gas Co. for the drilling of "Federal-Spurrier 1" south of Vale. The company later arranged to have R. N. Ranger & Assoc. of Houston, Texas, drill a well under a similar agreement on its acreage at Willow Creek north of Vale. Ranger & Assoc. relinquished rights in Sinclair's holdings after drilling to 300 feet. Sinclair moved in equipment a month later and drilled "Eastern Oregon Land Co. 1."

Only two of the 22 holes drilled between 1950 and 1961 encountered amounts of gas approaching commercial value, but several wells produced significant flows of gas from wet sands (see Appendix - Well Data). Oroco "V. Johnson 1" blew out in May 1955 while drill pipe was being pulled out of the hole. Casing collapsed in this drilling as a result of the blowout, and subsequent attempts to repair the well failed. A formation test made in the interval 1382-1432 feet before reaching the depth at which the well blew out yielded a 350 MCF/D flow of gas (McCusker, 1955). El Paso drilled "V. Johnson 2" to evaluate sands causing the blowout in the first well and found that the formations were not permeable enough to sustain a large flow for any period of time. (See Appendix - Porosity and Permeability Data.)

Natural gas has been used at various times by ranchers in the Snake River area for heating and cooking. At the time of a visit by the authors in 1960, Frank Freel at Adrian, Oregon, was using the natural gas which bubbled up in his water well for domestic purposes. Gas was trapped in a tank into which the well water flowed.

Geology

Previous geologic investigations

Clarence King, one of the early-day Federal Survey geologists, visited the lower part of the western Snake River basin around 1869 and collected a number of fossils from the "white sands and marls" at Castle and Sinker Creeks, tributaries of the Snake River south of Boise. The relative stratigraphic positions of the continental sedimentary rocks and intercalated lava flows were generally established before 1900, but problems later arose when it was discovered that the sediments could be divided into at least two separate formations. That these two formations were laid down during different time intervals is now well documented by considerable fossil evidence. The younger clastics were called the "Idaho Formation" and the older the "Payette Formation."

Around the turn of the century, such geologists as Lindgren (1898a), Russell (1902), and Washburne (1909) recognized that the Payette and Idaho Formations were separate entities; however, they failed to differentiate the two sedimentary units on geologic maps because of the apparent similarity in lithology. Bryan (1929) was the first to attempt to map them as separate units. Later Kirkham (1931) summarized all previous work on the Payette and Idaho Formations and concluded that in the "Snake River Downwarp" they were separated by 600 feet of Columbia River Basalt of Miocene age.

Since Kirkham's work, very little information has been published concerning the geology of the western Snake River basin. In recent years the bordering area in Oregon has been mapped by graduate students from the University of Oregon, and the geology of the Mitchell Butte quadrangle has been published by the Oregon Department of Geology and Mineral Industries as one of its geologic map series (Corcoran and others, 1962). In Idaho, Savage (1958, 1961) has published reports on the geology and mineral resources of Canyon, Ada, Gem, and Payette Counties. The information derived from these reports has been used to compile the geology of the basin and to aid in subsurface interpretation of the well logs. In describing the various stratigraphic units which crop out within and on both sides of the Snake River Plain, the authors have attempted to match formational names where they appear to be lithologic and age correlatives. Because the distance between some of these formations across the basin is as much as 60 to 70 miles, these correlations are subject to change after more detailed mapping and petrographic studies have been completed (figure 2).

General geologic setting

The Snake River Plain is a broad, alluvial terraced area with low, gentle slopes into the major drainage systems. Locally, the terrain has been dissected sufficiently to resemble badland topography. Gravel, sand, silt, clay, and ash of the Pliocene-Pleistocene Idaho Group, together with thin basalt flows of the Snake River Group, capped by Recent terrace gravels and sands underlie the major part of the basin area. Along the flanks of the basin older Tertiary nonmarine clastics and volcanics, usually showing a greater degree of deformation, crop out at the surface and presumably underlie the younger rocks in the central plain. The age of these older sedimentary rocks, based on vertebrate fossil remains, is upper and perhaps middle Miocene. The high mountain area east of Boise and Emmett, Idaho, is underlain by Jurassic-Cretaceous plutonic rock of the Idaho Batholith. Slightly metamorphosed volcanics and sediments north and west of the basin are of Permian to Jurassic age.

Several fault belts, more or less paralleling the borders of the Snake River Plain, have fractured the older Tertiary sediments and volcanics and, to a lesser extent, the Pliocene-Pleistocene Idaho Group. Subsurface information and geophysical evidence indicate that the Snake River Plain may occupy a large sediment- and lava-filled graben (plate 1).

Stratigraphy

Pre-Tertiary rocks.

The oldest rocks exposed at the surface are sedimentary and igneous rocks occurring at the northern

	Adapted from Kirkham 1931	Adapted from Savage 1958, 1961	Adapted from Malde & Powers 1962	Corcoran and others 1962
Pleistocene	Snake River Lavas	Snake River Eruptives	Snake River Group	Basic & acidic intrusives & flows
Plio-Pleistocene	Idaho Fm.	Idaho Fm.	Idaho Group	Idaho Group
		Poison Creek Fm.		Deer Butte Fm.
Upper and Middle (?) Miocene	Owyhee Rhyolite	Silicic vol. rocks	Idavada vols.	unnamed silicic vols.
	Columbia River Bas. (upper series)	Late Columbia River vol. rocks	Undifferentiated rocks	Owyhee Basalt
	Payette Fm.	Payette Fm.		Sucker Creek Fm.
				unnamed silicic vols.
	Columbia River Bas. (lower series)	Early Columbia River volcanic rocks (not exposed)		unnamed basaltic lavas
Late Mesozoic	Granitic rocks of the Idaho Bath.	Granitic rocks of the Idaho Bath.		? ? ? (base not exposed)

Figure 2. Stratigraphic Correlation Chart for the Western Snake River Basin.

end of the basin in the general vicinity of Brogan and Huntington, Oregon, and southwest of the basin near South Mountain, Idaho. The section exposed in the Brogan-Huntington area consists of metamorphosed Permian (?) sediments and volcanics intruded by gabbro, peridotite, and serpentine overlain by a sequence of greenschists, phyllites, and marble of Upper Triassic age and limestone, shale, sandstone, graywacke, and conglomerate of Lower and Middle Jurassic age (Prostka, 1962; Wagner, 1963). The rocks in the vicinity of South Mountain, Idaho, consist of contact-metamorphosed schist and limestone of Paleozoic (?) age (Lindgren, 1904). Regional diastrophism, accompanied by the intrusion of quartz diorite and granodiorite stocks during the Nevadan or Laramide revolutions in Late Jurassic or Cretaceous time, greatly deformed and slightly metamorphosed the pre-Tertiary rocks. Boise Ridge, above the town of Boise, is composed largely of these crystalline rocks which have been uplifted, faulted, and eroded during a long episode of crustal unrest. The pre-Tertiary marine sediments in this region are exposed only in mobile belts around the margin of the basin, where the intense orogenic movements and accompanying intrusive activity have folded and altered them to varying degrees. It is possible that in the basin, the pre-Tertiary rocks, presumably underlying the Tertiary section, will have undergone little, if any, alteration since the time of original deposition, and may therefore be the source beds for some of the gas found in the younger Tertiary sediments.

Tertiary rocks.

Payette-Sucker Creek Formation: Where they are exposed around the margin of the basin, the Tertiary rocks lie on the deformed pre-Tertiary section with profound unconformity. Although early Tertiary volcanics are widely exposed to the west in central Oregon and to the east near Challis, Idaho, the oldest known rock lying on the basement crystallines and metamorphics in the western Snake River Plain is middle or upper Miocene in age.

The term "Payette-Sucker Creek" is used to denote these older beds. Although the name "Payette Formation" has priority (Lindgren, 1898a), the authors have used the local name "Sucker Creek Formation" for the sediments and volcanics on the Oregon side of the basin because of the wide area of younger rocks that separates these units. There is no doubt, however, that the two formations are of about the same age and stratigraphic position. Fossil vertebrates and leaves from these beds in Sucker Creek Canyon, Oregon, and fossil leaves from Payette beds near Horseshoe Bend, Idaho, are of middle or upper Miocene age.

In Oregon, the Payette-Sucker Creek Formation is composed of volcanic tuffs and tuffaceous lake beds ranging from pale yellow to drab shades of orange. The sediments are characterized chiefly by their high volcanic ash content and lack of induration. Most beds are platy shales and massive siltstones and claystones with numerous thin beds of dark organic or carbonaceous shales. Pyroclastic ash and pumice tuff are fairly widespread but make up only a small proportion of the total section. The separate lithologic units in this series, because of their lacustrine or fluviatile origin, are invariably local in extent, and individual members show rapid facies change or else pinch out completely. The thickness of the formation ranges, therefore, from a few hundred to perhaps as much as 2,000 feet.

In Idaho the Payette-Sucker Creek Formation does not have as extensive an area of outcrop as it does across the basin in Oregon, the main exposures being in the general vicinity of Montour on the Payette River above Black Canyon Dam. Savage (1961) reports three small exposures of clay, silt, silty ash, and thin coaly layers identified with this unit.

Lava flows of generally basaltic composition are interbedded with the lower part of this formation along the Oregon side of the basin. Kirkham (1931) described two major flows of basalt in Idaho which he referred to as "early and late Columbia River volcanic rocks" separated by the sediments of the Payette Formation. Savage does not find any of the older "Columbia River volcanic rocks" beneath the Payette Formation in his area.

Silicic volcanic rocks, generally rhyolitic in composition, occur in the upper part of the Sucker Creek Formation. These lavas are exposed best in the vicinity of Jump Creek in the hills southwest of Nampa and in the area around the dam at Owyhee Reservoir. Because of their apparent relatively high viscosity, the flows did not spread very far before cooling.

Owyhee-Columbia River Basalt: Lindgren (1898a) and Russell (1902) were among the first geologists

to make note of the numerous basalt flows which are prevalent in this part of the Pacific Northwest. At least two separate volcanic sequences were recognized; Russell named the older of these the "Columbia River lava" and the younger flows the "Snake River lava." Since that time, it has been shown that basalt flows occur at several different horizons in the Miocene-Pliocene section, but one particularly thick sequence appears to be fairly widespread. This series of flows of probable upper Miocene age has been called the "Owyhee basalt" (Bryan, 1929) in Oregon and "Columbia River volcanic rocks" (Kirkham, 1931) in Idaho.

In Oregon, the main mass of the Owyhee Basalt underlies the Owyhee Ridge where a series of west-dipping flows and interbedded pyroclastics, as much as 1,500 feet thick, form the highland bordering the western edge of the Snake River Plain. These flows can be traced discontinuously northward and westward to the middle or upper Miocene Columbia River Basalt near John Day. In Idaho, along the east side of the basin, the Columbia River Basalt is exposed as scattered erosional remnants from the general vicinity of Boise Ridge northwestward to a point about 16 miles northeast of Payette. Northeast of this line the volcanic rocks are nearly continuous. Excellent exposures of west-dipping flows of Columbia River Basalt lying on the granite erosion surface of the Idaho Batholith can be seen along the north side of Black Canyon Reservoir and up Squaw Creek between Emmett and Horseshoe Bend.

In hand specimen the rock is generally somewhat platy, fine-grained, dark gray to black, and ranges from very dense to highly vesicular. On weathered surfaces the flows usually show a reddish iron-oxide color. The composition of the lavas is variable, ranging from typical tholeites to normal olivine basalts, and many of the flows contain andesine plagioclase. The layers of tuff and ash between separate flows are characteristically lenticular. The pyroclastic interbeds, because of their soft friable nature, do not stand out as prominently as the resistant flows, but close examination of some of the canyon walls shows that in many instances at least half of the total section is composed of tuff.

Silicic volcanic rocks: West of the Owyhee Reservoir in Oregon is an unnamed section of rhyolitic or dacitic volcanic rock at least 1,000 feet thick, which is disconformable on the underlying Owyhee Basalt. The lavas are best exposed along the west side of the Harper Basin in Oregon and south of there on the broad upland of the Owyhee Plateau. The light-colored acid flows in the bottom of the El Paso Natural Gas Co. "Federal 1" are probably a part of this formation.

The volcanic sequence appears to be a complex of flows and associated feeder dikes. The flows are numerous, but, as is usual with silicic rocks of this type, seem to have a limited areal extent. The lithology varies greatly from flow to flow, but it usually has certain recognizable characteristics. The fresh rock is light pink, red, purple, dark gray to brown with bands of much lighter colors in the distinctly flow-banded rocks. Flow banding is the predominant texture, although in places the rock is spherulitic, vesicular, or lithophysal. There has been a marked degree of secondary silicification and opalization in much of the rhyolite, with some alteration to clay (Holloway, 1961). In places the rhyolite is very porphyritic, the phenocrysts being about 2 to 4 mm in diameter and probably consisting of sanidine and perhaps tridymite. Some of the flows, particularly those in the Harper area, are quite glassy and can be called true vitrophyres (Weeden, 1963).

In Idaho silicic volcanic rocks which appear to be younger than the Payette Formation and Columbia River Basalt are well exposed south of Pearl along the South Fork of Willow Creek. The rock is reddish brown, gray to almost black, and pinkish to lavender. Like the rhyolite in Oregon, these rocks contain lithophysae, perlitic structures, and flow layers.

Kirkham (1931) correlated the Owyhee Rhyolite in Idaho with silicic volcanic rocks in Oregon exposed at the Owyhee Dam. The rhyolite at the dam, however, is part of the silicic series of flows interbedded with the upper part of the Payette-Sucker Creek Formation which lies beneath the Owyhee-Columbia River Basalt. The presence of a thicker, more widespread series of acid lavas above the basalt was not known until field reconnaissance was done by the authors in the region west of the Owyhee Reservoir during the past two seasons. Although more field study is needed, the apparent similarity in stratigraphic position between the silicic volcanics on both sides of the Snake River Plain indicates that they are probably regional correlatives.

Deer Butte-Poison Creek Formation: In Oregon the Deer Butte Formation contains a section of fine-grained tuffaceous sediments with a few intercalated basalt flows in the lower part, grading upward into massive sandstones and conglomerates. The well-cemented arkoses and conglomerates are best exposed along the western margin of the plain in Vale Buttes, Mitchell Butte, Deer Butte, and Dry Creek Butte.

South of Dry Creek, the less indurated lower part of the formation predominates with only a few intercalated layers of cemented sandstone and dense basalt. The color of those finer-grained beds is characteristically pale orange to yellowish orange, although tinges of red, green, and gray are not uncommon. Most of the sediments show faint bedding and appear to have been deposited in small lakes under much the same environmental conditions as the older Sucker Creek deposits. The lithologic similarity of the lower part of the Deer Butte Formation to the Sucker Creek Formation makes identification and separation in the field or in drill samples difficult, particularly in areas where the intervening Owyhee Basalt may be missing.

On the east side of the basin north of Boise, a sedimentary section lying on rhyolite or basalt is of the same general lithologic composition as the conglomerates, sandstones, and siltstones of the upper part of the Deer Butte Formation. Because of the resistant nature of this unit, high-standing mesa remnants crop out along a northwest trending belt from Boise 60 miles northward as far as Weiser, Idaho. These beds have been tentatively assigned to the Poison Creek Formation by Savage (1961).

The total thickness of the Deer Butte-Poison Creek Formation varies considerably from place to place, being much greater on the Oregon side of the Basin than in Idaho. A maximum thickness would probably be on the order of 1,500 to 2,000 feet. No fossils have been reported from the Poison Creek Formation where it crops out along the northeastern margin of the Snake River basin. Vertebrate remains in the Deer Butte Formation have been dated as upper Miocene (Barstovian) by J. A. Shotwell (oral communication, 1961).

Idaho Group: The Idaho Group of Pliocene to Pleistocene (?) age underlies the central part of the Snake River Plain as a broad, almost flat-lying sedimentary blanket with some intercalated basalt flows, and is the most widespread unit in the area. The group shows considerable local variation in lithology, and for this reason several different formational names have been applied to it by geologists working in both Oregon and Idaho. It lies on an erosion surface developed on the Miocene sedimentary and igneous rocks and, along the edges of the basin, is separated from these older units by a large angular and erosional unconformity.

The Idaho Group consists of unconsolidated to semi-consolidated clay, silt, sand, volcanic ash, diatomite, fresh-water limestone, and conglomerate. There are several interflows of basalt generally distinguishable from older Miocene flows by higher olivine content and a more coarsely crystalline texture. Separate flows are usually thinner but perhaps more widespread.

The formation is believed to be mainly of fluviatile origin, with the layers of diatomite, limestone, silt, and clay representing local lake basins. Savage (1961) suggests that the finer-grained constituents accumulated during a transition from a ponded basin (Lake Payette) environment to a piedmont plain environment with shrinking and fluctuating shallow lakes. The younger beds of the Idaho Group tend to be coarser grained, particularly on the Idaho side of the plain, and are apparently derived from weathering and erosion of the Idaho Batholith to the east.

A study of the well logs from the central part of the basin indicates that none of the drillings penetrated the entire Idaho section. The thickening and thinning or facies change of sedimentary units within the Idaho Group makes it difficult to correlate sections from one well to another, particularly when they are as widely spaced as in the Snake River Plain. Kirkham (1931) estimated that there could be as much as 18,000 feet of sediments of the "Idaho Formation" in the central portion of the downwarp. This figure is probably too high, but judging from the electric logs and sample descriptions of the drill tests located in the middle of the basin (Kiesel 1 and Cleveland 1), the Idaho Group must be at least 4,000 to 5,000 feet thick.

Quaternary rocks.

Lying disconformably on the sediments of the Idaho Group is an unconsolidated section of silt, sand, and gravel of Pleistocene age. These gravels cap many of the low-lying hills and broad divides within the Snake River Plain. Higher level terrace deposits, as much as 150 feet above the present drainage channels, occur in the foothills surrounding the central plain. These beds are probably roughly equivalent to Kirkham's (1930) lower and upper Mesa Gravels.

On the Idaho side, the terrace deposits consist mostly of crystalline pebbles and cobbles with some sandstone, orthoquartzite, and silt. In Oregon, the rocks are mostly basaltic in composition with lesser amounts of rhyolite, quartzite, and granite. Most of the deposits show well-developed cross bedding, and their general coarseness is indicative of torrential stream deposition, probably resulting from large quantities of water during the Pleistocene.

In the southeastern corner of the map area are young lava flows and cinder deposits called the "Snake River eruptives" by Savage (1958) that lie on or interfinger with the Quaternary sediments. The volcanics consist of fine- to coarse-textured fissure basalt flows and pyroclastics which are more prominant farther east in the central portion of the Snake River Plain. In this eastern area, the assemblage of Quaternary volcanics and river deposits has been termed the Snake River Group by Malde and Powers (1962).

The total measured thickness of the Quaternary rocks, not including the Recent alluvium in the valley floors, is approximately 500 feet, although a composite thickness would probably be somewhat greater.

Structure

The Snake River basin appears to be a major structural feature, the development of which began at least by middle Miocene time. The older Tertiary units which crop out on both sides of the basin show considerable block faulting and give the impression that the basin is a broad, depressed region filled with later Tertiary and Quaternary sediments and volcanics. Savage (1958) reviewed the evidence concerning the structures that border the Idaho side of the western Snake River basin and on his maps shows several faults along the margin, particularly in the region north and south of Boise. This zone is probably a westerly extension of the fault belt described by Malde (1959) in the King Hill area 80 miles southeast of Boise.

On the Oregon side of the basin the section which includes the Sucker Creek Formation - Owyhee Basalt-Deer Butte Formation has been extensively block faulted, and the younger Pliocene sediments and volcanics of the Idaho Group lap against their upturned edges. There is also some faulting of the Idaho Group in the border region, but the amount of displacement is considerably less.

In the central portion of the basin, the sediments of the Idaho Group show very little deformation. Dips average less than 5 degrees, and, although there are numerous small flexures in the beds, most of these minor structures cannot be traced for any appreciable distance. Some of the dips are probably initial, resulting from deposition on an inclined slope. The Pliocene beds tend to dip toward the center of the basin, but the apparent axis of the downwarp is several miles north and east of the present channel of the Snake River. The subsurface section across the basin (plate 3-a) indicates that this axis probably lies between Caldwell and Boise and parallels the eastern margin as far north as Weiser.

The best possibilities for entrapment of oil or gas in the basin appear to be in up-dip pinch-outs of sand horizons in the Idaho Group. The coarser sediments are known to be fairly lenticular and their apparently high porosity and permeability offer favorable reservoirs. Unfortunately, there are few surface indications of subsurface stratigraphic traps, and until more test wells are put down, the location of potential reservoirs of this type will have to depend on detailed geophysical studies. Other possibilities which should be tested by the drill are zones where the younger sediments lap against older buried topographic highs or where they are cut off by fault surfaces.

A gravity survey map (Plate 4 in pocket) covering most of the central portion of the basin is included with this report. This map is from a thesis by H. L. Baldwin, "Gravity Survey in Part of the Snake River Plain, Idaho," 1960, released as an open-file report by the U.S. Geological Survey as part of a study on volcanism and crustal deformation in southern Idaho.

In the area covered by the report, the most conspicuous features are several elongate positive gravity anomalies that seem to parallel the linear trend of the basin. The largest of these can be traced from a point 3 miles south of Meridian, Idaho, northwestward to about 3 miles east of Nyssa, Oregon, a distance of about 40 miles. According to Baldwin, the most plausible explanation for this large anomaly is a thick accumulation of basaltic lava at some depth parallel to its major axis. In interpreting the structural relationship between the granitic and basaltic rocks, two possibilities are suggested: fault contacts and downwarps. Baldwin believes that faulting best fits the observed gravimetric data, and, as he points out, even if a downwarp does exist, it is unlikely to have occurred without concomitant large-scale fault movement. Field evidence along the western side of the basin where the block-faulted nature of the older Tertiary rocks is well exposed supports the theory of a grabenlike basin. Savage (1961) suggests a third possibility to explain the gravity high: erosion and basalt fill. He postulates that a large river excavated a major valley north of the present Snake River. This deep valley was subsequently filled by the sediments and lavas of the Idaho Group. The subsurface data show the thickness of the Pliocene-Pleistocene sediment-basalt section in the basin to be at least 5,000 feet and maybe considerably greater, because the base of the Idaho Group was never encountered by the drill except near the edge of the plain.

Aside from the gravity highs described above, no other major anomalies are known to exist in this part of the basin. Many small anomalies are scattered throughout the basin, particularly along the margins, but these were probably caused by isolated outcrops of near-surface occurrences of Miocene lavas brought up by faulting, or by buried feeder vents.

The largest surface structure on the Oregon side of the basin is the Double Mountain anticline, located about 10 miles southwest of Vale. The folding appears to have been caused by numerous basaltic to dacitic intrusives which shouldered aside the overlying sediments and volcanics of the Idaho Group in late Pliocene or early Pleistocene time. The deepest hole in the Western Snake River basin (7,470 feet) was drilled on this structure by El Paso Natural Gas Co. in 1954. The well penetrated sediments and volcanics of the Idaho Group and Deer Butte Formation before entering rhyolite and andesite flows at a depth of 6,570 feet (see well log on p. 47).

Hydrocarbons in Tertiary Nonmarine Sediments

Substantial amounts of oil and gas have been found in rocks of nonmarine origin, but thus far most of the world's petroleum reserves have been produced from marine sediments. Although marine rocks have been the chief focus for petroleum exploration in the past, it is probable that continental sediments will receive increasing attention and eventually provide a greater portion of the world reserves than they do now. The purpose in discussing this subject is to call the reader's attention to the occurrence of hydrocarbons in continental sediments in various parts of the world and to summarize geologic conditions necessary for the synthesis of organic material into petroleum in these rocks.

Origin of petroleum

Petroleum generally forms from organic material deposited in near-shore marine sediments under conditions which limit the supply of oxygen. Small amounts of optically active substances occurring in plants and animals are also found in petroleum. In nearly all cases, naturally occurring hydrocarbons also contain pigments of animal coloring matter and green coloring matter of plants (chlorophyll). Saline conditions are thought to be necessary for the formation of petroleum by most present-day geochemists (Rankama and Sahama, 1949). Krejci-Graf (1930) believes brines are the main product of petroleum formation and oil the by-product.

Organic material carried by streams to the shores of the sea composes a large portion of the available substance from which coal and petroleum are believed to have been formed. Streams similarly deposited large amounts of organic debris into intermontane valleys which were occupied by fresh, brackish, and saline lakes during geologic time.

Producing areas in nonmarine rocks

Oil and gas have been found in fresh water and saline lake deposits at various places in the world: Magdalena Valley, Colombia; West Pakistan; and Lancashire, England. In the United States, petroleum has been found in nonmarine sediments: San Joaquin Valley and Santa Barbara Embayment, California; Uinta-Piceance Basin of Utah and Colorado; Green River Basin, Wyoming; Nye County, Nevada; and Great Salt Lake, Utah. Most of these occurrences must be disregarded as support for nonmarine origin of petroleum, because there is evidence that the petroleum migrated from marine rocks to nonmarine facies.

In several instances, the occurrence of oil in nonmarine sediments cannot be explained by migration from marine rocks. Oil found in the shales of the coal measures of Lancashire, England, occurs 1,000 to 2,000 feet above marine strata (Kent, 1954). In some portions of the coal measures there were no faults or fractures to allow upward migration of the oil; in other portions where faulting is evident, most faults contained no trace of hydrocarbons. Analyses made of the oil indicate it was indigenous to the nonmarine beds. The source shale associated with the oil showings may be of either fresh-water or brackish-water origin.

Another example of oil originating in nonmarine sediments is seen in northeastern Utah. Here, during the Tertiary, approximately 12,000 feet of lacustrine, fluviatile, and subaerial debris, together with tremendous quantities of organic material, were deposited in a large intermontane lake now called the Uinta Basin. Water varied from brackish to saline depending upon climatic changes during the period of deposition. At Roosevelt and Duchesne Fields, oil is produced from fractured bituminous shales in the basal portion of the Green River Formation. Fossils in the lower part of the section are pelecypods and gastropods that lived in a brackish and fresh-water environment. Oil shales are found only in the lacustrine facies within the basin, and in numerous localities the shale is cut by veins of solid hydrocarbons: ozocerite, albertite, gilsonite, and wurtzilite.

The organic matter extracted from the oil shales in the Uinta Basin was found to be very similar in composition to the associated asphalt. Composition of the organic material in the shales varied vertically within stratigraphic units, and these changes corresponded with similar compositional changes vertically in the associated free vein hydrocarbons. The bituminous lake beds in the basin were unquestionably established as the source of the solid hydrocarbons. Comparison of infrared spectrums of asphaltic sandstones with spectrums of solid hydrocarbons indicated both were from a common source (Hunt and others, 1954).

The Great Salt Lake Basin perhaps offers the best evidence uncovered in this study of synthesis of petroleum from Quaternary fresh-water sediments. A considerable quantity of gas (methane 84.6 percent, nitrogen 14.4 percent) was produced from these fresh-water lake deposits at the Farmington Field near Salt Lake City (Heylmun, 1963). Between 1891 and 1897, approximately 20 shallow wells supplied gas to Salt Lake City for a period of 19 months through a wooden pipeline. Maximum monthly production was 17,000 MCF. Largest gas well in the Farmington Field was reported to have produced 4,900 MCF/D at time of completion. Continual plugging of the wells with sand and declining pressure brought about closure of the shallow gas field. Initial wellhead pressures ranged between 200 and 250 psi (Richardson, 1905). Some 60 miles northwest of Farmington Field, at Rozel Point, asphalt is found seeping from Quaternary lake-bed deposits along the shore of the Great Salt Lake and can be seen rising to the surface of the lake half a mile from shore. In places the asphalt seeps from pitch springs, where it occurs in sizable concentrations.

Asphalt in the vicinity of Rozel Point occurs in vesicular basalt intercalated with Quaternary and Tertiary sediments to depths between 130 and 300 feet. The geologic evidence suggests the asphalt originated in the Quaternary lake sediments overlying the basalt. Carbon 14 dating also indicates a Quaternary age for the asphalt. One of the wells at Rozel Point produced five barrels of low-gravity oil per day (Boutwell, 1905). Showings of oil and gas were encountered in 45 of the 80 drillings in the Great Salt Lake Basin, but commercial production has not been found to date. Deep drillings made in this area on the theory that the asphalt had migrated from deeply buried marine rocks have been unsuccessful in finding any evidence to support this idea.

Gas has been produced also from vesicular Miocene basalt associated with fresh-water sediments at

the Rattlesnake Hills Field in Benton County, Washington. This field was found in 1913 by the Conservative Land Investment Co. of Spokane while drilling for water. The discovery well was flared for several years before value of the gas was realized. The gas zones were encountered at depths between 700 and 1,000 feet (Livingston, 1958). "Walla Walla No. 1" initially produced at a rate of 25 MCF per day and registered 7 psi well-head pressure. Three wells drilled later yielded initial flows in excess of 1,000 MCF per day (Hammer, 1934). The volume obtained at such low pressure is truly amazing and must indicate that fractured and vesicular zones in the basalt are interconnected and open. The field supplied the towns of Grandview, Prosser, Sunnyside, Mabton, and Zilla in the lower Yakima Valley with fuel from 1929 to 1941. A total of 16 producing wells furnished the area with approximately 120,000 MCF of natural gas per year. In 1935, a total of 207,355 MCF was delivered to the lower Yakima Valley. Reservoir pressure was noted to vary during wet and dry seasons, indicating that a ground-water drive system played a part in the entrapment of the gas. Composition of the gas (99.35 percent methane, 0.65 percent nitrogen) showed no petroleum fractions.

Gas at Rattlesnake Hills was sealed in porous zones within the basalt by overlying layers of clay. Apparently lava flows repeatedly dammed stream channels forming small fresh-water lakes into which sediments were deposited. Interbasalt clays range in thickness from a few inches to 90 feet and contain carbonized wood and lignite (Glover, 1936). It is not known whether the gas originated from the sediments interbedded with the basalt or if it came from older formations below. Some investigators believe the gas may have migrated upward to the fractured basalt from underlying sediments. Tertiary continental and lacustrine sediments of the Swauk and Roslyn Formations crop out 60 miles north of the gas field. These formations contain beds of subbituminous coal and a few reported oil shows. South of Wenatchee, the Swauk sediments dip beneath the Miocene basalt (Culver and Lupher, 1937). Approximately 60 miles northwest of the Rattlesnake Hills, pre-upper Eocene sedimentary beds, chiefly of terrestrial origin, with intermixed volcanics underlie the basalt (Huntting, Bennett, Livingston, and Moen, 1961). Miocene basalt was found to be 3,000 feet thick at Union Gas 35 miles west of the gas field (Miocene Petroleum Co., Livingston, 1958). Standard Oil Co. drilled a deep test hole 15 miles north of the Rattlesnake Hills Field in 1958 and the basalt was found to be more than 10,655 feet thick at this location.

Nonmarine sediments in the Snake River Basin

At least 10,000 feet of tuffaceous lacustrine, channel debris, and subaerial sediments have been deposited since late Tertiary time in the western Snake River basin. Thin beds of carbonaceous shale and coal occur sporadically throughout the Payette-Sucker Creek section but are more common in the lower part of the Idaho Formation (see Appendix - Descriptions of Drill Cuttings: El Paso Natural Gas Co.-Federal Spurrier 1; R. A. Stamey - Russell 1). During early Pliocene time, the basin was covered by a large lake (Kirkham, 1931) which varied from fresh to brackish, as indicated by the abundance of calcium in these sediments and occasional thin beds of limestone in the lower part of the Idaho Formation. Several wells encountered brackish water at depths ranging from 1,000 to 1,500 feet in the central portion of the basin.

A geologic environment suitable for the formation of hydrocarbons apparently existed in the western Snake River Basin during late Miocene and early Pliocene sedimentation. By middle or late Pliocene, sediments being deposited in the basin were coarse, mainly fluviatile, so that conditions were unfavorable for the formation of hydrocarbons.

Washburne (1909) concluded that chances for finding a gas field in the Tertiary sediments of the Snake River Basin were good and those for finding oil in commercial quantities were slight. However, he believed in the volcanic origin of the gas, a theory that has since been largely discredited. Reports by Buwalda (1923), Kirkham (1935), and Youngquist and Kiilsgaard (1951) were all unfavorable to the possibility of finding commercial petroleum deposits in this region. Felts (1954), on the other hand, considered that thick continental sedimentary sections, such as underlie the Snake River Basin, might offer gas and oil potentialities comparable to marine strata.

Gas occurs in about 200 wells in the Snake River downwarp region. Sands in the center of the basin contain water below 1,200 feet, and in places along the flanks of the downwarp water is encountered at

a depth of 300 feet. Many wells producing gas are also flowing water because the downwarp forms an ideal artesian basin. Water associated with the gas is in many instances heated and contains large amounts of ammonia carbonate and some sulfate. An odor of hydrogen sulfide can be noted in the warm water. Several gas gushers were estimated to have blown at rates of 20,000 MCF per day. The Payette "gusher" was the largest flow encountered in the region; it blew sand and water 150 feet into the air. All the "gushers" either sanded up within a few days or in a short time depleted the reservoir to the extent that little gas remained (Kirkham, 1935).

Natural gas from the area contains a high percentage of nitrogen and some hydrogen sulfide along with occasional traces of helium. It also contains on the average 10 percent of ethane and heavier petroleum fractions (see Appendix - Gas Analyses). Some of the gas found in the basin has had from 0.12 to 1.3 gallons of gasoline per MCF (Kirkham, 1935). Heating values range between 940 and 1490 Btu. It can be concluded that not all the gas is marsh gas nor did all of it originate in fairly recent sediments. Synthesis of the gas from lacustrine organic material took place in an environment favorable also to the formation of oil, at least in small quantities. Under these conditions, commercial amounts of gas could have been generated; such accumulations may exist provided reservoir rock is available and structural elements are suitable for entrapment.

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APPENDIX

WELL DATA

Idaho Wells

Company	Well Name	Total Depth	Date Drilled	Location and Elevation	Gas Zones and Formation Tests
ADA COUNTY					
Boise Oil Co.	Well No. 1	1,625'	1937	Sec. 27, T4N, R3E. (Elev. 3,050')	No gas zones encountered. Artesian water at 175'. Several water zones below.
Scott Anderson, et al.	Dry Creek well	1,562	1927	Sec. (?), T4N, R1E. (Elev.?)	No gas
CANYON COUNTY					
El Paso Nat. Gas Co.	Webber-State 1	4,528	1956	SW¼ sec. 16, T5N, R3W (Elev. 2,443')	FT (2451-2535) - Packers failed. FT (2465-2535) - Packers failed. FT (2650-2690) - Recovered 2,290' of fresh water. IFP 400psi, FFP 1020 psi, SIP 1070psi, IHH 1400psi, FHH 1380psi, BHT 118°F. FT (2990-3040) - Recovered 110' of drilling mud. IFP 235psi, FFP 235 psi, SIP 595psi, HH 1625psi. FT (2705-2740) - Recovered (?) feet of fresh water. FT (3905-3940) - Recovered 80' of slightly gas cut drilling mud. IFP 0 psi, FFP 0 psi, SIP 0 psi, HHP 1960 psi, BHT 150°F.
Oroco Oil & Gas Co.	Cleveland No. 1	4,038	1955	NW¼ sec. 9, T5N, R4W (Elev. 2,490')	FT (3086-3183) - Recovered 150' of mud. Flow pressure nil.
Oroco Oil & Gas Co.	Richardson No. 1	3,048	1955	NE¼ sec. 19, T4N, R3W (Elev. 2,335')	FT (2993-3041) - Gas surfaced in 5 minutes. Recovered 195' of gas cut mud. FFP 325psi, SIP 1250 psi, gauged rate 300 MCF/D. Prod Test (2990-3040) - Est. flow 50 MCF/D, decreased to very small flow.
United Utilities Corp.	Johnson 1	?	1931	Sec. 27, T5N, R3W, (Elev.?)	No record available.
United Utilities Corp.	Armfield 1	?	1931	Sec. 19 or 20, T2N,R3W.(Elev.?)	No record available.
GEM COUNTY					
?	Berglund 1	576	1928	SE¼ sec. 3, T6N, R3W (Elev. ?)	No gas. Artesian water at 98-110' and warm (85°F.) artesian water at 432-576'.

Company	Well Name	Total Depth	Date Drilled	Location and Elevation	Gas Zones and Formation Tests
GEM COUNTY, Continued					
?	Berglund 2	693	1928	SE¼ sec. 3, T6N, R3W (Elev. ?)	Sands, 500-597', contained warm artesian water.
Bergdahl Oil Co.	Aikman 1	175'	1926	Sec. 35, T6N, R1W. (Elev. 2960')	No log available.
Bergdahl Oil Co.	Aikman 2 and 3	295'? 600+	1926 1930	Sec. 25, T6N, R1W. (Elev. 3000')	No log available
A. J. Eisele	Bishop 1	1,500?	1955	NE¼NE¼ Sec. 3, T6N, R3W	Flowed brackish water from sand, 1,320 - 1,340'.
R. H. Lent	?	800+	1942	Letha, Idaho	Flow of sulphur water in gravel at 785'.
OWYHEE COUNTY					
Helmerick & Payne, Inc.	Parker 1	3,808	1950	Sec. 19, T6S, R8E (Elev. 2633)	No significant show. Top of basalt 3,200'.
Helmerick & Payne, Inc.	State 1	2,653	1950	Sec. 16, T6S, R7E. (Elev. 2,775)	No significant shows. Top of basalt 2,550'.
B.B. & M. Oil & Gas Co.	W.L. Turner 1	1,746'	1930	Sec. ?, T5S, R3 E.	No log available.
B.B. & M. Oil & Gas Co.	W.L. Turner 2	?	1931	Sec. ?, T5S, R3E.	No log available.
?	Clinton Basset 1	500	?	Sec. 28, T5S, R1E	No log available.
Pan American Petroleum Corp.	McKnight 1	1,182'	1960	Sec. 23, T3S, R6W. (Elev. 4618')	No gas encountered. Top of basalt 480'.
PAYETTE COUNTY					
Henry & Cox	Bane Land 1	879'	1908	Approx. sec. 33, T8N., R2W. (Elev. 2600")	Some gas encountered.
Idaho-Oregon Petroleum Co.	Well No. 1	1,830	1921	Near the City of Payette; T9N, R5W. (Elev. 2230')	Sand, 1125-1127. Contained considerable amount of gas, shut-in pressure 150-200psi. Sand, 1685-1690. Yielded a strong gas blow.
International Finance Corp. (deepened by Ida.-Oreg. Pet. Co.)	Well No. 2	1,730	1930	At the City of Payette.	Well blew out March 23, 1930, after drilling into a gas sand at 1270-1280. Hole apparently caved. Ida.-Oreg. Pet. Co. encountered only minor gas shows deeper.
Payette Exploration Co.	Yager 1	892	1935	Sec. 12, T8N, R5W. (Elev. 2254)	Lost tools in the hole. Well was abandoned.

Company	Well Name	Total Depth	Date Drilled	Location and Elevation	Gas Zones and Formation Tests
PAYETTE COUNTY, Continued					
Ohio Oil Co.	Kramlich 1	4,011'	1931	Sec. 5, T9N., R4W (Elev. 2300')	All sands encountered were wet (brackish?). Slight gas show in sand 2053-2065'.
Oregon Oil & Gas Co.	"Payette Well"	800±	1907	Within 3 blocks of main business district of Payette.	Well blew out October 18, 1907. spewing gas, water, sand and shale 150' into the air. The hole eventually caved. (Blow out described by R.N. Bell in the Ninth Annual Rept. of the Idaho Bur. Mines, 1907.)
Consolidated Oil Co.	?	?	?	Sec. 2, T8N, R5W.	No log available.
Taylor, et al.	Idaho Canning Co.	2,000±	1907 (?)	Sec. 33, T9N, R5W. (Elev. 2140')	Encountered a strong gas flow, hole caved after ½ hour.
Idaho-Oregon Petroleum Co.	Idaho Canning Co.	2,500	1928	Sec. 33,	Hit gas at 1270', reported to have shut-in pressure of 800 psi.
Idaho-Oregon Prod. Co.	Well No. 2	2,397	Sec. 34, T.9 N., R.5 W.		FT (1610-2397) - Small flow of gas, some condensate. SIP 60psi.
Oroco Oil & Gas Co.	Betty Carpenter 1	2,775	1955	NE¼ sec. 4, T8N, R5W (Elev. 2140')	FT (1230-1248) - Packer failed after after 8 minutes. Recovered 540' of slightly gas cut mud. HH 550psi. FT (1428-1442) - Immed fairly strong blow. Flow rate est. 50 MCF/D. Recovered 315' net rise of fluid, 135' of gas cut mud, 180' fresh water. FFP nil, SIP 75psi, HH 580psi. FT (1523-1567) - No blow. Recovered 42' of mud. FFP 0psi, HH 725psi. FT (1705-1750) - Flowed gassy brackish water. Est 50MCF/D of gas. IFP 290psi, FFP 510psi, SIP 600psi, IHH 875psi, FHH 850psi. FT (1930-1990) - Recovered 40' of mud, no gas. FFP 0 psi, SIP 400psi, FHH 1100 psi. Prod Test (1443-1444) - Fair blow. Recovered 1380' of muddy, gassy fresh water. IFP 125psi, FFP 460psi, IHH 650psi, FHH 630psi.
Oroco Oil & Gas Co.	V. Johnson 1	4,040	1955	SE¼ sec. 27, T8N, R4W (Elev. 2,195')	FT (1410-1610) - Recovered 350 MCF/D blow of dry gas.

Company	Well Name	Total Depth	Date Drilled	Location and Elevation	Gas Zones and Formation Tests
PAYETTE COUNTY, Continued					
Oroco Oil & Gas Co., cont.					Well blew out while pulling pipe. Gas zone 1500-1650(?). The blow out caused the casing to collapse. An unsuccessful attempt was made to repair the well.
Oroco Oil & Gas Co.	Ted Daws 1	1,685'	1955	NE¼ sec. 34, T8N, T4W. (Elev. 2,203')	No gas encountered.
El Paso Nat. Gas Co.	V.Johnson 2	3,521	1955	Sec. 27, T8N, R4W (Elev. 2, 194)	An attempt was made to drill the hole with air but water zones were encountered at shallow depth so mud had to be used. DST (1566-1680) - Recovered 32' of slightly gas cut mud. DST (1569-1680) - Packer failed. DST (1567-1684) - Packer failed. DST (1143-1684) - Good blow. SI pressure at the surface was 80psi after 1 hour and 190psi after 4½ hours. Recovered 530' of gas cut mud. SIP 535psi, IF 220psi, FFP 350psi. Tester open for 11¼ hours. Halliburton sand-oil fractured perforated intervals. Swabbed the hole but recovered only a small flow of gas.
El Paso Nat. Gas Co.	Assmussen 1	4,017	1956	Sec. 8, T9N, R3W. (Elev. 2,917')	No shows recorded on the gas analysis. No formation tests were made. Several fairly thick sands were penetrated but cores of the sands appeared to be wet.
WASHINGTON COUNTY					
Boise Petroleum Co.	?	1,995(?)	1930	Sec. 13, T10N, R3W (Elev. 2,200)	Hit artesian water at 190'. Encountered several water sands deeper.
Bradshaw et al.		1,165	1920 (?)	Sec. 32 T11N, R5W (Elev. 2,200')	No log available.
Crystal Dome Oil & Gas Co.	Daniel 1	1,516	1929	Sec. 32 T10N, R4W (Elev. 2,760)	Hole junked when casing ruptured.
Crystal Dome Oil & Gas Co. (later deepened by Mt. Sts.Oil & Gas Co.	Daniel 2	1,865	1930	SE¼ sec. 32, T 10N, R4W (Elev. 2760')	Gas in shale 1530-1845. Sand 1865 gave strong blow. Well was capped and tested. Reported to be a "real well."

Idaho Wells, Cont.

Company	Well Name	Total Depth	Date Drilled	Location and Elevation	Gas Zones and Formation Tests
WASHINGTON COUNTY, Continued					
Mountain States Oil & Gas Co.	Freeman 1	?	1931	Sec. 32 T10N, R4W (Elev. 2,760)	No log available.
Oroco Oil & Gas Co.	T.B. Carr 1	2,320'	1955	NE¼ sec. 15 T11N, R5W (Elev. 2,306')	No gas shows. Drilled mostly in volcanic rocks.
The Bankers Petroleum Co.	Government 1	2,600	1953	SW¼ sec. 32 T10N, R4W (Elev. 2,600)	No significant shows encountered.

Oregon Wells

Company	Well Name	Total Depth	Date Drilled	Location and Elevation	Gas Zones and Formation Tests
MALHEUR COUNTY					
Baker & Malheur Oil Co.	Well No. 1	340'+	1909	SW¼ sec. 4 T19S, R45E (Elev. 2,400')	No gas encountered. Artesian water in coarse sand at 227-250'.
Baker & Malheur Oil Co.	Well No. 2	320'+	1909	NE¼ sec. 10 T19S, R45E. (Elev. 2,600')	Sand, 147-162, a little gas. Hot water in sand at 277-290.
Baker & Malheur Oil Co.	Well No. 3	163'+	1909	NW¼ sec. 29 T19S, R45E (Elev. 2,650')	No gas encountered to this depth. Complete log not available.
Boyer Residence	Water Well	215'	1902	SE¼ sec. 9 T18S, R47E (Elev. 2,170')	Gas from water well used for lighting and cooking for several years.
Columbia Oil & Gas Develop. Co.	Well No. 1	975'+	1909	SW¼ sec. 4 T20S, R44E (Elev. 2,640')	Sand 580-590. Fair gas show. Hydrogen sulfide odor. Sand was encountered directly below a basalt layer.
Eastern Oregon Oil Co.	Well No. 1	815'+	1909	Sec. 12 T20S, R45E (Elev. 2,470')	Sand, 250-335. Small flow of gas.

Company	Well Name	Total Depth	Date Drilled	Location and Elevation	Gas Zones and Formation Tests
MALHEUR COUNTY, Continued					
El Paso Natural Gas Co.	Federal-Spurrier 1	7,470'	1955	NE¼ sec. 5 T20S, R44E (Elev. 2,520')	Gas analyzer registered shows: 2480-2620, 2700-2780, 3120-3330, 3430-3580, 5030-5090. FT (6065-6196) - Recovered 900' of muddy fresh water, probably mud filtrate (Salinity nil). IFP 50psi, FFP 480psi, SIP 2400psi, HH 3325psi. FT (6484-6692) - Packers failed.
Idaho Oregon Production Co.	Elvera-Recla 1	4,611'	1950	SE¼ sec. 9 T19S, R44E (Elev. 2331')	No record other than the electric log.
Malheur Oil Co.	Well No. 1	1,680'+	1909	Sec. 31 T19S, R44E (Elev. 2,590')	Sand, 122-130. Trace of gas.
Mammoth Oil & Gas Co.	Well No. 1	1,280'+	1909	Sec. 6 T. 20S, R45E (Elev. 2,630')	Sand, 58-73, 152-161, 543-548, 558-564. Trace of gas. Artesian water in gravel at 183'.
Northwestern Pacific Oil & Gas Co.	Well No.1	1,140'+	1919	Near sec. 12 T20S, R43E (Elev. ?)	No log available (dip reported to be 6°N.)
Ontario Cooperative Gas & Oil Co.	Well No.1	3,650'	1908	Sec. 9 T18S, R47E (Elev. 2,159')	Shale, 636-711. Small amount of gas. Sand, 968-982. Good gas blow. Sand, 1058-1066. Gas blew a 1,000 foot column of water out of the hole and over the top of the derrick. The zone was cased off so drilling could proceed. Sand, 2199-2200. Gas blew a 2000 foot column of water out of the hole and over the derrick crown. The zone was cased off in order to drill deeper. At the time of C. W. Washburne's visit in 1909 the well was capped. The gauge on the well-head registered 420psi. When the valve was opened gas escaped with a roar but the flow deceased considerably within a half hour. Washburne reported that the gas had a gasoline odor.
Oroco Oil & Gas Co.	Bolles 1	1,966'	1955	NW¼ sec. 15 T17S, R47E (Elev. 2,147')	Well blew out while pulling the drill pipe, depth 1540'. An iridescent film was noted on the gas-cut mud returning from the bottom of the hole.

Company	Well Name	Total Depth	Date Drilled	Location and Elevation	Gas Zones and Formation Tests
MALHEUR COUNTY, Continued					
Oroco Oil & Gas Co., cont.					When tested with an ultra-violet lamp the film fluoresced a spotty, pale blue. DST (1082-1084) - Heading blow for the entire test. Recovered a 1049' net rise of fluid; top 30' drilling mud, 999' of brackish water and 20' of sand on the bottom. IFP 300psi, FFP 440psi, IHH 475psi and FHH 460psi.
Oroco Oil & Gas Co.	McBride 1	4,506'	1956	SE¼ sec. 19 T16S, R46 E (Elev. ?)	No significant gas zones encountered.
H. K. Riddle	Kiesel Estate 1	5,137'	1954	SW¼ sec. 8 T19S, R47E (Elev. 2,177')	FT (1908-1932) - Packer failed. FT (2152-2178) - Fair blow of gas. Recovered 200' of gassy fresh water. IFP 150psi, FFP 0 psi. Prod Test (1924 - 1951) - Recovered gassy water. Prod Test (924-1293) - Recovered gas cut water. Prod Test (4050-5042) - Recovered slightly gas cut water.
Sinclair Oil & Gas Co.	Eastern Oregon Land Co. 1	4,888'	1955	SW¼ sec. 15 T16S, R44E (Elev. 2,515')	No significant gas zones encountered.
R.A. Stamey (Sta-Tex Petroleum)	Russell 1	4,336'	1954	NW¼ sec. 14 T19S, R44E (Elev. 2,297')	Gas analyzer registered shows: 1750, 1831-1855, 2076, 2248-2252, 2280, 2306-2324, 2334-2336, 2340-2358, 2749-2754 (weathered basalt), 2779-2786 (weathered basalt), 2971, 2968-2973, 3547-3552, 3586-3588, 3619-3635, 3662, 3800-3804. FT (2275-2289) - Recovered 216' of fresh water, no gas. Salinity nil.
Sunset Oil Co.	?	500'+	1919	Sec. 35 T16S, R46E. (Elev. ?)	No interesting shows encountered (dip very gentle).
United Development Corp.	Dorman 1	625'	1932	Sec. 25 T18S, R46E (Elev. ?)	Small gas show at 540'.

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SCOTT ANDERSON

Well name ?

Sec. ?, T. 4 N., R. 1 E.

Ada County, Idaho

Descriptions of Well Samples*

0 - 320	Soil, sand, and gravel
320 - 1560	Shale, blue gray
1560 - 1562	Basalt

Dry Hole

*Idaho Bureau of Mines and Geology.

EL PASO NATURAL GAS COMPANY

Webber - State 1

Sec. 16, T. 5 N., R. 3 W.

Canyon County, Idaho

Description of Formation*
(Well drilled entirely in upper Idaho Formation)

280 - 420	Sand, unconsolidated quartz, and sanidine with siltstone stringers.
420 - 450	Buff shale, sandy.
450 - 500	Sand with gray to brown shale stringers.
500 - 540	Brown shale.
540 - 750	White, unconsolidated sand.
750 - 1128	Clay, with mica, quartz, and sanidine.
1128 - 1159	Sand, unconsolidated with shale stringers.
1159 - 1320	Light-gray clay with quartz and mica.
1320 - 1470	Light-gray shale.
1470 - 1650	Light-gray, soft siltstone, some shale, calcareous.
1650 - 1800	Light-gray sandstone, partly shaly.
1800 - 1830	Light-gray shale.
1830 - 1890	Light-gray, shaly siltstone.
1890 - 1935	Light-gray, calcareous shale.
1935 - 2460	Light-gray to tan clay, bentonitic and calcareous.
2460 - 2665	Light-gray shale, bentonitic and silty.
Core No. 1	
2670 - 2690	Recovered 14 feet.
2670 - 2674	Sandstone: Water saturated. Mostly volcanic ash, sand size.
2674 - 2676	As above with shaly partings.

*Idaho Bur. Mines - well log.

2676 - 2678	Light-gray, soft shale.
2678 - 2679	Sandstone.
2679 - 2680	Shale.
2680 - 2681	Sandstone.
2681 - 2684	Shale.
2700 - 2820	Light-gray shale, silty.
2820 - 2835	Light-gray to tan siltstone.
2835 - 2880	Light-gray shale with siltstone stringers.
2880 - 2895	Light-gray sand, unconsolidated with shale stringers.
2895 - 2955	Light-gray shale with siltstone stringers; some high in volcanic ash.
2955 - 2970	Light-gray siltstone with shale stringers.
2970 - 3000	Light-gray, silty shale.
3000 - 3030	Sand, shaly and unconsolidated.
3030 - 3050	Light-gray shale, silty.
3050 - 3065	Light-gray to tan siltstone.
3065 - 3320	Light-gray shale, silty and sandy.
3320 - 3365	Light-gray siltstone.
3365 - 3425	Light-gray shale.
3425 - 3455	Sandstone and siltstone, arkosic.
3455 - 3500	Light-gray siltstone with arkosic sandstone stringers.
3500 - 3515	Light-gray to tan sandstone.
3515 - 3530	Light-gray siltstone, sandy.
3530 - 3605	Arkose.
3605 - 3675	Light-gray sandstone, some silty and arkosic.
3685 - 3695	See Core No. 2 (page 3).

El Paso, Webber - State 1
Canyon County, Idaho

Core No. 2 - 3685 - 3694: Recovered 1 foot 3685-3686 light-gray, medium-grained, arkosic sandstone, water saturated. Missing portion probably similar to above. Verified by electric log.

3695 - 3785	Light-gray, arkosic sandstone, shale stringers.
3785 - 3845	Light-gray shale with arkosic sandstone stringers.
3845 - 3890	Arkosic sandstone, shale stringers.
3890 - 3910	Light-gray shale.
3910 - 3940	White quartz sandstone, silty shale stringers.
3940 - 4035	Silty, light-gray shale.
4035 - 4080	Light-gray siltstone.
4080 - 4185	Light-gray to tan shale with sandstone stringers.
4185 - 4245	Light-gray siltstone.
4245 - 4320	Light-gray, silty shale, arkosic streaks and slightly calcareous.
4320 - 4380	Sandstone, medium to fine grained, slightly arkosic.
4380 - 4410	Light-gray siltstone with arkosic sandstone stringers.
4410 - 4522	Light-gray, arkosic sandstone.

T.D. is 4528.

OROCO OIL AND GAS COMPANY

J. R. Simplot Company

Cleveland 1

Sec. 9, T. 5 N., R. 4 W.

Canyon County, Idaho

Descriptions of Well Samples*

0 - 279	Sand
279 - 285	Sand and shale
285 - 290	White sand
290 - 615	Shale, sand, and soft, sticky, silty clay
615 - 925	Shale and sand
925 - 1261	Soft, sticky shale
1261 - 1642	Soft shale and clay
1642 - 1804	Shale
1804 - 2195	Gray shale
2195 - 2198	Sand
2198 - 2234	Shale
2234 - 2238	Sand (Recovered 4-foot core, no show.)
2238 - 2242	Shale
2242 - 2244	Sandy shale (Recovered 2-foot core, no show.)
2244 - 2606	Shale
2606 - 2713	Shale and sand
2713 - 3086	Shale
3086 - 3183	Sand and shale
3183 - 4038.08	Shale

*Idaho Bureau of Mines and Geology.

OROCO OIL AND GAS COMPANY

Richardson No. 1

Sec. 19, T. 4 N., R. 3 W.

Canyon County, Idaho

Descriptions of Well Samples*

0 - 181	Gravel and lake bed mud.
181 - 588	Lake bed mud.
588 - 1682	Shale and lake bed mud.
1682 - 1780	Mud.
1780 - 2111	Shale.
2111 - 2688	Shale.
2688 - 2760	Hard sand and mud.
2760 - 2993	Shale.
2993 - 3048	Shale and sand.

*Idaho Bureau of Mines and Geology.

COMPANY ?

"Berglund Well 1"

Sec. 3, T. 6 N., R. 3 W.

Gem County, Idaho

Descriptions of Well Samples*

0 - 8	Soil
8 - 35	River gravel and sand
35 - 35½	Mud
35½ - 90	Alternate shale or mud and sand (beds 3- to 10-feet thick).
90 - 98	Shale
98 - 110+	Sand (artesian water)
110 - 430	Sand and shale: Some calcareous cement in sand.
430 - 432	3 inches black shale; 4 inches very hard lime and sand cored.
432 - 576	Sand with thin streaks of shale (artesian water at 500 feet).

Note: Had drilled to 525; mud became thin and water broke through. Water went 20 feet over top of rods which were 40 feet above floor. Hole filled up to 500 feet which is probably aquifer.

*Idaho Bureau of Mines and Geology.

COMPANY ?

"Berglund Well 2"

Sec. 3, T. 6 N., R. 3 W.

Gem County, Idaho

Descriptions of Well Samples*

0 - 500	Same as "Berglund Well 1" Shell zone at 432 feet.
500 - 597	Sand and shale: With shale immediately above 597. Artesian water about same as Well No. 1. Flowed 5 days. Water stopped, cleaned hole. Water pressure did not return. Water warm.
597 - 610	Plastic material and sand.
610 - 620	Plastic material and sand: Oily froth.
620 - 693	Plastic material, sand, shale: Cored last 5 feet. Puttylike, limy shale and sand.

*Idaho Bureau of Mines and Geology.

PAN-AMERICAN PETROLEUM CORPORATION

McKnight 1

Sec. 23, T. 3 S., R. 6 W.

Owyhee County, Idaho

Source of Samples - Flow Line

0 - 50	Gravel: Coarse green quartz and granite wash with some hard gray and brown shale streaks.
50 - 75	Shale: Medium gray, silty with carbonaceous inclusions.
75 - 80	Sandstone: Gray, very fine grain, friable.
80 - 100	Shale: As above.
100 - 120	Volcanic ash: White, bentonitic.
120 - 150	Sandstone: Fine grain to silt, carbonaceous, hard and tight.
150 - 162	Shale; Brown, hard.
162 - 180	Sandstone: As above.
180 - 190	Shale: Brown, as above.
190 - 200	Shale: White, flaky, bentonitic, brittle.
200 - 225	Shale: Medium dark brown, soft, with carbonaceous inclusions.
225 - 240	Shale: White, bentonitic with abundant sand grains.
240 - 260	Shale: Brown, as above.
260 - 280	Shale: White, bentonitic, as above.
280 - 300	Shale: Flesh colored, dense, brittle.
300 - 440	Shale: White to very light green, soft but brittle with occasional light to dark-brown carbonaceous shale streaks.
440 - 460	Shale: Red brown to light brown, siliceous, very hard and dense.
460 - 487	Shale: White, soft, slightly bentonitic.
487 - 500	Basalt: Dark green to gray with abundant black minerals.
500 - 560	Basalt: Medium green with very fine crystalline, black ferro-magnesium minerals and scattered coarse calcite crystals.
660 - 750	Basalt: Predominantly medium green, dense to coarsely crystalline matrix with abundant fine to medium crystals of black minerals and traces of white calcite and light-colored minerals.
750 - 910	Basalt: As above, but predominantly dark gray with occasional zones with a green cast.
910 - 920	Shale: Medium gray, dense, siliceous with light-brown, dense basalt nodules.
920 - 1100	Basalt: Dark gray as above with basalt light to dark brown, dense to very fine grained with red, black, white, and green mineral inclusions.
1100 - 1182	Basalt: Dark green, gray as above with occasional loose pyrite.

October 14, 1960

IDAHO-OREGON PETROLEUM COMPANY

Well 1

At City of Payette

Payette County, Idaho

Descriptions of Well Samples*

0 - 16	Sand, gravel, and boulders.
16 - 340	Shale: Blue, brown.
340 - 346	Sand, water: Gas plentiful.
346 - 790	Shale: Stratified, brown, black, blue, in 2½- to 6-foot layers; brown is more sandy.
790 - 795	Gas sand: Brownish, light chocolate. No water, slight gasoline smell, 2 percent ethane.
795 - 908	Shale.
908 - 909	Sand-rock: 8 to 10 inches, porous, hard shell on top (not porous); small amount of oil in bailer.
909 - 1125	Shale: Dark, sandy, laminated.
1125 - 1127½	Gas sand: Light brown, fine, 8 to 10 inches thick. Gas-rock pressure 150 to 200 pounds.
1127½ - 1400	Shale: "Water sand" but no water.
1400 - 1685	Shale: Brown.
1685 - 1690	Big gas blow: Gas blew bailer out of hole and howled in casing.
1690 - 1830	Shale: Brown.

*Idaho Bureau of Mines and Geology.

IDAHO-OREGON PETROLEUM COMPANY-
INTERNATIONAL FINANCE CORPORATION

Well 2

At City of Payette

Payette County, Idaho

Descriptions of Well Samples*

0 - 40	Sand-gravel: Soft.
40 - 220	Shale: Blue with hard ribs.
220 - 306	Shale: Soft, sandy.
306 - 320	Shale: Soft water and gas.
320 - 337	Sand: White. Soft water and gas.
337 - 347	Shale:
347 - 422	Shale:
422 - 440	Shale: Soft with hard ribs.
440 - 460	Sand: Soft.
460 - 520	Shale: Soft, light and dark streaks.
520 - 600	Shale: Soft.
600 - 625	Shale: Gas in shale.
625 - 800	Shale: Blue, soft, with hard ribs.
800 - 890	Shale: Soft, foot gray sticky.
890 - 1180	Shale: Blue, soft and sticky.
1180 - 1240	Shale: Blue, soft and sticky. Set 10-inch casing under ream.
1240 - 1246	Shell: Lime, hard.
1246 - 1270	Shale: Blue, hard.
1270 - 1280	Sand: Gas and pressure (big blow March 23, 1930).

*Idaho Bureau of Mines and Geology.

Well 2: City of Payette

Foregoing Log Furnished by Idaho-Oregon Petroleum Company

1280 - 1288	Shale: Dark, sandy.
1288 - 1302	Shale: Blue.
1302 - 1302½	Lime: Soft.
1302½ - 1325	Shale: Blue.
1325 - 1355	Shale; lime: White.
1355 - 1395	Shale: Blue, sandy.
1395 - 1400	Shale: Black.
1400 - 1420	Shale: Blue.
1420 - 1460	Shale and lime mixed
1460 - 1505	Shale: Blue.
1505 - 1510	Lime: Blue white (with thin shell hard lime).
1510 - 1545	Shale: Gray, calcareous. Showing of gas 1540 feet.
1545 - 1565	Shale: Blue.
1565 - 1568	Sand: Fine, gray, mixed with shale, calcareous, showing gas.
1568 - 1570	Shale: Dark blue.
1570 - 1670	Shale: Blue, gassy.
1670 - 1700	Shale: Black, gassy.
1700 - 1705	Shale: Dark, sandy, gassy.
1705 - 1720	Shale: Dark blue, gassy.
1720 - 1730	Shale - lime: Blue, gassy.

PAYETTE EXPLORATION COMPANY

Yager 1

Sec. 12, T. 8 N., R. 5 W.

Payette County, Idaho

Descriptions of Well Samples*

0 - 15	Soil: Sandy.	
15 - 42	Clay: Brown.	
42 - 45	Gravel: Coarse.	(water)
45 - 60	Sand: Light.	
60 - 90	Silt	
90 - 720	Shale: Blue, sticky.	
720 - 730	Water, sand	
730 - 845	Shale: Blue, sticky.	
845 - 846	Lime shell	(gas showing)
846 - 892	Shale: Blue, lighter.	

Note: A packer twisted off in bottom of this hole and it was abandoned; hole drilled with 4½-inch rotary bit; was plugged with cement from 700 feet down to protect gas sand at 845.

First 115 feet drilled with cable tools; remainder of hole drilled rotary using practically clear water to keep weight down but unable to take satisfactory samples of formation other than blue shale and one water-sand encountered.

*Idaho Bureau of Mines and Geology.

OHIO OIL COMPANY

Kramlich 1

Sec. 5, T. 9 N., R. 4 W.

Payette County, Idaho

Descriptions of Well Samples*

0 - 25	Shale
25 - 45	Shale
** 45 - 83	Sand and shale
83 - 160	Shale and sand
160 - 208	Sand and gravel
208 - 236	Gravel
236 - 239	Shale: (set 12-½ inch)
239 - 309	Shale
309 - 396	Water sand
396 - 428	Shale
428 - 472	Gravel
472 - 515	Shale and gravel
515 - 526	Shale
526 - 762	Shale: Light shell.
762 - 851	Shale: Sandy.
851 - 856	Gravel: Lost circulation.
856 - 871	Shale
871 - 949	Shale
949 - 979	Shale
979 - 1010	Shale: Sticky.
1010 - 1024	Shale
1024 - 1122	Shale: Sticky.
1122 - 1150	Shale: Sticky.
1150 - 1200	Shale and shell: Sandy.
1200 - 1296	Shale
1296 - 1459	Shale
1459 - 1522	Shale
1522 - 1567	Shale: Sticky.
1567 - 1636	Shale:
1636 - 1666	Shale: Gray, hard.
1666 - 1700	Shale: Gray, hard.
1700 - 1745	Shale: Gray, hard.
1745 - 1769	Shale: Sandy.
1769 - 1775	Shale
1775 - 1804	Shale: Gray, hard.
1804 - 1815	Shale
1815 - 1857	Shale
1857 - 1914	Shale: Hard.
1914 - 1968	Shale: Gray.
1968 - 1980	Shale: Hard.
1980 - 2015	Shale: Hard.
2015 - 2029	Shale: Hard.
2029 - 2053	Shale: Gray
** 2053 - 2065	Sand: Dark gray.
2065 - 2096	Sand: Dark gray.

*Idaho Bureau of Mines and Geology.
**All of the sands mentioned in this log are wet.

**Little puff of gas.

Ohio Oil Co.-Kramlich 1

2096 - 2114	Shale: Sandy.
2114 - 2125	Sand: Gray.
2125 - 2150	Sand: Gray.
2150 - 2205	Sand: Gray.
2205 - 2231	Shale: Brown.
2231 - 2239	Shale: Brown.
2239 - 2246	Shale and sand
2246 - 2266	Sand
2266 - 2348	Sand: Gray.
2348 - 2522	Shale: Gray.
2522 - 2540	Shale: Gray.
2540 - 2855	Shale: Brown.
2855 - 2942	Sand: Gray, hard.
2942 - 2962	Shale: Brown.
2962 - 3041	Shale: Brown.
3041 - 3045	Sand: Gray, hard.
3045 - 3047	Shale: Brown.
3047 - 3049	Sand: Gray, hard.
3049 - 3096	Shale: Brown.
3096 - 3099	Sand: Gray.
3099 - 3102	Sand: Gray.
3102 - 3103	Sand: Gray, hard.
3103 - 3157	Shale
3157 - 3249	Sand: Gray.
3249 - 3341	Shale
3341 - 3430	Sand: Gray.
3430 - 3435	Shale: Brown.
3435 - 3506	Sand: Gray.
3506 - 3525	Sand: Dark.
3525 - 3528	Sand: Gray.
3528 - 3532	Sand: Gray.
3532 - 3543	Sand: Dark.
3543 - 3544	Sand: Gray.
3544 - 3604	Sand: Gray.
3604 - 3613	Shale: Sandy.
3613 - 3614	Sand: Hard.
3614 - 3619	Shale: Sandy.
3619 - 3621	Sand: Gray.
3621 - 3666	Sand: Gray.
3666 - 3686	Volcanic ash and lava
3686 - 3694	Shale: Gray, sticky.
3694 - 3707	Shale: Gray, sticky.
3707 - 3733	Sand: Gray.
3733 - 3755	Sand: Dark.
3755 - 3769	Sand: Gray.
3769 - 3777	Shale: Sandy.
3777 - 3795	Shale: Brown, sandy.
3795 - 3797	Shell: Hard.
3797 - 3818	Shale
3818 - 3856	Shale: Gray, with streaks of sand.
3856 - 3859	Shale
3859 - 3879	Shale: Gray.
3879 - 3895	Shale: Gray.
3895 - 3935	Shale: Gray, hard.

Ohio Oil Co. - Kramlich 1

3935 - 3960	Shale: Gray.
3960 - 3968	Shale: Gray.
3968 - 3970	Shell: Hard.
3970 - 3977	Shale
3977 - 3998	Shale: Gray.
3998 - 4004	Sand: Gray, hard.
4004 - 4007	Sand: Gray, soft, wet.
4007 - 4011	Sand: Gray, hard, wet.

239 feet of 12½-inch, 45 pound and 50 pound pipe and 2050 feet of 8¼-inch, 32 pound seamless pipe have been left in the hole. The hole is open below 2050 feet.

OROCO OIL AND GAS COMPANY

J.R. SIMPLOT COMPANY

Betty Carpenter 1

Sec. 4, T. 8 N., R. 5 W.

Payette County, Idaho

Descriptions of Well Samples*

0 - 45	Gravel
45 - 185	Gravel and shale
185 - 253	Shale
253 - 400	Shale and sand
400 - 780	Shale
780 - 973	Shale and sand
973 - 1213	Shale
1213 - 1247	Sand and shale
1247 - 1438	Shale
1438 - 1442	Sand
1442 - 1545	Shale
1545 - 1567	Shale and sand
1567 - 1705	Shale
1705 - 1750	Shale and sand
1750 - 1751	Sand
1751 - 1845	Sand and shale
1845 - 2350	Shale
2350 - 2475	Shale and sand
2475 - 2775	Shale

*Idaho Bureau of Mines and Geology.

OROCO OIL AND GAS COMPANY

Virgil Johnson 1

Sec. 27, T. 8 N., R. 4 W.

Payette County, Oregon

Descriptions of Well Samples*

0 - 45	Gravel
45 - 100	Gravel, sand, and clay
100 - 254	Clay
254 - 931	Sand and clay
931 - 1236	Sand and shale
1236 - 1305	Shale
1305 - 1320	Hard sticky shale
1320 - 1432	Sand and shale
1432 - 1676	Shale
1676 - 1959	Sand and shale
1959 - 1979	Shale
1979 - 2035	Sticky shale
2035 - 2053	Hard sand and shale
2053 - 2088	Soft sand and shale
2088 - 2131	Hard shale
2131 - 3992	Shale
3992 - 4040	Shale and basalt

*Idaho Bureau of Mines and Geology.

OROCO OIL AND GAS COMPANY

Ted Daws 1

Sec. 34, T. 8 N., R. 4 W.

Payette County, Idaho

Descriptions of Well Samples*

0 - 50	Gravel
50 - 103	Gravel and shale
103 - 495	Shale and sand
495 - 677	Shale
677 - 893	Sand and shale
893 - 1393	Shale
1393 - 1457	Shale with trace of sand
1457 - 1487	Bentonite and shale
1487 - 1611	Shale
1611 - 1664	Shale with trace of sand
1664 - 1685	Shale

*Idaho Bureau of Mines and Geology.

EL PASO NATURAL GAS COMPANY

V. Johnson 2

Sec. 27, T. 8 N., R. 4 W.

Payette County, Idaho

State No.12

Description of Formation*

(Well drilled in entirety in upper Idaho Formation)

230 - 330	Light-gray, silty shale, bentonitic in part.
330 - 340	Light-green siltstone, light-gray silty shale.
340 - 410	Light-gray to greenish-white unclassified subangular quartz sands.
410 - 500	Light-gray arkosic sandstone with sanidine, some bentonitic shale with sandy stringers.
500 - 520	Sandstone, arkosic.
520 - 540	Gray, calcareous siltstone.
540 - 640	Shale, silty, calcareous, some bentonite.
640 - 680	Gray siltstone.
680 - 690	Sandstone, poorly sorted.
690 - 850	Siltstone, arkosic, some tuffaceous and bentonitic material.
850 - 1390	Shale, mainly light gray, silty and tuffaceous, some bentonitic.
1390 - 1440	Shale, light brown.
1440 - 1550	Shale, gray to brown, silty and some slightly calcareous.
1550 - 1630	Siltstone, gray to tan.
1630 - 1640	Gray shale with tuff stringers.
1640 - 1660	Siltstone, gray to tan.
1660 - 1800	Shale, gray to tan, silty and slightly calcareous.
1800 - 1810	Brown siltstone, gray shale, bentonitic and calcareous.
1810 - 1850	Gray-green shale, bentonitic and calcareous.
1850 - 1880	Gray siltstone.
1880 - 2300	Gray-to-green shale, silty, tuffaceous, calcareous.
2300 - 2310	Light-gray and brown shaly siltstone.
2310 - 2450	Gray shale, tuffaceous, silty, calcareous.
2450 - 2660	Light-gray to light-tan tuff, sandy to shaly.
2660 - 2810	Light-gray and brown shale, tuffaceous and calcareous.
2810 - 2960	Light-gray tuff, silty.
2960 - 2970	Light-gray shale, tuffaceous.
2970 - 3010	Light-gray to light-brown tuff.
3010 - 3040	Light-gray siltstone, tuffaceous.
3040 - 3200	Gray-to-brown tuff, shale, and siltstone.
3200 - 3300	Light-gray shale.
3300 - 3320	Light-gray siltstone.
3320 - 3330	Light-gray tuff.
3330 - 3390	Light-gray and tan shale.
3390 - 3430	Gray siltstone, tuffaceous, calcareous.
3430 - 3460	Shale, soft and silty.
3460 - 3521	Light-tan to gray siltstone, tuffaceous.

T.D. is 3521.

*Idaho Bur. Mines - well log.

Assmussen No. 1
Payette County

EL PASO NATURAL GAS COMPANY

Assmussen No. 1

Sec. 8, T. 9 N., R. 3 W.

Descriptions of Well Samples

155 - 410	Sand.
410 - 490	Shale.
490 - 580	Sand.
580 - 615	Shale.
615 - 645	Sand.
645 - 690	Shale.
690 - 980	Sand and interbedded shale.
980 - 1010	Shale.
1010 - 1070	Sand.
1070 - 1160	Shale: With thin interbeds of sand.
1160 - 1210	Sand.
1210 - 1300	Shale.
1300 - 1330	Sand.
1330 - 1350	Shale.
1350 - 1670	Sand: With thinly interbedded shale.
1670 - 1770	Shale: Some sand.
1770 - 1810	Sand: Some shale interbedded.
1810 - 1830	Shale.
1830 - 2300	Sand: With shale interbedded.
2300 - 2400	Shale and interbedded silty sand.
2400 - 2515	Sand: With thin interbeds of shale.
2515 - 2550	Shale.
2550 - 2930	Sand: With thin interbeds of shale.
2930 - 2960	Shale.
2960 - 3040	Sand.
3040 - 3060	Shale.
3060 - 3460	Shale: With thin sand beds.
3460 - 3570	Shale.
3570 - 3725	Sand and interbedded shale.
3725 - 3765	Shale.
3765 - 4017 T.D.	Sand and shale.

BOISE PETROLEUM COMPANY

Well Name ?

Sec. 27, T. 4 N., R. 3 E.

Ada County, Idaho

Descriptions of Well Samples*

Surface - 8	Sand: Soft.
8 - 10	Sand: White
10 - 60	Sand: Gray, soft.
60 - 75	Clay: Brown.
75 - 80	Sand: Gray, soft.
80 - 105	Clay: Brown
105 - 115	Shale: Blue.
115 - 125	Sand: Yellow.
125 - 145	Sandstone: Yellow, hard.
145 - 175	Shale: Brown, sandy.
175 - 227	Sand: Black. Water at 190 feet; rose to 176 feet.
227 - 317	Shale: Blue.
317 - 340	Shale: Slate colored.
340 - 430	Shale: Blue, sandy.
430 - 485	Sand: Gray, soft.
485 - 490	Shale: Blue.
490 - 498	Shale: Green, sandy.
498 - 548	Clay: Green, 2 small pebbles. Water at 544 feet; rose to 330 feet.
548 - 580	Quartz: Black, sandy.
580 - 582	Shale: Black, sticky.
582 - 586	Lime: Black, hard.
586 - 591	Shale: Blue, sticky.
591 - 593	Shale: Black, hard.
593 - 597	Shale: Blue, sticky.
597 - 660	Shale - basalt: Black, hard.
660 - 665	Shale: Red, sticky; water pebbles. 15½-Inch casing landed at 608 feet.
665 - 670	Shale: Brown, sticky.
670 - 672	Lime: Gray, hard.
672 - 673	Shale: Brown.
673 - 675	Lime: Gray; water pebbles. Water rose to 300 feet of surface.
675 - 685	Shale: Gray.
685 - 690	Shale: Black, hard, limy.
690 - 695	Shale: Dark, soft; 2 water pebbles. Water at 695 feet.
695 - 710	Shale: Black, hard, limy.
710 - 715	Shale: Gray; small amount gypsum.
715 - 727	Shale: Black, hard, sandy.
727 - 735	Shale: Red, green, soft.
735 - 740	Shale: Black, hard.
740 - 755	Shale: Gray; black lime.
755 - 757	Shale: Blue, soft.
757 - 760	Lime: Black, hard.
760 - 765	Shale: Blue, muddy.
765 - 770	Shale: Black, hard, limy.
770 - 775	Shale: Gray, dark, broken.

*Idaho Bureau of Mines and Geology.

775 - 790	Shale: Black, gray, coarse.
790 - 805	Shale: Black, colored pebbles.
805 - 870	Sand: Black, hard. Showing of oil; pint or more in boiler in mornings.
870 - 880	Shale: Grayish brown, sticky.
880 - 895	Sand: Gray, soft, dry.
895 - 906	Shale: Green.
906 - 909	Sand: Gray, dry.
909 - 937	Shale: Green, sandy.
937 - 975	Shale: Blue.
975 - 982	Sand: Gray, dry.
982 -1005	Shale: Blue, sandy.
1005 -1010	Shale: Limy, hard.
1010 -1019	Lime - shale: 2 feet soft brake, 2 feet lime shell, 1 foot soft brake and limy shale hard.
1019 -1020	Shale: Green.
1020 -1025	Shell: Hard.
1025 -1030	Shale: Blue.
1030 -1032	Shell: Hard.
1032 -1040	Shale: Blue, muddy.
1040 -1050	Shale: Gray, sandy.
1050 -1070	Shale: Green.
1070 -1090	Shale: Red.
1090 -1092	Sand: All colors.
1092 -1095	Shale: Red; gypsum.
1095 -1100	Shale: Light.
1100 -1120	Shale: Red.
1120 -1182	Shale: Light, sticky.

Boise Petroleum Co.
Ada County, Idaho

1182 - 1184	Shelly.
1184 - 1195	Shale: Gray, sandy.
1195 - 1205	Shale: Red.
1205 - 1220	Sand: Gray, hard. 12⅝-inch casing landed at 1206 feet. Water shut off.
1220 - 1300	? Quartzlike: Very hard blue white, red greenish, black; dries out very light color.
1300 - 1370	Shale: Mostly blue, sandy.
1370 - 1395	Sand: White. Considerable water; ran 10¼-inch casing to water.
1395 - 1397	? Gray, green, and black colors.
1397 - 1415	Sand: Gray, black, green.
1415 - 1425	Shale: Dark, and dark sand.
1425 - 1450	Sands: Light gray.
1450 - 1465	Shale: Black, sandy.
1465 - 1535	Sands: Light gray.
1535 - 1625	Shales: Black, sandy.

May 12, 1939.

CRYSTAL DOME OIL & GAS COMPANY

Daniel 2

Sec. 32, T. 10 N., R. 4 W.

Washington County, Idaho

Descriptions of Well Samples*

0 - 30	Sand: Brown, brown sandy clay.
30 - 70	Sand and clay: Brown.
70 - 90	Sand: Coarse, loses water, have to use mud.
90 - 115	Blank
115 - 160	Blank
160 - 207	Clay: Sandy with hard ribs.
207 - 250	Sand: Brown.
250 - 300	Blank
300 - 325	Sand: Brwon, with hard ribs.
325 - 345	Sand: Hard.
345 - 359	Sand: Does not mix; have to use clay.
359 - 400	Blank
400 - 440	Sand: Brown, with some hard ribs.
440 - 450	Blank
450 - 460	Shale: Blue. Water at 460 (451 feet 3 inches, 21 joints 15½-inch pipe).
460 - 480	Blank: Setting 15½-inch csg.
480 - 510	Blank
510 - 535	Shale: Sandy with hard ribs; very hard.
535 - 575	Shale: Soft.
575 - 580	Shale: Sandy, with hard ribs.
580 - 616	Shale: Sandy, with hard ribs.
616 - 656	Shale: Sandy, with hard ribs.
656 - 692	Shale: Sandy, with hard ribs; black when wet, gray when dry.
692 - 732	Shale: Sandy, with hard ribs; black when wet.
732 - 762	Shale: Gray, soft, sticky.
762 - 800	Shale: Gray.
800 - 830	Shale: Lighter gray, very sticky.
830 - 855	Shale: Gray, sticky.
855 - 885	Shale: Gray, sticky.
885 - 915	Shale: Gray, soft.
915 - 933	Shale: Gray, soft.
933 - 966	Shale: Gray, soft to 950 (950 to 966, shale, green). Pulled 20-inch csg at 966; ran cement in hole 7/21/30 (8 sacks). 7/26/30 ran one joint 15½-inch csg. Cleaned out hole and cement was not set. 7/27/30 cleaned out. Csg will not harden, formation too soft. 8/5/30 set 15½-inch csg on bottom; 8/8/30 got 10-inch csg on bottom.
966 - 961	Blank: 8/10/30.
981 - 1017	Shale: Gray, with hard ribs.
1017 - 1047	Shale: Sticky; will not mix with water.
1047 - 1092	Shale: Light, sticky.
1092 - 1132	Shale: Gray, sticky.
1132 - 1163	Shale: Gray, sticky.
1163 - 1193	Shale: Sticky.
1193 - 1213	Shale: Sticky. Tools drive and stick, bailer does not want to follow, mud balls stick on walls. Using brick in hole.
1213 - 1250	Shale: Very sticky.
1250 - 1275	Shale: Gray, sticky.
1275 - 1305	Shale: Gray with white streaks, sticky.

*Idaho Bureau of Mines and Geology.

1305 - 1330	Shale: Gray, does not mix with water.
1330 - 1355	Shale: Gray.
1355 - 1410	Shale: Gray.
1410 - 1430	Shale: Lighter gray. Gas makes warts on mud bit.
1430 - 1450	Shale: Light gray; very sticky.
1450 - 1470	Shale: Gray.
1470 - 1500	Shale: Gray; very sticky. Tools mudded up; had to jar them loose.
1500 - 1530	Shale: Gray. 10-inch csg will not go any more.
1530 - 1550	Shale: Gray. 10-inch csg will not go without under-reaming.
1550 - 1570	Shale: Gray. Caving bailed hole to 680 feet.
1570 - 1580	Shale: Gray. Omitted one run 6 feet but stuck bad. Drilled one more run, had considerable gas. Afraid gas will blow. 9/3/30 filled hole with water. Pulled 10-inch pipe loose, bailed hole. Lots of gas at 1530; need 10-inch pipe; afraid gas will blow, 9/4/30. Lots of gas 9/5/30. Runned 55 feet 9/6/30.
1580 - 1582	Sand: Brown, and light-gray shale. Put 10 inch to 1582 feet. Some gas.
1582 - 1600	Blank (9/12/30): 9/13/30, caving bad. Put 8-inch casing on bottom.
1600 - 1640	Shale: Light gray. Some black gas sand (9/16/30). 9/17/30, reclaiming 8 inches.
1640 - 1670	Shale: Light gray. Gas.
1670 - 1705	Casing will not go, 9/19/30. Filled hole with water 9/30/30. Freed casing.
1705 - 1729	Shale: Gray; small amount sand.
1729 - 1735	Probably a correction.
1735 - 1755	Shale: Gray.
1755 - 1775	Shale: Gray. Some gas tools sticking.
1775 - 1800	Shale: Light gray; small amount sand.

1800 - 1825	Shale: Light gray. Some gas.
1825 - 1845	Shale: Gray.
1845 - 1865	Struck gas at 1865, 9/28/30. Put on control. Head, making plenty of gas. Looks real well. H.H.Day shift.
9/29/30	- pressure still up.
10/2/30	- set bra. head on 10-inch pipe.
10/5/30	- ran 2-inch line to top of rig. Put on 2 x U for volume test.
10/6/30	- released pressure; put on 2-inch nipple. Wind wrong direction, afraid to back out.
10/9/30	- 600-foot water in hole bailer lacked 60 feet going to bottom. Gas strong as ever.
10/13/30	- gas as strong as ever.
10/24/30	- gas as strong as ever.

OROCO OIL AND GAS COMPANY

E. W. Pauley

T. B. Carr 1

Sec. 15, T. 11 N., R. 5 W.

Washington County, Idaho

Descriptions of Well Samples*

0 - 93	Shale
93 - 620	Shale and sand
630 - 645	Hard black basalt
645 - 670	Black volcanic basalt
670 - 710	Feldspars and basalt, igneous and volcanic
710 - 730	Sand
730 - 800	Pyrite and shale
800 - 900	Pyrite, shale, and mica
900 - 960	Volcanic ash, igneous wash, quartz grains
960 - 1040	Hard black volcanics
1040 - 1080	Red volcanics
1080 - 1100	Black basalt with bright green xenoliths
1100 - 1120	Quartz
1120 - 1140	Black volcanics
1140 - 1160	Red volcanics and black volcanics, green xenoliths
1160 - 1190	Black basalt and green xenoliths
1190 - 1206	Red volcanics and black basalt
1206 - 1290	Volcanic ash, black basalt, and quartz crystals
1290 - 1330	Trace pyrite, soft, gray volcanic ash with trace of quartz crystals
1330 - 2320	Volcanics, purple, red, green, and gray q/ show of quartz crystals.

*Idaho bureau of Mines and Geology.

BAKER AND MALHEUR OIL COMPANY

Well 2

Sec. 29, T. 19 S., R. 45 E.

Malheur County, Oregon

Descriptions of Well Samples*

0 - 10	Dirt.
10 - 32	Shale: Gray, soft.
32 - 40	Conglomerate: Hard.
40 - 42	Sand: Sharp.
42 - 130	Sand: Fine, brown, or soft sandstone, with scattered pebbles as large as beans in lower part.
130 - 147	Shale: Rather hard.
147 - 162	Sand: Brown, sharp, with some gas, "greasy odor."
162 - 182	Shale: Blue, with a few thin strata of conglomerate.
182 - 192	Clay: "Blue gumbo," hard to drill, as it would not mix with water.
192 - 203	Shale: Blue, sandy, some water.
203 - 277	Shale: Blue, with much "gumbo."
277 - 290	Sand: With very hot water, rising 60 feet in the hole.
290 - 320	Shale: Blue, hard.

Depth on August 13, 1909.

*Washburne, C. W., Gas and Oil Prospects near Vale, Oregon, and Payette, Idaho: U.S. Geol. Survey Bull. 431-A, p. 42, 1911.

EASTERN OREGON OIL COMPANY

Well No. 1

Sec. 12, T. 20 S., R. 45 E.

Malheur County, Oregon

Description of Well Samples

0 - 50	Sandstone: Brown.
50 - 85	Conglomerate: Pebble.
85 - 95	Sandstone: Yellow.
95 - 105	Conglomerate.
105 - 110	Sandstone: Yellow.
110 - 160	Sandstone: Blue.
160 - 250	Clay: Blue.
250 - 335	Sandstone: Dark blue. Gas at top; trace of of oil below.

Well was still being drilled at the time C. W. Washburne visited it in October 1909. A flow of oil was reported after Washburne's visit but was not confirmed.

Ref: Washburne, C.W., 1911, Gas and Oil near Vale, Oregon and Payette, Idaho: U.S. Geol. Survey Bull. 431, Pt II.

EL PASO NATURAL GAS COMPANY

Fed-Spurrier 1

February 6, 1963

Sec. 5, T. 20 S., R. 44 E.

Malheur County, Oregon

Descriptions of Well Samples*

230 - 240	Shale and bentonite: Light gray - greenish, silty to fine sandy.
240 - 260	Agglomerate (?)
260 - 280	Shale and bentonite: Light gray, silty.
280 - 290	Agglomerate (?)
290 - 300	Shale: Light gray, sandy.
300 - 340	Basalt (?): Slightly altered, dark gray - black, with small irregular cavities containing opal and calcite.
340 - 360	Tuffaceous sandstone: Whitish, calcareous, friable, medium grained, with partly altered feldspar grains.
360 - 400	Crystal tuff: Whitish, firm calcareous vitric ash, with fragments of feldspar and pyroxene (?) crystals.
400 - 410	Vitric tuff and tuffaceous siltstone: Pinkish and white with scattered small fragments of black crystals.
410 - 450	Andesite (?): Medium gray, vesicular. Some thin interbeds of ash.
450 - 710	Basalt: Dark gray, with calcite veining and cavity filling. Some quartz filling, microcrystalline. Some black, more dense basalt near base. A few interbeds of light-colored ash.
710 - 740	Rhyolite (?): Dark pinkish gray, small quartz-filled cavities, also some calcite filling.
740 - 750	Claystone: Pinkish - red, baked.
750 - 843	Claystone: Pinkish and whitish.

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*By V.C.Newton, Jr., Petroleum Engineer, State of Oregon Department of Geology and Mineral Industries.

843 - 900	Basalt: Brownish black, microcrystalline, top portion medium-gray color. Calcite veining and cavity filling.
900 - 930	Ash: Pink and whitish.
930 - 945	Basalt: Brownish black, partly altered with calcite.
945 - 960	Ash: Whitish with minute black crystal fragments.
960 - 990	Basalt: Brownish black, microcrystalline with some calcite veining.
990 - 1030	Rhyolite (?): Reddish with milky-white veinlets of quartz and calcite. Some zeolite in small cavities. Medium-gray basalt at bottom.
1030 - 1070	Varied colored ash
1070 - 1110	Basalt: Pinkish dark gray with some calcite and zeolite.
1110 - 1240	Tuffaceous siltstone: Whitish and pinkish, with a few small pieces of chalcedony.
1240 - 1280	Basalt: Dark gray, somewhat altered. Contains greenish zeolite in small cavities, some calcite. Some chloritization.
1280 - 1310	Basalt: Dark brownish black, hard, microcrystalline.
1310 - 1330	Tuff: Fine, varied colored, firm.
1330 - 1345	Sandstone: Whitish, friable, very fine grained, containing a few small subrounded basalt fragments. Some claystone stringers included.
1345 - 1375	Siltstone: White, friable.
1375 - 1410	Rhyolite (?): Pinkish gray, with veinlets of milky-white quartz. Some dark-brownish basalt in lower portion.
1410 - 1425	Tuff: Whitish and pink, firm.
1425 - 1438	Rhyolite (?): Pinkish gray with veinlets of milky-white quartz.
1438 - 1460	Tuff: Grayish white and pink, firm to soft.
1460 - 1472	Basalt: Dark grayish black, hard, fine grained with zeolite-filled cavities.
1472 - 1483	Tuff: Pink and white, firm to soft.

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1483 - 1490	Basalt: Black, hard, fine grained.
1490 - 1580	Tuff: Pink and white, firm to soft.
1580 - 1620	Rhyolite (?): Grayish pink with wavy veinlets of milky-white quartz, some calcite, zeolite, and chlorite.
1620 - 1660	Tuffaceous siltstone: Pinkish, whitish, and light gray. Whitish siltstone is partially altered to clay.
1660 - 1740	Basalt: Brownish black, hard, fine grained. Lower portion somewhat chloritized.
1740 - 1770	Basalt: Dark pinkish gray, hard, microcrystalline, slightly altered.
1770 - 1785	Tuff: Pinkish and white with some light-green claystone and white ash.
1785 - 1820	Basalt: Dark grayish black, hard, fine grained, with some calcite and chlorite.
1820 - 1848	Tuff: White and pink, firm with some white claystone.
1848 - 1854	Sandstone: Whitish, firm to friable, very fine grained.
1854 - 1880	Tuff: White and pink as above.
1880 - 1890	Crystal tuff: White, very fine, firm.
1890 - 1985	Tuff: Grayish white and pink, firm, thin interbeds of black carbonaceous shale, few thin stringers of whitish, firm, very fine-grained sandstone with clayey matrix.
1985 - 1990	Welded tuff (?): Pinkish gray, hard, cemented, siliceous, contains some calcite.
1990 - 2080	Tuff: Pink and light brown, firm, some interbedded brown shale. Some thin beds of black carbonaceous shale containing black shiny coal.
2080 - 2095	Sandstone: White, firm, very fine grained, feldspathic.
2095 - 2108	Siltstone: Grayish white and light green, firm, with some grayish-white limestone containing pyrite. Also some thin layers of black carbonaceous shale.
2108 - 2147	Sandstone: Grayish white, firm, very fine grained, partially cemented, containing some pyrite.

2147 - 2155 Tuff: Whitish, green and pink, firm, with interbeds of grayish-black fissile shale.

2155 - 2175 Limestone: Grayish white, firm, hard, with light-colored interbeds of siltstone and fine, friable sandstone.

2175 - 2200 Basalt: Reddish gray, partially altered with quartz filling cavities.

2200 - 2240 Tuff: White, pink and light gray, friable and grayish-black shale with thin streaks of coal. Also a small amount of limestone.

2240 - 2250 Coal: Black, thinly laminated, shaly.

2250 - 2267 Limestone: Grayish white, hard to firm.

2267 - 2278 Tuff: Pink, red, green, and white. Firm.

2278 - 2295 Sandstone: Medium gray, friable, fine grained.

2295 - 2305 Tuffaceous siltstone: White, green and gray, firm to friable, and shaly black brittle coal. Thin bed of coarse sandy limestone in this section.

2305 - 2320 Sandstone: Whitish light green, friable, coarse, subangular, composed of fragments of limestone, siltstone, and altered volcanic rock in a silty matrix. Some interbedded grayish-white, fine-grained, firm to friable silty sandstone containing carbonaceous material.

2320 - 2430 Tuffaceous siltstone: Medium gray and light green, friable, containing small fragments of black carbonaceous material and interbedded with coarse sandstone above.

2430 - 2510 Rhyolite: Dark pinkish gray and reddish gray, some partially altered and having quartz-lined cavities. Thin layers of baked clay and interbeds of varied colored siltstones.

2510 - 2520 Sandstone: Whitish, fine, subrounded feldspathic. Slight gas show on analyzer (Rotary Engineering - Well Logging Service).

2520 - 2555 Tuff fine: White, pink and light gray, friable to firm, containing some thin layers of black shaly coal.

2555 - 2560 Welded tuff (?): Pinkish dark gray, hard.

2560 - 2570 Sandstone: White, friable to loose, coarse silty, composed of feldspar, quartz and rock fragments. Fair show on gas analyzer.

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2570 - 2610 Siltstone: Dark to medium gray, friable, containing small splintery fragments of black carbonaceous material and some black shale. Also a small amount of light-gray, fine- to medium-grained, quartz sandstone. Gamma Ray - Neutron indicates possible gas zone. Fair show on analyzer.

2610 - 2645 Tuffaceous siltstone: White and light greenish gray, friable with interbeds of white, fine, hard, cemented quartz sandstone. Show on analyzer.

2645 - 2660 Siltstone: White, fine sandy, friable, with many slivers of white shell (?) fragments; some fine-grained, loose sand intermixed. Also thin layers of black shale.

2660 - 2675 Shale: Black, brittle and shaly, fissile coal.

2675 - 2720 Siltstone: White to medium-gray, very fine sandy, friable, and fine silty sandstone.

2720 - 2815 Shale: Grayish-black, and medium-gray, friable to firm siltstone with splinters of black carbonaceous material. Small amount of coal. Some silty sandstone in lower section. Fair gas show on analyzer.

2815 - 2890 Shale: Black, fissile with thin layers of coal and occasional layers of interbedded medium-grained, firm to hard, silty, feldspathic sandstone.

2890 - 2955 Sandstone: White, firm to hard, medium grained, feldspathic, cemented with lime.

2955 - 2970 Tuffaceous siltstone: Light gray and green, firm.

2970 - 2990 Welded tuff (?): Medium gray, containing large fragments of feldspar crystals.

2990 - 3050 Siltstone: Light gray, green and tan, firm, and dark gray, firm siltstone containing fragments of carbonaceous material. Some thin layers of black shale and coal.

3050 - 3085 Tuffaceous siltstone: Light gray and green, firm, and fine sandy siltstone.

3085 - 3090 Siltstone: Medium to dark gray, firm to hard, with small pieces of black carbonaceous material and thin layers of coal.

3090 - 3110 Welded tuff (?): Pinkish, grayish black, hard.

3110 - 3310	Tuff fine: Light gray and pink, firm, with interbedded thin layers of dark-gray shale and coal. Good gas show on analyzer 3220 - 3260.
3310 - 3330	Welded tuff (?)
3330 - 3410	Tuff: As above.
3410 - 3440	Shale: Medium gray, firm with scattered small fragments of carbonaceous material, some black shaly coal.
3440 - 3450	Sand: Medium gray, friable, fine grained containing coarse subrounded grains of black shale. Slight gas show on analyzer.
3450 - 3505	Sand: Tan, friable, medium to fine grained; interbeds of grayish-black shale and medium-gray shale with thin layers of coal.
3505 - 3568	Tuffaceous siltstone: Light gray and green, firm.
3568 - 3577	Sandstone: White, firm to hard, medium to coarse grained, feldspathic, cemented with lime.
3577 - 3599	Tuffaceous siltstone: As above.

Core No. 1 (3598 - 3632)

3598 - 3599	Shale: Light gray, soft bentonite.
3599 - 3600	Siltstone: Light gray, very sandy, micaceous, soft.
3600 - 3601	Sandstone: Light green, speckled with small black mineral fragments, fine-grained, silty friable, subangular grains.
3601 - 3602	Shale: Light gray, soft sandy.
3602 - 3603	Sandstone: Light gray, silty, fine grained, partially cemented, micaceous.
3603 - 3604	Siltstone: Medium hard, very sandy, inclusions of quartz and shale.
3604 - 3607	Siltstone: Gray, dense, micaceous.
3607 - 3608	Sandstone: Light gray, fine grained, silty, subrounded, micaceous, poorly sorted.
3608 - 3610	Sandstone: White, medium grained, hard, well cemented, subangular, micaceous.
3610 - 3613	Siltstone: Dark gray, carbonaceous inclusions, micaceous.

3613 - 3614	Siltstone: Light gray, carbonaceous streaks, micaceous, sandy.
3614 - 3615	Sandstone: Speckled with minute fragments of black minerals, calcareous, medium hard, micaceous, poorly sorted.
3615 - 3616	Sandstone: As above but harder.
3616 - 3632	No recovery. Gas zone indicated on Gamma Ray - Neutron log (3610 - 3618). Slight gas show on analyzer.
3632 - 3643	Shale: Light gray, firm, silty.
3643 - 3730	Sandstone: Light gray, friable, medium to coarse grained, subrounded and interbeds of light gray hard siltstone.
3730 - 3840	Crystal tuff, fine: White, hard, very fine, vitric with partially altered feldspar.
3840 - 3890	Siltstone: Medium gray, firm to hard, with some laminae of black soft carbonaceous material and coal.
3890 - 3895	Shale: Medium gray to dark gray, firm.
3895 - 3910	Sandstone: Grayish white, firm to hard, medium grained, subangular, feldspathic, cemented with lime.
3910 - 3950	Crystal tuff, fine: White, hard, very fine grained, silicified.
3950 - 3965	Sandstone: White, friable, medium grained, subangular, feldspathic. Feldspar partially altered.
3965 - 3970	Shale: White, limy, firm.
3970 - 4000	Sand: White, loose, coarse grained, subangular, feldspathic.
4000 - 4035	Siltstone: Light gray, firm.
4035 - 4060	Sandstone: White, firm, medium grained, subangular, cemented with lime and scattered fragments of partially altered pyroxene (?).
4060 - 4070	Sand: White, loose, subangular, feldspathic.
4070 - 4095	Shale: Medium gray, brittle, silty with some black carbonaceous streaks.

4095 - 4145	Sandstone: White, firm to friable, medium grained, angular, partially cemented with lime and scattered small fragments of dark minerals.
4145 - 4150	Siltstone: Medium to darkish gray and grayish tan, firm to brittle.
4150 - 4260	Sandstone: Dark gray, fine grained, silty, speckled with minute fragments of dark minerals.
4260 - 4370	Siltstone and shale: Dark gray, firm.
4370 - 4435	Crystal tuff, fine: White, fine grained, silicified, underlain by white fine- to medium-grained, subangular, partially lime-cemented sandstone. Many small black mineral fragments in the sandstone.
4435 - 4440	Shale: Dark grayish black, firm, with thin layers of coal.
4440 - 4460	Sandstone: Medium gray, hard, fine silty with scattered medium-sized grains of feldspar and quartz.
4460 - 4470	Siltstone and shale: Medium gray to grayish black, firm with thin layers of black carbonaceous material.
4470 - 4515	Sandstone: Medium to dark gray, firm, fine grained, containing thin layers of carbonaceous material and a little coal.
4515 - 4530	Shale: Medium gray, firm.
4530 - 4582	Sandstone: Light to medium gray, firm, fine silty, feldspathic, with thin layers of coal.
4582 - 4805	Siltstone: Medium to light gray, firm, sandy grading to fine sand and interbedded with grayish-black, firm shale. Some coal.
4805 - 4915	Diorite - gabbro (?): Medium to dark gray, fine-grained, feldspar and hornblende crystals. Some metallic sulphide mineralization. Interbedded medium-gray siltstone and fine sandstone.
4915 - 4980	Andesite (?): Medium gray, fine grained, hard.
4980 - 5010	Siltstone: Medium to light gray, firm with some black carbonaceous material.
5010 - 5065	Tuff, fine: Light gray, greenish and pink, firm. Greenish siltstone partially altered to clay.

El Paso, Malheur County

5065 - 5085	Sandstone: Whitish light gray, firm to friable, very fine grained, silty. Slight gas show on analyzer.
5085 - 5095	Shale: Medium to dark gray, firm to brittle, with pieces of black carbonaceous material.
5095 - 5135	Andesite (?): Light gray, firm to hard, partially altered with small areas of metallic sulphide mineralization.
5135 - 5150	Shale: Medium gray, firm.
5150 - 5170	Gabbro - diorite (?): Dark gray, microcrystalline, feldspar and hornblende.
5170 - 5190	Tuffaceous siltstone: Light gray and green, firm; green siltstone partially altered to clay. Interbeds of medium- to dark-gray silty shale.
5190 - 5240	Tuffaceous siltstone and shale: As above.
5240 - 5340	Gabbro - diorite: Medium dark gray, hard, fine crystalline. Few interbeds of sandy siltstone.
5340 - 5450	Tuffaceous siltstone: Light gray, tan, and green, firm and thin beds of black shale with some coal. Green siltstone partially altered to clay.
5450 - 5580	Siltstone and sandstone: White, hard, silty to silty medium grained, feldspathic, partially cemented.
5580 - 5650	Tuffaceous siltstone: Whitish, pink and medium to dark gray, firm with thin beds of gray, very fine-grained sandstone speckled with minute fragments of black crystals. Some thin layers of brittle black shale.
5650 - 5660	Tuffaceous sandstone: Medium to dark gray, hard, fine to medium grained, silicified, with slightly altered feldspar.
5660 - 5740	Shale: Grayish black, firm, silty.
5740 - 5745	Siltstone: Light gray and tan, firm, containing some friable layers of fine sandstone.
5745 - 5805	Shale: Grayish black, firm, and medium-gray, fine sandy siltstone with small fragments of carbonaceous material. Some coal.
5805 - 5850	Tuffaceous siltstone: Gray, green and white, firm siltstone with layers of fine sandy siltstone and gray, hard, fine-grained sandstone speckled with minute fragments of black crystals.

5850 - 5945	Sandstone: Grayish white, firm, fine silty to silty medium grained, feldspathic.
5945 - 6055	Shale: Grayish black, firm, silty, with medium-gray siltstone containing small irregular pieces of black carbonaceous matter. Some thin beds of gray, fine silty sandstone speckled with very small fragments of black crystals. A small amount of coal in the shale.
6055 - 6080	Sandstone: Medium gray, hard, medium grained, subrounded, well cemented.
6080 - 6090	Siltstone: Medium gray to grayish black, fine sandy, firm.
6090 - 6195	Sand: Light grayish white, loose, coarse grained, angular feldspathic with pieces of dark volcanic rock.
6195 - 6212	Siltstone: Light gray, firm and medium-gray to dark-gray, firm shale.
6212 - 6230	Sand: White, loose, coarse grained, angular, feldspathic with scattered weathered mica plates. Becomes more indurated toward bottom.
6230 - 6240	Shale: Dark gray, firm, silty with laminae of black carbonaceous material. Some fine-grained silty, firm sandstone interbedded.
6240 - 6265	Sandstone: Whitish , medium- to coarse-grained, friable, some weathered, sandstone composed of quartz and feldspar.
6265 - 6280	Sandstone: Whitish, medium to coarse grained, fairly well cemented, firm, with some pyrite.
6280 - 6500	Sandstone: Medium gray, hard, fine silty, calcareous, cemented, feldspathic sandstone. Some finely disseminated pyrite in portions.
6500 - 6535	Shale: Dark gray-black, silty, some fine silty sandstone interbedded.
6535 - 6550	Sandstone: Medium greenish-gray, hard, cemented sandstone, siliceous. Some pyrite.
6550 - 6565	Shale: Medium-gray to grayish black, silty-to-fine, sandy shale.
6565 - 6570	Sandstone: White, coarse, soft, with angular grains of quartz and feldspar.

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6570 - 6990	Altered rhyolite (?): White, calcareous, firm to very firm. Areas of finely disseminated pyrite. Becomes less limy with depth. Core No. 2 (6854-6864), rhyolite - light gray, inclusions of quartz and sanadine.
6990 - 7060	Andesite: Medium dark gray, hard. Core No. 3 (7053 - 7056), andesite - above.
7060 - 7340	Rhyolite: White, partly altered, firm to very firm. Occasional thin interbeds of fine micaceous sandstone and siltstone.
7340 - 7355	Andesite: Medium greenish gray, hard.
7355 - 7460 T.D.	Rhyolite: Partly altered, small patches of chlorite and finely disseminated pyrite. Mineralization appears to increase with depth.

MALHEUR OIL COMPANY

Well No. 1

Sec. 31, T. 19 S., R. 44 E.

Malheur County, Oregon

Descriptions of Well Samples

0 - 40	Clay: Yellow.
40 - 85	Clay: Blue.
85 - 115	Sand: Dry.
115 - 122	Shale: Black.
122 - 130	Sand: Trace of oil and gas.
130 - 138	Shale: White.
138 - 140	Clay: Blue.
140 - 280	Sand: With traces of oil.
280 - 292	Clay: Blue.
292 - 314	Sand: With traces of oil.
314 - 319	Clay: Brown.
319 - 325	Shale: Gray.
325 - 400	Conglomerate: With artesian water.
400 - 405	Basalt.
405 - 445	Clay: Red.
445 - 453	Basalt.
453 - 495	Clay: Red.
495 - 507	Conglomerate.
507 - 595	Conglomerate: Red.
595 - 687	Clay: Variegated colors; firm, soapy.
687 - 702	Shale: Blue.
702 - 735	Basalt: Vesicular.
735 - 741	Clay: Chocolate and red colors.
741 - 750	Shale: Blue.
750 - 760	Basalt: Very hard.
760 - 767	Conglomerate: Soft.
767 - 768	Limestone.
768 - 901	Boulders of igneous rock and clay.
901 - 946	Basalt: Very hard.
946 - 951	Clay: Dark brown.
951 - 1036	Shale: Light colored.
1036 - 1038	Conglomerate: Fine.
1038 - 1051	Sand: Gray; fragments of bones; trace of oil.
1051 - 1057	Sand: Coarse.
1057 - 1061	Shale: Blue.
1061 - 1261	Diabase lava: Partly decomposed; locally miscalled "dolomite."
1261 - 1311	Shale: White; probably volcanic ash.
1311 - 1361	Shale: Tough, blue, with show of oil.
1361 - 1506 T.D.	Shale: White, gritty; probably volcanic ash.

Washburne, C.W., 1911, Gas and Oil near Vale, Oregon and Payette, Idaho: U.S. Geol. Survey Bull. 431, pt. II, p. 42-43.

MAMMOTH OIL AND GAS COMPANY

Well No. 1

Sec. 6, T. 20 S., R. 45 E.

Descriptions of Well Samples

0 - 8	Soil.
8 - 16	Sandstone.
16 - 20	Sand: Light gray.
20 - 34	Shale: Gray, hard at base.
34 - 58	Sandstone: Dark gray.
58 - 73	Sand: Gray; trace of oil and gas.
73 - 143	Clay: Blue, tough, sticky.
143 - 152	Gravel: Coarse; pebbles ½ inch to 2 inches in diameter.
152 - 161	Gravel: Fine; and clay, with gas.
161 - 183	Shale: Blue.
183 - 193	Gravel: Fine, with water which rose 30 feet in well.
193 - 314	Clay: Compact, tough, blue, hard layer at base.
314 - 326	Shale: Light gray.
326 - 366	Shale: In alternating hard and soft layers.
366 - 371	Sandstone: Marly, fossiliferous.
371 - 383	Shale: Light gray.
383 - 397	Sandstone: Gray, hard, fine grained.
397 - 407	Shale: Dark, laminated.
407 - 411	Sandstone: With fossil Unio.
411 - 431	Clay: Gray.
431 - 437	Sand: Fine grained, with water.
437 - 461	Gravel and clay.
461 - 491	Shale: Hard, dry, gray.
491 - 501	Clay: Blue, tough.
501 - 513	Sand: With water.
513 - 525	Shale: Light blue.
525 - 533	Clay: Dark blue, tough ("gumbo").
533 - 543	Clay: Blue.
543 - 548	Sand: With gravel; trace of oil and gas.
548 - 558	Shale: Gray.
558 - 564	Sandstone: Gray; some gas.
564 - 584	Shale: Blue.
584 - 590	Sand: Coarse.
590 - 614	Shale: Light blue.
614 - 677	Sand: Dark gray; trace of oil.
677 - 697	Clay and sand: Hard at base.
697 - 717	Shale: Gray.
717 - 729	Clay: Blue, tough ("gumbo").
729 - 774	Shale: Green, soft, hard at base.
774 - 784	Clay: Light gray.
784 - 794	Clay: Blue.
794 - 884	Clay: Tough, blue, sticky, with "oil colors".
884 - 909	Shale: Blue.
909 - 921	Shale: Gray.
921 - 933	Gravel: Fine, pebbles 1/16 to 1/4 inch; trace of oil.
933 - 951	Clay: Blue, hard at base.
951 - 961	Sand and clay.
961 - 991	Clay: Blue, tough.

Mammoth Oil & Gas Co.
Well 1, Malheur County

991 - 1010	Shale: Blue.
1010 - 1015	Clay: Black.
1015 - 1020	Shale: Laminated.
1020 - 1025	Clay: Blue.
1025 - 1035	Shale: Light gray.
1035 - 1045	Limestone: Impure, argillaceous.
1045 - 1080	Limestone and shale: Alternating light and dark.
1080 - 1140 T.D.	Clay: Blue.

Washburne, C. W., 1911, Gas and Oil near Vale, Oregon and Payette, Idaho: U.S. Geol. Survey Bull. 431, Pt. II, p. 44.

ONTARIO COOPERATIVE GAS AND OIL COMPANY

Well No. 1

Sec. 9, T. 18 S., R. 47 E.

Malheur County, Oregon

Descriptions of Well Samples

0 - 8	Soil: Black, sandy.
8 - 24	Sand and coarse gravel: With water.
24 - 91	Clay: Blue, soft.
91 - 101	Sand: With much water.
101 - 155	Shale: Sandy.
155 - 156	Hard "shell."
156 - 636	Shale: Blue.
636 - 706	Shale: Blue, gas.
706 - 711	Shale: With some gas.
711 - 836	Shale: Blue.
836 - 837	Hard "shell."
837 - 846	Shale: With trace of oil.
846 - 878	Shale: Blue.
878 - 880	Hard "shell."
880 - 968	Shale.
968 - 982	Sand: With gas under high pressure.
982 - 986	Shale.
986 - 993	Sand.
993 - 1058	Shale.
1058 - 1066	Sand: With gas under very high pressure.
1066 - 1198	Shale.
1198 - 1199	Hard "shell."
1199 - 1219	Shale.

Ontario Cooperative O&GCO.
Well. 1, Malheur County

1219 - 1220	Hard "shell."
1220 - 1223	Shale.
1223 - 1226	Hard "shell."
1226 - 1304	Shale.
1304 - 1305	Hard "shell."
1305 - 1596	Shale and sand.
1596 - 1676	Shale: Brown.
1676 - 1696	Shale: Sandy.
1696 - 1781	Shale: Blue.
1781 - 1786	Hard "shell."
1786 - 1896	Shale: Brown.
1896 - 1996	Shale: With a little gas.
1996 - 2146	Shale: Blue.
2146 - 2156	Shale: Blue, with gravel.
2156 - 2199	Shale: Sandy.
2199 - 2200	Sand: With trace of oil and much gas under high pressure.
2200 - 2476	Shale: Soft.
2476 - 2506	Shale: Hard.
2506 - 2671	Shale: Blue.
2671 - 2836	Shale: Blue, mixed with small pebbles of black chert.
2836 - 2886	Shale: Hard, brittle.
2886 - 3006	Shale: Soft, blue.
3006 - 3026	Shale: Hard.
3026 - 3106	Shale: Dark.
3106 - 3331	Shale: Blue.
3331 - 3401	Shale: Dark, hard.

Ontario Cooperative O&G Co.
Well 1, Malheur County.

3401 - 3466	Shale: Blue.
3466 - 3507	Shale: Dark, hard.
3507 - 3567	Shale: Dark, blue.
3567 - 3596	Shale: Dark, hard.
3596 - 3650 T.D.	Shale: Blue.

Washburne, C.W., 1911, Gas and Oil near Vale, Oregon and Payette, Idaho: U.S. Geol. Survey Bull. 431, pt. II, p. 41.

OROCO OIL AND GAS COMPANY

Bolles No. 1

Sec. 15, T. 17 S., R. 47 E.

Malheur County, Oregon

Descriptions of Well Samples

0 - 70	Gravel.
70 - 110	Gravel and shale.
110 - 709	Shale.
709 - 1077	Shale.
1077 - 1170	Sand and shale: Formation test (1082-1087); yielded gassy water.
1170 - 1966 T.D.	Shale.

November 5, 1962

OROCO OIL AND GAS COMPANY

McBride No. 1

Sec. 19, T. 16 S., R. 46 E.

Malheur County, Oregon

Descriptions of Well Samples*

0 - 500	Sandstone: Whitish, very fine silty, calcareous, friable, partly tuffaceous and medium-gray, firm siltstone interbedded.
500 - 1845	Shale and siltstone: Light gray, firm, calcareous layers, occasional laminae of black carbonaceous material, some gypsum, some finely micaceous siltstone, some fine tuffaceous siltstone. Gas shows 1260 to 1510. Lost circulation at 1022 and 1260 feet.
1845 - 1965	Tuff (?): Medium greenish gray, hard, cut by many small veins of white fibrous zeolite. Some interbedded, firm siltstone containing pyrite, some pyrite in the welded tuff. Some chlorite. Gas shows 1845 to 1860 feet. Lost circulation at 1810 feet.
1965 - 2115	Siltstone and silty tuff: Firm to hard, some pyrite.
2115 - 2280	Basalt: Dark pinkish gray and greenish, altered, with considerable amount of zeolite, some pyrite, firm to hard. Occasional bed of brick-red claystone. Portions contain a great deal of chlorite. Interbedded light-gray, firm shale and siltstone. Gas shows 2220 to 2330 feet.
2280 - 2342	Basalt: Black, hard, unaltered basalt.
2342 - 2410	Siltstone: Light gray, firm, some fine scattered mica flakes, few scattered medium grains of quartz. Lost circulation at 2381 feet.
2410 - 2960	Basalt: Medium gray to dark grayish-black, partly altered basalt, some zeolite and pyrite, a small amount of calcite. Interbedded light-gray, firm shale and siltstone. Gas shows 2585 to 2760 feet. Lost circulation 2380, 2700 to 2760.
2960 - 3000	Shale: Light gray, silty, fine.

*By V.C.Newton, Jr., Petroleum Engineer, State of Oregon Department of Geology and Mineral Industries.

McBride No. 1
Malheur County

3000 - 3548	Basalt: Medium gray to grayish dull black, with zeolite, partly altered, firm to hard, with numerous interbeds of light- to medium-gray shale and siltstone. Lost circulation 3380, 3520.
3548 - 4065	Basalt: Grayish black, hard, dense, microcrystalline; some zeolite and quartz veining. Some interbeds of gray shale and red claystone.
4065 - 4293	Basalt: Dull black, partly altered, zeolite, firm to hard. Some interbeds of siltstone.
4293 - 4376	Shale and siltstone: Light to medium gray, firm to hard with some intercalated weathered grayish-black zeolitized basalt.
4376 - 4392	Cored - Basalt: Medium to dark gray, altered, firm to soft basalt cut by many criss-crossing veinlets of zeolite; some calcite.
4392 - 4506	Basalt: As above.

H. K. RIDDLE

Kiesal Estate No. 1

March 14, 1962

Sec. 8, T. 19 S., R. 47 E.

Malheur County, Oregon

Descriptions of Well Samples*

130 - 150	Crystal ash: Grayish white, hard, very fine, partially cemented with silica.
150 - 180	Tuffaceous sandstone: Grayish white, fine to medium grained, hard, partially cemented with silica and lime. Contains a layer of conglomerate sandstone composed of dark chert pebbles and pieces of white, fine volcanic ash.
180 - 190	Siltstone: firm.
190 - 240	Sandstone: Grayish white, firm to very friable, fine grained, with coarse fragments of subrounded black chert and medium-sized quartz grains. Slightly calcareous. Some fine magnetite crystals.
240 - 330	Siltstone: Light gray, firm, fine sandy, with scattered coarse subrounded fragments of black chert and medium-sized quartz grains. Slightly calcareous. Very small gas show in mud.
330 - 905	Tuffaceous siltstone - Shale: Light gray, firm, slightly calcareous. Occasional small pieces of chert, white ash, and quartz. Gas analyzer recorded 41 units (516 - 520).
905 - 935	Tuffaceous sandstone: Light gray, friable, fine silty, feldspathic with fine pieces of dark rock and volcanic glass. Gas shows on analyzer (Rotary Engineering Company - Well Logging Service).
935 - 1145	Siltstone: Light gray, firm to brittle, some laminated shaly portions.
1145 - 1195	Sandstone: Light gray, firm, fine silty, with scattered medium-sized quartz grains and chert fragments. Calcareous. Gas shows on analyzer.

*By V.C.Newton, Jr., Petroleum Engineer, State of Oregon Department of Geology and Mineral Industries.

1195 - 1215 Silty shale: Whitish gray, firm to brittle, calcareous.

1215 - 1250 Sandstone: Light gray, firm to friable, fine, feldspathic, with quartz and dark chert fragments. Good gas shows on analyzer, 54 units.

1250 - 1655 Tuffaceous shale: Light gray, firm, silty; some scattered small pieces of fine white ash and chert.

1655 - 1695 Sandstone: Grayish white, friable, fine to medium grained, silty, feldspathic, with scattered small fragments of dark-gray and black chert. Occasional brownish chert fragments. Calcareous.

1695 - 1770 Tuffaceous shale: As above described.

1770 - 1850 Conglomeratic sandstone: Light-gray, friable, medium- to fine-grained sand matrix. Pebbles to coarse-grained pieces of chert. Scattered medium-sized grains of quartz. Interbedded with siltstone and fine sandstone. Calcareous.

1850 - 1870 Tuffaceous shale: As above described.

1870 - 2260 Sandstone: Grayish white, friable to firm, fine to coarse grained, feldspathic. Composed of medium to coarse grains of quartz and chert; fines are feldspar, some lime. Interbedded with firm siltstone. Gas shows through this section on the analyzer, maximum 50 units.

2260 - 2370 Shale: Grayish white, firm, calcareous, with thinly interbedded fine- to medium-grained sandstone.

2370 - 2395 Tuffaceous sandstone: Light gray, very fine, firm, with medium grains of quartz, dark chert, and fine white ash. Slightly calcareous. Gas show on analyzer 48 units.

2395 - 2420 Shale: As above described.

2420 - 2520 Tuffaceous sandstone: Above but medium grained. Some interbedded sandy siltstone. Gas shows on analyzer, 18 to 24 units.

2520 - 2618 Siltstone: Light gray, firm to brittle, fine sandy, interbedded with thin fine- to medium-grained sandstone. Slightly calcareous.

2618 - 2632 Sandstone: As above but partially cemented. Gas show on analyzer.

H.K.Piddle, Malheur County
Kiesal Estate No. 1

2632 - 2665 Siltstone: As above with thin interbedded sand stringers. Gas show on analyzer.

2665 - 2715 Tuffaceous sandstone: Whitish, friable, very fine silty, with coarse subrounded pieces of dark grayish-black chert and small pieces of fine white ash. Also occasional small mica flakes, weathered. Gas shows on analyzer.

2715 - 2736 Tuffaceous siltstone: Light gray, firm to brittle, with scattered medium-sized chert, fine white ash and quartz particles.

2736 - 2830 Tuffaceous sandstone: Thin beds, whitish, firm, medium to fine grained with dark grayish-black chert fragments, small pieces of fine white ash and medium-sized quartz grains. Slightly calcareous. Interbedded with fine sandy siltstone.

2830 - 3010 Tuffaceous shale: Light gray, brittle, slightly calcareous. Scattered small pieces of fine white volcanic ash. Some small chert fragments, also.

3010 - 3160 Sandstone: Grayish white, firm to friable, fine to medium grained, feldspathic, scattered subrounded fragments of grayish-black chert. Interbedded with thin shale beds. Gas shows on the analyzer, 20 to 30 units.

3160 - 3820 Shale: Light gray, hard, silty.

3820 - 3870 Basalt: Fractured, brownish black, hard, microcrystalline containing a considerable amount of olivine. Gas analyzer recorded 36 units.

3870 - 3900 Siltstone: Medium gray, firm to hard. Gas show on analyzer.

3900 - 3935 Basalt: Brownish black, microcrystalline, some coarse grained, containing a considerable amount of olivine. Gas show on analyzer.

3995 - 4040 Siltstone: Medium gray, brittle, thinly bedded. Gas show on analyzer.

4040 - 4150 Basalt: Brownish black, firm, weathered dull luster, olivine altered to brownish yellow. Thin interbeds of shale. Gas show on analyzer.

4150 - 4270 Shale: Medium gray, friable to brittle, silty, with a few scattered pyrite crystals. Gas show on analyzer, 40 units.

H.K.Riddle, Malheur County
Kiesal Estate No. 1

4270 - 4320	Tuffaceous sandstone: Medium gray, firm to friable, fine silty, with small pieces of fine white volcanic ash and scattered small basalt fragments. Gas show on analyzer, 70 to 80 units.
4320 - 4378	Basalt: Brownish black, hard, containing a large amount of olivine.
4378 - 4410	Tuffaceous sandstone: Grayish white, firm, very fine grained, silty, containing small pieces of white ash and fragments of basalt. Calcareous.
4410 - 4435	Basalt: Brownish black, firm to hard, with olivine; portions weathered to dull brown luster.
4435 - 4450	Sandstone: Light to medium gray, very fine silty, friable to firm with very small segregations of white-colored gypsum.
4450 - 4500	Tuffaceous siltstone: Light gray, friable to brittle, thinly bedded with numerous small pieces of fine white ash.
4500 - 4530	Basalt: Brownish black, hard, microcrystalline, olivine.
4530 - 4550	Tuffaceous sandstone: Whitish, firm, fine silty, with scattered medium-sized quartz grains, calcareous. Also some small pieces of white ash. Thin interbeds of siltstone.
4550 - 5106	Basalt: Brownish black, hard, microcrystalline, olivine. Some thin interbedded light-gray shale and siltstone. Gas analyzer recorded 40 to 110 units between 5044 and 5054.

SINCLAIR OIL AND GAS COMPANY

Eastern Oregon Land Company 1

Sec. 15, T. 16 S., R. 44 E.

Malheur County, Oregon

Descriptions of Well Samples*

0 - 210	Light-colored tuffaceous silts, micaceous with a few grains of quartz.
210 - 230	Sandstone: Fine to medium grained, angular to subrounded, unconsolidated, composed of quartz grains with some pyrite.
230 - 340	Tuffaceous silts: As above described.
340 - 350	Sandstone: As above.
350 - 400	Tuffaceous silts: As above.
400 - 450	Sandstone: Light colored, fairly well indurated, medium to coarse grained, angular to subrounded, moderately sorted, composed of quartz, chert, and feldspar. Also numerous grains of pyrite associated with the sandstone. Some dark reddish-brown claystone apparently just above the sandstone horizon.
450 - 460	Siltstone: Light cream colored, massive.
460 - 470	No recovery.
470 - 480	Altered basalt (?): With some chert fragments intermixed.
480 - 540	No recovery.
540 - 590	Tuff: Yellowish white to darker cream, with numerous angular fragments of chert.
590 - 630	Tuff: Tan to purplish, massive.
630 - 740	Tuff and tuff siltstone: Tan to cream color, with few fragments of basalt and chert (corings ?).
740 - 800	No recovery.
800 - 810	Tuff and tuffaceous siltstone: Tan and cream colored with a few fragments of basalt and chert (corings?).

*R.E.Corcoran, Geologist, and V.C.Newton, Jr., Petroleum Engineer, State of Oregon Department of Geology and Mineral Industries.

810 - 837 As above - plus a few grains of light colored, fine to medium grained, angular to subrounded, moderately well sorted, indurated, with pieces of sandstone.

837 - 845 Basalt: Holocrystalline with some calcite, plus fragments of above mentioned.

845 - 890 Tuff and tuffaceous siltstone: Light tan to cream color, with scattered pieces of basalt, sandstone, chert, and quartz veinlets.

890 - 920 Tuff: White with grains of fine to medium, angular to subrounded, moderately indurated quartz and feldspar. One grain of tuff had nothing but crystals of pyrite embedded in it, some calcite.

920 - 930 Tuff and tuffaceous siltstone: Tan to cream color. Some of the tan-colored tuff also contains grains of pyrite.

930 - 960 Crystal tuff: Grayish to brownish gray and tuffaceous sandstone containing grains of basalt with scattered pieces of silica veinlets, calcite, and some slough.

960 - 970 No recovery.

970 - 980 Basaltic tuff (?): Brownish to grayish brown with considerable amount of volcanic glass. Also appears to contain large amount of secondary silica.

980 - 1020 Siliceous sandstone: Light colored, calcareous, made up of basic volcanic grains and dark tuff fragments in a crystal matrix of calcite and secondary silica.

1020 - 1050 Tuffaceous sandstone: White, fine to medium, angular to subangular, moderately indurated.

1050 - 1070 As above - but with some grayish-brown tuff fragments, numerous grains of chert and quartz.

1070 - 1100 Tuffaceous siltstone: Grayish white with above sandstone intermixed.

1100 - 1110 Tuffaceous siltstone: Grayish white, containing much dark basic material plus material from above.

1110 - 1120 Tuffaceous siltstone and sandstone: Fine grained, similar composition as siltstone, slightly calcareous, and containing some pyrite and calcite fragments.

1120 - 1170 Siliceous sandstone: Light colored, calcareous, composed of basic volcanic grains and dark tuff fragments, crystal matrix of calcite and silica, medium grained, well indurated.

E. Oregon Land Co. 1
Malheur County

1170 - 1180 No recovery.

1180 - 1250 Mixture of above rock types, medium-grained, calcareous sandstone appears predominant.
Note: Much of the siliceous and calcareous material with imbedded grains of dark tuff and basalt may be cored material, but they are predominant over the cream and tan-colored tuffs and tuffaceous siltstone.

1250 - 1300 Equal amounts of light- to dark-gray tuff and calcareous, siliceous sandstone. Veinlets of calcite in tuff.

1300 - 1340 Tuff: Light colored with intermixed fragments of sandstone and scattered pieces of basalt.

1340 - 1360 Tuff: Light gray, with fine to medium angular grains of feldspar and some quartz (?).

1360 - 1370 Tuff: As above but with fragments of black shale or claystone.

1370 - 1380 Tuff: Light gray with imbedded grains of dark basalt or tuff with veinlets of calcite.

1380 - 1465 Tuff: Various colors ranging from dark gray to white. Also some white calcareous sandstone and intermixed fragments of basalt from above.

1465 - 1520 Tuff: Dark gray to dark reddish gray, massive. Some basalt fragments intermixed.

1520 - 1635 Basalt: Grayish brown, occasionally slight reddish cast, fine crystalline.

1635 - 1670 Tuffs: Light colored, dark gray, red to purplish red, varied-colored fragments, very fine grained to silty, massive with scattered pieces of finely crystalline basalt. Numerous fragments of chert and calcite.

1670 - 1810 Basalt: Very finely crystalline, fragments of above tuffs. Also some pieces of brownish siltstone. Some of the basalt fragments have a vitreous luster giving them the appearance of having been silicified.

1810 - 1920 Basalt: Appears to be more coarsely crystalline than above. Some intermixed fragments of pink tuff and angular pieces of white chert.

1920 - 1940 Tuffs: Various colors.

1940 - 1945	Tuffs: As above with a few grains of pinkish crystal rhyolite or dacite.
1945 - 2000	Basalt: Finely crystalline, good vitreous luster.
2000 - 2020	Basalt: As above with some finely crystalline dacite (?).
2020 - 2070	Tuffs: Light to dark colored, varied colored, with some intermixed basalt fragments.
2070 - 2080	Tuffs: As above with basalt fragments and considerable number of chert fragments.
2080 - 2090	Tuff: Medium to dark gray and brownish gray with scattered pieces of very fine to microcrystalline basalt.
2090 - 2110	Tuff: As above with considerable pinkish to reddish silty tuff.
2110 - 2130	Basalt: Very finely crystalline with intermixed silty tuffs and siltstone.
2130 - 2155	Siltstone: Grayish brown to brownish red.
2155 - 2182	Basalt: Grayish brown to gray, finely crystalline with material from above mixed in.
2182 - 2240	Tuffs: Drab colored, some pieces of basalt from above.
2240 - 2280	Tuff: As above with numerous grains of brownish gray, very fine-grained sandstone and siltstone.
2280 - 2310	Basalt: Finely crystalline, some intermixed tuff and siltstone in the interval.
2310 - 2360	Tuff: Drab colored, some pinkish baked.
2360 - 2400	Tuff and basalt: Intermixed fragments in cuttings. Apparently the drilling mud was in poor condition when these samples were taken.
2400 - 2520	Basalt and interbedded drab-colored tuff. Some grayish-black cinder.
2520 - 2570	Tuff: Fine, red-pinkish baked, some light tan, very fine-grained sandstone containing dark shale fragments. Also few fragments of dark siltstone in sample.

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Malheur County

2570 - 2640	Basalt: Dark pinkish gray, microcrystalline. Some interbedded tuffaceous siltstones, light gray to medium greenish gray, hard; some black volcanic glass. Tuffs contain veinlets of white quartz.
2640 - 2720	Basalt: Brownish black, microcrystalline. Contains quartz, calcite, and olivine. Few thin interbeds of dark siltstone. Portions of basalt contain metallic sulphides.
2720 - 2780	Basalt: Brownish black and dark pinkish gray, microcrystalline, some milky quartz and calcite. Some red and bluish-gray cinder intermixed.
2780 - 2840	Tuffaceous siltstone and claystone: Light-brown and dark-gray tuff with included subrounded, medium-sized fragments of basalt, feldspar, and pieces of white ash in a silty matrix.
2840 - 2915	Basalt: Brownish black, microcrystalline, with small amount of quartz and calcite. Also with small white fibrous crystals of zeolite. Zeolite lined fissures and filled cavities in basalt. Some portions contain a considerable amount of zeolite.
2915 - 2935	Tuff: Reddish brown, few scattered fragments of basalt, silty matrix.
2935 - 2970	Basalt: Brownish black, microcrystalline, fresh, with a small amount of zeolite.
2970 - 2990	Tuff: Pinkish and brownish.
2990 - 3280	Basalt: Dark gray to pinkish gray, altered with considerable amount of zeolite. Small amount of calcite also, and thin interbeds of tuffaceous siltstone, light brown to medium brown, firm, brittle.
3280 - 3300	Basalt: Dark greenish and pinkish gray, extensively mineralized, containing considerable zeolite, some clear quartz, greenish quartz, and calcite.
3300 - 3476	Basalt: Brownish black, microcrystalline to fine crystalline, contains olivine, with some zones of medium-gray colored mineralized basalt containing zeolite. Occasional thin beds of brownish and gray siltstone, some white tuffaceous very fine-grained sandstone.
3476 - 3495	Siltstone: (E log correlation).

3495 - 3710	Basalt: Black, microcrystalline to fine microcrystalline, with occasional interbeds of brown siltstone and greenish-brown claystone. Zones of medium-pinkish and greenish-gray, fine crystalline, mineralized basalt. Basalt contains zeolite and some quartz.
3710 - 3755	Tuff: Reddish brown with fragments of basalt, zeolite, and brown siltstone.
3755 - 4070	Basalt: Black, microcrystalline to fine microcrystalline, containing olivine, some amygdules, and veins of zeolite and quartz; some interbedded tuff.
4070 - 4090	Siltstone: Medium gray and brownish, firm.
4090 - 4170	Basalt: Dark grayish black, microcrystalline, with quartz, some zeolite. Also contains partly altered olivine.
4170 - 4240	Altered basalt: Black dull luster, partly altered, some glassy looking, containing zeolite.
4240 - 4255	Basalt: Dark gray, greenish black, partially chloritized, some unaltered, containing quartz and zeolite veins. Some interbedded brown and black shale. Quartz contains a small amount of pyrite.
4255 - 4270	Shale: Dull black, firm to hard. Some pieces of light-colored mica schist (?) and serpentine in the sampled interval. Also fragments of microgranite containing considerable amount of weathered biotite.
4270 - 4380	Basalt: Black, brownish black, microcrystalline, some glassy. Some interbedded medium-gray, firm siltstone. Portions contain zeolite and quartz. Small amount of pyrite mineralization in quartz. Basalt contains olivine. Some medium-gray microcrystalline basalt with zeolite.
4380 - 4505	Shale: Medium to light gray, firm, and dull black. Sample contained fragments of weathered microgranite with mica, quartz, and a few scattered pieces of greenish dark-gray, fibrous actinolite. Few fragments of whitish ash.
4505 - 4888 T.D.	Diorite (clastic material ?): Light colored, with weathered biotite flakes. Fragments of medium-gray siltstone and black basalt also scattered in the sample.

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Malheur County

CORES

Core No. 1

3477 - 3478	Basalt: Black, hard, microcrystalline.
3478 - 3481	Basalt: Black, slightly serpentinized, cut by a few very fine veinlets of calcite; contains olivine.
3481 - 3484	Basalt: As above, some vertical fractures.
3484 - 3487	Basalt: As above.
3487 - 3490	Basalt: As above.
3490 - 3493	Basalt: As above.
4869 - 4871	Diorite: Medium grained, hard, with crystals of partly altered hornblende, some very fine veinlets of calcite.

STA TEX OIL COMPANY

(R.A. Stamey)

Russell No. 1

August 13, 1962

Sec. 14, T. 19 S., R. 44 E.

Malheur County, Oregon

Descriptions of Well Cuttings*

0 - 40	Gravel
40 - 310	Shale: With a few thin interbedded sands.
380 - 652	Shale: Soft, sticky.
652 - 1320	Shale: Sandy.
1320 - 1360	Sand: Tan, soft - firm, extremely fine grained. Possible oil fluorescence reported by Well Logging Company. No gas detected in this interval, however.
1360 - 1750	Shale: Firm to hard.
1750 - 1809	Sand: Brownish white, soft - firm, fine grained. Gas show, 15 units dry gas and 18 units of wet gas recorded on the logging unit in this interval.
1809 - 1828	Sand: Greenish-white, soft - firm, fine grained.
1828 - 2248	Shale: Firm and some soft, grayish green to whitish, fine-grained sand. Small show of gas.
2248 - 2289	Sand: Grayish white, soft, fine grained, thinly interbedded with shale. Gas logging unit recorded 32 units of dry gas and 35 units of wet gas.
2289 - 2296	Shale: Medium to dark grayish black, firm.
2296 - 2321	Siltstone: Light gray and greenish, firm, with some thin interbedded whitish, feldspathic very fine-grained sandstone.
2321 - 2336	Sandstone: Light gray, very fine grained, silty, friable, with an occasional large mica flake. A thin layer of coarse sandstone composed of quartz and feldspar toward the bottom of the zone. Gas logging unit recorded 10 units methane, 14 units propane.
2336 - 2350	Siltstone: Medium to light gray, firm, and some thinly interbedded medium to dark grayish-black shale.
2350 - 2356	Sandstone: Whitish gray, very fine grained, silty, and some silty coarse-grained friable sandstone with quartz, basalt, and white ash. Occasional large mica flakes. Gas logging unit recorded 14 units methane, 10 units propane.
2356 - 2390	Siltstone: Medium to light gray, firm, and thin interbeds of dark-gray siltstone.
2390 - 2406	Sandstone: Whitish-gray, friable, very fine-grained silty, tuffaceous sandstone.
2406 - 2417	Siltstone: Light grayish, fine sandy, and thinly layered black shale and white ash interbedded.
2417 - 2510	Sandstone: Whitish light green, very fine silty, tuffaceous, and thinly interbedded siltstone. Occasional mica flakes and thin layers of white ash.
2510 - 2545	Siltstone: Light gray, very fine sandy, tuffaceous. Small pieces of black shale and white ash intermixed with siltstone in the cutting sample. Occasional large flakes of mica in the siltstone. Grades back and forth between sandy siltstone and silty sandstone.
2545 - 2575	Sand: Whitish, medium to coarse grained, loose - friable, tuffaceous, with subangular grains of quartz and feldspar. Scattered fragments of hard black shaly coal, some calcite. Some light-grayish chert fragments.
2575 - 2580	Siltstone: Whitish gray, fine sandy, firm to friable, slightly calcareous, tuffaceous
2580 - 2644	Sandstone: Whitish, fine to coarse, tuffaceous, slightly calcareous, composed of quartz and feldspar, some chert, white ash, and a small amount of coal, and interbeds of light-gray, firm to hard siltstone.
2644 - 2680	Sand: Whitish, loose, coarse to medium grained, composed of subangular quartz and feldspar with fragments of white ash, some dark-gray chert and interbedded light-gray, firm to hard, siltstone.
2680 - 2684	Siltstone: Light gray, firm to brittle, thinly bedded. Some interbedded black shale.
2684 - 2690	Sandstone: Friable, whitish, coarse grained, composed of subangular quartz and feldspar grains. Some subrounded pieces of basalt.

*By V.C.Newton, Jr., Petroleum Engineer, State of Oregon Department of Geology and Mineral Industries.

2690 - 2740 Basalt: Brownish-black, hard, microcrystalline, olivine (?), and interbeds of light-gray, firm to hard siltstone. Occasional mica flakes in the siltstone.

2740 - 2840 Siltstone and shale: Light-gray to medium-gray, firm siltstone, and interbedded dark-gray to black, firm, carbonaceous shale. Some thin layers of coal. Occasional layers of fine silty sandstone. Medium-sized grains of quartz and small basalt fragments appear to be scattered in the siltstone. Gas logging unit recorded 8 units methane, 6 units propane, 4 units butane.

2840 - 2850 Shale: Medium dark gray to grayish black, firm to hard. Some white ash fragments intermixed.

2850 - 2900 Siltstone: Medium gray, fine, sandy, firm with some white ash fragments intermixed. Occasional areas of pyrite mineralization. Some interbedded dark-gray and grayish-black shale at bottom. Occasional thin layers of coal.

2900 - 2906 Sandstone: Dark-gray, very fine-grained, firm graywacke. Some white and light-brown, very fine-grained tuffaceous sandstone, with medium quartz grains and basalt particles.

2906 - 2916 Siltstone: Light to medium gray, some light green, firm. Some of the medium-gray siltstone contained small splinters of carbonaceous material. Some thinly interbedded black shale.

2916 - 2920 Siltstone and ash: Light-gray, firm siltstone and fragments of firm white ash.

2920 - 2960 White ash: Very fine, particles, mostly crystal debris. Some interbedded light-gray siltstone and black carbonaceous material.

2960 - 2965 Claystone: Light greenish gray, waxy looking, firm.

2965 - 3003 Siltstone: Medium light gray, fine sandy, with some scattered white ash fragments, some black carbonaceous fragments also. Some greenish-gray claystone.

3003 - 3020 Sandstone: Light gray, medium to coarse grained, silty, composed of subangular quartz and feldspar grains, some subrounded chert fragments, slightly calcareous.

3020 - 3048 Siltstone: Whitish gray, fine sandy, thinly bedded, firm. Some coal streaks and layers of black shale. A small amount interbedded light-gray, tuffaceous, feldspathic, silty sandstone.

3048 - 3060 Siltstone: Light gray, tuffaceous, fine sandy, friable, with scattered medium-sized grains of quartz; some feldspar and a small amount white ash.

3060 - 3070 Sandstone: Whitish, fine, silty, feldspathic, with small pieces of biotite.

3070 - 3088 Siltstone: Light gray, firm, fine sandy, with scattered medium-sized subangular grains of quartz and feldspar. Some gray chert fragments and a small amount of ash fragments, occasional mica flakes. A few thin interbeds of black shale and coal.

3088 - 3095 Shale: Medium gray to grayish black, firm. Also some black microcrystalline basalt fragments intermixed in the cutting sample in this interval.

3095 - 3100 Siltstone: Light gray, fine sandy, firm, with medium-sized grains of quartz scattered throughout.

3100 - 3110 Sand: Light color, loose to friable, composed of medium-sized grains of quartz, chert, and occasional fragments of white ash.

3110 - 3160 Siltstone: Light gray, firm, some interbedded black shale and coal.

3160 - 3165 Shale: Black, firm, and shaly black coal.

3165 - 3175 Sandstone: Whitish, very fine grained, silty, feldspathic.

3175 - 3195 Siltstone: Light gray, firm, with occasional mica (muscovite) flakes.

3195 - 3220 Sandstone: Whitish, firm, fine- to medium-grained, feldspathic sandstone with fragments of medium- to dark-gray chert. Partly cemented with silica (?).

3220 - 3230 Siltstone: Light gray, tan, and greenish, firm.

3230 - 3235 Shale: Dark gray to black, firm; some coal.

3235 - 3250 Siltstone: Light gray and greenish, fine sandy, firm. Some interbedded black shale and shaly coal.

3250 - 3290 Shale: Black, firm, massive and thin coal seams. Some interbeds of light-gray and green siltstone.

3290 - 3295 Basalt: Brownish black, hard, microcrystalline; some of the olivine weathered brownish pink.

3295 - 3305 Siltstone: Light gray to medium gray, firm; some thin interbeds of whitish medium-grained feldspathic sandstone, partially cemented with silica.

3305 - 3315 Shale: Black, brittle, and some shaly coal.

3315 - 3437 Basalt: Brownish black, firm, weathered, microcrystalline; some quartz veinlets and some interbedded medium-gray, firm siltstone.

3437 - 3450 Basalt: Black, hard, microcrystalline.

3450 - 3480 Siltstone: Medium gray, some pinkish, firm, tuffaceous, fine sandy, and interbeds of firm white ash.

3480 - 3500 Basalt: Brownish black, weathered, some zeolite.

3500 - 3580 Siltstone: Light gray, sandy, tuffaceous, firm, with grains of quartz and feldspar (contains fragments of white ash and basalt); some interbedded thin black shale layers.

3580 - 3640 Basalt: Brownish black, fairly hard, microcrystalline with veinlets and cavity fillings of quartz; some calcite. Some of the basalt is softer, weathered. Thin interbeds of medium-gray siltstone and reddish, baked clay. Gas logging unit recorded 6 units methane, 2 units propane (3619-3635).

3640 - 3770 Sand: Loose, coarse to medium grained, angular grains of quartz and feldspar; some basalt fragments. Occasional grayish-green chert fragments. Contains a small amount of magnetite, slightly calcareous. Gas logging unit recorded 14 units methane, 14 units propane, 20 units butane.

3770 - 3820 Siltstone: Light gray and green, brittle. Grades to fine sandy siltstone. Some fine white ash interbedded. Medium-sized grains of quartz and feldspar scattered throughout siltstone. Gas logging unit recorded 6 units methane, 4 units propane, 2 units butane.

3820 - 3860 Sand: Loose, friable, medium grained, composed of quartz and feldspar grains; some basalt fragments and scattered grains of olivine.

3860 - 3895 Siltstone: Medium gray, light gray, and greenish gray, firm, with some thinly inberbedded dark-gray siltstone and shale. Some thin coal layers.

3895 - 4110 Sand: Loose to friable, medium grained, fairly uniform, composed of subangular grains of quartz and feldspar, some basalt fragments. Somewhat limy in portions. Some of the cuttings' samples contain a considerable amount of basalt which may represent cobbles or boulders of basalt. Interval (4020 to 4025) had a great deal of pyroclastic material intermixed with the sand. Also some magnetite.

4110 - 4150 Basalt: Grayish black, microcrystalline, hard, with some calcite veinlets.

4150 - 4170 Shale: Black, firm to brittle, and shaly coal. Also medium-gray shale.

4170 - 4195 Sand: Loose to friable, composed of subangular grains of quartz and feldspar with some basalt fragments. Bottom portion finer and partially cemented with lime.

4195 - 4210 Siltstone: Whitish, light green, and pink, firm.

4210 - 4215 Shale: Medium gray to black, firm.

4215 - 4255 Sandstone: Whitish gray, firm, silty, fine, with medium to coarse grains of quartz and feldspar scattered throughout. Also some basalt fragments. Slightly calcareous. A small amount of limestone, also. Occasional pieces of greenish-gray chert scattered in the sandstone. Thin interbeds of dark-gray siltstone and shale.

4255 - 4320 Sand: Loose to friable, fine to medium grained, subangular, composed of quartz and feldspar with lesser amount of basalt fragments. Slightly calcareous. Interbedded whitish-colored siltstone.

Note: No gas shows were reported below 3806 in the well records, but the records must be missing as the sands in the bottom of the hole should contain gas.

GAS ANALYSES

Company	Well	Methane	Ethane	Heavier Fractions	Nitrogen	Carbon-Dioxide
A. F. Boyer	Water well	99.1			0.90	
Court House - Weiser	Water well	95.83	1.42		2.43	0.32
Oliver Freel	Water well	88.6			10.8	0.4
El Paso Nat. Gas	V. Johnson 2	91.67	3.82	1.12	0.81	
Oroco Oil & Gas Co.	V. Johnson 1	91.13	3.94	1.30	0.57	0.15
Oroco Oil & Gas Co.	B. Carpenter 1	97.73	1.07		0.41	0.79
H. K. Riddle	Kiesel Est. 1	96.5	1.0		2.5	

(Hydrogen sulfide nil in these samples.)

POROSITY AND PERMEABILITY DATA

Core Analyses

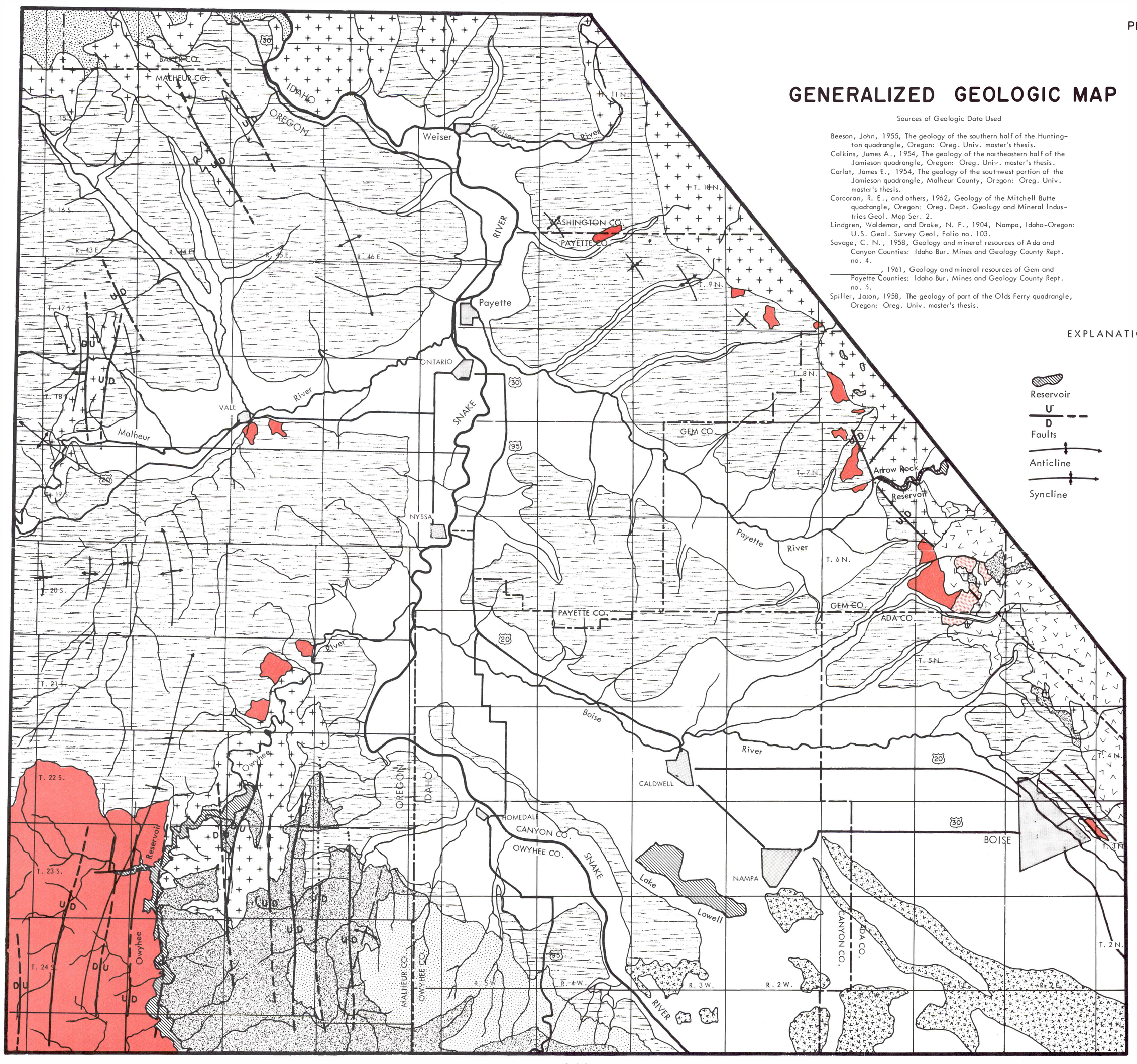
Company	Well	Interval	Permeability in md	Porosity in %	Water Saturation in %
El Paso Nat. Gas Co.	Assmussen 1	2667	267	23	95
		2670-71	281	25	88
El Paso Nat. Gas Co.	Fed. Spurrier	3600	Less than 1	11.7	61
		3601	Less than 1	13.6	49
		3607	Less than 1	10.4	75
		3608	Less than 1	14.5	50
		3609	Less than 1	9.1	70
		3615	Less than 1	11.7	83

Microlog Analyses*

Company	Well	Interval	Porosity in %	Water Saturation in %
El Paso Nat. Gas Co.	Assmussen 1	1953-2014	26	61
		2893-2921	21	97
		3674-3710	13	100
		3906-3926	25	62
El Paso Nat. Gas Co.	Webber-State 1	810- 860	25	24
		1465-1510	23	30
El Paso Nat. Gas Co.	Fed.-Spurrier 1	2108-2147	33	30
		6100-6150	21	24
El Paso Nat. Gas Co.	V. Johnson 2	(No permeable zones on microlog)		
Oroco Oil & Gas Co.	V. Johnson 1	(No permeable zones on microlog)		
Oroco Oil & Gas Co.	Bolles 1	1083-1148	19	100

*Calculations by V.C. Newton

GENERALIZED GEOLOGIC MAP



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EXPLANATION

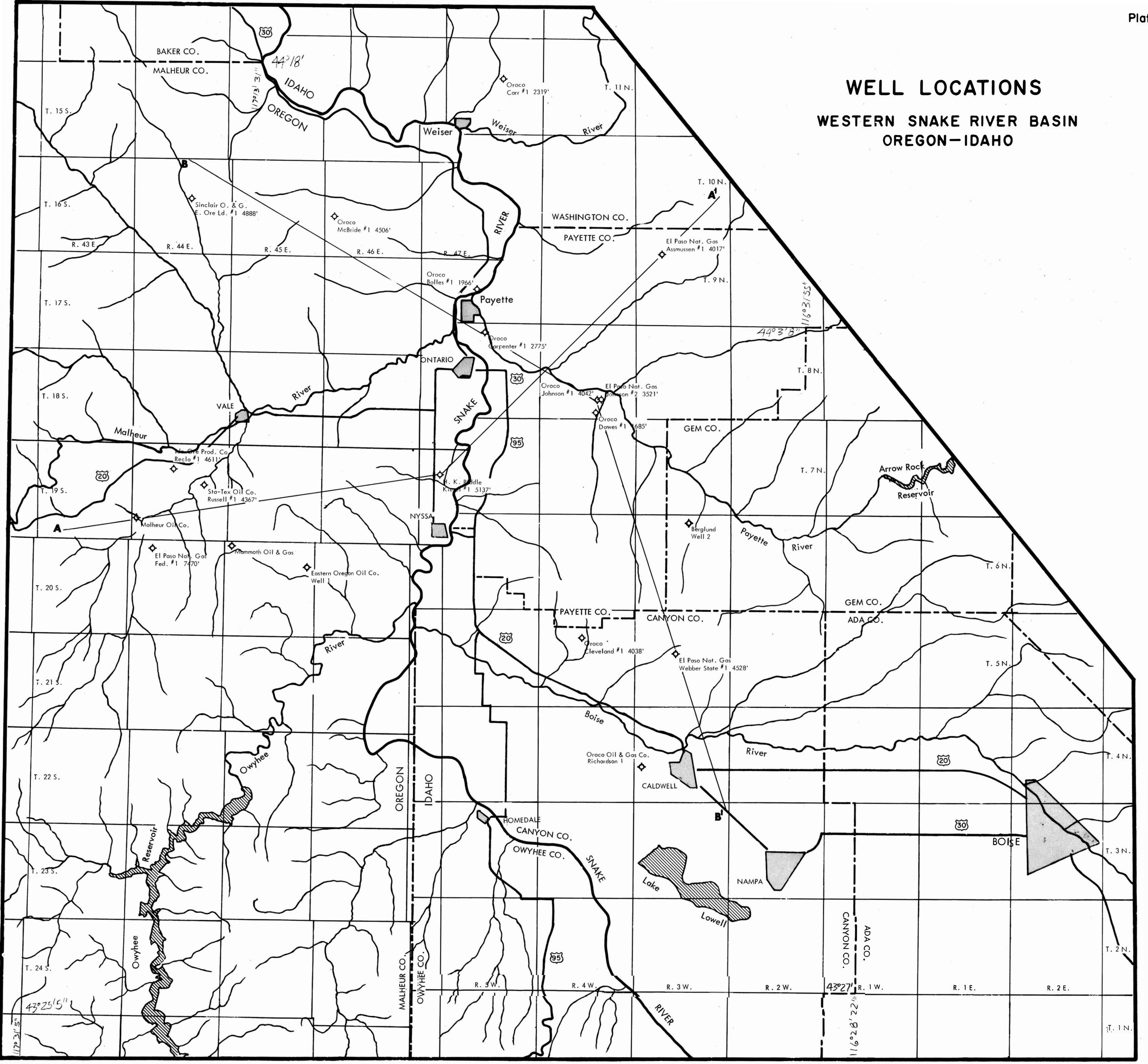
- Reservoir
- Faults (U / D)
- Anticline
- Syncline
- Quaternary alluvium & terrace deposits
- Post-Idaho Basalt-Snake River Eruptives
- Idaho Group
- Poison Creek Fm.-Deer Butte Fm.
- Silicic volcanics
- Columbia River Basalt-Owyhee Basalt
- Payette Fm.-Sucker Creek Fm. w/ rhyolite lavas in upper part.
- Idaho Batholith
- Paleozoic-Mesozoic Rocks

Scale 1 250,000

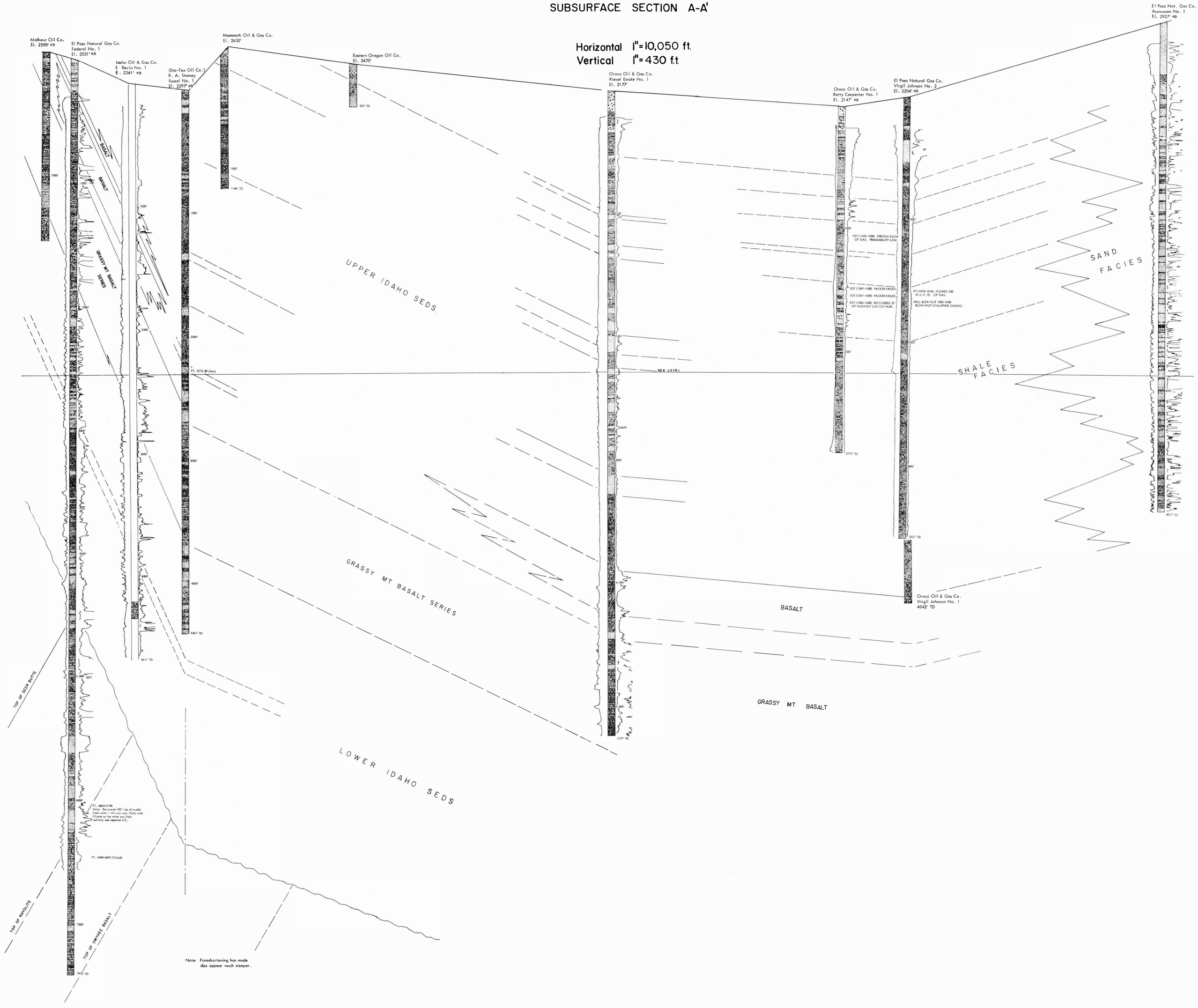
5 0 5 10 15 20 Statute Miles

WELL LOCATIONS

WESTERN SNAKE RIVER BASIN
OREGON—IDAHO

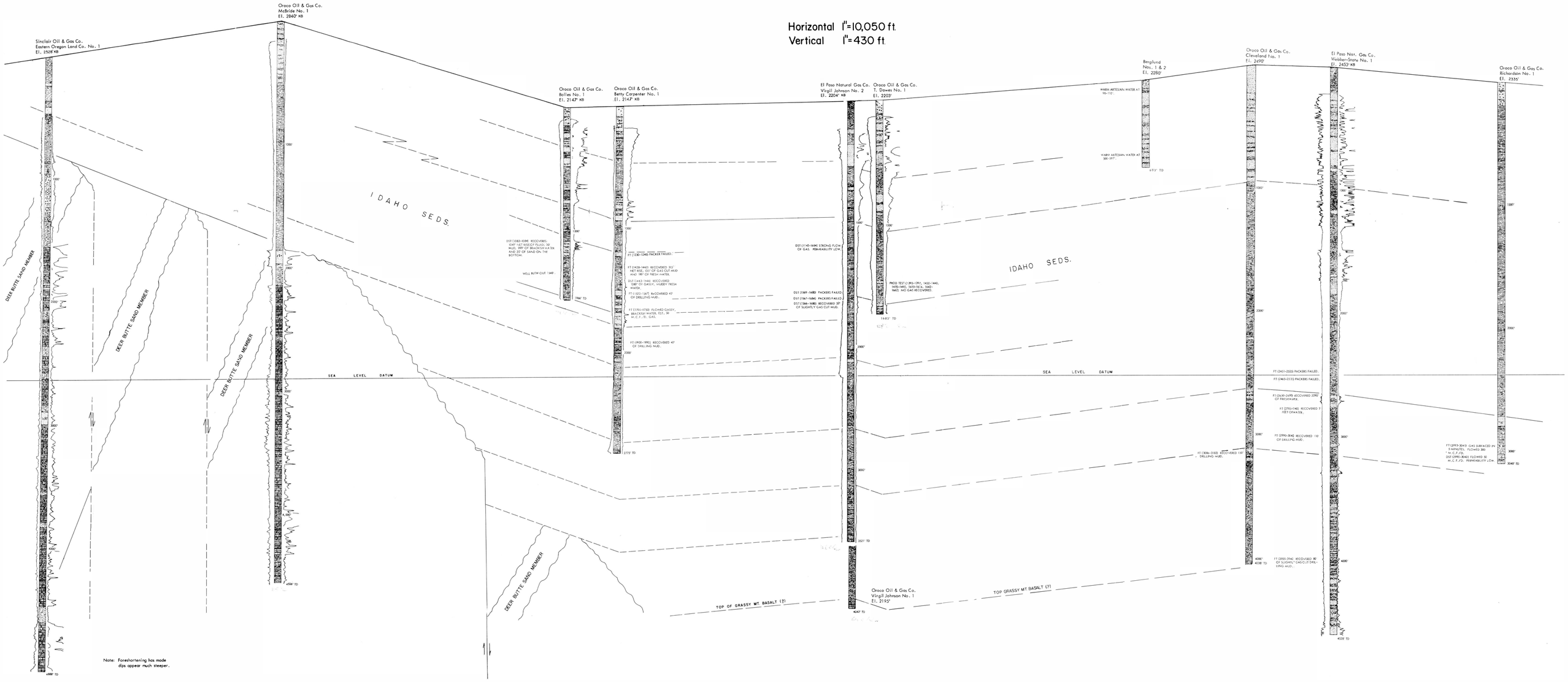


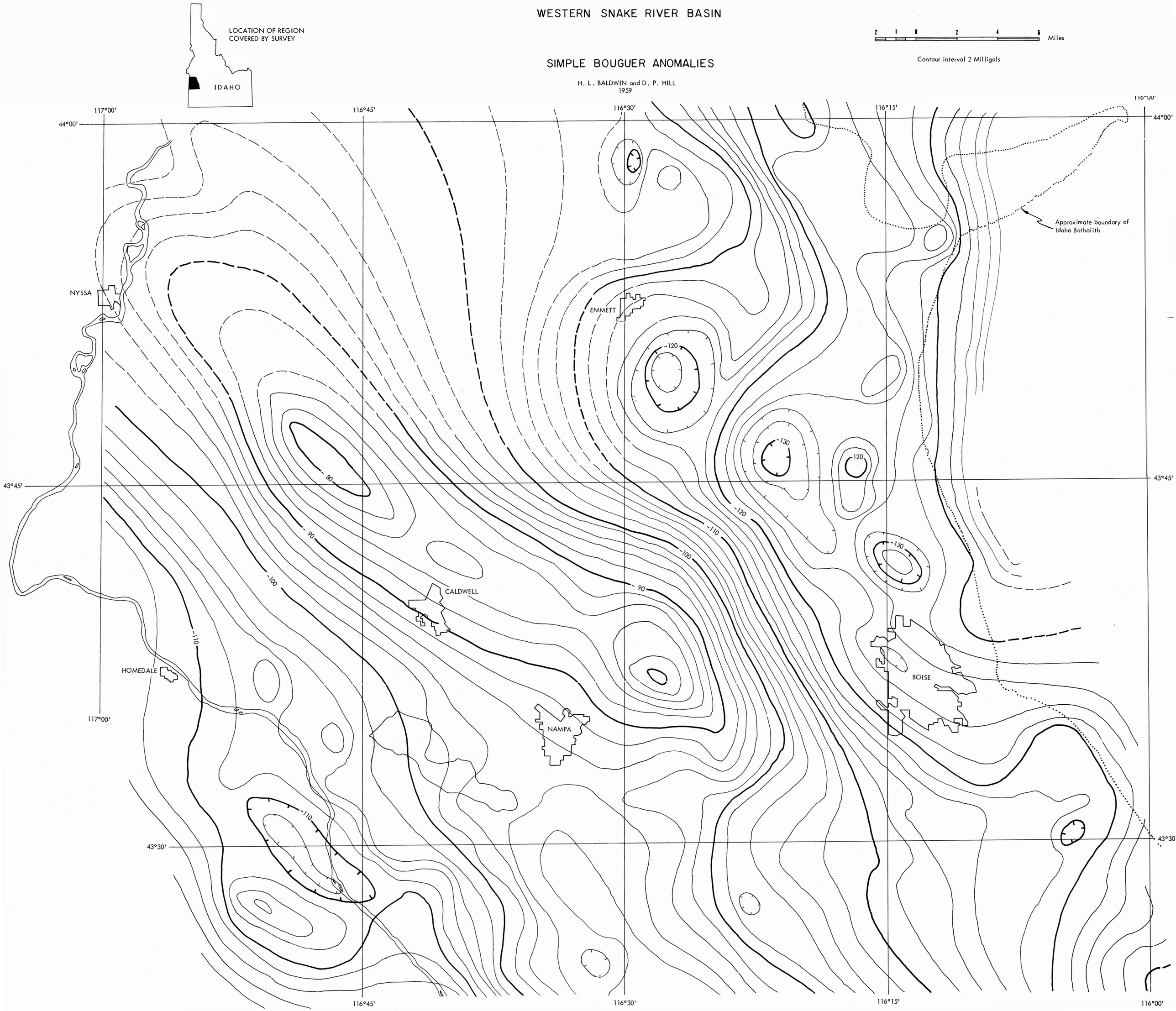
SUBSURFACE SECTION A-A'



SUBSURFACE SECTION B-B'

Horizontal 1"=10,050 ft.
Vertical 1"=430 ft.



GRAVITY METER SURVEY

WESTERN SNAKE RIVER BASIN