Water and Mineral Resources of the Palouse

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THE ASSOCIATION of the Palouse Formation with the Columbia River Basalt is typical of the Palouse area. I will use "Palouse" to designate an informal rock unit characterized by this association without regard to the landforms, ecology, or land use. I will limit the discussion to the mineral and water resources that can be obtained from the Palouse rock unit in a typical outcrop area in Whitman County, Washington, and Latah County, Idaho (Figure 1).

The rock-unit approach to a definition of Palouse results in problems in selecting boundaries. The eastern limit of the outcrop area is quite irregular. I do not know how far west the rock unit extends.

Mineral Resources

The Palouse virtually lacks metallic mineral resources. A little gold has been recovered from placers along the Snake River (Huntting, 1956), and some of the clays have been investigated as sources of aluminum (Hubbard, 1957).

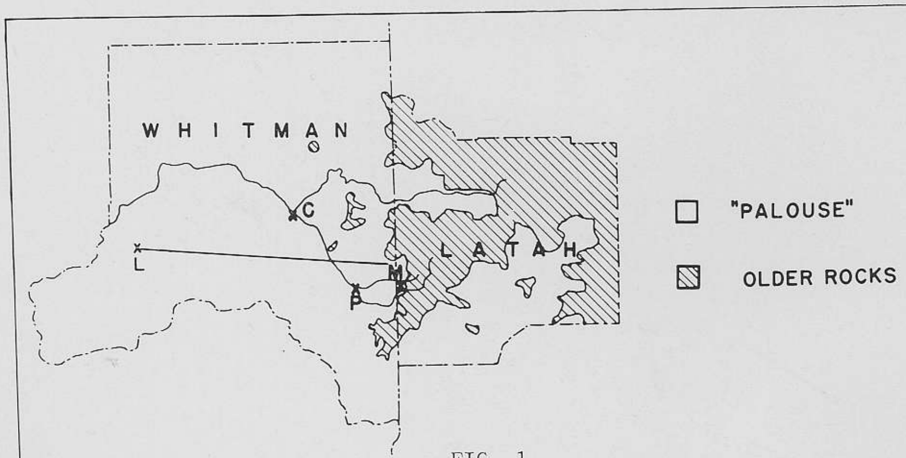

FIG. 1

INDEX TO THE "PALOUSE" IN WHITMAN CO., WASH. & LATAH CO., IDAHO

Except for precious opal, the nonmetallic mineral resources of the Palouse (Figure 2) are unromantic but useful items such as sand and gravel, crushed rock, building stone, clays, and water (Valentine, 1949; Hubbard, 1957). Such materials generally sell at low prices and must depend upon favorable costs of operation and closeness to markets to be exploited at a profit.

Opal was mined in eastern Whitman County in 1891 and 1892. According to Glover's (1949) summary of the old reports, the opal formed vesicle fillings in basalt and ranged in size from "half a pea" to as large as a "hen's egg." The larger stones were of inferior quality, but the smaller were compared favorably with precious opal from famous deposits. Although the deposit yielded opal valued at $6,000 and may still contain opal, it has been inactive for nearly 70 years.

Sand and gravel that can be used for roads or in concrete aggregate is scarce in the Palouse. Latah County has none, but some deposits have been worked in Whitman County. The farthest pit to the northwest (Figure 2) is in a scabland channel, and some of the other pits may also be in scabland deposits. The eastern deposits probably were laid down by the Palouse River.

Because natural gravels are scarce, basalt is extensively used as crushed rock for asphalt pavement and gravelled roads. The quarries shown on Figure 2 are only those that have been active in recent years; inactive quarries are numerous.

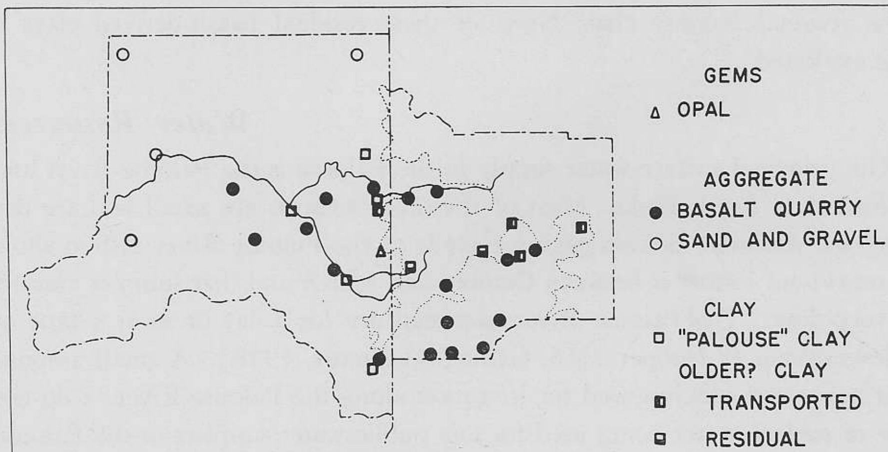

FIG. 2

MINERAL RESOURCES OF THE "PALOUSE" IN WHITMAN CO., WASH. & LATAH CO., IDAHO

Formerly, basalt was used to some extent as building stone. Examples may be seen in older buildings throughout the Columbia Plateau.

For my discussion, it is convenient to class all of the clays into two groups: the Palouse clay, and the "older (?) clays." Glover (1941) defined the Palouse clay as consisting of two types of clay materials: loess, and residual clays formed by the decomposition of basalt. Glover stated that the two types are similar in occurrence, physical properties, and uses. The typical residual Palouse clay makes excellent red-firing material useful for common brick, whereas the loess fires into paler colors. Formerly, brick plants in the larger towns of the Palouse used Palouse clay. I do not know if any of these plants are still being operated.

The "older (?) clays" do not include loess, but may include time equivalents of the residual Palouse clay. The "older (?) clays" are older than the loess, but may not be older than the residual Palouse clay. The "older (?) clays" are characterized by granite-derived transported clays interbedded in the Columbia River Basalt and by granite-derived residual clays that may be older than the Columbia River Basalt. The granite-derived clays are suitable for making high-grade ceramics. A residual granite-derived clay in central Latah County has been used for many years to make fire brick. A transported granite-derived clay in eastern Latah County is being developed as a source of sizing for "slick" paper. Almost every one of the transported granite-derived clays is underlain by a basalt-derived residual clay that may be a time equivalent of the residual Palouse clay. None of these residual basalt-derived clays is being exploited.

Water Resources

The principal surface-water supply in the Palouse is the Palouse River and its North and South Forks. Most of the other streams are small and are dry during the summer. Stream-gaging records of the Palouse River system show that maximum runoff is between October and March and that summer runoffs are very low. The Palouse River has been dry for a day or so at a time as far downstream as Hooper (U.S. Geological Survey, 1958). A small amount of surface water is being used for irrigation along the Palouse River. I do not know of surface water being used for any public water supplies in the Palouse area. Stevens (1960) and Foxworthy and Washburn (1957) suggested that water from the Palouse River system could be used for artificial recharge of ground water in the Moscow basin and Pullman basin.

Most of the water used in the Palouse is ground water, and nearly all of it comes from wells. The Palouse Formation (Figure 3) is a poor aquifer

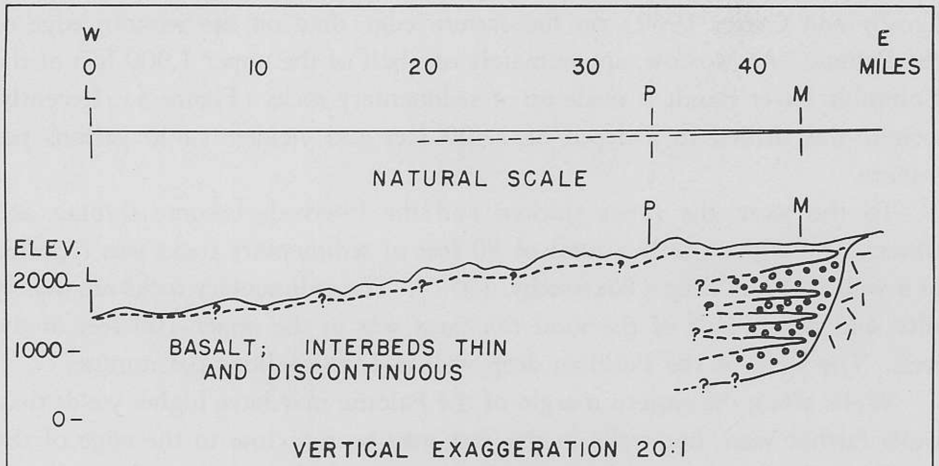

FIG. 3

HYPOTHETICAL EAST-WEST GEOLOGIC SECTION ACROSS THE "PALOUSE" IN WHITMAN CO., WASH. & LATAH CO., IDAHO

because it has very low permeability and yields only small quantities of water to wells. Large-diameter dug wells have been used to supply water for domestic use.

The basement of metamorphic and igneous rocks is a very poor aquifer. As a general rule, drilling should be stopped when these rocks are reached. I do not know of any large yields out of the basement rocks, but I do know of some very deep and very dry holes in them.

The Columbia River Basalt is the principal aquifer in the Palouse. Water is obtained from two kinds of permeable layers: (1) various kinds of broken basalts, generally at the tops or bottoms of basalt flows; (2) sediments interbedded between basalt flows. If the sedimentary interbeds are sandy, large amounts of water may be obtained; on the other hand, silty interbeds yield little water. A layer of sediments commonly lies between the lowest basalt flow and the basement; this layer is a potential aquifer provided that sufficiently permeable zones are present.

The most productive well generally is the well that cuts the greatest number of permeable zones. In the Columbia River Basalt, the most successful well is the well that passes through the largest number of flow tops and flow bottoms and the sandiest and thickest of interbeds.

The basalt flows are thinner and the interbeds are sandier (Stevens, 1960;

Crosby and Cavin, 1960) on the eastern edge than on the western edge of the Palouse. At Moscow, appoximately one-half of the upper 1,000 feet of the Columbia River Basalt is made up of sedimentary rocks (Figure 3). Recently, a well was drilled to a depth of 1,300 feet and yielded 1,800 gallons per minute.

To the west, the flows thicken and the interbeds become thinner and siltier. At Pullman, only a total of 80 feet of sedimentary rocks was reported in a well 954 feet deep (Foxworthy, 1957). The sedimentary rocks are mostly silts, and nearly half of the total thickness was in the upper 100 feet of the well. The yield of the Pullman deep well is 1,000 gallons per minute.

Wells along the eastern margin of the Palouse may have higher yields than wells farther west, but wells in the east may be too close to the edge of the aquifer and may deplete the ground water supply by pumping in excess of available recharge. Records at Moscow and Pullman show a long-continued decline in yields and depths to water because of overpumping (Stevens, 1960; Foxworthy and Washburn, 1957).

According to Vogt and Hyman (1959), the number of water witches is greatest where chances are smallest that any one well will be successful. They state that in the Columbia Plateau the ratio of witches to population is the highest in the United States. The reason is not that water is scarce, but rather that the permeability of the Columbia River Basalt is extremely variable. A well that yields large quantities of water can be drilled within a few tens of feet of a well that was a dry hole. The deep wells at Moscow and Pullman demonstrate that large permeabilities do exist, but, as yet, the geologist does not have enough data on the stratigraphy of the Columbia River Basalt to predict depths to permeable layers. However, the U.S. Geological Survey plans to begin a ground-water study of Whitman County in 1962 and several people are now working on the stratigraphy of the Columbia River Basalt in the central and eastern Columbia Plateau. In a few years, the stratigraphy and ground-water geology of the Palouse will be well enough known that depths to permeable layers can be predicted. However, geologists will still have difficulty in predicting horizontal variations within the permeable layers in order to select exact locations for wells. Accordingly, the witches will still be with us.

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