CANADA
DEPARTMENT OF MINES
HON. T. A. CRERAR, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

BUREAU OF ECONOMIC GEOLOGY
GEOLOGICAL SURVEY

MEMOIR 194

Eagle-McDame Area, Cassiar District British Columbia

BY

G. Hanson and D. A. McNaughton

OTTAWA
J. O. PATENAUDE, I.S.O.
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
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Illustration

Eagle-McDame Area, Cassiar District, B.C.

INTRODUCTION

Eagle-McDame area is rectangular in outline and embraces about 3,500 square miles in northern British Columbia between longitude 129 degrees and longitude 130 degrees. Its southern border is the divide between Tanzilla and Stikine rivers at latitude 58°10′ and its northern border is McDame creek at latitude 59°15′. Approximately 2,700 square miles of new territory were mapped during 1935, the remainder of the area having been mapped previously.

Placer gold deposits have been known in Cassiar district since the early seventies, but it was not until 1934 that its lode deposits received any notice. In that year a ton of gold quartz ore, which contained 4 ounces of gold, was shipped out by airplane. This shipment aroused a good deal of interest, especially when it was reported that free gold occurred in other veins around McDame creek.

In 1887 Dawson mapped Dease river and located the boundaries of the Cassiar batholith where crossed by the river.[1] In 1925 the bedrock geology and placer deposits of Dease lake and vicinity were studied by Johnston and Kerr.[2] The area has been visited also by engineers of the Department of Mines of British Columbia. Their reports deal mainly with the gold placers and general conditions of the area and are contained in the Annual Reports of the Minister of Mines of British Columbia.

The writers were ably assisted in the field by J. G. Gray, E. B. Vick, D. C. Holland, Chas. Campbell, and G. B. Paulin. Many courtesies were extended by R. F. Latimer and Jack Fleming of Dease Lake and by R. J. Meek and W. Glennie at McDame. The writers are also indebted to the prospectors and others in the area for courtesies received.

GENERAL CHARACTER OF THE AREA

LOCATION AND MEANS OF ACCESS

The usual mode of entry to the region from Vancouver is by steamship to Wrangell, Alaska, and thence by river boat 150 miles up Stikine river to Telegraph Creek. The Barrington Transportation Company connects with the northbound Canadian Pacific Railway steamships at Wrangell and maintains a weekly schedule on Stikine river during the summer months. The trip from Wrangell to Telegraph Creek is made in three days and the return trip downstream usually in one day.

[1] Dawson, G. M.: "Report on an Exploration in the Yukon District, N.W.T., and Adjacent Northern Portion of British Columbia"; Geol. Surv., Canada, Ann. Rept., vol. III, pt. 1 (1889) and Pub. No. 629 (1898).

[2] Johnston, W. A.: "Gold Placers of Dease Lake Area, Cassiar District, B.C."; Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 33-74.

Kerr, F. A.: "Dease Lake Area, Cassiar District, B.C."; Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 75-99.

A fair truck road extends 72 miles from Telegraph Creek to Dease lake. Dease lake is just north of the Arctic divide and is the head of navigation for Dease and Liard rivers. Shallow-draft boats make the trip from the head of Dease lake to McDame creek in a day. From McDame, at the mouth of McDame creek, trails lead northward to the head of McDame creek and southward to the head of Fourmile creek.

Several trails extend from the head of Dease lake to the eastern and southeastern parts of the area. The Muddy River trail follows the northern side of the broad depression between Hotailuh and Cassiar mountains for approximately 25 miles east of Little Eagle river to the junction of Snowshoe creek and Muddy river. This trail is fairly well defined throughout the greater part of its length and although soft in places it is passable for horses from May to October. A poorly defined trail leads up Tanzilla river into Hotailuh mountains.

Stikine river is open to navigation from June to the middle of October. Ice leaves Dease lake early in June and closes the lake early in December. Consequently, the working season for outsiders is relatively short, being approximately four months.

Most of the area can be easily and quickly reached by plane from bases along the Alaskan coast or from Atlin, B.C. In the winter planes are used for carrying mail from Atlin to Telegraph Creek.

Freight charges from Wrangell to Telegraph Creek are $50 a ton; from Telegraph Creek to Dease Lake $80 a ton; and from Dease Lake to McDame $60.

Telegraph Creek is the outfitting point for this part of northern British Columbia. Supplies can be purchased also from W. H. Latimer and the Hudson's Bay Company at the head of Dease lake, and from the Hudson's Bay Company at McDame. Pack-horses can be obtained at Telegraph Creek and from Fred Callison at McDame.

GAME

The larger animals include moose, caribou, sheep, goat, and bear. These animals are scarce in the vicinity of McDame creek, but are more plentiful in the central and southern parts of the area. Moose and bear are particularly common around the headwaters of Eagle river, whereas caribou, goat, and sheep appear to be more numerous in Hotailuh mountains. Timber wolves are fairly common, but fur-bearing animals in general are scarce. Whitefish and grayling are caught in the streams and lakes.

PHYSICAL FEATURES

The region here described may be considered as a cross-section, some 70 or 80 miles long, of Cassiar and Hotailuh mountains. Cassiar mountains trend northwest across the central and northern part of the area and are reported to extend southeast to the headwaters of Finlay river and northwest to Teslin lake in Yukon. Hotailuh mountains are a rugged, easterly trending range south of Dease lake, which merge with Cassiar mountains on the east side of McBride river. Both ranges contain peaks more than 7,500 feet in elevation, but the general summit level is about 6,500 feet. The elevation of Dease lake is 2,440 feet, so the maximum relief is about 5,000 feet.

The northern part of the area is drained by Dease river, which flows north via Liard and Mackenzie rivers to the Arctic ocean, and the southern part by Tanzilla and McBride rivers, which flow south to Stikine river. The divide between the Arctic and Pacific waters is 1 mile south of Dease lake and only 150 feet higher.

Most of the larger streams occupy broad U-shaped valleys. The valley bottoms are drift filled and in some places contain numerous shallow depressions called kettle-holes. These depressions were caused by melting of blocks of ice that had been covered with stream wash or glacial debris. Long, narrow ridges of gravel, called eskers, are another characteristic glacial feature of some of the valley bottoms. These gravel ridges are believed to have been formed by streams flowing under glaciers.

Some of the tributary streams occupy hanging valleys graded throughout the greater part of their length and precipitous near their junction with the main stream valleys. These valleys lie transverse to the direction of movement of the Pleistocene ice-sheet and do not appear to have been glaciated. Tanzilla and McBride rivers and most of their tributaries head in glacial cirques, some of which contain small glaciers.

Stream-cut terraces constitute one of the interesting topographic features of the area. The Tanzilla valley, south of Dease lake, is terraced to an elevation of 3,000 feet, that is, 400 feet above the present divide between Dease lake and Tanzilla river. Gravel terraces are also present along McDame creek and on the banks of Dease river below Cottonwood river. Stream terraces also occur on a flat 2 miles wide immediately below Cottonwood river and were formed by this stream, which formerly entered Dease river several miles below its present outlet.

GLACIATION

Johnston and Kerr say the Pleistocene ice-sheet moved south across Dease Lake area. In the northern part of Eagle-McDame area numerous granite boulders occur as glacial erratics up to elevations of 6,000 feet north of the Cassiar batholith and show that there the ice moved to the north. The distribution of erratics along the Muddy, Tanzilla, and McBride valleys indicates that the last movement of the ice in the southern part of the area was also to the north. These valley glaciers were at least 2,000 feet thick, for granitic and volcanic boulders from Hotailuh mountains are found on all but the higher peaks bordering Tanzilla and Muddy River valleys. In the northern part of the area the direction of movement of valley glaciers, during at least the waning stages of the Pleistocene, is apparent. Ice moved down Cottonwood river to join the ice stream along the Dease. Part of the Cottonwood Valley ice moved north through a broad pass to the junction of Quartz and Trout creeks and then down McDame Creek valley. Part of the McDame Valley ice stream moved down the valley to Dease river and part moved north through a broad pass to join the Dease Valley ice stream 20 to 30 miles below McDame creek.

Lang, Trout, and Quartz creeks flow southeast and south and become McDame creek below their junction. The broad Cottonwood glacier, entering this valley from the side, because of its larger feeding ground persisted in its flow after the ice had receded out of the upper Lang, Trout, and Quartz Creek valleys. The presence and final disappearance of this ice stream led to interesting adjustments in drainage. Shore-lines mark a lake level on Trout creek 300 to 400 feet above the present floor of the creek. The lake was evidently backed up behind ice that could enter only through the Cottonwood pass. Lang creek flowed out toward Trout creek along the side of this ice and cut a channel that is now on the hill-side and built up a large, flat fan of gravel 200 feet deep, in Trout Creek lake. Lang, Trout, and Quartz Creeks' waters flowed around the north side of the glacier and cut a similar channel on the hill-side between Quartz and Snow creeks and also for a short distance below Snow creek. As the ice melted the drainage of Snow, Quartz, and Lang creeks became gradually adjusted to their present channels and this adjustment is marked by at least four abandoned stream channels north of the present junction of Quartz and Trout creeks.

GEOLOGY

On the geological map the rocks of the area are grouped in five map units. The oldest unit is the Dease series consisting of quartzites, limestones, and argillites. These sediments are succeeded by the McLeod series of flows, fragmentals, sediments, and intrusives. Serpentine occurs at and above the base of the McLeod series, and in some places in the upper part of the Dease series. Part of the serpentine is mapped as a separate unit, but some of it is included in the McLeod series. The granitic Cassiar batholith intrudes the rocks already mentioned. Lavas and fragmental rocks of Pleistocene age occur in a few places.

DEASE SERIES

Rocks of the Dease series form wide, northwesterly trending bands on the north and south sides of the Cassiar batholith. The series is sedimentary and consists largely of limestone, thinly bedded argillite, quartzite, and chert. Coarser clastic sediments include fine- to coarse-grained, arkosic sandstone and some cobblestone conglomerate. Adjacent to intrusive bodies of serpentine the argillaceous sediments and limestone have been recrystallized to mica schists and coarse-grained marbles.

On the north side of the Cassiar batholith the lower part of the series consists of quartzite and argillaceous quartzite. These rocks are fine to medium grained and white to light grey. Quartzite, argillite, and thick bands of white limestone, up to 500 feet thick, characterize the middle part of the series. Several thin bands of white to grey limestone at McDame are oolitic. The quartzite and argillite commonly contain calcareous cement. Limestone, argillite, and banded chert constitute the upper part of the series. The limestone is white to tan and occurs in bands up to 50 feet thick. Banded chert, made up of alternating thin bands of chert and argillite, and having a thickness of about 500 feet, forms the top of the series in some places. At McDame it is overlain by argillite and on Sheep mountain by quartzite.

South of the Cassiar batholith the stratigraphic sequence is not as well known. Structural evidence suggests that the thick, massive limestones on the southern edge of the belt of sediments are the lowest members exposed. Near the headwaters of Goldpan creek these limestones are separated from the overlying argillaceous sediments by a limestone boulder conglomerate. This conglomerate was not seen in the mountains east of McBride river so it may be local in extent.

Above the conglomerate and limestone is a series of thinly bedded argillites, argillaceous quartzites, and slates. These rocks are brown to black and possess a marked slaty cleavage. Southeast of the headwaters of Eagle river there appears to be a gradual transition along the strike from these clastic sediments on the west to limy sediments and cherts on the east.

In the vicinity of Dome mountain the argillites contain intercalated massive beds of arkosic sandstone. The sandstones are usually light greyish green on a fresh fracture, and many contain small flakes of carbonaceous material. Rocks of similar lithological character are seen on the ridge southeast of Eagle lake and also near the summit of Tanzilla butte. Under the microscope these sandstones are seen to be quite similar in mineral content and appearance. The most abundant constituents are angular to subangular grains of feldspar (orthoclase and plagioclase) and quartz. There are, as a rule, a number of rock fragments present, some of which are fine-grained feldspar porphyries; others are granitic in appearance; and still others are made up mainly of calcite. Larger fragments of these same rock types make up pebble and cobblestone conglomerates which are closely associated with the sandstones. Both the sandstones and conglomerates are thoroughly indurated and in places slightly sheared. Squeezed and elongated limestone boulders in the conglomerates have their long axes parallel to the dip of the beds.

The thickness of the northern band of the Dease series, judging from dips across a width of 8 miles, is about 15,000 feet. Only a very rough estimate can be made of the thickness of this series on the south side of the Cassiar batholith. The maximum thickness of the different members includes 3,000 feet of massive limestones, 500 feet of limestone conglomerate, 4,000 feet of argillite and arkosic sandstone, 8,000 feet of thinly bedded argillite, slate, and argillaceous quartzite, and 500 feet of massive marble included in a large body of serpentine, or a total maximum thickness of about 16,000 feet.

Several patches of highly metamorphosed sediments within the batholith have been mapped as Dease series.

The age of the entire series has not been established. Permian fossils were found in Dease Lake area by Kerr. Fossils of probable Silurian age were collected in the northern part of the Eagle-McDame area. Several thousand feet of sedimentary rocks are present below the Silurian horizon, so it would seem that much of Palæozoic time is represented. Kerr found Triassic fossils in limestones above serpentine believed by him to be an altered basic lava. The writers also found bands of serpentine but believe they are altered basic intrusive rocks. Because of this interpretation it is impossible to regard the serpentine as a definite horizon marker throughout the area and to consider the underlying rocks Palæozoic and the overlying one Mesozoic. The upper part of the series that may be in part Triassic could not be distinguished lithologically from the lower sediments, and as it yielded no fossils it was included with the Dease series.

MCLEOD SERIES

Volcanic and sedimentary rocks of the McLeod series form the entire northern side of Hotailuh mountains and extend from Thenatlodi peak on the west to the headwaters of McBride river on the east. Smaller patches of the McLeod series outcrop in Big Eagle valley south of Black mountain. North of the Cassiar batholith the series forms a belt 40 miles long that extends northwest from Beale lake past the head of Quartz creek. The rocks are quite resistant to erosion and form most of the higher peaks in Cassiar and Hotailuh mountains.

The McLeod series is a rather complex interbedded assemblage of volcanic fragmental rocks and flows, and minor amounts of sandstone, greywacke, cherty quartzite, and conglomerate. It is usually possible to distinguish between volcanic and sedimentary members of the series in the field, but they are so intimately associated that they cannot be separated on the accompanying map.

There are intrusive bodies of augite porphyrite within the belt of volcanic rocks on the north side of the Cassiar batholith. In some places the augite porphyrite is partly altered to serpentine and because of this relationship it will be described along with the other basic rocks associated with serpentine.

The basal member of the McLeod series in the vicinity of Black mountain is a conglomerate that contains rounded cobbles of limestone and quartzite in a tuffaceous matrix. Several miles to the southeast the basal member is a fine-grained andesite.

The tuffs, agglomerates, flows, and interbedded sediments exposed in Hotailuh mountains are at least 10,000 feet thick. The base of the series is not exposed. The rocks have been intruded on the south by granite, and on the north dip under recent alluvium and glacial drift between Cassiar and Hotailuh mountains. Several fairly complete sections show a gradation from predominantly sedimentary rocks in the south, to predominantly volcanic rocks in the central and northern parts of the mountains.

Extrusive rocks which make up the greater part of the McLeod series are well exposed in Hotailuh mountains east of Tanzilla river. Massive flows up to 400 feet thick are intercalated with tuffs and agglomerates. Although these rocks are varicoloured on weathered surfaces they are green on fresh fractures.

The lavas are fine-grained andesites. Some are amygdaloidal and many are porphyritic, feldspar and pyroxene forming the phenocrysts. Microscopic examination shows that the feldspars, oligoclase-andesine in composition, are altered to saussurite and that the pyroxene phenocrysts are partly altered to chlorite. The groundmass is made up of a fine felt of feldspar laths, chlorite, calcite, magnetite, hematite, and, possibly, some glass. Quartz and calcite are present as amygdule fillings.

Tuffs and agglomerates exhibit wider variations in composition and appearance than do the lavas. Some fine-grained, siliceous tuff closely resembles chert and other massive, coarse crystal varieties are very similar in general appearance to the lavas. Fragments in the agglomerates vary in size from blocks 5 or 6 feet square to pieces of microscopic dimensions. The agglomerates are stratified in a few places and the fragments then are fairly well rounded, but more often there is a chaotic arrangement of large and small angular blocks in a tuffaceous matrix. Fragments of sedimentary rocks, andesite, andesite porphyry, and a fine-grained feldspar porphyry, are contained in the agglomerates. The tuffaceous matrix of the agglomerates contains feldspar fragments and glass in addition to small rock fragments.

The sedimentary rocks include thinly bedded argillite, chert, slate, quartzite, sandstone, greywacke, conglomerate, and occasional thin beds of limestone. Many of these rocks are quite similar to members of the Dease series, but are distinguished from the latter by their close association with volcanic rocks. Well-stratified conglomerates containing pebbles and cobbles of volcanic rocks occur at two localities in Hotailuh mountains. In the canyon of Gnat creek, about 1 mile above its junction with Tanzilla river, coarse-grained sediments are interbedded with flows. East of McBride river, in the southeast corner of the area, a conglomerate containing pebbles of limestone, chert, jasper, and volcanic rocks is intercalated with massive agglomerates. Greywacke east of the mouth of Eagle river contains grains of volcanic rock and of augite porphyrite. However, sediments in the northern part of the area occur only in small amount and appear to be restricted to the top and bottom of the group.

Both the volcanic and sedimentary rocks have been intruded by granite and by a basic rock now largely altered to serpentine, and are slightly to highly metamorphosed adjacent to the larger masses of granite. Selective replacement of the volcanic rocks by granite has, in some places, developed a pronounced gneissic banding. In other places, the intruded rocks, at the contacts, are schistose, and contain small amounts of chalcopyrite and pyrite.

A zone of sheared and mineralized volcanic rocks extends in a northwest direction along the northern front of Hotailuh mountains for approximately 8 miles. In places, the rocks in this zone are slightly mineralized andesites and andesite porphyries and in other localities, where the alteration has been more complete, the rocks are talc schists. Most of the schists contain appreciable amounts of pyrite and, consequently, weather in various shades of red and brown.

STRUCTURE

In a broad way the structure of the northern part of the area is simple. Northeast of the Cassiar batholith the Dease and McLeod series are folded into a broad syncline which is succeeded to the northeast by a broad anticline. The distance between the axes of the two folds is about 14 miles. The limbs of the main folds have moderate dips, but locally the strata have been crumpled and bent into minor folds. The folds trend northwest and their axes are practically horizontal except at the western edge of the area where the syncline pitches southeast. Southeast of Quartz creek the McLeod series outcrops along the centre of the syncline, but northwest of Quartz creek the series has been removed by erosion.

The Cassiar batholith intrudes the southwestern limb of the syncline and cuts across the structural trend of the older rocks at an acute angle. Palæozoic rocks of the Dease series are exposed next to the batholith in the northwestern part of the area, but to the southeast this band of Palæozoic sediments narrows and disappears, and at Fourmile creek the granite is in contact with the McLeod series at the axis of the syncline.

The sedimentary and volcanic rocks between the Cassiar and Hotailuh batholiths strike north 30 degrees to 80 degrees west, and, as a rule, dip at medium to high angles to the northeast. The regional structure appears at first glance to be a simple homocline, but the distribution of rocks proves that this is not so. The McLeod series forms the northern side of Hotailuh mountains and appears to dip under the older Dease series to the north. Farther to the north, around the headwaters of Eagle river, a band of the McLeod series outcrops between northeasterly dipping sediments of the Dease series. The Dease-McLeod contact along the northern edge of this band is slightly overturned to the southwest. If the structure of the Dease series were homoclinal the massive limestones that outcrop along the northern side of the wide valley between Cassiar and Hotailuh mountains should be the oldest beds of the series. However, poorly preserved fossils of Upper Triassic age have been found along the strike of these limestones some 20 miles to the west in Dease Lake area, indicating that those massive limestones may be near the top rather than near the base of the Dease series.

Although this structure has not been interpreted it probably resulted from close folding and overturning on a large scale, combined with some faulting. Faulting on a small scale is common in both the Dease and McLeod series. However, there is little direct evidence of large-scale faulting unless the alined valleys along the southern Dease-McLeod contact be regarded as topographic evidence of a major fault in the underlying rocks.

The contact between the batholithic rocks and the McLeod series is, as a rule, fairly flat dipping in Hotailuh mountains. Bordering the contact the intruded rocks are in many places overturned and disrupted by minor thrust faults with displacements of as much as 100 feet. The strike of the McLeod series in this part of the area commonly parallels the contact of the Hotailuh batholith. Along at least a part of the northern boundary of the Cassiar batholith the contact with the McLeod series is believed to be a steep, northeasterly dipping, normal fault. The McLeod series is unaltered and its contact with the granite is marked by cleft-like depressions in the hill-sides and by saddles in the ridges.

INTRUSIVES

The intrusives of the area may be divided into three groups, namely: serpentine and related basic rocks; granitic rocks of the Cassiar and Hotailuh batholiths; dykes and plugs. Granitic rocks cut the serpentine and the granites in turn are cut by basaltic dykes.

Serpentine

A belt of serpentine extends from the headwaters of Eagle river southeasterly to the eastern edge of the area. It averages 4 miles in width and attains a maximum width of 8 miles on the east side of Muddy river. There are smaller bodies near the headwaters of Little Eagle river and in the neighbourhood of Tanzilla butte. North of the Cassiar batholith serpentine bodies are small and were not mapped.

The main serpentine belt contains a wide variety of rock types. In addition to serpentine and the partly serpentinized basic rocks, there are inclusions of highly metamorphosed sediments. Depending upon the degree of alteration, the associated basic rocks vary from almost pure serpentine to those with the appearance of comparatively fresh diorite The serpentine varies somewhat in lithological character from one locality to another, but is typically massive, and is light to dark green in colour. Sheared and slickensided varieties are fairly common and in some places spheroidal weathering of the serpentine simulates pillow structure in lava.

Microscopic examination of the serpentine yields very little information as to the original character of the rock. Most of the sections studied are made up of colourless serpentine and small amounts of magnetite which follows the original outlines and cleavage cracks of olivine grains. In spite of their dioritic appearance, most of the associated basic rocks are almost as badly altered. However, they usually contain a few ragged crystals of enstatite and actinolite or tremolite in addition to serpentine. The only section that did not show a comparatively high degree of alteration was of peridotite from the summit of Tanzilla butte. This rock is made up of fresh olivine and minor amounts of augite.

North of the Cassiar batholith bands of light green to black serpentine occur at the base of the McLeod series and near the top of the Dease series. The bands are, in most places, about 100 feet thick and contain thin, discontinuous, dyke-like bodies of white rock. The serpentine consists mainly of the mineral serpentine, but also contains a colourless pyroxene and chromite. The associated white rock consists of colourless pyroxene, probably diopside, and a good deal of garnet.

Basic rocks are associated with the serpentine in the northern part of the area. They are mainly augite porphyrite and occur in bodies varying in size from a few hundred feet wide to 5 miles or more in diameter. Stocks of augite porphyrite that are circular or oval in outline are largely confined to the belt of volcanic rocks, whereas elongate bodies resembling sills of irregular shape occur in the Dease series. Some of these bodies are partly altered to serpentine.

The augite porphyrite is very dark grey in colour and is commonly porphyritic. Most samples examined microscopically contained phenocrysts of augite, but a few contained hornblende. The feldspars could rarely be identified because of alteration to secondary products, but labradorite was recognized.

Basic dykes and sills containing serpentine intrude the argillites and limestones of the Dease series in the vicinity of Tanzilla butte, and in many localities immediately adjacent to the main serpentine belt. These dykes and sills are usually less than 20 feet wide.

In the southern part of the area serpentine is believed to be intrusive into the Dease series and in the northern part of the area it is associated with bodies of augite porphyrite which occur in the lower part of the McLeod series and also to some extent throughout the series. A granite dyke intrudes the serpentine 3 miles northwest of the large bend in Muddy river. The serpentine is, therefore, of McLeod age believed to be Jurassic. Similar occurrences of serpentine in southern British Columbia and in southern Yukon are considered to be Jurassic in age.

Batholithic Rocks

Batholithic rocks occupy approximately 50 per cent of the map-area. The Cassiar batholith crosses the central and northern parts of the area in a northwest direction and is from 20 to 25 miles wide. Several large bodies of older rocks occur as roof pendants or inclusions within the batholith. The granitic body of Hotailuh mountains is exposed for 20 miles along its northern contact and is known to be at least 10 miles wide. Several outlying stocks of granite occur on both sides of the Cassiar batholith.

The batholithic rocks are usually massive, medium to coarsely crystalline, and dark to light grey in colour. They range in composition from diorite to granite. Gneissic and schistose phases are found close to the inclusions and roof pendants of the older rocks. Aplitic and pegmatitic varieties occur locally in both the Hotailuh and Cassiar intrusive masses.

The contact between the batholithic rocks and the McLeod formation is fairly flat in Hotailuh mountains. On the north side of the Cassiar batholith the contact is steep and east of Dease river is believed to be a fault contact.

The age of the batholithic rocks is not definitely known. They are intrusive into volcanic and sedimentary rocks of the McLeod series. The McLeod series is correlated on the basis of lithological character with Jurassic sediments and volcanics of central British Columbia and southern Yukon, so the indicated age of the batholithic rocks is not older than Jurassic.

Dykes

Dykes are of very infrequent occurrence in the area, but there are at least three types. Dykes so highly altered that the rock type could not be ascertained are abundant near Quartz City. They are roughly parallel to one another and strike north 30 degrees to 60 degrees east, crossing the intruded rocks at right angles to their strike. Though observed only in the volcanics it is not known whether they are restricted to these rocks or extend along the strike into adjoining sediments. On the mountain at Snow creek the dykes are 1 foot to 10 feet wide and are so closely spaced that they constitute 10 to 20 per cent of the total rock in a belt 2 to 3 miles wide. Some of the rock in the canyon on Quartz creek near its junction with Trout creek appears to be the same as that of the dykes, but in this place it occurs in widths up to 300 feet. A striking feature of the dykes is that they contain many narrow quartz veins parallel to their strike and also commonly have quartz veins along one or both walls.

This close association of the dykes with quartz veins suggests that they are related in origin. In the larger body of dyke-like rock on Quartz Creek canyon, quartz occurs as large masses of irregular shape. A width of 100 feet consists roughly of 75 per cent quartz and 25 per cent dyke rock. Hydrothermal action, presumably associated with the formation of the quartz veins, has introduced much carbonate and some sericite and pyrite into the dykes and adjoining volcanic rocks, rendering all the rocks near the veins light grey in colour.

Microscopic examination shows that the dykes consist mainly of carbonate and sericite. Some dykes contain chlorite, epidote, and carbonate. The outlines of former feldspar crystals remain as long, narrow laths. The coarser grained part in the interior of one dyke exhibited a type of arrangement of feldspar laths characteristic in diabase.

Narrow, medium- to coarse-grained, basic dykes cut the volcanic rocks of the McLeod series and the serpentine. They have been altered to about the same extent as the volcanic rocks of the McLeod series and are probably related to the igneous activity that produced this series of rocks.

Dykes, ranging in composition from granite to diorite, intrude the serpentine, the McLeod series, and the Dease series. These dyke rocks have approximately the same composition as the batholithic rocks and are believed to be genetically related to them.

The youngest intrusive rocks are the basaltic dykes and plugs of the Tuya formation. These dykes are numerous only in the vicinity of cinder cones of the Tuya formation. Two large dykes of diabase observed in the northern part of the area are quite unaltered, and their unusual freshness suggests that they are Tertiary or younger. They are presumably related in origin to the Tuya eruptives.

TUYA LAVAS AND CINDER CONES

Black cinder cones form one of the most striking topographic features of the area. The cones are most abundant in the northwesterly trending belt of sedimentary rocks south of the Cassiar batholith, but Black mountain, a large volcanic cone on the north side of Eagle river, and several small lava flows in the vicinity of Eagle lake lie entirely on the Cassiar batholith.

The cones are generally elliptical in plan and conical in section, and rise to elevations of 6,500 feet. Although their highest summits are 1,000 feet lower than some of the peaks in Cassiar and Hotailuh mountains, their symmetrical shape and long, black, talus slopes make them conspicuous landmarks in the region.

The summit of the cones is generally close to a central conduit or feeding fissure. Slightly consolidated cinders and intermingled bombs surround the central conduit and make up the greater part of the cone. Basaltic dykes occur in the cones. They are dark-coloured, fine-grained, porphyritic rocks containing phenocrysts of olivine. Most of the flows are vesicular and some are scoriaceous near the base.

Several lines of evidence would indicate that the volcanic cones are Pleistocene rather than Recent or pre-Pleistocene in age. The cones are elongated in the direction of movement of glacial ice in the nearby valleys, and glacial erratics are found close to the summits of the highest cones. The cones, therefore, must have been in existence during at least a part of the Pleistocene. The older sedimentary and igneous rocks, in contact with flows and cinders where they normally would be protected from ice erosion taking place after the cones were built, are fresh and unweathered, thus suggesting an earlier glaciated surface. The cones were, therefore, formed during the Pleistocene. In Dease Lake map-area Johnston found glacial erratic boulders in the volcanic tuffs and considers the cinder cones to be of early Pleistocene age.

ECONOMIC GEOLOGY

Prospectors have been at work in Cassiar district since about 1860, but production was small until placer gold was discovered on Thibert creek in 1873. Placers were discovered on Dease and McDame creeks shortly after those on Thibert creek and in 1874 the production of gold from the district was $1,000,000. This was the best year and despite new discoveries on creeks in the outlying districts production declined steadily after 1875. The total value of gold taken from Cassiar district amounts to about $5,000,000, of which $1,500,000 is reported to have been taken from McDame creek and $1,200,000 each from Dease and Thibert creeks.

During the past ten years interest in Cassiar district has been revived by new placer discoveries. These discoveries, although relatively unimportant, are interesting because they show that placer deposits are not confined to McDame, Dease, and Thibert creeks, but do occur in other localities where geological conditions are somewhat similar.

Despite the large production of placer gold, very little effort had been made prior to 1933 to locate lode gold deposits. In 1934, a quartz stringer containing high-grade gold ore was found on Quartz creek, a tributary of McDame creek. A ton of ore from this vein was shipped out by airplane and was found to contain 4 ounces of gold. The shipment aroused a good deal of outside interest, especially when it was reported that other veins in the district contained free gold. By the end of the 1935 season, several hundred claims had been staked in the vicinity of Quartz City, near the junction of Snow and Quartz creeks, and about forty veins containing free gold had been found.

GOLD PLACERS

According to Johnston,[1] placer gold deposits occur in three or possibly four different ways in Dease Lake area. "(1) In gravels resting on bedrock in the old high-level channels of Dease and Thibert creeks. These gravels are only a few feet thick and are cemented in places. They are probably pre-Glacial (late Tertiary) in age. They formed the most important source of placer gold in the district, except the beds of those streams where the old channel has been cut away. (2) In glacial or (and) interglacial gravels that partly fill the old stream channels and present valleys. Some gold was included in the glacial drift by ice-erosion of pre-existing placers and was reconcentrated to some extent by stream action.

[1] Johnston, W. A.: Op. cit.

As a rule, however, gold is scattered through these gravels and is only slightly concentrated into paystreaks. (3) In post-glacial or surface gravels in the beds and on the low benches of the present streams. These gravels were rich in places where an old gold-bearing channel of the stream had been cut away by the present stream.

"A fourth class includes lava-buried placers. Gravels overlain by lavas and tuffs occur in Eagle River country, but are not definitely known to be gold-bearing. They occur in places along Stikine River valley."

McDame Creek

McDame creek has been the most productive creek in Cassiar district. It heads in Cassiar mountains and flows 30 miles in a general easterly direction to Dease river. The principal tributaries are Trout, Quartz, and Snow creeks, and first, second, and third north forks.

Placer gold was taken from bench gravels at Pendleton camp, Centreville, Holloway bar, and from present stream gravels on Snow creek, 10, 12, 15, and 25 miles, respectively, above McDame. According to Dawson, the richest placer claim in Cassiar district was on Snow creek. Howay and Scholefield state, in the History of British Columbia, that in 1877 McDame creek produced the largest nugget found in British Columbia, worth $1,300.

During the summer of 1935 placer mining in McDame Creek area was limited to small-scale hydraulicking on an old channel of Quartz creek, by David Wing. The old channel had previously been mined by drifting for about 2,000 feet upstream from where it is cut by the present Quartz creek. Presumably the gravels were too lean at that point to yield a profit with dry mining methods. Below Quartz creek the channel was also mined by drifting for a short distance down the slope, but water prevented the miners from going very far. Mr. Wing reports that gold is found in a stratum of gravel about 20 feet above bedrock, as well as on bedrock.

Only a small amount of gravel has been moved in this hydraulic operation and the clean-ups have been small. It was pointed out earlier in this report that a branch of the Cottonwood Valley glacier moved north to McDame valley and there changed direction and moved to the east down the valley. At the place where the glacier changed from its northern to eastern course, Lang, Trout, Quartz, and Snow creeks united in a stream flowing east along the northern side of the ice. The channels of these streams shifted as the ice melted and at least four different channels remain above the present level of McDame creek. These channels probably contain placer gold, but they may not have been occupied by the streams for a sufficient length of time to form valuable placers.

Goldpan Creek

Goldpan creek rises on the southwestern slope of Dome mountain, 14 miles east of the head of Dease lake. Placer gold was discovered in the creek in August 1924, and to date it has yielded around 2,000 ounces of gold. A description of the placer deposits may be found in the reports of Johnston and Kerr on Dease Lake area and in the 1933 Annual Report of the Minister of Mines of British Columbia. The creek was not visited by the writers.

Boulder Creek

Boulder creek rises at the base of King mountain, the highest peak in this part of Cassiar district, and flows 8 miles in a northerly direction to Muddy river. For approximately 3 miles above its junction with Muddy river the creek occupies a narrow canyon 50 feet to 100 feet deep at the lower end. There it falls 75 feet over limestone cliffs into the flat-bottomed valley of Muddy river. Above the canyon the creek occupies an open, V-shaped valley.

Boulder Creek canyon is cut in sedimentary rocks of the Dease series for about one mile above the falls and in serpentine throughout the remainder of the canyon. Cemented and stratified stream gravels outcrop in the creek bottom on Shea's lease at the head of the canyon. These gravels fill an old stream channel which had a somewhat lower gradient than that of the present creek. In addition to fragments of sedimentary rocks and serpentine, the cemented gravels contain rounded cobbles of granite, andesite, and basalt; that is, rocks that do not outcrop in the drainage basin of Boulder creek and, consequently, must have been carried there by Pleistocene glaciers. The gravels are covered by glacial drift in some places, indicating that they were deposited before the last advance of the ice.

Placer gold was discovered on Boulder creek in 1932 when Carl Johnson recovered about 24 ounces of gold from small test pits in the lower part of the canyon. J. W. Wheaton purchased the Johnson lease in 1933 and during the summers of 1934 and 1935 he and F. Bobner built a dam and a diversion canal and also did a small amount of ground-sluicing. According to Mr. Wheaton, approximately 100 ounces of gold has been recovered. This figure is very encouraging, for work below the diversion dam has been restricted to the western edge of the creek channel where a band of schistose rocks has provided a series of natural riffles.

Depth to bedrock in the lower part of the canyon is from 4 feet to 7 feet. Large boulders up to 7 feet or 8 feet in diameter must be broken and removed by hand. Consequently, the work preparatory to sluicing is slow and arduous.

Percy Peacock and Mr. and Mrs. V. Shea have placer leases on Boulder creek 1 and 2 miles above Wheaton's lease. In the summer of 1935 they were constructing dams preparatory to ground-sluicing.

The gold particles taken from Boulder creek are flat and fairly coarse. The source of the gold is not known. The present concentrations on bedrock in the creek bottom and around the edges of large boulders in the present stream gravels are post-glacial in age and may have been formed by the reworking of pre-glacial placer deposits or by the re-concentration of gold in glacial drift.

Future Possibilities

It should be borne in mind when prospecting for placer gold deposits in Cassiar district that the region has been heavily glaciated in comparatively recent geological time. Most of the main valleys were filled with moving ice to a depth of several thousand feet and pre-glacial placer deposits in these valleys may have been scattered and destroyed.

With the exception of McDame creek, the productive creeks in the region are in valleys that lie transverse to the direction of ice movement and, consequently, did not suffer the full effects of glacial erosion. These valleys are commonly V-shaped in contrast with the marked U-shape of the glaciated valleys.

Practically all of the valleys in Hotailuh mountains head in glacial cirques and are U-shaped. Consequently, the possibilities of finding any extensive gold placer deposits in these valleys are poor.

The productive creek valleys in Cassiar district are in the sedimentary and volcanic rocks on the north and south sides of the Cassiar batholith. Streams flowing entirely through areas underlain by granitic rocks have not been found to contain commercial placer deposits. Therefore, prospectors would be well advised to avoid the central parts of Cassiar and Hotailuh mountains, which are largely made up of granite.

In conclusion it may be said that the areas to the southeast and northwest of Dease lake warrant careful and intelligent prospecting.

LODE DEPOSITS

The gold quartz deposits near Quartz City occur as vein fillings in fissures in a band of volcanic rocks of the McLeod series. The veins are roughly parallel to one another and form a well-defined belt about 3 miles wide. They strike north 30 degrees to 60 degrees east, and cut across the northwesterly trending volcanic rocks at right angles.

Development work has been confined to a few open-cuts and surface pits. The veins are largely drift covered, so information regarding their nature is rather meagre. The known gold-bearing veins vary in width from a few inches to 4 feet. Other bodies of quartz that are in the gold-bearing vein belt but are not known to contain gold are as much as 50 feet in width. Many of the veins are over 500 feet long and as exploration proceeds may be found to be much longer. Information regarding the persistence of veins at depth is limited to a natural cross-section seen on a high cliff near the head of Quartz creek. Here, veins which have a maximum width of about 3 feet persist down the dip to a depth of several hundred feet. Those with a maximum width of 1 foot have a vertical length of about 100 feet and narrow stringers extend downward a much shorter distance. In other words, the persistence at depth of the veins appears to be roughly 100 feet for each foot of width.

Pits and open-cuts are not numerous and have not been sunk through the oxidized zone, but they show that the gold in the veins is practically restricted to an inch or two on one or both walls. The interior parts of the gold-bearing veins do contain some fine gold, but do not return commercial assays. Pyrite is practically the only sulphide, but occurs in very small amounts and appears to be mainly along the vein walls with the gold. Specimens from the walls of the better veins exhibit many particles of gold somewhat smaller than grains of rice adhering to rust in cavities in the quartz. The shapes of the cavities suggest that they were filled originally by ankerite and pyrite.

Some of the gold-bearing veins were sampled in the summer of 1935, but the assays, in general, were quite low. It should be borne in mind, however, that in general the rusty vein walls are broken down and dissipated at the surface and that the samples for assay would, therefore, include very little of the richer parts of the veins.

Twenty or thirty gold-bearing veins were discovered near Quartz City in 1935 and these discoveries do not by any means exhaust the possibilities there. The area is recommended for further prospecting.

Quartz veins occur in many localities in the Eagle-McDame area, but nothing is known of their value except at Quartz City. The areas underlain by volcanic rocks of the McLeod series almost invariably show some signs of the mineralization. In Hotailuh mountains the rocks adjacent to Hotailuh batholith are, in many places, sparingly mineralized with pyrite and chalcopyrite. The mineralized and sheared zone of volcanic rocks on the northern front of Hotailuh mountains has been mentioned in the description of the McLeod series. If the region were more accessible and the cost of transportation a little lower, one would not hesitate to recommend it as a promising area for prospecting.