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PROBLEMS ASSOCIATED WITH THE EXTENSION OF THE STRATIGRAPHIC

UNITS OF SOUTH-CENTRAL WASHINGTON

Part II: The Post Basalt Sediments

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PROBLEMS ASSOCIATED WITH THE EXTENSION OF THE STRATIGRAPHIC
UNITS OF SOUTH-CENTRAL WASHINGTON

Part II: The Post Basalt Sediments

INTRODUCTION

This is the second of two reports dealing with the problems associated with the extension of stratigraphic units in South-Central Washington. The first report dealt mainly with the late basalt flows, the Ellensburg Formation and the lowest part of the Ringold Formation. This report concerns itself primarily with the post-basalt sediments, which include the Ringold Formation, Palouse soil, Touchet beds, and the glacial outwash gravels.

New field evidence, discovered in recent years, makes possible the correlation of the fluvial, glaciofluvial, lacustrine, and eolian deposits which overlie the Columbia River Basalt in this part of Washington. There are several problems associated with making such correlations, however. One of the most significant of these is in the use of obsolete descriptions of these sedimentary deposits at their type localities. Another problem is the glaring lack of formal names to which three of these four units can be referred.

This paper will describe the four principle stratigraphic units as they are found in the Pasco Basin and present a possible chronological sequence of events to explain the various relationships observed between each of those units at that site. Several published descriptions of those stratigraphic units will be discussed to illustrate the problem of correlating those sediments from one area to another. This paper will show that by properly extending and defining those units at their type localities simplified correlations throughout the entire region of South-Central Washington are then possible.

POST BASALT SEDIMENTS IN THE PASCO BASIN

There are four distinct rock assemblages which overlies the basalt bedrock within the Pasco Basin. In ascending order these are the Ringold Formation, the Palouse soil, and the Touchet sediments and the glacial outwash gravels which are largely contemporaneous.

The Ringold Formation is a lacustrine and fluvial deposit which has accumulated to a thickness ^{greater than} ~~of over~~ 1,200 feet. That formation consists of sand, gravel, clay, and silt with some beds of volcanic ash. Most of these materials were deposited in a shallow lake formed during Pliocene-Pleistocene time by the rise of the Horse Heaven Hills athwart the course of the Columbia River.

Three lithologic zones ^{are} ~~have been~~ recognized within the Ringold Formation in the central part of the Pasco Basin. These zones are characterized by their local names as the lower "blue clay" zone, the middle conglomerate zone, and the upper silt zone. The blue clay zone was so named for the blue-gray to greenish sandy silts and clayey silts with local gravels that lie directly on the basalt bedrock. The sediments in this lower zone are believed to be correlatable, at least in part, with the Ellensburg beds exposed to the west of the Pasco Basin. With ~~differential~~ movement along the Hog Ranch axis to the west, the Ellensburg sediments in the Pasco Basin gradually became isolated from the main deposit in the Ellensburg-Yakima region. These remnant Ellensburg beds of tufaceous andesitic to basaltic gravels were soon buried beneath more exotic-type (quartz-and mica-rich) sands and gravels of the Columbia River. The characteristic blue-green color of the silts and clays indicate the typical reducing environment in which these materials have remained since their deposition. The middle zone of the Ringold Formation is made up largely of cemented sands and gravels. This middle conglomerate zone represents an old gravel train of the Columbia River which extends from Sentinel Gap in the Saddle Mountains southeastward toward Wallula Gap in the Horse Heaven Hills. The percent gravel in this middle zone decreases with increasing distance

normal to the lineation of the gravel swath, and particularly to the northeast. Beds of silt and clay within the middle zone show that conditions were somewhat the same as those which existed during the deposition of the lower Ringold member, and indicate that a gradual transition between these two zones occurred rather than a sharp change. Complex interfingering, pinching out and lensing of the beds indicate a combination of a flood plain and stream delta environment, one in which the stream frequently changed course in response to flow rate and volume changes and one which discharged into a shallow lake.

The remnant upper zone of the Ringold Formation, dominantly lacustrine, as exposed in the White Bluffs, is composed of fine sands and silts. Although these sediments represent a sharp change upward from the middle Ringold in the White Bluffs, well data both in the basin center and in the Irrigation Project area show what is believed to be a more normal size gradation there. Mineralogically, the upper Ringold sediments are similar to the earliest eolian sediments found in the Pasco Basin. Analyses of samples show ^{that} both of these deposits have similar grain-size distributions and heavy mineral compositions. This evidence suggests that the upper Ringold beds, as exposed in the White Bluffs, represent an accumulation of fine-grained sediments in a shallow Ringold lake. These sediments were transported into an arid Pasco Basin by wind as well as water. After the lake disappeared the winds apparently decreased in velocity leaving a relatively gentle and stable land surface across which the Columbia River meandered. During this period a thick layer of caliche formed near the land surface in both the Ringold and eolian sediments. Following the formation of the caliche layer the winds ~~again~~ increased to sufficient velocity to again cause severe dust storms. These fine wind-blown materials blanketed the land surface deepening the existing eolian deposits and forming new deposits on top of the upper Ringold surface.

As the Wisconsin stage neared its end, rivers, having a northerly source, increased significantly in size as a result of large volumes of meltwater entering

~~entering~~ these rivers at their headwaters. As the lobes of the ice sheet melted, ice-marginal lakes ponded behind these lobes gave way and released tremendous quantities of water to the already swollen rivers. Again a lake was formed, this time behind a narrow restriction in the Columbia River gorge below The Dalles. Brought down with these flood waters were huge quantities of fine- and coarse-grained sediments. These sediments soon started to fill the lake in the Pasco Basin; the coarse-grained sediments confined to the stream channel and delta regions and the fine-grained sediments to the slack-water areas of the lake. Flooding was cyclic during this period with the size of the lake constantly fluctuating in response to each flood stage. Evidence for this is found in the offlap-onlap relationship between the coarse-grained and fine-grained sediments in the central part of the basin. Locally the fine-grained lacustrine sediments are referred to as Touchet beds and the outwash gravels as the glaciofluviatile deposits, but no formal name has been given to these sediments.

PUBLISHED DESCRIPTIONS OF STRATIGRAPHIC UNITS

Of the four stratigraphic units described above only the Ringold has been given official formational status. The description, from Merriam and Buwalda (1), is as follows;:

"Chiefly light-colored muddy sandstone and sandy clays, and in minor part fine gravels, volcanic ash, and calcareous strata. They clearly represent a formation distinct from the Ellensburg, as indicated by their faunas and by the physical evidence. Known thickness is 500 $\pm$ feet, but as Columbia River has not cut down to base of the formation the total thickness is not known. Appears to occupy an area of at least 300 square miles and may extend over 500 or 600 square miles. These beds have formerly been included in Ellensburg Formation (Miocene) as that name has been applied in this area, but they are now known to be younger than Ellensburg, and evidence favors Pleistocene, rather than latest Pliocene as their age."

Newcomb (2) extended the Ringold Formation to include beds which lie below the level of the Columbia River down to the underlying basalt. On the basis of data obtained from drillers' logs, he also recognized the three zones of the Ringold and traced them westward across the Pasco Basin. In 1960, Brown

and Brown (3) described the relationship between the lowermost beds of the Ringold Formation and the Ellensburg Formation. They showed that differentiation between these two formations could be made on the basis of rock types or source material, and that in the western part of the Pasco Basin basaltic and andesitic materials (Ellensburg) grade upward into exotic gravels typical of the Ringold Formation. On the basis of this work they concluded that the Ringold extended back to early Pleistocene or even Pliocene. In 1960 Brown (4) made a mineralogical study of the Ringold Formation. These data showed a striking relationship between the lower beds of the Ringold and the Ellensburg; a marked difference between the middle and upper Ringold zones; and strong correlation between the upper Ringold beds, the Palouse soil of eastern Washington, and the eolian deposits which overlie the Ringold Formation in the Pasco Basin.

In view of the above information the Ringold Formation possibly can be extended up the Yakima Valley and into the Walla Walla Basin to include the blue clays which can be traced from the Pasco Basin into those areas. The cemented sands and gravels of the middle Ringold zone may be equivalent in age to the thick wedge of cemented sands and gravels which occurs in the Lewiston Basin, and may even have been deposited as the result of the same climatic, or even interglacial, event. Recognition of these possibilities and ultimately redefinition of the Ringold Formation to formally include the lower and middle members and more sharply define the formation relationship to the Ellensburg Formation will be a significant contribution. Its extension to include those immediately adjacent deposits which now have no designation then may be feasible.

The upper Ringold, the entire formation as first described by Merriam and Buwalda, can be traced eastward into massive buff-colored silts described as Palouse soil. The Palouse soil is the generally accepted name for the loessial deposit which blankets the basalt plain in eastern Washington. Treashers' description (5) of this material follows:

"Of all the evidences with reference to Palouse loess, by far the greater part indicated (1) water deposition rather than eolian; (2) that the laminated phase is older than the massive phase. The laminated loess may have been deposited either in a lake, or on a flood plain, or a combination of both."

Treasher and others ~~have~~ proposed a formational name for the Palouse soil, but because of the many conflicting opinions regarding its origin it never achieved this rank.

From the description of the upper Ringold and the eolian deposits in the Pasco Basin given earlier, it appears that Treasher was describing the upper Ringold in his older laminated phase and the eolian or Palouse soil in the upper massive phase. This paper does not suggest that the Ringold Lake in which the upper Ringold beds were deposited in the Pasco Basin extended so far eastward as to include the laminated beds observed by Treasher. Rather, it is believed that many small lakes dotted the broad plain to the east and that the laminated phase of the Palouse soil may be equivalent in age and mode of deposition to the upper Ringold beds. Such an interpretation would greatly simplify the stratigraph and allow for a broader regional correlation of these deposits.

The name Touchet beds was first used by Flint (6) to describe fine-grained sediments of fluvial and lacustrine origin. He described them as being "buff to cream-colored silt and fine sand with erratic stones, grading stratigraphically and topographically into the scabland fill. The deposit ranges from a barely appreciable veneer to more than 100 feet in a single exposure." Allison (7) recognized these fine-grained sediments as being lacustrine but did not call them by any particular name. The only theory postulated for the formation of the lake into which these sediments were deposited was a blockade of the Columbia River in the gorge below The Dalles by ice jams, landslides, or a Mt. Hood valley glacier. Unfortunately, ^{the occurrence} ~~no evidence~~ of such events are ^{not} ~~not~~ evident on the wall of the Columbia River gorge there. Bretz (8) states, "an ice jam, capable of withstanding the pressure of at least 900 feet of water is a herculean requirement" and implies that it would not have sufficient strength to hold back a lake of this size.

This is probably true, but the fact that a lake did exist during this period cannot be denied on the basis of field evidence. It is not difficult, however, to show a mechanism by which this lake could have formed without resorting to a blockage of the Columbia River as Flint and Allison proposed. Assuming a flood, the size as that postulated by Pardee (9) and accepted by Bretz, of nine and a half cubic miles of water per hour for a period of two days the Columbia River would have to maintain a velocity of over 100 feet per second to accomodate a discharge of this magnitude through the Wallula Gap. A gap of even smaller cross sectional area exists below The Dalles and probably was the controlling topographical feature in the discharge of this flood water to the Pacific Ocean. Such a restriction would tend to regulate the flow of water down the Columbia River gorge and the excess water would be backed upstream forming a temporary lake. A lake formed in this manner would also explain the upstream-dipping beds of the Touchet deposit described by Bretz.

If the Touchet beds can be shown to be dominantly lacustrine and the fine-grained phase of the outwash gravels, they can be extended farther to the north into the scabland tract.

The coarse-grained sediments have been described by many geologists working in South-Central Washington but were never given a stratigraphic name. These sediments represent a distinct rock assemblage and could logically be assigned a name which would greatly simplify the mapping and description of the stratigraphy in this region.

SUMMARY

There are four distinct stratigraphic units within the Pasco Basin which if interpreted on the basis of recent field evidence and described properly could be traced over most of Southeastern Washington. At the present time these post-basalt sediments are described in the literature in such a way as to make extensive correlations impossible. Some descriptions overlap more than one

unit whereas others describe only a part of the unit. We propose that all interested geologists in the Pacific Northwest now consider reconciling the differences which exist in the names and descriptions of those sedimentary deposits in light of this new evidence.

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