

SUMMARY REPORT OF MAJOR ACTIVITIES
DIVISION OF GEOLOGY
for the biennium 1935-37

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AIMS OF GEOLOGIC WORK

In considering the following summary statement of the major activities of the Division of Geology, it should be borne in mind that notwithstanding the extremely varied character of this work, it is all made to focus on the one objective which activates the Division, i. e., the dissemination of facts to aid development of the mineral industry. Necessarily, much of the work is of a strictly scientific and technical character, the results of which cannot be applied by the layman, but are used in the furtherance of the program of economic development to which the Division is committed.

For convenience in this brief report, the work of the Division of Geology is placed under the following heads: Economic Geology, Basic Geology, and Topographic Mapping.

ECONOMIC GEOLOGY

1. Geologic map of the State

The forthcoming map, now in press, 32" x 48", shows by colors and patterns the rock formations appearing at the surface throughout the whole state. Probably this is the most useful geologic tool of the mineral industry, from the preliminary prospecting stage to the ultimate development of a property.

The background which makes the preparation of this map possible comprises a great number of distinct scientific investigations, the character and scope of which is indicated by the following list of items, which constitute only a small fraction of the total number.

- a. Thickness and origin of the auriferous Swauk gravels.
- b. Mineralization of Pasayten sedimentary rocks accompanying thermal alteration.
- c. Differentiation of chromite and olivine-bearing rocks from peridotitic intrusives.
- d. Fossil plants of the interbasalt sediments.
- e. Correlation of late Mesozoic rocks in western Washington.
- f. Occurrence of major folds in the area east of the Cascades.
- g. Eocene volcanic rocks of the Lake Crescent region.
- h. Porosity of sedimentary rocks in the Grays Harbor area.

Each of these projects, several hundred in the aggregate, constitutes an independent scientific investigation planned and carried out primarily for its bearing on the distribution and occurrence of our mineral resources.

2. Summary of the general geology of the State

This bulletin, now in outline form only, is planned to accompany the geologic map of the State and will present in easily understood terms the general features of the stratigraphy and structure of all the rock formations which are mapped. There will be included a resumé of the geologic history of the State so that the reader may gain a concept of the development of the varied and complicated features. For the geologist or trained mining man, there will be added a chapter giving in tabular form the correlations of all published and unpublished work which have been used in the final mapping. Through the addition of references to published material, the technician will be able to determine easily where each of the several hundred described rock masses has been placed in the geologic column. This is planned to appear as Bulletin 32 and should be ready for publication in October.

3. Catalog of nonmetallic resources

This report brings together all of our available information on the occurrences and development of those substances which make up ninety per cent of the mineral production of the State. Production statistics up to and including 1933 are incorporated. This is ready for printing as Bulletin 33 of the Divisional series.

4. Summary report of Washington minerals, production and resources

Here are presented the more significant figures on production of both metals and nonmetals, with comments on the present development and future possibilities. There is included a very useful list of the substances and the values thereof which are produced in each of the counties of the State. This appeared as Circular of Information No. 2.

5. Inventory of mines, mining companies, and mineral occurrences

Lists of these three inseparable items--the reported occurrences of minerals of economic value, the companies organized to develop them, and the names of the mines where development has progressed--taken together constitute an invaluable inventory of resources. During this biennium, data for this inventory have been secured from a great number of independent sources, checked and rechecked for accuracy, both by comparison of various published reports and, where possible, by field examinations. This information has been placed on index cards and makes a treble file (comprising between 3,000 and 4,000 items to date) from which can be obtained readily all facts as to occurrences of rare or common minerals and the degree to which they may have been developed insofar as information on them has been published or secured in the field by the Divisional staff.

6. Compilation of bibliography and index of the geology of Washington

It has long been recognized that a large amount of information on the geology of the State of Washington was scattered through the thousands of books and articles which have been published in past decades. Many of these appeared in obscure publications and are practically lost so far as the general public is concerned, since they are available only in the largest libraries.

Numerous attempts have been made by various agencies to compile a list of these items, but none has been even approximately complete. By the end of this biennium the Division of Geology will have completed not only the most extensive bibliography of Washington geology ever attempted, but will have ready at the same time a complete bibliographical index with crossed references. This is scheduled to appear as Bulletin 35 during the coming biennium and will be of the greatest value to all who are interested in the mineral industry of Washington.

7. Estimation of magnesite reserves

Such varied estimates (ranging from 1 to 20 million tons) have been published for the magnesite resources of the State of Washington that it seemed desirable to undertake a more accurate calculation. This must be based on the field examination of outcropping rock ledges so that approximate percentages of magnesite can be determined. As a matter of fact, no reliable method was known by which the magnesite in a rock ledge could be recognized without laboratory tests. So it became necessary to start this investigation by attempting to devise a method by which this could be accomplished.

During this biennium a large number of outcrops, some of which were known to contain magnesite, have been carefully mapped and measured. For each of these, extensive sampling has furnished ample material on which to conduct laboratory tests as a means of checking the accuracy of the field identification method. There seems no doubt that the newly devised tests, with certain slight modification, will prove to be not only easily used in the field, but much more accurate than any method previously described. By this means it will be possible to secure satisfactory information as to the magnesite content of the limestone deposits in the State. Coincidentally, it will be possible to arrive at an equally fair estimate of the amount of dolomite in these formations. This is important, since it seems probable that high-grade dolomite will be nearly as valuable in the development of magnesium metal as magnesite.

The information secured in this whole investigation, both as to the methods of field examination and as to the results obtained, will appear as a new bulletin which will supersede Bulletin 25, which relates to the magnesite resources and industry.

8. Ore deposits of northeastern Washington

The study and mapping of the rocks in Chelan, Okanogan, Ferry, Stevens, and Pend Oreille counties have made it clear that certain geologic factors have controlled not only the distribution of the intrusive granitic rocks, but also the distribution of the accompanying ore deposits. An examination of published reports on individual mining camps by earlier workers shows that in the main these investigations were restricted to areas of such small size that the regional relations were not perceptible. For nearly a decade the Division has been accumulating field evidence bearing on these broadly operating geologic factors.

During the present biennium the work has been extended in several particulars. A set of scientific investigations comprising field and laboratory studies is under way, by which it is hoped to distinguish and correlate the large granitic masses which dominate this region. Another set is concerned with the structures and relations of the very large number of highly metamorphosed rock formations. Still other studies are directed to the determination of the exact character of the solutions which produced the mineralization. Taken together, this series of studies is planned to clear up some of those features of the ore deposits in northeastern Washington which have been puzzling mining men for decades and seriously handicapping both discovery and development.

Two or three areas in which significant relations between the intrusives and the metamorphic rocks are revealed happen to lie in the zone which will be flooded by the waters behind the high dam at Grand Coulee. On that account, work during the present biennium on this problem is being centered on these low areas of the Columbia Valley, and it is planned to complete this portion of the long-term investigation before the region is submerged.

As a part of this general study, the Division continued its detailed examination of the Metaline district during this biennium. Since the U. S. Geological Survey has a representative doing mapping in the Metaline quadrangle during 1936, the State Division has withdrawn and is cooperating unofficially with that agency.

9. Miscellaneous economic studies

From time to time it has been possible to carry on local detailed studies of economic character in various districts of the State. Preliminary studies of this character had been completed on the St. Helens mining district in Skamania County, and the results were published during this biennium as Reports of Investigations No. 3. Similar work has been done during the biennium in other metallic deposits, such as the iron of Pend Oreille County and chromite of Okanogan and Whatcom counties. These studies have not been brought to the publication stage.

Investigations of economic character as to certain non-metallic substances have also been made. Examples of this work are seen in the report on the oil and gas possibilities of Washington, which is ready for the printer and will appear as Reports of Investigations No. 4, a similar but detailed report for Skagit County which is ready for printing as Report of Investigations No. 5, and studies on the clays of Washington, essentially ready for printing at once as Bulletin 24.

10. Collections of ores and rocks

As a part of the state-wide investigations, it has been necessary to make comparison of rock formations in all parts of the State. This work has led to the accumulation of a complete collection representing practically every formation appearing in each county throughout the State. This constitutes an exceptionally valuable "library of rocks" which is available not only to staff members, but to anyone who is interested. This reference collection numbers thousands of specimens, without any duplication whatsoever. While primarily intended for men of technical training, this collection is valuable to prospectors and others who wish to work in any areas within the State.

11. Mineral identification service

To judge from the numbers of samples that have been submitted this biennium, the mineral identification service has greatly increased its usefulness. To date, the samples have been arriving at the rate of nearly 700 for the biennium. This activity constitutes a real service to a large number of persons throughout the State. During the past two years, thirty-one of the thirty-nine counties have been represented by inquiries regarding samples. These are about equally divided between the east- and west-side counties. It is interesting to note that of the total submitted, somewhat less than half have been of nonmetallic character, the remainder being sent in for their metallic contents. About forty per cent of the total number of samples have contained substances of economic importance. To an increasing extent, prospectors and others are availing themselves of this service to secure information on ores and minerals which they find. It is usually possible to suggest to inquirers some means by which the prospecting or other preliminary work can be advantageously carried on.

12. W. P. A. mineral investigations

Late in 1935 the Division received a request from the state administrator of W. P. A. activities to plan and supervise an approved W. P. A. project for mineral investigation in eight specified counties of the State. As early as possible in January county supervisors were selected and placed in charge of the instruction of non-relief workers in the eight counties. Under the direction of a state-wide superintendent, these men were instructed in the elements of mineralogy and

geology to provide some general education and give some training which would be helpful in their subsequent work in the field. Following the completion of this school work, these parties have been placed in the field to carry on specific studies under the general direction of the Division of Geology.

While, as is generally recognized, the W. P. A. set-up does not provide for the most efficient prosecution of technical work of this character, it has been possible, by careful supervision, to make a good start on the acquisition of valuable data. It is believed that this project will, in the end, provide a real contribution to our knowledge of certain mineral resources.

BASIC GEOLOGY

Under this heading are grouped a few studies of highly technical or scientific character which are undertaken largely as a cooperation between the staff members of the Division of Geology and the faculty members of the Department of Geology of the State College of Washington. The location of the State offices on the campus greatly facilitates this cooperative work. During the present biennium, investigations of research character have been under way, both in the field and in the laboratory, to determine the nature and amount of metamorphism of some of the sedimentary rocks which have been intruded by great granitic masses. It is expected that from this work will be obtained an approach to the solution of some of the important problems of the ore deposits in this State. Other studies, also of a research character, have been undertaken to determine the character of the fauna contained in the Pasayten formation of Mesozoic age in the mountainous portions of Okanogan and Whatcom counties. This work is very largely financed by the State College of Washington, which pays salaries and laboratory expenses. The Division financial cooperation comprises only the very modest field expenses for short periods during the summer.

TOPOGRAPHIC MAPPING

The topographic work of the Division is largely confined to cooperative mapping with the Topographic Branch of the U. S. Geological Survey.

Quadrangles mapped

During the present biennium an appropriation of \$25,000 was apportioned to permit mapping on both sides of the mountains. Work is under way on two fifteen minute quadrangles in the Yakima area, as well as some large-scale work in this region, and also on two fifteen minute quadrangles, Destruction Island and Queets, in the Olympic Peninsula. Control work is also to be started in the Gate quadrangle, comprising parts of Grays Harbor, Thurston, Lewis, and Pacific counties.

In addition to this cooperative work, it should be recognized that the federal government is mapping, independently, additional areas on both sides of the mountains to equal, if not exceed, the amount done cooperatively.

Contoured map of the State

Although only approximately half of the state has been mapped in the regular quadrangle sheets, it has been possible, through the careful compilation of all available elevation data, to prepare a relatively accurate map of the State, showing the relief in 1,000-foot contours. Copies of this map on the scale of 1:500,000 (8 miles to 1 inch) have been drawn up and colored in a shaded series of yellows and browns ready for lithographic reproduction. When published, this will accompany a brief bulletin outlining the physiography of Washington. This map furnishes an incomparable base on which to indicate mining districts, forests, and other land use data, not to mention the usual engineering projects for which a topographic base is essential.

Publication

In response to a continuing demand for information as to the topographic work in the State, there was prepared a careful summary of all topographic work up to this biennium, with complete information as to the areas already mapped and plans for completion of the topographic work in the State. This appeared as a 10-page mimeographed Circular of Information No. 1.

ACKNOWLEDGMENTS

Owing to the complicated inter-relations of all the activities in which the Division of Geology is engaged, it has not been possible, in the foregoing summary report, to indicate the part played by various cooperating agencies. During the present biennium, the Division of Geology has enjoyed the assistance of representatives of many federal agencies, including the U. S. Geological Survey, the U. S. Bureau of Mines, the U. S. Department of Agriculture, the Federal Power Commission, the Soil Conservation Service, the Agricultural Adjustment Administration, and the Works Progress Administration. Members of the faculties of several institutions of higher learning, including the State College of Washington, the University of Washington, the University of Chicago, and Yale University, have cooperated freely in furthering Divisional work. Most of the State departments having headquarters at Olympia, including the State Planning Council, have also cooperated in various ways during the biennium. In addition, a really large number of private agencies, both corporate and individual, have made invaluable contributions.