CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

PAPER 53-20

PRELIMINARY MAP

KLUANE LAKE

(WEST HALF)

YUKON TERRITORY

By

J. E. Muller

OTTAWA

1954

Price, 25 cents

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DESCRIPTIVE NOTES FOR KLUANE LAKE MAP, WEST HALF, Y. T.

Accessibility

Except for the high, rugged glacier-covered region in the southwest corner, the entire area is readily accessible with pack-horses. Trails are poor or non-existent, but as forest vegetation is light most valleys may be travelled without much trail-cutting. Southwest of the Alaska Highway, Donjek and Duke Rivers afford good travelling for pack-horses on the gravel bars or in places on old trails through timber. Thus, Kluane Glacier may be reached, via the mouth of Wade Creek, either from Duke River bridge and the trail over Burwash Uplands, or from the Donjek bridge along the east side of the Donjek, and thence by trail past Donjek Glacier. The valleys of Lynx, Wolverine, Steele[1], Ptarmigan, Halfbreed, and Grizzly Creeks may also be traversed with little trouble. Travel along the west side of the Donjek is more difficult, owing to swampy conditions, fairly thick timber, cut-banks along the river, and frequent occurrence of high water in the four glacier-fed tributaries to be crossed. Travel up Donjek Glacier requires back-packing over rough ice and lateral moraines. Lack of firewood and horse-feed may be a difficulty in all valleys above an elevation of 4,000 feet. Northeast of the Alaska Highway all valleys are accessible, though they are commonly swampy and covered with ponds and lakes. Pack-horses are usually available at Burwash Landing, on Kluane Lake.

General Geology

The oldest rocks known in the area have, as elsewhere in Yukon Territory, been assigned to the Yukon group. They are here tentatively grouped into three subdivisions (1A-1C), which exhibit a decreasing degree of metamorphism. The most highly metamorphic assemblage(1A) consists mainly of garnet-, biotite-, and staurolite-bearing gneisses, but includes some undifferentiated small bodies of dunite and pyroxenite. Dunite occurs east of Kluane River and in isolated outcrops south of Dogpack Lake, and pyroxenite was seen west of the latter outcrops near Kluane River; no evidence of mineralization was noted in these ultrabasic rocks. The second division(1B) consists mainly of quartz-biotite schists, which in places also contain garnet and muscovite. With these rocks are associated some amphibole-bearing quartzites, or amphibolites. Quartz-biotite schists and fine-grained gneisses in the upper Donjek region have been tentatively correlated with the rocks of this map-unit. The third subdivision(1C) is characterized by thick zones of dolomitic limestone and chlorite schist, but may also contain rocks resembling those of map-unit 1B, the boundaries of the two subdivisions having been drawn mainly on the basis of the occurrence or lack of limestone. The latter rock is predominant in a belt that extends north of Nuntaea Creek, across the length of Dogpack Lake and the south part of Tincup Lake, and thence across Kluane River to the first bend of Donjek River north of the highway bridge, ending in a lone limestone butte west of that river. No fossils have been found in any of these Yukon group rocks. In adjacent areas they have been generally regarded as mainly of Precambrian age, but it seems possible that at least the limestone-bearing unit(1C) may be younger and correlative with fossil-bearing early Palaeozoic limestone-bearing formations in Alaska.

M. Dev.

A thick series of limestone, calcareous schist, argillite, and slate(2A) is well exposed in the rugged mountains northwest of Walsh Creek. It has a general southwest trend, but air photographs indicate that the strata swing to the southeast in the middle reaches of Walsh and Donjek Glaciers, in the extreme southwest corner of the map-area. East of Donjek River Valley, these rocks presumably continue to the southeast, but are partly obscured by overlying Tertiary lavas and by an irregular intrusive body that holds many small migmatized roof pendants of limestone, slate, and phyllite. In the upper reaches of Duke River, east of the map-area, the same rocks reappear. Poorly preserved, crushed and recrystallized corals are abundant in some of the limestone, and, according to D. J. McLaren of the Geological Survey, indicate a possible Middle Devonian age. An assemblage of chloritic greywackes and tuffs(2B) on upper Duke River and Grizzly Creek is probably younger than the limestone-slate series(2A), and, although included tentatively with the Devonian rocks, may be in part or entirely younger.

L. Perm.

A group of sedimentary and volcanic rocks (3) underlies most of a belt, 10 to 15 miles wide, southeast of Shakwak Valley. In part, as on Mount Wade and thence southeastward, it consists of an undivided group of mainly altered (chloritic) andesite and tuff, some of which is schistose, with minor slate and phyllite. Elsewhere it is generally less altered, and has been subdivided tentatively into lower assemblage(3A) of mainly sedimentary and pyroclastic rocks and an upper series(3B) of mainly extrusive rocks. Marine fossils occur abundantly in some of the limestones and greywackes of the lower subdivision(3A) and, according to P. Harker of the Geological Survey, indicate a Lower Permian age. A section of these rocks, comprising an estimated thickness of 5,000 feet of strata, was examined north of Hoge Creek and east of Donjek River. Its lower part consists mainly of volcanic breccia and boulder conglomerate, with some fine-grained tuffaceous rock; the conglomerate becomes less coarse toward the top, and grades into tuff, greywacke, and chert-pebble conglomerate. The higher beds contain fewer pebbles, more calcareous greywacke and sandstone, and, in some beds, many brachiopods. The upper part of the sedimentary section consists mainly of silty limestone, chert, and cherty tuff, and is distinguished by vivid, light red, orange, purple, yellow, and pure white colours. The uppermost beds contain intercalated layers of medium-grained, gabbroic or basaltic rocks similar to those of the overlying subdivision(3B). A section of Permian strata, roughly similar to that near Hoge Creek, but much disturbed and probably thinner, occurs in a presumably anticlinal structure whose axis follows Arch and

Nickel Creeks and extends farther east. Coarse pyroclastic rocks occur in the central part of the structure, near the valley bottom, and are flanked by highly disturbed argillite, chert, fossiliferous limestone, and minor gabbroic rock(3A). These rocks are overlain, in the higher parts of the mountains on either side of the Arch-Nickel Creeks Valley, by a thick succession of amygdaloidal andesite(3B).

The Permian strata north of Hoge Creek are overlain, or intruded by, medium-grained (1 to 4mm.) diopside basalt or gabbro (3B, in part). It could not be established with certainty whether these rocks are extrusive flows or intrusive sills. Their similar stratigraphic position and petrographic resemblance to some of the Nicolai greenstone of adjacent areas in Alaska, considered to be entirely extrusive[2], suggest a like origin for the rocks under discussion. However, their relative coarseness, irregular distribution, and apparent genetic connection with sills of fine-grained, black peridotite, ranging in thickness from a few to several hundred feet, argue in favour of an intrusive origin. These medium-grained gabbroic rocks and associated peridotite sills also occur in the mountains east of Ptarmigan Creek and northeast of Duke River, mainly beyond the map-area, and in minor amounts in the area between Burwash and Arch Creeks, Donjek River, and Shakwak Valley. In the latter area they are intercalated with sedimentary rocks, and have been included in map-unit 3A; map-unit 3B in the same locality is represented by a thick succession of dark greenish and purplish grey, amygdaloidal andesite, in part with phenocrysts of feldspar, and with only minor dark minerals.

Though Lower Permian fossils have been identified from the lower subdivision(3A), the age of the entire group(3) is not so well established. The amygdaloidal andesites of map-unit 3A probably overlie the fossil-bearing beds of map-unit 3B, and the medium-grained gabbroic rocks occur mainly in a stratigraphic position near the contact of map-units 3A and 3B. Both andesites and gabbroic rocks are probably older than the Upper Triassic strata (4A, 4B), and their age is thus defined between Lower Permian and Upper Triassic, a stratigraphic position similar to that of the Nicolai greenstone in Alaska. It may be that part of the group, especially the altered rocks of the undivided map-unit(3), are older than the fossil-bearing strata and may be of pre-Permian age.

A band of massive, brecciated limestone(4A), a few hundred feet thick, exhibits jagged peaks in mountain areas and steep cliffs along the streams that cross it. It may be traced for many miles on air photographs by its distinctive light colour and rough topography. The overlying, black, silty limestone and limy argillite (4B) occur in well-defined beds 1 inch to 1 foot thick, and are closely folded and crumpled in most exposures; marine fossils from them were determined by F. H. McLearn of the Geological Survey as indicating an Upper Triassic age. A nearly straight, but discontinuous, belt of these rocks, about a mile wide, may be traced from the head of Ptarmigan Creek to the lower part of Cement Creek. This Triassic sequence is correlative with that of the

Nizina and Chitistone limestones and McCarthy shale in Alaska, but seem to be much thinner.

A poorly preserved belemnite, found in calcareous argillite near Tetamagouche Creek, has established the presence of Upper Jurassic or Lower Cretaceous sedimentary rocks(5) in the area. Another occurrence of bedded argillites north of Maple Creek is thought to represent the same group. Except, however, for well-developed cone-in-cone structure in some beds and rod-like, vegetable(?) imprints in others the rocks are not noticeably different from some of the Permian or Triassic argillaceous strata.

A series of continental deposits(6), consisting of sandstone and conglomerate, or their unconsolidated equivalents, and minor shale and coal occupies a discontinuous belt, 2 to 6 miles wide, across the area, mainly north of the belt of Triassic rocks. In a steep gulch east of Wolverine Plateau, about 2,600 feet of these beds were measured; they are overlain by a thick succession of tuff, volcanic breccia, and basalt(7). The sediments were laid down in a northwest trending trough, and the original southwest limit of deposition coincides roughly with the present limit of outcrops. Near this margin, south of Granite Creek and east of Ptarmigan Creek, coal seams about 20 feet thick were discovered, about half of each seam consisting of relatively clean coal. Farther southwest, Tertiary lavas rest directly on pre-Tertiary rocks, except for small, intervening pockets of gravel and sand at some contacts. Plant fossils collected by Bostock[3] north of Granite Creek indicate a Paleocene age.

Vesicular to massive basaltic lavas of Tertiary age(7), in places with phenocrysts of plagioclase, occur throughout the area southwest of Shakwak Valley. Scattered remnants capping rocks of all ages suggest their much greater extent in late Tertiary time. Their largest area is between Wolverine and Steele Creeks, where a flat-lying to moderately dipping, snow-capped succession of plateau lavas and pyroclastic rocks is at least 4,500 feet thick. In places there is a gradual transition from Paleocene sandstone and conglomerate(6) through a mixed zone of sedimentary, pyroclastic, and extrusive rocks to the upper group(7) of only volcanic rocks. Though the base of the latter group may, therefore, be of early Tertiary age, it seems probable that extrusions continued at intervals throughout much of the Tertiary Period, possibly into Pleistocene time..

Intrusive rocks underlie about one-fourth of the map-area and were observed to have invaded all previously described formations except those of Mesozoic age. This exception seems anomalous, as the bulk of all intrusions in the western Canadian Cordillera is generally accepted to be of late Mesozoic age. It may, however, be only a fortuitous circumstance, in part owing to the limited ext ent of Mesozoic rocks in the map-area; on the other hand, the occurrence of boulders of gabbro in the Permian volcanic conglomerate north of Hoge Creek suggests the occurrence of pre-Permian intrusions in this region.

The Yukon group is intruded by rocks that range in composition from granite to gabbro. Coarse-grained porphyritic granite(A1), with white orthoclase phenocrysts up to a centimetre or more in length, smoky quartz crystals, and a little biotite and oligoclase, probably represents the uncontaminated central part of an intrusive belt northeast of, and parallel with, Shakwak Valley, and another belt that extends easterly from the north end of Tincup Lake. An area of similar rocks, but commonly containing pink orthoclase phenocrysts, is inferred to underlie Mount Walsh in the extreme southwest corner of the area, as well as other peaks along the backbone of the St. Elias Range. Evidence for this great area of granite is the abundant granite float in moraines of Donjek and Walsh Glaciers, the characteristic topography, and the large area of granite mapped by Sharp[4] south of Steele Creek Glacier west of the map-area.

Much of the rock intruding the Yukon group is quartz diorite(A2), with hornblende or biotite as dark constituents, but some of it is monzonite, quartz monzonite, and gabbro. These rocks commonly contain abundant xenoliths, or exhibit a gneissic or schlieren structure, suggesting that they are a hybrid product of the intrusive granite(A1) and invaded sedimentary rocks.

Hornblende quartz diorite also forms the main part of a possibly continuous, narrow, northeast trending body invading the belt of Permian rocks south of Shakwak Valley. Nearby sills of greenish black peridotite(A6), previously mentioned, and dykes or small stocks of light-coloured latite(A5), in places cutting the peridotite, may be related to this intrusion.

Syenite, alkali-granite (alaskite), and porphyritic rholite(A3), are the characteristic rocks of an intrusive mass surrounding the snout of Donjek Glacier. They consist mainly of potash feldspar, especially microperthite, and contain little or no free plagioclase or dark minerals. An area of similar rocks occurs near Onion Creek, in the northeast corner of the area. These alkaline rocks are associated with much gneissic and migmatitic material, probably mainly a result of granitization processes, invaded by swarms of acidic dykes; where the rock is dominantly intrusive it commonly contains a large to preponderant volume of dioritic xenoliths.

A stock of medium- to coarse-grained gabbro (A4) occurs near the mouth of Steele Creek, and a smaller body is exposed where Donjek River has cut deep, now partly abandoned, canyons around the snout of Donjek Glacier. These rocks, in part considerably altered, are thought to be pre-Tertiary age, and may be related to the gabbroic basalts in the Permian sequence. However, another small body of gabbro, near the one on Steele Creek, but unaltered and containing light red augite, seems to intrude the Tertiary volcanic rocks and is, therefore, mapped as a Tertiary stock(8).

All other rocks intrusive into Tertiary sedimentary and volcanic strata are laccoliths and sills of light-coloured, porphyritic trachyte and latite(9). In the upper Cement Creek area, two conical, lake-filled depressions surrounded by walls of trachyte rubble are probably craters formed by explosion from a trachyte laccolith.

Basaltic and andesitic dykes occur fairly commonly in all Palaeozoic and older rocks and the intrusive rocks invading them but have not been mapped separately. They may be related to the older suite of volcanic rocks(3).

Structure

The general geological structure of the map-area is that of a graben-like belt of late Palaeozoic to Tertiary rocks, with minor intrusions, compressed between two masses of early Palaeozoic to Precambrian rocks, which are invaded by larger intrusions. This graben belt is bounded by fault zones: in the southwest, a zone of overthrust faults, extending from the lower part of Steele Creek to the mid-section of Duke River, brings Devonian and older rocks over Permian and younger formation; in the northeast, another fault zone has been assumed by Bostock to underlie the Pleistocene and Recent deposits of Shakwak Valley. Within this 'graben', faulting and folding are most intense in the Permian sedimentary and associated volcanic rocks, obscuring their stratigraphic relationships; the belt of Triassic rock is folded into tight, narrow synclines and anticlines; and the belt of Tertiary rocks is flat-lying to gently dipping in its northeast part but exhibits open folds farther southwest, near the zone of overthrust faults. Here pre-Tertiary rocks outcrop along the axes of the anticlines, or have been faulted against the Tertiary rocks. The decreasing degree of folding of Permian, Triassic, and Tertiary formations, all of which exhibit a general northwesterly strike, suggests that compressive forces were active more than once in post-Palaeozoic time, although the only unconformity that can be recognized with certainty is that at the base of the Tertiary rocks. In addition, the higher degree of metamorphism and, in places, different general trends - particularly those to the west and southwest - of Devonian and Yukon group rocks also suggest one or more pre-Permian periods of folding; in this regard it may be noted that the strike of dykes cutting these older rocks in many parts of the area is prevailingly north.

Undoubtedly many more faults occur in the area than are shown on the map, but insufficient information on the stratigraphic succession, particularly of the volcanic and metamorphic rocks, does not at present permit a more elaborate structural analysis.

Prospecting Notes

Placer gold has been known and mined in several streams within the map-area. The canyon of Burwash Creek has been worked in recent years by Kluane Dredging and Burwash Mining Companies, but the former has now moved its floating separator and dragline-scraper to Gladstone Creek across Kluane Lake. Placer gold has also been mined on Arch Creek, and on Bullion and Sheep Creeks east of the area and west of the south end of Kluane Lake. No placer deposits are known in the area northeast of Shakwak Valley, but some have been discovered east of the map-area, on Gladstone, Snyder, and other creeks, in areas underlain by Yukon group rocks.

Cairnes[5] believed that much of the concentration of placer gold had taken place in preglacial stream channels. In most instances these placer deposits were removed by the ice, but in some places they were preserved from erosion and may be found above or at one side of the present stream channels. It is noticeable that all streams carrying placer gold in Kluane Lake map-area have recent canyons incised below gravel and boulder deposits that, judging from their high position, are possibly older than the latest advance of ice in the main glacial valleys. In Burwash Canyon, the gold, together with granite boulders up to 10 feet or more in diameter, may have been concentrated from the boulder till or related fluvioglacial deposits covering Burwash Uplands. Similar, very coarse boulder till occurs on Wolverine Plateau, several thousand feet above the present glacial valleys of the Donjek and Wolverine Creek. It is suggested that it was deposited, before the glacial excavation of these valleys, by a pre-Wisconsin glacier moving southeastward from Wolverine Plateau across the present Donjek Valley to Burwash Uplands. Thus, all canyons incised into this older boulder till might be favourable places for the accumulation of placer gold, although the large boulders could be a handicap in mining operations.

Since about 1910, copper has been known to occur as bornite and malachite in the volcanic rocks north of Tetamagouche Creek, and is found as slabs of native copper in placer workings on creeks draining areas of these rocks. These volcanic rocks, as well as medium-grained gabbroic rocks previously referred to (3B, in part), are probably correlative with the Alaskan Nicolai greenstone, which, together with overlying Triassic limestone(correlative with map-unit 4A), contains the well-known Kennecott copper deposits.

Sulphide ore containing up to 3 per cent nickel and a little platinum was found at the contact of a sill of peridotite cutting Permian sedimentary rocks near Quill Creek in 1952. The prospect is currently being drilled by a subsidiary of Hudson Bay Mining and Smelting Company, Limited, which has staked a great number of claims in that vicinity. More claims have been staked in adjacent areas by other companies and individuals. It seems that in further prospecting work special attention should be given to the Permian limestone-chert zones, with which are commonly associated medium-grained gabbroic basalt and greenish black, fine-grained peridotite, the latter carrying the ore. Three separate zones of these rocks may be distinguished. One follows Arch and Nickel Creeks and runs about due east from there; it may continue westward under Wolverine Valley, where a few outcrops of Permian sedimentary rocks were observed. A second zone extends from Wade Creek, across Burwash Creek to the lower part of Duke River; in addition to Permian sedimentary and volcanic rocks it contains an elongated intrusive mass of quartz diorite and sills of peridotite and latite. A third, discontinuous zone lies south of the belt of Triassic rocks; it extends from the area north of Steele Creek to north of Hoge Creek, and continues again on Duke River, east of Halfbreed Creek, to beyond the map-area.

In a few places indications of mineralization were observed in contact zones of the syenitic complex(A3) adjacent to Donjek Glacier. A 10-foot dyke of white syenite east of the south end of Donjek Glacier contains abundant disseminated pyrite, but an assay by the Mines Branch, Ottawa, revealed no gold and only 0.03 ounce silver a ton.

Small occurrences of gypsum were noted near the junction of Wade and Maple Creeks, and on Burwash Creek about a mile below Burwash Glacier. At the former locality the exposures occur near fossil-bearing Permian rocks, but on Burwash Creek they are associated with limestone strata thought to be of Triassic age. These deposits may be correlative with gypsum deposits on Bullion Creek, east of the map-area, to which attention was recently drawn by Bostock[6].

Coal occurs at various places in Tertiary sedimentary rocks. In 1914 Cairnes[7] estimated an aggregate thickness of 30 to 50 feet of clean coal in the exposed section in the "badlands" area north of Granite Creek. Seams about 20 feet thick, about half of which is clean coal, occur south of Granite Creek and east of Ptarmigan Creek. Two seams of clean coal, 2 1/2 and 3 feet thick respectively, were observed west of Donjek River, between Cement and Steele Creeks. All these more promising showings of coal occur near the southwest edge of the Tertiary sedimentary basin, beyond which Tertiary lavas rest directly on older rocks. This marginal zone of thicker seams is moderately folded and faulted; the pitch of the seams and the steep mountain slopes may prohibit strip-mining; on the other hand, shaft-mining would encounter serious difficulties due to the poor consolidation of the sediments in which the seams occur. A section and analyses of the coal examined near Granite Creek has been published by Bostock[8]; the coal is classified as sub-bituminous C.

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[1]Recently the names Steele Creek and Steele Glacier have been officially approved by the Canadian Board on Geographical Names, Department of Mines and Technical Surveys, to the creek and glacier named Wolf Creek and Wolf Glacier in earlier publications.

[2]Moffit, F. H.: Geology of the Chitina Valley and adjacent area, Alaska; U.S. Geol. Surv., Bull. 894, 1938, pp. 37-42.

[3]Bostock, H. S.: Geology of Northwest Shakwak Valley, Yukon Territory; Geol. Surv., Canada, Mem. 267, 1952, p. 33. On the accompanying Map 1012A Granite Creek is named Badlands Creek.

[4]Sharp, R. P.: Geology of the Wolf Creek area, St. Elias Range, Yukon Territory, Canada; Bull. Geol. Soc. Amer., vol. 54, pp. 625-650 (1943).

[5]Cairnes, D. D.: Explorations in Southwestern Yukon; Geol. Surv., Canada, Sum. Rept. 1914, pp. 13-25 (1915).

[6]Bostock, H. S.: op. cit., p. 42.

[7]Cairnes, D. D.: op. cit., pp. 32, 33.

[8]Bostock, H. S.: op. cit., p. 44.

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