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THE COAST MOUNTAINS PLUTONIC-METAMORPHIC COMPLEX AND RELATED ROCKS BETWEEN HAINES, ALASKA, AND FRASER, BRITISH COLUMBIA-- TECTONIC AND GEOLOGIC SKETCHES AND KLONDIKE HIGHWAY ROAD LOG

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INTRODUCTION

This guide is intended to cover four main topics pertaining to the region that includes the Skagway, Alaska, to Fraser, British Columbia, Klondike highway: (1) general tectonic setting; (2) general characteristics of the Coast Mountains plutonic-metamorphic complex (CMPMC); (3) road log with a description of the geology traversed and more specific information for selected stops; and (4) references for those interested in pursuing the details further. The guide covers not only the Klondike Highway, but also the area from Skagway south to Haines, Alaska. From here on, this whole area is referred to as the Skagway transect.

Figure 1 is a lithotectonic terrane map of southeastern Alaska and an index map showing the area covered by the geologic sketch map (Fig. 2). The Klondike Highway is in the eastern part of the Skagway transect and is also shown in figure 2. As noted above, we have also included a general description of the geology of the western part of the transect along Chilkoot and Taiya Inlets for those who may be traversing those waterways via ferry or other means.

It is important to understand that this transect across the CMPMC is seriously incomplete. This is not obvious from the important articles of Barker and others (1986) and Barker and Arth (1990). Almost all of the western metamorphic belt as defined by Brew and Ford (1984a) and elaborated on by Brew and others (1989), Himmelberg and others (1991), and Brew and others (1992b) is missing, together with the 95-Ma plutons of the Admiralty-Revillagigedo belt (Brew and Morrell, 1983; Brew and others, 1990) that typify the western metamorphic belt from Juneau south into British Columbia. This means that the transect provides information only on the three eastern zones, or belts, of the CMPMC; namely the central metamorphic, central granitic, and eastern metamorphic.

This limitation of the Skagway transect is important not only because of the way it truncates understanding of the general features of the CMPMC, but because the contact between the Intermontane and Insular superterranes (composite terranes I and II of Monger and others, 1982) may actually be somewhere in the missing western metamorphic belt rocks. This is discussed some below in the Tectonic Sketch. This limitation could also affect our eventual understanding of the boundary between the Stikine and Nisling terranes (Currie and Parrish, 1993; Brew and others, 1994), because that relation is under discussion, as is that of the Nisling to other rocks in the western metamorphic belt.

All geologic names used in this article for lithotectonic terranes, faults, suites, and plutons are informal.

TECTONIC SKETCH

Lithotectonic terranes exposed in the Skagway transect are: (1) Wrangellia and Alexander terrane; this unit actually consists of part of the Wrangellia terrane and the pre-Wrangellia part of the Alexander terrane; (2) Wrangellia *sensu stricto*; (3) Behm Canal structural zone; and (4) Nisling terrane. The following brief descriptions of these lithotectonic terranes (Fig. 1) are modified from Brew and others (1992b) and W.J. Nokleberg and others (manuscript in review). The other lithotectonic terranes to the west and to the east that are shown on figure 1 are described in those reports and in Brew and others (1991a). The four terranes in the transect are described from west to east. For each there is a (1) general description of the terrane as a whole, (2) some regional information, (3) some specifics for the transect, and (4) a note concerning the different names that have been applied to the terrane in this transect.

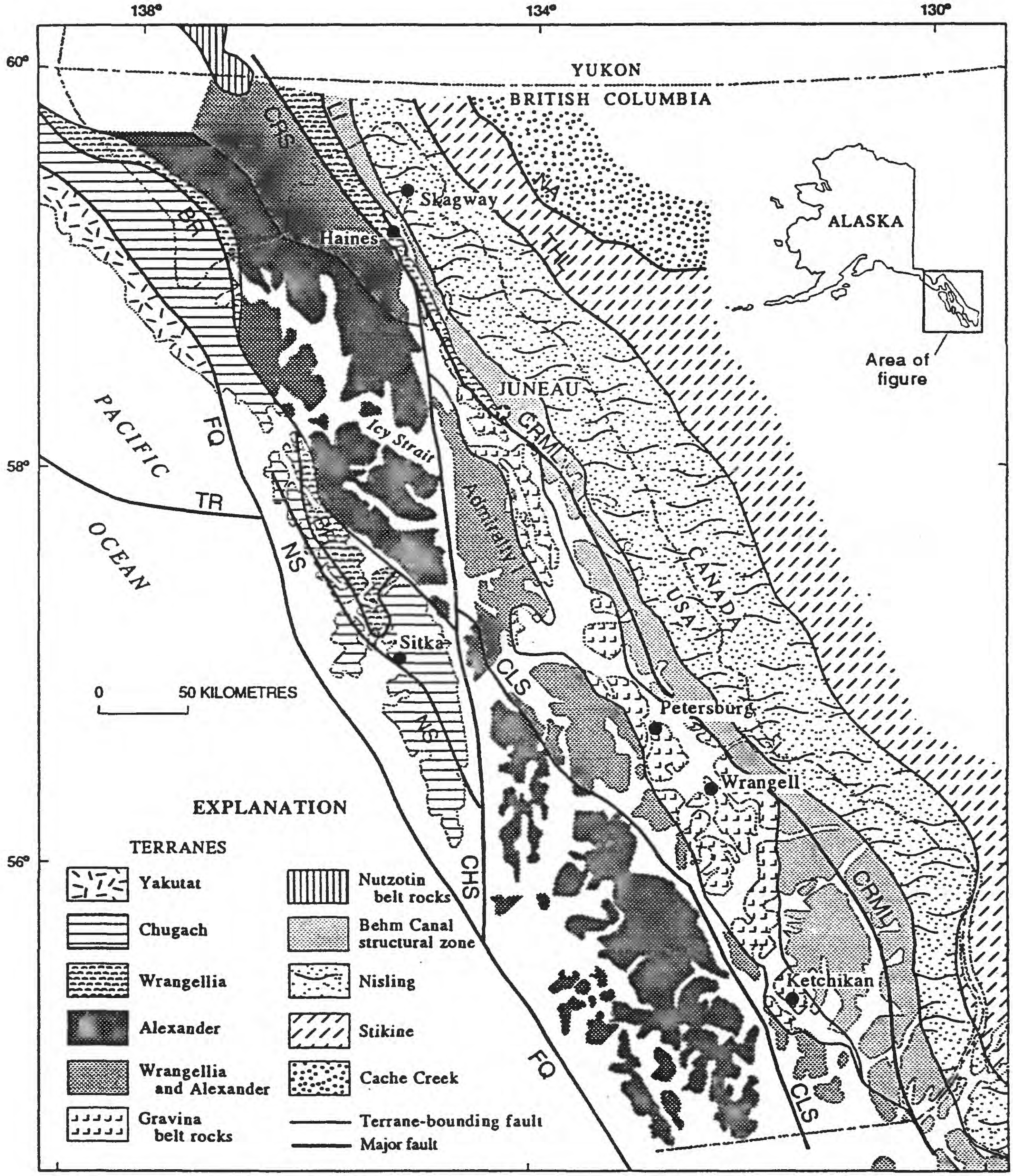


Figure 1. Map showing location of the Skagway transect (which is the area covered by figure 2) and lithotectonic terranes of southeastern Alaska. The latter adapted from Brew and others (1992a) and from D.A.Brew *in* Nokleberg and others (manuscript in review). Major faults are indicated by heavy lines and are labelled as follows: ***BR***, Border Ranges; ***CHS***, Chatham Strait; ***CRS***, Chilkat River; ***CLS***, Clarence Strait; ***CRML***, Coast Range megalineament; ***FQ***, Fairweather-Queen Charlotte; ***LI***, Lutak Inlet-Chilkoot River; ***NA***, Nahlin; ***NS***, Neva Strait; ***THL***, Tally Ho-Llewellyn; and ***TR***, Transitional. The ***CHS***, Chatham Strait; ***CRS***, Chilkat River; and ***LI***, Lutak Inlet-Chilkoot River faults are all part of the Denali fault system.

The reader may notice that there is no mention of the Taku terrane (Berg and others, 1978) in this article, except for noting where other workers have applied the term. This is because we believe that what has been called the Taku terrane by others consists of either coherent slices of other major terranes or of the intimate mixture of different terranes juxtaposed in what we call the Behm Canal structural zone.

Wrangellia Terrane and the Pre-Wrangellia Part of the Alexander terrane

Wrangellia and pre-Wrangellia Alexander terrane rocks are exposed in the southwesternmost part of the transect. In general, at this latitude the pre-Wrangellia part of the Alexander terrane *(sensu Berg and others, 1978)* consists of oceanic-island-arc Silurian or older through Pennsylvanian pelitic, semipelitic, and carbonate sedimentary rocks, some intermediate-composition metavolcanic rocks, and at least one Devonian granitoid (G.E. Gehrels, oral comm., 1990). The Wrangellia part of the Alexander terrane consists of a mixed volcanic and sedimentary section of Permian and Triassic(?) age. Lower(?) Jurassic chert and sandstone overlie Triassic(?) rocks locally in this section. These rocks are interpreted to be a facies of the type Wrangellia terrane. The Chilkat River fault (Fig. 1), which is a segment of the Denali fault system, is the contact between these Wrangellia and pre-Wrangellia Alexander terrane rocks to the southwest and the Wrangellia terrane to the northeast.

Wrangellia Terrane *sensu stricto*

Wrangellia terrane rocks are also exposed in the southwestern part of the transect near Haines (Plafker and others, 1989; Ford and Brew, 1993) (Figs. 1 and 2). Regionally, in most of southern Alaska and British Columbia, the basal part of the Wrangellia terrane consists of upper Paleozoic volcanic breccias, flows, and volcaniclastic rocks that are locally intruded by late Paleozoic granitic rocks of the Skolai arc. These are overlain by nonvolcanic Permian limestone, pelitic rocks, and chert that are in turn overlain by Ladinian black cherty argillite. These are succeeded by many thousands of meters of Upper Triassic subaerial to pillowed massive tholeiitic basalt with locally abundant gabbro dikes, sills, and small plutons that are in turn overlain by platformal and basinal Upper Triassic limestones that grade upward into basinal, spiculitic, argillaceous and calcareous rocks. Jurassic volcaniclastic rocks overlie these strata in northern south-central Alaska. Sub-greenschist- to low greenschist-metamorphic facies mineral assemblages are present. The terrane is overlain by the Gravina overlap assemblage and the post-amalgamation Wrangell Lava, and is intruded locally by extensive Late Jurassic and Early Cretaceous plutonic rocks.

Within the transect, the Wrangellia terrane consists almost entirely of subaerial massive amygdaloidal basalt. The basalt is overlain locally by discontinuous fossiliferous limestone and is underlain by a thin section of marine volcaniclastic rocks and chert. The age range represented is latest Carnian to late Norian. The basalts and the underlying rocks are lithologically equivalent to the "type" Wrangellia terrane and the pre-basalt part of the Wrangellia terrane, respectively, elsewhere in Alaska as described by Panuska (1990), Richards and others (1991), and Jones and others (1992). Brew and Ford (1993) followed these authors' lead and proposed a superplume origin for both facies of the Wrangellia terrane in southeastern Alaska.

The rocks of the Wrangellia were referred to the Taku terrane by Berg and others (1978), by Monger and Berg (1987), Wheeler and McFeely (1991), and Silberling and others (1992), but, as noted above, were recognized as belonging to the Wrangellia terrane prior to the article of Plafker and others (1989). Brew and others (1991a,b; 1992a,b) referred them to their combined Wrangellia and Alexander terranes.

In the transect, the rocks of the Wrangellia terrane are intruded by equant mid-Cretaceous ultramafic bodies (G.R. Himmelberg and R.A. Loney, manuscript in review) and by elongate Cretaceous granitic plutons (Redman and others, 1984). South and east of the transect, Wrangellia rocks are intruded by the latest Cretaceous and Paleocene plutons of the Great tonalite sill belt. In both localities, the Wrangellia rocks are included in unit MzPzsa of Brew and others (1991b).

Behm Canal Structural Zone

We are using the term "Behm Canal structural zone" in southeastern Alaska to denote the composite terrane consisting of large thrust slices composed of Gravina belt and of Alexander, Wrangellia, Stikine, and Nisling terrane rocks, the Alava sequence of Rubin and Saleeby (1991), part of the Kah Shakes sequence and a lower Paleozoic gneiss complex of Saleeby and Rubin (1990) and Rubin and Saleeby (1991). The structural juxtaposition occurred in the Late Cretaceous and the rocks were metamorphosed to greenschist- to amphibolite-facies mica schist, granitic orthogneiss, calc-silicate rocks, and minor marble and amphibolite in the Late Cretaceous and early Tertiary. This metamorphism obscured most original fault features, generally leaving only contrasing lithologic sequences as field evidence of the juxtaposition. Brew and others (1991a, 1992a) used the abbreviation "YAWG" for this structural unit, an acronym formed from the first letters of **Y**ukon prong, **A**lexander, **W**rangellia, and **G**ravina, the original terrane rock-units juxtaposed in the structural zone.

This zone is poorly exposed in and close to the Skagway transect. The rocks of the Behm Canal structural zone occur in only a small area in the western part of the transect, across the Chilkoot Inlet fault to the northeast of the Wrangellia rocks (Figs. 1 and 2). The western margin of the structural zone is exposed south and east of the transect; there it is a post-metamorphism high-angle-contractional fault that puts gneiss and schist against amygdaloidal basalt of the Wrangellia terrane. The schist and gneiss may be part of the Nisling terrane. The eastern margin of the zone is obscured by 50- to 60-Ma plutons that are referred to in this article as belonging to the informally named Skagway plutons suite.

In the transect, the rocks of the Behm Canal structural zone consist of migmatite, locally iron-stained pelitic schist and gneiss, and minor marble. They are intruded by the very elongate sill-like masses of latest Cretaceous foliated tonalitic rocks belonging to the Great tonalite sill belt (Brew, 1988; Gehrels and others, 1991; Hutton and Ingram, 1992) and by the stubby, but elongate, Paleocene to Eocene (Brew, 1988) Skagway plutons. Little, if any, evidence of the presumed west-directed pre-metamorphism contractional faulting that formed the zone is preserved.

If this zone does indeed contain rocks of all the different terranes listed above, then it contains at this latitude the westernmost remnants of the Nisling terrane. If the Nisling is considered to beequivalent to the lowest part of the Stikine terrane, then this zone marks the Insular-Intermontane superterrane boundary. If that is not the case, and the Nisling is considered a separate tectonic element, then the boundary lies to the east, as discussed below.

Nisling Terrane

Rocks of the Nisling terrane are exposed as the wallrocks of the intrusive rocks that dominate the Skagway traverse. The name "Nisling" is taken from Wheeler and McFeely (1991), who used the term "Nisling assemblage" for rocks on the east side of the Coast Mountains. Samson and others (1991) extended the terrane to the west through and across the Coast Mountains on the basis of Nd isotopic characteristics. Brew and others (1991a) used the term "Yukon prong" to describe the long and narrow extension in map view of these rocks southward from their northern counterpart, the Yukon-Tanana terrane (Mortenson and Jilson, 1985; Gehrels and others, 1990).

We use the term "Nisling terrane" here for the metamorphic rocks derived from Proterozoic and (or) lower Paleozoic depositional materials interpreted to have come from the western margin of ancestral North America. Prior to the latest Cretaceous to middle Tertiary plutonism and metamorphism in the Coast Mountains, the terrane consisted of locally metamorphosed (in pre-Late Triassic time) quartz-rich and pelitic sedimentary rocks, carbonate rocks, ultramafic rocks, and intermediate- to mafic volcanic rocks that were sparsely intruded by middle Paleozoic granitoid rocks. Rocks in the terrane are now metamorphosed to amphibolite-facies mica schist, granitic orthogneiss, amphibolite, quartzite, marble, and calc-silicate rocks.

In southeastern Alaska as a whole, the terrane includes the lower Paleozoic Kah Shakes sequence and the East Behm Canal Paleozoic gneiss complex of Saleeby and Rubin (1990) and Rubin and Saleeby (1991), as well as all or some of the various metamorphic-assemblage units along the west side of the Coast Mountains proposed by Samson and others (1991). These rocks of the Nisling terrane correspond geographically to part of the Tracy Arm terrane of Berg and others (1978); to part of the Taku terrane of Tipper and others (1981); to the batholithic rocks unit of Monger and Berg (1987), Wheeler and McFeely (1991), and Silberling and others (1992); and to the "undifferentiated metamorphic rocks and migmatite" of "...Alexander and Wrangellia terranes and Gravina overlap assemblage affinities" unit of Brew and others (1991b). In addition to these various names, this unit has also been called the Yukon crystalline terrane by Gehrels and others (1990), but this usage turned out to be confusing because no one knew whether the rocks of the Yukon-Tanana terrane in Yukon Territory and east-central Alaska or the rocks in southeastern Alaska were being referred to.

In the Coast Mountains outside of the transect, the Nisling terrane is recognized in the field by the association of quartz-rich schist and gneiss, pelitic schist, and thick discontinuous marble units, with only rare amphibolite units. Where the quartz-rich units are missing, the association could well be derived from rocks of the Alexander terrane (Brew and Ford, 1984b) and isotopic methods have been used to differentiate the Nisling terrane (Gehrels and others, 1990; Samson and others, 1991). As noted above, the schist and gneiss of the Behm Canal structural zone that are faulted against Wrangellia rocks south and east of the transect may belong to the Nisling terrane. The western boundary of the Nisling terrane was described in the above section, which noted the uncertainty about the relation of the Nisling and Stikine terranes and about the western margin of the Intermontane superterrane.

Within the Skagway transect, the Nisling terrane consists of highly deformed biotite-quartz-feldspar schist and gneiss, thick massive marble units, migmatite, and local quartz-rich schist and gneiss.

The Nisling terrane is probably intruded by the very elongate sill-like masses of latest Cretaceous foliated tonalitic rocks of the Great tonalite sill belt (Brew, 1988, Gehrels and others, 1991; Erdmer and Mortensen, 1993); is certainly intruded by the stubby, but elongate, Paleocene to Eocene tonalite to granodiorite bodies (Brew, 1988) that are referred to in this article as the Skagway plutons suite; and by at least two other subbelts of plutons of the Coast Mountains plutonic belt (Brew and Morrell, 1983; Brew, 1988). All of these plutons are described in more detail in the following sketch of the Coast Mountains plutonic-metamorphic complex.

If the Nisling and Stikine terranes are separate tectonic elements, then the eastern contact between the two terranes lies either within the Behm Canal structural zone (Rubin and Saleeby, 1991) or, at the latitude of the Skagway transect, somewhere near the International Boundary (Brew and others, 1985; Mihalynuk and Rouse, 1988a,b). The contact of the Nisling and Stikine terranes is not exposed along the Klondike Highway; if it is present, it is obscured by the many plutons. Currie and Parrish (1993) asserted that the contact is the Wann River shear zone of Middle Jurassic age on the east side of the Coast Mountains, but Brew and others (1994) pointed out that this cannot be because Stikine rocks are present in the Coast Mountains well to the west of the Currie and Parrish study area. Brew and others (1994) also support the hypothesis of many other workers (cited in Currie and Parrish (1993)) that the juxtaposition of the Nisling and Stikine terranes took place in pre-Early Triassic time.

Tectonic Evolution Questions

Monger (1993) has summarized the sequential interpretations of the tectonic evolution of the northern North American Cordillera and, in his figure 7, provided a synthesis of his current interpretations of the times of amalgamation and accretion of the major tectonic elements in the Cordillera. Three points from his figure 7 are worth discussing here as they pertain directly to the interpretation of the evolution of the rocks in the Skagway transect: (1) the tectonic affinity of the metamorphic country rocks of the Coast Mountains plutonic-metamorphic complex is bypassed completely and the area of the complex is left blank on the map; (2) the time of amalgamation of the Wrangellia and Alexander terranes is indicated to be Middle to Late Jurassic; and (3) the time of accretion of the Insular belt or superterrane to the Intermontane superterrane is indicated to be Early Cretaceous.

Regarding point (1): the presence of ancient crustal material of the Nisling terrane in the western Coast Mountains at the latitude of the transect as well as farther north (Erdmer and Mortensen, 1993) and south (Monger, 1993, figure 7a; Gehrels and others, 1990; Brew and others, 1991b; Samson and others, 1991) strongly suggests that most of the country rocks of the CMPMC belong to the Nisling terrane. The original relation or nonrelation of the Nisling terrane to the Stikine terrane thus becomes critical in interpreting the time of accretion of the Insular superterrane to the Intermontane superterrane; i. e., if the Nisling terrane is the substrate to even part of the Stikine terrane, then the western contact of the Nisling is the vestige of that accretionary event; if the Nisling terrane is separate from the Stikine terrane, then it has to treated as something other than either the Insular or Intermontane superterranes.

Regarding point (2): the article of Gardner and others (1988) demonstrates that the Alexander and Wrangellia terranes were amalgamated during or before Pennsylvanian time. Brew and Ford (1993) argued that they probably have always been together and that the "type' Wrangellia terrane and the Wrangellia-equivalent rocks in what was originally defined as part of the Alexander terrane by Berg and others (1978) are facies that resulted from the passage of a mantle superplume beneath the pre-Triassic Alexander rocks.

Regarding point (3): Rocks of the Gravina overlap assemblage overlie the Wrangellia and Alexander terranes just outside of the southwesternmost part of the transect and elsewhere along the eastern side of the Alexander terrane *(sensu Berg and others, 1978)* and are as young as early Late Cretaceous (Cenomanian). They were deformed in the collision of the Insular superterrane to the west with the Nisling terraneand other rocks to the east and that deformation preceded the latest Cretaceous regional metamorphism related to the emplacement of the Great tonalite sill belt plutons (Brew and others, 1989; Himmelberg and others, 1991); thus this accretion is probably middle Late Cretaceous in age. Again, if the Nisling terrane is separate from the Stikine terrane, then this contact has to be treated as something other than the Insular-Intermontane superterrane boundary.

Tectonic Evolution Summary

The four tectonic terranes or elements in the transect (Wrangellia and pre-Wrangellia Alexander terrane, Wrangellia terrane *sensu stricto*, Behm Canal structural zone, and Nisling terrane) are interpreted to relate to each other in the following ways, discussing them from west to east:

The Wrangellia and pre-Wrangellia Alexander terrane, which is exposed only in the southwest corner of the transect (Fig. 2), was amalgamated during or before Pennsylvanian time and probably has always been a single entity. This facies of the Wrangellia terrane differs from that of the type Wrangellia terrane in that more of it is a marine and (or) transitional facies that resulted from the passage of a mantle superplume beneath the preexisting rocks of the Alexander terrane. The preexisting rocks Alexander terrane rocks formed as an oceanic-island arc that evolved into a long-lived minicontinent.

The present contact between this terrane and Wrangellia *sensu stricto* terrane to the northeast is the Chilkat River segment of the Denali fault system which, at this latitude, was active from at least the middle Tertiary to almost the present-day and is inferred to have about 150 km of right-lateral separation. The original contact is inferred to have been a facies transition. The preaccretionary location of this terrane is uncertain, but it almost surely was situated somewhere south and west of its present position.

The rocks of the Wrangellia *sensu stricto* terrane, which are also exposed in the southwest corner of the transect (Fig. 2), are overlain nearby by the Gravina overlap assemblage and are offset about 40 km right-laterally by splays of the Denali fault system outside the transect. On the east side of the Denali fault, Wrangellia basalts are in high-angle, east-dipping, contractional, post-metamorphic fault contact with rocks that are interpreted to be the Nisling terrane. This fault is interpreted to be relatively young, probably late Tertiary in age, and probably related to uplift of the Coast Mountains and movement on the Denali fault system. The Nisling rocks are in the Behm Canal structural zone. The preaccretionary location of the Wrangellia terrane was like that described above.

The Behm Canal structural zone is poorly exposed in the Skagway transect, perhaps in part because of poor development and certainly because of abundant younger intrusive rocks within it. Farther south, it is interpreted to be comprised of the Alexander, Wrangellia, Nisling, and Stikine terranes and rocks of the Gravina overlap assemblage that were juxtaposed on east-dipping contractional faults during the middle Late Cretaceous collision of the Insular superterrane with the rocks to the east. Latest Cretaceous metamorphism and younger intrusive events have obscured the original features of the zone. The eastern margin of this zone is obscured by intrusive rocks, but is inferred to be with Nisling rocks. The Behm Canal structural zone developed adjacent to previously accreted terranes along North America somewhere south of its present position.

The original relation of the continental-margin assemblage rocks of the Nisling terrane to the volcanic-arc rocks of the Stikine terrane to the east is critical in interpreting the time of accretion of the Insular superterrane to the Intermontane superterrane. Either the present western contact of the Nisling terrane is the vestige of that accretionary event; or, if the Nisling terrane is separate from the Stikine, then the eastern contact is the important one. Several lines of reasoning (summarized in Currie and Parrish, 1993, and Brew and others, 1994) suggest strongly that some of the Triassic rocks of the Stikine terrane stratigraphically overlap the Nisling rocks, indicating either pre-Triassic accretion of the Nisling and Stikine terranes or that the two terranes are the same entity. The preaccretionary location of the Nisling and Stikine terranes are uncertain, but they almost surely were somewhere south and west of their present positions.

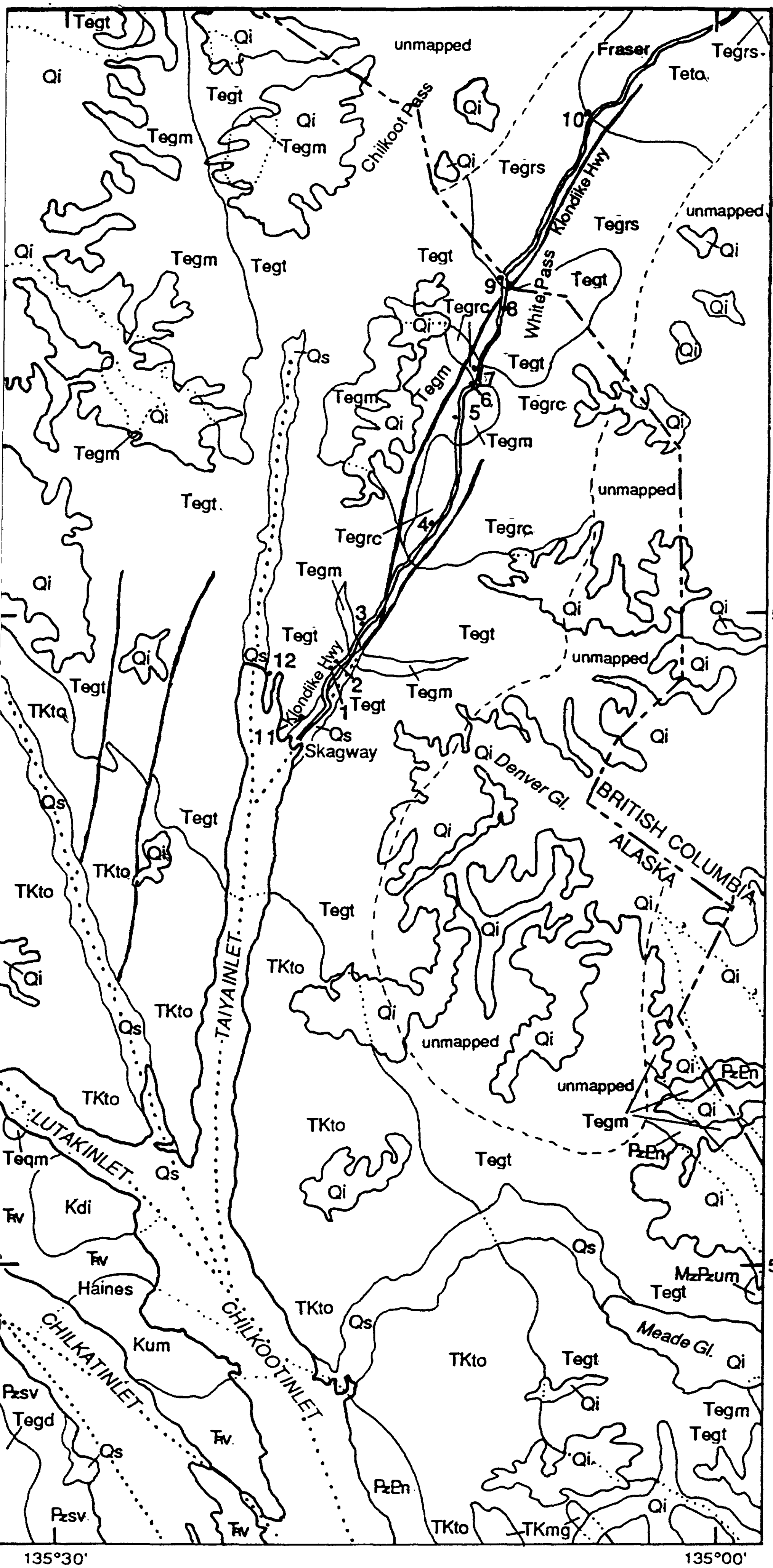
GEOLOGIC SKETCH OF THE COAST MOUNTAINS PLUTONIC-METAMORPHIC COMPLEX (CMPMC)

This sketch is tied closely to figure 2. However, it starts with a note on the nomenclature applied to the Coast Mountains plutonic-metamorphic complex (CMPMC) which can be ignored by the disinterested. It briefly describes the rocks to the west of the complex in the Haines area and then the complex itself. The description of the CMPMC itself is divided into two parts, the first covering the rocks south of Skagway that are accessible only by boat, and the second covering the rocks at and north of Skagway along the Klondike Highway. This second part will be most useful to users of the Road Log part of this article. Lithotectonic terranes (described above), major subdivisions of zones (Brew and Ford, 1984b), and plutonic belts (Brew and Morrell, 1983; Brew, 1988) are used as the framework for the descriptions. The major Chilkat River fault mentioned here are shown on figure 1.

A Note on Nomenclature

Different terms, including Coast Plutonic Complex, Coast plutonic-metamorphic complex, Coast crystalline belt, Coast Range batholithic complex, Coast Range batholith, Coast batholithic complex, Coast Range plutonic complex, Coast batholith, and Coast Mountain belt, have been and are being used by different workers for all or parts of what is essentially the same major geologic feature. That major feature is the 1750-km-long mass of plutonic and associated metamorphic rocks that extends from the Fraser River valley near Vancouver north-northwestward as far as Yukon Territory at the 141st meridian within the Coast Mountains physiographic unit. The feature includes both metamorphic rocks and plutonic rocks of different ages. Many of the plutons are of batholithic dimensions and most have been grouped into chronometric-modal-compositional belts. After dealing with the plentitude of terms for about 30 years, we have decided to here informally call this world-class geologic feature the Coast Mountains plutonic-metamorphic complex (CMPMC). We don't necessarily expect others to follow, but this note informs others of the problems involved and our reasoning.

Figure 2. [On facing page] Geologic sketch map of the Skagway traverse. Locations of described stops are indicated by heavy dots with leaders and sequential numbers. Geology adapted from Redman and others (1984); Barker and others (1986); Gilbert and others (1990); Brew and others (1991b); and D.A. Brew and A.B. Ford (unpub. mapping). Mapping by Christie (1957) is not included. Base map is from U.S.G.S. Skagway and Atlin 1:250,000 topographic series.



EXPLANATION

Qi	Glacier ice (Holocene)
Qs	Surficial deposits (Holocene and Pleistocene)
Teqm	Biotite quatrz monzonite near Lutak Inlet (Eocene or Oligocene) [Wrangellia terrane]
Tegd	Biotite-hornblende granodiorite of Mt. Emmerich pluton (Eocene or younger) [Alexander and Wrangellia terrane]
Tegrc	Biotite granite of Clifton pluton (Eocene) [Nisling terrane]
Tegrs	Biotite granodiorite of Summit Lake pluton (Eocene) [Nisling terrane]
Teto	Biotite tonalite of Fraser pluton (Eocene) [Nisling terrane]
Tegm	Gneiss and migmatite associated with Skagway plutonic suite (Eocene and Paleocene) [Nisling terrane]
Tegt	Biotite granodiorite and biotite tonalite of Burro Creek, Porcupine Creek, and Mount Cleveland plutons (Eocene and Paleocene) [Nisling terrane]
TKmg	Migmatite associated with Ferebee pluton (Paleocene? and Late Cretaceous) [Behm Canal structural zone]
TKto	Foliated biotite-hornblende tonalite and hornblende-biotite granodiorite of Ferebee pluton of Great tonalite sill belt (Paleocene? and Late Cretaceous) [Behm Canal structural zone]
Kgr	Biotite-hornblende granite of Log Cabin pluton (Late Cretaceous) [Nisling terrane] [Does not appear on this map]
Kdi	Hornblende diorite of Mt. Ripinski pluton (Cretaceous?) [Wrangellia terrane]
Kum	Undifferentiated ultramafic rocks (Cretaceous) [Wrangellia terrane]
TRv	Amygdaloidal basalt and related rocks (Late Triassic) [Wrangellia terrane]
MzPzum	Undifferentiated ultramafic rocks (Mesozoic and (or) Paleozoic) [Nisling terrane]
Pzsv	Sedimentary and volcanic rocks (Paleozoic) [Alexander and Wrangellia terrane]
PzPn	Gneiss and schist (Paleozoic and Proterozoic) [Nisling terrane]
⁀⁀⁀ . . .	Contact, dotted where concealed
━━ . . .	Fault or lineament, dotted where concealed

SCALE 1:250,000

15 Kilometres

This may strike many readers as a tempest in a teapot, but there are factors that should influence the nomenclature for this world-scale geologic entity. One is the set of accepted guidelines for naming geologic features (North American Commission on Stratigraphic Nomenclature (NACSN), 1983): the North American Stratigraphic Code prescribes that the term complex be "An assemblage or mixture of rocks of *two or more genetic classes*, i.e., igneous, sedimentary, or metamorphic,..." (NACSN, 1983, Article 37). Another factor is the realization that describing all of the several regional-scale plutonic-metamorphic complexes of southeastern Alaska (Brew and others, 1992b, 1993) requires some fairly careful choice of names and abbreviations. A third factor is that detailed study of specific areas and transects has resulted in identifying several individual batholiths within the whole feature.

As noted in the Introduction, Brew and Ford (1984a) divided what they called at the time the Coast plutonic-metamorphic complex into four zones; from west to east: (1) western metamorphic, (2) central metamorphic, (3) central granitic, and (4) eastern metamorphic zones. One of the main reasons for this was to establish the close linkage between the rocks of the western metamorphic zone and the other parts. We (Brew and Ford, 1978), as well as others, had tended to exclude those rocks from the rest of the complex, yet their origin and evolution is inextricably linked to the other parts.

Rocks West of the Coast Mountains Plutonic-Metamorphic Complex (CMPMC)

The rocks discussed in this section are those southwest of the Lutak Inlet-Chilkoot River fault (Fig. 1). Two fault blocks are present: one between the Lutak Inlet-Chilkoot River fault and the Chilkat River fault and one southwest of the latter fault (Figs. 1 and 2).

The block southwest of the Chilkat River fault shown on figures 1 and 2 consists of Silurian or older pelitic, semipelitic, and carbonate sedimentary rocks and some intermediate-composition volcanic rocks (Pzsv) that are intruded by biotite-hornblende granodiorite of the pluton centered at Mt. Emmerich (Tegd), which is just off of figure 2. Gilbert (1988) considers this pluton to be Cretaceous in age; based on our unpublished regional mapping in the area, we think it more likely that its age is at least in part Eocene or younger. Brew (1988) included it with the Glacier Bay region plutonic belt and any Cretaceous parts, if present, would probably belong to the Chilkat-Prince of Wales plutonic province of Sonnevil (1981) or to the Muir-Chichagof belt of Brew and Morrell (1983). Neither of these is considered part of the CMPMC.

The Chilkat River fault is the main local segment of the Denali fault system; the others noted above are less important splays. The Denali system is a right-lateral feature with about 150 km of displacement (summarized in Brew and others, 1991b, p. 849). A major unnamed splay cuts across the Chilkat Peninsula south of Haines and connects with the Lutak Inlet-Chilkoot Inlet fault (Fig. 1).

That major splay cuts through the Upper Triassic amygdaloidal basalts (Ŧv) that make up most of the Chilkat Peninsula. The basalts are intruded by mid-Cretaceous ultramafic rocks of the pluton at Haines (Kum), by Cretaceous(?) hornblende diorite of the pluton at Mt. Ripinski (Kdi), and by a small plug of Eocene(?) leucocratic quartz monzonite (Teqm) on the southwest side of Lutak Inlet. Available evidence suggests only minor separation on the Lutak Inlet-Chilkoot Inlet fault and the faults to its northeast (Redman and others, 1984).

The Coast Mountains Plutonic-Metamorphic Complex (CMPMC) South of Skagway

The CMPMC proper lies on the northeast side of the Lutak Inlet-Chilkoot Inlet fault. The rocks in the transect are described here from south to north along Taiya Inlet. There are only three major rock units exposed between that fault and the town of Skagway. The first consists of pelitic schist, gneiss, and migmatite of the Nisling(?) terrane that occur on the mainland shore south and east of Haines (Fig. 2, unit PzPn) and as screens within the Ferebee pluton of the Great tonalite sill belt. These screens are not shown on figure 2, mainly because none of the three investigators who have mapped the shorelines to date (Redman and others, 1984; Brew and Ford, unpublished mapping; Barker and others, 1986) agree on their extent.

The Ferebee pluton (Redman and others, 1984; unit TKto) is part of the Great tonalite sill belt (Brew, 1988; Gehrels and others, 1991; Hutton and Ingram, 1992). It consists of mostly foliated, medium-grained, locally lineated, color index about 12-25, hornblende-biotite granodiorite and sphene-biotite-hornblende tonalite. There are large areas of metamorphic rocks and migmatite within the Ferebee, but they are intentionally not shown on figure 2. The Ferebee pluton is in the central metamorphic belt of Brew and Ford (1984a). Brew (1988) summarized the then-available modal and chemical data. Barker and others (1986, sample AK-223) reported a ^{206}Pb-^{238}U age on zircon of about 68.2 Ma on a sample from the shore of Lutak Inlet and Gehrels and others (1991, sample 88GC275) reported a U-Pb concordia lower intercept age of 82.6±2.6 Ma and an upper intercept age of about 1130 Ma on a sample that from what our mapping indicates is a large xenolith northwest of the Barker and others (1986) sample. Gilbert and others (1990) reported several K-Ar ages from the pluton, all in the mid 50's; Barker and others (1986) reported K-Ar ages of 59.9 Ma on hornblende and 43.3 Ma on biotite. We interpret the K-Ar ages to have been reset, in part by the younger plutons of the adjacent Skagway plutonic suite and locally in young shear zones.

The pluton which intrudes the north side of the Ferebee pluton was referred to by Redman and others (1984) as the Burro Creek pluton. This pluton is the same one that is exposed at Skagway, and we refer to it in both places as the Burro Creek pluton. It and other plutons to the north are included in the Skagway plutons suite, as discussed below.

The informally named "Skagway plutons suite" (unit Tegt) as defined here and in the following section are similar to, but not quite the same as, the tonalite of Skagway of Barker and others (1986). Those authors defined their unit on a chemical, mineralogical, and textural basis and applied that term to several rock bodies which we interpret on the basis of preliminary field mapping to be separate plutons. They also excluded two plutons which we include in our suite. Further mapping and sampling are needed to fully define the situation. The U-Pb age reported by Barker and others (1986) for their tonalite of Skagway is actually from the pluton at Fraser, B.C. and is discussed later in this article. The Skagway plutons suite occurs in the central granitic belt of Brew and Ford (1984a) and the Coast Mountains belt of Brew and Morrell (1983).

The Burro Creek pluton south of Skagway consists of generally massive, but locally foliated, medium- to coarse-grained, color index about 15, biotite granodiorite and (or) tonalite, and quartz monzonite (Redman and others, 1984). Euhedral biotite books as large as 6 mm occur locally. Brew (1988) included this pluton with the Juneau-Skagway area Paleocene plutonic belt and summarized the then-available modal and chemical data.

The Coast Mountains Plutonic-Metamorphic Complex (CMPMC) At and North of Skagway

The CMPMC at and north of Skagway consists of two suites of plutons and of locally intervening screens of metamorphic and migmatitic rocks. One suite is the already-mentioned Skagway plutons suite of early Eocene age and the second is of the White Pass plutons suite of middle Eocene age. To the south-southeast of Skagway, but in this same general belt of plutons, are schist and gneiss of the Nisling terrane, Triassic volcanic rocks (Stuhini Group(?)) of the Stikine terrane (Brew and others, 1985, 1994), and alpine-type ultramafic rocks (Himmelberg and others, 1985; Brew and others, 1994). To the north of Skagway are large areas mapped by Gilbert and others (1990) as gneiss and migmatite; these are shown as gneiss and migmatite (Tegm)on figure 2 , but our unpublished reconnaissance mapping indicates that much of the outcrop area consists of pelitic schist and gneiss and massive marble that are probably part of the Nisling terrane. In addition to these major units, there are numerous basalt and andesite(?) dikes that are near-vertical, 0.2- to 2.0-m wide, and generally strike about 025; They are undated in the transect, but are probably about 25 Ma in age, based on their lithologic similarity to dikes elsewhere in the CMPMC. All of this part of the transect is in the central granitic zone of Brew and Ford (1984a). The rocks in the transect are described here from south to north along the Klondike Highway.

The Skagway plutons suite at and north of Skagway includes the (all informally named) Burro Creek pluton, which is exposed at Skagway; the Porcupine Creek pluton, exposed on both sides of that creek where it crosses the Klondike Highway; the Mount Cleveland pluton, exposed at that place; and the Fraser (tonalite) pluton, at that locality. Gilbert and others (1990) reported several K-Ar ages from the Skagway plutons suite, all in the mid 50's. Unpublished zircon ages from the same belt southeast of Skagway are also in the mid 50's (G.R. Tilton, written comm., 1986).

The White Pass plutons suite crops out north of Skagway and includes the Clifton pluton, exposed at that locality; and the Summit Lake pluton, exposed at that locality. As described below, these plutons may be phases of a single larger body.

The Burro Creek pluton is part of the Skagway plutons suite (Tegt) and is well exposed at Skagway and on the road up Taiya Inlet to Dyea townsite. It consists mainly of locally well jointed, but otherwise massive, medium- to coarse-grained, color index about 15, hornblende-biotite tonalite and (or) granodiorite (Brew, 1988, Fig. 14). Euhedral biotite books to 3 mm are common and euhedral hornblende to 3 mm occurs locally. Small screens and 10-cm-size inclusions of metamorphic rock appear to be most common near the margins of the body. The only available age information for this pluton is that described previously for its exposures south of Skagway. Road Log Stops 1, 2, 11, and 12 are in this unit (Fig. 2). Callahan and Wayland (1965) described a part of this pluton near Dyea. A screen of migmatite consisting of pelitic and semipelitic schist cut by Burro Creek-affinity dikes separates the Burro Creek pluton from the Porcupine Creek pluton (Fig. 2).

The Porcupine Creek pluton is also part of the Skagway plutons suite; it was described by Barker and others (1986) as a nonmigmatitic orthogneiss unit. Our mapping indicates that this pluton consists of well-foliated, medium- to coarse-grained, color index about 15, sphene-biotite-hornblende tonalite. Gehrels and others (1990, sample 84GC08; 1991) referred to it as the tonalite northeast of Skagway and reported a lower intercept age of 58.6±0.9 Ma and an upper intercept age of about 1790 Ma from a 9-fraction zircon sample. Road Log Stop 3 is in this unit (Fig. 2).

The Clifton pluton is part of the White Pass plutons suite (Tegrc) and is made up of pink to light brown, coarse- to fine-grained, color index 5-8, K-spar porphyritic (max. 1.2 cm), biotite granite. Flat-lying joints are locally prominent. Barker and others (1986) reported concordant zircon U-Pb ages of about 48 Ma for sample AK-208 (which actually is not located on their map but it is inferred to be from this pluton) and Gehrels and others (1991, sample 84GC05) reported a concordant 3-fraction zircon concordant U-Pb age of 48.8±1.0 Ma for this pluton. Road Log Stop 4 is in this unit (Fig. 2).

A wide zone of complicated 5- or 6-phase migmatite (Tegm) interrupts the Clifton pluton from below the spectacular Moore Creek suspension bridge (at mile 11.0) to just above it. Granite dikes from the Clifton pluton are the youngest phase and biotite-plagioclase-hornblende amphibolite of the Nisling(?) terrane is the oldest. Road Log Stops 5 and 6 are in this migmatite unit (Fig. 2).

The highway enters the informally named Mount Cleveland pluton of the Skagway plutons suite (Tegt) after another mile or so of the Clifton pluton (Road Log Stop 7 is in these Clifton exposures (Fig. 2). This may or may not eventually map out to be the Burro Creek pluton that is exposed at Skagway; our mapping in the Coast Mountains to the south-southeast of the Skagway transect suggests that this particular rock type occurs in relatively small individual bodies adjacent to each other. The rocks of the Mount Cleveland pluton are medium- to coarse-grained, color index 18, biotite-hornblende tonalite that is noticeably grayer than the Burro Creek pluton at Skagway. Barker and others (1986, sample AK-206,) reported a highly discordant, single-fraction, ^{206}Pb-^{238}U age of 61.7 Ma from this pluton and K-Ar ages of 54.7 Ma for hornblende and 49.4 Ma for biotite, apparently from the same locality. Road Log Stop 8 is in this unit (Fig. 2).

The Mount Cleveland pluton is intruded by the Summit Lake (granite) pluton (Tegrs) of the White Pass plutons suite a few 10's of m west of the International Boundary marker on the Klondike Highway. The Summit Lake pluton is coarse-grained, brownish gray, color index 6, K-spar porphyritic (max. 1.0 cm), biotite granite that closely resembles that of the Clifton pluton. Barker and others (1986, sample AK-207) reported a 53.1 Ma ^{206}Pb-^{238}U age on zircon from the Summit Lake body, however, which is significantly different than the 48 Ma age of the Clifton pluton; and it is therefore shown as a separate pluton. No contact has yet been mapped between the Clifton and Summit Lake bodies. Road Log Stop 9 is in this unit (Fig. 2).

The Summit Lake pluton has a somewhat messy intrusive contact with the Fraser pluton (Teto) of the Skagway plutons suite, with abundant dikes of Summit Lake aplite and rhyolite into the margin of the Fraser pluton. Road Log Stop 10 is at this contact (Fig. 2). The Fraser sample cited by Barker and others (1986, table 1, AK-212) is a color index 16, hornblende-biotite tonalite. Barker and others (1986) reported a slightly discordant, single-fraction, ^{206}Pb-^{238}U age of 53.6 Ma on zircon from that sample.

The central granitic zone of the CMPMC continues on beyond the community of Fraser almost to Tutshi Lake. According to Barker and others (1986), the Fraser pluton is surrounded by the Summit Lake pluton, which intrudes the Log Cabin granite body near where the Klondike Highway crosses the White Pass Railroad (these last two localities are off of figure 2). Mihalynuk (1993) does not differentiate the Summit Pass pluton from the Log Cabin pluton here and considers the Log Cabin to extend all the way to the Fraser pluton.

The Log Cabin pluton (Kgr) is reported by Barker and others (1986) to consist of locally foliated, pinkish-gray, medium- to coarse-grained, color index 2 to 15, K-spar porphyritic (max. 5 cm) biotite-hornblende granite. They reported a slightly discordant, single-fraction, ^{206}Pb-^{238}U age of 72.4 Ma on zircon. In the field the rocks of this pluton closely resemble those of the Tertiary White Pass plutons suite described above.

Barker and Arth (1990, p. 399) consider the Log Cabin pluton to be only a coincidental part of the CMPMC, relating it instead to the Surprise Lake-type plutons in the Stikine terrane to the southeast, which are of similar age and composition. The rocks of the Stikine terrane are interpreted to be intruded by the Log Cabin pluton near Tutshi Lake (Barker and others, 1986; Mihalynuk and Rouse, 1988b; Mihalynuk, 1994).

Given the accepted interpretation that all of the tectonic elements in and around the CMPMC were assembled by 72 Ma, then the relation between the Log Cabin pluton and the plutons of about the same age and younger to its west probably is not coincidence. Essentially, what the Log Cabin pluton is telling us is that a static, relatively high-structural-level environment existed on the east side of what is now the CMPMC only a few m.y. before the Great tonalite sill belt plutons were being emplaced in a contractional, high P and T, long, narrow, high-angle, reverse shear zone on the west side (Brew, 1988; Brew and others, 1989; Himmelberg and others, 1991; Gehrels and others, 1991; Hutton and Ingram, 1992). The origin of the Log Cabin pluton may be unrelated to that of the other plutons in the CMPMC, but the nearly coeval emplacement of Great tonalite sill belt rocks and Log Cabin granite in strongly contrasting, but geographically close, environments requires explanation of the sources of both intrusive types and of the character of the intervening rocks.

Coast Mountains Plutonic-Metamorphic Complex (CMPMC) Evolution

Barker and others (1986) and Barker and Arth (1990) considered the modal, chemical, isotopic, and geochronologic features of the Skagway transect rocks in relation to available information concerning the local geology and concluded that: (1) the plutons are syn- to post-accretionary and coeval with subduction; (2) the plutons as a whole are emplaced in tectonically thickened oceanic rocks of the Alexander and Stikine terranes; (3) cratonic rocks were absent during emplacement; (4) the plutons belong to three episodically emplaced (68?-, 54,- and 52 to 48-Ma) units or suites; and (5) the major-chemical and isotopic data indicate that most plutons formed by the fractionation of subduction-related high-Al tholeiite mixed with melts from metamorphosed mafic to siliceous igneous rocks and flysch of Paleozoic to Mesozoic age; and smaller high-SiO_2 granite bodies may represent melt derived from flysch or siliceous igneous rocks. These interpretations may conceivably be modified based on data from new mapping and sampling.

On a regional, rather than a local, scale, there are significant unresolved questions regarding the origin of the intrusive rocks in the Skagway transect. One question concerns the previously noted relation of the homogeneous and statically emplaced Late Cretaceous Log Cabin (granite) pluton to the nearly coeval foliated and dynamically emplaced Ferebee (tonalite) pluton of the Great tonalite sill belt. The latter is only 45 km to the southwest across an intervening area that probably underwent extension during the emplacement of the Eocene plutons; the Log Cabin and the Ferebee plutons may have been significantly closer together at the time of their emplacement.

Another question concerns the driving mechanism for, and the homogeneous products of, the Eocene plutonism of the very lengthy Coast Mountains plutonic belt. Brew (1988, figure 24) implied that the nearly coeval Eocene granitic bodies of the Fairweather-Baranof belt and of the Coast Mountains plutonic belt were both related to the final stages of juxtaposition and collapse of eastward-driven lithotectonic terranes. The Fairweather-Baranof belt arose from the Chugach terrane collapsing against the oceanward side of the Alexander terrane and adjacent Wrangellia terrane and the Coast Mountains belt from the collision and collapse of the Gravina overlap assemblage between the Alexander terrane and the terranes to its east. These two collisions and collapses were in response to nearly orthogonal subduction of a Pacific plate, but the dimensions of that plate, together with the variations in the country rocks that had to have been traversed by the Eocene plutons during their emplacement, argue for more compositional variation than is apparent in the Coast Mountains belt (Brew, 1988).

A third question concerns the emplacement environment and the original extent of the bodies of the early Eocene Skagway plutons suite and their effect on the younger intrusions that were emplaced in and through them. In the transect, the Skagway plutons suite rocks underlie most of the Coast Mountains. In the Juneau Icefield area (Brew and Ford, 1986) remnants of similar plutons occur within the Eocene Turner Lake batholith all the way to the International Boundary. It appears that the Skagway-plutons-suite-type plutons were originally of much greater extent. Their great apparent original volume suggests emplacement during major tectonic extension almost immediately following the contractional emplacement of the Great tonalite sill belt plutons a few m.y. earlier.

Many gold rush-era buildings still stand within the Skagway Historic District. The following are some of the more prominent ones. Their locations are keyed, by number, to the map. The date of construction follows the building's name.

1 White Pass and Yukon Route Railroad Depot (1898). Serves as the park visitor center.
2 White Pass and Yukon Route Railroad General Offices (1900).
3 Martin Itjen House (1901).
4 Arctic Brotherhood Hall (1899).
5 Verbauwhede Confectionary (1899).
6 Boas Tailor & Furrier (1899).
7 Pacific Clipper Line Office (1898).
8 Mascot Saloon (1898).
9 Lynch & Kennedy Dry Goods Store (1908).
10 Pantheon Saloon (1903).
11 J. Bernard Moore House (1897).
12 Captain William Moore Cabin (1887).
13 Boss Bakery (1897).
14 Goldberg Cigar Store (1897).
15 Peniel Mission (1900).
16 City Hall and Museum (1899).
17 Golden North Hotel (1908).
18 Trail Inn & Pack Train Saloon (1908).
19 Pullen House (1901).
20 Jeff Smith's Parlor (1897).
21 Kirmse Jewelry Store (1904).

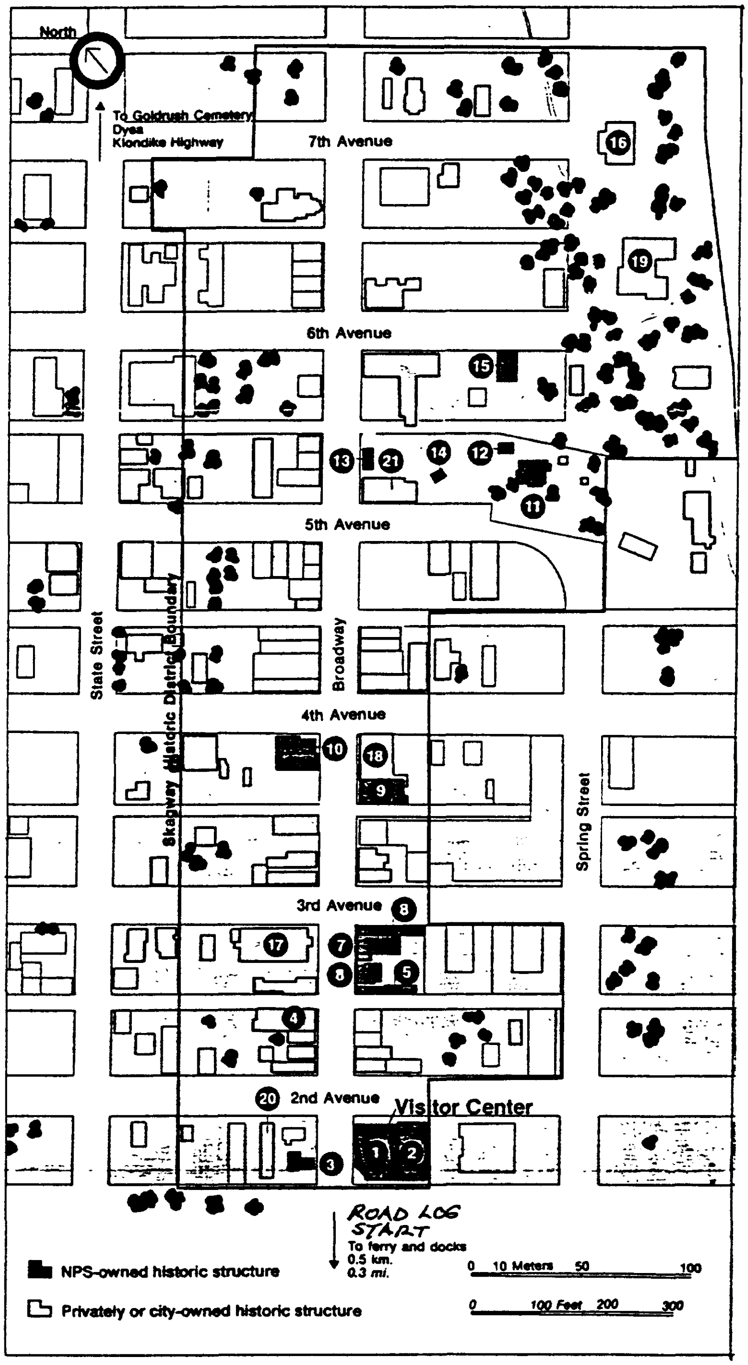


Figure 3. Downtown Skagway street map, showing major points of interest and western starting point for the road log. From U.S. National Park Service, National Historical Park, Skagway, Alaska, map.

ROAD LOG: SKAGWAY, ALASKA, USA, TO FRASER, BRITISH COLUMBIA, CANADA

General

Before starting your trip, take an hour and seek out the Skagway National Historical Park Visitors Center and the adjacent museum. They are located near the railroad terminal downtown, not far from the road log western starting point at the ferry terminal.

Better yet, take two or three hours and wander around Skagway. Pick up a copy of the Skagway Walking Tour brochure, see the sights, read the historical placards, admire the restored buildings. Remember, there has never been a scene quite like that at Skagway and Dyea in 1898, and this is the time to get a flavor of it. Admittedly, things have changed a lot, and the town's winter population of 500 or so swells to over 2,000 during the summer as shopkeepers, motel employees, and others migrate north to serve the ever increasing numbers of tourists and sightseers (including you). Figure 3 is a copy of the local street map with the main points of interest indicated.

If you are interested in the local engineering geology, look up the report by Yehle and Lemke (1972).

Road Log

The format used is as follows. The first two columns are the interval and cumulative mileages starting at Skagway and ending at Fraser, B.C. The final two columns are the same, but starting at Fraser and ending in Skagway. The middle column describes the feature(s) to be noted. If the trip is from Fraser to Skagway, then read left for right and *vice yersa* in all descriptions. Those features warranting a stop are indicated with bold Stop Numbers in this column. Stops are shown with their number and a dot on figure 2. The best stops are identified in the stops' descriptions with an asterisk. At the end of the Road Log section is the log for a side trip from Skagway up Taiya Inlet to Dyea townsite and the western end of the Chilkoot Trail. Latitudes and longitudes given in square brackets at the ends of some descriptions are GPS determinations and are in degrees and decimal minutes. Foliation and other structural attitudes are recorded using the dip-to-the-right method.

The historical exhibits and many of the outcrops noted in the log cannot be seen during winter months; the former because they are [probably] removed and the latter because of snow cover.

PLEASE WATCH FOR, AND BE CAREFUL AND CONSIDERATE OF, HIGHWAY TRAFFIC!

Inter-val miles	Cum. from SKG	Description of geologic and other features	Inter-val miles	Cum. from Fraser
0.0	0.0	Start of Road Log, just outside of gate to Alaska Marine Highway terminal, Skagway, Alaska. North is straight ahead up the valley. South is down Taiya Inlet. To the east are signs and graffiti painted on cliffs of the Burro Creek pluton by cruise ships' crews and others. To the west are the ore concentrate sheds that from about 1970 to this April 1993 held zinc concentrates trucked down the Klondike Highway from the Anvil mines in Yukon Territory. [59°27.040', 135°19.328'] From here go north on Broadway, turn left on 11th Avenue, right on State Street, left on 23rd Avenue.	1.5	22.3
1.5	1.5	On the right are the White Pass Railroad car barns.	0.1	20.8
0.1	1.6	On the right is the road to the Gold Rush Cemetery.	0.05	20.7
0.05	1.65	Cross the Skagway River and turn right on Klondike Highway. The tank farm on the left is from World War II times.	0.75	20.65
0.75	2.4	Intersection with Dyea road on left. Road log for the Dyea side trip is at end of main road log.	0.3	19.9

Inter-val miles	Cum. from SKG	Description of geologic and other features--Continued	Inter-val miles	Cum. from Fraser
0.3	2.7	**STOP 1:** State of Alaska Highway Maintenance Station; room to park on right side of road across from it. The cuts behind the station and in an old, small quarry 50 m south are in weathered Burro Creek pluton of the Skagway plutons suite (Tegt). The rock is light gray, coarse-grained, unfoliated, C.I. 12-15, hornblende-biotite tonalite or granodiorite. Biotite is in conspicuous books. Crosscutting dikes of medium green very fine-grained plagioclase porpyhritic microdiorite are present. There are few inclusions here, but they are common not far to the north towards the migmatite screen. [59°28.859', 135° 17.492']	0.3	19.6
0.3	3.0	**STOP 2:** Road leaves alluvium of Skagway River valley; room to park on right side of road near abandoned historical marker. Outcrops are the Burro Creek pluton (Tegt); here heterogeneous, fine- to coarse-grained, C.I. 18, hornblende-biotite granodiorite with abundant inclusions (to 10x15 cm) of fine-grained biotite granofels. [59°29.008', 135°17.105']	0.1	19.3
0.1	3.1	Road Gate. Just ahead is the contact of the Burro Creek pluton with the migmatite screen rocks (Tegm): meter-size biotite schist and gneiss inclusions in well jointed, foliated biotite tonalite and dikes of C.I. 03 biotite granite-aplite.	0.7	19.2
0.7	3.8	Eastern contact of gneiss and migmatite (Tegm) screen rocks.	0.2	18.5
0.2	4.0	4-mile marker.	1.0	18.3
1.0	5.0	**STOP 3*:** 5-mile marker; room to park on right side. View to east is up the East Fork of the Skagway River; Porcupine Creek fault/lineament is below us; White Pass Railroad visible below; on far side of river: Twin Dewey Peaks to SE are 5,645±'; ridge to NE is Clifton (granite) pluton up to about 4,500'. Stop is in the Porcupine Creek pluton of the Skagway plutons suite (Tegt); the rock is well foliated, medium- to coarse-grained, C.I. 15±, sphene-biotite-hornblende tonalite; some ratio layering and aligned inclusions define the foliation; both aligned and nonaligned inclusions are fine-grained, C.I. 70, hornblende meladiorite and are up to 1 m long. This is probably the location of Gehrels and others (1990) sample 84GC08 that gave a zircon lower intercept concordia age of 58.6±0.9 Ma. [59°30.412', 135°15.371']	0.9	17.3
0.6	5.6	Historical exhibit on right: (1) Trail of '97, (2) Brackett Road, and (3) White Pass and Yukon Railroad.	0.3	16.7
0.3	5.9	Porcupine Creek and fault/lineament crossing. Same rock of Porcupine Creek pluton on both sides; some large inclusions just S of bridge.	0.1	16.4
0.1	6.0	6-mile marker.	0.1	16.3
0.1	6.1	**Old U.S Customs station**; new station is under construction at about cumulative mileage 6.7.	0.1	16.2
0.1	6.2	Contact of Porcupine Creek pluton to S with Clifton pluton of the White Pass plutons suite to N is marked by reticulate granite dike network in a dark screen.	0.8	16.1
0.8	7.0	7-mile marker.	0.5	15.3

Inter-val miles	Cum. from SKG	Description of geologic and other features--Continued	Inter-val miles	Cum. from Fraser
0.5	7.5	**STOP 4***: Big pullout on right side. View to E across Skagway River valley is of Pitchfork Falls. (The next pullout has a better view of the falls and also a 3-m-wide basalt dike, but the granite is less varied.) Rock at stop is Clifton (granite) pluton (Tegrc), here somewhat weathered light brown to pinkish, fine- to very-fine-grained, C.I. 04-10, biotite granite; local aplitic and K-spar porphyritic (max. 1 cm) phases. Some biotite haloes on older(?) quartz(?) grains. Prominent flat-lying joints locally. This is probably the location of Gehrels and others (1991) sample 84GC05 that gave a zircon age of 48.8±1.0 Ma. Barker and others (1986) zircon age for the Clifton pluton is 48±2. [59°32.070', 135°12.909']	0.5	14.8
0.5	8.0	8-mile marker.	0.2	14.3
0.2	8.2	Road gate.	0.8	14.1
0.8	9.0	9-mile marker.	0.1	13.3
0.1	9.1	Historical exhibit on right: (1) Gold and White Pass, (2) White Pass City, and (3) Deadhorse Gulch. Avalanche sign just ahead.	0.4	13.2
0.4	9.5	Swirly contact of Clifton pluton (Tegrc) to S with heterogeneous migmatite (Tegm) to N; attitude is about 091/78. There are some rafts of migmatite in the Clifton near the contact.	0.3	12.8
0.3	9.8	**STOP 5:** Hard to find a good place to park here--this stop is at the runaway-truck ramp on the left side, which is not recommended, and the whole stretch here is in a Winter-Spring avalanche zone. Migmatite (Tegm) is 5-phase, from youngest to oldest: (5) 1- to 2-cm thick vertical± dikes of Clifton (granite) pluton; (4) lensy biotite-hornblende granodiorite dikes 0.5- to 10-cm thick of the Skagway plutons suite that form angular agmatite with units (1) and (2); (3) foliated, C.I. 40 hornblende tonalite; (2) foliated, C.I. 70 biotite-plagioclase-hornblende amphibolite; and (1) dense, unfoliated amphibolite. Units (2) and (1) are interpreted to be Nisling terrane affinity, but could be Stikine terrane. Very generalized attitude is 211/42. [59°34.085', 135°12.048'] At this point the highway leaves the Skagway River valley and veers to the W to follow the trace of the Porcupine Creek fault/lineament. Views to the S of the White Pass Railroad and of unnamed peaks.	1.1	12.5
1.1	10.9	50-m wide fine-grained tonalite(?) dike in migmatite.	0.1	11.4
0.1	11.0	Moore Creek suspension bridge; one of about a dozen of this cantilever design in the world.	0.5	11.3
0.5	11.5	**STOP 6*:** Wide pullout on right with a good view of the bridge. Roadcrops on other side are of migmatite (Tegm), here somewhat different than those at Stop 5 because phases (1) and (2) are not present. However, there are two youngest-of-all near-vertical dikes as an additional phase: one a plagioclase-porphyritic andesite about 0.3-m wide and the other an amygdaloidal basalt about 0.5m wide; both strike about 020 to 036.	0.1	10.8
0.1	11.6	Contact of migmatite (Tegm) to S with Clifton pluton (Tegrc) to N.	0.3	10.7
0.3	11.9	**STOP 7**: Wide pullout on right just below construction camp site. Is this granite of the White Pass plutons suite Clifton (Tegrc) or Summit Lake (Tegrs)? Rock is fine- to medium-grained, light- to medium-gray, C.I. 10 biotite granite; local prominent flat-lying joints and K-spar porphyritic (max. 0.5 cm) phase.	0.3	10.4
0.3	12.2	Contact of granite to S with Mount Cleveland pluton of the Skagway plutons suite (Tegt) to N.	0.6	10.1
0.6	12.8	Highway crosses over to E. side of valley.	0.2	9.5

Inter-val miles	Cum. from SKG	Description of geologic and other features--Continued	Inter-val miles	Cum. from Fraser
0.2	13.0	13-mile marker. Sparse dikes of Clifton/Summit Lake (granite) pluton in Mount Cleveland (tonalite) pluton here and on to Stop 8.	1.0	9.3
1.0	14.0	14-mile marker.	0.3	8.3
0.3	14.3	**STOP 8***: Sign: "White Pass Summit-Elevation 3292"; big pullout on left. This is not the real White Pass that the railroad goes through and many of the 97'ers went through; that pass is about 1 mile to the SE, over the hill. Mt. Cleveland (6,350) visible to WSW between two closer peaks. Rock belongs to the Mount Cleveland pluton (Tegt); it is foliated, medium gray, medium- to coarse-grained, C.I. 18 sphene-biotite-hornblende tonalite with hornblende phenocrysts up to 1 cm; ≤5% dark fine-grained inclusions; and vague flat foliation at 001/32(?). [59°37.368', 135°09.812']	0.1	8.0
0.1	14.4	Contact of Mount Cleveland pluton rocks (Tegt) to S with Summit Lake pluton (Tegrs) to N.	0.3	7.9
0.3	14.7	**STOP 9*:** There are pulloffs on both sides before the International Boundary and the road gate. The rock is Summit Lake pluton of the White Pass plutons suite (Tegrs); coarse-grained, C.I. 05 biotite granite, with local K-spar phenocrysts to 1 cm. It looks a lot like some granite of the Clifton pluton, but Barker and others (1986) give a zircon age of 53±2 Ma, in contrast to the Clifton's 48±2 Ma (Barker and others, 1986) and 48.8±1.0 Ma (Gehrels and others (1991). [59°37.721', 135°09.844'] On to the N, the highway is soon out of the Coast Mountains in the strict physiographic sense, and onto the Tagish Highland of the Yukon Plateau (Holland, 1964).	3.3	7.6
1.9	19.9	**STOP 10*:** Pulloff to right on shoulder. Contact of Summit Lake (granite) pluton to S with Fraser pluton of the Skagway plutons suite to N. Contact is somewhat messy, with m-scale dikes of Summit Lake aplite and rhyolite in the Fraser pluton. Exposures of good(?) Summit Lake at the SW end of the roadcrop and of good Fraser at the NE; there it is medium-to coarse-grained, C.I. 25-30, biotite-hornblende tonalite. [59°41.634; 135°05.641] The Fraser pluton cited by Barker and others (1986, table 1, AK-212) is a C.I. 16 hornblende-biotite tonalite; they obtained a zircon U-Pb age of about 54±2 Ma on their sample from this body.	2.4	2.4

Inter-val miles	Cum. from SKG	Description of geologic and other features--Continued	Inter-val miles	Cum. from Fraser
2.4	22.3	**Canadian Customs Station at Fraser**. Another part of the field trip guide takes over about 0.1 mile beyond this point, at the tourist/history exhibit on the E side of the road (Stop 1 of Mihalynuk, 1993). According to Barker and others (1986), the Fraser pluton continues on to the N for about 0.5 miles, and then the highway reenters the Tertiary Summit Lake pluton through a complicated contact zone. Stop 2 of Mihalynuk (1993) is probably in this contact zone. Because of the apparent absence of field criteria for the delineation of the Summit Lake from the Log Cabin pluton, Mihalynuk (1993) considers all of the granite from this contact to Tutshi Lake to belong to the Log Cabin pluton. Barker and others (1986), in contrast, put a contact between the Summit Lake and Log Cabin plutons about 4.6 miles farther N, near where the highway crosses the White Pass Railroad. Barker and others (1986) report a zircon age of 72±2 Ma for Log Cabin granite. The first outcrops of the Log Cabin pluton of Barker and others (1986) are on the N side of the road just beyond the railroad crossing. The highway has good roadcrops of Log Cabin granite for about 5.7 miles until surficial deposits take over. In another 2.2 miles are the outcrops of Stikine terrane affinity rocks near the W end of Tutshi Lake (Stop 3 of Mihalynuk, 1993); the contact is covered along the highway.	0.0	0.0

Road Log for Side Trip from Skagway to Dyea

Inter-val miles	Cum. from turn-off	Description of geologic and other features	Inter-val miles	Cum. from road end
0.0	0.0	Dyea Road turnoff from Klondike Highway (Mile 2.4 of previous road log); this whole trip is in the Burro Creek pluton of the Skagway plutons suite, with local basalt and other dikes.	0.1	8.4
0.1	0.1	Cemetery access road on right.	0.5	8.3
0.5	0.6	Another cemetery on the left.	0.1	7.8
0.1	0.7	Skagway town dump on left.	0.7	7.7
0.7	1.4	**STOP 11:** Vista Point; parking on left side of road. Views of Skagway River, town, and airport to E; Twin Dewey Peaks in distance to NE; and peaks of Halatu Ridge to S. Road/prospect crops on W side of road are of Burro Creek pluton; they are weakly foliated, coarse- to medium-grained, C.I. 15 hornblende-biotite tonalite; hornblende is euhedral and up to 0.7 cm, biotite is in euhedral books up to 0.3 cm; foliation is 330/71; cut by fine- to very fine-grained felsic dikes that are slightly radioactive, hence this U-Th prospect. [59°27.755', 135°19.206']	0.4	7.0
0.4	1.8	End of pavement. Just before the end, on the left, is a road that goes down to the local rifle range. From there roads and trails lead to view points of Taiya Inlet at Yakutania Point and Smugglers Cove.	0.1	6.6
0.1	1.9	Trailhead on right for Skyline trail to AB Mountain. This is a nice trail through the forest for its first two-thirds, before it starts the steep part; much of the trail is on bare Burro Creek pluton and the trail takes advantage of both the flat-lying joints and the glacial grooves.	0.1	6.5
0.1	2.0	Mysterious road with gate goes off to right (N).	0.4	6.4
0.4	2.4	Nahku Bay on left; Parsons Peak (about 5,600 ') across upper Taiya Inlet to W;	0.1	6.0

Inter-val miles	Cum. from turn-off	Description of geologic and other features--Continued	Inter-val miles	Cum. from road end
0.1	2.5	5-mile marker (from ferry terminal).	0.1	5.9
0.1	2.6	Persistent geotechnical road maintenance problem.	0.8	5.8
0.8	3.4	Mathews Creek at head of Nakhu Bay.	0.1	5.0
0.1	3.5	6-mile marker	0.8	4.9
0.8	4.3	Upper Taiya Inlet on left.	0.2	4.1
0.2	4.5	7-mile marker	0.5	3.9
0.5	5.0	Edge of Dyea tidal flats and mouth of Taiya River; to NW note pilings that remain from the 7,500'-long pier that was built at Dyea in 1898.	0.7	3.4
0.7	5.7	**STOP 12:** Dyea Flats to left; a few small places to pull off to right. Roadcrops of Burro Creek pluton consist of weakly foliated, coarse-grained, C.I. 15 hornblende-biotite tonalite; euhedral hornblende to 0.3 cm, euhedral biotite to 0.3 cm; foliation is 264/50; cut by a 3-m thick composite basalt dike at 032/78. [59°29.538', 135°20.759']	0.7	2.7
0.7	6.4	9-mile marker.	0.2	2.0
0.2	6.6	Road goes onto alluvium of Taiya River; Dyea information and history exhibit on left; Dyea townsite is directly W across river.	0.1	1.8
0.1	6.7	Dyea U.S. National Park Service Ranger Station on left.	0.5	1.7
0.5	7.2	Chilkoot Trail trailhead and information/exhibiton right beyond small parking area; Taiya River bridge.	0.1	1.2
0.1	7.3	Road junction: Dyea townsite and Slide Cemetery to left (SW), West Creek Road to right, continue on it.	1.1	1.1
1.1	8.4	West Creek bridge; on far side road to left goes up about 2.3 miles, apparently built for logging and soon becomes difficult; road to right up Taiya river not investigated. [End of road is 59°31.703', 135°21.077']	0.0	0.0

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