STATE OF WASHINGTON

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

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REPORTS OF INVESTIGATIONS - NO. 1

ABSTRACT OF THE REPORT ON THE GEOLOGY AND RESOURCES of the PASCO AND PROSSER QUADRANGLES

by

Harold E. Culver

PREFATORY NOTE

In 1923 and 1924 a general survey of the Pasco and Prosser quadrangles was made by Dr. Solon Shedd, former Supervisor of Geology. Since the publication of his report will of necessity be delayed for some time, it has seemed desirable to prepare a brief abstract which might be distributed with the engraved geologic map of the quadrangles. By this means, all those interested will have the benefit of the economically important portions of the report without undue delay. It was not possible to have this abstract made by the author of the complete report, but in its preparation the attempt has been to present faithfully his conceptions and conclusions.

Harold E. Culver,
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June 12, 1926

ABSTRACT OF PASCO-PROSSER REPORT

The study of the Pasco-Prosser quadrangles was planned as a basis for a detailed report on the general geology, attention having been drawn to the area through the discovery of gas and the prospect of oil in the Rattlesnake Hills which border the Yakima Valley on the north.

The sedimentary rocks of the area include but two formations older than the alluvium of the present valleys. The older of these, the Ellensburg formation, is interbedded with the basalt in a few places, but is entirely absent elsewhere so far as outcrops show. From the distribution of the known Ellensburg it is probable that it is a remnant of an originally widely distributed formation. It outcrops in but three places: (Pl. 1) T. 10 N. R. 27 E. Secs. 8, 18 and 19; T. 8 N. R. 25 E. Sec. 6; T. 9 N. R. 25 E. Sec. 14 and 23. Without exception these exposures of Ellensburg show it to be fine, sandy, and pumiceous, composed largely of glass. In one other locality, Sec. 26, T. 12 N. R. 23 E., is a limited outcrop of relatively unconsolidated sediment which is tentatively considered to be Ellensburg. Its relations to the basalt are not known, nor is it lithologically identical with the other exposed beds.

The younger formation is known as the Ringold. This outcrops over a rather wide area in the northeastern part of the Pasco quadrangle, from the east bank of Columbia River to the margin of the upland eight to ten miles to the east. It is a deposit of slightly consolidated sand, distinctly bedded, which is, in the main, light yellow or gray, of fine grain, somewhat clayey in part, distinctly calcareous. It includes some gray limestone and more or less calcareous, sandy clays and volcanic ash. From its character and position it is believed to have originated on the flood plain of an early Columbia River during the Pleistocene period.

The alluvium of present streams is composed of fine river silts with sands and gravels. This material covers the surface of the Columbia Valley outside of the uplands known as the Rattlesnake Hills, and also up the Yakima Valley above the vicinity of Prosser. Windblown sands and silts, with some volcanic ash and soil, cover practically the whole area under discussion. These, with loose material, effectually conceal outcrops of all rocks except in the rougher parts of the quadrangles.

Of the igneous rocks, the whole area is underlain by the Yakima basalt of Miocene age, which is more than 2000 ft. thick in places. This rock, where fresh, is dark, nearly black, developing brownish discoloration on weathering. The texture varies from very dense to porphyritic. The more dense portions are essentially glass while locally the matrix of the porphyritic portion is fine crystalline. There is no information available from these quadrangles as to the character of the pre-basalt surface. By inference from other portions of the Columbia Plateau, it is probably that the underlying surface is one of erosion on old metamorphic and igneous rocks, such as are found in the numerous buttes and similar elevations standing up above the level of the uppermost basalt flows. While there is no reason to doubt that the relief of this pre-basalt surface is rather great, amounting to several thousand feet, in the absence of any data on its elevation in the Pasco-Prosser district, it is impossible to estimate what local relief or roughness would appear. No reported drilling records have penetrated the pre-basalt strata.

STRUCTURE

For the purposes of investigations of the oil and gas resources, the study of structural conditions is of paramount importance. The two upland areas, the Rattlesnake Hills and the Horse Heaven Hills, have both been considered as possible oil structures. It is to be regretted that the small amount of data available from field study of outcrops fails to lead to conclusive inferences regarding the sub-surface structures.

Rattlesnake Hills: The Rattlesnake Hills have been the site of drilling for gas for some time past and it has been assumed that the hills themselves represented an anticlinal structure across the Prosser and possibly the Pasco quadrangles. Very little direct evidence was obtained in the field but by inference the structure of the hills in the Ellensburg area to the northwest should carry through. In that field, without doubt, the rocks composing the Rattlesnake Hills are arched up in a definitely asymmetrical anticline. Since the surface configuration appears to be uniform from that point to the Yakima River in the Pasco quadrangle, it seems reasonable to assume that the structure is also uniform, the Rattlesnake Hills of the Prosser region being merely the eastern extension of those in the Ellensburg field. On this basis, therefore, it seems probable that the structure is anticlinal.

Horse Heaven Hills: As in the case of the Rattlesnake area, here, also, there is little detailed evidence to be obtained in the field. Outcrops are extremely rare and scattered and it is difficult to obtain precise structural determinations on either slope of the uplands. Earlier, the Horse Heaven Hills were considered a fault structure, but later work to the northwest has suggested to other students that they are probably anticlinal in structure. The topography itself suggests an anticlinal structure since there is a markedly gentle and gradual slope from the south up to the brink of the Yakima Valley where the surface pitches steeply to the north. Where there are exposures on the south slope the beds appear to dip parallel to the surface of the ground. This does not hold good for the north slope but it is by no means certain that there are any true exposures of rock in place.

It thus appears that the Rattlesnake Hills are tentatively to be classed as anticlinal in structure, while the Horse Heaven Hills are less probably so and may be fault scarps.

ECONOMIC GEOLOGY

The economically important mineral resources, aside from water and soils, are building stone and gas.

Building Stone: Building stone includes but two varieties, the Ellensburg and the Yakima basalt. In general, the Ellensburg is so poorly consolidated that it has little value for building purposes, but in one place the stone was quarried for use in Prosser. Under the local climatic conditions it appears to be fairly satisfactory, although, on account of its high content of volcanic ash, and its lack of consolidation, it is not to be classed structurally as a building stone. Basalt is found over large areas and has been used to a limited extent for construction of buildings. It is readily quarried, accessible, and widespread in occurrence. On account of irregular jointing it is not easily worked into dimension blocks and because of its dark color it is not pleasing when used for building purposes. It makes a very satisfactory foundation rock, however, and is used for this purpose to some extent.

Gas and Oil: The possibility of gas and oil in this area has been under consideration for more than a decade. The northeastern slope of the Rattlesnake Hills in the Prosser quadrangle has yielded some gas since early in 1913. The original discovery was accidental since the first drilling was done in an effort to obtain deep artesian water. All but two of the wells here reported have been located in a single township, (T. 11 N. R. 26 E) and in every case near the discovery well.

In the following paragraphs is given a summary statement of the report from each well of which the Survey has recorded. The wells are numbered on the map (Pl. 1) for identification.

The first well, located in the SE¼ of the SE¼ of Sec. 20, T. 11 N. R. 26 E., was drilled to a depth of 1234 feet. Gas was encountered at 700 feet below a layer of clay or shale. Three successive layers of porous basalt are reported to have been encountered, each containing some gas. These layers ranged in thickness from eight to 21 feet. The well has been cased to a depth of about 800 feet and has maintained an estimated flow of gas from 70,000 to 500,000 cu. ft. per day. The second well drilled in the area is in the NW¼ of the SW¼ of Sec. 21, T. 11 N. R. 26 E. This went to a depth of 800 feet, gas being found at 700 feet. The flow here has been variously estimated and measured to range from 2,600,000 to 3,000,000 cu. ft. per day. The gas from this well has been used as fuel for drilling other wells in this locality. The logs of No. 1 and No. 2 wells are as given below:

LOGS OF NO. 1 and NO. 2 WELLS

WELL NO. 1			WELL NO. 2		
Material	Thickness	Depth	Material	Thickness	Depth
Surface	16	16	Surface	16	16
Basalt	110	126	Gravel and bowlders	39	55
Sandstone, yellow, soft	40	166	Basalt	45	100
Basalt	340	506	Sand, loose, white	28	128
Basalt, gray	122	628	Basalt	40	168
Shale or clay, greenish blue	71	699	Basalt, blue	117	285
Basalt, porous; and gas	20	719	Broken formation	25	310
Basalt, porous; 5½ lb. pressure	25	744	Basalt, blue	80	390
Basalt, hard	70	814	Broken formation, water	30	420
Basalt; porous; more gas	13	827	Basalt, blue	100	520
Basalt, hard	13	840	Granite	10	530
Basalt, porous; more gas	8	848	Basalt	80	610
Basalt, hard	46	894	Slate, green	90	700
Basalt, porous; more gas	21	915	Basalt, gas	30	730
Basalt, alternating hard and soft; no further gas	319	1234	Basal, hard, gray. Bottom	70	800

Well No. 3 in the NE¼ of the NE¼ of Sec. 19, T. 11 N. R. 26 E. was drilled to a total depth of 1507 ft. Gas was reported at a depth of 782 ft. but the well was plugged in shooting.

Well No. 4 in the NE¼ of the NE¼ of Sec. 21, T. 11 N. R. 26 E. encountered clay at a depth of 640 ft. and this was not drilled through. Water was reported at 300 ft.

Well No. 5 in the SE¼ of the SE¼ of Sec. 20, T. 11 N. R. 26 E. penetrated 1200 ft. of volcanic ash and clay, then 125 ft. of gravel and loose basaltic bowlders with basalt below. A total depth of 780 ft. was reached with a reported open flow of gas amounting to 1,300,000 cu. ft.

Well No. 6 in the NE¼ of the SE¼ of Sec. 18, T. 11 N. R. 26 E. was stopped at a depth of 205 ft.

The deepest well of the area is No. 7, located in the NW¼ of the NW¼ of Sec. 27, T. 11 N. R. 26 E. The first 300 feet of this well were drilled with a churn drill and a core was taken for the rest of the distance, the total depth being reported as 2212 feet. The first gas encountered was at a depth of 699 feet. Between this and 916 feet three other layers containing gas were reported. These were given as 11, 10 and 21 ft. thick, respectively. The estimated capacity for this well was 400,000 cu. ft. per day. The log of this well is given below:

LOG OF WELL NO. 7

WELL NO. 7

Material	Thickness	Depth	Material	Thickness	Depth
Churn drill hole	295	295	Soft gray basalt shale	51	1141
Blue basalt hard	4	299	stringers		
Blue basalt porous	12	311	Hard gray basalt solid	21	1162
Blue basalt solid	72	383	Soft black porous basalt	10	1172
Blue basalt shattered	9	392	Gray porous basalt hard		
Gray sand rock	2	394	stringers	8	1180
Blue basalt broken	21	415	Gray basalt hard and solid	35	1215
Black basalt hard	113	528	Red porous basalt soft	5	1220
Gray basalt hard	96	624	Black porous basalt soft	4	1224
Gray basalt broken	4	628	Hard gray basalt	47	1271
Shale or blue volcanic ash	59	687	Black porous basalt	9	1280
White sand	3	690	Hard gray basalt	55	1335
Blue volcanic ash shale	9	699	Gray porous basalt	18	1360
Black porous basalt, puffs of			Gray basalt	47	1407
gas	21	720	Gray porous basalt	23	1440
Black porous basalt	19	739	Gray basalt	76	1516
Cavity	1	740	Gray basalt slightly porous	66	1582
Black porous basalt	5	745	Gray basalt	47	1625
Gray basalt solid	8	753	Soft gray basalt and shale	4	1629
Gray basalt broken	4	757	Black porous basalt	6	1635
Gray basalt solid	36	793	Conglomerate, shale and		
Gray basalt broken	1	794	porous shale	12	1647
Gray basalt solid	12	806	Blue gray basalt	117	1764
Volcanic Ash or shale	2	808	Soft porous basalt	4	1768
Black porous basalt, gas	11	819	Green shale	12	1780
Gray basalt solid	5	824	Gray porous basalt	16	1796
Black porous basalt	4	828	Gray basalt	60	1856
Gray basalt solid	3	831	Gumbo	11	1867
Gray basalt broken, gas	10	841	Gray porous basalt	43	1910
Gray porous basalt	19	860	Gray basalt	61	1977
Gray basalt solid	33	893	Gray porous basalt	64	2041
Volcanic ash	2	895	Gray basalt	14	2055
Black porous basalt, gas	21	916	Black basalt	2	2057
Gray basalt solid	151	1067	Gray basalt	20	2077
Black porous basalt with shale			Black basalt	7	2084
stringers	5	1072	Gray basalt	22	2106
Soft Black porous basalt	18	1090	Black basalt	27	2143
			Soft gray basalt	22	2165
			Gray porous basalt	47	2212

In well No. 8 in the N½ of Sec. 27, T. 11 N. R. 26 E. an artesian flow of water was met at a depth of 450 ft. and clay was penetrated at 600 ft. The total depth is reported as 806 feet.

Well No. 9 in the NW¼ of NW¼ of Sec. 28, T. 11 N. R. 26 E. has not been reported in any detail and was apparently stopped before any great depth had been reached.

No. 10 well in the SW¼ of the SW¼ of Sec. 16, T. 11 N. R. 26 E. was reported abandoned at a depth of 720 ft.

Well No. 11 in the SW¼ of the NW¼ of Sec. 5, T. 11 N. R. 25 E. was reported to have been drilled to at least 1000 ft.

Well No. 12 in the SW¼ of the SW¼ of Sec. 32 T. 10 N. R. 25 E. is on the southwestern slope of the Rattlesnake Hills, while those previously described are on the northeastern slope. This was drilled to a depth of 482 ft. with a churn drill and continued with a diamond drill to a depth of 825 ft. The log of this well is given below:

LOG OF WELL NO. 12

Material	Thickness	Depth	Material	Thickness	Depth
Old well drilled with casing in.	482	482	Basalt, porous	3	647
Basalt, gray	72	554	Basalt, porous	11	658
Burned shale	4	558	Semi-Porous basalt	3	661
Basalt, gray mixed with burned shale	2	560	Basalt, gray	75	736
Conglomerate	12	572	Basalt, porous	10	746
Lime shale or conglomerate	52	624	Cavity	2	748
Lime shale, very sticky	5	629	Basalt, porous, gray	6	754
Lime shale, sandy	9	638	Black volcanic ash	2	756
Sand	3	641	Basalt, slightly porous	24	780
Shale, brown	1	642	Basalt, solid gray	24	804
Shale, green	2	644	Basalt, solid gray	10	814
			Shale, black, crumbly	3	817
			Basalt, gray, porous	8	825

SUMMARY

All the productive wells in the field encountered gas at a depth of some 700 to 800 ft. Above the layer in which gas was met, there was in every case material which was reported as shale, slate, volcanic ash, or clay. This stratum, 70 to 100 ft. thick, was variable in color, being blue or greenish blue most commonly.

Certain features of the occurrence of gas in this field merit attention: (1) All the gas found in the field, so far as reported, is encountered in porous basalt. Since the basalt, averaging several thousand feet in thickness, presumably overlies igneous or metamorphic rocks which are equally unlikely sources for the gas, it seems fair to infer that the gas comes from the thin sedimentary beds interstratified with the basalt. (2) The analysis of the gas shows the chief component to be methane (CH_4), or marsh gas, none of the heavier hydrocarbons, which are commonly associated with petroleum deposits, being present. (3) The gas pressure is low, as gas fields go, five and one-half lbs. being the highest pressure reported while the average is slightly more than three lbs. (4) Structurally, so far as the meager data indicate, the field is favorable but the stratigraphy does not warrant the hope of a commercially important gas field, nor is there any indication that any important amount of oil will be found associated with the gas.

~~BULLETIN 32, PLATE I~~
R. I. #1

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
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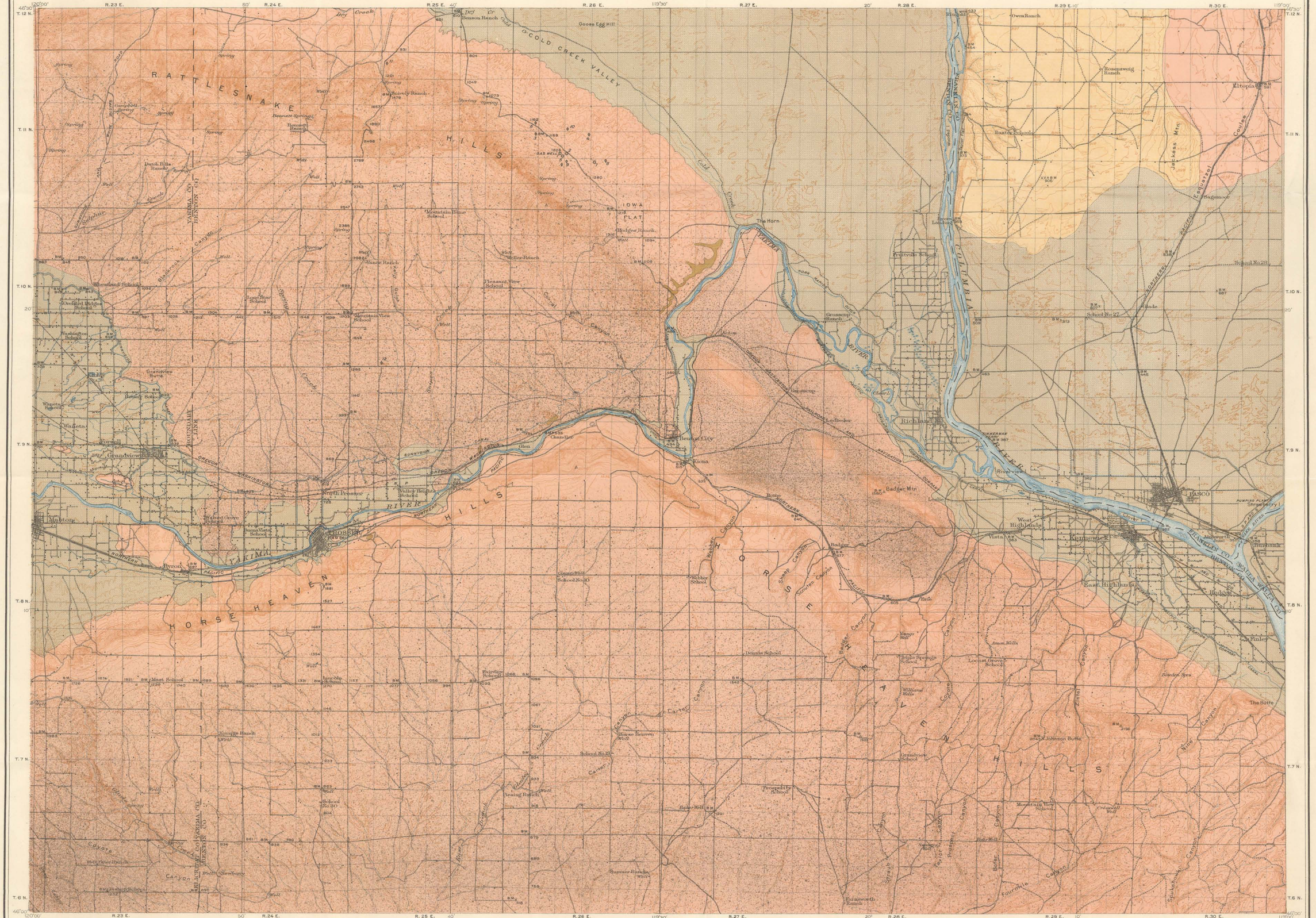
PROSSER QUADRANGLE

PASCO QUADRANGLE



LEGEND

SURFICIAL MATERIAL — RECENT

- Wind blown (*mainly silt, sand and volcanic ash*)
- Valley alluvium (*fine river silt, sand and gravel*)

SEDIMENTARY ROCKS — PLEISTOCENE

- Ringold formation (*stratified deposits of clayey sandstones, gray limestone and unindurated deposits of sand and clay.*)

SEDIMENTARY ROCKS — MIOCENE

- Ellensburg formation (*deposits of stratified silts, sand, and gravels of volcanic materials.*)

IGNEOUS ROCKS

- Yakima basalt (*extensive series of lava flows and tuffs.*)

* Gas well

♦ Drilled for gas; idle or abandoned

GEOLOGIC MAP OF PASCO AND PROSSER QUADRANGLES, WASHINGTON

Topographic base map surveyed in co-operation with U. S. Geological Survey

Geology by S. Shedd

Scale 1/125000

1 ½ 0 1 2 3 4 5 Miles

1 ½ 0 1 2 3 4 5 Kilometers

Contour interval 50 feet.

Datum is mean sea level.

1925