State of Washington
ARTHUR B. LANGLIE, Governor

Department of Conservation and Development
W. A. GALBRAITH, Director

DIVISION OF MINES AND GEOLOGY
SHELDON L. GLOVER, Supervisor

Bulletin No. 40

# GEOLOGY

OF THE

# BEAD LAKE DISTRICT

## PEND OREILLE COUNTY, WASHINGTON

By

MELVIN C. SCHROEDER

STATE PRINTING PLANT
OLYMPIA, WASH.
1952

For sale by Department of Conservation and Development,
Olympia, Washington. Price, 75 cents.

# CONTENTS

## ILLUSTRATIONS

# FOREWORD

The Bead Lake district, to which this report refers, is a local designation for the general Bead Lake vicinity in southeastern Pend Oreille County. Although it is a part of a much larger area lying on both sides of the Pend Oreille River and which is commonly referred to as the Newport district, the Bead Lake term restricts the area under discussion to the country lying east of the Pend Oreille River and including what constitutes essentially the northeastern quarter of the Newport 30-minute topographic quadrangle of the U. S. Geological Survey.

The study of the geology of this area was begun by Mr. Melvin C. Schroeder in 1947 and carried on as a graduate thesis problem under the direction of Dr. Harold E. Culver, Chairman, Department of Geology, State College of Washington. As the area is adjacent on the south to the economically very important Metaline district, the Division of Mines and Geology arranged to aid in the investigation to the extent of supplying Mr. Schroeder's field expenses, so that the information acquired as a result of the study could be published and made generally available to the mining industry.

The basic geological data are being submitted to the Department of Geology, State College of Washington, as a doctoral dissertation. In accordance with the plans for publication, Mr. Schroeder prepared for the Division of Mines and Geology the present paper, including all essential geological data in concise form together with statements on the economic aspects of the mineralization of the area.

It is apparent that the Bead Lake district does not have a mineral potential corresponding to that of the region to the north, yet interesting deposits occur and parts of the area warrant more attention than heretofore received. It is believed, therefore, that the investigation was well justified and that this report will be of interest to the mining industry.

SHELDON L. GLOVER, Supervisor
Division of Mines and Geology

August 1, 1952

# GEOLOGY OF THE BEAD LAKE DISTRICT, PEND OREILLE COUNTY, WASHINGTON

By Melvin C. Schroeder

## INTRODUCTION

### LOCATION

The area described in this report is the northeastern part of the Newport quadrangle, which is in the northeastern part of Washington, and extends about 1½ miles into Idaho. The area is bounded by longitude 48° 30′ and latitude 117° on the north and east. The Pend Oreille River is the boundary on the other two sides. The area is roughly that of the Bead Lake district, a subdivision of the Newport mining district. The Bead Lake district is in the southeastern part of Pend Oreille County and is adjoined on the southeast corner by Newport, the county seat. Excellent Forest Service roads connecting with the LeClerc road provide access to most of the area. The LeClerc road, which is located on the east side of the Pend Oreille River, is connected with the Newport-Metaline highway by bridges across the Pend Oreille River near Newport and at Usk.

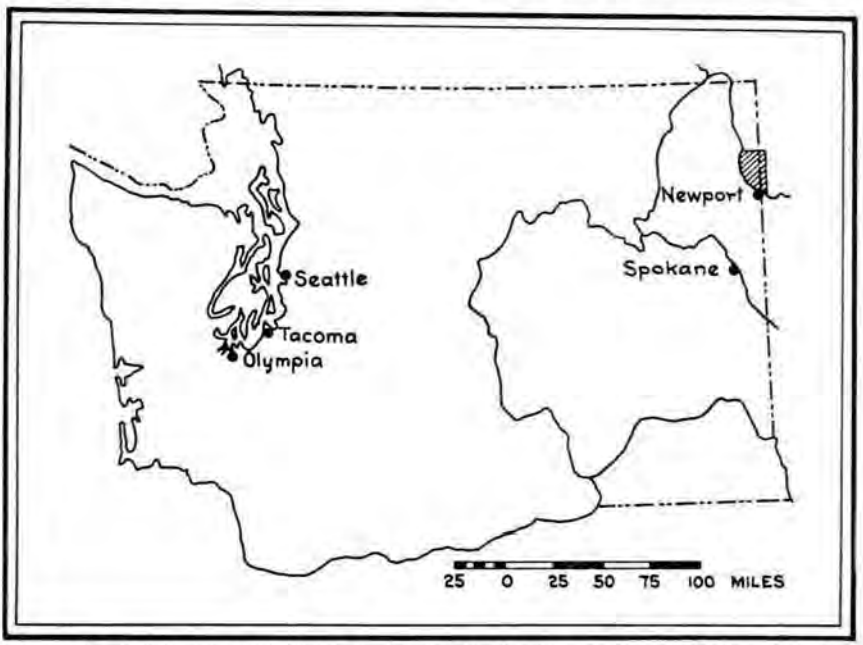



Figure 1.—Index map of Washington showing the location of the Bead Lake district.

## TOPOGRAPHY

The mountainous topography is in a mature stage of erosion and is dominated by a divide that includes most of the higher peaks of the district, South Baldy, Ojibway Knoll, and Bead Lake Peak. Streams flowing eastward from the divide drain into the Priest River, which, in turn, flows into the Pend Oreille River several miles to the east of Newport. The streams west of the divide drain into the northward-flowing Pend Oreille River. Continental glaciation has dammed many of the valleys with glaciofluvial gravels, forming lakes.

## ACKNOWLEDGMENTS AND FIELD WORK

Mr. Sheldon L. Glover, Supervisor of the Washington State Division of Mines and Geology, has directed the study of the Bead Lake district. The study was made possible by the assistance and provision of funds for field expenses from the Division of Mines and Geology. The project has been under the immediate supervision of Dr. Harold E. Culver, consultant geologist to the Division of Mines and Geology. His very helpful suggestions greatly expedited the field work and aided in the author's understanding of many of the problems encountered. The helpful criticism of the manuscript by both supervisors facilitated preparation of this report.

The petrographic studies necessary for this report were greatly facilitated by the aid of Dr. Charles D. Campbell. His opinions concerning some of the mineral assemblages and the metamorphism indicated by the assemblages have been indispensable in the formulation of some of the author's concepts.

The author was capably assisted by Mr. George Becraft during the 1948 field season, and wishes to acknowledge the aid of Messrs. Fred Wolf, Ed Alger, Charles Barker, C. N. Newburn, and Carl Witherstrom, District Ranger, U. S. Forest Service, all of Newport, who furnished information concerning the mining properties.

The field work was done during the summers of 1947 and 1948. Field notes and mapping were done with the aid of contact prints of vertical aerial photographs and the U. S. Geological Survey topographic map of the Newport quadrangle having a scale of about 2 miles to the inch.

## SUMMARY OF EARLIER WORK

Previous work in the area has been mainly the examination of mineral properties where active development programs were in operation. Patty[1] in 1921 described several mining properties and concluded that the intrusive which encloses the quartz veins is a basic phase of the granitic intrusive. The basic rock is now consid-

[1] Patty, E. N., The metal mines of Washington: Washington Geol. Survey Bull. 23, pp. 71-81, 1921.

ered to be older than the granite. Jenkins[1] in 1924 described several developments to the south of Bead Lake. The Colville Engineering Company[2] in 1943 briefly described workings of most of the prospects and mines of the district.

The series of metamorphic rocks was mapped as Cambrian, Ordovician, and younger Paleozoic sedimentary rocks on the State Geologic Map of 1936. It is mentioned in the legend that some pre-Cambrian rocks may be included with these Paleozoic rocks.[3]

## SCOPE OF THE REPORT

The complex problems of modern prospecting require, as a basis for their solution, a knowledge of the stratigraphy and structure of the rocks of the area under consideration. This report is concerned primarily with these features, although it is not possible to disassociate completely the conditions of deposition of the sediments, or their metamorphism subsequent to deposition, from the problem of determining the stratigraphic sequence of the sedimentary rocks within this area. In addition, metamorphism is discussed when it is an important feature associated with certain structures or with igneous rock contacts. The information that is available concerning the mineralization of the area will be presented as part of the data that suggest some of the geologic controls that may be responsible for localizing ore deposits in this area.

*Chart of formations and igneous rocks*

| Age | | Formation | Thickness (feet) | Character |
|---|---|---|---|---|
| Quaternary | | Undifferentiated Pleistocene and Recent deposits | | Gravels, sands, and silts |
| Tertiary | | Tiger formation | 800+ | Conglomerate |
| Tertiary | | Pend Oreille andesite | 1,100± | Andesite flows |
| Cretaceous (?) | | Kaniksu batholith | | Granodiorite |
| Pre-Cambrian (?) | | Marshall diorite | | Metamorphosed quartz diorite |
| Pre-Cambrian | Newport group | Skookum formation | 13,000+ | Quartzites, sandstones, argillites, and limestones |
| | | No Name argillite | 4,200 | Dark-gray argillite and some limestone |
| | | Bead Lake formation | 12,500+ | Sandstones and argillites |

[1] Jenkins, O. P., Lead deposits of Pend Oreille and Stevens Counties, Washington: Washington Div. Geology Bull. 31, pp. 39-47, 1924.

[2] Colville Engineering Co., Report on minerals in Pend Oreille County: The Public Utility District of Pend Oreille County, Newport, Washington, (mimeographed) 75 pp., 1943.

[3] Culver, Harold E., The geology of Washington, Part I, General features of Washington geology: Washington Div. Geology Bull. 32, pp. 1-70, 1936.

## PRINCIPAL GEOLOGIC FEATURES

A series of metamorphosed pre-Cambrian sediments, at least 29,000 feet thick, is present at the eastern limb of a syncline. This group of rocks, the Newport group, is composed mainly of quartzites, argillaceous sandstones, and argillites. The Newport group has been differentiated into three formations, the Bead Lake formation, the No Name argillite, and the Skookum formation, in order of successively younger ages. Neither the top nor the base of the group has been observed, but it is presumed that the top may be present in the southwest part of the Metaline quadrangle.

The Pend Oreille River Valley has been eroded since the deformation which produced the Newport syncline. The Tertiary valley andesite flows and a younger conglomerate, the Tiger formation, lap unconformably upon different formations of the Newport group within this valley. Glacial and Recent stream deposits also cover the rocks of the Tertiary and of the upper members of the Newport group.

Two intrusives are recognized in the district. The older, a quartz diorite in the form of sills and dikes intruded into the Newport group, is tentatively considered as pre-Cambrian in age. The Kaniksu batholith, composed of granodiorite, is referred to the Cretaceous (?). The younger intrusive has produced recognizable contact effects in the rocks of the Newport group.

A second deformation occurring after the period of folding is suggested by joints which are present in the granitic rocks of the batholith which was intruded after the folding and in the intruded sedimentary rocks. At least two periods of faulting are recognized, respectively before and after the intrusion of the batholith. It has not been possible to determine the attitude of the faults, but it has been established that the faulting involves the Newport group, and, in addition to the pre-Cambrian rocks, the Kaniksu batholith, and possibly the Tertiary rocks.

## SEDIMENTARY ROCKS

### GENERAL FEATURES

The sedimentary rocks of this district can be differentiated into three divisions. The first and oldest group is the thick series of metamorphosed sediments that underlies most of the area west of the divide between the Priest and Pend Oreille Rivers. The second is the Tertiary (?) conglomerate that crops out within the present valley and forms parts of the valley's eastern wall. The unconsolidated gravels, sands, and silts of the Pleistocene and Recent represent the third division.

## PRE-CAMBRIAN SEDIMENTS—NEWPORT GROUP

The 29,000+ feet of argillaceous sandstones, argillite, quartzitic sandstones, quartzites, and carbonate rocks cropping out in the area have been named the Newport group, the name being taken from the town of Newport, which is near exposures of the rocks of the group. The base of the group is not exposed within the map area, and a reconnaissance traverse from Cuban Hill to Newport Hill in Idaho suggests that the base is not exposed in that area to the east of the map area. The upper part of the group has not been observed, but it is presumed that sedimentary rocks higher in the section stratigraphically than those exposed in this district may be present in the southwestern part of the Metaline quadrangle.

No fossils have been found. The lithologic sequence within the Newport group suggests that it probably is equivalent in age to the pre-Cambrian Beltian formations exposed near Lake Pend Oreille in the Clark Fork district of Idaho.

The subdivision of the group must be based upon lithologic grounds. The criteria used in determining horizons within the formations and the diagnostic features of the formations will be presented with the description of the formations.

The oldest formation, the Bead Lake, which is named from the lake, is composed of fine-grained argillaceous and quartzitic sandstones with important quantities of light-colored argillite and light-colored arenaceous argillite. The arenaceous argillites and argillaceous sandstones of the upper part of the formation crop out exceptionally well along the north shore of the lake. Ripple marks have been observed in the upper part of the formation.

The dark-gray argillites stratigraphically above the Bead Lake formation have been named after No Name Peak. Cliffs formed of the upper part of the No Name argillite occur along the south flank of the peak in sec. 5, (32-45E).[1] Ripple marks and mud cracks have been noted in these thinly bedded argillites.

The Skookum formation, which overlies the No Name argillite, has been named after Skookum Peak. The formation does not crop out abundantly anywhere in the map area. The formation is the most varied in the district. The most common rocks of the formation are argillaceous and quartzitic sandstone. Red, green, and dark-gray argillites; calcareous beds; and quartzites are present in subordinate amounts. Ripple marks, mud cracks, cross-bedding, and rill marks have been observed in much of the formation. Near the top of the Skookum formation is the coarse-grained Moon Hill quartzite member. The member name is from Moon Hill, where the quartzite forms the crest of the hill. The top of this member has not been observed, and it is the youngest unit that has been included in the Newport group.

[1] Section 5, Township 32 North, Range 45 East, Willamette meridian. Similar abbreviations are used throughout this report.

## Bead Lake Formation

### Distribution and thickness

The Bead Lake formation crops out along the divide that extends between the Priest and Pend Oreille Rivers, from Ojibway Knoll southeastward to the boundary of the map area. Near Ojibway Knoll it forms a belt a mile wide which becomes 4 to 5 miles wide in the southeastern part of the district. In the northern part of the district the Bead Lake formation composes much of the western flank of South Baldy. Several masses within the granitic batholith belong to this formation.

The rocks of the Bead Lake formation do not crop out prominently. Fortunately, outcrops are fairly abundant on the east flank of No Name Peak and along the north shore of Bead Lake. A coarse sandstone crops out in the SE¼SE¼ sec. 33, (33-45E) and can be traced almost 2 miles south of Bead Lake. This sandstone and a recognizable argillaceous zone, about 3,800 feet stratigraphically below the coarse sandstone, have been used as marker zones. A compilation of the traverses and measured sections along the north shore of Bead Lake and the traverses in the vicinity of Marshall and Shearer Lakes and east of Stone Johnny and the map area indicates that about 12,500 feet of the Bead Lake formation is exposed.

### Stratigraphic relations

The argillaceous sandstones and arenaceous argillites of the upper part of the formation grade up into the dark-gray argillites of the No Name argillite.

The base of the formation is unexposed. The lowermost beds observed are located near the crest of the Snow Valley anticline about 2½ miles due east of Shearer Lake.

Pre-Cambrian (?) and Cretaceous (?) igneous rocks have been injected into the formation. The former, the Marshall diorite, has been injected as sills and dikes, and the latter, the Cretaceous (?), has been intruded as a batholithic mass.

### Lithology

A generalized section of the Bead Lake formation has been compiled from the traverses previously mentioned in determining the thickness. The section can be roughly divided into the following subdivisions, although only the coarse-grained sandstone is a mappable unit.

*Composite section of Bead Lake formation*

| | Feet |
|---|---|
| No Name argillite | |
| Bead Lake formation: | |
| Argillite, light-gray and brown; and sandstone, argillaceous, light-gray and brown | 3,500 |
| Sandstone, quartzitic, coarse-grained, greenish-gray | 400 |
| Sandstone, argillaceous, light-gray and light-brown | 1,800 |
| Argillite, medium-gray and light-gray; some of the beds of the upper part contain biotite porphyroblasts; the lower part shows flow and fracture cleavage | 1,500 |
| Sandstone, quartzitic, micaceous, thick-bedded, grayish-white | 1,700 |
| Sandstone, quartzitic, thin-bedded, grayish, with partings of dark-gray argillite | 2,000 |
| Argillite, arenaceous, thin-bedded, light-gray, with interbeds of argillaceous and quartzitic sandstone | 800 |
| Schist, quartz mica, and interbeds of quartzitic sandstone, base unexposed | 800+ |
| Total exposed thickness of Bead Lake formation | 12,500+ |

Transitional zones are present between the aforementioned beds except for the coarse sandstone member.

The rocks are a rust-brown color on weathered surfaces. The colors of the unweathered rock are generally in the light grays and browns. There are no brilliant and pure-colored red or green rocks, such as are common in the Skookum formation. Very little dark-gray argillite is present in the formation. The laminated argillites have dark greenish-gray to dark-gray laminae that rarely exceed 50 laminae per inch. The great amount of arenaceous material in these rocks is a striking feature. The fragments of sandstone and argillite of the upper parts of the formation composing the talus or part of the mantle cover are from thin-bedded members and resemble flagstones.

The rocks of the Bead Lake formation are composed of quartz and sericite and, in many instances, also chlorite or biotite. The percentages of the constituents in the different sedimentary rocks vary considerably. Some of the more argillaceous rocks have as low as 15 percent quartz, although generally they contain some light-colored layers up to one-tenth of an inch thick that contain as high as 90 percent quartz. The argillites of this formation generally are quite arenaceous, containing about 30 percent quartz. Biotite or chlorite, when present, composes less than 20 percent of the rock.

The dark laminae of the argillites generally have a greenish tinge and are composed of chlorite and sericite. In some places the dark laminae are speckled with porphyroblasts of biotite.

## No Name Argillite

### Distribution and thickness

The dark-gray argillites of the No Name argillite form a north-south belt of rock interrupted by faulting and by the presence of the Kaniksu batholith. The argillite forms the ridges from No Name

Peak northward to Bearpaw Ridge. Other exposures are in several fault blocks forming the mountain slopes in the vicinity of Halfmoon Lake and in the area that extends northward from Browns Lake for a distance of 3 miles.

The No Name argillite crops out exceptionally well on the south slopes of No Name Peak and on Bearpaw Ridge, where there is apparently no duplication of the strata. The formation is 3,000 feet thick in that area. On the divide immediately north of Browns Lake, the formation is about 4,200 feet thick with no suggestion of duplication of any of the beds. The latter thickness is probably more nearly accurate than the former, although the difference may represent a thickening of the formation.

#### Stratigraphic relations

The sandstones of the Bead Lake formation grade up into the No Name argillite, the transition zone being about 200 feet thick. The No Name argillite grades up into the quartzitic and argillaceous sandstone of the overlying Skookum formation. This transition zone of alternating beds of argillite and sandstone is about 400 feet thick, where it is exposed on the west side of Bearpaw Ridge.

#### Lithology

The No Name argillite is composed predominantly of dark-gray argillite. Beds of light-gray argillaceous sandstone occur in a few places in the formation. Limestone lenses occur within the formation near Halfmoon Lake.

A 150-foot thickness of limestone is exposed in a fault block in the SW¼NE¼ sec. 26, (34-44E). The southern extension of this same bed is present in the fault block a quarter of a mile east of Halfmoon Lake. At this point it appears to be thinner than it is farther to the north. The No Name argillite does not contain limestone either north of Browns Lake or south of Skookum Creek. The known lateral extent of the limestone is about 1 mile.

A second limestone bed crops out due north of Halfmoon Lake on the ridge in the western part of sec. 26. The thickness of this bed is about 100 feet, and it possibly is a duplication of the limestone bed east of Halfmoon Lake.

The No Name argillite may be recognized by several characteristics. It is composed predominantly of dark-gray argillite, much of it having a slaty or flaggy appearance. This characteristic is due to a bedding parting that is generally very closely spaced. A poor-to-good fracture cleavage is discernible in a few places. The strike of the cleavage is commonly parallel to the inferred axis of the Newport syncline, and the dip is to the west, generally less than the dip of the beds. Much of the argillite is laminated, and in many places there are as many as 80 to 100 laminae to the inch. Pyrite cubes, or pits resulting from the weathering of pyrite cubes, are quite common.

Some of the larger cubes are 2 centimeters across, and the cubes do not appear to be shattered or deformed and are generally oriented with a face of the cube parallel to the bedding.

The Skookum formation and the Bead Lake formation also contain dark-gray argillite; however, these argillites do not contain pyrite cubes and, except for a bed in the Bead Lake formation, they also lack fracture cleavage and are not over 400 feet thick. Although the bed of medium-gray to dark-gray argillite in the Bead Lake formation has the two latter characteristics, the bed shows a higher degree of metamorphism and contains biotite.

The dark-gray argillites are very fine grained and contain a fairly high percentage of quartz, but insufficient thin sections were examined to say whether this pertains to all the dark-gray argillites of the formation. The rock contains up to 40 percent quartz in grains from 0.01 to 0.04 millimeter in diameter. Sericite is the predominant mineral. Additional minerals are muscovite and a green mineral approaching biotite in optical properties that probably is stilpnomelane. The two micas reach 0.05 millimeter in length and are oriented with the long dimensions parallel to the bedding. The micas make up about 10 percent of the rock.

## Skookum Formation

### Distribution and thickness

The Skookum formation crops out in the western part of the map area, forming parts of the ridges that extend southwestward from the drainage divide. The formation comprises a belt of exposures several miles wide and about 14 to 15 miles long, the exposures separated from each other by alluvium and glacial drift. The band is separated from the Pend Oreille Valley by the Tertiary rocks along most of its length.

A thin veneer of glacial drift covers many of the ridges composed of this formation, so that few outcrops have been noted. In addition to the obscuring of the formation by glaciofluvial deposits, the formation has been considerably faulted, so that an unfaulted section of the entire formation could not be observed. An estimated thickness of 13,000 feet for this formation is based on certain assumptions discussed later in this report.

### Stratigraphic relations

As previously mentioned, a transition zone is present between the Skookum formation and the underlying No Name argillite. The dark-gray argillites gradually become thinner and thinner in the zone until the argillaceous and quartzitic sandstones predominate.

The nature of the contact between the Moon Hill quartzite member and the remainder of the Skookum formation is unknown. The Moon Hill quartzite is very resistant, and the rocks immediately

below the quartzite do not crop out. The abrupt change from non-resistant to resistant beds suggests that there is not a gradual transition, but that the contact is probably sharp and well defined. The top of the Moon Hill quartzite member is concealed by the Tiger formation.

### Lithology

The Skookum formation is the most varied of the formations in the district. It is composed predominantly of argillaceous sandstone and quartzite. Red and dark-gray argillites, and carbonate rocks are also of importance. Zones that can be used as stratigraphic markers have been recognized with difficulty.

A generalized summary section has been compiled from the traverses across the formation and is as follows:

*Composite section of Skookum formation*

| | Feet |
|---|---|
| Skookum formation: | |
| Quartzite, coarse-grained, white to reddish (Moon Hill quartzite member named from Moon Hill) | 1,100 |
| Argillite, purplish-red and light-brown and gray argillaceous sandstone | 400 |
| Sandstone, argillaceous, light-brown, and light-brown arenaceous limestone | 400 |
| Sandstone, argillaceous, light-brown, with some light-green beds of argillaceous sandstone near the base | 2,500± |
| Sandstone, argillaceous, medium-gray with partings or thin interbeds of dark-gray argillite | 500± |
| Limestone, medium- to dark-gray with some dark-gray argillite interbeds | 600± |
| Sandstone, argillaceous medium- to light-gray with dark-gray argillite partings or thin interbeds, possibly dark-gray argillite at top | 600± |
| Sandstone, argillaceous | 600± |
| Quartzite with numerous interbeds of red argillite (4th red zone) | 100± |
| Quartzite, light-gray containing a few beds of gray arenaceous argillite | 500± |
| Argillite, red, and red arenaceous argillite containing a few interbeds of greenish argillaceous sandstone and argillite, and including a 15- to 20-foot thickness of greenish, very siliceous dolomite near the base (3rd red zone) | 300± |
| Quartzite, grayish-white and light-brown | 1,000± |
| Quartzite, reddish, and red argillite interbeds (2nd red zone) | 400± |
| Quartzite, light-gray to white and purplish-red | 400± |
| Quartzite, white to medium-gray | 1,300± |
| Quartzite, purplish-red, cross-bedded with considerable amounts of red argillite in lower part (1st red zone) | 400± |
| Sandstone, argillaceous, and quartzite, light-gray and brown | 2,000± |
| Total thickness of composite section | 13,100± |

No Name argillite

The lower 11,600 feet of the section is based upon a compilation of traverses across the area between the Pend Oreille Valley and the ridge from Bearpaw Ridge to No Name Peak. Within this area and south of Cooks Lake, it has been assumed that the rocks are not faulted and particularly that the fault between Bearpaw Ridge and Cooks Mountain does not extend southward. The extension of the

limestone that is mapped west of Cooks Mountain is apparently concealed by a thick forest cover and glacial drift. The sequence of gray argillaceous sandstone with thin interbeds of dark-gray argillite overlain by light-brown argillaceous sandstone, which overlies this limestone, has been observed west of Cooks Creek.

The upper 1,500 feet of the composite section of the formation has been determined by comparing the lower part of the composite section with two additional generalized sections, one between Browns Lake and Gibraltar Rock, the other between Halfmoon Lake and Gibraltar Rock. A series of traverses from west of Halfmoon Lake on the two ridges, one north and one south of Halfmoon Creek, cross an apparently unfaulted section of the upper part of the formation. The compiled section is as follows:

*Generalized section of Skookum formation in and near Halfmoon Creek*

| | *Feet* |
|---|---|
| Skookum formation: | |
| Quartzite, Moon Hill member | 1,100 |
| Argillite, purplish-red | 300 |
| Concealed | 100 |
| Limestone, arenaceous and argillaceous sandstone | 400 |
| Sandstone, argillaceous light-brown | 300 |
| Sandstone, argillaceous light-brown; interbeds of brown and dark-gray argillite | 400 |
| Sandstone, argillaceous light-gray and brown; a few thin (6-inch) interbeds of reddish quartzite | 700 |
| Argillite, dark-gray | 50 |
| Sandstone, argillaceous light-gray and brown | 1,400 |
| Argillite, dark-gray to dark reddish-gray | 50 |
| Sandstone, argillaceous light-brown and gray. Upper 250 feet in southern ridge is, in part, greenish-gray in color. At least upper 400 feet on north ridge is not exposed, but abundant sandstone float is present | 1,200± |
| N-S fault west of Halfmoon Lake | |
| Total thickness | 6,000± |

Between the fault in the aforementioned section and Halfmoon Lake, a thin limestone is present within the dark-gray argillite. This sequence, compared to that above and below the limestone in the composite section, suggests the possibility that this may not be a fault and that the sequence is a part of the Skookum formation, the limestone being the same one that occurs west of Cooks Mountain. However, the argillites of the sequence are similar to those of the No Name argillite and are therefore considered to belong to that formation.

Two faults cut across the section compiled from a traverse on the ridge between C. C. A. Creek and Browns Creek. It is presumed that the fault half a mile west of Browns Lake has not disturbed the relative sequence of the beds, and it therefore has been assumed that the two lower sections, totaling 8,600 feet, represent a continuous section. This section is as follows:

*Traverse section of Skookum formation on ridge between C. C. A. and Browns Creeks*

| | Feet |
|---|---|
| Skookum formation: | |
| Quartzite, Moon Hill member | 1,100 |
| Sandstone, argillaceous light-brown and gray | 300 |
| Argillite, reddish | 100 |
| Sandstone, argillaceous light-gray, and light-gray and reddish argillite | 1,500 |
| Total thickness | 3,000± |
| Fault | |
| Quartzite and argillaceous sandstone, green | 100 |
| Concealed, no suggestion of lithology; possibly argillaceous sandstone | 1,300 |
| Quartzite, reddish | 100 |
| Quartzite and argillaceous sandstone, light-gray | 700 |
| Sandstone, argillaceous light-gray and light-brown | 1,400 |
| Total thickness between faults | 3,600± |
| Fault ? | |
| Quartzite and quartzitic sandstone, light-gray and brown | 1,400 |
| Sandstone, quartzitic and argillaceous, green | 900 |
| Sandstone, argillaceous light-brown | 2,700 |
| Total thickness between fault and top of No Name argillite | 5,000± |
| No Name argillite | |

The green-colored sandstone and quartzite at the top of the section bounded by the two faults are lithologically similar to the sandstones 1,200 feet above the section traversed west of Halfmoon Lake. If it is assumed that they are the same, a thickness of 13,400 feet can be compiled for the formation in the northern part of the map area. The lower 11,900 feet of this section should be equivalent to the 11,600 feet of strata traversed in the southern part of the outcrop area. Some of the red argillites noted in the composite section appear to change to dark-gray argillite where traced laterally. Therefore, it certainly appears that there are some lateral changes in the formation.

The composite section, compiled from sections based upon assumed continuity of beds in certain areas, appears to be an adequate and perhaps representative section.

The lithology of the Skookum formation is the most varied of those occurring in the area. It is the only one in the district that contains considerable thicknesses of quartzite. The argillites generally lack the thin laminations that are characteristic of many of the argillites of the Bead Lake formation and No Name argillite. The limestones are more arenaceous than the limestone noted in the No Name argillite. It is the only formation in the district that has argillites and quartzites colored in tints of purplish red and green. The color of the rocks changes laterally from purplish red to dark gray and from green to light gray or brown. The argillites characteristically vary in thickness laterally, generally being lens shaped. The

sandstones can be differentiated from those of the Bead Lake formation by the sheen of muscovite or sericite nearly always present on the bedding parting.

Mineralogically, the rocks of the Skookum formation are not unlike those of the Bead Lake formation. The light olive-gray argillaceous sandstones that form most of the lower part of the section and that also occur farther up in the section are fine grained and somewhat slaty. They contain an abundance of sericite and occasionally some muscovite. The green-colored quartzitic sandstones owe their color to chlorite, which is present in about equal quantities with sericite, both together making up as much as 25 percent of the rock. Some zircon grains of detrital origin have been noted in these sandstones.

The argillites range in composition from rocks that are predominantly sericite with about 15 to 25 percent quartz to green-colored argillites containing about equal amounts of chlorite and quartz. The dark-green argillites are composed of equal amounts of chlorite and quartz and generally contain a small amount of sericite. The purplish-red argillites are composed mainly of sericite and fine-grained quartz. The coloration is apparently due to dusty-appearing hematite.

## Conditions of Sedimentation

Ripple marks, cross-bedding, mud cracks, rill marks, bedding, and swash marks have been noted in many places in the rocks of the Newport group.

A very prominent feature of many of the argillites of the No Name argillite and the Skookum formation is the closely spaced bedding. The bedding-plane surfaces appear to be flat and, in many instances, there are as many as 100 laminae in a 1-inch thickness of the strata. The appearance of the bedding is similar to that of varves. The laminae are generally of three different compositions, (1) quartz grains, (2) sericite, and (3) sericite and chlorite. Some laminae are composed of sericite and porphyroblasts of biotite. The laminae made up primarily of quartz grains alternate with the mica-rich laminae, although in some rocks the sericite layers are gradational from the quartz to chlorite layers and from chlorite to the quartz. This bedding is suggestive of alternate deposition of sand and silt and of silt and clay-size particles in fairly quiet water.

Oscillation-type ripple marks are common features in the upper part of the Bead Lake formation, the No Name argillite, and the Skookum formation. Ripple marks do not occur in the zones where the argillites are thinly bedded. Swash marks similar to the kind that, according to Schrock, [1] are developed by successively overriding waves, were noted at two places in the Skookum formation.

[1] Schrock, R. R., Sequence in layered rocks, McGraw-Hill, N. Y., p. 128, 1948.

The gentle slope of these marks, to the east up the dip of the beds, indicates that the sea extended eastward from near that point.

Arenaceous fillings in mud cracks in the argillites of the Skookum and No Name probably represent periods of rapid deposition following periods of drying.

Quartz, sericite, and chlorite are the most abundant minerals in the rocks. The original minerals from which the sericite and chlorite were developed were probably clay minerals.

The quartz grains, where the fragmental texture has not been greatly altered, are subround. The sphericity of the grains is poorly developed. The quartz grains that are scattered through the argillaceous material of the No Name argillites and through some of the limestones of the Skookum formation give an impression of poor sorting, but the quartz grains of the sandstones and quartzites and of the quartz layers of the argillites generally show fairly good sorting. Detrital grains of zircon have been noted in some of the sandstones and quartzites.

The original grains of most of the sediments apparently were of fine size. The fineness of the material and the fact that the sediments were completely weathered products containing no unweathered detrital mineral fragments, such as feldspar, indicate that the land mass providing the sediments was a fairly stable low-lying area.

The vertical sequence of strata of the Bead Lake formation could be related to a nonuniform rate of settling of the area of deposition. The sedimentary features of the No Name argillite suggest that the environment of its deposition varied from mud flats to quiet waters of shallow to moderate depths. The characteristics of the "platform" sediments of Dapples [1] and Krumbein, [2] which are deposits laid down upon a surface of low relief, either on the land or in the sea, during widespread conditions of tectonic stability in the source and depositional areas, are similar to the characteristics of the Newport group. The Newport group was probably deposited upon a broad plain which was delicately balanced in relationship to sea level and which, at times, was an alluvial plain and, at other times, a gently sloping sea bottom.

## Correlation

The Newport group parallels, in a stratigraphic sense, a part of the rocks in the Metaline quadrangle mapped by Park and Cannon[3] as the Priest River group. Exposures of the Newport group are separated from most of those of the Priest River group by 12 to 15 miles, but an isolated mass of the Priest River group in the southeast corner of the Metaline quadrangle extends to Tola Peak in the north-

[1] Dapples, E. C., Sandstone types and their associated depositional environments: Jour. Sedimentary Petrology, vol. 17, pp. 91-100, Dec. 1947.

[2] Krumbein, W. C., Shales and their environmental significance: Jour. Sedimentary Petrology, vol. 17, pp. 101-108, Dec. 1947.

[3] Park, C. F., Jr., and Cannon, R. S., Jr., Geology and ore deposits of the Metaline quadrangle, Washington: U. S. Geol. Survey Prof. Paper 202, p. 6, 1943.

east corner of the Newport quadrangle, where the writer has mapped the Bead Lake formation of the Newport group. The rocks of the Priest River group and the Newport group are similar in rank of dynamic metamorphism, and the two groups are similar lithologically, although the Priest River has not been differentiated into formations.

Daly[1] divided a complexly folded and metamorphosed rock terrane into seven lettered units grouped into the Priest River terrane. These rocks were later mapped in more detail by other Canadian geologists, who however did not use the term Priest River terrane. Rice[2] mapped these rocks in the east half of the Nelson map-area, immediately to the northeast of the Metaline quadrangle, and applied the term Purcell series. In mapping the extension of these rocks in the Metaline quadrangle, Park and Cannon[3] reverted to the disused Priest River term but raised the rank of the unit to that of a group without completely differentiating the unit.

In an area in Idaho which includes the narrow strips along the eastern side of the Newport and Metaline quadrangles and extends to the valley of the Priest River, Ross and Forester[4] show undifferentiated Belt series rocks.

Walker[5] considers the Windermere series of British Columbia as equivalent to the rocks Daly[6] described as the Summit series. At the 49th parallel, the Summit series unconformably overlies the rocks of the Priest River terrane. In the Salmo area, B. C., Walker[7] has found the Windermere series to unconformably overlie the Purcell series, which is, in part, the northward extension of the late Beltian formations, the Roosville, Phillips, and Gateway.[8] The Priest River terrane is probably equivalent, at least in part, to the Purcell series. The Newport group is probably Beltian.

The Newport group is located geographically between the pre-Cambrian Deer Trail group[9] of Stevens County and the Beltian rocks of northern Idaho. These rocks crop out respectively 30 miles west and 20 miles east of the nearest known exposure of the Newport group. There is a greater lithologic similarity between the rocks of the Newport group and the Beltian rocks than between the Newport group and the Deer Trail group. The sequence of No Name

---

[1] Daly, R. A., Geology of the North American Cordillera at the 49th parallel: Canada Geol. Survey Mem. 38, pp. 258-271, 1912.

[2] Rice, H. M. A., Nelson map-area, east half, British Columbia: Canada Geol. Survey Mem. 228, pp. 7-13, 1941.

[3] Park, C. F., Jr., and Cannon, R. S., Jr., op. cit., p. 6, 1943.

[4] Ross, C. P., and Forrester, J. D., Geologic map of the state of Idaho: Idaho Bur. Mines and Geology, 1947.

[5] Walker, J. F., Geology and mineral deposits of the Salmo map area, B. C.: Canada Geol. Survey Mem. 172, pp. 2-6, 1934.

[6] Daly, R. A., op. cit., pp. 141-159, 1912.

[7] Walker, J. F., Geology and mineral deposits of the Windermere map area, B. C.: Canada Geol. Survey Mem. 148, p. 16, 1926.

[8] Schofield, S. J., Relationship of the pre-Cambrian (Beltian) terrain to the lower Cambrian strata of southeastern British Columbia: Canada Geol. Survey Bull. 35, Geol. series 14, p. 15, 1922.

[9] Bennett, W. A. G., Preliminary report on the magnesite deposits of Stevens County, Washington: Washington Div. Geology Rept. of Inv. 5, pp. 7-8, 1941.

argillite and Bead Lake formations appears to be similar to the lithologic sequence of dark-blue banded shales and sandstones of the Pritchard formation in the Clark Fork district of Idaho as reported by Anderson.[1]

The Skookum formation probably is equivalent in part to the Ravalli group, undifferentiated St. Regis, Revett, and Burke formations; and the No Name argillite and Bead Lake formations are equivalent to the Pritchard formation.

## TERTIARY SEDIMENTS

### Tiger Formation

#### Distribution and thickness

Conglomerate of continental origin forms a low hill about 1½ miles northwest of Furport in sec. 23, (32-44E), and also Gibraltar Rock and the ridge for a distance 2 miles north of the rock, and the western and southern flank of Moon Hill. The semi-consolidated rock breaks down easily, and it is possible that the area mapped as Pleistocene in secs. 21 and 28, (34-44E) may be underlain by the conglomerate.

The maximum observed thickness of the Tiger formation is about 800 feet in the vicinity of Gibraltar Rock.

#### Lithology

The Tiger formation in this district is predominantly a conglomerate, the materials being poorly sorted and the beds poorly defined. The rock has a dark-brown color on the weathered outcrop surfaces. The material larger than 2 millimeters in diameter generally is well rounded, with some pebbles being subround. The exposure near Furport shows a lesser degree of roundness than is common for the formation near Gibraltar Rock.

Boulders 6 inches to 1 foot in diameter have been noted near Gibraltar Rock. The pebbles and coarser material are mainly quartzite and argillite, the material of an individual exposure being similar to the rocks of the Newport group exposed in the adjacent valley. Near Gibraltar Rock the matrix is composed of quartz sands, biotite flakes, and kaolin. Farther south, near Furport, the matrix appears to change, as more and more sand of argillite and quartzite is present.

#### Age

The conglomerate was deposited in a valley similar to that existing at present. The close proximity of the material to the source is suggestive of alluvial fan deposition or of a valley alluvial fill

[1] Anderson, Alfred L., Geology and ore deposits of the Clark Fork district, Idaho: Idaho Bur. Mines and Geology Bull. 12, pp. 14-15, 1930.

caused by a damming of the stream occupying this old valley. The occurrence of the conglomerate, the degree of induration, the structural and stratigraphic relationships, and the probable conditions of sedimentation are such as to indicate that it is the same as the series of rocks in the Metaline quadrangle that has been designated by Park and Cannon[1] as the Tiger formation. There the poorly preserved fossil leaves which they were able to collect from the formation did not lead them to any specific conclusion as to its age.

The beds are more indurated than the known Pleistocene sands and gravels in this area. The conglomerate contains weathered products of the Kaniksu batholith and also cobbles and boulders of the Pend Oreille andesite, which may be genetically related to the Miocene basalts of the Columbia Plateau. These facts suggest a Tertiary age for the conglomerate.

### QUATERNARY DEPOSITS

No effort has been made to distinguish between the Pleistocene and Recent deposits. The Pleistocene deposits are all products of glaciation and glacier melt waters. The Recent deposits are mainly in the bottom of the valleys and are of minor importance. The Continental ice sheet covered most of the area and extended as far south as Bead Lake Peak. The ridges north of Bead Lake Peak are all covered by a thin veneer of glacial drift, most of which has not been mapped. The valley fills and terraces are the quantitatively important deposits and are the ones that have been mapped.

The highest terrace in the Pend Oreille River Valley is at 2,500 feet elevation. Higher-level terraces, some as high as 3,500 feet, occur toward the heads of many tributary valleys, damming them to form lakes such as Browns Lake, Kings Lake, the Skookum Lakes, and Mystic Lake.

## IGNEOUS ROCKS

### INTRUSIVE ROCKS

The two intrusive rock varieties of the district are the Marshall diorite and the Kaniksu batholith.

#### MARSHALL DIORITE

**Distribution**

The diorite has been named from Marshall Creek, along which a sill of the igneous rock is well exposed. With the exception of a sill 3 or 4 feet thick exposed by a road cut in the Skookum formation on the west side of C. C. A. Peak, diorite has not been noted in any but the Bead Lake formation. The diorite occurs mainly as sills

[1] Park, C. F., Jr., and Cannon, R. S., Jr., Geology and ore deposits of the Metaline quadrangle, Washington: U. S. Geol. Survey Prof. Paper 202, p. 23, 1943.

which vary in thickness from 3 to 1,200 feet. Two of the thicker sills crop out at Stone Johnny Peak and near Marshall Creek. The thickness of the sills is not constant along the strike, and in places they bifurcate and cut across the strike as dikes.

#### General character and petrography

The rock ranges from medium gray to almost black. A gradation from the lighter-colored rock at the upper margin to darker-colored rock toward the lower stratigraphic margin of several of the sills is apparent. Microscopic examination shows the rock to be a quartz diorite. The light-colored variant is an albite-rich rock composed predominantly of albite and quartz, with brown biotite being the next most prominent mineral. The brown biotite is fine grained, has a mosaic texture, and interfingers in and around the grains of quartz and albite. Embayments and fracture fillings of biotite separate some of the albite crystals. Some alteration minerals such as needles of actinolite, masses of zoisite, and grains of kaolin, calcite, muscovite, and fine-grained quartz occur in the albite, presumably as alteration products of the albite.

A megascopically discernible gradation from the albite-rich variant to the dark-colored hornblende variant is noted across the sill at the Marshall Creek locality and across the sill at Stone Johnny Peak from the western edge and upper stratigraphic margin to the eastern edge and lower stratigraphic margin. This gradation is discernible in some of the other sills where outcrops expose the rock sufficiently. Hornblende is the predominant mineral, making up at least half of the dark variant. Plagioclase is next in quantitative importance and it is generally andesine (Ab 55). Quartz is present in small quantities that are exceeded by that of the alteration minerals present in both the hornblende and the plagioclase. In several instances only the form of the hornblende crystal is preserved, the original mineral having been replaced by magnetite, chlorite, brown biotite, and epidote or by clusters of sphene granules. The plagioclase contains considerable amounts of the secondary minerals, chlorite and epidote or zoisite.

It is noteworthy that a great proportion of the minerals are secondary; in fact, some of the assemblages appear to be entirely secondary. The composition of the rocks indicates that they were originally quartz diorites. The occurrence of the feldspars and the hornblende in certain stratigraphic zones suggests differentiation. The subsequent alteration of the minerals after intrusion is believed to be a clue to the nature of the regional metamorphism (see p. 34).

#### Age

The geographic distribution of the two variants within each sill indicates that gravity segregation of certain minerals occurred before the magma consolidated. The rocks were originally com-

posed mainly of albite and quartz in the western part of the sills and calcic plagioclase and possibly hornblende, but probably augite (see p. 33) in the eastern part. Albite and quartz have a specific gravity less than 2.66, whereas calcic plagioclase, augite, and hornblende are greater than 2.67. The segregation of the minerals is probably the result of a gravity differentiation that occurred during and after the crystallization of the minerals and before the consolidation of the magma. The heavier minerals probably sank to the lower parts of the sills, which are now the eastern parts. The positional relationship of the sills is the same as the beds of the enclosing Newport group. The diorite magma probably was intruded into the Newport when the beds were horizontal. The quartz diorite intrusion probably occurred before the late Mesozoic, because the folding preceded the emplacement of the Kaniksu batholith which truncates the folds.

Sills of similar composition in Idaho and Montana have been considered as being possibly of pre-Cambrian age. In northern Montana, Fenton and Fenton[1] noted that sills and dikes of similar composition cut units of the Belt series between the Altyn limestone and the Spokane formation. They recognize these dark-gray to greenish, altered gabbro-diorite (Siyeh) sills as having been intruded during early Spokane or latest Siyeh time.

The Marshall diorite is tentatively considered as being pre-Cambrian in age.

## Kaniksu Batholith

### Distribution

The Kaniksu batholith underlies most of the northeastern part of the Bead Lake district. The exposures of this granitic rock are continuous into the southern part of the Metaline quadrangle where the batholith was named by Park and Cannon.[2] The batholith appears to be continuous with the Bayview granodiorite of Gillison[3] in the Selkirk Mountains. In general, the rock of the batholith crops out in but few places, forms rounded ridges, and is generally deeply weathered.

### General character and petrography

The Kaniksu batholith in this district exhibits a variety of compositional features. There are also two variants in texture. The variations of texture and composition can be grouped into three facies: (1) the predominant one is porphyritic with phenocrysts of orthoclase perthite, (2) a nonporphyritic textural variant composing part of the border of the batholith, and (3) a porphyritic border

[1] Fenton, C. L., and Fenton, M. A., Belt series of the North: stratigraphy, sedimentation, paleontology: Geol. Soc. America Bull., vol. 48, pp. 1903-1904, 1937.
[2] Park, C. F., Jr., and Cannon, R. S., Jr., op. cit., p. 43.
[3] Gillison, J. L., Granodiorites in the Pend Oreille district of northern Idaho: Jour. Geology, vol. 35, pp. 1-32, 1927.

variant with phenocrysts of oligoclase. Transitional varieties apparently occur instead of there being sharp contacts between the facies.

All the facies are quartz monzonite very close to a granodiorite in composition. Field observation indicates that in some places the quartz monzonite grades into granodiorite. Orthoclase, oligoclase, and quartz are the principal essential constituents of all the facies. The accessory minerals noted are magnetite, titanite, apatite, zircon, rutile, pyrite, and some garnet. Potash feldspar and oligoclase are present in almost equal amounts, the oligoclase being in slightly greater quantity. Both feldspars make up 40 to 75 percent of the rock. Quartz makes up 20 to 40 percent of the rock, the higher percentages being present in the border facies.

#### Minor intrusive bodies

Dikes of lamprophyre and granophyre, that may be genetically related to the batholith, crop out very poorly in the district. Very few of these have been observed and their dimensions were so small that they have not been mapped.

#### Age

The age of the Kaniksu batholith has not been determined with any certainty. At present, the age determination is based upon the assumption that the Kaniksu batholith was intruded at the same time as other batholiths of similar composition in the adjoining districts. According to Park and Cannon, [1] the best available evidence seems to point to a Cretaceous, possibly late Cretaceous age.

## EXTRUSIVE ROCK

### Pend Oreille Andesite

#### Distribution

Trachitic hornblende andesite crops out 1½ miles north of Furport along the eastern edge of the Pend Oreille River Valley. The andesite forms the valley wall for a distance of 7 miles from there to the Skookum Creek Valley near the State Fish Hatchery. North of Skookum Creek the andesite is overlain unconformably by the Tiger formation. The andesite is named from its occurrence within the valley of the Pend Oreille River.

#### General character and petrography

The andesite is a dark-gray rock containing megascopically conspicuous hornblende phenocrysts. The phenocrysts are, in general, oriented, and in one place on the ridge south of Skookum Peak where orientation was noted it is roughly parallel to the valley walls. Clusters of phenocrysts of hornblende, bytownite, and diopside in

[1] Park, C. F., Jr., and Cannon, R. S., Jr., op. cit., p. 26.

a groundmass containing slightly more than 50 percent andesine give the rock a glomeroporphyritic texture. The andesite generally weathers to a light- to medium-gray color. Delicate green and pink colors produced by weathering have also been observed.

The rock occurs as flows in an old valley that had been cut into the metamorphics of the Newport group. In the SW¼ sec. 15, (33-44E) a road cut reveals what is possibly pillow structure. Individual flows could not be discerned. The andesite has been noted as high as 3,300 feet in elevation and as low as 2,200. On the presumption that the flows are horizontal, there would be a thickness of 1,100 feet exposed. In the SW¼ sec. 17, (32-45E) a dike of andesite showing horizontal columnar jointing forms the backbone of a south-southeastward-trending spur from the hill in the northwest quarter of the section. This is the only dike of hornblende andesite that has been recognized, and it may be a feeder dike for some of the flows.

#### Age

The Pend Oreille andesite has provided some of the material for the conglomerate of the Tiger formation. The andesite does not show the jointing that is common to the Newport group, the Marshall diorite, and the Kaniksu batholith. If the volcanics were Mesozoic in age, they should also show this jointing, which was developed in the late Mesozoic or later (see p. 30), and, as they do not, it is believed that the valley flows are of Tertiary age. Petrologically, the andesite is similar to some of the basalts and andesites of the Columbia River basalts.[1] The Pend Oreille andesite possibly is of Miocene age.

## STRUCTURE OF THE PRE-TERTIARY ROCKS

### GENERAL FEATURES

The rocks of the Newport group generally dip to the west and form the east limb of the Newport syncline and the west limb of the Snow Valley anticline. The Kanisku batholith has apparently intruded in part along the axis of the Snow Valley anticline. The rocks of both the Kaniksu batholith and the Newport group show jointing and have been involved in faulting.

### FOLDS

#### Newport Syncline

The Newport syncline, named from the town of Newport, is the only major fold that possibly has its axis within the area. Sandstones of the Bead Lake formation cropping out near the highway

[1] Campbell, C. D., Petrology of the Columbia River basalts: present status and ideas for future work: Northwest Sci., vol. 24, pp. 74-76, 1950.

in the NW¼ sec. 12, (31-45E), west of the Pend Oreille River, show a drag fold that plunges 20° N. 35° W. and with overturning that suggests that the fold is located on the west limb of a syncline. However, the direction of the drag fold axis is 20° to the east of the direction of the dip of the beds and suggests that the paralleling synclinal axis is to the west of the minor fold. The axis of the Newport syncline is probably in the proximity of the NW¼ sec. 12, (see plate 1), because of the relationship of the dip to the minor fold axis and the overturning of that fold.

### Snow Valley Anticline

The crest of the Snow Valley anticline is located about 2 miles east of Stone Johnny Peak and outside of the map area. Sandstones and quartz mica schists in the SW¼ sec. 33, (56-5W, Idaho) strike N. 50° W., dip 5° NE., and are slightly east of the axis of the anticline, since sandstones of the Bead Lake formation, 2 miles farther east, strike N. 5° W. and dip 15° NE. The beds observed west of the two outcrops just mentioned dip consistently to the west, while the beds east as far as the Priest River in Idaho consistently dip to the east. The trace of the axis of the anticline probably trends north from Cuban Hill toward Snow Valley, where it is either terminated or interrupted by the Kaniksu batholith. The structure is named from Snow Valley, located in Idaho.

### Subordinate Folds

In addition to the drag folds, there are several subordinate anticlines and synclines. Many of these appear to plunge to the north and appear to lack persistence throughout the district. Some of the structures, for instance those to the east of Browns Lake, are probably continuations of the same structures south of the Browns Creek fault. Difficulty in finding outcrops in that area has made it impossible to definitely identify continuations of the structures across the fault. Most of the minor structures appear to occur in the Bead Lake formation, although an anticline and syncline formed of rocks of the Skookum formation have been noted at C. C. A. Peak and their apparent continuation observed in sec. 22, (34-44E).

Examination of the geologic map accompanying this report gives an impression of uniformity of dips that actually does not prevail in the field. Most of the abrupt changes of dip are due to local overturning of the beds and to slight warps on the main structure in which, when traversed from east to west, the dip of the beds changes from the regional westward dip of 50°-60° to 10°-30° for a distance of 15 to 30 feet horizontally, and then changes again to the original dip of 50°-60°. On such a gently sloping structural terrace a small drag fold of discordant relationship to the Newport syncline was noted. It is accordant, however, with the western fold in the terrace-like structure. The folds are almost chevron folds breaking into

overthrusts, and in one place, space has been developed by the folding. These folds appear to have been formed under conditions such that the beds involved were competent and, therefore, not genetically related to the major folds. Tension fractures were noted on the western fold of one of these previously described terrace-like structures exposed on the road above Mystic Lake. These fractures and the chevron folds were probably formed by a deformation after the principal folding. Probably the stresses of this deformation were mainly relieved by jointing.

## FRACTURE AND FLOW STRUCTURES

### Rock Cleavage

Rock cleavage, in most instances, appears to be related to the folding. The instances not related to the folding are adjacent to the Kaniksu batholith and will be discussed in connection with the contact metamorphism. Both fracture and flow cleavage have been noted in the rocks of the Newport group. The argillite 5,700 feet stratigraphically below the top of the Bead Lake formation shows fracture cleavage on the ridge south of Marshall Lake. Farther north this cleavage gives way to flow cleavage such as that on Bead Lake Peak and a short distance to the south of the peak.

Fracture cleavage is well developed in the lower part of the No Name argillite on the north shore of Browns Lake. Farther south, about 3½ miles west of Bead Lake Peak and on the south flank of No Name Peak, the argillites in places show a very poor fracture cleavage, striking roughly parallel to the direction of plunge of the drag folds in the argillite and dipping to the west. East of the C. C. A. Peak fault the No Name argillite in the contact zone of the Kaniksu batholith exhibits a flow cleavage. It is possible that this cleavage has been emphasized by the effects of the intrusion of the batholith, but it seems reasonable to believe that it must have been developed, to some extent, prior to the intrusion of the granitic magma.

In sec. 6, (56-5W, Idaho) fine-grained quartz sericite schist is intercalated with quartzitic sandstone. This rock is referred to the lowermost 800 feet in the section of the Bead Lake formation. The flow cleavage is evident in both the schist and the sandstone, although it is not as well developed in the sandstone. Sericite is oriented parallel to the flow cleavage, which strikes N. 60° W., and dips 50° SW. The strike of the cleavage is roughly parallel to the trend of the axis of the Newport syncline southwest of this area. The bedding strikes N. 25° W. and dips 45° SW.

Both the No Name argillite and the argillite of the Bead Lake formation, which has rock cleavage, are between relatively thick series of sandstones or quartzites. The distribution of the rock cleavages in the two units, the fairly uniform relationship of the

attitude of the rock cleavage to the attitude of the bedding and the direction of the synclinal axis (see pl. 1), and the stratigraphic relationship previously mentioned, indicate that the cleavage was developed during the folding by differential movement between the more competent sandstone beds. The change from fracture cleavage to flow cleavage from south to north in the sheared rocks and the character and distribution of the cleavage suggest that the rocks to the north were buried more deeply than the ones toward the south during the development of the cleavage.

### Joints

Superficially, it appeared in the field that the joints had some connection with the folded structures. It is especially noticeable that where the bedding dips to the east and the strata form subordinate structures on the east limb of the Newport syncline, the bedding plane joint system is not as prominent as it is where the beds dip to the west. This would suggest that this jointing, which, in some places, is really only an excellent bedding-plane parting, has been developed along the partings previously emphasized by a differential movement of the beds during the development of the folds.

There appears to be no reason to differentiate in time the jointing of the Kaniksu batholith from that of the intruded rocks. It is believed that the jointing in both occurred at the same time—that is, if all the jointing of the Newport group can be attributed to the same deformation.

The attitudes of 177 joints were noted in this district and plotted on an equal-area projection of an upper hemisphere; from this a contour diagram of the joint concentration was prepared. Figure 2, the contour diagram, shows a high concentration of joints approximating N.-S., 45° W., which is the joint system parallel to the bedding; a high concentration of E.-W., steeply dipping joints; and fairly strong N.-S., 45° E., and E.-W., high-angle concentrations.

Several correlations with the structure of the district can be made. The drag folds on the east flank of the Newport syncline indicate a general pitch of 30° to the northwest and an axis trend of about N. 30° W. The orientation of joints does not coincide perfectly with the theoretical arrangement of the joints on the flanks of the syncline. Although there are not many data available concerning the Snow Valley anticline, it is inferred that the axis strikes north, and that if it plunges, it does so at a very low angle. It is suggested that the "grain" of the district has been controlled by the intrusion of the Kaniksu batholith into the anticlines. The orientation of the grain is roughly parallel to the inferred N.-S. axis of the Snow Valley anticline. The orientation of the joints with this grain then falls into a pattern approaching the theoretical arrangement.

The E.-W.-striking joints of steep dip probably are the tension joints due to elongation, and the conjugate N.-S. joints may be

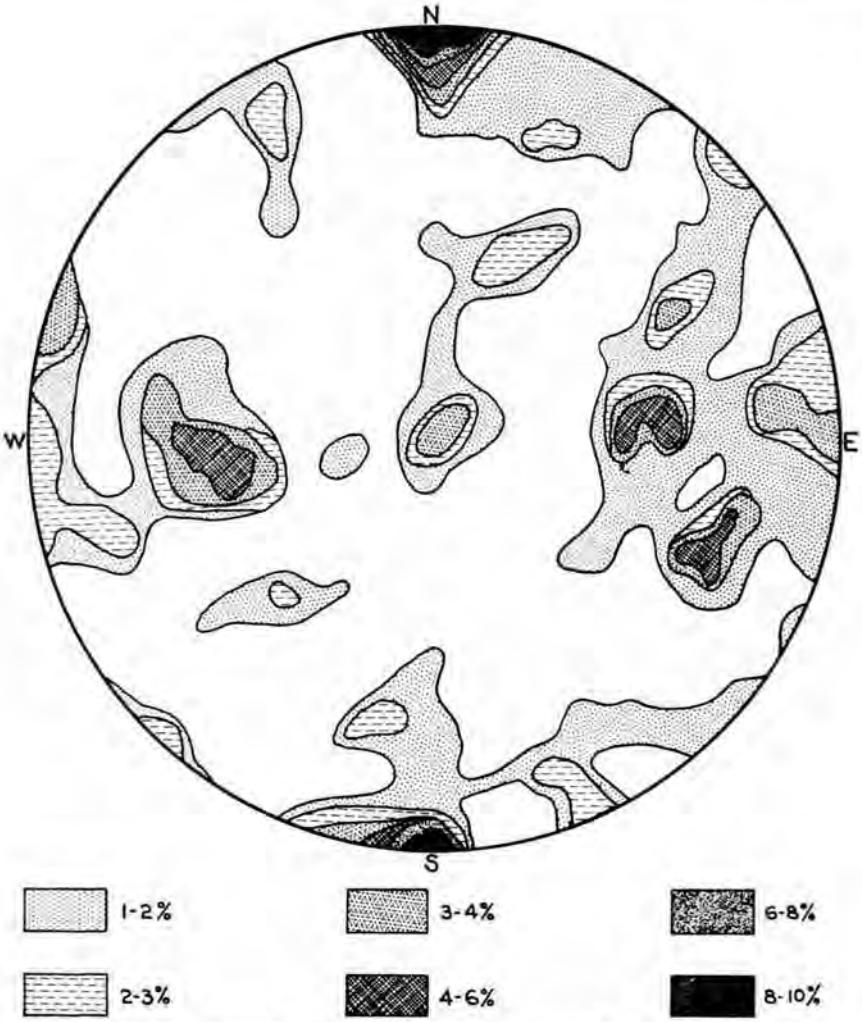



FIGURE 2.—Contour diagram of the concentration of joints on equal area projection.

either release joints formed at right angles to the axis of the compressive force, after the stress was released, or shear fractures due to differential movement of the beds involved in the Snow Valley anticline. A heavy load generally results in release of accumulated stresses by conjugate sets of vertical joints at an angle of 45° to the compressive forces. In such a situation the strain ellipsoid would then be oriented with the greatest strain horizontal and trending N.-S.; the least-strain axis, or axis of shortening, horizontal and trending E.-W.; and the intermediate-strain axis perpendicular to the surface of the earth. There is only a slight orientation of joints in the requisite position for the concentration of joints parallel to

the planes of maximum shear. However, there is a high concentration of joints near N.-S., 45° W. parallel to the bedding and near N.-S., 45° E. These would require the strain ellipsoid to be oriented with the intermediate-strain axis horizontal and trending N.-S., the least-strain axis horizontal and trending E.-W., and the greatest-strain axis perpendicular to the surface of the earth. This would indicate that the easiest relief was upward, and therefore the overlying load of rocks could not have been very thick during the development of the joints.

The conditions necessary to produce the flow cleavage in some of the argillites of the Bead Lake formation would have necessitated a much heavier load than that which was present during the formation of the joints. The deformation producing the Newport syncline and the Snow Valley anticline took place before the intrusion of the late Mesozoic (?) batholith, and it is here considered that the igneous invasion coincided with the last phases of the forces producing those structures. After the emplacement of the Kaniksu batholith, a second compressive deformation is inferred to have taken place, developing most of the jointing noted in the rocks of the district. It is even possible that the emplacement of the batholith occurred under the influence of this second period of stresses and that the stresses were still operative during the final stages of intrusion after the cooling of most of the intrusive mass. The mineralization, presumably related genetically to the batholith, of E.-W. fissures which may have had their conception as joints is in harmony with this latter concept.

### Faults

Surfaces of the major faults have not been observed. The offset of certain strata indicates that faults are present and also indicates their approximate location. Some of the faults have been named in order to prevent confusion. They all appear to be of the high-angle variety, and the direction of the dip of the individual planes is not suggested except for the N.-S. fault in sec. 11, (33-44E), which probably dips at a moderate angle to the east.

The faults can generally be delineated into three trends, (1) E.-W., (2) NE.-SW., and (3) N.-S. to NNW.-SSE.

It is evident from plate 1 that there is a probability that some of the northward- and northwestward-striking faults are of pre-batholith age. If the fault zone at the western base of Cooks Mountain is an offset continuation of the fault across the ridge extending southwest of Kings Mountain, at least two, possibly three, periods of pre-batholith faulting are probable.

At least one east-west fault, the Browns Lake fault, is of post-intrusive age, apparently faulting both the batholith and Tertiary rocks. The apparent termination of the Halfmoon Lake faults by

the Browns Lake fault suggests that this group of north-striking faults is younger than the Browns Lake fault.

No evidence of any Pleistocene or Recent faulting was found in this district.

The faults cannot be grouped according to their age relationships, as such a relationship, in most instances, is obscure. However, it is inferred that some of the faults antedate the intrusion of the Kaniksu batholith and some postdate the intrusion, including at least one that is of late Tertiary or younger age.

## AGE OF THE DEFORMATIONS

The Kaniksu batholith cuts across the strike of the beds and across the minor folds and, as such, is definitely a discordant batholith. The intrusion certainly occurred after the development of the Newport syncline and the Snow Valley anticline. A similar conclusion regarding the time relationship of the folding to the intrusion of the batholith is presented by Park and Cannon[1] for the structures in the Metaline quadrangle. Their data concerning the stratigraphy of the Metaline quadrangle indicate that the deformation producing the folds was probably post-Ordovician. It would appear that this deformation could have occurred late in the Paleozoic or in the Mesozoic.

Evidence presented previously indicates that the deformation producing the joints is post-batholith, or at least that it followed the emplacement and consolidation of a major part of the batholith. The E.-W. quartz veins that occur abundantly in the southern part of the district do not show jointing and certainly were developed after the jointing, possibly along fissures that evolved from joints. The quartz veins are believed to be genetically related to the batholith, probably the last phases of the intrusive activity. It is believed that the joint development must certainly be due to regionally operative stresses. It seems probable that these stresses may have been a controlling factor in the emplacement of the batholith and were operative until late in the period of intrusive activity.

The relationship of the various faults to each other and to the batholith suggests two, possibly three, periods of major faulting—a pre-intrusive period and one, possibly two, periods of post-intrusive faulting. The drifts of the Key Fraction and the Skippy claims reveal that considerable faulting of minor displacement has taken place after the time of mineralization.

[1] Park, C. F., Jr., and Cannon, R. S., Jr., op. cit., pp. 6-23, 34.

# ALTERATION OF THE SEDIMENTARY ROCKS AND THE MARSHALL DIORITE

## GENERAL FEATURES

The sedimentary rocks of the Newport group and the Marshall diorite were folded prior to the emplacement of the Kaniksu batholith. The regional metamorphism presumed to be genetically related to the deformation developed new minerals and converted the indurated sediments into metamorphic rocks, such as quartzites, quartzitic and argillaceous sandstones, argillites, and very fine grained marbles. The metamorphic rocks, in general, appear to have the same grade of metamorphism, except in areas adjacent to the Kaniksu batholith. The rocks in a zone approximately a mile wide adjacent to the batholith are recognizably different from the same rocks away from the zone. This difference is attributed to igneous metamorphism.

## REGIONAL METAMORPHISM

### Newport Group

The principal minerals in the metamorphic rocks are quartz, sericite, chlorite, muscovite, biotite, and stilpnomelane. The quartzites are composed of quartz with small amounts of sericite. The sandstones contain quartz, sericite, chlorite, and, in some places, muscovite. The argillites have been noted to contain quartz, sericite, chlorite, biotite (in the Bead Lake formation), muscovite, and stilpnomelane (in the No Name argillite). In addition to calcite and quartz, the limestones contain, in at least one place, small quantities of muscovite. The limestone, although very finely crystalline, could be called marble.

The presence of stilpnomelane, biotite, and sericite, and the character of the metamorphics, such as the crystallization of the No Name argillite, are suggestive of static metamorphism. The occurrence of the biotite in the Bead Lake formation and of stilpnomelane in the No Name argillite, suggestive of a variation due to a difference of depth of burial during metamorphism, is in harmony with this concept.

The low-grade metamorphics are probably the result of progressive metamorphism, suggested by the presence of stilpnomelane, a progressive metamorphism transition mineral between chlorite and biotite.

### Marshall Diorite

The present mineralogic assemblage of the quartz diorites is not the same as it was immediately after solidification of the dioritic magma. Embayments and fracture fillings of biotite and quartz in

the albite crystals suggest a deuteric alteration before complete solidification of the magma.[1] Evidence pointing to albitization has not been observed in the albite-rich rocks of the upper part of the thicker sills. Fine-grained brown biotite similar to that in the albite facies of the diorite is present in the saussuritized diorite of the lower part of the thicker sills and of the other sills.

The calcic plagioclase in the lower part of the thicker sills has been almost completely altered, the alteration minerals being fine-grained hornblende, chlorite, biotite, muscovite, quartz, and calcite. The large-grained hornblende is greenish blue in color and has a frayed appearance, and is therefore interpreted as a decomposition product of augite.[2] The interfingering of the strings of hornblende with the feldspar indicates that the uralitization of the augite occurred after the crystallization of the plagioclase and augite and probably after the solidification of the magma. If the associated biotite is similar genetically to the biotite in the albite variant—and it seems that it should be—the biotite development in the albite variant should be related to the metamorphism accomplishing the uralitization and saussuritization.

Obviously, the chloritization of some of the hornblende and biotite indicates a later alteration of these minerals. As chlorite is common in the remnants of plagioclase, it is probable that some of the chlorite was developed during the saussuritization.

Three steps in the development of the rocks are postulated from the inferences in the preceding paragraphs:

(1) gravity differentiation (albite to calcic plagioclase-augite)
(2) uralitization and development of biotite
(3) saussuritization and chloritization

The last two steps, uralitization and saussuritization, may take place simultaneously, as they are sometimes complementary.[3]

The degree of alteration is not constant. In the sill along the south shore of Bead Lake, chloritization has produced a very fine grained rock of chlorite and quartz. In the sill at the east end of Bead Lake the minerals of the basic rock have been altered to actinolite, zoisite, and quartz.

Undoubtedly the metamorphism can be considered a process of metasomatism. It cannot be as easily determined if the metamorphism is due to hydrothermal effects induced by a granitic intrusion, or whether the alterations are due to dynamic metamorphism. Gibson and Jenks[4] have found in northwestern Montana that the more intensely metamorphosed zones in the diorite sills are adjacent to

---

[1] Grout, F. F., Petrography and Petrology, McGraw Hill, New York and London, p. 100, 1932.
[2] Harker, Alfred, Metamorphism, Methuen & Co., Ltd., London, pp. 106-108, 1932.
[3] Turner, F. J., Mineralogical and structural evolution of metamorphic rocks: Geol. Soc. America Mem. 30, p. 120, 1948.
[4] Gibson, R., and Jenks, W. F., Amphibolization of sills and dikes in the Libby quadrangle, Montana: Am. Mineralogist, vol. 23, pp. 302-313, 1938.

the mineralized veins in the diorite. They concluded that, as the mineralization is attributed to the quartz monzonite batholith, the metamorphism of the sills was the result of hydrothermal metamorphism attributable to the same igneous batholith. In the Bead Lake district there appears to be no such relationship between the metalliferous veins and the intensity of metamorphism, although actinolite is present as inclusions in the quartz veins and some is developed in the diorite along the vein walls.

A study of the time relationship of the period of metamorphism to the other geologic events should help to suggest the means of metamorphism. The inferred differentiation of the sills suggests that the sills were intruded before the enclosing sediments were folded. The crosscutting relationship of the Kaniksu batholith (Cretaceous?) indicates that it was intruded after the folding. Some of the large-grained primary quartz and the small-grained secondary quartz developed by saussuritization show slight undulatory extinction. This feature, caused by straining of the quartz, must have been developed by stresses that could cause internal deformation of the diorite sills. The only deformation recognized as having sufficient intensity to accomplish this is the folding.

There is a striking similarity in degree of metamorphism of the Marshall diorite and of the sedimentary rocks of the Newport group. The Marshall diorite sills, during metamorphism, were buried at the same depth as the Bead Lake formation. The latter contains argillites, which in turn contain biotite porphyroblasts and argillites showing flow cleavage. The difference in depth of burial of these rocks and the remainder of the Newport group would explain the slightly higher grade of metamorphism noted at some places within the Marshall diorite and the Bead Lake formation. The author believes that the metamorphism of the diorite is a dynamic alteration produced during the period of folding.

## IGNEOUS METAMORPHISM

The rocks of the Newport group in a belt about a mile wide adjacent to the Kaniksu batholith show an alteration that is the direct result of the intrusion. The quartzitic sandstones have become quartzites, and the argillites and argillaceous sandstones have been changed to rocks containing an abundance of biotite and muscovite. In several places cordierite, andalusite, or sillimanite have been noted in these rocks. The degree of addition of material from the magma appears to vary considerably.

Two areas of schistose rocks adjacent to the batholith are present in the district in sec. 1, (34-44E), and in the mass of metamorphosed rocks in the northeastern part of the district. Another locality of schist was noted outside of the map area about 3 miles south of Snow Valley.

West of the Upper West Branch Priest River, a part of a roof pendant of metamorphic rocks is composed mainly of rusty-weathering quartz mica schists. Near the western margin of the roof pendant, quartzitic sandstones crop out. Since the attitude of the schistosity in the southern part of sec. 7, (59-5W, Idaho) is not divergent to the attitude of the bedding of the sandstone, it is believed that the schistosity is parallel to the bedding of the schist. The schist is banded, muscovite layers alternating with layers predominantly of quartz with biotite and muscovite. The muscovite flakes range from 0.2 millimeter to 2 millimeters across; and their orientation—some parallel to the banding, some at slight angles to the banding, and some at random—gives the rock its schistosity.

Alternations of quartzitic sandstone and quartz mica schist crop out in the SW¼SW¼ sec. 33, (57-5W, Idaho) just to the east of the inferred axis of the Snow Valley anticline. The schistosity is parallel to the bedding which strikes N. 50° W. and dips 5° NE. The micas, biotite and muscovite, are concentrated in layers with sufficient foils oriented parallel to the bedding to give the rock a cleavage, the remainder being unoriented.

It has previously been pointed out that a difference in depth of burial, those in the north of the area having been more deeply buried than those farther south, resulted in differences in the rock cleavage as developed in the metamorphic rocks where effects of the intrusion of the batholith are not noticeable. This difference in depth of burial and the distribution of the areas of schistose rocks suggest that the great difference in the conditions of metamorphism necessary to produce the schists and argillites did not exist during the period of dynamic metamorphism. It seems more likely that the schists were developed by mimetic crystallization during the intrusion of the Kaniksu batholith. The orientation of the mica was probably controlled by an already existing poor flow cleavage or the bedding.

## ORE DEPOSITS

### HISTORY OF MINING

The earliest record of production of ore from the Bead Lake mining district was in 1918. It is not definitely known when prospecting started in the area, but at least one claim had been staked as early as 1890. Many of the mine dumps now have 6-inch pine trees growing on them. One of the oldest properties is the Calispell mine, some of its workings being at least 50 years old.

The most active prospecting program in the district was undertaken by the Bead Lake Mining Co. and its successor, the Hoover Mining Co. The workings of the "Old Bead Lake" tunnel, the Kootenai Conquest, and the Comstock claim of the Alger group, represent the major part of this development program. The failure

to place either the Comstock or the Kootenai Conquest on a paying basis and the subsequent death of W. E. Allan who was instrumental in the organization of the Hoover Mining Co., resulted in the termination of the activity.

At least half of the prospecting and development work in the district was done prior to World War I, and, except for the relocation of old mining claims, the remainder was done between that war and the early 1930's. The total production probably does not exceed $20,000, as the recorded production is approximately $9,000.[1]

## GUIDES FOR FURTHER PROSPECTING

Evidence from geologic investigation and the examination of the mines and prospects suggests that the areas adjacent to the faults might be further prospected to advantage. Most of the prospects that show mineralization are near the mapped faults. The veins in several of the properties are apparently mineralized fissures. The fissures are probably genetically related to the faults.

Quartz veins in the few areas where glacial melt waters have been active are easily found; however, these areas are few. As in all glaciated areas, the outcrops of veins in this district are inconspicuous. A typical gossan or "iron cap" composed of a cellular mass of limonite and quartz generally is destroyed by glaciation. A hematite-filled breccia crops out near the center of sec. 11, (33-44E) adjacent to the fault. The hematite was possibly deposited in the fault zone by ground water. The iron could have been taken into solution by the water during the development of an overlying and now eroded gossan. There may be other and similar features in the area that might warrant further investigation.

Prospecting to a lesser degree than in the localities near the faults has been done in the remainder of the area where the Newport group is the bedrock. Mineralization has apparently not been found in any of these surface excavations or short drifts. Apparently no prospecting has been done in the part of the Newport group that is in the contact-metamorphic zone of the Kaniksu batholith. This is understandable, as ore deposits of the contact-metamorphic type rarely form in argillites, sandstones, and quartzites, which are the rocks composing the border zone.

Pegmatites, dikes composed of very coarse grained igneous rocks genetically related to the granitic rock, probably are present in the border zone and the batholith. A mass of quartz which has a diameter of about 400 feet is exposed on the west side of Freeman Lake in Idaho. It is surrounded by rocks of the Bead Lake formation. It probably originated as a pegmatitic fraction of the magma. The Cusick feldspar occurrence also suggests that there may be other

[1] Estimate based upon production data from Mineral Resources: U. S. Geol. Survey, and Minerals Yearbook: U. S. Bur. Mines.

pegmatitic masses within the granitic rocks. Pegmatites contain minerals such as feldspar and muscovite, and often minerals containing tin, beryllium, tungsten, zirconium, and rare-earth metals. A sufficiently large pegmatite located near adequate transportation could be of economic value even if it lacked the rare minerals.

In most mineralized districts, the areas of limestone or dolomite and the areas where fissures were present before the deposition of minerals are the more favorable localities for prospecting. Limestones in the contact-metamorphic zone of a batholith are very receptive to minerals; however, the limestones in this area are not exposed in that zone. The general lack of dolomitization, which apparently causes the resulting dolomite to be receptive to mineralization, and the lack of any indication of mineralization in the limestone suggest that prospecting the limestone would not be economically advisable.

The Skippy mineralization was discovered by surface trenching about 1930. Within the last 2 years the Lena Belle antimony mineralization was uncovered by a bulldozer while making a road. These recent discoveries, which have not as yet been prospected sufficiently to determine their value, should give some encouragement to further prospecting. The areas adjacent to the faults shown on the geologic map appear to be more favorable for prospecting than the remainder of the district. Most of the favorable area is readily accessible by road, so that tools and equipment can be easily brought in. Surface trenching by hand or with a bulldozer is probably the only method of preliminary exploration that is economically feasible for this area. After mineralization is discovered, properly directed core drilling or drifting can be used to determine the extent of the deposit.

## MINES, PROSPECTS, AND QUARRIES

There are a few prospect pits in the district that were not described because of the obvious lack of mineralization. There are probably many other prospects that were not found because of the forest and brush cover. All of these undescribed prospects probably have been abandoned for 40 or 50 years.

The locations of most of the properties described are shown on figure 3. All were idle in 1948, and the condition of the workings permitted entry to only four. Many are no longer owned by the original prospector or developer, and, in most instances, reliable information concerning the properties could not be obtained. Meager information was acquired from the dumps and the generally poor exposures of the vicinity. The description of the properties examined follows.

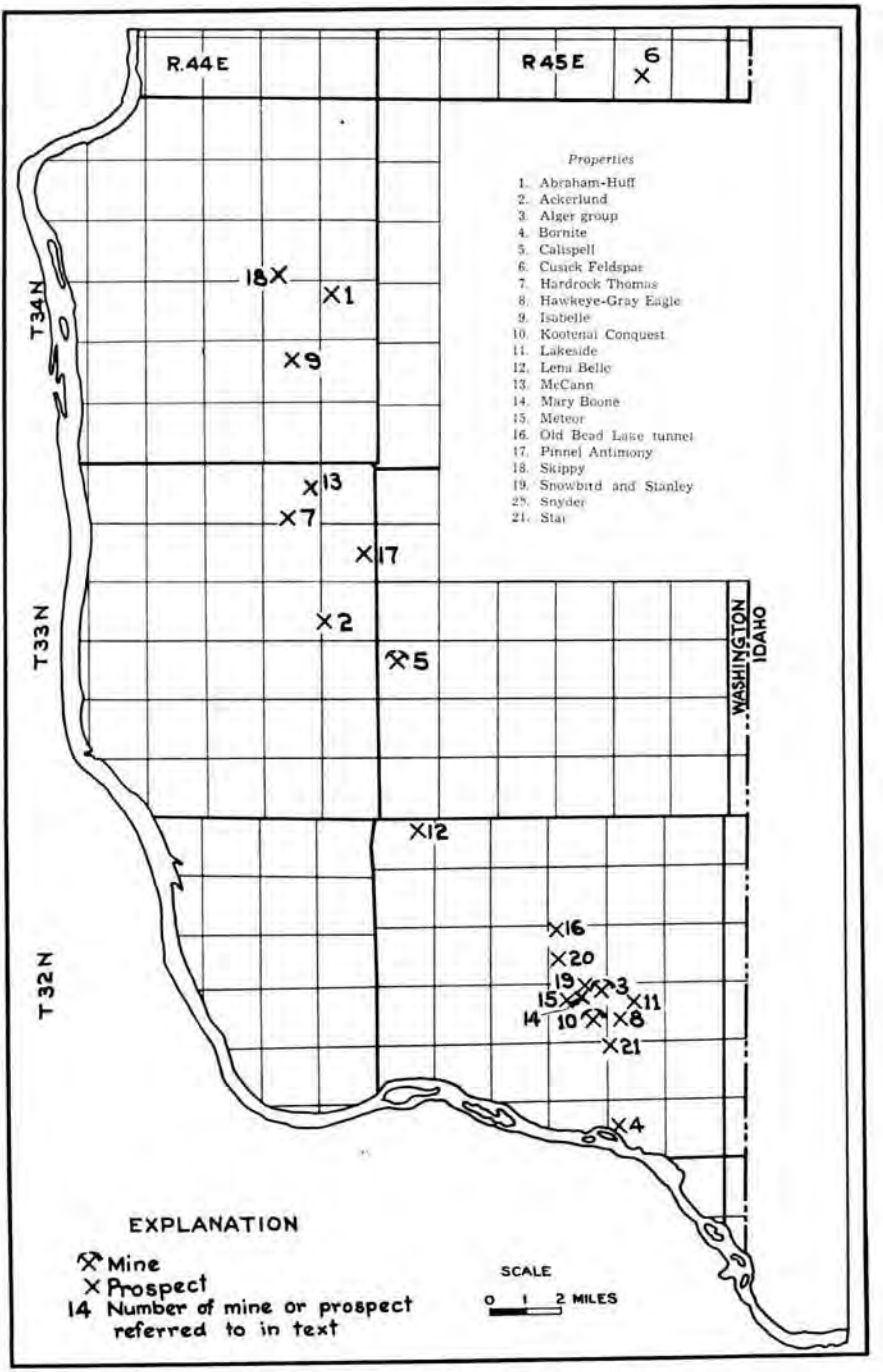



FIGURE 3.—Sketch map showing location of mining properties.

### Abraham-Huff Claim (1)

The Abraham-Huff claim is located on the south shore of Browns Lake in sec. 24, (34-44E), about 50 yards east of the end of the road at the lake. The abandoned workings consist of three adits driven by J. C. Huff and W. W. Abraham. The adits enter southward into argillaceous sandstones of the Bead Lake formation which here strike N. 10° W. and dip 55° SW.

The westernmost adit is 75 feet long. At 60 feet from the portal it cuts and follows a vertical fault striking S. 60° W. There is 6 inches of gouge in the fault zone. This fault is probably a part of the fault zone that is mapped as underlying Browns Lake. No mineralization is apparent.

The middle adit is 400 feet east of the western adit. It follows a S. 15° W.-trending brecciated zone in the argillaceous sandstone. The zone is from 2 to 3 feet wide and is impregnated with quartz occurring as veins about ¼ inch wide and even narrower veinlets. The quartz is sparsely mineralized with chalcopyrite, pyrite, chalcocite, and some bornite. About 50 feet from the portal a water-filled winze prevented examination of the face of the adit.

The eastern adit, 20 feet long, enters into thickly bedded sandstone at a place 40 feet east of the middle adit.

### Ackerlund (2)

The Ackerlund property is located in a saddle on the top of the ridge at an elevation of 3,400 feet in the SW¼ sec. 13, (33-44E). The prospect was located by G. S. Ackerlund as a stone and timber claim. The workings consist of a water-filled inclined shaft and a caved adit. These workings are reached from the road along the North Fork of Skookum Creek by leaving the road at a barn a mile southeast of the Ackerlund farm and climbing the southern ridge.

The country rock is dark-gray argillite, which dips 65° W. and which is somewhat similar to the No Name argillite. It is a part of the Skookum formation and underlies a limestone member of the formation. The shaft follows the vein down, and the dump size suggests about 200 feet of workings. The adit, a short distance downhill toward the North Fork of Skookum Creek, probably has some 400 feet of workings.

An 18-inch-wide quartz vein is exposed on the ridge by trenching. It strikes N. 75° W. and dips 45° NE. The quartz is stained by malachite and limonite. It is pitted as if calcite might have been weathered and dissolved from the vein. Samples from the dump show the quartz to contain calcite and chalcopyrite. The calcite exposed to weathering on the dump has a rust-colored surficial stain. Veinlets and thin veins of quartz accompanied by chalcopyrite cut the calcite of some of the samples. The surface exposure of the vein suggests

that the calcite deposition occurred after the development of the quartz vein and that the quartz carrying the chalcopyrite was deposited still later.

### Alger Group (3)

The Alger group is located in the NE¼ sec. 22, (32-45E) and is accessible by road. The workings consist of the Key Fraction, the Comstock mine, the west Bead Lake mine drift, and the east Bead Lake mine drift. Most of the claims in this group were originally staked by Ed Alger, the present owner; although a few of the claims originally were the property of the Hoover Mining Co. The property includes three patented claims, the Surprise, Comstock, and Key Fraction, and several unpatented claims, which include the Poorman, Harriet, Fair Hope, and Fair Hope Fraction. In the past decade about seven other unpatented claims have been abandoned.

All of the workings except the Key Fraction were driven by the Bead Lake Mining Co. and its successor, the Hoover Mining Co., which also did the exploration work in the Old Bead Lake tunnel and the Kootenai Conquest. The Comstock mine of this group shipped a carload of smelting ore in 1930 that brought $1,650, and 6 to 8 tons of ore were reportedly shipped in 1918. The only workings that could be examined in 1948 were those of the Key Fraction. A sketch map of the workings of the Alger group, adapted from maps

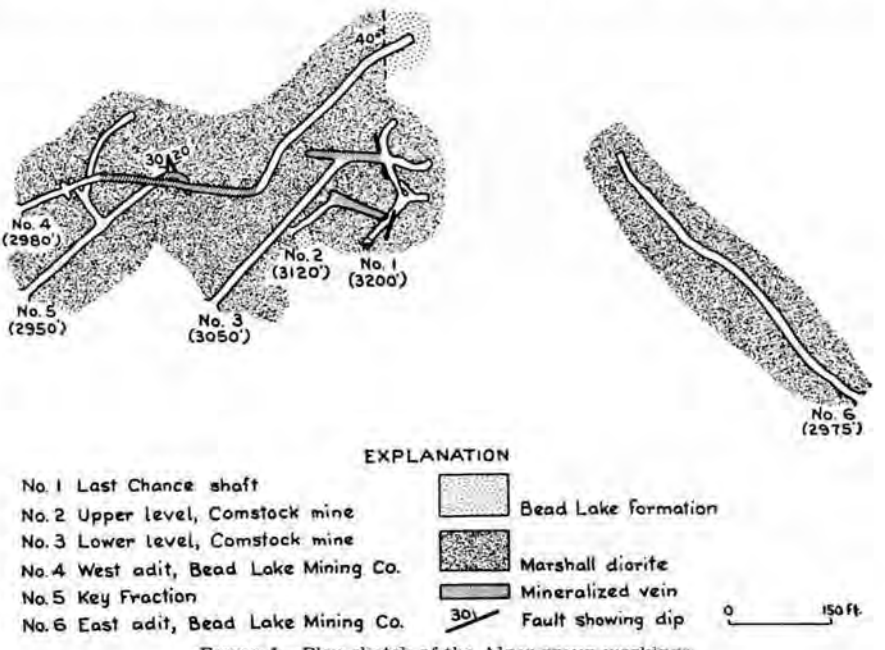



Figure 4.—Plan sketch of the Alger group workings.

and data of Jenkins[1] and Patty,[2] shows the location of the Key Fraction with relationship to the other workings (fig. 4).

The symbol locating this property on figure 3 approximates the location of the Key Fraction (drift No. 5 of figure 4). Reference to plate 1 shows that this location is in the NE¼ sec. 22, (32-45E) and it is northeast and north of two nearby faults. The strike of the sandstones west of the diorite sill and a quarter of a mile north of the nearest fault is N.-S., and the dip is 70° W., while south of the fault the beds strike N. 15° W. and dip 55° SW.

The diorite in the vicinity of this property appears to be concordant in detail with the beds, but generally discordant. It is believed that there is some fingering and lensing out of the Marshall Creek diorite sills in this vicinity; the quartzitic sandstone exposure in portal No. 2 (see fig. 4) is the result of the bifurcation and lensing of the sills. The contact of the quartzitic sandstone and the diorite in drift No. 4, as reported by Patty and by Jenkins, probably is a fault contact and may involve the same fault reported in the Comstock workings. The block to the east of that fault would be the down-faulted side.

The Comstock mine was inaccessible in 1948. Jenkins[3] describes the workings, which include a shaft and an upper and lower level, as follows:

> The workings on the Comstock lie on the hillside above and to the east of Fractional Key. The lower tunnel (No. 2) [No. 3, fig. 4] enters diorite in which irregular quartz veins form ore zones. One vein zone is 75 feet from the portal and another occurs 325 feet from the portal. The dip of the first is N. 80° W., 22° to 45°. The tunnel contains some 700 feet of workings and is connected by a chute to the upper No. 1 [No. 2, fig. 4] tunnel.
>
> The upper tunnel (No. 1) [No. 2, fig. 4], some 80 feet higher in elevation, enters slaty quartzite, dipping S. 72° W. at an angle of 55°. The contact with diorite is 57 feet from the portal. At 100 feet from the portal, the vein zone begins. The dip of this zone is S. 20° W. 52°. Some ore was stoped from these workings, with values in lead and silver, it is stated. The ore from these workings consists of galena, chalcopyrite, a little sphalerite, with some carbonate minerals in the oxidized zone. Besides quartz, calcite and siderite are gangue minerals. The country rock is diorite, usually greenish and serpentinized, occurring as fragments in the massive quartz vein matter. Slickensiding is very abundant.
>
> Farther up on the hill is an incline [No. 1, fig. 4], said to be 100 feet long, as well as a number of other smaller prospects. The incline slopes 55°, directed S. 65° W. It is said that rich galena ore was found in this incline. In another surface prospect a quartz vein was found to be dipping N. 34° E. at an angle of 80°. The surface is stained with iron oxide.
>
> The East Tunnel [No. 6, fig. 4] was driven in order to cut the ore body in the other workings. The tunnel is directed N. 40° W., in diorite. At 258 feet from the portal there is a quartz vein in slickensided diorite. At 285 feet the tunnel bends to the left. At 312 feet there is some galena in a quartz vein zone. At 472 feet there is a drift to the left on quartz veins.

---

[1] Jenkins, O. P., Lead deposits of Pend Oreille and Stevens Counties, Washington: Washington Div. Geology Bull. 31, pp. 39-46, 1924.

[2] Patty, E. N., The metal mines of Washington: Washington Geol. Survey Bull. 23, pp. 75-80, 1921.

[3] Jenkins, O. P., op. cit., pp. 43-44.

At 510 feet is another drift to the right on some quartz stringers. At 530 feet, which was the face of the tunnel, veins of quartz and a little calcite were observed in the diorite rock.

Jenkins[1] also describes the west adit (No. 4, fig. 4) which was also inaccessible in 1948:

In the upper tunnel ore was struck at 100 feet from the portal. From this point on for 200 feet farther, the diorite country rock contains numerous quartz veins which strike due east, standing nearly vertically. Beyond this point, the diorite is not mineralized to any great extent and shows plainly its dense texture and jointed structure. At a point 750 feet from the portal is the clean cut contact with quartzite. The quartzite is bedded, fine grained, full of joint planes. It dips due west, at an angle of 41°. For the rest of the length of the tunnel quartzite is the only rock present. In places it is argillaceous but silicified. A few stringers of calcite occur in this rock. It has the appearance of having once been a calcareous shale but has subsequently been silicified by intense metamorphism.

The ore body consists of irregular branching veins and stringers running through greenish serpentinized diorite. The vein matter includes fragments of the country rock, in many places with the appearance of having absorbed or replaced the rock. Slickensides are predominant, showing the presence of innumerable slips and fault planes.

The surface outcroppings are oxidized to a red stain of iron, with some green copper stains intermixed. The iron stains reach a depth of not much over 60 feet. Galena is found in places at the surface of the outcrop, not altered to any great extent.

A NNW.-trending quartz vein about 2 feet wide is encountered at 125 feet in from the portal of the Key Fraction. This is followed by a drift northward for about 45 feet to where the vein pinches out. The quartz vein is bounded on the east by a fault which the drift follows a short distance to the north before turning to the east. The main drift encounters a N.-S. fault, dipping 30° W. at 240 feet from the portal, and a quartz vein mineralized with galena, chalcopyrite, and pyrite. The vein is faulted, the drift turning to the east to pick up the vein after a 20-foot offset by a curving fault. In the face the vein is also offset about 3 feet by another fault. This is probably the same quartz vein reported in the west Bead Lake Mining Co. adit from 150 to 370 feet from the portal some 30 feet above this lower level. This vein may be a faulted and offset portion of the north-dipping vein in the Comstock, although the difference in their dips suggests that they are two different veins. It is evident from the faults exposed in the Key Fraction, and the reported faults in the Comstock, that any future development of this property will be complicated by the faulting.

The mineralized quartz vein varies from about 6 inches to 2 feet in thickness in the Key Fraction. The ore that was mined between the upper and lower levels of the Comstock was as much as 9 feet wide. It apparently occurred as a shoot. The galena is accompanied by small amounts of chalcopyrite and pyrite. The latter two minerals are noted to occur separated from the galena in masses

[1] Jenkins, O. P., op. cit., pp. 44-45.

3 to 6 inches across. Actinolite, apparently altered from diorite, is also present with calcite in the quartz. The age relationships of the galena, chalcopyrite, pyrite, and calcite were indeterminable from ore samples from the Key Fraction. Ore samples from the dump of the General MacArthur-Admiral Dewey mine, owned by Charles Barker, Newport, Washington, and located almost in the center of sec. 2, (31-45E), outside of the district, are similar mineralogically to samples from the Key Fraction and were examined for this reason. The ore contains more chalcopyrite than that of the Key Fraction. In polished section the galena appears, in many instances, to almost surround large masses of chalcopyrite. Small masses of each mineral also appear to be included in the other. Chalcopyrite, however, is noted to cut across and separate masses of galena having an identical cleavage orientation and to extend in along the cleavage of the galena. It is suggested from this evidence that the chalcopyrite is later than the galena. Both minerals appear to have been deposited in brecciated quartz which, in places, is a dark greenish gray owing to included actinolite. Both the galena and chalcopyrite are cut by quartz. Pyrite is included in the chalcopyrite, and it may have developed contemporaneously with the chalcopyrite.

### Bornite (4)

The Bornite property is located in sec. 35, (32-45E), adjacent to the LeClerc road. The property is owned by the Holneck Mining Co., which apparently was controlled in 1941 by W. H. Weston.

The portals of two drifts are located in the NW¼SW¼ of the section, in rocks of the Bead Lake formataion west of a sill of Marshall diorite. The bedding strikes N. 15° W. and dips 55° SW. There reportedly are about 1,200 feet of drifts.

One drift, caved at the portal, enters into quartzite on a heading of N. 10° E. The size and composition of the dump indicate that the drift is approximately 200 feet long and passes through quartzite, quartzitic sandstone, and some argillite. The other drift, also caved at the portal, enters on a heading of N. 20° E. into the hillside. The size of the dump suggests about 1,000 feet of workings. The rock is mainly Marshall diorite.

Some white "bull" quartz, slightly iron stained, was on the dump. The quartz contains some chalcopyrite, pyrite, and bornite.

### Calispell (5)

The Calispell property, located in the SE¼NW¼ sec. 19, (33-45E), is about 100 yards west of the end of the Cooks Lake road. The workings are probably the oldest in the district. The property is at present owned by Jack Gallagher, who also located the adjoining Victory Copper claim. The previous ownership is unknown, although this is probably the "Calispell Quartz" claim staked on May

11, 1893 by E. M. Cook. No record of ore shipments has been found, but it is reported that some ore was shipped.

The workings consist of two caved adits entering westward into Cooks Mountain. The size of the dump indicates that the southern adit is slightly more than 500 feet long. Northeast 80 yards and at the same elevation a second adit was driven, probably about 300 feet long. The rocks entered are green quartzitic sandstones and quartzites of the Skookum formation, which strike N. 10° W. and dip 55° SW. near the mine.

The material on the dump of the southern adit suggests that the drift followed a quartz vein for about half its distance and that the last workings were driven in quartzitic sandstone, not following a quartz lead. The quartz on the dump is malachite stained and contains veinlets of chalcopyrite.

### Cusick Feldspar (6)

The Cusick property is reportedly[1] in sec. 35, (35-45E), in the northeast corner of the district, and has also been reported as on North Baldy, which is several miles north of the district. The property may not be in the Bead Lake district. In all probability, the feldspar deposit is within 1 to 3 miles of a road. One of the owners in 1924 was Mr. H. C. Meyers of Cusick, Washington.

Shedd,[2] Wilson,[3] and Glover[4] describe the property, a feldspar deposit. The feldspar, the variety microcline, is intergrown with coarse quartz. It forms a lens in granodiorite 30 feet long and 1 to 3 feet thick exposed in a cliff. The quantity of feldspar appears to be too small for commercial use. However, the occurrence of this mass of feldspar suggests the presence within the Kaniksu batholith of other such masses, some of which may be large enough to be of economic importance.

### Hardrock Thomas (7)

The Hardrock Thomas prospect is located in the SE¼SW¼ sec. 2, (33-44E.), about 0.3 mile southwest of the junction of the Halfmoon Lake and Kings Lake roads and 100 yards south of the road. The property was originally located by J. C. Huff and Wm. Burdet. The adit was driven by "Hardrock" Tom Smith for a group of business men. The property is now owned by Richard Cunningham of Spokane. It is reported that the drifting totals 1,000 feet, but the size of the dump indicates that the adit is 300 to 400 feet long. The adit is inaccessible.

---

[1] Shedd, Solon, The mineral resources of Washington with statistics for 1922: Washington Div. Geology Bull. 30, pp. 126-127, 1924.
[2] Shedd, Solon, idem., pp. 126-127.
[3] Wilson, Hewitt, Some feldspathic materials of the Pacific Northwest: U. S. Bur. Mines Rept. Inv. 2794, p. 10, 1927.
[4] Glover, Sheldon L., Nonmetallic mineral resources of Washington: Washington Div. Geology Bull. 33, p. 44, 1936.

The adit, entering on a SE. heading, penetrates light-brown argillaceous sandstone and some quartzite. The strike of these rocks of the Skookum formation in the vicinity is N.-S., and the dip 65° W. The drift reportedly cut a quartz vein from 4 to 6 inches wide at about 20 feet and followed it for 40 feet. It was reported to be sparsely mineralized. Fragments of quartz on the dump were noted to contain small amounts of chalcopyrite and pyrite.

### Hawkeye-Gray Eagle (8)

The Hawkeye-Gray Eagle prospect is located in sec. 23, (32-45E). The property includes two patented claims and one unpatented claim previously owned by the Hoover Mining Co., subsequently by V. P. Campbell, and recently by Delia Karsunky. The portal of the drift is caved and is about 1,000 feet northwest of the end of the road at Marshall Lake. The size of the dump indicates about 300 feet of drifting.

The portal enters into quartzite which strikes N. 10° W. and dips 50° SW. No evidence of mineralization was noted on the dump.

### Isabelle (9)

The adits of the Isabelle claim, owned by A. E. Walgren of Newport, are located in the SE¼NW¼ sec. 26, (34-44E). The workings are 50 yards east of the Browns Lake road and 0.3 mile north of Halfmoon Lake. Both adits are inaccessible. The lower adit is reported to be 75 feet long, and the upper adit, which is about 35 feet higher and 100 feet east, is about 65 feet long.

The upper adit enters at N. 10° E. into the No Name argillite along the axis of a drag fold and follows a quartz vein that is parallel to the bedding, which dips 40° to 50° NW. At 20 feet from the portal an E.-W., 4- to 6-inch-wide mineralized quartz vein was reportedly cut and was followed to the east for 45 feet. The lower adit, on an east heading, has not cut the vein.

Samples of the ore from the upper dump of the Isabelle contain as primary minerals chalcopyrite, pyrite, and polybasite scattered in quartz. Azurite is the predominant secondary mineral, filling cracks as veinlets and as an alteration product of chalcopyrite. A very small amount of chalcocite is also present as an alteration of chalcopyrite. The polybasite is apparently later than some of the pyrite. However, an age relationship between the pyrite and chalcopyrite cannot be discerned, although the chalcopyrite and polybasite appear to be of the same age.

The owner reports that a hand-picked sample of high-grade ore assayed in 1921 shows values of $15.00 in copper, $3.00 in gold, and $2.00 in silver per ton. Another assay, made in November 1939, of a hand-picked sample that the owner believed to be representative showed the following values: 0.4 percent lead, 0.6 percent zinc, and 0.2 ounce of silver per ton.

The distribution of the No Name argillite near the property indicates that there are three main faults in the vicinity of Halfmoon Lake. The Browns Lake road in the vicinity of Halfmoon Lake approximates the trace of the central fault. Along this road numerous outcrops show the beds of argillite overturned to the east. However, on the slopes above the road and this inferred slump zone, the beds dip to the west. Although the author has not seen the vein, it seems likely that it is a fissure filling, probably a fissure subordinate to and related to the faults in this vicinity.

### Kootenai Conquest (10)

The Kootenai Conquest mine, also known as the Bead Lake, or Conquest, mine, is located in the SE¼ sec. 22, (32-45E). A short unimproved road from the Bead Lake road provides access to the mine. The Old Bead Lake tunnel claims and the Comstock claim were, at one time, owned by some of the same companies that owned the Conquest mine. The ownership of this property is involved, and, as nearly as can be determined, the principal operation has been conducted by the following: In 1898, Conquest Gold and Copper Mining and Milling Co. staked the Conquest and Conquest Millsite on May 31. The claims were located on the east bank of Indian Creek 2 miles from its mouth, and apparently are the claims that formed the nucleus for the property; 1907, Conquest Consolidated Mining Co.; 1908-18, Bead Lake Gold Copper Mining Co.; 1918, Bead Lake Gold and Silver Mining Co.; 1921-24, Bead Lake Gold Copper Mining Co.; 1924-26, Bead Lake Mining Co.; 1930-42, Hoover Mining Co.; 1951, Newport Mining and Leasing Co. The Mining World[1] reports as follows:

> The Hoover lead-silver mine north of Newport, Washington, is being reopened for operation by the Newport Mining and Leasing Company, newly incorporated by Harry E. Scott and Roy Lance of Metaline Falls, Lloyd Ek of Ione, and Paul A. Culver of Spokane. The company acquired the properties formerly operated by Hoover Mining Company and began rehabilitating tunnels and shafts several months ago.

The shaft and two portals were inaccessible when visited in 1948. The data concerning this mine are, by necessity, from reports of Patty[2] and Jenkins[3] and from conversations with Ed Alger, a miner who is familiar with the property. This mine has been the most active in the district, and a 100-ton mill and aerial tramway were built and completed in 1922. In 1927 five men were reported to be employed for most of the year in underground work, and the mill was operated. The only shipments recorded are 2 carloads of concentrate valued at $5,229 shipped in 1928 after the mill ceased

---

[1] Mining World, vol. 13, no. 7, p. 84, June 1951.
[2] Patty, E. N., The metal mines of Washington: Washington Geol. Survey Bull. 23, pp. 71-81, 1921.
[3] Jenkins, O. P., Lead deposits of Pend Oreille and Stevens Counties, Washington: Washington Div. Geology Bull. 31, pp. 39-47, 1924.

operation. It seems probable that more concentrate was shipped than has been reported. Most of the stoping in 1927 was apparently between the no. 1 and no. 2 levels, with some stoping above the no. 1 level (see fig. 5, a mine diagram compiled from data from Patty and Jenkins and other sources).

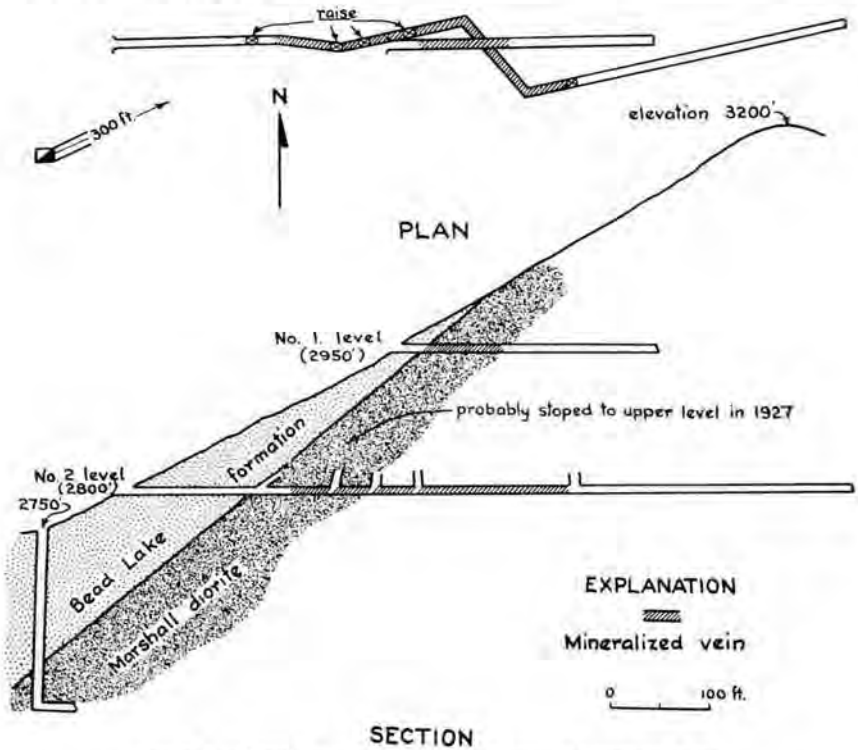



FIGURE 5.—Sketch of workings of the Kootenai Conquest mine.

Several factors may have influenced the closing down of this property. Two factors are readily apparent: (1) metal prices dropped precipitately between 1927 and 1932, and (2) according to reports, the underground supervisor, in the mistaken belief that it was cheaper to run the mill continuously instead of intermittently, diluted the ore by mining a width more than that of the 5-foot vein in order to provide a sufficient quantity of rock for the mill.

The workings enter into quartzitic sandstones of the Bead Lake formation which here strike N. and dip 70° W. About 150 to 200 feet up the hillside from no. 1 drift, and east of the drift, a diorite sill crops out. Both the no. 1 and no. 2 drifts penetrate diorite after entering quartzitic sandstones. No. 1 level follows the vein for some 300 feet. Tunnel no. 2, that enters about 150 feet below no. 1 tunnel, follows the vein for a little more than 500 feet.

The workings, except for the shaft, were examined by both Patty and Jenkins. The publications containing the reports of the examinations are both out of print, and because of the extent of the development work it is desirable to quote the descriptions. In 1921 Patty[1] described the operation as follows:

> This property has been idle for several years and was examined because of the extent of the development work coupled with the fact that no public information on developments is known to be in existence. It was owned by the Coverly estate of New York but has recently been purchased by the Bead Lake Gold-Copper Company.
>
> The principal workings are located about 100 feet south of the Bead Lake camp and the property totals 160 acres of patented ground. It is well equipped for mining, with a 100-horsepower boiler furnishing power to a small hoist and an engine which operates a 5-drill Ingersoll-Rand compressor. Other equipment consists of two pumps, two air drills, a well-equipped blacksmith shop and auxiliary equipment, all in good repair. There are 10 tons of ore which were sorted and sacked but apparently were not of sufficient grade to encourage shipment. The property is reported to have shipped several carloads of ore, the returns of which are not available.
>
> The development work has been poorly directed and a large expenditure of capital accomplished by erratic tunnel exploration. The main tunnel, which comprises about 2,000 feet of work, is driven into the hill in an easterly direction. The first 150 feet is in quartzite and it then passes into diorite for the remainder of this distance. Several hundred feet from the portal an aplite dike three to five feet in width was encountered and drifted on for a length of 700 feet without exposing any ore
>
> Vertically 150 feet above this level an upper tunnel is driven due east a length of 300 feet on a small quartz vein averaging from ten inches to four feet in width which contains an ore shoot 100 feet in length. This shoot is well mineralized with chalcopyrite, pyrite, marcasite, sphalerite and galena. Stopes have been opened on it from the level up to the surface. It is difficult to understand why this vein was not cut in the lower workings. Mine maps were not available but the dip of the vein suggests that it would lay to the north of the lower tunnel. Short crosscuts have been run both north and south from the lower tunnel but the north crosscut has not been driven far enough to prove the existence or non-existence of the vein in that direction. Further prospecting on the opposite side of the small ravine west from the tunnel portals might disclose the extension of the vein.
>
> At the bottom of the ravine a shaft was sunk to a reported depth of 140 feet and 300 feet of drifts run from the bottom of the shaft. It is stated that this work encountered the vein and some ore was mined. This shaft was filled with water at the time of visit.

Jenkins in 1924 was unable to investigate the upper level, but he did report on the lower level in greater detail than Patty. The following is quoted from Jenkins:[2]

> The mine workings on the Conquest consist largely of a shaft 200 feet deep with deeper underground workings, which, it is said, lie 600 feet below the upper No. 1 tunnel; a tunnel (No. 2) 50 feet higher than the shaft, 800 feet long; an upper tunnel (No. 1) 250 feet long, 116 feet above the lower tunnel, connecting with No. 2 by a chute, and several other shorter tunnels and prospects above these on the steep hillside whose crest is composed of quartzite. The workings first enter quartzite and then pass into diorite in which the ore bodies occur as irregular quartz veins and stringers. Apparently quartzite occurs on the east side of the diorite as well as on the west side. The largest body of good ore came from the

[1] Patty, E. N., op. cit., pp. 79-80.
[2] Jenkins, O. P., op. cit., pp. 42-43.

shaft, it is reported. Unfortunately, the writer was unable to enter the shaft, since it was full of water.

In tunnel No. 2 quartzite occurs from the portal for a distance of 160 feet, at which place it is in contact with diorite, dipping S. 84° W. at an angle of 44°. A chute (No. 1) was made at this point. Ore occurs at 180 feet from the portal. It consists of white quartz veins running irregularly through quartz-diorite, dipping S. 5° W. at an angle of 80°. At 228 feet from the portal there is a chute (No. 2) on ore extending from No. 1 tunnel. At this point the tunnel follows the ore body which strikes S. 80° W. At 256 feet from the portal is No. 3 chute. At 305 feet from the portal is No. 4 chute. At 330 feet from the portal the veins and likewise the tunnel turn, the ore body striking S. 40° E. At 435 feet, the ore turns back again. At 483 feet is located raise No. 5. The face of the tunnel is in a green serpentinized diorite rock full of white quartz veins running irregularly in various directions with but little ore.

Tunnel No. 1 also enters quartzite, dipping S. 65° W. at an angle of 48°, but it is apparently not thick here, for the stoping has been carried on 30 feet from the portal in ore which occurs in diorite. It is stated that a considerable amount of ore was taken from these stopings, between the two tunnels. Caving prevented the writer from investigating this tunnel.

The ore minerals on the dump of No. 1 tunnel consist of galena, chalcopyrite and arsenopyrite, in a matrix of quartz vein matter and other gangue minerals such as siderite and calcite. Some pyrite is present and a little sericite occurs.

The minerals found on the dump of the shaft and of No. 2 tunnel are: galena, chalcopyrite, pyrite, and a little arsenopyrite as ore minerals, with quartz and a green chloritic or serpentinized rock often intermixed. Calcite and siderite occur secondary to the other minerals. The country rock appeared to be greenish diorite, though pieces of black diabase were found. The quartzite is gray in color, banded, finegrained, argillaceous, though silicified, and greatly jointed.

The ore occurs in a shoot about 5 feet in width that has a reported stope length of 100 to 200 feet. The vein is located within the diorite. Other parts of the vein are presumably sparsely mineralized. In the no. 1 level the shoot starts at the diorite contact. In the no. 2 level the shoot starts very near the diorite contact. It seems probable, from the scant data, that there may be a controlling relationship between the diorite and sandstone contact and the ore shoot.

The ore is reportedly the same as the ore of the Comstock and Key Fraction workings of the Alger group. The ore consists of galena and chalcopyrite with pyrite in white quartz. The metals recovered from a ton of ore (probably mill feed) are reported to average as follows:[1] silver, 1.03 ounces; lead, 3.93 percent; and copper, 0.79 percent per ton.

### Lakeside (11)

The Lakeside claim was staked by E. M. Cook on June 9, 1890. The workings on the north shore of Marshall Lake probably belong to this claim, as it was on the "north shore of Marshall Lake, two miles east of Pend Oreille River." This is the oldest claim of record in the district that can be found with certainty. It is at lake level in the SE¼NW¼ sec. 23, (32-45E) on property reportedly owned by W. H. Wright, and is 0.3 mile by trail from the end of the road at

[1] Mineral Resources U. S., 1928, pt. 1, pp. 695, 701, U. S. Bur. Mines, 1931.

Marshall Lake. One drift, caved at the portal, enters on a heading of N. 35° W. into a diorite sill which is about 200 feet thick. A considerable amount of white quartz, which contains small amounts of chalcopyrite, is on the dump.

### Lena Belle (12)

The Lena Belle is located in the SE¼NE¼ sec. 6, (32-45E) near the foot of the southwest slope of No Name Peak. It is reportedly on the northeast side of the Bead Lake road, about 2½ miles west of Bead Lake. Apparently, this deposit was discovered after the author completed the field work.

C. Phillips Purdy, Jr., [1] describes the property from data supplied by the owners, C. W. Carter and W. M. Miles of Newport, as follows:

> The deposit was uncovered by a bulldozer while a road was being built. A showing of massive stibnite 18 inches thick was exposed over a strike length of about 10 feet. The country rock is said to be dolomite.

This dolomite is probably in the lower part of the Skookum formation which is composed predominantly of argillaceous sandstone and quartzitic sandstone, although some thin beds of dark-gray argillite are present. The formation in the vicinity of the prospect strikes N. 10° E. and dips 50°-60° W.

Brecciated zones are apparently common in this locality. One such zone occurs along the Bead Lake road about 0.1 mile north of the reported location of the prospect and about 0.3 mile southeast of the springs at the head of Indian Creek. The road cut exposes 20 feet of argillaceous sandstone and 34 feet of biotite lamprophyre. The sandstone and a 6-foot-wide zone in the lamprophyre are brecciated. The zones strike N. 10°-30° E. and appear to be inclined vertically. It is not known if the mineralization of this property is related to a brecciated zone similar to that at the Pinnel property. However, brecciated zones in this locality should be investigated, as some of them may be mineralized with antimony.

### McCann (13)

The McCann prospect is reportedly located in the SE¼NE¼ sec. 2, (33-44E). The author could not locate the property, and, because of the network of logging roads in that area, detailed directions are needed in order to find the workings. The Colville Engineering Co. report[2] describes the property as follows:

> The McCann property consists of 80 acres of deeded land owned by M. W. McCann. A quartz vein striking NE.-SW. is said to be mineralized with copper, silver, and gold, ranging in size from a few inches to four feet in width. The development work consists of some tunnel and several open cuts all of which are caved and not accessible. There is ample timber, a road that is rough in spots leads to the property, and water is some distance away.

---

[1] Purdy, C. P., Jr., Antimony occurrences of Washington: Washington Div. Mines and Geology Bull. 39, p. 126, 1951.

[2] Colville Engineering Co., Report on minerals in Pend Oreille County: The Public Utility District of Pend Oreille County, Newport, Washington, (mimeographed) p. 70, 1943.

### Mary Boone (14)

The Mary Boone, an abandoned claim, is located in the NE¼NW¼ sec. 22, (32-45E). The land is now a patented homestead owned by Ed Alger. The owner said that very little development work was ever done.

### Meteor (15)

The Meteor property is located in the E½NW¼ sec. 22, (32-45E) adjacent to the Bead Lake road and adjoining the Mary Boone claim on the south. The prospecting was done by Ed Alger and H. McCullough as lessees. The deeded land is at present owned by Mr. Johnson of Newport, Washington.

The author did not find the workings, which apparently enter northward in the diorite sill that crops out west of the coarse sandstone member of the Bead Lake formation. Jenkins[1] reports that the mineralization is mainly copper and arsenopyrite. Patty[2] describes the property as follows:

> One-half mile northwest of the Bead Lake camp, H. McCullough and Ed Alger have taken a lease on 40 acres of patented land and are prospecting a 16-inch, well-defined quartz vein carrying mineralization in chalcopyrite, pyrite, marcasite, and small amounts of galena. The vein cuts the intrusive rocks, strikes north 25° east and dips 49° to the southeast. It is opened by two short drifts into the hillside at a difference in vertical elevation of 75 feet.

### Old Bead Lake Tunnel (16)

The drift of the Old Bead Lake tunnel is located in the NW¼-NW¼ sec. 15, (32-45E) in the draw on the east side of the Bead Lake road and was driven, presumably, as a gold prospect. According to claim records, on June 6, 1901 the Bead Lake Copper Mining and Milling Co., F. C. Heller, President, and B. F. Seeley, Secretary, filed on a claim called the "Lone Cabin," 2½ miles northeast of the Pend Oreille River. The claim joins the southwest side of the Oregon claim, which was filed on May 2, 1900 by Smith and Niedermaier, ¾ mile southeast of Bead Lake. The Oregon claim is probably located in the center of the N½ sec. 15, (32-45E), where the author noted some excavations on a barren quartz vein. In 1901 the company also filed on the Aetna claim and Bead Lake claim, and in 1902 filed on the Bead Lake Gold claim. All of these claims are probably in the SW¼ sec. 10 and NW¼ sec. 15, (32-45E). In 1924 this property was owned by the Bead Lake Mining Co., which, at a later date, apparently abandoned these claims. There are reportedly some 2,800 feet of drift and crosscuts. The size of the dump suggests at least that much development work.

The adit, caved at the portal, enters due east into argillite and sandstones of the Bead Lake formation and penetrates the diorite

[1] Jenkins, O. P., op. cit., p. 40, 1924.
[2] Patty, E. N., op. cit., p. 80, 1921.

sill that crops out to the east. It is not known whether the drift goes through the diorite sill into the westward-dipping sandstones and argillites that crop out to the east of the sill.

The pieces of vein quartz "frozen" to diorite scattered over the dump indicate that a quartz vein was cut and probably followed in the diorite. Masses of calcite and actinolite are included in the quartz. Pyrite and chalcopyrite are present in very small quantities. Calcite in the form of dogtooth spar was also found on the dump.

### Pinnel Antimony (17)

The Pinnel property is also known as the Maryland property and is owned by Ed Maryland of Northport. It is located in sec. 12, (33-44E), near the road along the North Fork of Skookum Creek about 1 mile above the Ackerlund farm. A 480-foot adit enters at S. 70° E. About 100 feet to the east and between 40 and 70 feet above the portal is about 500 cubic feet of trenching.

The portal enters the sandstones of the Skookum formation that have been altered to quartzites by igneous metamorphism brought about by the intrusion of the Kaniksu batholith. Entry was not possible at the time of examination. C. Phillips Purdy, Jr.,[1] in a previous examination, reported that the only mineralization he noted was at 390 feet from the portal, where a small shattered zone contained scattered pyrite.

The quartzites in the vicinity commonly strike N. 10° W. and dip 70° SW. In the open cuts the attitude of the beds varies from a strike of N. 5° W. and a dip of 85° SW. to overturned beds striking N. 5° W. and dipping 80° SE. Stibnite was noted to occur in one of the cuts in some of the thin veins of very drusy quartz that occurs in the fractured quartzite.

The prevailing trend of the fracturing is generally indeterminate, although in one instance the drusy quartz filling seems to be parallel to the bedding of the quartzite. The tension fractures so far observed in rocks of the Newport group have generally been present along the crests of the minor folds on the limb of the Newport syncline and are referable to the period of deformation producing the jointing. The position of these fractures in relation to the crest of the minor fold of this local overturning of beds is not proper to be related to such development. If the fault on the east side of Cooks Mountain continues northward, it cuts through the rocks in this vicinity. It seems likely that the fracturing of the quartzite is genetically related to this fault.

The association of the stibnite with drusy quartz suggests that the mineralization took place near the surface (epithermal). The proximity of outcrops of the Kaniksu batholith and the nature of the

[1] Purdy, C. P., Jr., Antimony occurrences of Washington: Washington Div. Mines and Geol. Bull. 39, p. 127, 1951.

mineralization make it unlikely that the latter is genetically related to the batholith. The only other igneous rock in the district with a source that could possibly be related to the minerals is the Pend Oreille andesite.

### Skippy (18)

The Skippy prospect at one time was known as the Fairview Copper. It is located in the SW¼ sec. 14, (34-44E). Four claims, including the Jay Don, the Norma Joy, and the Fairview Copper, were originally located by C. N. Newburn. The upper portal is near the section line between secs. 14 and 23 and may actually be in sec. 23. Several of these original claims were staked in sec. 23. The upper adit was driven in on the vein after trenching on the surface had revealed a mineralized vein. Canadian interests examined the upper adit of the property in the early 1930's and were interested in determining if the lower adit also hit the vein. In 1933 the lower adit penetrated a mineralized zone. C. N. Newburn, the owner, and the parties that proposed to develop the property lost interest in it after some of the claims were found to be in the W½ sec. 23, which belonged to the Northern Pacific Railway. Since then all sec. 23 and the mineral rights have been returned to the U. S. government, so that all sec. 14 as well as 23 are now in Federal ownership. In 1939 J. A. Gallagher and Jack Sallee relocated the workings as the Skippy claim, with the Queen Bess being located to cover possible extensions of the mineralization.

The workings are at about 4,000 feet elevation, 600 feet higher than and ½ mile north of the Browns Lake road, and consist of an upper adit, reportedly 80 feet long, that is caved at the portal, and an adit 105 feet long, located 50 feet lower and about 150 feet north of the upper adit.

The workings are in light-gray quartzitic sandstone and white quartzite of the Skookum formation. The beds strike N.-S. and dip 85° W. A narrow channel trending northwest across the ridge west of Browns Lake is on the west side of the claims. This channel, because of its steepness, has been interpreted as a fault, the channel resulting from erosion by glacial melt waters along the presumed fault zone.

The upper adit, entering on a north heading, is reported to cut a quartz vein from 10 to 12 inches wide that is highly mineralized with argentiferous galena. The drift followed the vein for about 14 feet due north and was then discontinued when the lower adit was started. The east wall of the vein is reported to be bounded by a fault with considerable gouge.

The lower adit penetrates the quartzites of the Skookum formation on a heading of N. 70° E. The quartzite strikes N.-S. and dips 85° W. The adit cuts a brecciated zone bounded by four faults (fig. 6). The proximity of a fault to the west suggests that this brecciation is

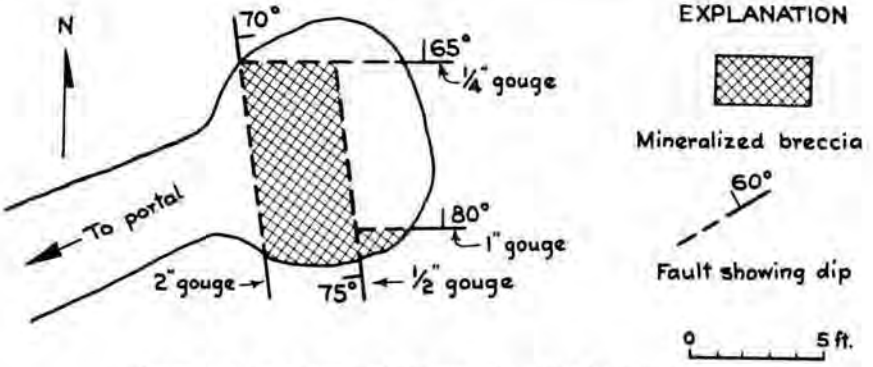



FIGURE 6.—Plan of east end of lower adit of the Skippy claim.

related to that fault. The faults that bound the mineralized zone are post-mineralization in age. The deposit is a breccia filling and partial replacement by quartz, with galena being the ore mineral. The relationship of veins and veinlets cutting each other suggests the following sequence of mineralization: (1) quartz deposited in fractures of brecciated quartzite with some replacement of quartzite, (2) fracturing and faulting of brecciated quartzite, (3) deposition of quartz accompanied by galena and pyrite, and (4) deposition of quartz and galena. C. N. Newburn reports that an assay of a channel sample from the mineralized zone of the lower adit in 1933 showed value of $8.00 per ton with values mainly in lead and silver, with some zinc.

The difference in the nature of the mineralization in the two adits suggests the possibility that two mineralized zones are present, although the face of the lower adit is at the proper place to intersect the vein cut in the upper adit.

### SNOWBIRD AND STANLEY (19)

The Snowbird and Stanley claims are in sec. 22, (32-45E) and were located by Dr. Sutherland of Newport. The workings, reportedly consisting of two drifts, one 25 feet long and the other considerably longer, are reported to be on the hillside west of the workings of the Alger group where sandstones of the Bead Lake formation crop out. The dense brush cover prevented the writer from finding the adits. Reportedly, the drifts follow quartz veins that are from about 4 to 6 inches wide. Galena is said to be present in the veins, several of which are exposed on the face. The veins are reported to thicken and thin.

### SNYDER (20)

The Snyder property, deeded land owned by E. E. Snyder of Newport, Washington, is located in the NW¼SW¼ sec. 15, (32-45E). The workings are apparently those of the Gold Coin, an unpatented

claim abandoned by the Hoover Mining Co. The property is adjacent to the Bead Lake road.

The only drift enters northward into light-gray arenaceous argillite which strikes N. 5° W. and dips 35° SW. The drift, reported to be about 80 feet long, is caved. Reportedly, the workings are sparsely mineralized, although the author observed no vein material on the dump. Although the present owner did not do the development work, he reports that, to the best of his knowledge, examinations of the drift when it was still open did not reveal any mineralization.

### Star (21)

The Star prospect is on the old Independence claim, which is located mainly in the SW¼ sec. 23 and the NW¼NW¼ sec. 26, (32-45E), and consists of a shaft with workings off the shaft. The workings are about 300 feet north of the Marshall Lake road in sec. 26. The claim is reportedly owned by V. P. Campbell.

All of the workings are within a sill of Marshall diorite. The size of the dump suggests 300 to 400 feet of workings. The shaft is now filled with water.

The shaft has been sunk on a quartz vein 2 feet wide. Its strike is N. 50°-60° W. and dip 80° NE. No mineralization is apparent where the quartz is revealed near the top of the shaft.

### Abandoned Claims

There are probably a great number of claims that have been abandoned. Many of these do not have extensive workings, and the author has not attempted to find or identify any of these claims. In this category are the Idaho, Montana, Last Chance No. 2, Mystic, and Antler, formerly of the Alger group, and the Baker City and Last Chance of the Bead Lake Gold and Copper Mining Co. All these claims are in sec. 15, (32-45E).

Extensive workings are on a few claims. The Old Bead Lake tunnel is on several abandoned claims which are mentioned elsewhere. The workings of the Hardtack claim, formerly held by the Hoover Mining Co., reportedly consisted of a shaft and two short drifts. The claim is located in the S½SW¼ sec. 15, (32-45E) and can be reached by logging roads from the Snyder property. Logging operations have destroyed the evidence of these workings. The Colville Engineering Co. report[1] describes the mineralization of the Hardtack and Gold Coin (Snyder) as follows: "It is said that small values of silver, lead, and copper were found in a quartz vein."

There may be a few other abandoned claims which have mineral showings or extensive workings that have not been brought to the attention of the author.

[1] Colville Engineering Co., op. cit., p. 66, 1943.

### Browns Lake Placer

A placer prospect was located in the NW¼NE¼ sec. 24, (34-44E) at the east end of Browns Lake in 1918 or 1920 by Bill Abraham and C. N. Newburn. The locality is accessible by a logging road along the south side of Browns Lake.

A shaft was sunk in the gravel to a depth of 20 feet. Work was discontinued when only an occasional gold color was observed in the material from the base of the shaft.

### Quarries and Pits

A quarry operated by Bennion Colorok Co., Spokane, Washington, in the slabby No Name argillite produces decorative and garden stone. It is located on the north side of the Bead Lake road, a quarter of a mile west of No Name Lake in the SE¼ sec. 5, (32-45E).

Sand and gravel pits are developed in the terrace deposits, which are mapped as alluvium and glaciofluvial deposits. Road metal is the main product of the pits. The following pits are in the Bead Lake district.[1]

| *Operator* | *Property location* |
|---|---|
| Dept. of Highways ..... | NE¼NE¼ sec. 35, (32-44E) |
| Pend Oreille County (?)..... | Sec. 30, (32-45E) |
| Pend Oreille County..... | NE¼NE¼ sec. 33, (32-45E) |
| Pend Oreille County..... | NW¼SW¼ sec. 35, (32-45E) |
| Pend Oreille County..... | NE¼NW¼ sec. 15, (33-44E) |

The last three pits in the list, operated by Pend Oreille County, produced sand and gravel in 1948.

## DEVELOPMENT OF THE ORE DEPOSITS

The scarcity of information concerning most of the properties might be considered as an indication of the opinions of the prospectors regarding the possibilities of the district and the future of mine development there. In the early 1900's, when prospectors were actively investigating the area, the country was fairly open with very little underbrush, owing to a forest cover of fairly large trees. Certainly the easily discovered veins as revealed by surface exposures or by float were probably found, as many pits and trenches on barren quartz veins were observed in the course of this study.

The contact zone of the Kaniksu batholith and the limestones show no indications of mineralization. The lack of mineralization in the limestones may be due to the fact that they are not dolomitized. Limestones in the rocks of the same age as the Newport group in the eastern part of the Metaline quadrangle are not known to contain any productive mineral deposits.

[1] Valentine, G. M., Inventory of Washington minerals, Part 1, Nonmetallic minerals: Washington Div. Mines and Geology Bull. 37, p. 85, 1949.

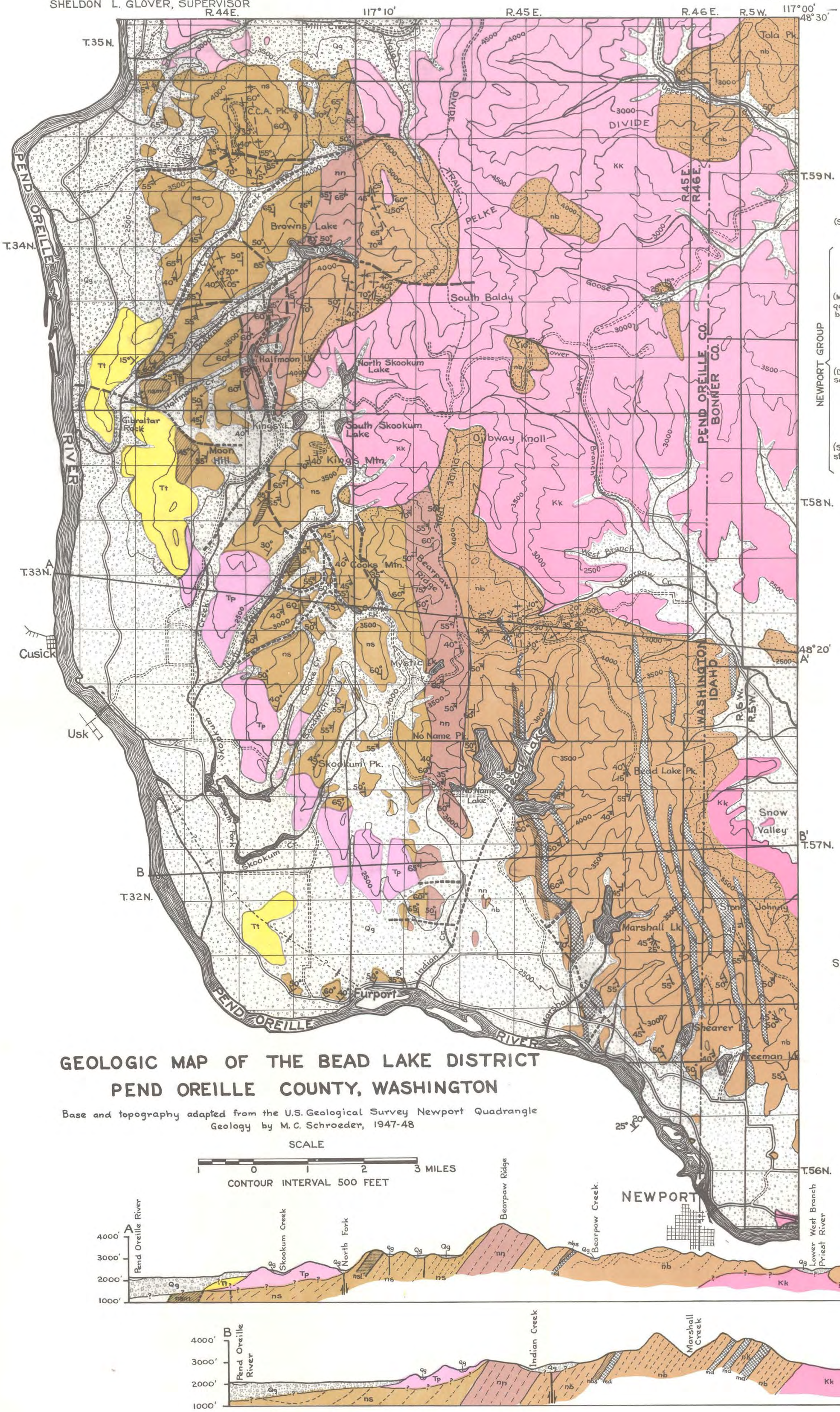
The only structural features that appear to have a relationship to the generally sparse mineralization in the district are faults. The brecciated zone in the Skippy claim is probably related to a near-by fault. All the quartz veins noted in the Bead Lake formation and the Marshall diorite in the southern part of the district are parallel to the east-west steeply dipping joints. The vein in the Key Fraction of the Alger property and the one in the Kootenai Conquest are apparently of similar orientation. These particular veins fill fissures that were probably opened up along joints by minor faulting.

Control of ore deposition by structure of the Newport group is probable only in the Kootenai Conquest. The west-dipping sandstone bounding the diorite sill on the west near the upper portal of the property possibly acted as a dam to the mineralizing solutions, resulting in ore deposition in the more receptive diorite. However, no difference between the character of the metamorphism in the diorite in the vicinity of mineralized veins and in the diorite away from the veins was determinable.

The rather scant data concerning the properties do indicate that there are a few showings that may be favorable development risks. There is a fairly good showing in the Key Fraction, although there are certainly no minable quantities of ore exposed. Ore has been mined in the Kootenai Conquest, and there may still be minable quantities present, as it is reported that there is still ore exposed in the workings. Much of the expensive preliminary development work has been done on this property. It would appear that this property has some possibility of becoming a small mine if its reactivation is supervised by competent personnel. The showings in the Skippy, when compared to the amount of workings, certainly justify further development work.

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
DIVISION OF MINES AND GEOLOGY
SHELDON L. GLOVER, SUPERVISOR

BULLETIN 40
PLATE 1




# GEOLOGIC MAP OF THE BEAD LAKE DISTRICT
# PEND OREILLE COUNTY, WASHINGTON

Base and topography adapted from the U.S. Geological Survey Newport Quadrangle
Geology by M. C. Schroeder, 1947-48

SCALE

1 0 1 2 3 MILES

CONTOUR INTERVAL 500 FEET

## EXPLANATION

### BEDDED ROCKS

**QUATERNARY**

Qg — Alluvium and glaciofluvial deposits

**TERTIARY**

Tt — Tiger formation (Semiconsolidated gravel and conglomerate)

**PRE-CAMBRIAN — NEWPORT GROUP**

nsm, nsl, ns — Skookum formation (Mainly quartzitic sandstone, with Moon Hill quartzite member nsm at top and limestone beds nsl)

nn — No Name argillite (Dark gray argillite with some beds of sandstone and limestone)

nb, nbs — Bead Lake formation (Sandstone and argillite, with coarse sandstone nbs)

Contact metamorphic zone of the Kaniksu batholith

### IGNEOUS ROCKS

**EXTRUSIVE**

**TERTIARY**

Tp — Pend Oreille andesite

**INTRUSIVE**

**PRE-CAMBRIAN(?) CRETACEOUS(?)**

Kk — Kaniksu batholith

md — Marshall diorite

Fault

50° — Strike and dip of beds

Strike of vertical beds

45° — Strike and dip of fracture cleavage

30° — Strike and dip of flow cleavage

20° — Pitch of drag fold

Axis of anticline

Axis of syncline

Probable axis of syncline