UNITED STATES DEPARTMENT OF THE INTERIOR

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INTRUSIVE ROCKS AND PLUTONIC BELTS OF SOUTHEASTERN ALASKA, U.S.A.

By

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This report is preliminary and
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for conformity with Geological
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ABSTRACT

Available information on the map distribution, composition, and ages of intrusive rocks in southeastern Alaska has been compiled and the results interpreted to indicate the presence of six major and five minor belts.

About 30 percent of the 175,000 km^2 of southeastern Alaska is underlain by intrusive igneous rocks. From west to east, the major belts are: the Fairweather-Baranof belt of early to mid-Tertiary granodiorite; the Muir-Chichagof belt of mid-Cretaceous tonalite and granodiorite; the Admiralty-Revillagigedo porphyritic granodiorite, quartz diorite, and diorite belt of probable Cretaceous age; the Klukwan-Duke belt of concentrically zoned or Alaskan-type ultramafic-mafic plutons of mid-Cretaceous age which is mainly within the Admiralty-Revillagigedo belt; the Coast Plutonic Complex tonalite sill of unknown, but perhaps mid-Cretaceous, age; and the Coast Plutonic Complex belt I of early to mid-Tertiary granodiorite and quartz monzonite.

The minor belts are distributed as follows: layered gabbro complexes of inferred mid-Tertiary age lie within and are probably part of the Fairweather-Baranof belt; the Chilkat-Chichagof belt of Jurassic granodiorite and tonalite lies within the Muir-Chichagof belt; the Sitkoh Bay alkaline, Kendrick Bay pyroxenite to quartz monzonite, and Annette and Cape Fox trondhjemite complexes, all interpreted to be of Ordovician (?) age, form the crude southern Southeast Alaska belt within the Muir-Chichagof belt; the Kuiu-Etolin volcanic-plutonic belt of mid-Tertiary age extends from the Muir-Chichagof belt eastward into the Admiralty-Revillagigedo belt; and the Behm Canal belt of mid- to late Tertiary granites lies within and next to the Coast Plutonic Complex belt II. In addition, scattered mafic-ultramafic bodies occur within the Fairweather-Baranof, Muir-Chichagof, and Coast Plutonic Complex belts. Palinspastic reconstruction of 200-km right-lateral movement on the Chatham Strait fault does not significantly change the pattern of

the major belts, but does bring mid-Tertiary volcanic-plutonic and Ordovician (?) granitic complexes closer together.

The major belts are related to different stratigraphic-tectonic terranes of Berg and others (1978) as follows: the Fairweather-Baranof belt is largely in the Chugach, Wrangell, and Alexander terranes; the Muir-Chichagof belt is in the Alexander and Wrangell terranes; the Admiralty-Revillagigedo belt is in the Gravina and Taku terranes; the Coast Plutonic Complex sill is probably between the Taku and Tracy Arm terranes; the Klukwan-Duke belt is in the Gravina, Taku, and Alexander terranes; and the Coast Plutonic Complex belt I is in the Tracy Arm and Stikine terranes.

Some of these belts are spatially and, in some cases, genetically associated with significant metallic mineral deposits. The Fairweather-Baranof belt granodiorites may be related to gold, copper, and molybdenum occurrences. The layered gabbros within that belt have magmatic copper-nickel deposits. The Coast Plutonic Complex sill is parallel and close to the Juneau gold belt with its gold, silver, copper, lead, and zinc occurrences; the Klukwan-Duke ultramafic-mafic belt contains iron deposits, and the Behm Canal belt has porphyry molybdenum deposits.

The Muir-Chichagof belt of mid-Cretaceous age and the Admiralty-Revillagigedo belt of probable Cretaceous age are currently interpreted as possible magmatic arcs associated with subduction events. In general, the other intrusive belts are spatially related to structural discontinuities, but genetic relations, if any, are not yet known. The Coast Plutonic Complex tonalite sill is considered related to a post-Triassic, pre-mid-Cretaceous suture zone that almost corresponds to the Tracy Arm-Taku terrane contact. The boundary between the Admiralty-Revillagigedo and Muir-Chichagof belt coincides nearly with the Seymour Canal-Clarence Strait lineament; it is also probably a major post-Triassic suture.

INTRODUCTION

About 30 percent of the 175,000 km^2 of southeastern Alaska (Fig. 1) is

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Figure 1 near here.

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underlain by intrusive rocks. Within the last few years several large parts of the region have been mapped, most in reconnaissance, but some in considerable detail. These areas, together with earlier compilations by Brew and others (1966); Souther and others (1974, 1979); Hutchison and others (1973); Beikman (1975); and Brew (1975) provided the intrusive rock map distribution and composition information summarized and interpreted here. All original sources of data were re-examined to produce a 1:1,000,000-scale compilation (Brew and Morrell, 1979a, b). That compilation should be referred to for specific sources of data. Almost all available radiometric ages from the region have been compiled by Wilson and others (1979); those data have been freely interpreted in this report. In general, the age assignments given here are based on extrapolation from potassium-argon-dated bodies to undated but lithologically and structurally similar bodies. Age interpretations in the Coast Plutonic Complex and vicinity are currently being re-evaluated, as uranium-lead dates on zircons from selected bodies become available (J. G. Arth and J. G. Smith, oral communications, 1978, 1979). Hudson's (1979) interpretation of Mesozoic plutonic belts of southern Alaska extends somewhat into southeastern Alaska; in general, his and our interpretations are compatible in the area of overlap.

This report contains three main components: 1) a series of maps showing distribution and composition of intrusive rocks of different ages, 2) a comparable series of maps showing our interpretation of how these rocks fall in six major and five minor belts, 3) a table (Table 1) summarizing the isotopic

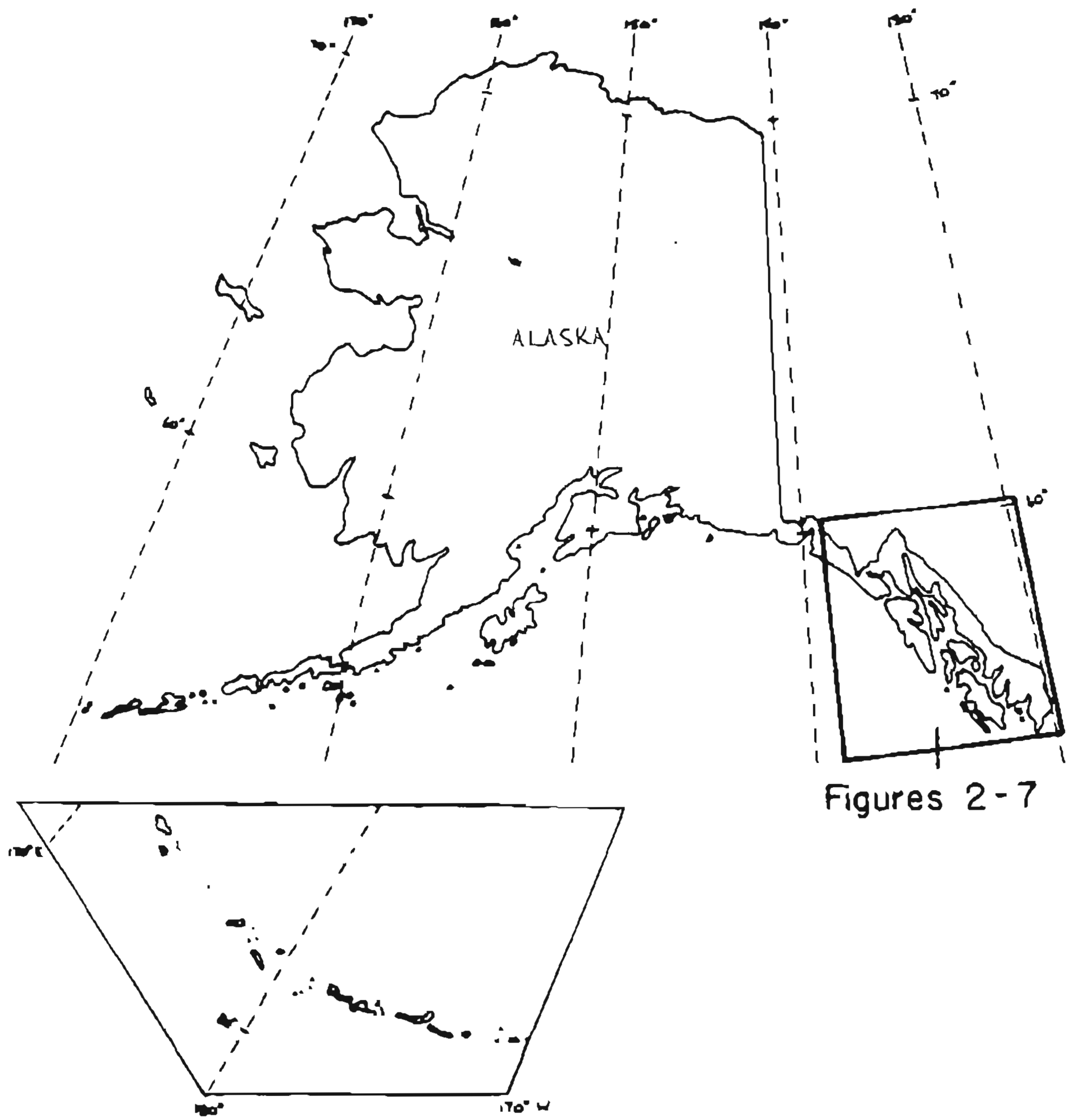

Figure 1. Index map showing southeastern Alaska and the area covered by figures 2-7. See figure 7B for individual place names.

TABLE 1 NEAR HERE.

age, composition, mineralogy, tectonic association (Berg and others, 1978), metamorphic characteristics, and metallogenic association information for the belts, and two other components: 4) brief comments on the different groupings of intrusive rocks, and 5) a discussion of several important general problems.

The compositional terms used here are those selected by Brew and Morrell (1979a) to provide a manageable general classification scheme that did not misrepresent any of the information taken from the original, diverse, sources. We first attempted to use the I.U.G.S. classification (Streckeisen, 1973) in the compilation, but found that many original sources did not provide enough information to allow its proper use. We reluctantly adopted a five-fold classification of granitoid rocks, as follows: those with less than 10 percent quartz are classified as alkalic (they are actually mostly syenites); those with greater than 10 and less than 50 percent quartz are subdivided according to potassium and plagioclase feldspar content with alkali granite having less than 10 percent plagioclase, granites (and peralkaline granites) between 10 and 35, quartz monzonites between 35 and 65, and granodiorites greater than 65 percent. The calc-alkalic part of the scheme is modified from Bateman (1961); alkalic, alkali granitic, peralkaline granitic, mafic, and ultramafic rock types are also included. The scheme combines diorite, quartz diorite, tonalite, and granodiorite. Because of different original classification schemes granite and quartz monzonite may be incorrectly depicted in some areas. We are aware that this general classification has serious shortcomings and fully expect that any future versions of these maps will incorporate new information from bodies that are now poorly known and the I.U.G.S. classification can be applied.

The information and interpretations given here will definitely be improved

TABLE 1.--Characteristics of intrusive rocks in plutonic belts of southeastern Alaska.

AGE	TERTIARY				TERTIARY AND/OR CRETACEOUS	
	1	2	3	4	5	6
Name of belt or intrusive (figure number reference)	Kuiu-Etolin plutonic/volcanic belt* fig. 2b	Behm Canal belt* fig. 2b	Fairweather Baranof belt** fig. 2b	Coast Plutonic Complex belt I** fig. 2b	Glacier Bay belt fig. 2b	Coast Plutonic Complex belt II fig. 2b
Isotopic age range (K-Ar method unless otherwise indicated).	Mid-Tertiary.	20-30 m.y. on biotite and approx. concordant biotite-hornblende.	Yakutat and Baranof areas: 1.20-30 m.y. on approx. concordant biotite and hornblende. 2.~40-50 m.y. on approx-concordant biotite/hornblende and biotite/muscovite. Glacier Bay area: 27-38 m.y. on biotite and muscovite.	45-54 m.y. on approx. concordant biotite/hornblende.	Discordant mid-Tertiary ages.	Discordant mid-Tertiary ages.
Dominant composition or compositional range.	1.Granite to quartz monzonite. 2.Gabbro sills near Keku Strait.	1.Alkali granite 2.Granite 3.Gabbro to granodiorite.	1.Tonalite to quartz monzonite. 2.Narrow "sub-belt" of gabbro-norite intrusives.	Granodiorite to quartz monzonite.	Granodiorite, tonalite, and quartz diorite.	Tonalite to quartz monzonite. Migmatite Orthogneiss
Primary characterizing and accessory minerals.	Biotite (olivine and clinopyroxene)	Biotite Minor pyrite and/or molybdenite. (Augite, hypersthene, hornblende and biotite in gabbro).	Intermediate rocks: Biotite with variable amounts of hornblende, garnet, muscovite, magnetite, sulfides, apatite. Rare clinopyroxene. Gabbro-norite: Olivine, pyroxene with variable amounts of hornblende, biotite, sulfides, magnetite, ilmenite.	Hornblende, biotite, sphene; locally garnet-bearing.	Hornblende, biotite, and local sphene and magnetite.	Biotite, hornblende with localized magnetite and sphene. K-feldspar phenocrysts are abundant in some units.
Host tectonostratigraphic terranes.†	Southern Craig Admiralty Gravina Taku	Taku Tracy Arm	Northern Craig Chugach Wrangell	Tracy Arm Stikine	Chugach Northern Craig	Tracy Arm
Foliation and metamorphic characteristics of plutons and country rocks	Unfoliated Plutonic contacts cut regional foliation trends. Extend of contact metamorphism is uncertain.	Unfoliated. Plutonic contacts cut regional foliation trends. Extent of contact metamorphism is uncertain.	Unfoliated except locally near contacts. Cross-cutting to conformable contact relations with respect to country rocks. Well-developed contact metamorphic aureoles. Typically surrounded by stockwork migmatite.	Unfoliated. Typically bordered by migmatite phase in Tracy Arm area.	Slightly foliated. Cross-cutting to conformable contact relations with respect to country rocks. Thermal aureoles developed (at least). Some plutons are extensively deformed and altered.	Weakly foliated to gneissic Cross-cutting to conformable contact relations with respect to country rocks Irregular compositional and textural variations Intrude sillimanite to kyanite-bearing schist and gneiss.
Metallogenic associations††	Has not been assessed. Tungsten geochem anomalies associated with volcanics on Zarembo Island.	Porphyry molybdenum (Quartz Hill, Groundhog Basin, Burroughs Bay) U-Th? prospect (Cone Mountain)	Cu-Ni-sulfide magmatic segregation deposits in gabbro-norite (Brady Glacier, Bohemia Basin, Mirror Harbor). Au-Ag-Cu-Pb, Zn quartz-sulfide veins (Chichagof-Sitka) Porphyry copper deposit (Margerie Glacier). Porphyry molybdenum deposit (the Nunatak).	Porphyry(?) Cu-Mo deposits and Mo-Ag deposits. Polymetallic(?) skarn deposits.		Magnetite skarn (Bradfield River prospect).
Remarks	Intrusive rocks generally miarolitic. Plutons associated with dike swarms and volcanics on Kuiu and with rhyolitic volcanics on Zarembo Island.	Intrusive rocks commonly miarolitic. Plutons associated with rhyolitic volcanics at Cone Mountain.	Gabbros in the Fairweather Range are layered.	This belt may include many of the intrusive rocks that have been included in the Tertiary and/or Cretaceous Coast Plutonic Complex belt II which have not been adequately dated.	Distinguished from the Tertiary bodies of the Fairweather belt primarily by the development of a weak foliation.	Heterogeneity of these units and discordance of isotopic dates make age determination ambiguous.
References	Berg and others, 1976; Brew and others, unpub. data; Muffler, 1967.	Berg and others, 1978, Berg and others, 1977; Elliott and Koch, unpub. data; Hudson and others, 1979	Brew and others, 1978; Brew and Sonnevil, unpub. data; Hudson and others, 1977; Loney and others, 1975; MacKevett and others, 1974.	Berg and others, 1978, Berg and others, 1977; Brew and others, 1977; Elliott and Koch, unpub. data, Ford and Brew, 1977; Hudson and others, 1979; MacKevett and others, 1974, Smith, 1977.	Brew and others, 1978; Brew and Sonnevil, unpub. data; Hudson and others, 1977.	Berg and others, 1978, Berg and others, 1977; Elliott and Koch, unpub. data; Hudson and others, 1979.

*Minor belt
**Major belt
†Tectonostratigraphic terranes are those defined by Berg and others, 1978. Terminology modified slightly here.
††Berg, H. C., 1979, was an additional source of information regarding metallogenic associations.

Table 1.--Characteristics of intrusive rocks in plutonic belts of southeastern Alaska. (cont.)

CRETACEOUS				MESOZOIC		
7	8	9	10	11	12	13
Muir-Chichagof belts I and II** fig. 3b	Admiralty-Revillagigedo belts I and II** fig. 3b	Coast Plutonic complex tonalite sill fig. 3b	Klukwan-Duke mafic/ultramafic fig. 6b	Baranof ultramafic belts fig. 6b	Admiralty ultramafics fig. 6b	Tracy Arm mafic/ultramafic belt fig. 6b
100-115 m.y. on approx. concordant biotite-hornblende. Pb-α ages on zircon of 110 m.y. and 150 m.y. (± 20 m.y.)	74-84 m.y. on nearly concordant biotite-hornblende reset to discordant ages to east by 50 m.y. event in Coast Plutonic complex.	110 m.y.? Discordant early Tertiary ages on biotite and hornblende.	100-110 m.y. determined by analysis of degree of concordance of biotite/hornblende with respect to proximity to younger granitic intrusives.	Mesozoic?	Mesozoic	Cretaceous or older.
Granodiorite, tonalite, quartz diorite, diorite, and gabbro. Minor monzonite, quartz monzonite (e.g. in Copper Mt. pluton on Prince of Wales Island).	Granodiorite, quartz diorite, diorite.	Tonalite	Dunite, pyroxenite, hornblendite, gabbro.	Wehrlite, serpentinite.	Serpentinite or serpentinized per-	Peridotite, dunite, pyroxenite, and minor gabbro and
Hornblende, biotite, sphene, apatite, sulfides. Pyroxene generally rare but abundant with uralite in gabbro.	Biotite, garnet, hornblende. Most bodies in belt II are characterized by plagioclase phenocrysts. Belt II bodies commonly lack plagioclase phenocrusts but have more hornblende.	Hornblende (typically euhedral), biotite, sphene magnetite. Rare garnet or augite in plutons grouped in this belt.	Olivine, clinopyroxene, hornblende, magnetite, biotite, serpentine.	Olivine, clinopyroxene, chromite with secondary serpentine, magnetite, and talc-carbonate alteration.	Antigorite, talc, carbonate.	Pyroxene, hornblende, olivine, biotite. Secondary anthophyllite and tremolitic amphibole. Serpentine rare or absent.
Craig Wrangell Admiralty Chugach (west of Fairweather fault)	Taku Gravina	Western edge of Tracy Arm	Craig Admiralty Annette Gravina Taku	Wrangell(?)	Admiralty (Retreat group)	Tracy Arm
Moderate to strong foliation. Contact zones are commonly stockwork migmatites. Contact metamorphism to amphibolite or hornblende-hornfels facies.	Belt II stocks are typically zoned with stronger foliation (and more felsic composition) near contacts and most are less metamorphosed than surrounding country rocks. Belt I plutons are strongly foliated and have both concordant and cross-cutting contact relations.	Moderate to strong foliation parallel to contacts. Sill truncates regional metamorphic isograds near Juneau.	Locally sheared or mylonitized. Sharp to gradational contact relations with country rocks. Uncertain contact metamorphic effects, but some definite aureoles.	Pervasive foliation. Serpentinization (to antigorite) was probably under greenschist facies conditions.	Sheared.	Strong foliation parallel to contacts and regional foliation. No contact metamorphic aureoles. In gneiss of almandine-amphibolite facies. Metamorphosed to (at least) greenschist facies.
W-Cu-Ag-Au quartz-sulfide veins in altered granitic rocks (Reid Inlet) W-Cu-Ag-Au-Zn skarn deposits (Highland Chief) Cu-Zn-Mo-Ag-Au skarn deposits where intruding Wales Group (Copper Mt. pluton).		Au quartz veins west of sill (Juneau gold belt) Cu-Zn, Au-Cu, and Zn-Pb sulfide mineralization in lenses and pods and disseminated to west of sill (Groundhog Basin Zn-Pb, Glacier Basin Zn-Pb, Berg Basin Pb-Zn, Tracy Arm Cu-Zn prospect, Sumdum Cu-Zn prospect).	Magnetite cumulate deposits.	Low-grade, impure chromite (Red Bluff Bay peridotite).		No anomalous metallic concentrations.
Belts I and II are of the same apparent age and compositional range. Belt I consists of large bodies with contacts concordant to foliation. Belt is widest in northern Glacier Bay National Monument, narrows north and south. Belt II consists mostly of small, scattered plugs.	Belt I bodies are large, strongly foliated, and either non-porphyritic or slightly porphyritic. Belt II bodies are generally small, isolated porphyritic stocks.	Sill is semi-continuous between Berners Bay and the Stikine River. South of the Stikine River, the typical sill lithology is found sporadically in heterogeneous gneiss and orthogneiss. Shown as granodiorite on MF-1048.	Rhythmically-layered, concentrically zoned, Alaskan-type intrusives. Zoning is generally ultramafic to gabbroic from core to periphery of intrusive.	Form two en echelon belts on Baranof Island. Age relation with country rock uncertain; bodies may be tectonically emplaced. Bodies resemble zoned ultramafics of Klukwan-Duke belt rather than harzburgitic alpine peridotites.	One body is crudely layered.	Many bodies in or near contact with marble. Ni-Cr content suggest primary igneous origin.
Brew and others, 1978; Brew and Sonnevil, unpub. data; Lathram and others, 1959, Lathram and others, 1975; MacKevett and others, 1974; Muffler, 1967; Turner and others, 1977.	Berg and others, 1976; Berg and others, 1978; Brew and others, unpub. data; Elliott and Koch, unpub. data.	Berg and others, 1978; Brew and others, 1977; Elliott and Koch, unpub. data; Ford and Brew, 1977a,b; Gault and others, 1953, Brew and others, 1976.	Berg and others, 1976, Berg and others, [illegible]; Irvine, 1974; Lanphere, 1968; Lanphere and Eberlein, 1966; Lathram and others, 1959; Lathram and others, 1965; MacKevett and others, 1974, Taylor, 1967	Loney and others, 1975.	Lathram and others, 1965.	Brew and others, [illegible]; Grybeck and others, 1977.

Table 1.--Characteristics of intrusive rocks in plutonic belts of southeastern Alaska. (cont.)

AGE	JURASSIC	JURASSIC AND/OR TRIASSIC		UPPER PALEOZOIC?	PENNSYLVANIAN
	14	15	16	17	18
Name of belt or intrusive (figure number reference).	Chilkat-Chichagof belt* fig. 4b	Bokan Mt. intrusive fig. 4b	Texas Creek granodiorite fig. 4b	Art Lewis Glacier pluton fig. 5c	Klawak intrusive [illegible] fig. 5b
Isotopic age range (K-Ar method unless otherwise indicated)	145-165 m.y. on hornblende and approx. concordant biotite hornblende. Pb-α ages on zircon are 160 m.y. and 180 m.y. (± 20 m.y.)	180-190 m.y. on reibeckite. Pb-α age of 240 ± 30 m.y. on zircon.	200-206 m.y. on hornblende.	Ages of 225 m.y. and 136 m.y. on hornblende.	276 ± 8 m.y. on biotite.
Dominant composition or compositional range.	Tonalite to quartz monzonite (more basic variants are minor).	Peralkaline granite.	Granodiorite.	Diorite, quartz diorite.	Syenite.
Primary characterizing and accessory minerals.	Hornblende, biotite, localized garnet, sphene, epidote, and apatite.	Reibeckite, acmite, zircon, xenotime, fluorite, uranothorite, cordierite, euhedral quartz phenocrysts.	Euhedral phenocrysts of hornblende and K-feldspar, biotite, sphene.	Hornblende(?), biotite(?), apatite, magnetite, pyrite.	Biotite, hornblende.
Host tectonostratigraphic terranes***	Northern Craig Wrangell	Southern Craig	Stikine	Hubbard terrane (equivalent to Craig?)	Southern Craig
Foliation and metamorphic characteristics of plutons and country rocks.	Foliated. Narrow contact metamorphic aureole to hornblende-hornfels facies. Steep contacts with country rocks.	Locally developed cataclastic texture. Albitized aureole in surrounding Ordovician(?) intrusives.	Locally developed cataclastic texture and shear zones.	Foliated. Both gradational and sharp, crosscutting contacts. Intrudes amphibolite, subordinate marble, mica schist.	
Metallogenic associations****		Uranium-thorium-REE deposits. 1 Primary segregation enhanced by hydrothermal concentration (Ross-Adams). 2 Syngenetic deposits in pegmatite and aplite dikes 3.Open space filling and replacement epigenetic hydrothermal deposits 4.Interstices of clastic sedimentary rocks.	Polymetallic quartz veins in sheared zones of Texas Creek granodiorite. Volcanogenic Cu-Pb-Zn-Ag-Au deposits in volcaniclastics of Hazelton(?) Group.		
Remarks	Locally porphyritic. Concentric zoning of Kennel Creek pluton on Chichagof Island	Roughly 3 square miles in area.		May correlate with Mt. Hubbard pluton with hornblende ages of 279 and 284 m.y. High zirconium and strontium content.	
References	Lathram and others, 1959; Loney and others, 1975.	Lanphere and others, 1964, MacKevett, 1963.	Berg and others, 1978; Berg and others, 1977; Byers and Sainsbury, 1956, Smith, 1977.	Hudson and others, 1977.	Churkin and Eberlein, 1975.

*Minor belt
**Major belt
***Tectonostratigraphic terranes are those defined by Berg and others, 1978.
****Berg, H. C., 1973, was an additional source of information regarding metallogenic associations.

Table 1.--Characteristics of intrusive rocks in plutonic belts of southeastern Alaska. (cont.)

ORDOVICIAN?				PRECAMBRIAN
SOUTHERN SOUTHEASTERN ALASKA BELT				
19	20	21	22	23
Sitkon Bay complex	Kendrick Bay complex	Prince of Wales mafics/ ultramafics	Annette complex	Ruth Bay intrusive
fig. 5b	fig. 5b	fig. 5b	fig. 5b	fig. 5b
Minimum age of 406 ± 16 m.y. on hornblende.	Minimum age of 446 ± m.y. on hornblende. Pb-α age of 510 ± 60 m.y. on zircon.	Minimum age of 430-440 m.y on hornblende.	Minimum age of 416 ± 12 m.y. on hornblende.	Minimum age of 730 m.y., U-Pb date on zircon.
Syenite, syenodiorite, trondhjemite. (Lesser amounts of a wide variety of compositions).	1.Quartz diorite to diorite. 2.Quartz monzonite to granodiorite. 3.Alaskite. 4.Minor syenite	1.Pyroxenite. 2.Gabbro.	Trondhjemite with minor leucogranite, quartz monzonite, and quartz diorite.	Trondhjemite.
Hornblende, biotite with localized nepheline, sodalite, cancrinite, and sodic pyroxene.	Hornblende, biotite, augite. Rare garnet and aegerine in syenite.	Augite, uralitic hornblende, biotite magnetite, apatite, pyrite and ilmenite in gabbro.	Muscovite, minor biotite and hornblende. Secondary chlorite, epidote.	Not published.
Northern Craig	Southern Craig	Southern Craig	Annette	Southern Craig
	Poor foliation except near contacts and in gneissic quartz monzonite unit. Alkalic rocks appear to have intruded calcic rocks but many contacts are gradational. Albitized in part.	Locally sheared. Pyroxenite intruded by Ordovician(?) quartz monzonite or syenite. Intrusive breccia contact zones. Gabbro in gradational contact with Ordovician(?) diorite.	Mild cataclastic texture in core: myionitic schist, gneiss, and breccia near periphery. Baked contact zone few cm wide.	Pre-intrusive greenschist facies metamorphism. Thermal event reset K-Ar ages of metamorphic rocks in Early Ordovician. Undeformed and unmetamorphosed.
	Cu-Au quartz-carbonate veins Au-Ag in massive pyrite in marble septum intruded by quartz diorite Gold-bearing calcite veins.	Possible concentrations of magnetite.		
Each body conspicuously heterogeneous. Clasts of syenite probably from this complex occur in: 1 Pt. Augusta Fm. (Silurian). 2.Kennel Creek Limestone (Silurian and/or Devonian) 3.Cedar Cove Fm. (Middle and Upper Devonian).	Inclusions of gabbro, amphibolite, gneiss, and schist in diorite.	Contact relations suggest ultramafics to be oldest intrusive rocks in Bokan Mt.-Kendrick Bay area. So their minimum age is considered 446 m.y.		In Wales Group.
Lanphere and others, 1965; Loney and others, 1975.	Lanphere and others, 1964 MacKevett, 1963; Turner and others, 1977.	MacKevett, 1963; Turner and others, 1977.	Berg, 1972; Berg and others, 1978.	Churkin and Eberlein, 1977, Turner and others, 1977.

upon as more details become available, but they probably define the major features of intrusive rocks in the region. It should be noted that Buddington and Chapin (1929) anticipated several of the belts discussed here.

INTRUSIVE ROCKS OF TERTIARY AND CRETACEOUS(?) AGE

The distribution of intrusive rocks of known Tertiary age and those of Tertiary and(or) Cretaceous age is shown in Figure 2a and the interpretation is given in Figure 2b.

Figures 2a and 2b near here.

Descriptions are in columns 1 through 6 of Table 1. The Tertiary and(or) Cretaceous age assignment for rocks in the Glacier Bay and Coast Plutonic Complex II belts is "temporary" in that both areas include either undated plutons or plutons with discordant ages that from field relations appear to be younger than nearby Cretaceous bodies and older than early Tertiary bodies; further dating studies will refine the assignment.

Some of these belts are related to tectono-stratigraphic terranes, other belts, and structural features in ways that are not obvious from either the individual figures or the table: 1) much of the Fairweather-Baranof belt is roughly parallel to the Tarr Inlet suture zone (Brew and Morrell, 1978), which is now interpreted to be a manifestation of the Wrangell (Wrangellia) terrane (Brew and Morrell, 1979c); 2) the Kuiu-Etolin (Brew and others, 1979) belt is unusual in that it cuts across the Alexander, Gravina, and Taku terranes; 3) for much of their length the Coast Plutonic Complex belts I and II are tightly constrained on the west by the mid-Cretaceous? Coast Plutonic Complex tonalite sill (Fig. 3a, 3b); 4) those belts are also continentward of the Cretaceous(?) Admiralty-Revillagigedo belt throughout all of its extent (Fig. 3a, 3b); and 5) the Behm Canal belt is of particular interest

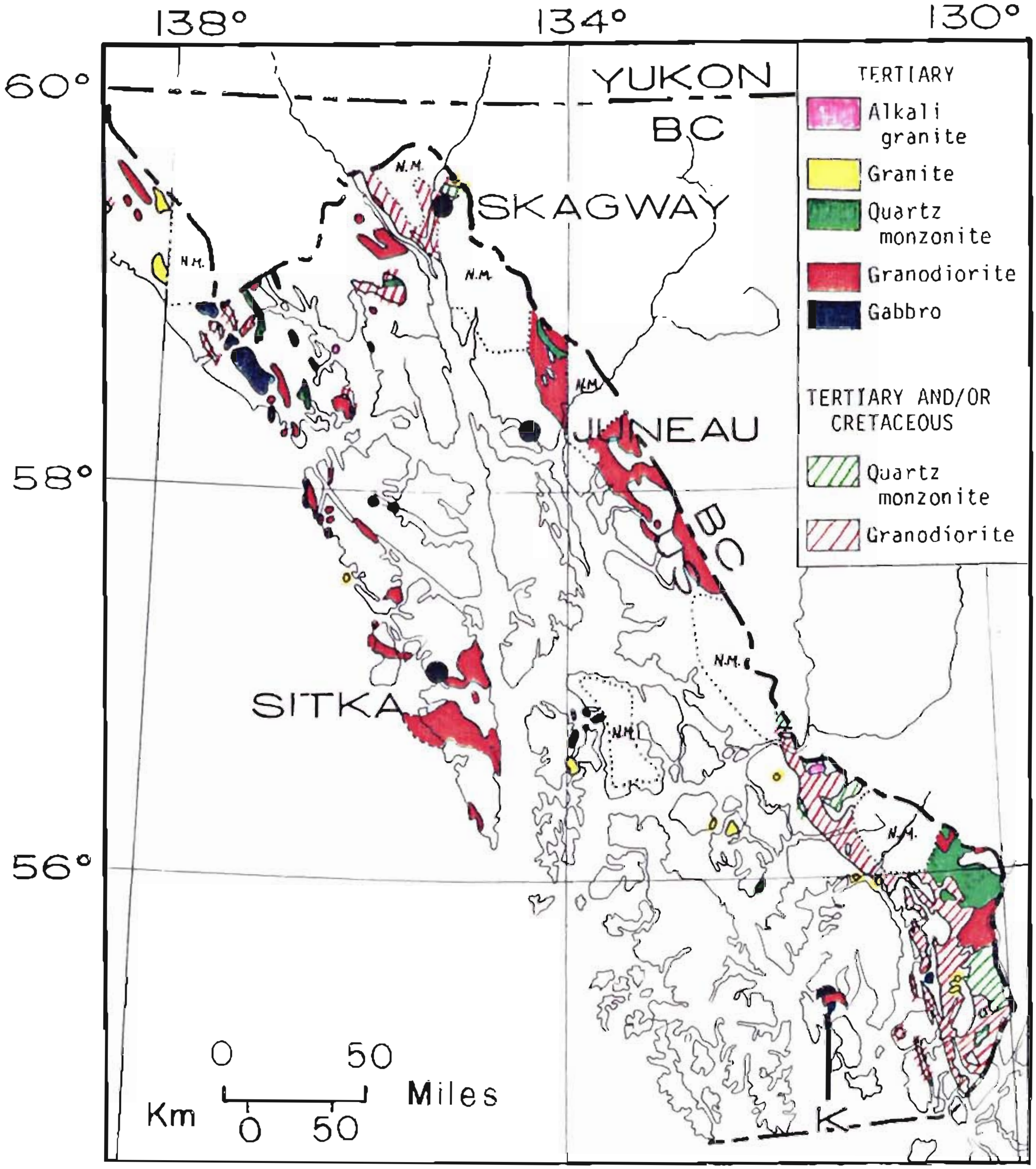

Figure 2A. Intrusive rocks of Tertiary and Tertiary and/or Cretaceous age, southeastern Alaska.

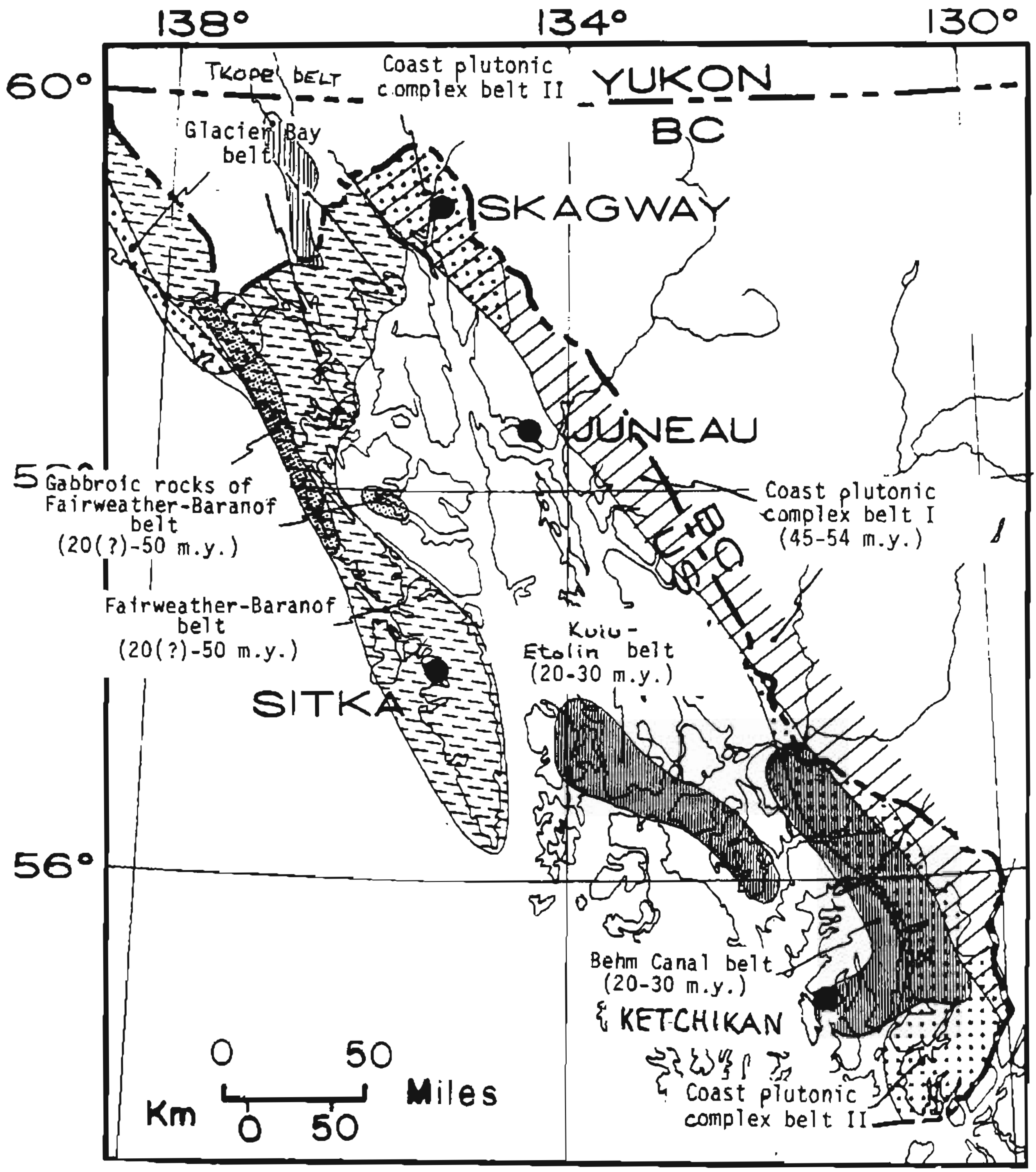

Figure 2B. Plutonic belts of Tertiary and of Cretaceous and(or) Tertiary age, southeastern Alaska.

because it contains the important Quartz Hill molybdenite deposit east of Ketchikan as well as the Burroughs Bay molybdenite deposit.

Although the 200 km of right-lateral movement on the Chatham Strait fault (Ovenshine and Brew, 1972) may completely or partly pre-date the Kuiu-Etolin belt, palinspastic reconstruction nevertheless brings it into approximate alignment with the southeast extension of the newly recognized Tkope belt in British Columbia about due west of Skagway (Campbell and Dodds, 1979).

INTERMEDIATE AND FELSIC INTRUSIVE ROCKS OF CRETACEOUS AND OR MESOZOIC AND(OR) PALEOZOIC AGE

Intrusive rocks of Cretaceous age are probably the most common in southeastern Alaska (Fig. 3a, 3b, and Table 1, cols. 7-9). The granodiorites shown

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Figures 3a and 3 b near here.

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as Mesozoic and(or) Paleozoic age in the southwestern part of Figure 3a are undated isotopically but are inferred to be Cretaceous also. On the other hand, plutons interpreted as Cretaceous in the middle part of the Muir-Chichagof belt are also undated and could be older.

Two of the belts, the Muir-Chichagof and Admiralty-Revillagigedo, are subdivided into sections labeled I and II. Section I contains abundant plutons and section II contains sparser plutons. These two belts adjoin at the Seymour Canal-Clarence Strait lineament, whose location is revised from that shown by Brew and Ford (1978). These two belts, together with the Coast Plutonic Complex sill, cover almost all of southeastern Alaska except the Chugach and part of the Wrangell terranes in the west (Brew and Morrell, 1979c, 1979d) and the main Coast Plutonic Complex on the east. Brew and Ford (1978) discussed the origin of the Coast Plutonic Complex sill and suggested that it was emplaced in mid-Cretaceous time along an important structural discontinuity. The sill becomes

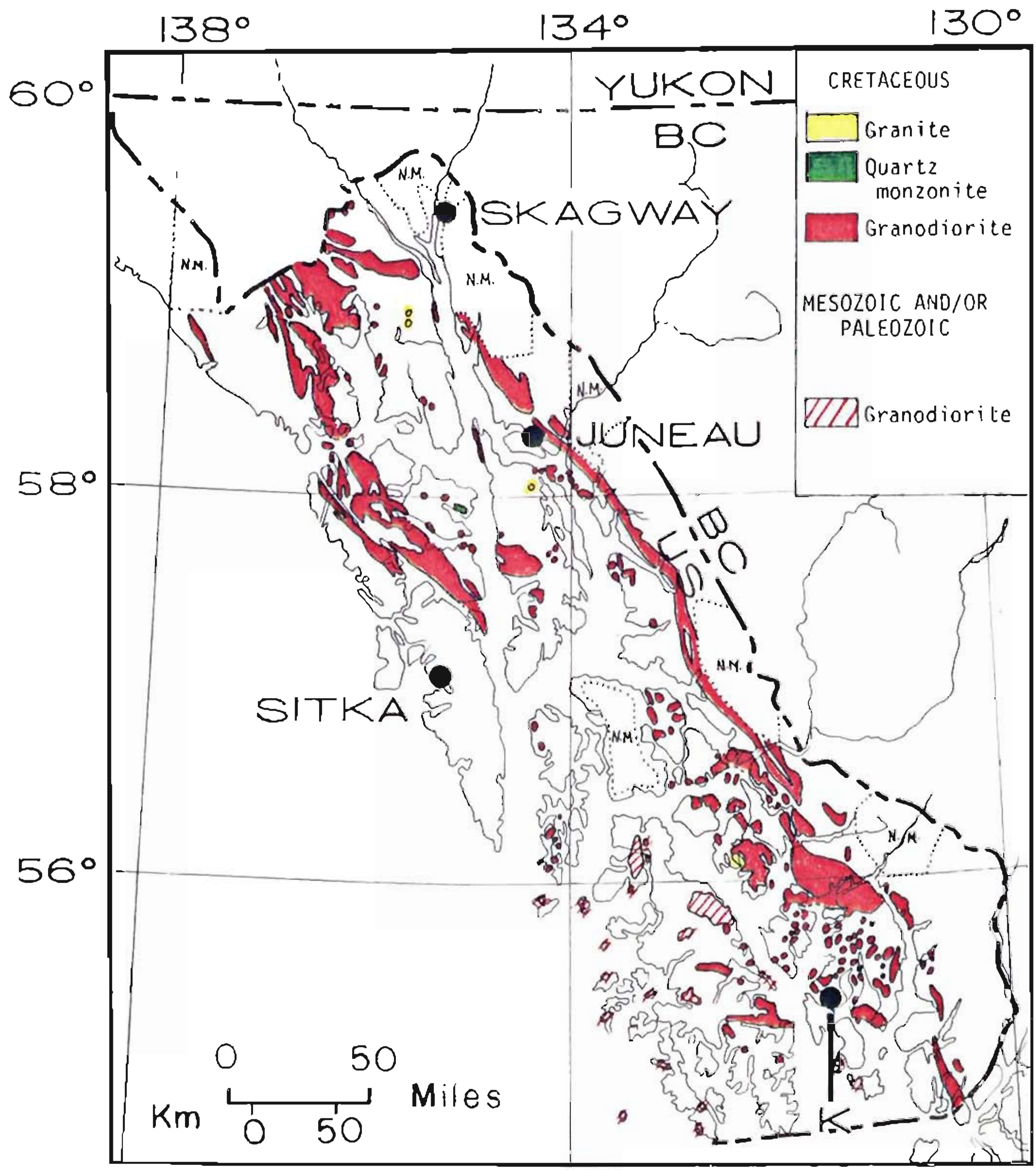

Figure 3A. Intermediate and felsic intrusive rocks of Cretaceous and Cretaceous(?) age, southeastern Alaska.

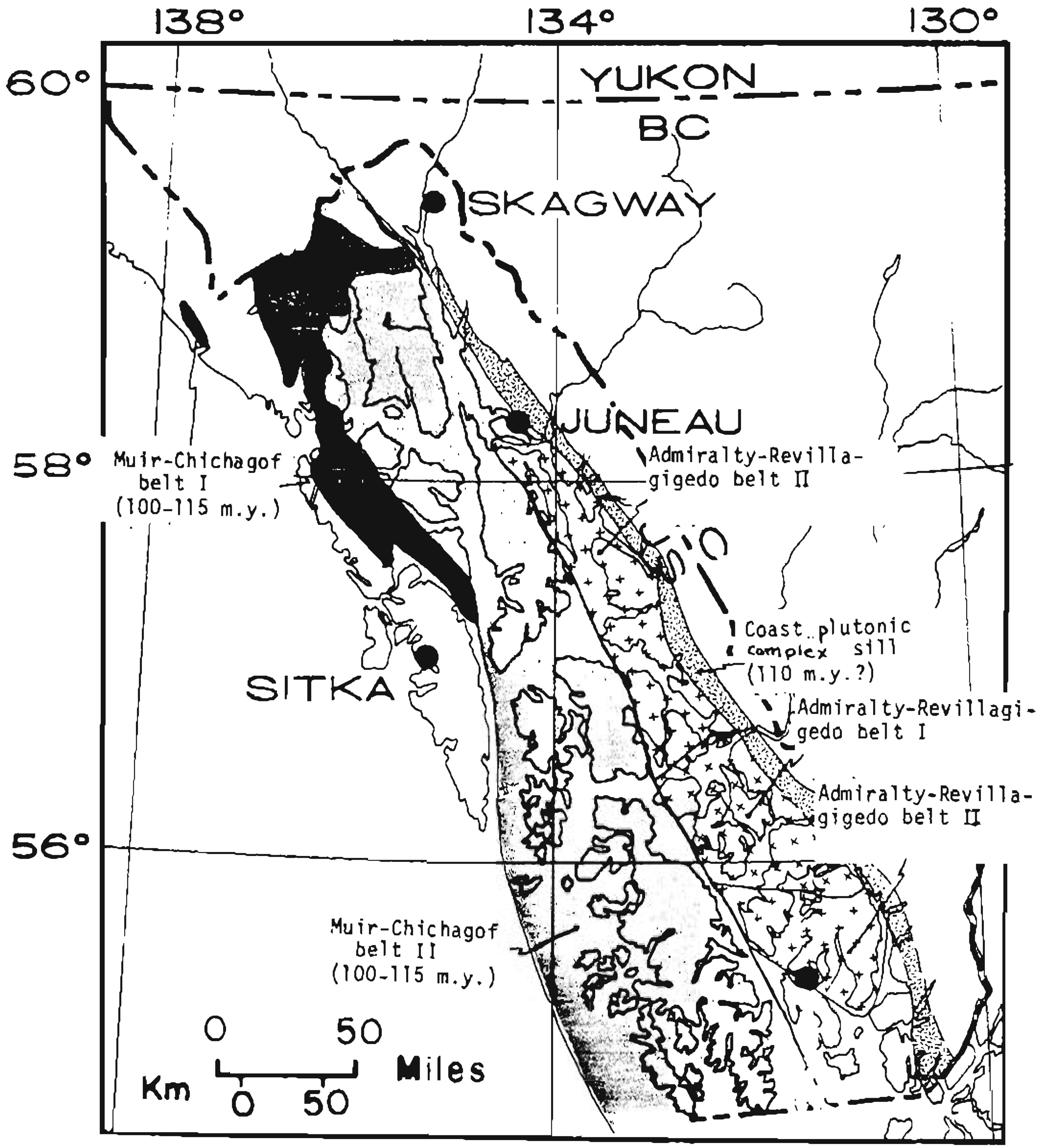

Figure 3B. Plutonic belts of intermediate and felsic rocks of Cretaceous age, southeastern Alaska.

very discontinuous to the south where it adjoins the Admiralty-Revillagigedo Belt I, but appears to reestablish itself near the Alaska-Canada boundary southeast of Ketchikan ("K" on figures). It continues southeast in Canada as the Quottoon pluton (Hutchison, 1979). The Muir-Chichagof belt more or less corresponds to the Nutzotin-Chichagof belt of Hudson (1979).

Reconstruction of the 200 km of right-lateral movement on the Chatham Strait fault increases the overall width of the Muir-Chichagof belt and makes its strike northwesterly.

INTRUSIVE ROCKS OF JURASSIC AND TRIASSIC(?) AGE

Relatively few recognized intrusives of Jurassic age and of Jurassic and(or) Triassic age are known (Fig. 4a, 4b, and Table 1, cols. 14-16). Many more

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Figures 4a and 4b near here.

Jurassic bodies may exist in southeastern Alaska, but are so similar petrographically to the Cretaceous bodies that they have not been recognized. Only one belt, the Chilkat-Chichagof, has been defined. Its southern end coincides with the Tonsina-Chichagof belt of Hudson (1979) but to the north that belt for some reason excludes radiometrically dated Jurassic bodies in the Chilkat Range and northeastern Chichagof Island and also includes a large area in which no Jurassic plutons have been identified.

INTRUSIVE ROCKS OF PALEOZOIC AND OF PRECAMBRIAN AGE

This is a very diverse group of older plutons (Fig. 5a, 5b, and Table 1,

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Figures 5a and 5b near here.

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cols. 17-23). The age of the Annette complex is uncertain and the different

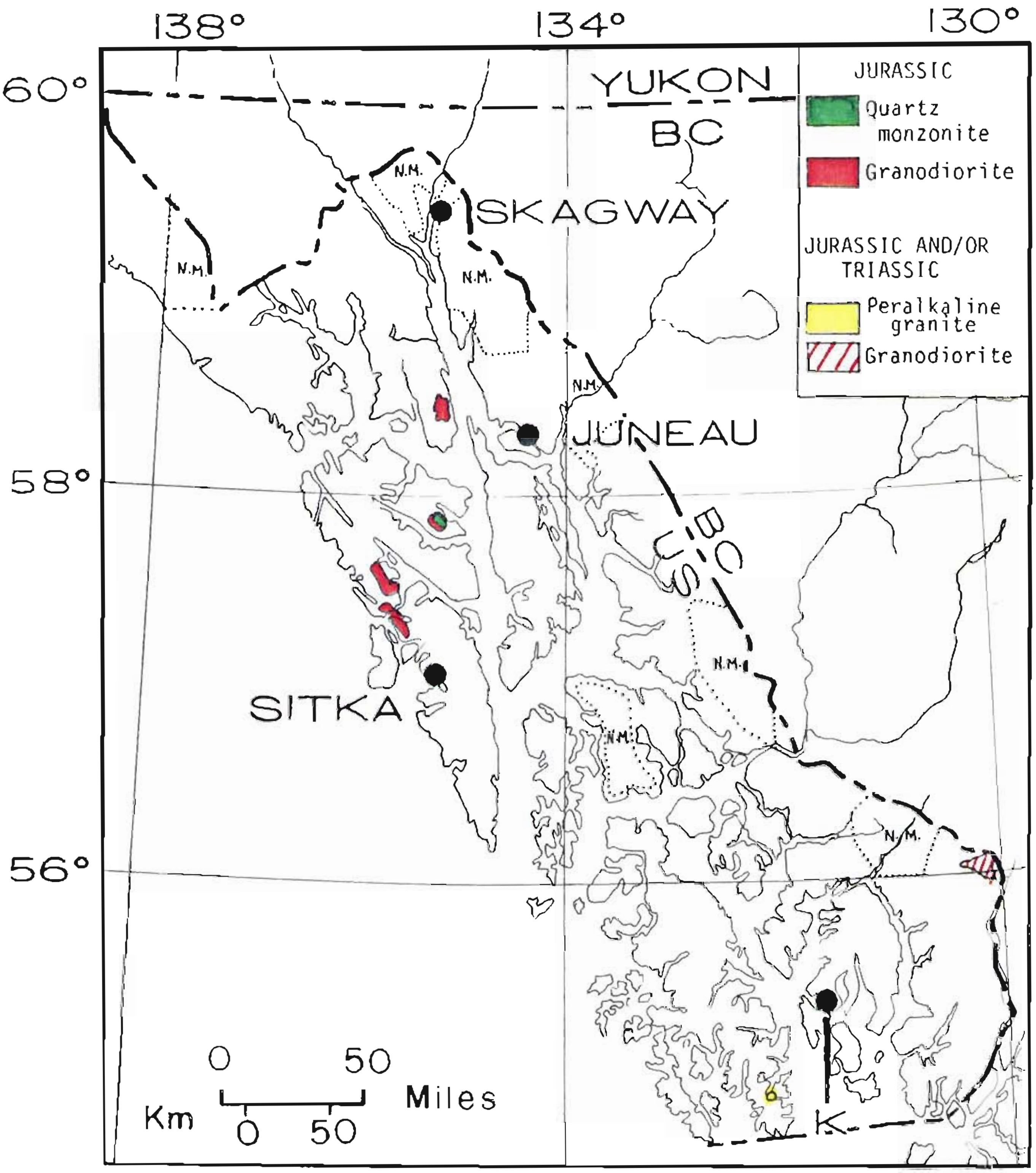

Figure 4A. Intrusive rocks of Jurassic age, southeastern Alaska.

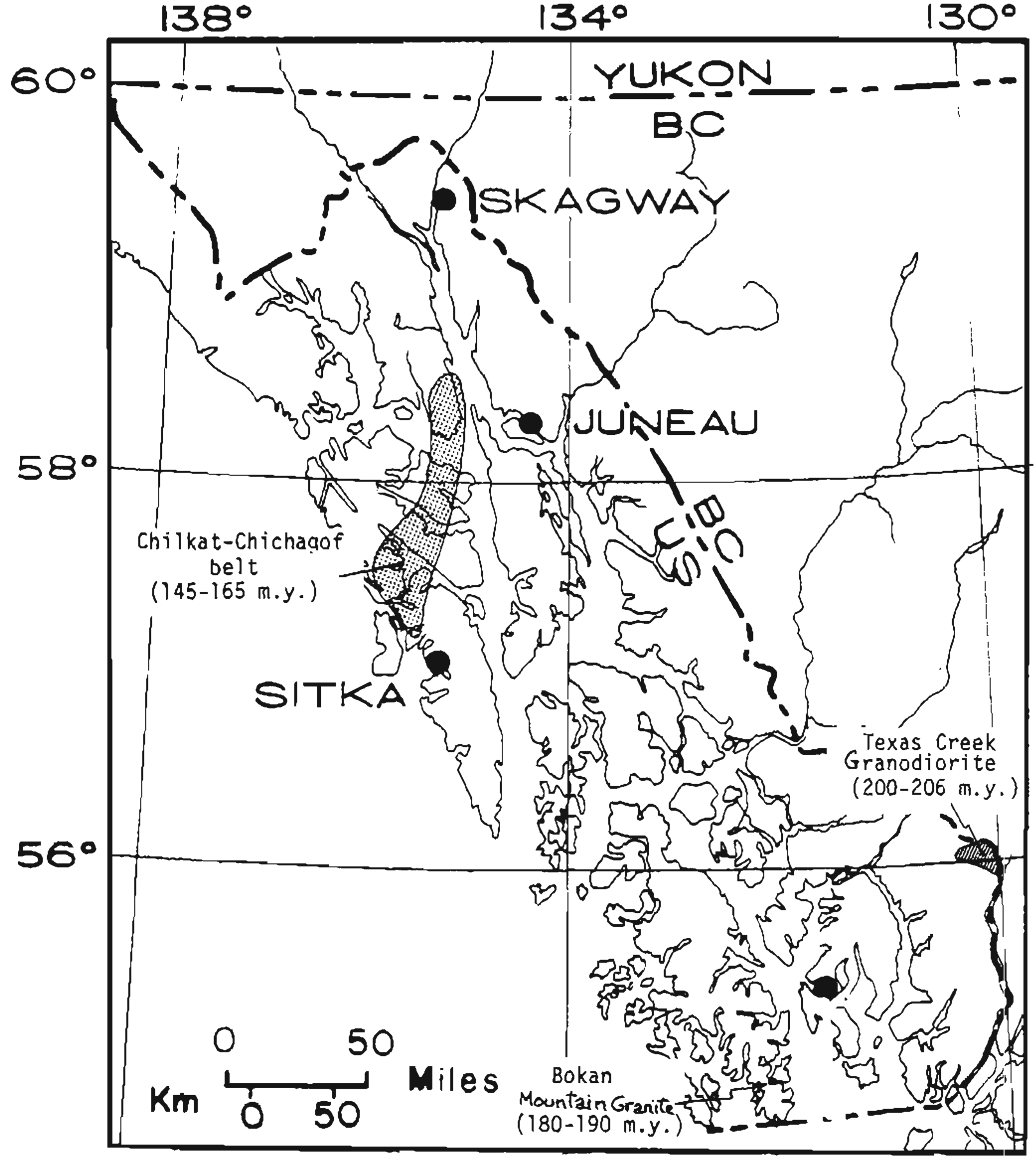

Figure 4B. Plutonic belts and isolated intrusions of Jurassic age, southeastern Alaska.

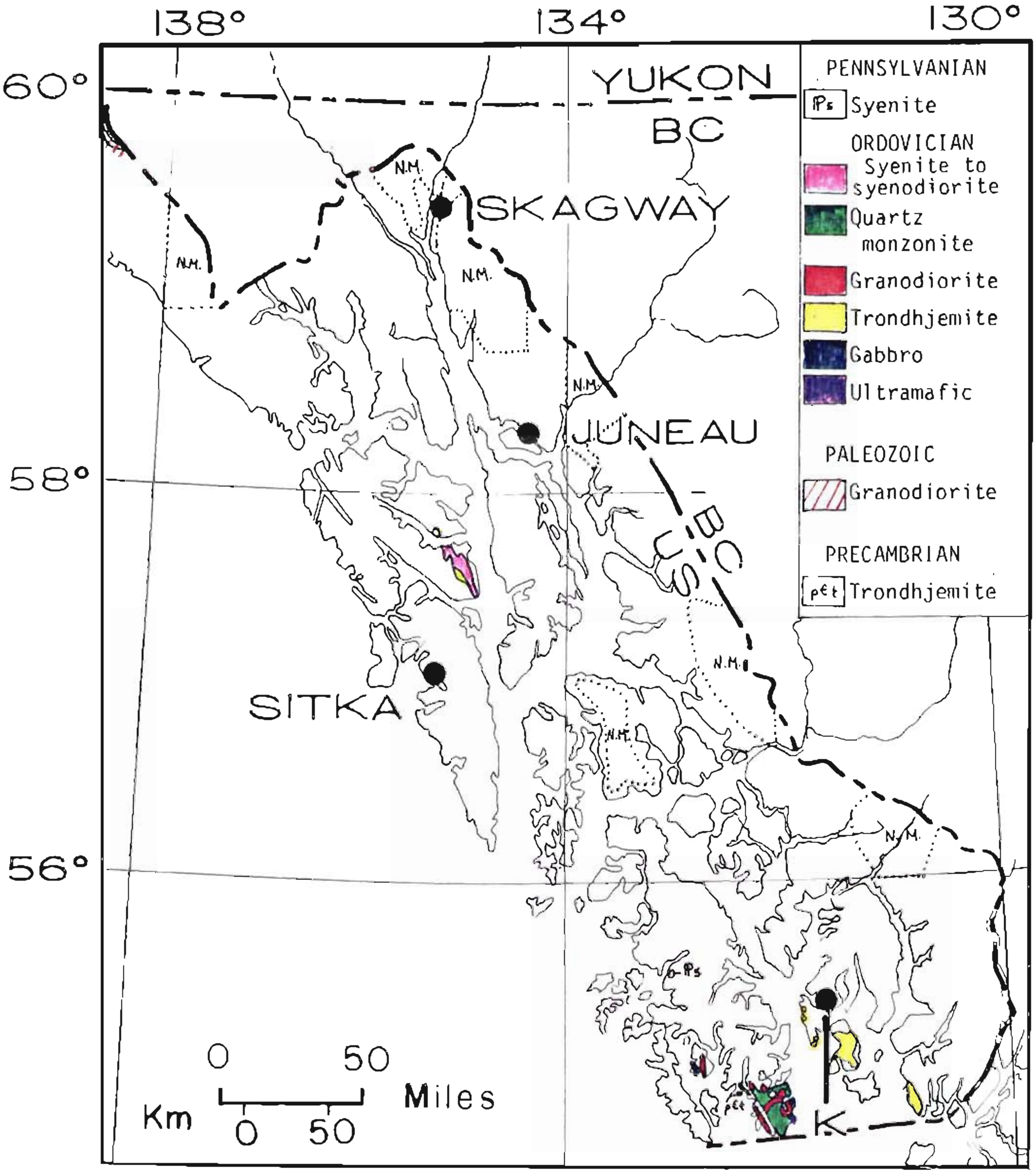

Figure 5A. Intrusive rocks of Paleozoic and Precambrian age, southeastern Alaska.

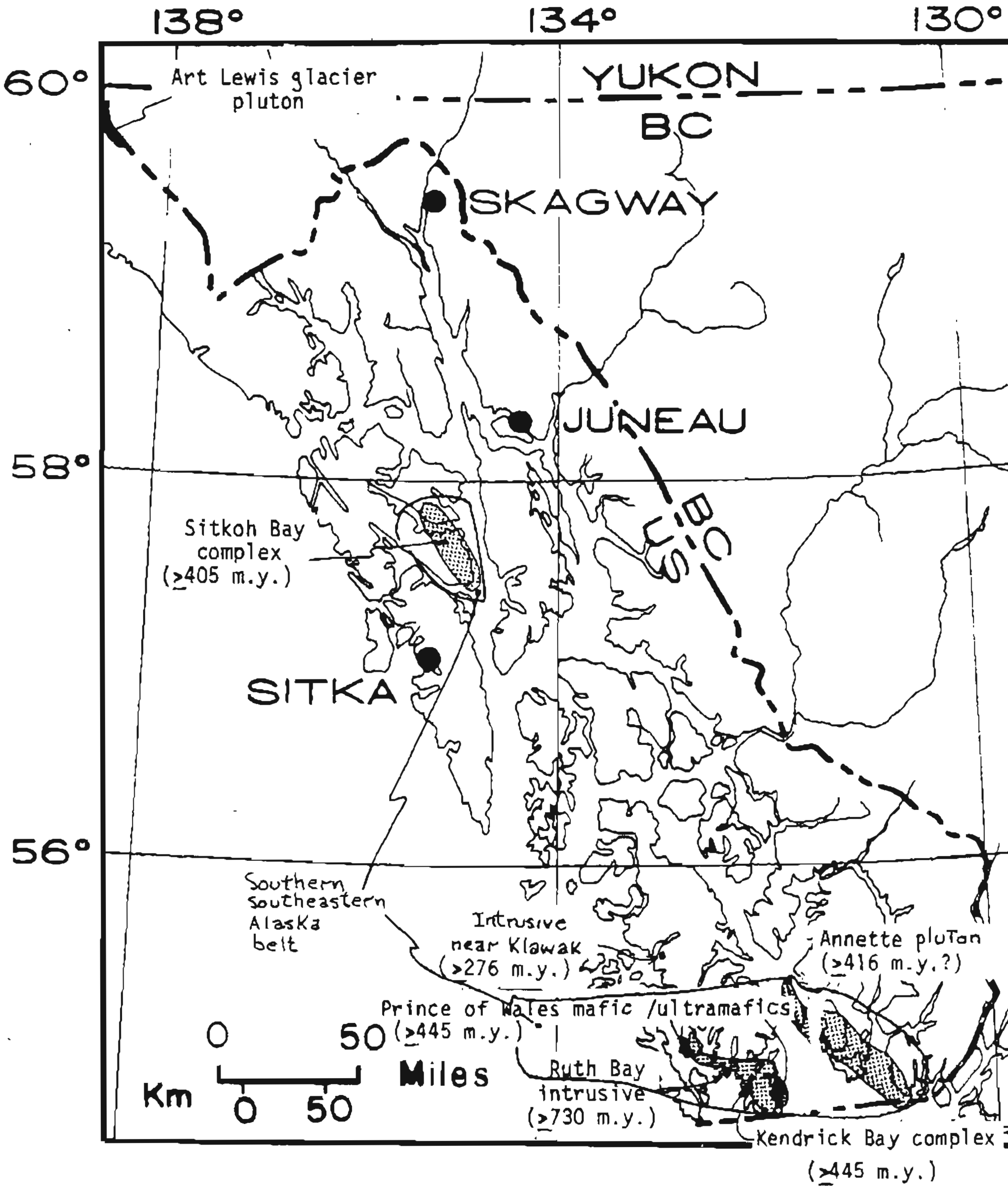

Figure 5B. Plutonic belts of Paleozoic and of Precambrian age, southeastern Alaska.

complexes differ compositionally; nevertheless, a widespread intrusive event of probable Ordovician age clearly occurred (M. A. Lanphere, oral communication, 1978). Palinspastic reconstruction of 200 km of right-lateral movement on the Chatham Strait fault (Ovenshine and Brew, 1972) brings these Ordovician(?) complexes significantly closer together and aligns them in a 160-km-long east-west trending area near the U.S.-Canada border.

The limited available isotopic evidence that reveals unusual bodies like the Pennsylvanian syenite and Precambrian trondhjemite on Prince of Wales Island suggests that more such plutons may be present but unrecognized.

GABBROIC AND ULTRAMAFIC ROCKS OF CRETACEOUS AND MESOZOIC AGE

A variety of gabbroic and ultramafic rocks of Cretaceous and Mesozoic age are present (Fig. 6a, 6b, and Table 1, cols. 10-13). Paleozoic mafic-ultramafic

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Figures 6a and 6b near here.

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rocks are shown on Figures 5a and 5b and described in column 21 of Table 1. The concentrically zoned or Alaskan-type mafic-ultramafic complexes form the only major belt. Hudson (1979) did not include these rocks in his analysis of Mesozoic plutonic belts.

DISCUSSION

The distribution, composition, and age information presented by Brew and Morrell (1979a) and reiterated here has been synthesized to give an interpretation of the plutonic belts in southeastern Alaska. Taken as a whole (Fig. 7a), the situation is very complex; and the major belts alone present a complicated picture (Fig. 7b).

Figures 7a and 7b near here.

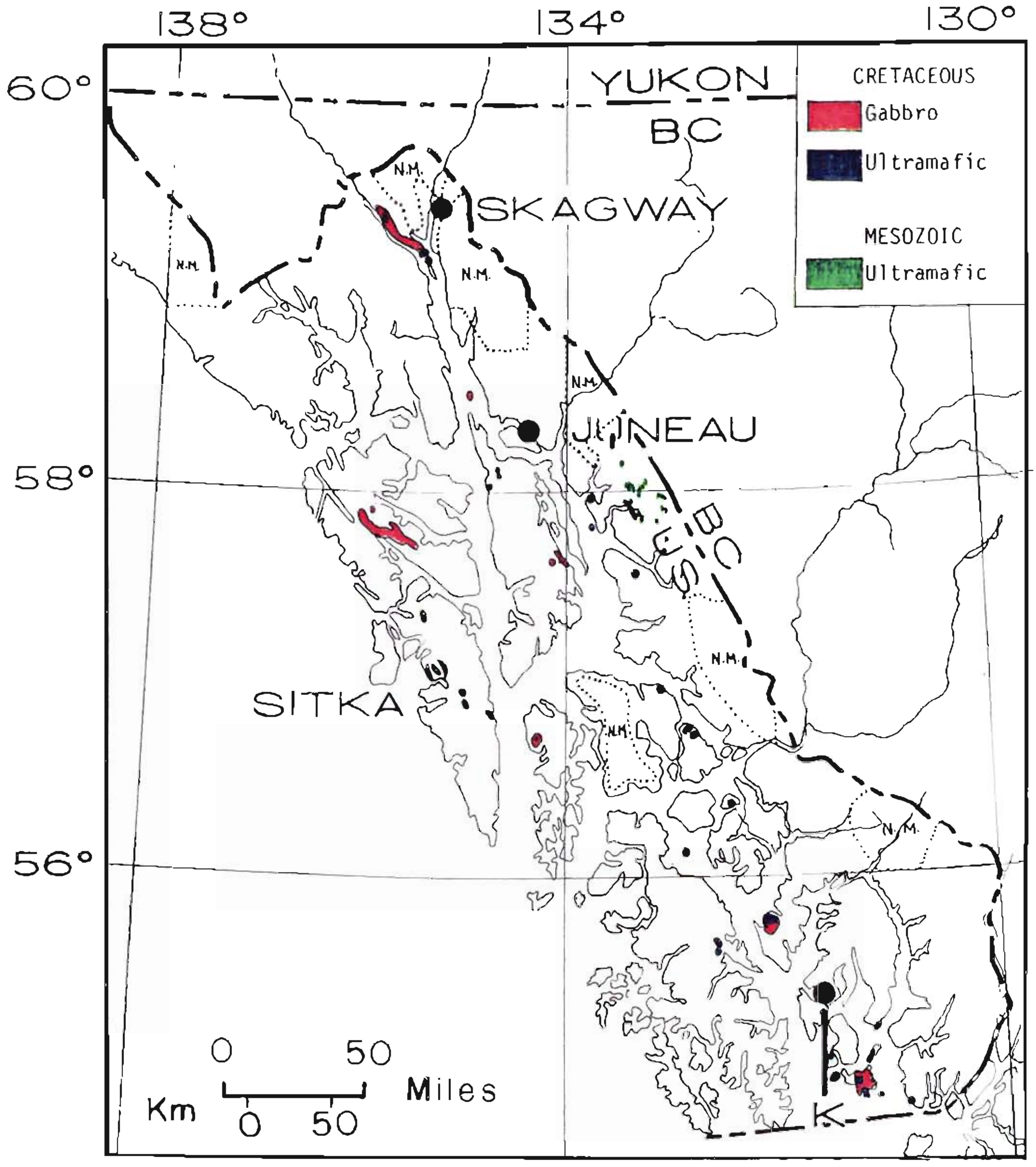

Figure 6A. Gabbroic and ultramafic rocks of Mesozoic age, southeastern Alaska.

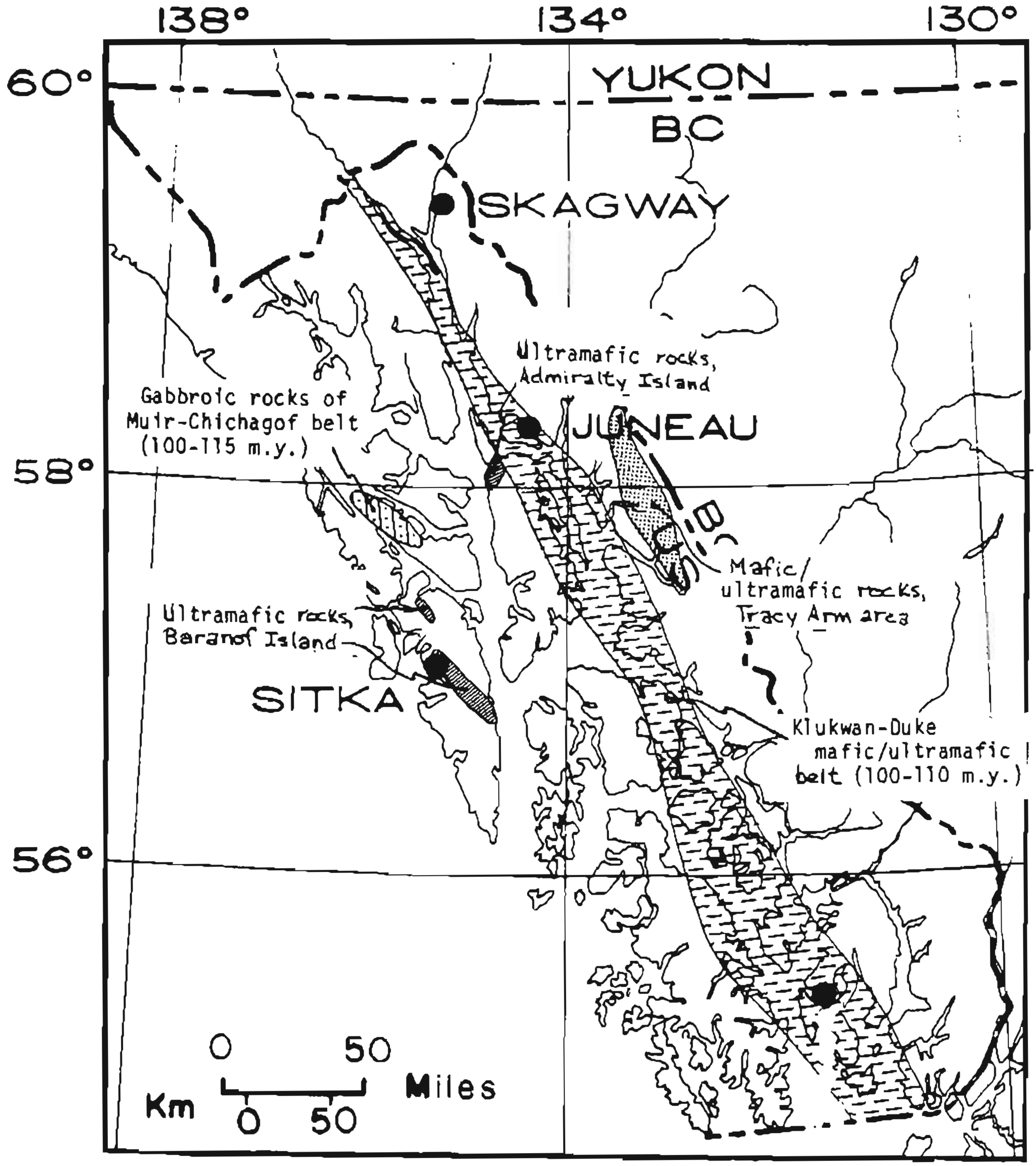

Figure 6B. Gabbroic and ultramafic belts of Mesozoic age, southeastern Alaska.

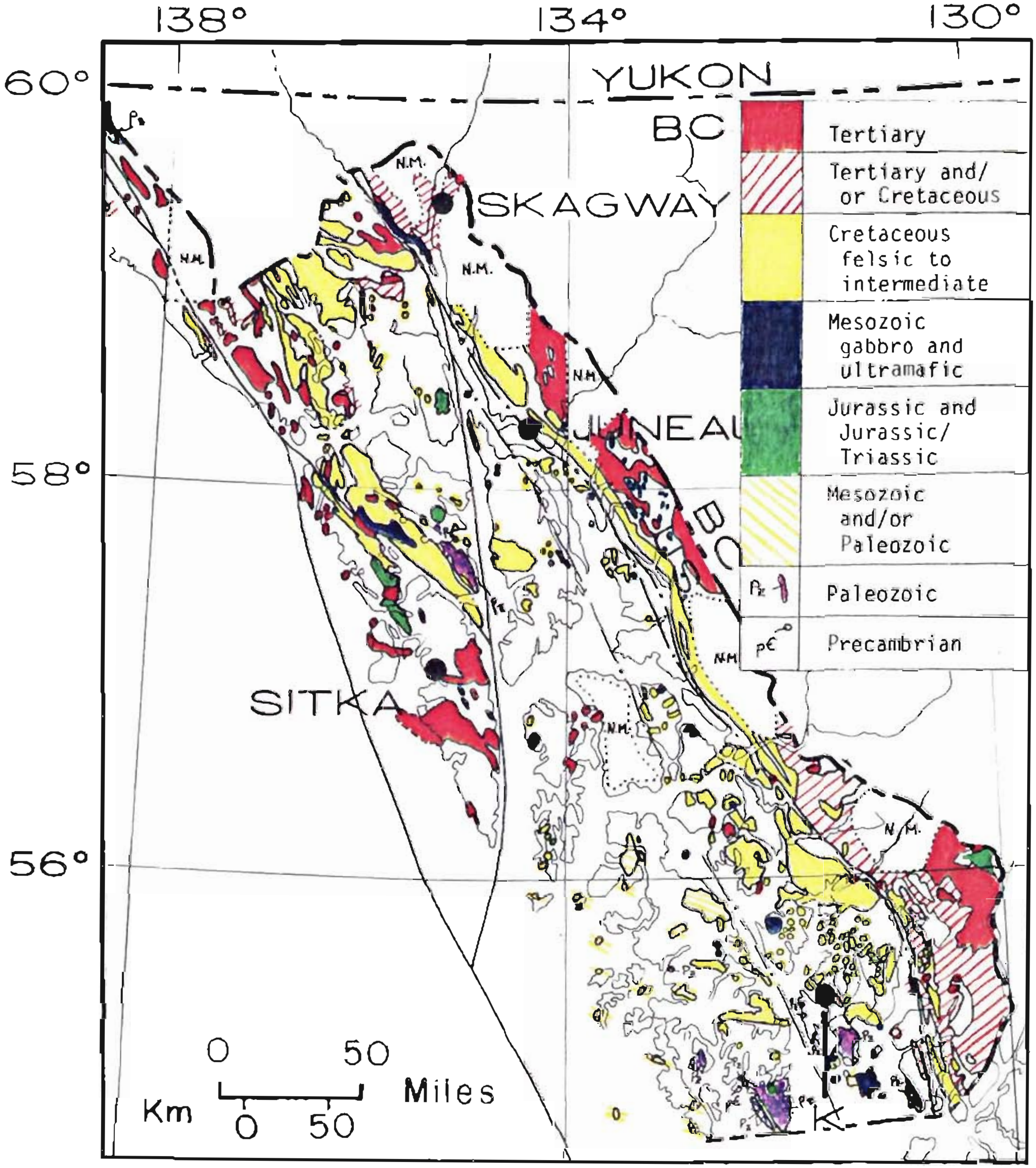

Figure 7A. Intrusive rocks of southeastern Alaska.

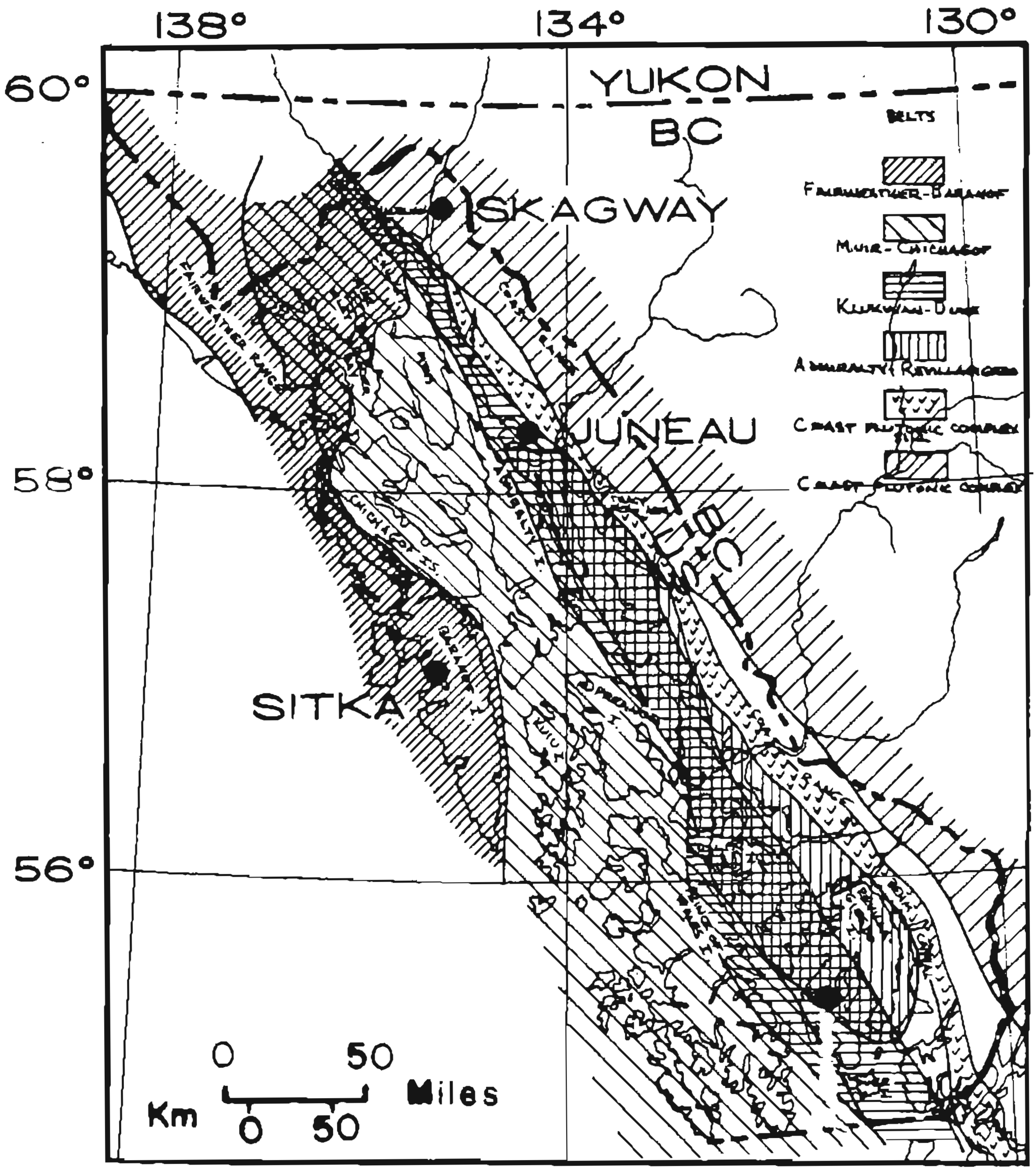

Figure 7B. Plutonic belts of southeastern Alaska.

No simple time-space distribution of the plutonic belts of southeastern Alaska exists; nevertheless, some assertions are appropriate about the major and some of the minor belts:

1. The Kuiu-Etolin (20-30 m.y.), Behm Canal (20-30 m.y.) and perhaps Tkope belts are not obviously related to any single tectonic element. We suggest they are related to either a) mid- to late-Tertiary vertical movements (Brew, Loney, and Muffler, 1966; Brew, 1968) that led to the development of local continental sedimentary basins or b) tension associated with large-scale strike-slip movements. In either case deep fractures provided conduits for magmas derived from below or within the lower crust.

2. The Fairweather-Baranof (20(?)-50 m.y.) and Coast Plutonic Complex I (45-54 m.y.) belts flank the dominant Cretaceous plutonic belts of southeastern Alaska on the west and east, respectively. The Tertiary belts are grossly similar but have some important differences. Hudson and others (1977) argued that plutons in the Fairweather-Baranof belt are anatectic and derived from the thick accretionary prism of Cretaceous turbidites in the same area. This hypothesis does not account for the gabbroic rocks that are apparently part of the same belt, nor could it apply to the Coast Plutonic Complex belt because of its diverse host rocks. Brew and others (1978) suggested that the oblique subduction directed to the north in early to middle Tertiary time was an unlikely cause for the Fairweather-Baranof belt, but had no alternative hypothesis to offer.

3. The Muir-Chichagof, Admiralty-Revillagigedo, Klukwan-Duke, and Coast Plutonic Complex sill belts form the plutonic spine of southeastern Alaska; understanding their significance depends on their mutual age relations, but these relations are still uncertain. All are presently thought to be about the same age (100-115 m.y.) except for the slightly younger Admiralty-

Revillagigedo belt (74-84 m.y.), whose plutons deform the foliation that penetrates the Coast Plutonic Complex sill.

The Klukwan-Duke belt of concentrically zoned mafic-ultramafic plutons generally adjoins, but slightly overlaps, the Muir-Chichagof belt. We interpret these belts as being closely related, with the mafic-ultramafic rocks possibly representing the "roots" of the volcanic piles that make up much of the Gravina terrane (Irvine, 1973; Berg and others, 1972) and the foliated granitics possibly representing the base of the magmatic arc. The Coast Plutonic Complex sill is interpreted (Brew and Ford, 1978) as having been emplaced at about the same time along a pre-existing structural discontinuity that may have separated the Taku and Tracy Arm terranes of Berg and others (1978). The slightly younger Admiralty-Revillagigedo belt may represent another magmatic arc or a late phase of the 100-115 m.y. plutonism just described.

A preliminary lead-uranium age of 140 m.y. on a pluton from the Admiralty-Revillagigedo belt raises the possibility that the belt is Jurassic rather than Cretaceous. Scattered, as-yet unrecognized, Jurassic plutons may exist within both the Muir-Chichagof and Admiralty-Revillagigedo belts.

4. Jurassic plutonism of the Alaska-Aleutian Range batholith has been extensively studied by Reed and Lanphere (1973), but the connection with the Chilkat-Chichagof belt via the Tonsina-Chichagof belt of Hudson (1979) is not established. Reed and Lanphere (1973) concluded that a magmatic arc with northward-dipping polarity was present, but Hudson (1979) suggested that the evidence is not sufficient.

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