DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

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GEOLOGY OF THE LITUYA DISTRICT, GULF OF ALASKA TERTIARY PROVINCE, ALASKA

By
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This map is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

EXPLANATORY NOTES

This map of the Lituya district is one of five maps at the same scale, showing the geology of the Gulf of Alaska Tertiary province (see index map). In this province, an arcuate belt more than 300 miles long and 2 to 40 miles wide, sedimentary rocks of Tertiary age are exposed or are inferred to underlie lowland areas covered by Quaternary unconsolidated deposits or ice (Miller, Payne, and Gryc, 1959, p. 37-47). Field studies were carried out in the province intermittently from 1944 to 1960, under the Geological Survey's program of petroleum investigations in southern Alaska.

Bedrock geology

The crystalline complex (Mzc) mapped along the northeast side of the Fairweather fault consists of bedded metamorphic rocks that strike generally parallel to the fault and dip steeply northeast. These rocks are described as amphibolite and chlorite schists at the head of Lituya Bay (Mertie, 1933, p. 125), and as mainly amphibole schist and biotite schist in the area between Lituya Bay and Palma Bay (D. L. Rossman, written communication, 1959). Fine-grained amphibole schist crops out at one locality examined on the ground at the southeast margin of the Alsek Glacier, 1 mile northeast of the Fairweather fault.

The volcanic unit (Mzv) in this district includes altered sedimentary and volcanic rocks previously described as the slate-greenstone group in the vicinity of Lituya Bay (Mertie, 1933, p. 126-127), and small bodies of intrusive igneous rocks. The bedded rocks consist mainly of dark-gray to black, locally slaty, argillite; and greenstones that are derived from flows, volcanic breccias, tuffs, and volcanic graywackes. Some of the greenstone may be intrusive. Crystalline limestone or dolomite, gray and white marble, calcareous schist, chert, and banded quartzite also occur in the bedded sequence. The bedded rocks are intensely deformed, and are intruded by dioritic and more felsic igneous rocks, mainly in small, tabular bodies. The largest intrusive mass, a stock of nearly white, medium- to coarse-grained granite which is differentiated on the map (Mzi), forms the northeastern part of Deception Hills and probably extends beneath Grand Plateau Glacier to the north end of the next ridge to the south.

The bedded rocks here included in the crystalline complex (Mzc) and the volcanic unit (Mzv) are believed to be of Mesozoic age, based on their similarity in lithologic character to bedded rocks exposed on strike to the southeast on Chichagof and Yakobi Islands (Kennedy and Walton, 1946, p. 69; D. L. Rossman, written communication, 1959). Rossman believes that the schists northeast of the Fairweather fault are the metamorphosed equivalents of the bedded rocks included in the volcanic unit southwest of the fault.

Bedded rocks of Tertiary age in the Lituya district are here provisionally divided into three formations. Formations A and B are believed to be at least partly equivalent in age, for the marine beds of formation A appear to grade into and interfinger with the predominantly or wholly nonmarine beds of formation B just south of Lituya Bay, and both formations are overlain with apparent conformity by the marine formation C. All three formations rest unconformably, at different places, on the volcanic unit of Mesozoic age. Sections of the Tertiary rocks have been measured and described on Cenotaph Island, on Topsy Creek, and at Icy Point (Miller, 1953).

Formation A is estimated to be about 1,200 feet thick and is about three-fourths siltstone and one-fourth sandstone in a well-exposed section along the upper part of Topsy Creek. At this locality formation A rests with angular contact on the volcanic unit, and is overlain accordantly by formation C. The siltstone is gray on fresh surfaces, weathers reddish brown, and contains lenticular concretions and thin, discontinuous beds of impure limestone. Most of the sandstone is fine- to medium-grained, and gray or greenish gray. Nearly 4,400 feet of interbedded siltstone and sandstone are assigned to formation A in a section measured at Icy Point. The base of the formation is not exposed at this locality.

Poorly preserved marine invertebrate fossils found in formation A between Topsy Creek and Lituya Bay are not more closely diagnostic of age than Tertiary, but a Miocene age seems likely from the apparently conformable relationship with overlying fossiliferous beds of formation C, of latest Miocene or earliest Pliocene age.

Formation B is best exposed on the south shore of Cenotaph Island, where it consists of at least 850 feet of green, red, and purple volcanic breccia and tuff, overlain by 400 feet of interbedded green and red tuffaceous siltstone, green sandstone, and green pebble-cobble conglomerate. The base of the formation is not exposed at this locality but a depositional contact with the underlying volcanic unit of Mesozoic age is tentatively mapped to the east, near the south shore of Lituya Bay. Lava flows, probably andesite, are present in the basal part of formation B just south of Lituya Bay, and in the lower part of the sequence assigned to this formation on Steelhead Creek. The green conglomerate and sandstone, containing lenses and thin, discontinuous beds of low-rank coal, are characteristic of the uppermost part of the formation B at all localities where it was seen in contact with formation C. A Miocene age for at least the upper part of formation B is inferred from its apparently conformable contact with formation C.

Most of formation C, including the base, is exposed in nearly continuous outcrops along the Crillon River and the lower part of Topsy Creek, and in reefs along the beach from near the mouth of the Crillon River northwest to the mouth of Steelhead Creek. The lower part, ranging in thickness from 600 feet to at least 2,400 feet, consists mainly of interbedded light olive-gray to dark-gray siltstone and light-gray to greenish-gray sandstone. In the upper part, at least 8,000 feet thick, gray to greenish-gray conglomeratic sandy mudstone is interbedded with the siltstone and sandstone. Angular depositional contacts of formation C with the underlying volcanic unit (Mzv) were seen at several places on the south margin of the outcrop area mapped south of the Fairweather Glacier. No outcrops were found near the inferred contact mapped between formation C and the volcanic unit northwest of the Fairweather Glacier, but faulting is suspected at this locality.

Formation C closely resembles the Yakataga formation in the type area (Miller, 1957), but the lithologically similar lower parts of the two formations are not equivalent in age. On the basis of his study of the marine invertebrate fossils, F. S. MacNeil of the U.S. Geological Survey believes that the basal part of formation C is either latest Miocene or earliest Pliocene and equivalent in age to about the middle part of the Yakataga formation, and that the highest part of formation C is younger than the highest part of the Yakataga formation, though still of Pliocene age.

Mineral resources

Little attention has been given to the petroleum possibilities of the Lituya district, due to the limited areal extent of rocks of Tertiary age and to the complex structure and steep dips in these rocks southeast of Lituya Bay. Federal oil and gas leases in effect at the end of 1960 covered the coastal area northwest of Fairweather Glacier. Reports of oil seeps and gas seeps in the vicinity of Lituya Bay and farther northwest have not been confirmed. An oil film and petroliferous odor was noted in sandstone near the top of Tertiary formation B, in an outcrop on Topsy Creek about a mile from the beach.

Gold has been mined sporadically from sand along the present beach near the mouth of Lituya Bay, mainly during the period from 1894 to 1917 (Mertie, 1933, p. 133-135). A small amount of platinum was recovered with the gold. The beach sands of this district also contain ilmenite (Rossman, 1957).

References cited

Kennedy, G. C., and Walton, M. S., Jr., 1946, Geology and associated mineral deposits of some ultrabasic bodies in southeastern Alaska: U.S. Geol. Survey Bull. 947-D, 65-84.

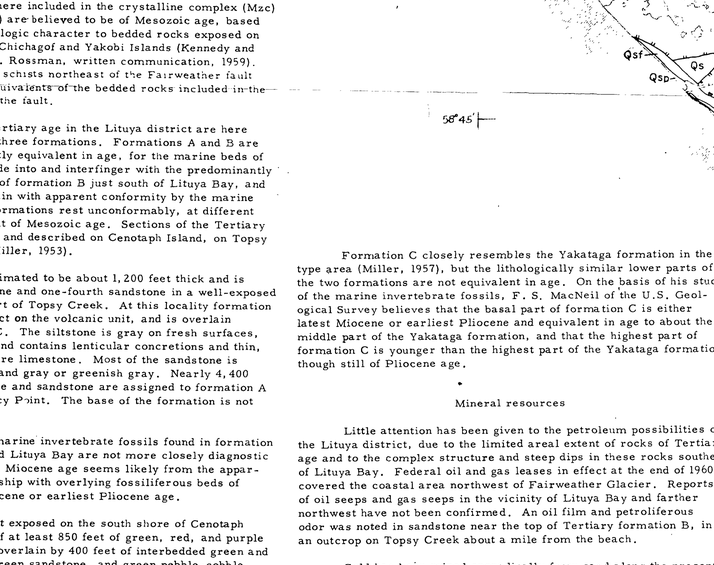
Mertie, J. B., Jr., 1933, Notes on the geography and geology of Lituya Bay, Alaska: U.S. Geol. Survey Bull. 836-B, p. 117-135.

Miller, D. J., 1953, Preliminary geologic map and correlated columnar sections of Tertiary rocks in the southeastern part of the Lituya district, Alaska: U.S. Geol. Survey open-file report.

_____, 1957, Geology of the southeastern part of the Robinson Mountains, Yakataga district, Alaska: U.S. Geol. Survey Oil and Gas Inv. Map OM-187.

Miller, D. J., Payne, T. G., and Gryc, George, 1959, Geology of possible petroleum provinces in Alaska: U.S. Geol. Survey Bull. 1094, 131 p.

Rossman, D. L., 1957, Ilmenite-bearing sands near Lituya Bay, Alaska: U.S. Geol. Survey open-file report.



EXPLANATION

UNCONSOLIDATED SEDIMENTARY DEPOSITS

The units listed below overlap in age and therefore are not arranged in stratigraphic order.

QUATERNARY — Recent

- **Qs** — Undifferentiated surficial deposits. Mainly glaciofluvial and fluvial gravel, sand, and mud. Includes lagoon and tidal-estuary deposits at present and former shorelines
- **Qg** — Glacial moraine deposits. Undifferentiated deposits of one or more glacial advances; mainly till, but includes lake and glaciofluvial deposits in places
- **Qsp / Qsf** — Marine shoreline deposits. Mainly sand; gravel or mud in places. Qsp, beach, beach-ridge, and dune deposits associated with present shoreline. Qsf, beach, beach-ridge, spit, and dune deposits associated with former shorelines

BEDROCKS

TERTIARY

Miocene (?) and Pliocene

Unconformity

- **Tc** — Formation C. Siltstone and sandstone interbedded with massive conglomeratic sandy mudstone (tillite) in upper part; mainly uniformly bedded siltstone and sandstone in lower part; marine

Miocene (?)

- **Tb** — Formation B. Bedded volcanic rocks, green sandstone and conglomerate, siltstone, and minor coal; nonmarine and marine(?)
- **Ta** — Formation A. Mainly siltstone, interbedded with sandstone; marine

Unconformity

MESOZOIC

- **Mzi** — Intrusive igneous rocks
- **Mzv** — Volcanic unit. Mainly interbedded flows, pyroclastic deposits, and volcanic graywacke, altered to greenstone; and argillite; small bodies of dioritic and more felsic intrusive igneous rocks
- **Mzc** — Crystalline complex. Mainly bedded amphibole and biotite schists

GEOLOGIC SYMBOLS

- Contact. Dashed where approximately located, dotted where concealed, queried where inferred
- Fault. Dashed where approximately located, dotted where concealed. U, upthrown side; D, downthrown side
- Anticline
- Syncline

Folds

Showing trace of axial plane of fold, dashed where approximately located

- Strike and dip of beds
- Strike and dip of beds, up side not known
- Strike and dip of overturned beds
- Strike of vertical beds (90 is on up side, where known)

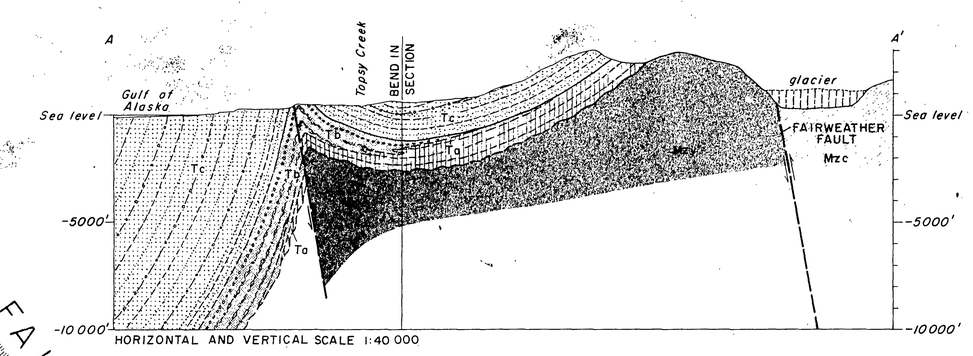
Attitude of beds

Dashed strike bar indicates attitude estimated from ground or aerial photographs or from distant views; query indicates bedding not definitely recognized

- M1035 — Fossil locality, showing Geological Survey reference number. Localities not shown in area of more detailed mapping from Lituya Bay to Palma Bay

GLACIERS AND LANDFORMS

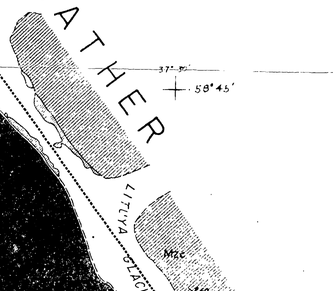
- Present margin of glacier or ice field
- Maximum stand of glaciers during youngest Recent advance; coincides with boundary of Qg deposit in places; dashed where approximately located. Projections are on side toward ice
- Maximum stand of glaciers during older Recent advance; dashed where approximately located, queried where inferred. Projections are on side toward ice
- Maximum stand of glaciers where definite evidence of only one Recent advance is recognized; coincides with boundary of Qg deposit in places; dashed where approximately located. Projections are on side toward ice
- Raised sea cliff. Line is at base of cliff and shows position of former marine shoreline, dashed where approximately located; coincides with boundary of bedrock formation or unconsolidated deposits in places. Figure shows approximate altitude of former marine shoreline
- Wave-cut bedrock surface overlain by thin or discontinuous unconsolidated deposits
- Relatively flat erosion surface on bedrock, overlain by thin or discontinuous unconsolidated deposits; origin uncertain. Figures show approximate altitude
- Ridge line



SECTION ALONG LINE A-A'

BASE MAP COMPILATION DIAGRAM

1. Preliminary copy of U.S. Geological Survey topographic map of Yakutat A-1 quadrangle. Mainly from aerial photographs taken in 1948, with revisions in coastal area and along Alsek River from photographs taken in 1958
2. Topographic map compiled by stereoplotting method from vertical aerial photographs taken in 1948. Shoreline of Lituya Bay revised from photographs taken in 1958
3. Planimetry by radial line and stereoplotting methods from aerial photographs taken in 1948
4. U.S. Geological Survey topographic map of Mt. Fairweather (1951) quadrangle, revised by projection method from aerial photographs taken in 1948



GEOLOGY COMPILATION DIAGRAM

1. Field mapping by D. J. Miller, D. L. Rossman, and George Plafker, 1952, 1953, and 1958, supplemented by photointerpretation
2. Field mapping by D. L. Rossman and others, 1952-1953
3. Field mapping and photointerpretation by D. J. Miller, 1960

Scale 1:96,000

1 0 1 2 3 4 5 6 7 miles

APPROXIMATE MEAN DECLINATION, 1961