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APPLICATION OF GEOLOGY TO THE BUILDING AND REAL ESTATE PROFESSIONS IN THE PUGET LOWLAND METROPOLITAN AREA, WASHINGTON

By
Ernest R. Artim

Geologic problems in the State of Washington cost the people an estimated $100 million each year. Certain geologic problems, such as earthquakes and landslides, occur as natural geologic hazards inherent to the environment. Other problems, including instability of cuts, erosion, and water pollution, pose actual or potential threats because of unwise or poorly planned activities of man. Still others may have more to do with the economics of land use or development. These would include difficult excavation, expansive soils, or lack of nearby sources of earth materials suitable for fill. Sand and gravel and other raw materials for construction are of concern to planners and developers; but the economic geology of any mineral resource occurring within an area may have a critical bearing on local land use and development.

Landslides alone have been estimated to cost more than $5.6 million yearly in damages to the transportation routes within the state. King and Kitsap Counties suffer approximately $2 million damages each year from landslide-related devastation of private property (Coombs, 1974). Statewide, landslides have been estimated to cause nearly $20 million in damages each year. Some of the nearly $100 million total losses could be avoided by simply using the geologic information that is presently available when considering land use and land use plans.

However, much of the geologic information is not being utilized because of the following problems: the information may not be understood; there may be reluctance to expend time and effort to become informed; the applicability may not be recog-

nized; or the information may not be readily available. Because of the lack of utilization or the misinterpretation of geologic information, the result is sometimes poor land use and possible land or structure failure.

An excerpt from Urban Geology (California Division of Mines and Geology, 1973) states:

> Some of the problems, such as landsliding, and loss of mineral resources, can be solved to a large extent by the application of current state-of-the-art procedures. All that is needed is the requirement that appropriate known loss-reduction measures be applied and that the requirement be effectively enforced.

Steps in the development phase involve the building of structures and the sale of undeveloped land prior to construction. These are very critical phases of the development process; real estate brokers and home builders should depend heavily on the characteristics of the earth materials that determine how land, our most fundamental natural resource, can be most effectively and safely utilized.

In a study in Texas conducted by Mathewson and Ruckman (1974), it was indicated that real estate brokers and builders are not proficient in engineering or geology, nor do they intend to be. Respondents to a questionnaire stated that they did not feel it necessary to be knowledgeable in the field, and that if such information were needed, a consultant would be called. Mathewson and Ruckman further state their study revealed strong evidence that a basic awareness of the value of geology in land use decisions exists. They felt that real estate brokers and builders would use that advice if it were presented in an intelligible, but still informational, way.

Division Conducts Survey

A review of the study indicated that the results may not be applicable for a specific local area. Within the Puget Lowland geographic region of the State of Washington, there is a different attitude and less awareness of the value of geologic advice in land use planning and development. In order to test this hypothesis, that portion of Mathewson and Ruckman's survey utilized in determining their conclusions was duplicated in a survey conducted by the Washington Division of Geology and Earth Resources. The information gained from that questionnaire is also to be used as a guide by the Washington Division of Geology and Earth Resources in an effort to provide more meaningful and useful information to the general public and other governmental agencies.

Survey Outline

Questionnaires were mailed by our division to 285 real estate brokers and 100 builders chosen randomly from the Olympia-Tacoma-Seattle-Everett metropolitan belt of the Puget Lowland. The questionnaires were designed to evaluate the respondent's geologic knowledge and to determine what information was desired from the geologic profession. The survey was divided into two parts. Part A (Appendix A) had the dual purpose of determining the engineering and geologic vocabulary real estate brokers and builders have, and how engineering geology factors influence their land use analyses. The respondents were asked to rate each factor for its importance in a land use analysis, or to indicate that he did not understand the terms. Some factors that were not necessarily considered important or relevant were included in the questionnaire because they are presently an integral part of geologic reports. Part A was intended to answer the question "How much specialized geologic vocabulary and concepts can be used with real estate brokers and builders who are expected to use, or should use, geologic information"?

Part B (Appendix B) was designed to be a straightforward request for information. A list of engineering and environmental geologic maps was presented and the respondent was asked to select the maps that he would like to have available for a land use analysis.

Survey Results

The first part of this survey, a mixture of technical and nontechnical terminology, yielded results similar to that of Mathewson and Ruckman: Real estate brokers and builders are unfamiliar with engineering and geologic vocabularies (table 1). Technical factors—engineering soil properties—are rated lower than the more general factors—surface topography and surface drainage. Of the four categories listed in table 1, only hydrology has an overall high rating. Any differences in the results between real estate brokers and builders were probably not those of technical "know-how" but of what was considered important—a reflection of the fact that one group is involved in the sales aspect of land use and the other in the construction aspect. It was pointed out that had we changed the wording of some factors, the results would probably have been much different. For instance, change "modern Holocene geology" to "surface geology" or "surficial geology." Just the word association with "surface" appears to strike interest or recognition on the part of most laymen, but the purpose of this survey was to test the knowledge of real estate brokers and builders in regard to geologic and engineering vocabulary and concepts as they are presently being used.

The results from Part B (Appendix B) differed markedly from those of Mathewson and Ruckman (table 2). Their study indicated that requests for interpretive maps outnumbered those for technical maps by more than 3 to 1. Our survey did not prove the 3 to 1 ratio as indicated by Mathewson and Ruckman. In fact, their conclusion caused some concern as to what is a technical or interpretive map. In order to clarify the problem, we asked geologists to rate the maps. Eight geologists designated each of the 34 maps included in Part B as being either technical or interpretive. The eight geologists could agree on only 5 of the maps, and on the rest, there was approximately a 50-50 difference of opinions. The general consensus was that most of these maps could be either technical or interpretive, depending upon the methods of data collection, evaluation, and presentation.

Our survey did indicate that several currently available maps had no apparent value to the respondents. Chief among these was the "traditional" geologic map, which was requested by only 9 percent of the real estate brokers and by none of the builders. Generally, real estate brokers requested maps that pertain to land acquisition and development, whereas builders requested those maps that would aid construction. It was noted that several geologic factor maps were requested rather frequently: Slope stability—real estate brokers, 39 percent; home builders, 45 percent. Depth-to-water table—real estate brokers, 59 percent; home builders, 59 percent. Engineering geology recommended land use map—real estate brokers, 50 percent; home builders, 30 percent. This probably indicates an awareness of particular geologic factors that had previously caused problems for the respondents. A comparison of the map requests of this study with Mathewson and Ruckman's study reveals that the requests for engineering and environmental geologic maps in Texas were nearly twice as great as those in the Puget Lowland metropolitan region.

Factor ratings in Part A were correlated with map requests in Part B to evaluate inconsistencies. Correlations of specific factors generally coincided, but there were some notable contradictions: Forty-five percent of the real estate brokers requested an engineering soils classification map, yet 89 percent of the respondents had indicated they didn't understand the unified soils classification, or they considered it to be insignificant and of low importance in land evaluations. Ninety-two percent of real estate brokers and 93 percent of the home builders indicated that they considered surface drainage to be of high to extreme importance in the evaluation of a homesite, yet only 27 percent of the real estate brokers and 52 percent of the home builders requested a surface drainage map. There were other inconsistencies, such as the low rating for the geologic map

TABLE 1.—Engineering and geologic factor knowledge of real estate brokers and builders, based upon results of Part A survey

ENGINEERING GEOLOGY FACTOR	REAL ESTATE BROKERS						BUILDERS					
	Don't Know	Insignificant	Low	Medium	High	Extreme	Don't Know	Insignificant	Low	Medium	High	Extreme
	Percent of responses											
HYDROLOGY												
Surface drainage	0	0	0	5	21	71	0	0	0	7	45	48
Local hydrology	13	27	21	13	7	7	22	15	7	26	19	7
100-year flood elevation	3	0	7	13	57	13	4	30	7	19	22	11
Subsurface drainage	0	3	15	5	43	23	4	15	4	37	30	11
Soil drainage	0	0	0	13	41	43	7	4	4	15	52	11
Depth-to-ground-water table	0	3	5	21	29	29	0	4	0	26	48	22
GEOLOGY												
Fault zones	0	5	15	29	13	29	4	15	19	7	4	48
Earthquake zones	0	9	0	41	15	29	7	7	19	22	19	19
Bedrock composition	21	29	13	29	5	0	19	30	26	19	4	0
Bedrock topography	23	27	7	15	13	0	22	33	15	19	4	4
Regional geologic structure	21	15	51	0	7	0	26	41	19	15	0	0
Modern Holocene geology	57	15	7	5	0	9	67	19	0	11	0	0
OTHER												
Biologic assemblies	29	21	29	13	0	0	45	33	15	4	0	0
Surface topography	0	7	15	9	7	61	0	0	4	30	22	41
Thickness of "A" horizon	57	21	7	0	9	0	78	15	0	4	0	0
Depth to "C" horizon	71	15	5	0	0	0	74	11	7	0	0	0
AASHO classification	63	21	7	0	0	0	70	11	4	4	4	0
Unified soil classification	37	29	23	5	0	0	37	30	19	7	0	0
Agricultural soil classification	29	27	23	9	0	3	19	48	7	11	7	0
SOIL ENGINEERING PROPERTIES												
Soil permeability	7	7	13	9	29	35	7	4	4	37	33	11
Soil water holding capacity	13	13	21	23	21	0	7	15	33	22	15	0
Soil drainage	0	0	0	13	41	43	7	4	4	15	52	11
Soil infiltration capacity	29	27	7	9	13	5	30	19	15	19	7	4
Soil mineralogy	13	51	21	9	0	0	22	45	22	7	0	0
Soil pH	37	39	21	0	0	0	48	30	7	7	0	0
Soil corrosiveness	21	29	21	13	7	0	15	37	15	19	4	4
Soil field density	29	13	23	21	7	0	26	22	15	22	7	0
Soil profile	5	21	23	37	9	0	19	11	37	11	11	4
Subsoil characteristics	5	23	13	29	13	11	11	15	7	48	7	4
Atterberg limits	59	15	13	7	0	0	82	7	4	4	0	0
Soil plasticity	15	21	15	31	9	0	19	26	22	11	15	0
Potential vertical rise	45	23	21	0	3	0	48	19	15	11	0	0
Free swell index	51	29	9	3	0	0	56	26	4	7	0	0
Soil swell potential	13	43	15	7	9	3	19	22	30	19	0	4
Soil compressibility	25	19	21	23	0	7	11	30	15	15	15	7
Soil unconfined compressive strength	29	37	5	13	7	0	30	26	11	15	4	7
Soil consolidation characteristics	23	11	21	29	9	0	19	26	22	22	4	0
Soil shear strength	43	21	9	7	11	0	15	26	15	22	7	7
Soil bearing capacity	11	13	0	23	9	43	7	19	4	11	26	26
Slope stability	3	0	0	5	35	53	4	0	0	22	41	26
Excavation characteristics	3	25	11	39	19	0	7	11	7	30	26	7

TABLE 2.—Choice of map as indicated by Mathewson and Ruckman and Division of Geology and Earth Resources surveys

	Type of map	Real estate brokers	Home builders
		Percent of requests 10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
A	Agricultural soils map		
B	Bedrock geology and topography		
C	Climatology		
D	Depth-to-water table (greater than or less than 10 feet)		
E	Distribution of resources of coarse aggregate		
F	Distribution of unconsolidated rock materials		
G	Engineering geology recommended land use map		
H	Engineering soil classification		
I	Excavation difficulty		
J	Geologic hazards		
K	Geologic map		
L	Ground-water pumping yield (greater than or less than 10 gallons per minute)		
M	Heavy construction suitability		
N	Homesite suitability		
O	Location of local wells and test holes		
P	Location of 100-year flood plain		
Q	Maximum dissolved solids for local streams		
R	Natural land slopes		
S	Rock quality		
T	Sanitary and water-related facilities and service areas		
U	Sites of solid waste storage and liquid waste discharge		
V	Size and configuration of surface drainage basins		
W	Slope stabilities		
X	Soil corrosiveness		
Y	Soil infiltration capacity		
Z	Soil quality		
AA	Soil unconfined compressive strength		
BB	Surface and subsurface drainage map		
CC	The lowest daily average of streamflow possible every 10 years		
DD	Thickness of principal clay unit		
EE	Thickness of the material overlying the principal clay unit		
FF	Topographic landforms		
GG	Topographic map		
HH	Waste-disposal suitabilities		

------Mathewson and Ruckman 1974

——— Division Survey 1975

(Part B), yet with high interest expressed for the fault zone factor (Part A). These probably represent cases of people wanting specific information and yet not knowing where or how to find it.

Conclusions

This survey indicated, as did Mathewson and Ruckman's study, that real estate brokers and home builders are not proficient in engineering or geology nor do they intend to be. However, this survey indicated that a large percentage of the respondents are not aware of the importance of geologic factor evaluation in land use and land planning decisions. "Hardly worth all these maps for residential use, some needed in rural areas, but already sewer and water in city." "Most of little value and certainly only when special conditions exist." A few of the respondents stated that they did not feel it necessary

to be knowledgeable in geology, and that if such information were needed, a consultant would be called. "If I want this information I can pay for it on an individual basis with a number of private engineering firms."

The Land Stability Insurance Company brochure (1974) states:

> There really is no way to guarantee against land failure. . . . However, there are things that may improve the odds against land failure. Engineering geologists, soil and foundation engineers, and civil engineers form a team of experts that can try to cope with the heterogeneous nature of soil and weather. They can provide information prior to construction, which can mitigate the chance of land failure.

Robert Legget, author of Cities and Geology (1973, p. 49), says:

> Consideration of the environment—geology—is therefore one of the most vital parts of this whole complex process, a part without which the planning operation cannot proceed with any degree of certain or true efficiency.

Why then is there almost a complete neglect of using geologic information or advice in the planning and construction of buildings in the metropolitan area of the Puget Lowland? The cost of the geological investigations required for planning is so small a part of the total planning and construction cost that it cannot be financial restrictions that have caused such a widespread nonusage of geological advice and information. The major problem probably has been the method and format in which geologic information and advice has been presented, and the lack of local grading ordinances that require obtaining geologic information. In some cases, the only way the information and advice will be utilized is through local grading and building ordinances. However, this will not solve the method and format problem; geologic information should be prepared so that it is easy to understand and be readily available.

George Otis Smith (1921, p. 13) stated:

> The geologist should tell his story in plain English, then because of the transparency of his statements his clients or the public can see things as they are. . . . There is really somewhat of an obligation upon us, both as scientists and as partners in the world's business, to show the world that geology is not mystery or magic, but only common language. The world has a right to discount our usefulness and even to distrust our honesty if we persist in concealing our thoughts, or lack of thoughts, behind a mask of professional jargon.

The Division of Geology and Earth Resources has found that the most useful of the general-purpose maps and reports relating to development and planning are those that emphasize geologic processes and characteristics of geologic materials significant to land use and engineering, such as slope stability maps, maps depicting areas of construction minerals, maps depicting areas subject to flooding, maps depicting areas subject to ground failure. To the land planner, real estate broker, or developer, it makes little difference whether earth material is of Cretaceous age or Miocene age. His basic concerns are "What will happen when this land is developed"? "Will the land be subject to landsliding"? "Will homes eventually begin to develop cracks from expansive clays"? "What mineral resources are present"? These are the questions that have to be answered in concise, clear, and easy-to-understand language.

It seems suitable to end with a statement by Robert Legget (1973, p. 41):

> . . . . with the geological information available today about the details of local geology and the workings of natural physical processes, there is no excuse for a repetition of any of the mishaps or mistakes of the past.

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APPENDIX A

GEOLOGIC FACTOR RATING

Questionnaire directed to real estate brokers and builders in the Puget Lowland metropolitan area relating to the importance of various engineering geologic factors in building site evaluations.

Part A

Kindly rate the significance of each of the engineering geology factors listed below as they apply to your evaluation of a homesite. Remember, it is as important to our study that you identify those factors that you do not know as it is that you rate the significance of the other factors. Please assume that all of the factors are available to you for your site evaluation. Rate factors in decreasing scale as follows: 1 - Extreme importance; 2 - High importance; 3 - Medium importance; 4 - Low importance; 5 - Insignificant; and 6 - Don't know.

Fault zones ..... ____
Surface drainage ..... ____
Depth-to-ground-water table ..... ____
Subsurface drainage ..... ____
Surface topography ..... ____
Local hydrology ..... ____
Soil permeability ..... ____
Modern Holocene geology ..... ____
Bedrock composition ..... ____
Biologic assemblies ..... ____
Regional geologic structure ..... ____
Soil mineralogy ..... ____
Thickness of "A" horizon ..... ____
Soil pH ..... ____
Bedrock topography ..... ____
Soil water-holding capacity ..... ____
100-year flood elevation ..... ____
Soil plasticity ..... ____
Atterberg limits ..... ____
Soil compressibility ..... ____
Soil corrosiveness ..... ____
AASHO classification ..... ____
Excavation characteristics ..... ____
Subsoil characteristics ..... ____
Soil profile ..... ____
Soil-swell potential ..... ____
Soil drainage ..... ____
Depth-to-"C" horizon ..... ____
Slope stability ..... ____
Field density of soil ..... ____
Soil-consolidation characteristics ..... ____
Unified soil classification ..... ____
Soil unconfined compressive strength ..... ____
Soil shear strength ..... ____
PVR (potential vertical rise) ..... ____
Free swell index ..... ____
Soil infiltration capacity ..... ____
Agricultural soil classification ..... ____
Soil-bearing capacity ..... ____
Earthquake zone ..... ____

APPENDIX B

MAP RATING

Questionnaire directed to real estate brokers and builders in the Puget Lowland metropolitan areas regarding the significance they attach to particular maps in engineering geologic reports.

Part B

Suppose you could specify the maps for an engineering geology report on a tract of land that you are considering for use as a housing project. Please circle the letter of those maps that you would like to have included in the report.

A. Agricultural soils map
B. Bedrock geology and topography
C. Climatology
D. Depth-to-water table (greater than or less than 10 feet)
E. Distribution of resources of coarse aggregate
F. Distribution of unconsolidated rock materials
G. Engineering geology recommended land use map
H. Engineering soil classification
I. Excavation difficulty
J. Geologic hazards
K. Geologic map
L. Ground-water pumping yield (greater than or less than 10 gallons per minute)
M. Heavy construction suitability
N. Homesite suitability
O. Location of local wells and test holes
P. Location of 100-year flood plain
Q. Maximum dissolved solids for local streams
R. Natural land slopes
S. Rock quality
T. Sanitary and water-related facilities and service areas
U. Sites of solid waste storage and liquid waste discharge
V. Size and configuration of surface drainage basins
W. Slope stabilities
X. Soil corrosiveness
Y. Soil infiltration capacity
Z. Soil quality
AA. Soil unconfined compressive strength
BB. Surface and subsurface drainage map
CC. The lowest daily average of streamflow possible every 10 years
DD. Thickness of principal clay unit
EE. Thickness of the material overlying the principal clay unit
FF. Topographic landforms
GG. Topographic map
HH. Waste-disposal suitabilities

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WASHINGTON STATE COAL RESOURCES

The growth and economic development of the State of Washington has been intimately linked with the discovery and development of its coal resources.

Although coal was first discovered in the Cowlitz Valley of southern Washington in 1833, it was of such poor quality that mining efforts were soon abandoned. It wasn't until nearly 20 years later that the first successful coal mining venture was started near what is now Bellingham.

Early-day mining operations in the Bellingham coalfields were not without difficulties. Mine explosions, floods, fires and strikes all exacted their toll of men and money. Persistence paid off however, and in time the Bellingham No. 1 mine had increased production to over 1,000 tons of bituminous coal per day, making it the largest commercial mine in this state at one time. Today, the casual observer must know exactly where to look to see vestiges of the former Bellingham No. 1 mine.

Statewide coal production hit a high of 3.9 million tons in 1910. Output had decreased to only 60 percent of that figure by 1915, but rebounded to an all-time high of 4.1 million tons in 1918. Since that time a slow and steady decline in coal production has occurred until less than one million tons was produced in 1950. The middle 1950's saw the switch from coal to petroleum products for private and commercial heating purposes and also the nation's rail transportation system. Washington's coal production was heavily dependent on both rail transportation and the heating industry; the gradual conversion from coal to oil by both of these entities signaled a further slump in the state's coal industry.

Coal production in the 1960's languished, with average production never exceeding 200,000 tons. However, the Washington Water Power's coal-fired thermo-electric plant near Centralia in the early part of the present decade caused coal production to increase dramatically. The coal produced at the Centralia strip mine has accounted for about 99 percent of the total tonnages in recent years (2.6 million tons in 1972 to almost 3.7 million tons in 1974).

With the energy shortage of late 1973 and early 1974, highlighting the nation's almost utter dependency on the whims and notions of the Arab oil cartel, renewed emphasis was placed upon the fact that traditional energy sources are indeed depletable. Such emphasis has caused a renewed interest in the state's coal resources by both U.S. and Canadian exploration companies, while one major midwest petroleum company has expressed some interest in the Cedar Creek lignite beds of southwest Washington.

Presently, coal exploration and development efforts are being carried on by the Canadian-American Exploration Company at Glacier, Washington, 35 miles east of Bellingham. Here, old adits and tunnels are being reopened with a program of exploration and development being undertaken by Can-Am affiliate, Gates and Fox, Inc. With less than 1 year of ex-

ploration and development behind them, Canadian-American - Gates and Fox conclude that the 1960 estimates of 5 million tons (Beikman and others, 1961) in the Glacier field will be increased by a substantial factor if present favorable exploration trends continue.

Occurrences

Most of the commercially significant coal in Washington State is found in a discontinuous belt of Tertiary rocks, which lies on the eastern and southern edges of the Puget Sound Lowland. (The Roslyn coal lying north and west of Ellensburg on the east flank of the Cascades is a major exception.) Most of these deposits began as swamps on the eastern margin of a north-trending depositional basin. Typically, coal-bearing rocks of continental origin undergo facies change and become marine-equivalent farther to the west. Deposition and volcanism were contemporaneous in many portions of the basin, accounting for locally high ash levels in the coal. A redeeming factor of Washington coal is relatively low sulfur content when compared with coal from the eastern states.

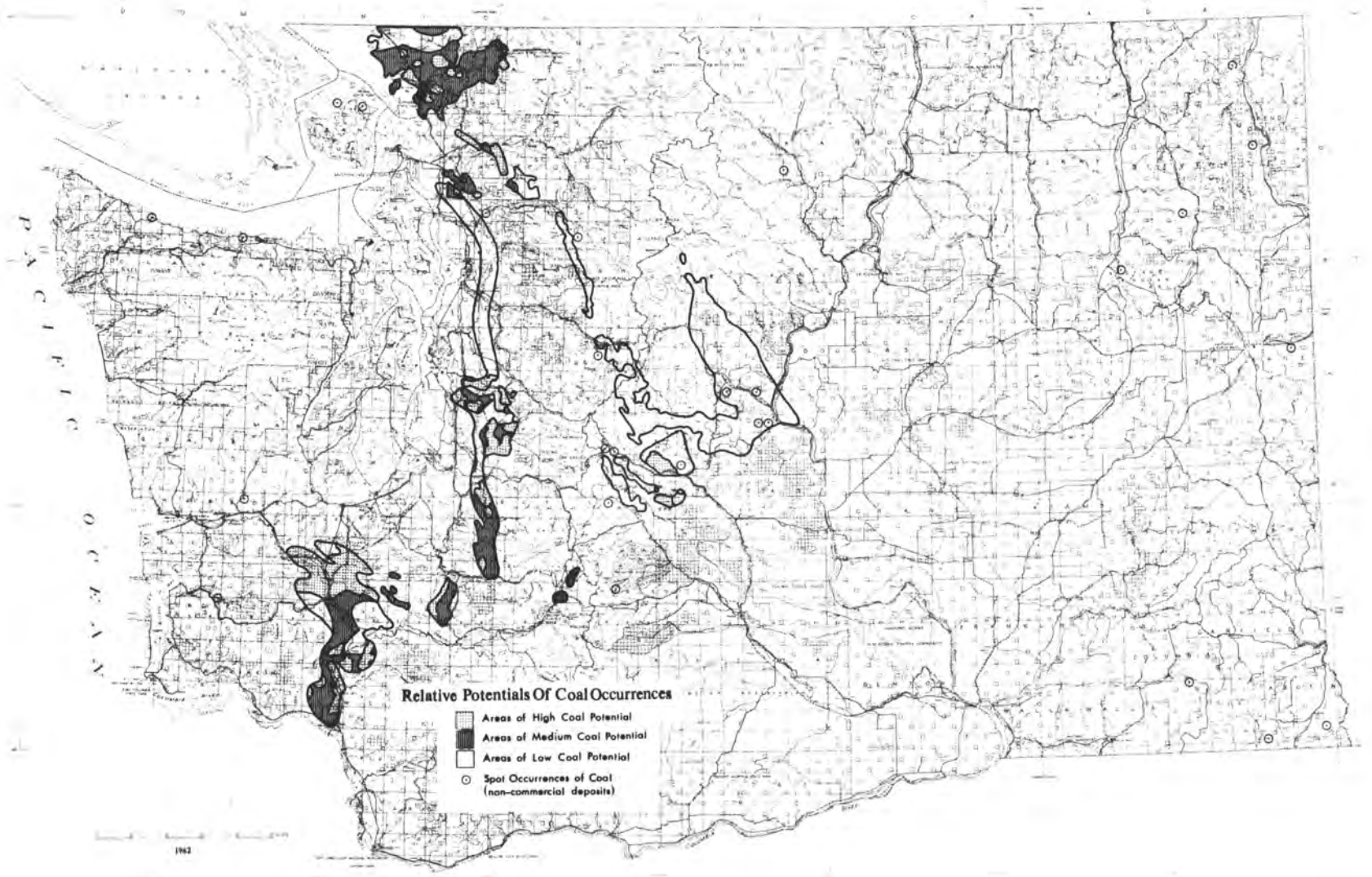
Degree of structural deformation and faulting varies greatly within the Puget Sound basin. In the Toledo and Centralia districts, folds are broad and open with dips typically 20° to 30°. On the other hand, the coal sequence of the Wilkeson-Carbonado district has been deformed into a series of tight, northwest-trending folds. Dip angles of 60° are common. Structural problems are complicated by numerous high angle faults. Coal deposits of southeastern King County display similar characteristics, but to a somewhat lesser degree.

The coal-bearing rocks in the Roslyn, Hamilton, and Bellingham districts have been recognized by earlier workers as being remnants of a broad low alluvial plain draining an ancestral topographic high centered somewhere in north-central Washington. The Roslyn basin is a broad southeast-plunging syncline, whose southwest limb has been more severely deformed structurally than the relatively flat-lying northeast limb. A conservative tonnage estimate by the U.S. Geological Survey shows some 240 million tons of reserves, although more exploration drilling to the southeast of the present limits of the field should increase the reserves by a significant factor. Clearly, more core drilling and development is indicated for the Roslyn basin.

The coal fields in the extreme northwestern part of the state are found almost entirely within arkosic sandstones of the Chuckanut Formation. As mentioned before, exploration efforts until now have been concentrated in the Glacier area. More recently, though, reconnaissance work and detailed geologic mapping have revealed other coal sequences of possible commercial importance in other areas of Whatcom County.

Structurally, the Whatcom basin shows a greater degree of deformation than the Roslyn basin. Folds in the Chuckanut Formation are open but tight, causing steep dip angles and local overturning of beds in some areas. Bedding-plane thrust-faults and "rolls" caused by sliding of sandstones nonconformably overlying weathered metamorphic basement rocks presented difficulties for some of the earlier mining ventures. Future profitable extraction of coal from some areas of the Bellingham district must take the problems of geologic structure into consideration. Considerable ingenuity and use of the most modern of mining techniques (such as hydraulic mining) will be required.

Coal represents approximately 75 percent of the hydrocarbon supply of both the world and the United States. It is fortunate that the United States (including Alaska) holds about 45 percent of the world's coal reserves. It stands to reason, then, that the effective utilization of this nation's coal wealth will undergo intensive study. Washington's geographic position with respect to other coal-bearing regions of the United States is very enviable. Tide-



MAP INDICATING AREAS OF COAL POTENTIAL IN WASHINGTON, 1975

water ports capable of housing bulk-loading facilities are numerous and Puget Sound has long been an acknowledged port-of-call for foreign shipping. Our state thus occupies a significant position in the global energy picture. It will be of great future interest to observe Washington's re-emergence as an important coal-producing state.

For more specific information, the reader is directed to the references listed below or write directly to the Department of Natural Resources, Division of Geology and Earth Resources, Olympia, Washington 98504.

Ellis R. Vonheeder

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GEOTHERMAL ACTIVITIES IN WASHINGTON

Geothermal exploration in Washington is becoming more serious. For the first time in Washington, holes are being drilled for the purpose of measuring thermal gradients and heat flow in prospective geothermal areas. Previous geothermal investigations by private and governmental organizations have concentrated on geologic mapping, thermal and mineral spring sampling, and geophysical surveys. These types of surveys are being continued, but two drilling projects are planned or underway. Both projects involve the drilling of relatively shallow holes in an attempt to determine the amount of heat flowing upward through the earth's crust. High heat flow is an excellent indication of geothermal potential. Both projects are being conducted under geothermal prospecting permits issued by the Gifford Pinchot National Forest.

Trailer-mounted rig drilling a heat-flow hole about 6 miles west of Trout Lake

Truck-mounted rig drilling a 500-foot geothermal exploration hole in the valley of Trout Lake Creek, Skamania, County

AMAX Exploration, Inc. plans to drill six holes in the Summit Creek Soda Spring area, near the southeast corner of Mount Rainier National Park. The holes will be drilled with a truck-mounted rotary rig. Planned depth is 50 meters (164 feet) each. The completed holes will be lined with 3/4-inch plastic pipe, and temperatures will be measured at intervals in the holes approximately 10 days after completion of the drilling.

The Division of Geology and Earth Resources has now completed the drilling phase of the National Science Foundation-supported geothermal project in the Steamboat Mountain-Lemei Rock-Big Lava Bed area of eastern Skamania County. Four holes have been drilled to depths of 500 feet, and two other holes reached 180 feet and 95 feet. One-inch iron pipe has been installed in each hole, and temperatures will be measured at intervals in each hole as soon as temperature disturbances caused by drilling have subsided. All temperature-gradient and heat-flow information from the six holes will be available for inspection in the near future. Temperature-gradient information should be available by November, and heat-flow data by December or January.

In addition to the above projects, Barry Wheeler of the Gifford Pinchot National Forest's Mount Adams district in Trout Lake is preparing a geothermal Environmental Analysis Report (EAR) for a large area of that national forest. The EAR must be prepared and approved before any of the lease applications for land in the area between Mount Adams and Mount St. Helens can be acted upon. When leasing of national forest lands becomes a reality, private companies will be able to carry on intensive geothermal exploration in the Southern Cascades of Washington.

J. Eric Schuster

QUATERNARY GEOLOGISTS MEET AT WESTERN WASHINGTON STATE COLLEGE

The International Geological Correlation Programme, project 73/1/24, "Quaternary Glaciations in the Northern Hemisphere," held its 3rd annual session at Western Washington State College with Professor Don Easterbrook as host. This year's session included presentation of technical papers on September 8-9, field trips in western and eastern Washington on September 10-13, and field trips in Canada on September 14-17.

The International Geological Correlation Programme (IGCP) is backed by the International Union of Geological Sciences and UNESCO. In addition to scientific interests, the IGCP hopes to achieve better worldwide knowledge of mineral resources, ground water, pollution, and future climate trends.

The "Quaternary Glaciations in the Northern Hemisphere" project has brought together prominent Quaternary geologists from eastern and western Europe, Canada, and the United States. At the sessions, the members observe and discuss character and stratigraphy of glacial and interglacial deposits. This session concentrated on the last glacial stage, the "Wisconsin". The members pay special attention to possible time synchronism of worldwide Quaternary deposits. Therefore, the technical papers emphasize chronological techniques, especially absolute dating, pollen, paleomagnetism, and oxygen isotopes.

Some of the features of this year's session included (1) great hopes for amino-acid dating, using shells; (2) a minor revision of the classic late Wisconsin stratigraphy in the Great Lakes' region; (3) a bid for use of the deep-sea oxygen isotope curve as a worldwide Quaternary stratigraphic standard; (4) a suggestion that glacial climates are initiated by geomagnetic fluctuations; (5) a suggestion that geomagnetic fluctuations are caused by glaciations; and (6) the arrival of summer weather in time for the field trips.

Technical papers will be published later in the year. The next session will be in September, 1976. Write to Don Easterbrook, Department of Geology, Western Washington State College, Bellingham, WA 98225, for further information.

Kurt Othberg

DIVISION GEOLOGISTS ATTEND MEETING

Don Ford, assistant supervisor of the division, and Ralph Kimmel, staff geologist, attended the annual meeting of the National Association of State Land Reclamationists, which was held in Kansas City, Missouri, on September 22-23. Topics discussed during the meeting included mining and reclamation in Missouri and the federal role in strip mined land reclamation. Individual workshop groups further discussed many aspects of reclamation and regulation in a number of states. Don was elected to the position of vice president for next year.

Several underground limestone quarries in the Kansas City area were visited by the geologists. An interesting facet of these quarries was the utilization of the mined-out areas for underground storage and warehouse facilities. Some of the advantages are the low cost and maintenance, ease of temperature control, and the ability to turn formerly useless space into a profit-making venture. Don and Ralph also visited several surface coal mining operations and observed on-going reclamation.

ANNUAL NWMA CONVENTION DRAWING NEAR

The 81st annual convention of the Northwest Mining Association will be held this year on Dec. 5th and 6th, at the Davenport Hotel, in Spokane, Washington.

"Mineral Economics" is the theme of the program, which was planned by Convention chairman Bob Garwood. Pre-registration materials and information may be obtained from the NWMA, West 1020 Riverside Ave., Spokane, WA 99201.

DIVISION RELEASES THREE NEW PUBLICATIONS

Three new geologic reports have been published by the division and are now ready for distribution. The road log (Information Circular 54) in the Ellensburg, Yakima, Chinook, and White Pass areas was written by Newell Campbell, of Yakima Valley College. There are four legs in the journey, each well illustrated by many pictures and sketches. The report contains a location map showing highways and area covered for each of the legs, a geologic map, and an informal stratigraphic column.

A multistation telemetered seismograph network has been operated in western Washington on a continuous basis since 1970 by the Geophysics Program at the University of Washington. During a 1-year period, a large number of earthquakes are located that may have significance for many areas of investigation. Our first published report containing earthquake data was Information Circular 53, which covered the time of July 1970 through December 1972. We plan to update this information on a yearly basis, and Information Circulars 55 and 56 have data for 1973 and 1974, respectively.

Complete titles and prices are listed below:

Information Circular 54 - A geologic road log over Chinook, White Pass, and Ellensburg to Yakima highways, by Newell Campbell, 82 p. Price $1.50.

Information Circular 55 - Compilation of earthquake hypocenters in western Washington, 1973, by Robert S. Crosson, 14 p. Price, 50 cents.

Information Circular 56 - Compilation of earthquake hypocenters in western Washington, 1974, by Robert S. Crosson and Richard C. Millard, 14 p. Price, 50 cents.

These reports may be purchased from the Department of Natural Resources, Division of Geology and Earth Resources, Olympia, WA 98504.

OREGON METAL MINE HANDBOOK REPRINTED

After having been out of print for many years, Oregon's Bulletin 14 on metal mines has been reprinted by a private individual. Information on the reprinted handbooks is available from George Srein, P. O. Box 1312, Bellevue, WA 98999. There are six reports, covering the following areas in Oregon: A - Baker, Union, and Wallowa Counties; B - Grant, Morrow, and Umatilla Counties; C-I - Coos, Curry, and Douglas Counties; C-II, sec. 1, Josephine County, and sec. 2, Jackson County; and D - northwestern Oregon.

YOUR STATE GEOLOGIST REPORTS

My friend and my former boss, Marshall Huntting, came in the other day. In the course of our conversation, he commented on some basic truths that I believe need to be reiterated until everyone, especially our decision-making leaders, really understand them. The subject was land planning and Marshall mentioned that the way many leaders are approaching planning is to ask the citizenry this question "What do you want for the future?" Marshall says this is like setting your family down and asking them to plan what they want to do for the rest of their lives.

Obviously the most important question the family needs to answer is "What do we need to survive?" The same is true in developing plans for the use of our land. There is no doubt that if this question were asked and answered honestly by the decision makers, the safeguarding of our mineral deposits along with agricultural lands would receive the highest priority. I question if there is a higher, more intensive use for land than mining. As an example, the Bingham copper pit in Utah appears to be about 2 miles across, which would equal about 2,000 acres in area. From that 2,000 acres of land, approximately $6 billion worth of copper has been produced. This means that each acre of land in this pit has contributed $3 million worth of new wealth to the economy. I suspect it will be hard for any other industry or occupation to equal that kind of record. The real point, however, is not necessarily what the dollar value of the copper is but rather what the value has been to mankind in terms of homes, transportation, medicine, appliances, power generation, etc. This value is so large that it probably is incalculable.

All of this points out that in any kind of planning procedure we always need to begin by considering what the necessities are for survival. After we have taken the necessary steps to protect the necessities, we can afford the luxury of asking "What do we want?" If we let our "wants" take precedent over our "needs," we will certainly experience some severe, and I might add, unnecessary shortages that will bring us very painfully to a realization of how necessary our minerals are and how dependent we are on them.

Ted Livingston

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