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# The Ore Bin



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# The Ore Bin

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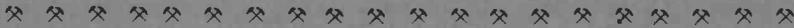
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for compiling this information will be appreciated.

## OREGON ROADS IN 1910

A recent search through the Department's ancient picture files revealed some wonderful photographs of Oregon roads taken 60 years ago. Some of the pictures are shown on the following pages.

Most of these photographs were taken in 1910 to illustrate Bulletin 1 "Road Materials in the Willamette Valley," published in January 1911 by the then new Oregon Bureau of Mines, an early predecessor of the State of Oregon Department of Geology and Mineral Industries. The bulletin stated as its purpose "... to set forth in plain language the fundamentals of geology as they apply to the principles of scientific road building...." According to the bulletin, the road builder was usually not sufficiently well versed in geology to be able to distinguish good, medium, and poor quality material, and he would often transport his rock long distances at extra cost when as good or better material was close at hand.

The bulletin provided the road builder with information on the location of quarry rock, its origin, composition, and physical properties, its performance under wear, and other basic data. Basalt, which was then and still is abundant in and along the margins of the Willamette Valley, was shown to be the most suitable type of rock for road material. The greater use of Willamette River gravel was highly recommended, however, since it could be dredged, crushed, and put on the road with much less expense than quarry rock. Among the agencies then in existence that assisted the road-materials survey were the Oregon Good Roads Association and the Department of Good Roads, Washington, D. C.

A "good road" in 1910 was apt to be one that you did not get stuck in. It usually had a crown (raised in center) and was drained. A road with no crown and poor drainage became a mudhole (see photos). On the other hand, if the road had too much crown vehicles were forced to straddle the center and eventually wore ruts. Earth and plank roads had their place but the superhighways of the time were the macadam roads. In those days, macadam (named after John McAdam, a British engineer of the 19th century) was not an asphalt pavement but rather a compressed layer of crushed basalt, or "trap rock." Dust was one of its main components.

A good macadam road started with a well-drained, carefully prepared bed about 15 feet wide with a low crown and substantial shoulders. It was topped with a 6-inch layer of crushed rock, grading from about  $2\frac{1}{2}$  inches in size down to the fineness of powder, all wedged together by means of

rolling and water-flushing, which compacted the mass and forced the finer particles into the voids.

The nonmetallic industry, which provided the road-building materials, was in its infancy in 1910, but the decade marked the beginning of awareness that geologic information was vital to the prosperity of the people of Oregon and that a State agency to supply such information was essential.



The road to Forest Grove in 1910.



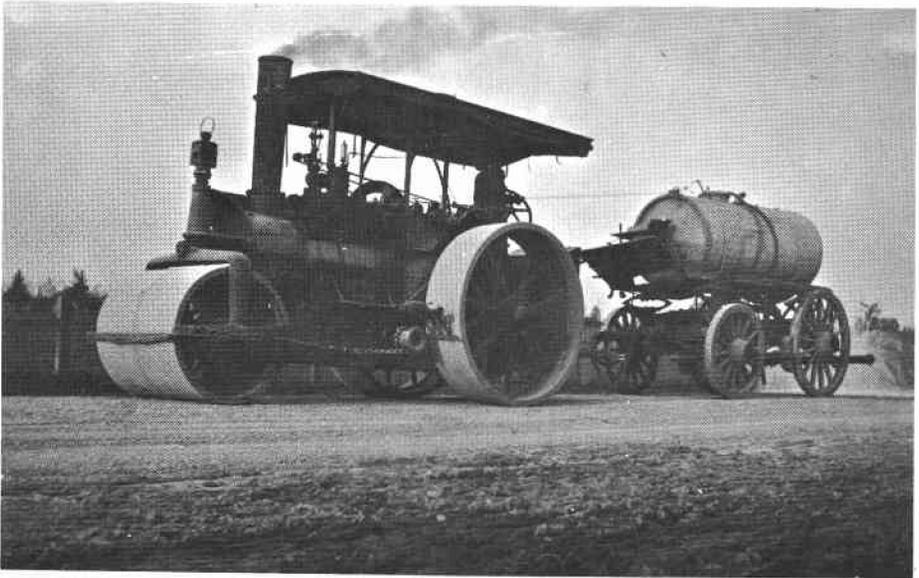
Unidentified basalt quarry in Willamette Valley in 1910.



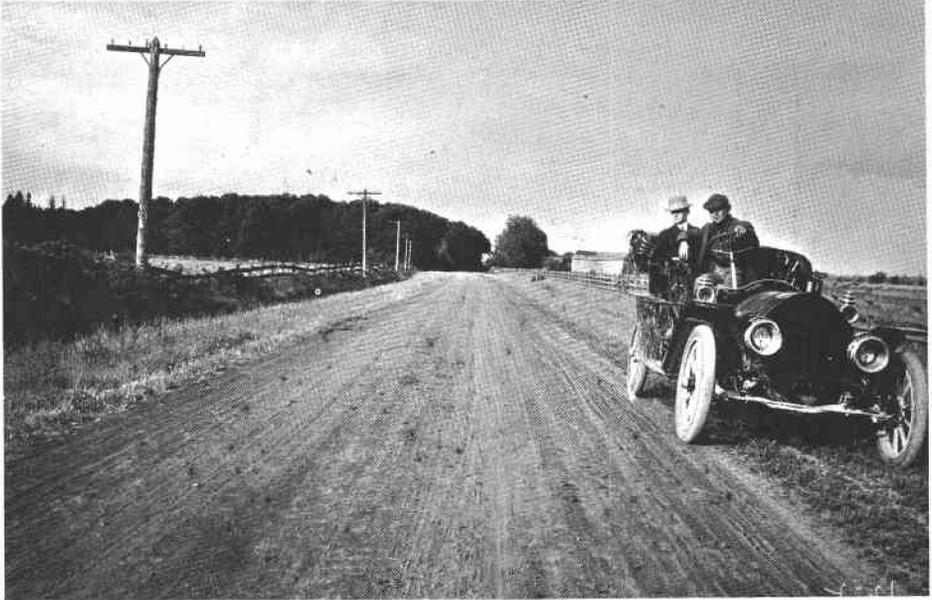
Ewald quarry,  $2\frac{1}{2}$  miles south of Salem in 1910. The dense hard, tough, and profusely fissured basalt was highly suitable for road rock.



Macadam road under construction at Hood River about 1910.



Rolling and water-flushing equipment used in constructing a macadam road in 1910.



Macadam road near the Salem Fairgrounds was designated as "U.S. Object Lesson Road."



Liberty road near Salem in 1910.



Neglected macadam road near Forest Grove in 1910.



Plank road at Forest Grove about 1910.



Earth road near The Dalles about 1910.



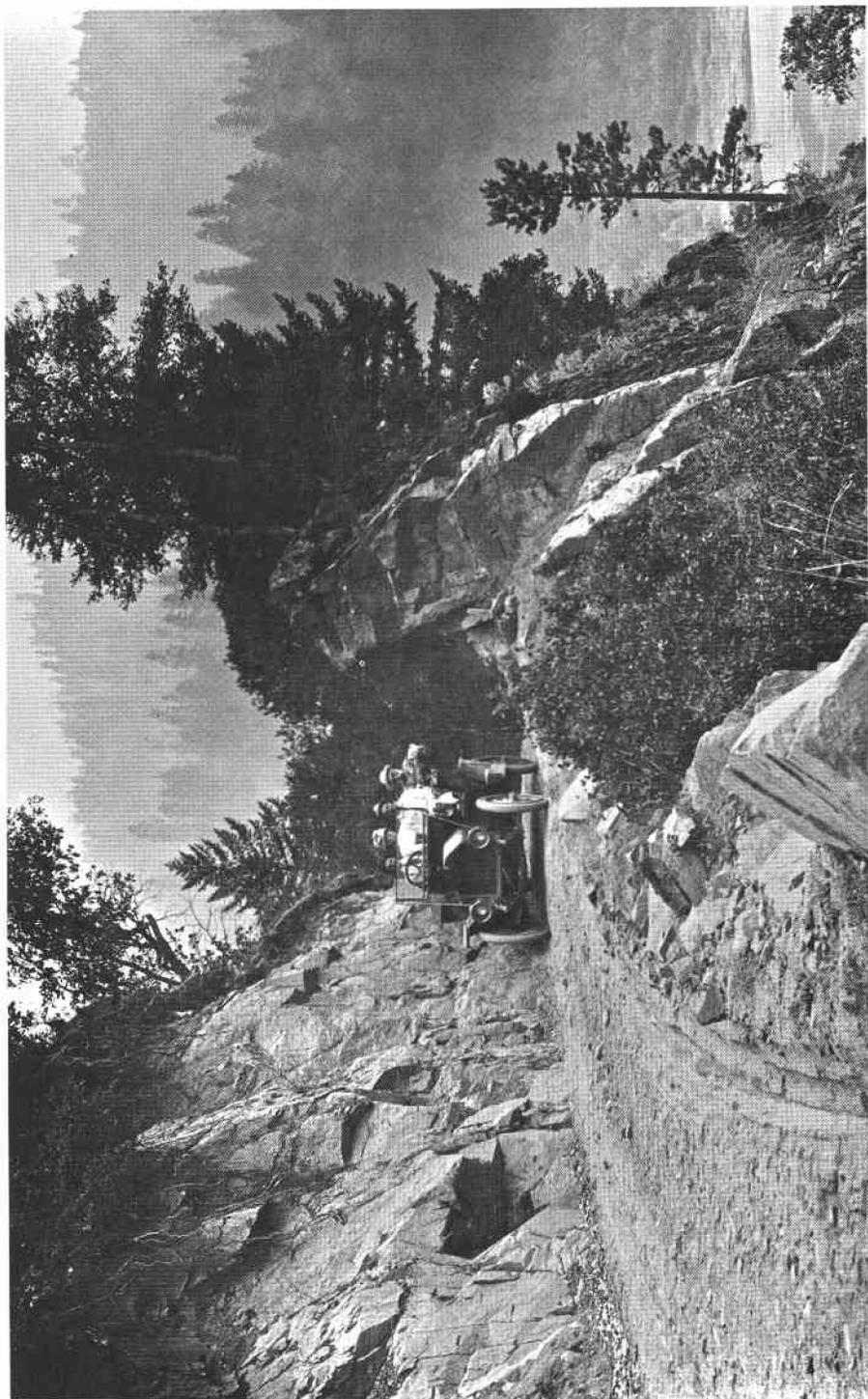
Macadam road at Pendleton about 1910; slightly ravelled surface was due to extremely dry weather.



Germantown Road near Portland in 1910 showing proper location of a macadam road in hilly country.



Another view of Germantown Road.



A Sunday drive along the Rogue River from Grants Pass to the Galice gold mines. Date unknown.

## MINING INDUSTRY FACES TWO-FOLD CHALLENGE

Meeting the constantly increasing demand for minerals in the future poses a dual challenge to the mining industry, according to Hollis M. Dole, Assistant Secretary of Interior for Mineral Resources.

Speaking before the Fall meeting of the Society of Mining Engineers in Seattle, Washington, September 22, Dole noted that not only would the mining industry have to advance its technology to provide the increased production needed, but also it must make its peace with a public now sensitized to environmental considerations. He warned that the latter task may prove to be the more difficult.

"Mining, indeed industry at large," Dole said, "has emerged as the villain in the bitter controversy over environmental protection." He noted that irresponsible actions on both sides of the controversy had made reconciliation difficult. "The industry was judged, found guilty, and by some extremists at least, sentenced to be hanged by the neck until dead. It is now up to the industry to correct the impression of it that has been implanted in the public mind, and to which its own irresponsible elements have contributed," he said.

Dole went on to point out that no retreat is possible from the high-income, high-production, high-consumption society in which we are living, which fulfills the American aspiration for comforts and conveniences. "More want in than want out," he concluded.

Providing all the minerals the nation needs while giving adequate protection to the environment will add to present costs, Dole warned, and the public must understand this fact. What must be made clear to the public --clearer than it has in the past--is that ecology is closely related to economics, and that if we are to have both affluence and environmental quality we will have to pay more than we did for affluence alone."

Dole said he was encouraged by evidence that the mining industry is now making up for its slow start in the environmental cleanup campaign, and expressed hope that all mining firms would follow the lead of the enlightened operators in controlling and repairing environmental damage. He cited the Mining and Minerals Policy Act passed by the last Congress, and the Mined Areas Protection Act now before the present congress, as examples of needed legislation to enable the mining industry to meet its social responsibilities. He praised the reorganization plan proposed by President Nixon which would create a Department of Natural Resources to handle the Federal government's responsibilities for protecting and developing the nation's natural resources, including those related to energy and minerals.

The Society of Mining Engineers is a national organization affiliated as a constituent society of the American Institute of Mining, Metallurgical and Petroleum Engineers. Its headquarters are in New York.

\* \* \* \* \*

# DESCRIPTION OF THE FERRUGINOUS BAUXITE ORE PROFILE IN COLUMBIA COUNTY, OREGON

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## Introduction

A bulk sampling program by Reynolds Metals Company during the summer of 1970 provided good exposures of the Pacific Northwest laterite.\* Prior to the opening of the pits, geological observations were limited to drill cores and a few relatively shallow cuts on hillsides. The pit faces in the mining undertaking were nearly vertical, exposing excellent 20- to 40-foot cross-sections of the overburden and ore. Detailed mapping by the author and John W. Hook, District Geologist, Reynolds Metals Co., revealed many features of interest; therefore, the purpose of this report is to supplement previous papers describing the ferruginous bauxites in northwestern Oregon.

The discussion of the laterite in this report pertains mostly to two prospect pits approximately  $3\frac{1}{2}$  (pit 1, figure 1A) and  $4\frac{1}{2}$  (pit 2, figure 1B) miles northwest of St. Helens, Columbia County, Oregon. Of the features under discussion many also were observed in Washington County, Oregon, and Cowlitz and Wahkiakum Counties, Washington.

For this study, the bauxite ore is arbitrarily defined as: 1) having no more than 10 percent silica, and 2) having no less than 30 percent alumina.

## General Stratigraphy

The laterite deposits in northwestern Oregon have developed on the upper flows of the Columbia River Basalt of Miocene age (Libbey and others, 1946). In most areas, a tan to red silty clay formation of Pliocene age overlies the bauxite (Lowry and Baldwin, 1952). The tan silt-like material occurs in the upper portions and transitionally grades at depth to a weathered mottled clay. The thickness of this formation ranges from 0 to greater than 30 feet.

## Form of the Ore

The ore horizon lies above the ground-water table as sheet-like deposits along tops of well-rounded hills and ridges. In a few localities, the

\* Pit faces are no longer exposed for study. The Reynolds Metals Co. has followed ecological procedures of filling pits, recontouring surfaces, and replanting.

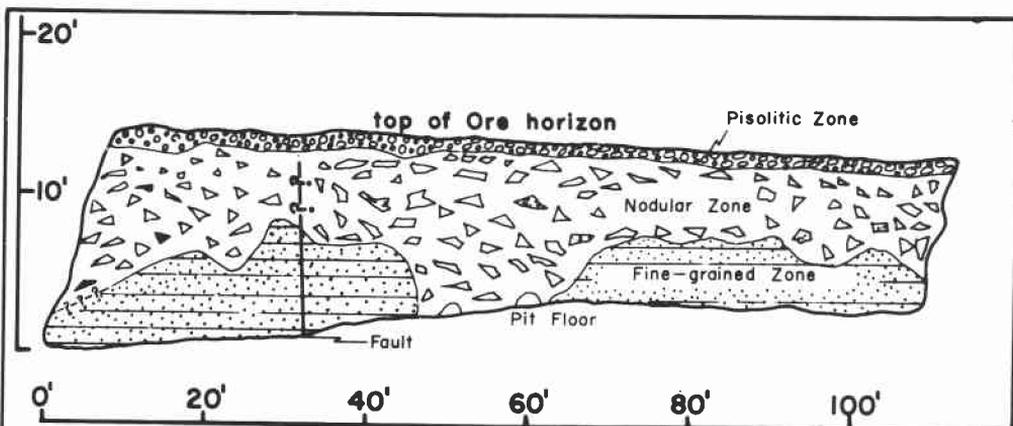


Figure 1A. Profile of the ore horizon at pit 1 showing textural zonation. Note the hummocks of the fine-grained zone. The intermediate nodular zone often drapes over the fine-grained zone and forms an undulating to "V"-shaped profile. Silt overburden is not shown.

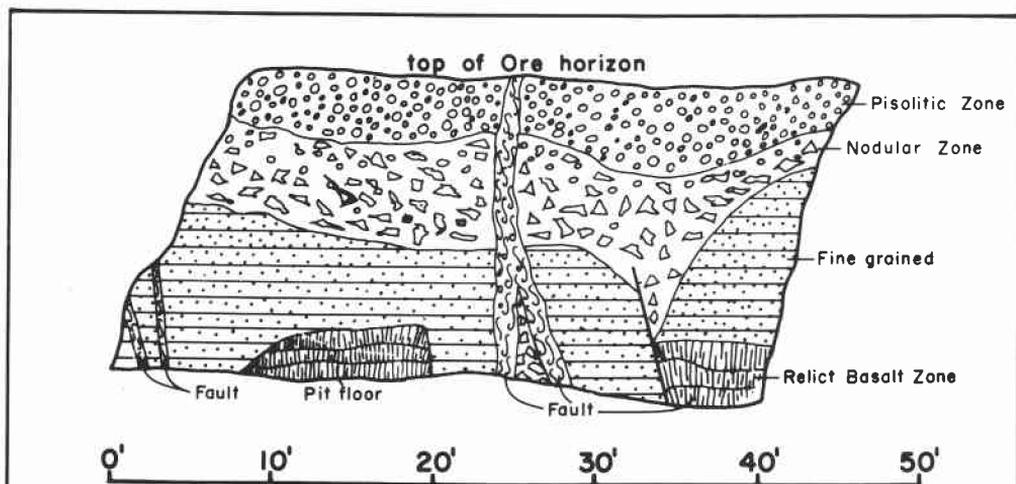


Figure 1B. Profile of the ore horizon at pit 2 showing textural zonation and faults. The fault zone consists of mottled clay with scattered pisolites. Silt overburden is not shown.

bottom and top contacts "drape" over the topographic highs. Locally, the bottom is quite irregular and often grades downward to a varicolored clay. The irregularities may be partially attributed to differential weathering of the basalt flows.

## Character of the Ore

The bauxitic material usually contains three mappable textural units referred to here as, in descending order, the pisolitic, nodular, and fine-grained.\* Figures 1A and 1B diagrammatically illustrate the "stratigraphic" position of these zones. In some areas, the textural zones are not easily distinguishable.

Allen (1948) and other workers have determined the mineralogy of the ferruginous bauxite and aluminous clays in Oregon. They reported that the chief aluminous mineral is gibbsite; the iron minerals are mainly goethite, hematite, "limonite," ilmenite, magnetite, and titaniferous magnetite, and the aluminous clays are composed predominantly of kaolinite, with minor amounts of halloysite.

Laterization involves a chemical breakdown of the parent material in which iron, titanium, and aluminum are concentrated and silica, alkalis, and alkaline earth are removed by leaching. A typical distribution of the principal laterite elements in Columbia County is shown diagrammatically in figure 2.

Normally, there are distinct visual differences between the top of the ore and the overburden. The ore is tough although friable, reddish and often pisolitic, whereas the overburden is tannish to mottled, plastic-like, soft and clayey.

### Pisolitic zone

The pisolitic zone (figures 1A and 1B) contains abundant reddish-brown pisolites in a reddish-brown to red, fine-grained, earthy matrix. Most pisolites are hard, magnetic, well-rounded to sub-rounded, and have a steel-black opaque core surrounded by an earthy oxidized rim. The smallest are less than 1/32-inch in diameter, the largest more than 1/2-inch. Frequently well-rounded to irregularly shaped nodules and pebbles composed entirely of pisolites are scattered through this zone. Libbey and others (1946, p. 16-17) found the pisolitic material is composed of "limonite," magnetite, gibbsite, cliachite, and goethite.

Forty-five core samples from the pisolitic zone at pit 1 and pit 2 averaged 11% SiO<sub>2</sub>, 31% Al<sub>2</sub>O<sub>3</sub>, 35% Fe<sub>2</sub>O<sub>3</sub>, 5% TiO<sub>2</sub>, 16% L.O.I. (loss on ignition). The silica content is relatively high and often exceeds the

\*Libbey and others (1946, p. 15) discussed three textural types as pisolitic ... "a softer earthy variety... and a hard porous granular type."

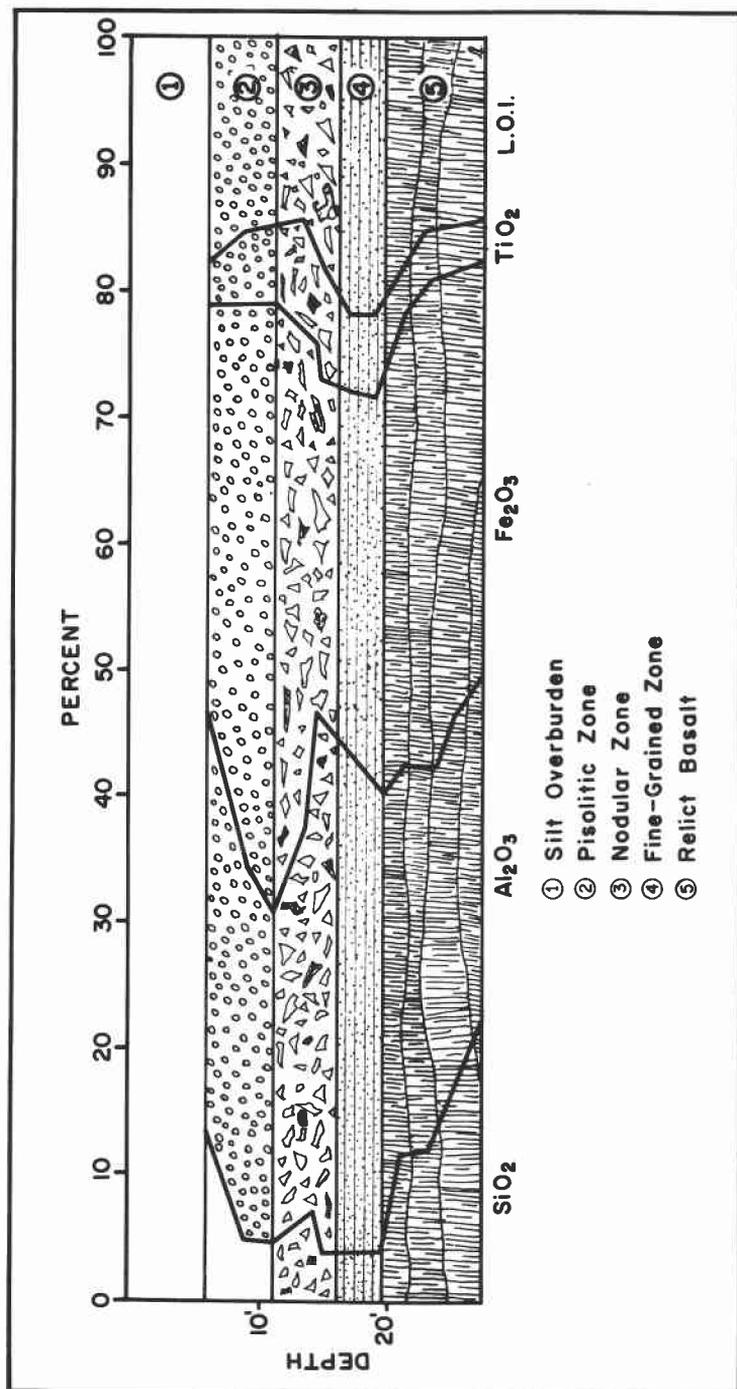


Figure 2. Chemical laterite profile of one core hole at pit 2.

10 percent cutoff for ore. However, recent analysis indicates that much of this is free silica. Livingstone (1966) studied the bauxites in southwestern Washington and identified quartz in the pisolitic material, which would at least account for part of the free silica; the writer suspects free silica also occurs partially in the form of crystalline quartz in Columbia County. Some origins for quartz in the bauxite are: first, quartz is residual from secondary quartz (agate or chalcedony) in the basalt; secondly, it is introduced by wind-blown or water-laid processes; thirdly, it is authigenic, being derived from the overlying silty clay formation. Evidence drawn from field observations tends to best support the authigenic origin. The lower portions of the silt have been weathered to a red mottled clay. Chemical breakdowns of the silicate minerals freed the silica, which was carried downward by solution to be partially precipitated as crystalline quartz in the pisolitic unit.

The contact with the underlying nodular unit is seldom sharp, but usually the transition occurs within 1 to 2 feet.

### Nodular zone

The nodular zone (Figures 1A and 1B) consists of unevenly distributed, hard, irregularly shaped gibbsite and "limonite" nodules in an orangish to brownish earthy bauxite matrix. A few pisolites may be scattered throughout the nodular zone. The gibbsite nodules are pink, creamy or gray, and are hard and porcelaneous to earthy. The "limonite" nodules are opaque, steel black, and sometimes platy; some have weathered to a yellowish-brown hard, earthy material. Gibbsite nodules are normally less than two inches in their longest dimensions and the "limonite" nodules vary from a few inches to nearly a foot. Also occurring in the nodular zone are patches and streaks of bluish-gray earthy gibbsitic material.

The average chemical composition of 45 core samples from the nodular zone at pit 1 and pit 2 is: 8% SiO<sub>2</sub>, 34% Al<sub>2</sub>O<sub>3</sub>, 35% Fe<sub>2</sub>O<sub>3</sub>, 5% TiO<sub>2</sub>, 20% L.O.I. Free silica content is nil.

The top of the nodular zone is relatively smooth, but the bottom is irregular and "drapes" over hummocks of the underlying fine-grained zone, giving a distinct undulating to V-shaped profile in cross-section (figure 1A). The contact between the two is gradational, but in some places it is quite sharp where it "drapes" over the hummocks and forms a thin parting.

### Fine-grained zone

The fine-grained laterite (figures 1A and 1B) is characterized by its texture, brownish color, and disseminated black, angular, hard metallic grains. The unit is durable, friable, feels gritty, and has a massive to platy structure. The metallic grains are often equidimensional and display varying degrees of magnetism; sometimes they are concentrated, forming nodules. Most are less than 1/32-inch in diameter. The grains are thought to be

composed of magnetite and ilmenite or a combination of both (titaniferous magnetite).

Fifty-six core samples from the fine-grained material at pit 1 and pit 2 averaged 5%  $\text{SiO}_2$ , 35%  $\text{Al}_2\text{O}_3$ , 33%  $\text{Fe}_2\text{O}_3$ , 6%  $\text{TiO}_2$ , 20% L.O.I. Free silica content is nil. In Columbia County this material was consistently lower in silica and iron and somewhat higher in alumina than either the intermediate nodular zone or the upper pisolitic zone.

The base of this unit is usually the bottom of the ore and physically and chemically changes downward to a kaolinitic-like clay. The bottom of this ore is locally quite irregular owing partially to differential weathering.

Relict basalt zone (usually is not ore, but as a matter of convenience is included in this section)

The relict basalt zone (figure 1B) underlies the ore horizon and is characterized by the spheroidal weathering pattern of the basalt "boulder" with associated fractures containing gibbsite, "limonite," black  $\text{MnO}_2$ , and clay. The weathered material is typically clayey, soft, plastic, varicolored, and often has a salt and pepper (basaltic) texture. Dominant colors are shades of purple and pink with bright red to orange streaks along fractures.

At pit 2, a spheroidal weathered basalt boulder approximately 12 inches in diameter was found in this zone. The central portions contained unaltered basalt; the outer portions have been weathered to a bauxitic clay. The boulder is unique because it represents the laterization sequence of basalt in small scale.

The relict basalt zone as discussed here extends to the unaltered parent material and may be greater than 100 feet thick (John W. Hook, personal communication 1971).

#### Other Features

The ore horizon contained many small faults having slickensides, well-defined strikes, and nearly vertical dips, but little measurable displacement. Most faults were striking in a westerly and northwesterly direction. The fault zones were from a fraction of an inch to more than 2 feet thick and were filled with material similar to the overburden. The most predominant fault at pit 2, for example, contained red mottled clay with scattered pisolites extending from the top of the ore at least 20 feet to the pit floor. In most cases, they did not extend into the overburden. Analysis of the fault zones shows a high silica content, 25 to 35 percent.

## Summary and Conclusion

The ore horizon at two prospect pits in Columbia County, Oregon contained three mappable textural zones referred to, in descending order, as the pisolitic, nodular, and fine-grained. The uppermost pisolitic zone tends to have a relatively high silica content. However, recent analysis shows a large portion of this is free silica. The intermediate nodular zone "drapes" over the hummocks of the lowermost fine-grained zone to form a distinct undulating to V-shaped profile in cross-section. Other pits had similar textural zonation. Locally, the bottom of the ore is quite irregular owing in part to differential weathering of the upper flows of Columbia River Basalt. Many other features were found including faults filled with material similar to the overburden.

The physical and chemical mechanism that formed the different textural varieties and zonation is not understood. Libbey and others (1946) concluded that the seasonal fluctuation of the ground-water table may be the most important factor. The information reported in this study is not adequate to allow an interpretation of the origin. Further studies are necessary to decipher the chemical history of the textural phenomena.

## Acknowledgments

The author is indebted to John W. Hook for the help he has given in preparation and interpretation. Many thanks to Professor Marvin H. Beeson, Professor John E. Allen, and Dr. John H. Moses for constructive criticism of the manuscript. Grateful acknowledgment to Reynolds Aluminum for use of their chemical data and for their permission to publish this report.

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## ENGINEERING GEOLOGISTS MEET IN PORTLAND

The Portland Section of the Association of Engineering Geologists hosted the 14th National Meeting at the Hilton Hotel in Portland, October 10-22, 1971. The meeting was attended by more than 400 persons coming from 29 states, the District of Columbia, and three Canadian provinces.

The technical program comprised two concurrent sessions on October 21 and two symposia on October 22. Approximately 30 papers were presented at the session, abstracts of which appear in the AEG program. The symposia, "Instrumentation -- Practical Application and Results" and "Rock Support Systems -- Underground and Open Excavations" are expected to be published in an early issue of the AEG Bulletin.

Included in the 1971 event were three pre-meeting excursions: to the Oregon Coast; to Mount Hood via Bonneville Dam and Hood River; and to features of geologic interest in the Portland area. Engineering works in the Columbia Basin were visited on a 3-day post-meeting field trip.

Co-chairmen R. Kenneth Dodds and Jasper L. Holland had the support and able assistance of officers and members of the Portland Section of AEG, and of exhibiting firms and sponsors. Herbert G. Schlicker, engineering geologist for the Oregon Department of Geology and Mineral Industries, helped lead the Oregon Coast trip; and Norman S. Wagner, geologist in charge of the Department's Baker field office assisted with the Columbia Basin trip.

\* \* \* \* \*

## McKELVEY APPOINTED NEW SURVEY DIRECTOR

Dr. Vincent E. McKelvey was sworn in as the new Director of the U.S. Geological Survey by Secretary of the Interior Rogers C. B. Morton on December 8. Dr. McKelvey was most recently the Survey's Chief Geologist (see July 1971 Ore Bin). As Director of the Survey he succeeds Dr. William T. Pecora, who was named Under Secretary of the Interior Department last May.

\* \* \* \* \*

## CORRECTION ON FOSSIL LOCATION

It has been called to our attention that the location for the Eocene crustacea given in text and on map by Orr and Kooser, June 1971 issue of The ORE BIN (vol. 33, no. 6, pages 119 and 120) is in error. The location should read "T. 35 S." instead of "T. 34 S."

\* \* \* \* \*

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(Please include remittance with order. Postage free. All sales are final and no material is returnable. Upon request, a complete list of the Department's publications, including those no longer in print, will be mailed.)

BULLETINS

8.	Feasibility of steel plant in lower Columbia River area, rev. 1940: Miller	0.40
26.	Soil: Its origin, destruction, preservation, 1944: Twenhofel . . . . .	0.45
33.	Bibliography (1st supplement) of geology and mineral resources of Oregon, 1947: Allen . . . . .	1.00
35.	Geology of Dallas and Valsetz quadrangles, Oregon, rev. 1963: Baldwin	3.00
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