UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Preliminary geologic map and fossil data, Solomon, Bendeleben, and southern Kotzebue quadrangles, Seward Peninsula, Alaska

by

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Open-File Report 86-276

This report is preliminary and has not been reviewed for conformity with Geological Survey editorial standards and stratigraphic nomenclature

1. Anchorage, Alaska
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1986

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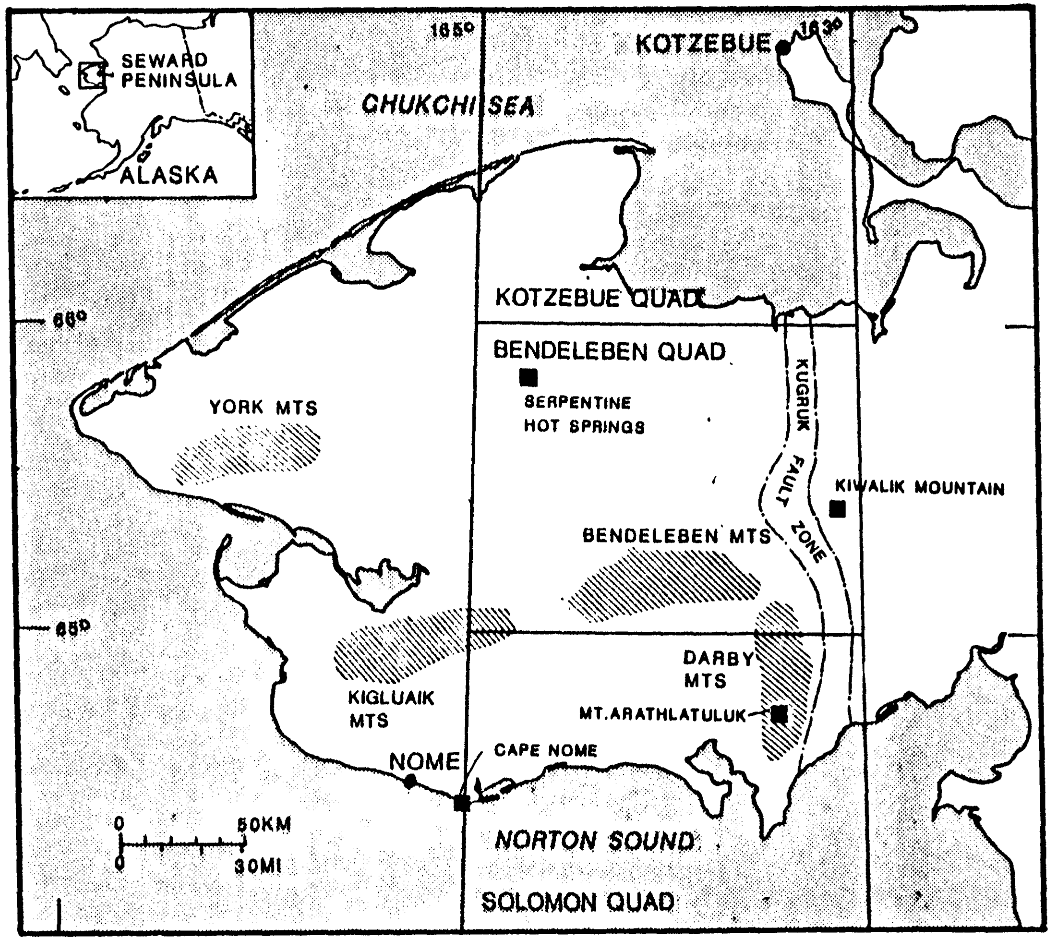


Figure 1: Location of quadrangles and geographic features in the study area

INTRODUCTION

The geologic map and fossil data presented here in preliminary form are products of the Solomon-Bendeleben project of the Alaska Mineral Resource Assessment Program (AMRAP). The project, undertaken in 1981, involved a team of geologists, geochemists, and a geophysicist; its object was to determine the geologic history and resource potential of the Solomon and Bendeleben 1:250,000-scale quadrangles (See fig. 1). Geologic mapping was extended into the southern Kotzebue quadrangle. The geologic map and fossil data presented here are the foundation piece for the AMRAP study.

Helicopter-supported mapping and sampling began in 1981 and was completed in 1985.

Other products of the Solomon-Bendeleben AMRAP will be an MF Folio comprising a Quaternary geologic map, a mineral resource assessment and map, a geophysical interpretation, geochemical studies, and a placer gold map. The fossil data presented here will be re-released as part of the folio, and the geologic map will be published in color (probably as part of the I-series).

ACKNOWLEDGEMENTS

The authors are indebted to the Elim native Corporation for permission to map on their lands. Thanks also to Bering Straits Native Corporation and NANA Corporation for access to their lands.

The success of our field seasons was aided by the generosity of Bill and Bette Laws of Council, C.J. Phillips of Nome, and the Department of Transportation in Nome. Special thanks go to Rinehart Berg for great logistical help and geologic observations. Thanks go to able helicopter pilots Lucky Wilson, Ed Miller, and in particular Paul Walters.

Processing and identification of microfossils included in this report was done in USGS labs in Washington, D.C., and Anchorage, Alaska. Thanks to Anita Harris and her technicians in Washington; thanks also to Darrell Kaufman, Bill Thompson, and Kitty Reed for their work in the Anchorage lab.

PREVIOUS WORK

Early geologic workers on the Seward Peninsula mapped parts of the Solomon and Bendeleben quadrangles (Brooks and others, 1901; Smith and Eakin, 1911). Some of the units designated by P.S. Smith (1910) in "Geology of the Solomon and Casadepaga quadrangles" (now the Solomon C-5 and D-5 quadrangles) have been adopted in this report. 1:250,000-scale geologic maps were made of the Bendeleben quadrangle (Sainsbury, 1974) and the western Solomon quadrangle (Sainsbury and others, 1972). A 1:250,000-scale map of the eastern Solomon and southeastern Bendeleben quadrangles was made by Miller and others (1972).

GEOLOGIC MAP UNITS

The bedrock geology of the central Seward Peninsula is dominated by metamorphic and igneous rocks. Both low- (blueschist and greenschist facies) and high-grade (amphibolite and locally granulite facies) metamorphic rocks are intruded by several suites of Cretaceous granitic rocks. Exposures of unmetamorphosed sedimentary rocks are rare and of late Cretaceous to Tertiary age. Voluminous Tertiary and Quaternary basaltic rocks form a plateau in the central Bendeleben quadrangle. Bedrock exposure in the Bendeleben quadrangle is poor outside of the glaciated peaks of the Bendeleben Mountains, due to the lava plateau and thick loess and colluvial cover. Exposure in the Solomon quadrangle is somewhat better because of the greater relief in the foothills south of the Kigluaik and Bendeleben Mountains.

In this report, metalimestone is used to describe carbonate rocks that have been partially recrystallized but retain some relict primary textures. All rocks described as dolostones also retain some primary textures. Marble is used to describe carbonates that have been totally recrystallized; all marbles referred to here are calcitic unles qualified as dolomitic.

Metamorphic rocks

Metamorphic rocks in the study area are divided into two groups by metamorphic grade: low-grade, blueschist-facies rocks belonging to the Nome Group, and high-grade, generally amphibolite-facies rocks. Where exposed in the study area, the contact between these groups is a high-angle fault, except in the Darby Mountains where a progressive increase in metamorphic grade from north to south occurs. The protolith package for these two groups of rock was the same, at least in part. Upgraded equivalents of Nome Group units can be mapped among the high-grade rocks.

The Nome group

The Nome Group, as originally defined by Moffit (1913), included two schist units with an interlayer of limestone. In his latest work Sainsbury (1974) included all Nome group rocks in the "slate of York region". Recent mapping shows that the Nome Group is a metamorphic unit which includes two parts: (1) a coherent, mappable pre-metamorphic stratigraphy (CpCs, OCx, Ocs, Oim) and (2) carbonate rocks with an unknown pre-metamorphic relationship to that stratigraphy (Ddm, Cd, Od, Sd, DObm, DCbm, among others). Both parts are composed of early Paleozoic and possibly older protoliths which have undergone Jurassic blueschist-facies metamorphism and deformation (Forbes and others, 1984; Thurston, 1985). The Nome Group, as used here, includes all lithologies which retain mineral assemblages stable at blueschist and greenschist facies. Most Nome group rocks contain blueschist-facies assemblages. Rocks in the vicinity of Kiwalik Mountain, also included in the Nome Group, equilibrated at greenschist facies conditions; Nome Group rocks mapped in the northern Darby Mountains show a biotite-grade overprint on blueschist-facies assemblages.

Nome Group rocks record a series of metamorphic conditions that are considered by Thurston (1985) to represent a monocyclic, polyfacial metamorphism. Early low-temperature, high-pressure assemblages (sodic pyroxene, glaucophane and lawsonite in metabasites) were overprinted by high-pressure assemblages stable at slightly higher temperatures (garnet, epidote and glaucophane in metabasites). Locally, retrograde low greenschist-facies assemblages were developed, probably during uplift. The prominent, pervasive foliation found in most Nome Group rocks is a product of the first and second stages of metamorphism. The deformation which accompanied metamorphism is characterized by ductile structures typical of deeper crustal processes; thrust faults have not been mapped within the Nome Group stratigraphy.

The flat-lying to shallowly dipping transposition foliation of the Nome group is an axial planar schistosity which is commonly parallel to lithologic layering; intrafolial isoclinal folds are abundant. This foliation is the product of penetrative ductile deformation which presumably has significantly altered original geometric relationships between lithostratigraphic units while leaving the stratigraphic succession largely intact. Lithologic contacts have been rotated into parallelism with the foliation in most exposures. Locally the foliation crosses lithologic layering at high angles, presumably in the vicinity of the hinges of outcrop- to map-scale recumbent folds. In the northeast Seward Peninsla, in the vicinity of Kiwalik Mountain, the metamorphic stratigraphy is inverted relative to most exposures of the Nome Group; this may indicate that nappe formation accompanied deformation. Stretching lineations (mineral aggregates, boudinage axes) and isoclinal fold hinges formed with the schistosity both have a north-south trend; vergence has not been observed. All the above-mentioned structures were formed during regional blueschist-facies metamorphism, and indicate that the Nome Group schists were at a sufficient depth in the crust to undergo ductile deformation accompanied by significant extension along a north-south trend. Patrick (1986) has used quartz petrofabrics to determine that the deformation had northward vergence.

The protolith package of the Nome Group includes submarine sedimentary and igneous rocks of possibly Precambrian to Devonian age. Early Paleozoic lithologies formed in an area restricted from terrigenous input, favoring deposition of carbonate and siliceous sediment (O€x). During Ordovician time, a mafic volcanic event was recorded in rocks now part of the Casadepaga Schist (Ocs). Carbonate deposition resumed after the volcanic event, and the impure chlorite marble unit (also Ordovician; Oim) was deposited. The depositional environment of post-Ordovician lithologies is less clear. Some carbonate deposition, on a platform or slope, continued on until the Devonian.

High-grade rocks of the Kigluaik, Bendeleben and Darby Mountains

Amphibolite- and locally granulite-facies metamorphic rocks of the Kigluaik, Bendeleben, and Darby Mountains are referred to here as the "high-grade rocks". These include upgraded equivalents of the Nome Group metamorphic stratigraphy (Oimh, Ocsh, O€xh, and €p€sh) and generalized units (Pzp€h, Pzp€g, Pzp€m) which may include rocks other than the Nome group, as well. The high-grade rocks had a variety of metamorphic histories. In the eastern Bendeleben and southern Darby Mountains, sillimanite-bearing schist and marble are found in envelopes surrounding plutonic rocks (Pzp€g), and record only one metamorphic event. High-grade rocks in the central and northern Darby Mountains, western Bendelebens, and eastern Kigluaik Mountains are polymetamorphic.

Polymetamorphism in the Kigluaik and Bendeleben Mountains produced early high-pressure assemblages including kyanite and staurolite and late low-pressure assemblages containing andalusite, cordierite, orthoamphibole, and sillimanite. Evidence for blueschist-facies metamorphism in these rocks is lacking, but may have been obliterated.

In the northern Darby Mountains, originally blueschist-facies Nome Group rocks show a biotite-grade thermal overprint. The grade of the thermal overprint increases southward to Mt. Arathlatuluk, where granulite-facies schist and stocks of anatectic granite are found. Here the high-grade metamorphism apparently has overprinted blueschist-facies rocks. Finally, andalusite-bearing contact metamorphic assemblages, formed with intrusion of the Darby pluton, cross-cut the prograde metamorphic sequence.

Rocks of the Kugruk fault zone

A zone of generally north-south trending vertical faults in the east part of the map area defines the Kugruk fault zone (Sainsbury, 1974; see fig. 1).

The most common rocks in the fault zone are Nome Group carbonates but blueschist-facies mylonitic metabasite (MzPzm), metabasalt (MzPzb), carbonate and mafic clast conglomerate (TKc), sandstone (TKs), an altered tonalite (MzPzt), and rare serpentinite (MzPzs) occur as well. The mylonitic metabasite (MzPzm) contains relict igneous as well as high-pressure minerals (glaucophane and lawsonite); the high-pressure minerals indicate metamorphism occurred at pressures greater than 7-8 kb. Despite overlap with metamorphic conditions of the Nome Group, the incomplete recrystallization and brittle deformation textures recorded in the mylonitic metabasite indicate it had a different deformational history. The carbonate and mafic clast conglomerate is a ridge-forming unit in the fault zone. It contains clasts of other bedrock units found in the fault zone (principally the mylonitic metabasite and Paleozoic carbonate lithologies) but also contains clasts of rocks not found locally in the fault zone or the surrounding Nome Group. The elongate Cretaceous Darby pluton is aligned along the southern section of the fault zone, and it is possible that this zone of crustal weakness was first active in Cretaceous time. Nome Group rocks have been identified on both sides of the zone, so it can not constitute the boundary between the "continental" rocks of Seward Peninsula and the oceanic rocks of the Yukon-Koyukuk province (Patton and Tailleur, 1977).

Igneous rocks

Intrusive rocks

The Devonian orthogneiss at Kiwalik Mountain (fig. 1), which intruded the protolith of the Nome Group, is the only orthogneiss in the study area of known Paleozoic age. Orthogneiss bodies (Pzg) near Serpentine Hot Springs and Cape Nome are possibly correlative in age. Early Paleozoic orthogneiss bodies have been found in the Nome Group in the Nome quadrangle (R.L. Armstrong, written comm., 1985).

Cretaceous magmatic activity on Seward Peninsula is represented by three to four suites of granites in the Bendeleben and Solomon quadrangles (Miller and Bunker, 1976; Hudson and Arth, 1983). Rocks of granitic composition have been named according to the IUGS classification scheme (Streckheisen, 1976).

Basic information on the 23 intrusive igneous rock units is included in Table 1. Composition, mineralogy, age, and significant references for each unit are listed. Textural characteristics, intrusive relationships, mineralization, and possible correlations are listed in the unit descriptions (Appendix A). Table 2 lists new radiometric ages which have been obtained; ternary diagrams showing model percentages of quartz, alkali feldspar and plagioclase (recalculated to 100 percent) for intrusive rocks are included in figure 2.

Volcanic rocks

During Cenozoic time, probably Eocene to Recent, basaltic volcanism has produced a plateau in the Bendeleben quadrangle (QTv, Qv, Qlj). Felsic hypabyssal rocks (Ta) in the Bendeleben Mountains may be in part coeval with the basalts.

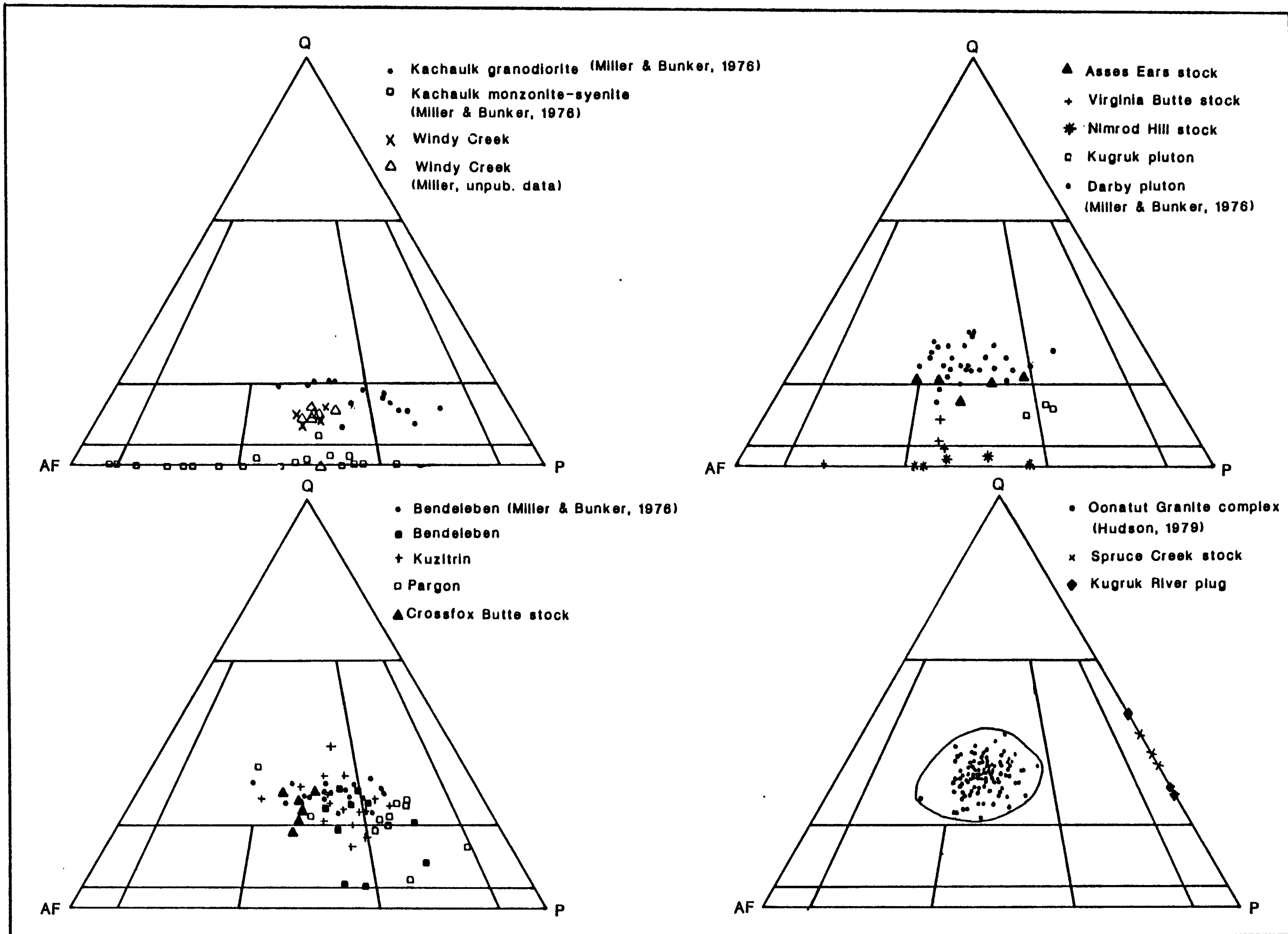
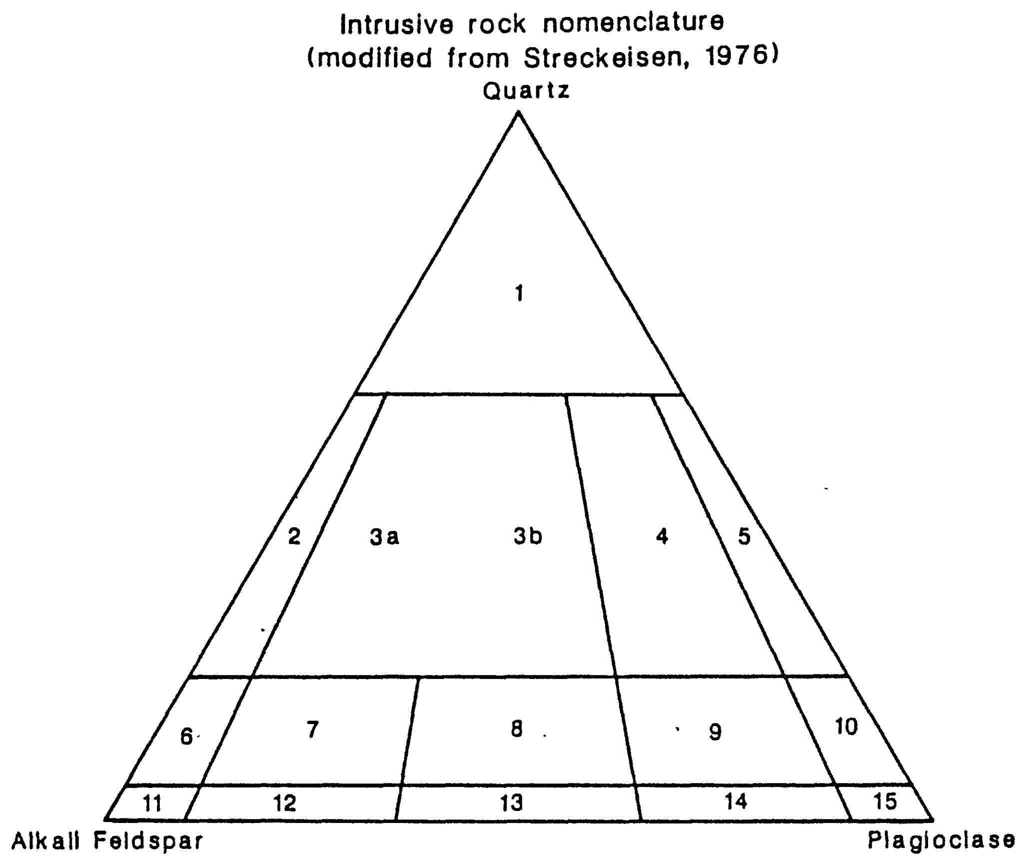


Figure 2: Ternary diagrams of quartz, alkali feldspar and plagioclase in intrusive rocks

Figure 2, continued:



1- quartz-rich granitoids
2- alkali-feldspar granite
3a- syenogranite
3b- monzogranite
4- granodiorite
5- tonalite
6- quartz alkali-feldspar syenite
7- quartz syenite
8- quartz monzonite
9- quartz monzodiorite/quartz monzogabbro
10- quartz diorite/quartz gabbro/quartz anorthosite
11- alkali-feldspar syenite
12- syenite
13- monzonite
14- monzodiorite/monzogabbro
15- diorite/gabbro/anorthosite

Table 1.--Characteristics of Intrusive Rocks

Intrusive	Composition	Essential Minerals	Accessory Minerals	Age (Ma)	Age Determination Type	Comments and References
Ta - quartz latite	quartz latite	plg,qtz,ksp (phenocrysts)	mag			porphyritic with aphanitic groundmass; plg invariably altered to ser±cct; mag variably oxidized to hem (12)
Tm - mafic dikes	andesite to basalt	plg,prx,bio hbl,chl; ±qtz,ksp	opq,apt			porphyritic, aphanitic to very fine-grained, intergranular groundmass, locally intersertal or subtrachytic; variably altered; intrude 82 Ma Bendeleben pluton; lev, ept, fex are alterations products; all essential minerals may occur as phenocrysts and(or) groundmass constituents
Kog - Oonatut Granite	granite	ksp,plg,qtz, bio	mag,all,apt, zir,sph, mnz(?)	69.2±2 71.2±2	K-Ar biotite K-Ar biotite	several textural phases including fine-grained equigranular, seriate and porphyritic; zoned tin granite complex; all essential minerals occur as phenocrysts in porphyritic phases; mus, flt, tml are late stage or deuteric minerals (4,5)
Kp - Pargon pluton	granodiorite, quartz monzodiorite, locally monzogranite	ksp,plg,qtz, bio;±hbl, prx	sph,zir;± apt,all,opq			fine-grained equigranular or fine- to medium-grained seriate; equivalent, in part to Kg and pCgn of Sainsbury (1974)
Kb - Bendeleben pluton	monzogranite to quartz monzodiorite	plg,ksp,qtz, bio	sph,opq;± all,zir,apt	81.8±2*	K-Ar biotite	fine-grained equigranular, seriate, fine- to medium-grained porphyritic; plg, ksp, qtz and bio are the phenocrysts in porphyritic phases (10)
Kkz - Kuzitrin pluton	monzogranite, quartz monzonite, granodiorite	ksp,plg,qtz, bio;±hbl	opq,sph,apt, all,zir	83.0±1.4	K-Ar biotite	fine- to coarse-grained seriate or porphyritic; mus is a secondary mineral; ksp is the phenocryst in porphyritic varieties (3)
Kku - Kugruk pluton	quartz monzonite to quartz monzodiorite	plg,ksp,qtz, hbl,bio	sph,mag,apt, zir,all	94.8±2.8*	K-Ar biotite	fine- to medium-grained, seriate; (age provided by T.P. Miller, written communication, 1984) (9,12)

Table 1.--(continued)

Kae - Asses Ears stock	monzogranite, syenogranite	ksp,plg,qtz, bio,hbl	all,apt,zir, sph,opq			coarse-grained, porphyritic; characterized by large ksp phenocrysts (2,3)
Kcb - Crossfox Butte stock	monzogranite to quartz monzonite	ksp,qtz,plg, bio	flt,mus,all, opq			fine- to medium-grained, seriate to subporphyritic; ksp is the phenocryst in subporphyritic varieties (2,3)
Kvb - Virginia Butte stock	quartz monzonite to syenite	ksp,qtz,plg, bio,hbl	all,zir,apt; ±opq	94.8±1.9	K-Ar biotite	fine- to coarse-grained, seriate to porphyritic; ksp and plg are phenocrysts in porphyritic varieties (3)
Knh - Nimrod Hill stock	monzonite	ksp,plg,hbl, prx;minor qtz and bio	sph,opq,apt, zir			fine- to coarse-grained, seriate or porphyritic; ksp is the phenocryst in porphyritic varieties (3)
Kd - Darby pluton	quartz monzonite, granodiorite	ksp,plg,qtz, bio,hbl	mag,all,sph, apt,zir; ±flt	90.5±1.5* 95.1±2.7* 94.4±2.9* 96.4±3*	K-Ar biotite K-Ar hornblende K-Ar biotite K-Ar biotite	coarse-grained, porphyritic; first 2 dates are a mineral pair; characterized by large ksp phenocrysts (10)
Kwc - Windy Creek pluton	quartz monzonite	plg,ksp,qtz, hbl,prx	sph,opq,apt, zir,all;± flt			fine- to coarse-grained, seriate to subporphyritic, locally porphyritic with aphanitic to very fine-grained groudmass; cut by biotite granodiorite dikes; locally argallized, Fe-stained, w/qtz-MoS_2-FeS_2 veinlets; plg, ksp and qtz are the phenocrysts in the porphyritic phase (7)
Kkd - diorite	syenite	ksp,plg,bio, hbl;minor qtz, prx	apt,opq; ±sph			coarse-grained; border phase(?) of Kkms (8)
Kkgm - gneissic monzonite	granodiorite	qtz,plg,ksp, bio	opq,apt;± ept			medium-grained; border phase(?) of Kkms; cct, mus and chl are secondary minerals (8)
Kkg - Kachauik granodiorite	granodiorite, quartz monzonite	plg,ksp,qtz, bio,hbl,prx	sph,zir,apt, all,mag			coarse-grained, porphyritic; plg and mafic minerals are phenocrysts and groundmass constituents (8,10)

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Table 1.--(continued)

Kkms - Kachauik monzonite-syenite	monzonite, syenite	ksp,plg,hbl, prx	sph,apt,zir, mag,all	99.3±3*	K-Ar hornblende	medium- to coarse-grained, porphyritic; ksp, hbl and prx are phenocrysts and groundmass constituents (8,10)
Kdc - Dry Canyon stock	nepheline syenite	nph,ksp,hbl, prx	sph,apt,opq	108±3*	K-Ar hornblende	trachytoid fabric (6,8)
Kad - alkaline dikes	nepheline syenite, pseudoleucite porphyry	ksp,nph,psl, gar,bio	flt	96.3±3	K-Ar biotite	fine- to medium-grained, equigranular to seriate, porphyritic; psl is the phenocryst in the porphyry (1,6,8)
Kpg - pegmatite	alkali feldspar granite to quartz monzodiorite	ksp,plg,qtz	tml,gar;± mus,bio,flt, opq,apt,sph, sil,kyt,and, all,prx			coarse-grained, seriate to equigranular
Kfg - foliated granite	granite	ksp,plg,qtz, bio;±hbl	apt,zir,opq, all,sph			mostly fine-grained, equigranular to seriate, foliated; mineral segretation layering common
Kgu - undiff. granite	granite, granodiorite	ksp,plg,qtz;	±bio,hbl mus,gar,tml, sph,opq,zir, all,apt, tpz(?),cdm(?), cdt(?)			fine- to coarse-grained, equigranular to porphyritic; ksp, plg, qtz, bio and hbl occur as phenocrysts in various porphyritic varieties
MzPzt - Spruce Creek stock	tonalite (calcic trondhjemite)	plg,qtz; ±hbl	opq,zir;±bio			fine- to coarse-grained, seriate to subporphyritic, locally porphyritic with very fine-grained groundmass; hbl preserved only in northernmost exposures of main body, elsewhere altered to chl+ept±opqs; plg and qtz; plg and qtz are phenocrysts in the porphyritic phase (12)

* previously reported ages recalculated with new (IUGS) K-Ar age constants

Table 1.--(continued)

Mineral abbrebviations used in this table

all	allanite	hbl	hornblende	prx	pyroxene
and	andalusite	hem	hematite	psl	pseudoleucite
apt	apatite	ksp	alkali feldspar	qtz	quartz
bio	biotite	kyt	kyanite	rtl	rutile
cct	calcite	leu	leucoxene	ser	sericite
cdm	corundum	mag	magnetite	sch	scheelite
cdt	cordierite	mnz	monazite	sil	sillimanite
ept	epidote	mus	muscovite	sph	sphene
fex	iron oxides	nph	nepheline	tml	tourmaline
flt	fluorite	opq	opaques	tpz	topaz
gar	garnet	plg	plagioclase	zir	zircon

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Table 2.--Analytical data for new K-Ar ages

Sample no.	Unit	Mineral	latitude	longitude	K_2O%	$^{40}Ar_{rad}$/gm	$^{40}Ar_{rad}$/$^{40}Ar_{total}$	Age	Analytical error (1σ)
83AGe124a	Virginia Butte stock	biotite	65° 42'50"N	163° 08'39"W	9.27 9.25 9.26 9.23	1.2851×10^{-9} 1.3065×10^{-9}	0.886 (88.6%) 0.935 (93.5%)	94.8	±1.9
83AGe90	Kuzitrin pluton	biotite	65° 23'18"N	163° 06'12"W	8.87 8.87 8.87 8.89	1.0818×10^{-9} 1.0862×10^{-9}	0.783 (78.3%) 0.918 (91.8%)	83.0	±1.35
68AMm324	Kugruk pluton	hornblende	65° 42'N	162° 35'W	0.660 0.665	9.275×10^{-11}	0.66 (66%)	94.8	±2.8

constants: $\lambda_\varepsilon = 0.572 \times 10^{-10} year^{-1}$, $\lambda_\beta = 4.93 \times 10^{-10} year^{-1}$

$\lambda'_\varepsilon = 8.78 \times 10^{-13} year^{-1}$

$^{40}K/K = 1.167 \times 10^{-4}$ atom percent

Footnote: Following completion of the geologic map, 2 new age determinations were reviewed. This information is reported here, but the sample locations are not on the geologic map

Sample no.	Unit	Mineral	latitude	longitude	K_2O%	$^{40}Ar_{rad}$/gm	$^{40}Ar_{rad}$/$^{40}Ar_{total}$	Age	Analytical error (1σ)
83Age117	Asses Ears stock	biotite	65°44'40"N	163°10'48"W	9.13 9.15 9.14 9.15	1.2953×10^{-9} 1.3051×10^{-9}	0.863 (86.3%) 0.910 (91.0%)	96.2	±1.6
83AGe126	Crossfox Butte stock	biotite	65°47'17"N	163°17'21"W	8.87 8.92 8.89 8.97	1.1723×10^{-9} 1.2347×10^{-9}	0.8387 (83.87%) 0.9612 (96.12%)	91.5	±2.8*

*Some biotite in 83AGe126 was chloritized, and this age should be considered suspect

Surficial deposits and sedimentary rocks

Sedimentary deposits are poorly exposed in the study area, and include rocks of Tertiary and possibly late Cretaceous age. The large basins which flank the Bendeleben and Kigluaik Mountains contain Tertiary sediments that are exposed locally on the basin boundaries. Sedimentary rocks of Eocene age have been found in a small basin in the northern Darby Mountains (T. Ager, written comm., 1985). The best exposures of sedimentary rocks (TKs, TKc) are found along the eastern boundaries of the Bendeleben and Solomon quadrangles in the Kugruk fault zone. Rocks containing significant amounts of coal are also found in this zone.

FOSSIL DATA

The fossil locality map and associated tables (Appendix B) contains all the pre-Quaternary megafauna and microfauna data collected during the course of the Bendeleben-Solomon AMRAP Project (1982-85). In addition, because fossil data from central Seward Peninsula are scarce, we have also tabulated all pre-Quaternary fossil occurrences (excluding pollen and plants) published since 1960 as well as all available previously collected but unpublished USGS fossil data.

Only a few collections were made in the map area prior to 1960 (Brooks and others, 1901; Collier, 1908; Smith, 1910; Smith and Eakin, 1911; Kindle, 1911). Re-collections were made at as many of these localities as could be precisely located by W.W. Patton, Jr., USGS, in the early 1970's and by Dumoulin during the Bendeleben-Solomon AMRAP Project. Results of the pre-1960 collections are summarized in the "Remarks" column of the fossil tables adjacent to the appropriate recollection. Where necessary, J.T. Dutro, Jr., USGS, provided revised age assignments, based on modern stratigraphic and paleontologic information, for the older collections.

Since 1960, fossil data from central Seward Peninsula has been published by Miller and others (1972); Sainsbury (1974); and Oliver and others (1975). All pertinent faunal lists and collection localities contained in these publications are reprinted here. Previously unpublished data from the map area was provided by T.P. Miller, W.W. Patton, Jr., and C.L Sainsbury. T.J. Ryherd, Alaska Division of Geological and Geophysical Surveys, kindly allowed reference to his unpublished fossil discoveries in the southern Kotzebue quadrangle.

Pre-Quaternary pollen and plant collections (not tabulated here) have been published in Hopkins (1963 and 1967), and Hopkins and others (1971). Data on Quaternary fossil collections from central Seward Peninsula can be found in Kaufman and Hopkins (1985).

The fossil locality map should be used in conjunction with the geologic map; geologic units are not shown on the locality map, but unit assignments are given in the tables. Fossil localities appear on the map according to field number; in the table, field numbers are listed in alphabetic and then numeric order, and USGS collection numbers are also listed where appropriate.

During the course of AMRAP, a few collections were made in the westernmost parts of the Norton Bay and Candle quadrangles where they adjoin the AMRAP map area. The results of these collections are listed in the tables although the localities are not shown on the map.

There are three explanatory tables in Appendix B. Table 1, the megafossil collections; Table 2, the microfossil collections; and Table 3, barren collections made in search of microfossils.

If more than one sample was collected at a single locality (for example, both megafossils and microfossils were collected, or microfossils were collected by two different workers or in two different years) cross references are given to all other collections from that locality in the "Remarks" column.

If different lithologies were collected at a single locality, or if the lithology collected represents a subordinate lithology for that geologic unit, this fact is mentioned in the "Remarks" column. In a few cases, fossils have been obtained from outcrops of a given geologic unit which are too small to be shown at the scale of the geologic map. Such cases of discrepancy between unit assignment in the fossil tables and unit distribution on the geologic map are explained in the "Remarks" column. Lastly, where newly obtained fossil data is in conflict with previously published age assignments, such conflicts have been noted (also in the "Remarks" column).

Megafossils have been found at 19 localities. The megafauna consists of tabulate and rugose corals, stromatoporoids, bryozoa, and brachiopods identified by W.A. Oliver, Jr., J.T. Dutro, Jr., and O.L. Karklins, all of the USGS. Most of the collections come from unit Ddm (11 collections); but Pzm (6), Od (1), and a clast in TKc (1) also yielded Paleozoic megafossils. Most of the known megafossil localities were also collected for microfossils.

Ninety-one microfossil collections were recovered from 80 localities. Conodonts dominate the Paleozoic microfauna, but phosphatic brachiopods, lapworthellids, phosphatic spine steinkerns, radiolaria, and ichthyoliths were also found. The Paleozoic microfauna was identified by A.G. Harris, J.E. Repetski, and K.M. Reed (USGS); and B.K. Holdsworth (University of Keele, England). Again, most of the collections (27) come from unit Ddm. Other units which contain Paleozoic microfossils are TKc (21 collections from individual clasts in the conglomerate), Od (11), D€bm (7), Pzd (6), O€x (6), DObm (5), Pzm (3), Sd (1), Oim (1), and €d (1). Younger microfossils (pollen) have been recovered from two localities in TKs and identified by E.B. Leopold (University of Washington).

Conodont color alteration indices (included under "Remarks") indicate minimum temperatures reached by the host rocks (see Epstein and others, 1977, for a full explanation of CAI theory and practice). The currently accepted temperature ranges for given CAI values are provided at the end of Table 2. However, it should be noted that anomalously high CAIs can be produced by exposure to saline or corrosive fluids (such as may be involved in episodes of mineralization or dolomitization).

Biofacies interpretations for conodont faunas are also provided, where appropriate, under "Remarks". More information on provincialism and biofacies in lower Paleozoic conodonts can be found in Clark (1984).

It should also be noted here that in the highly deformed and metamorphosed carbonates of central Seward Peninsula, much better success was achieved in recovering conodonts from dolomitic carbonates than from calcitic carbonates. This is the opposite of the situation in unmetamorphosed carbonates, where limestones typically yield more abundant and better preserved faunas than do dolostones (A.G. Harris, written commun., 1985). More than two thirds of the central Seward Peninsula conodont faunas were obtained from dolostones; only 30% of collections from dolostone were barren, compared to 65% of collections from metalimestone and marble.

Lastly, a list of localities which yielded collections barren of microfossils is included here for two reasons. First, to indicate that where fossil data from certain units or geographic areas is sparse, it is not usually due to lack of sampling. Second, to indicate where future sampling for conodonts might most profitably be undertaken.

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APPENDIX A:

UNIT DESCRIPTIONS, SOLOMON, BENDELEBEN, AND SOUTHERN KOTZEBUE QUADRANGLES

SURFICIAL DEPOSITS

Qbm - Modern beach deposits (Holocene)

Clean sand and cobbly sand forming modern spits, beaches, and barrier bars

Qb - Beach deposits (Pleistocene)

Silt, sand, and gravel deposited during the last interglacial (Pelukian) and perhaps older marine transgressions on the southern coastal plain (north of Safety Sound). Includes ancient barrier bars composed of well-sorted sand forming linear ridges

Qe - Dune sand deposits (Pleistocene)

Well sorted, fine sand generally overlain by thin silt cover. Found west of Golovin Lagoon where it is exposed in swales and river cuts

Qs - Silt and peat deposits (Quaternary)

Thick deposits of weakly stratified, well-sorted eolian silt with sand, organic-rich silt, and detrital peat. Contains ice wedges and high volume of interstitial ice. Supports numerous thaw lakes and pingos. Found in marshy, topographic depressions throughout the map area

Qlt - Lake terrace deposits (Pleistocene)

Stratified sand and silt with some fine gravel. Forms terraces above Imuruk, Kuzitrin, and Salmon Lakes

Qd - Glacial drift, undivided (Late Quaternary)

Unsorted, nonstratified till; locally stratified and sorted ice-contact and outwash gravel. Includes drift deposits from the four most recent glacial intervals recognized on the Seward Peninsula by Kaufman and Hopkins (1986). The oldest deposits (assigned to the Stewart River glaciation) are probably pre-Wisconsin in age. They form subdued, gravelly ridges that have been substantially modified by post-glacial weathering. Drift of the next younger interval (Salmon Lake) is found closely nested behind the older, outermost drift. In the study area, glaciers of this interval were largely restricted to mountain valleys, but south of the Kigluaik Mountains, they spread out beyond the mountain front forming large, piedmont lobes. Glaciers of the succeeding interval (Mount Osborn) were confined to mountainous tributary valleys where they left moraines that retain their morphologic freshness. The youngest ice advance is latest Wisconsin or early Holocene age, recorded only in a few of the highest valley heads.

The unit is found far inside the limits of much older drift which, on this map, has been included in map unit Qc. A more thorough discussion of the

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study area's glacial history is provided by Kaufman (1985) and Kaufman and Hopkins (1986)

Qc - Silty colluvium, undivided (Quaternary)

Massive to weakly stratified silt, fine sand, and pebbles derived predominantly from windblown or frost-rived materials. In valley bottoms, deposits include stratified organic silt and peat with abundant interstitial ice. On valley walls, deposits form solifluction lobes of poorly sorted stony silt. On hill tops and ridges, material is angular, frost-rived bedrock rubble. Along mountain flanks, unit includes aprons of inactive alluvial fans. North of the Kigluaik Mountains, around Safety Sound, and in McCarthy's Marsh, unit includes extensive areas of (early Pleistocene) glacial deposits highly modified by weathering processes and commonly overlain by a thick cover of windblown silt. The volcanic rocks of the Imuruk Lake lava plateau, also overlain by a thick mantle of silt, are included in this unit. The most widespread surficial unit throughout the map area

Qal - Alluvium, undivided (Quaternary)

Stratified deposits of sorted gravel, sand, and silt. Includes active channel, terrace, overbank, fan, oxbow lake fill, glaciofluvial and lagoon deposits, and dredge tailings. Also includes small eolian sand dunes on point bars in the major basins and thermal spring thaw zones

QTkg - Kougarok Gravel (Quaternary, Tertiary)

Oxidized, quartz-rich pebble-cobble gravel with lenses of silt, sand, and abundant detrital plant debris. Locally contains ice-wedge pseudomorphs. Forms as terrace remnants along the northwest margin of Kuzitrin River basin.

Locally divided into lignified wood and peat unit (1) exposed in wave-cut pingos near the confluence of Noxapaga River and Turner Creek (noted QTkg (1) on the map). Unit was called middle member of the Kougarok Gravel by Hopkins (1963) and Noxapaga Formation by Sainsbury (1974). Contains a middle Miocene pollen assemblage (T. A. Ager, written commun., 1985)

VOLCANIC ROCKS

Qlj - Lost Jim Basalt (Holocene)

A single basaltic lava flow and associated vent deposits which are undisrupted by frost brecciation. Found in the central Bendeleben quadrangle

Qv - Volcanic rocks, undivided (Quaternary)

Basalt flows and associated vent deposits that are slightly to strongly fragmented by frost riving and are locally overlain by windblown silt. Alkali olivine basalt and olivine tholeiite. Alkalic rocks contain phenocrysts of olivine with plagioclase, augite, and spinel in the groundmass. Tholeiitic rocks contain plagioclase phenocrysts with augite, hypersthene, olivine, and spinel in the groundmass (Swanson and others, 1981). Underlies portions of the Lost Jim Basalt in the central Bendeleben quadrangle. Includes the Camille Basalt and Gosling Volcanics of Hopkins (1963), as well as small flows in the valley centers of Lava and Bear Creeks. K-Ar determinations on basalt from the Kugruk River canyon (Turner and Swanson, 1981) and from Minnie Creek (Kaufman and Hopkins, 1985) indicate that the Gosling Volcanics were in part extruded between 0.8 and 0.9 Ma. The Camille Basalt is younger by an unknown amount of time

QTv - Volcanic rocks, undivided (Quaternary and Tertiary)

Basalt lava flows and associated vent deposits that are thoroughly fragmented by frost action. The most widely distributed and voluminous volcanic rocks underlying most of the Imuruk Lake lava plateau but mapped only where exposed through an otherwise 1-6 m thick mantle of windblown silt. Mostly alkali olivine basalt, lesser olivine tholeiite. Alkalic rocks contain phenocrysts of olivine with plagioclase, augite, and spinel in the groundmass. Tholeiitic rocks contain plagioclase phenocrysts with augite, hypersthene, olivine, and spinel in the groundmass (Swanson and others, 1981). Includes the Imuruk Volcanics of Hopkins (1963) which are between 2 and 5 Ma (Hopkins and others, 1971; Turner and Swanson, 1981). Flows of the Imuruk Volcanics were confined by modern valley systems that drained north from the Imuruk Lake area and, as a result of subsequent stream incision, are now found as bench remnants high on valley walls. South and east of Imuruk Lake, older volcanic rocks are found capping ridge tops. These older rocks include the Kugruk Volcanics of Hopkins (1963) which encompass flows dated at 26-29 Ma (Turner and Swanson, 1981). The term "Kugruk Volcanics" was abandoned by Hopkins and others (1971)

TKv - Felsic volcanics (Tertiary, Cretaceous)

Rubble crop of volcanic rocks along Limestone Creek in the Bendeleben D-1 quadrangle. Two varieties of rock are present, both moderately to strongly limonite stained. One is a volcanic flow or tuff that contains up to 4% phenocrysts in an aphanitic, devitrified groundmass. The phenocrysts are predominately sanidine with rare quartz and plagioclase. No mafic minerals are present, but the morphology of rare aggregates of sericite, opaques and limonite suggest the former presence of biotite. The other rock is fragmental and contains schist, devitrified volcanics, and angular quartz fragments in a felsic(?), sericite-bearing matrix. May be a volcanic flow breccia or vent breccia rock.

The age of this rock is unknown. Felsic tuffs on St. Lawrence Island have yielded a K-Ar age of 39.3 Ma (Patton and Csejtey, 1980)

NOME GROUP

Metasedimentary rocks

Ddm - Dolostone, metalimestone and marble (Devonian)

Medium- to dark-gray-weathering, black to dark-gray dolostone, metalimestone and marble. Typically weathers to fist-sized rubble; outcrops occur along river banks or sea cliffs. Outcrops are not foliated, but are strongly fractured, commonly brecciated, and may be veined with coarse-crystalline calcite or dolomite. Consists of fine-grained, mostly non-ferroan or slightly ferroan dolomite, with subordinate fine- to coarse-crystalline calcite. Relict sedimentary structures include zebra dolomite, fenestral fabric, and mm-scale (algal?) laminations. Thin section textures, where not obscured by recrystallization and dolomitization, show rocks consist of packstones and wackestones; clasts include pellets, crinoid ossicles, and other fossil fragments. Minor associated chert. Conodonts of Early to earliest Late Devonian age have been found in 20 localities (Table 2). A megafauna of late Early, Middle, and early Late Devonian age consists of tabulate and rugose corals, stromatoporoids, brachiopods, and rare bryozoans. Megafauna, microfauna, and sedimentary features all indicate shallow-water depositional conditions. Occurs east of the Darby Mountains (Bendeleben A-1, B-1; Solomon C-1, D-1), along the Kugruk and Burnt Rivers (Bendeleben D-2), along the Fish River (Solomon C-3, D-3), in beach exposures near the mouth of Koyana Creek (Solomon C-4), and as isolated hills in the Bendeleben C-6 and D-5 quadrangles. Best exposed in seacliffs in the Solomon C-1 quadrangle, about 5 1/2 km southeast of Elim. Dolostone is the dominant lithology in the eastern exposures; metalimestone and marble predominate in the west and central exposures. Partially equivalent to 'Ddl' of Miller and others (1972)

DObm - Black metalimestone and marble (Devonian through Ordovician)

Black to dark-gray metalimestone and marble and subordinate dolostone exposed on sea cliffs on Kotzebue Sound (Kotzebue A-2 and A-3 quadrangles). Weathers gray, locally buff; commonly has fissile partings and is well layered. Layers range from 2-50 cm thick, with rhythmic alternation of thicker, coarse-crystalline and thinner, fine-crystalline layers. Relict sedimentary structures include graded bedding, cross-bedding, flame structure, loaded bed bottoms, channelized beds, and imbricated rip-up clasts. Two miles west of Cape Deceit, a 15-20 m thick interval of dominantly matrix-supported carbonate breccia, with rounded and angular clasts up to 5 m in diameter occurs in the section, as well as thinner (up to 1 m) intervals of carbonate-clast breccia. Local solution collapse features occur, and dedolomitization textures are noted in thin section. Subordinate argillite, phyllite, and radiolarian chert are found about a mile and a half west of Cape Deceit; quartz-graphite schist and impure marble (containing up to 20% graphite, quartz, albite and white mica) are abundant in the vicinity of Toawlevic Point. Conodonts of Middle Silurian, Late Silurian, and Silurian through Middle Devonian age have been obtained from well layered metalimestone at three localities in the Kotzebue A-2 and A-3 quadrangles (83 ADn 44, 83 ADn 75, 84 ADn 79C). Conodonts of Middle to Late Ordovician age were obtained from thinly layered "flaggy" metalimestone exposed about a mile and a half west of Cape Deceit, and graptolites of Late Ordovician (Caradocian and Ashgillian) age were obtained from the "flaggy" metalimestone and from argillite and limey argillite at this locality (Ryherd and Paris, 1986). Well layered metalimestone containing redeposited(?) rugose and colonial corals of Middle to Late Devonian age have been described from Willow Bay, in the Kotzebue A-1 quadrangle; these rocks may be a part of the DObm package (T. Ryherd, written communication, 1985).

Two small gabbroic plugs, intruded into rocks of this unit, are found west of Cape Deceit. They show relict ophitic textures and are partially recrystallized to a low-grade metamorphic assemblage of actinolite, epidote, and garnet.

The carbonate rocks of DObm have been intepreted to be carbonate turbidites and debris flows which brought material derived from platform carbonates into a slope and basinal depositional setting (Dumoulin and Till, 1985; Ryherd and Paris, 1985, 1986). The rocks may correlate, at least in part, with D€bm, and are intercalated with, and possibly facies equivalents of D€ks. Partially equivalent to 'Ml?', 'p€l' and 'Pzm' of Hudson (1977)

D€bm - Black marble (Devonian through Cambrian)

Black to dark gray marble and subordinate fissile impure marble, calcareous schist and mafic schist. Best exposed in sea cliffs on Norton Bay (Solomon C-1 and Norton Bay C-6 quadrangles); also forms rubble covered hills inland. Marble in layers of 1-20 cm, with rhythmic alternation of purer, coarse-crystalline and more impure, fine crystalline layers. Common mafic dikes, sills, and plugs, intrusive into the carbonate rocks, are one-half to two meters across, and weather light green. Contact metamorphic affects preserved include bleached carbonate rocks and albite-, chlorite-, epidote- and tourmaline-bearing skarn assemblages. The mafic rocks themselves are composed of fine-grained chlorite, actinolite, albite, and white mica; glaucophane inclusions are found in the albite. At two localities, mafic minerals form layers and are disseminated in the fine crystalline carbonate rock. Some mafic volcanism may have accompanied deposition of the carbonate; all of the mafic volcanics were affected by regional metamorphism along with the carbonate rocks. The marble protolith may be carbonate turbidites and periplatform ooze; unit may represent a more deformed equivalent of DObm. Intercalated with and possibly facies equivalent of D€ks. Seven conodont faunas were obtained from six localities in D€bm. Two faunas are of probable Middle to Late Silurian age (84 ADn 5H, 85 ADn 2B), one is middle Early Devonian (84 ATi 23) and one is Late Silurian to Early Devonian (84 ADn 31). Two faunas from westernmost exposures of D€bm are considerably older: one is middle Early through Late Ordovician (84 ATi 15Z), the other is Early Cambrian (84 ATi 57). There is thus a gap of over 100 million years between the oldest and youngest faunas obtained from this unit. At least three explanations could be invoked for this faunal distribution. If all conodont collections represent depositional ages, the unit may represent two episodes of deposition of lithologically similar material--one of Early Cambrian age, one of Late Ordovician-Early Devonian age, separated by a long interval of non-deposition. Or, deposition may have extended more or less continuously from Cambrian to Devonian time--present fossil collections from D€bm are few and future collections may eliminate the apparent hiatus. Alternately, some or all of the conodont collections could be reworked, and the depositional age of the entire unit could be Late Silurian-Early Devonian or younger. In this case, the western faunas would represent material eroded from an older (Cambrian and Ordovician) carbonate platform source; the eastern faunas could represent erosion from a younger source or faunas contemporaneous with deposition. Partially equivalent to 'Dld' of Miller and others, 1972

D€ks - Calc-schist (Devonian through Cambrian)

Forms Sullivan Bluffs on Kotzebue Sound (Kotzebue A-3 quad), Mt. Kwiniuk in the eastern Solomon quad, and beach cliff exposures in that vicinity. The calc-schist is medium-grained, contains quartz, calcite, white mica, chlorite, albite and graphite and shows relict sedimentary cross-bedding and graded bedding. Is apparently interlayered with DObm and D€bm; possibly is facies-equivalent. Contains abundant disseminated pyrite where exposed on Kotzebue Sound

Sd - Dolostone (Silurian)

Forms a rubble-covered hill in the southeast quarter of the Bendeleben A-1 quadrangle, east of the Tubutulik River and north of Lost Creek. Dominant lithology is light-gray weathering, light- to dark-gray fine-grained dolostone; associated lithologies are black dolostone and black marble. The light-gray dolostone yielded a Middle-Late Silurian conodont fauna (83 ADn 27); the conodont species association indicates a shallow, warm-water depositional environment. Several other lithologically similar dolostones in the southeast Bendeleben and northeast Solomon quadrangles contain Silurian-Early Devonian conodonts. These occurrences are presently mapped as Pzd but may, at least in part, belong to Sd

Od - Dolostone (Ordovician)

Pink- to light-gray to tan-weathering, gray to tan dolostone. Forms rubble crop in tundra, and local cliffs along river banks. Consists of fine-grained, mostly non-ferroan dolomite. Relict sedimentary features include: distinct color-mottling, reflecting an original, thoroughly bioturbated fabric; zebra dolomite, suggestive of evaporitic supratidal conditions; fenestral fabric, which generally occurs in tidal flat or shallow subtidal environments; and probable oncolites, which also indicate a shallow-water depositional environment. Conodont faunas have been obtained from eleven localities in this unit. Three distinct ages are represented: middle to late Early Ordovician (83 ACl 94, 83 ACl 114, 82 ADu 69, 83 ADn 29A), early Middle Ordovician (82 ADu 71), and middle Middle Ordovician (84 ADn 80A). Most of the assemblages represent shallow, to very shallow warm-water biofacies of the North America Midcontinent faunal succession. A single collection of poorly preserved corals has been obtained from this unit (68 ASn 130). Best exposures are on the east fork of the Burnt River and east bank of the Kugruk River in the Bendeleben D-2 quadrangle. Also exposed near the Tubutulik River (Bendeleben A-1), near American Creek (Solomon D-5) and east of Serpentine Hot Springs (Bendeleben D-5, C-5)

Oim - Impure chlorite marble (Ordovician)

The unit underlies rounded, buff- to orange-weathering hills and is found in great abundance in Solomon quadrangle in the vicinity of the Fish and Bonanza Rivers. The unit crops out poorly; rare outcrops show well-foliated impure marble to calc-schist. Impurities are most commonly chlorite and albite. Lenses up to a meter across and fine layers of chlorite and albite are diagnostic of the unit, and trace foliation and folds. Chlorite-albite lenses and layers are more abundant near the base of the unit. Locally pods of fine-grained metabasite are found, also more common at the base of the unit. These pods are distinct from the bulk of metabasite pods in the Casadepaga schist in their general lack of appreciable garnet and sphene, common in the Casadepaga rocks. The pods can be recognized in the field as piles of massive medium-gray rubble several meters across. In rare instances the unit may include pure marble or orange-weathering dark-gray dolostone. The unit is a minimum of 1.2 km thick. Conodonts of Early through Middle Ordovician age have been obtained from a dolostone lens in the upper part of the unit in the Solomon D-6 quadrangle (84 ATi 281). Excellent exposures of the unit can be found in the central Solomon D-6 quadrangle, on hill 1672 on the ridge between the

Casadepaga and Bonanza Rivers. Equivalent to 'pCsm' of Miller and others (1972) and 'pCl' of Sainsbury (1974)

Ocs - Casadepaga schist (Ordovician)

Forms rounded hills of frost-riven light-green and greenish-brown mafic schist, locally punctuated by dark greenish-black torrs and rubble piles several meters across. The schists are of various quartz-poor lithologies, the torrs are metabasite. Lithologies are dominated by components of mafic and calcareous composition. Chlorite-albite schist, mafic schist, chlorite-albite-epidote-white mica schist, chloritoid-glaucophane metapelite, and calc-schist are common. Lithologies are intelayered on a scale of tens of centimeters; the layering may occur in repetitive couplets. The schists form rare, poor to good outcrops on ridgetops. Boudins, lenses and layers of fine- to coarse-grained, massive metabasite comprise the greenish-black torrs of the unit. In thin section these rocks are found to be composed of glaucophane, actinolite, chlorite, epidote, garnet, albite, white mica, sphene, and locally quartz, fe-carbonate, pyroxene, and barroisite. Most of these metabasites are appreciably enriched in iron and titanium. A smaller percentage of the massive metabasite pods are garnet- and sphene-poor, and light to medium green on fresh surfaces. Mafic schist layers in the surrounding rocks have mineral assemblages similar to both kinds of metabasite pods. The metabasite torrs, common albite porphyroblasts in dark-green, chlorite-rich schist, and quartz-poor nature of the rocks are characteristic of this unit. The unit is 0.6 to 1.6 km thick. The unit is best exposed in southeastern Solomon D-5 quadrangle, north of the Nome-Council road on the ridge north and northwest of Horton Creek; in the central part of the Solomon D-5 quadrangle at the headwaters of Alma and Venture Creeks; and in east-central Solomon D-6 quadrangle on the ridgeline between Eldorado and Nelson Creeks, including hills 2144 and 2067. No fossils have been found in the Casadepaga Schist, but its age is constrained by its stratigraphic position between the Mixed unit (OCx) and the Impure chlorite marble (Oim), both of which contain Ordovician conodonts. In the vicinity of Kiwalik Mountain, it is intruded by a granitic orthogneiss Dg of middle Devonian age. First described by Smith (1910). Partially equivalent to the 'slate of the York region' of Sainsbury (1974), and 'pCqms' of Miller and others (1972)

OCx - Mixed unit (Ordovician, Cambrian)

Interlayered pure and impure marble, quartz-graphite schist, pelite, calc-schist, and mafic schist. Marble, gray and orange weathering, and dark gray-black weathering quartz-graphite schist are the most common lithologies in the unit, which may be dominated locally by one or the other. The unit is further defined by its position stratigraphically between the underlying pelitic Solomon Schist and overlying Casadepaga schist. Good exposures are rare. Minor lithologies generally do not crop out; gray-weathering pure marble forms rounded ridgelines which may stretch along strike for several miles, and rounded hills of slabby, black quartz-graphite schist can be recognized from great distances. Internal stratigraphy is not consistent; lithologies thicken and thin along strike on a scale of kilometers, a feature which may be depositional as well as structural. Although most lithologies in this unit occur in others, the quartz-graphite schist is known only in this unit. The quartz-graphite schist is generally uniform, dark-gray or black, and compositionally limited to quartz, graphite, and small amounts of white mica, albite and chlorite. Graphite may comprise more than 50% of the rock, and may rub off on the hands. Locally a centimeter-thick banding of dark gray-black quartz-graphite schist and gray-black quartz-graphite-calcite schist are found. The uppermost lithology in the unit is commonly an orange weathering chlorite marble which forms stepped outcrops. Boudins of glaucophane-, epidote-, and garnet-bearing metabasite, similar to those found in the Casadepaga schist, are present locally at the top of the unit. These boudins are most common south of Salmon Lake in the northeast Solomon quadrangle. Thickness variable from 0.8 to 1.5 km. Age range of the unit not strictly known. Conodonts of Ordovician age were obtained from relatively pure marble in the upper part of the unit (sample 84 ADn 75Z). Recrystallized radiolaria collected in the northern Darby Mountains in banded calcite-bearing quartz-graphite schist are of probable pre-Devonian age (B. K. Holdsworth, written communication, 1985). Partially includes 'p€s' and 'slate of the York region' of Sainsbury (1974). Best exposed in the eastern Solomon D-5 unit on the ridge to the northwest of upper Birch and Auburn Creeks, and in east-central Solomon D-6 quadrangle on the ridgetop just south of Nelson Creek

€p€s - Solomon schist (Cambrian, Precambrian)

Tors of resistant, well foliated quartz-rich schist. Pelitic rocks are the dominant lithology in the unit, with lesser calc-schist and locally marble present. Outcrop appearance of the pelitic schist is diagnostic of the unit, and shows 1-2 cm-thick bands of quartz interlayered with micaceous minerals. In thin section, major minerals include quartz, muscovite, chlorite, chloritoid, and locally graphite, glaucophane and garnet. Quartz layers parallel foliation and trace isoclinal and chevron-style folds axial planar to the foliation. Minor lithologic variation may occur on outcrop scale, commonly of calc-schist and quartz-rich schist. Typical outcrops of the pelite occur in the northeast Solomon D-5 quadrangle, along the ridgeline south of the Bermudez Bluff to the headwaters of Camp Creek. The torrs on Monument Mountain, in the Bendeleben C-1 quad, also are composed of this unit. Calcareous schist may occupy expanses mappable at 1:63,360, as is the case in the central Solomon D-5 quad. Large marble and dolostone bodies, also mappable at 1:63,360, are found in the northern Solomon D-5 quad. These bodies may have depositional or structural relationships to the surrounding pelitic schist. Base not exposed; minimum 1.2 km thick. The age of the unit is not strictly known. No fossils have been collected from lithologies with demonstrably depositional relationships to the pelite. May have undergone one more period of deformation than the overlying schist (Gardner and Hudson, 1984). First described by Smith (1910). Equivalent to 'p€st' of Sainsbury (1974)

€d - Dolostone (Cambrian)

Forms several small knobs in the Solomon D-5 and D-6 quadrangles southwest of American Creek and north of Auburn Creek. Major lithology is light- or medium-gray to pinkish-orange dolostone which weathers gray to orange and forms hilltop rubble patches and subcrop. The dolostone is non-ferroan to moderately ferroan and locally contains a few percent quartz and white mica. Structurally underlying this dolostone is a section of schist and marble several tens of meters thick. The upper third of this section consists of quartz-white mica schist and chloritic marble; the lower two thirds is mostly marble containing about 10% quartz, white mica and chlorite. The orange-weathering dolostone contains lapworthellids (84 ADn 108D), a phosphatic microfossil indicative of Early (to possible early Middle) Cambrian age and a shallow-water depositional environment

Pzim - Impure marble (Paleozoic)

This impure marble forms low rolling buff- to orange-colored hills in the central and western Bendeleben quad. Forms rare poor outcrops, which characteristically show foliation defined by orientation of white mica or chlorite. Albite, quartz and graphite are also common impurities. Age unknown. Very likely in part equivalent to or facies equivalent of impure chlorite marble (Oim)

Pzwm - White marble (Paleozoic)

Medium- to coarse-crystalline, white to very light gray marble, which contains up to 20-25% orange-tan ferruginous material in amorphous blebs and stringers up to 10 X 20 cm in diameter. Locally isoclinally folded and intensely brecciated. Spatially associated with D€bm; cross-cut by metamorphosed mafic dikes now composed of chlorite, actiolite, and albite with glaucophane inclusions. May essentially be subset of Pzm. No fossils have been obtained from this unit

Pzm - Marble, undivided (Paleozoic)

Generally light-gray-weathering, white to medium-gray, medium to coarsely crystalline marble. Forms rubble-covered hills and small outcrops. Dominantly pure, but contains up to 10% quartz, white mica and albite locally. Relationship to metamorphic stratigraphy unknown. May include rock of several different ages; parts, at least, probably correlative with Ddm but lack faunal or sedimentologic evidence diagnostic of that unit. In the Bendeleben C-6 and Solomon D-5 quadrangles, 5 localities contain poorly preserved stromatoporoids and colonial and rugose corals of Silurian to Devonian age; 3 localities contain conodonts of Ordovician to Devonian or Silurian to Devonian age. Occurrences which have yielded no fossils are assumed to be Paleozoic due to physical proximity to known Paleozoic carbonates

Pzd - Dolostone, undivided (Paleozoic)

Generally light-colored, fine-grained featureless dolostone which forms rubble-covered hills. Probably includes rocks of several different ages. Silurian to Devonian and Ordovician to Devonian conodont faunas have been obtained from four localities. Occurrences which have yielded no fossils are assumed to be Paleozoic due to proximity to known Paleozoic carbonates.

Rocks presently mapped as Pzd at Cape Deceit in the Kotzebue A-2 quadrangle may belong to the DObm package (Ryherd and Paris, 1985, 1986). Pzd may also include rocks correlative with Od, Sd, and/or Ddm but which do not now contain sedimentologic or faunal evidence that allow assignment to one of these units

Metaigneous rocks

Dg - Granitic orthogneiss (Devonian)

Forms the rounded, frost-riven slopes of Kiwalik Mountain. Fine-grained, very light gray to orange-weathering, well foliated white to light tan schist of granitic to tonalitic composition. Commonly forms weathered boulders 0.5-1 m across. Crops out rarely; where foliation can be measured, it is parallel to the foliation in the surrounding schist. Contact crosses lithologic layering in surrounding schist. Layers and boudins of the orthogneiss which have chilled margins are commonly found in country rock close to the contact. Quartz, albite, k-feldspar, and white mica are the most common constituents. Accessory minerals include biotite, epidote, fluorite, magnetite and calcite. U-Pb zircon age of 381 ±2 Ma (John Aleinikoff, written communication, 1983)

Pzg - Granitic orthogneiss (Paleozoic)

Rubble crop and outcrop of metagranitic rocks, intrusive into the protolith of the Nome Group. Composition varies within expanses mapped. Rubble crop only north of Serpentine Hot Springs; rubble crop and outcrop at Cape Nome. Outcrop at Cape Nome may include metasedimentary or metavolcanic rocks as well

PzpCf - Felsic schist (Paleozoic, Precambrian)

Light orange to light green weathering fine to coarse-grained quartz-feldspar-white mica schist. Present on the southwest flank of Kiwalik Mountain and in stream gravel at the confluence of Independence Creek with the Kugruk River. Rarely accessory black tourmaline is found lying in plane of foliation. Stream gravels include apparently meta-clastic rock which has the appearance of a flattened matrix-supported conglomerate or fragmental volcanic, composed of clasts and matrix of the minerals listed above. Clasts show greatly varying grain size and internal textures. The contact between this lithology and the lithologies of the Nome Group may be a fault

HIGH GRADE ROCKS OF THE KIGLUAIK, BENDELEBEN AND DARBY RANGES

Oimh - Impure marble (Ordovician)

Orange weathering, well-foliated marble with biotite and/or chlorite defining foliation. Lenses of biotite, plagioclase, epidote, actinolite and chlorite occur locally. Upgraded equivalent of Oim. Best exposed in the northern Darby Mountains in the vicinity of the north fork of Omilak Creek. May be present in Bendeleben Range

Ocsh - Calcareous and mafic schist (Ordovician)

Brown to green weathering schist composed of a variety of quartz-poor lithologies, commonly including a mixture of mafic and calcareous minerals. Epidote, plagioclase, hornblende, calcite, and biotite are major minerals. Rocks may be color-banded in outcrop, showing brown biotite-rich layers and green hornblende and epidote-rich layers. Light-brown, massive schist composed of plagioclase porphyroblasts, biotite, and minor white mica may be a dominant lithology locally. Amphibolite, minor pelite, marble, and rare layers of orthoamphibole-cordierite schist also occur. Thought to be the upgraded equivalent of Ocs. Mapped in the Bendeleben and Darby Mountains; probably present in the Kigluaik Mountains

OCxh - Interlayered marble and quartz-graphite schist (Ordovician, Cambrian)

Light gray and dark gray to black layers of marble and quartz-graphite schist with minor interlayers of pelite, mafic schist, and calc-schist also present. Marble and quartz-graphite schist occur in layers tens of meters thick. Thought to be upgraded equivalent of OCx. Mapped in the Bendeleben Mountains; probably present in the Kigluaik and Darby Mountains

CpCsh - Pelitic schist (Cambrian, Precambrian)

Tors and ragged ridgelines characterize areas underlain by schist and gneiss of predominantly pelitic composition. Rock is dark brown to brownish-gray in outcrop, with bands and lenses of quartz up to 1-2 cm thick parallel foliation. Quartz bands trace folds with axial planes parallel to the foliation. Coarse pink garnets, 1-2 cm across, may be present. Pelitic minerals include biotite, garnet, kyanite, sillimanite, andalusite, staurolite, ± muscovite and k-feldspar. Rare cordierite. Metamorphic assemblages record at least two metamorphic events, high-pressure assemblages are overprinted by low-pressure minerals. Thought to be upgraded equivalent of the Solomon schist (CpCs)

PzpCh - High-grade schist, undivided (Precambrian to Mesozoic)

Metasedimentary and metaigneous schist and gneiss above biotite grade. Includes a variety of lithologies similar to those described in the units above. Contains areas in which above units (Oim, Ocsh, OCxh, CpCsh) probably can be mapped

PzpCm - High-grade marble, undivided (Precambrian to Mesozoic)

Generally light-gray weathering coarse-grained pure and impure marble, interlayered with units (PzpCh, Oimh, Ocsh) described above. Commonly massive, although meter-thick layers may be separated by thin layers of impurities or finer grained material. Minerals found in the marble include: calcite, dolomite, phlogopite, tremolite, quartz, scapolite, diopside, and graphite

PzpCg - Migmatite (Precambrian to Mesozoic)

Rocks similar to high-grade metamorphic units (PzpCh, Ocsh, OCxh, CpCsh, PzpCm) discussed above intimately intermixed on a scale of meters to tens of meters with and locally partially assimilated by granitic rock. Schist and gneiss upper amphibolite facies in grade; pelitic rocks generally contain assemblages above the second sillimanite isograd. Best exposed on Cape Darby. Also present around the Bendeleben pluton (Kb) and Kuzitrin pluton (Kks) in the Bendeleben Mountains

PzpCs - Metasediments (Precambrian to Mesozoic)

Amphibolite facies metasediments found on the northwest contact of the Oonatut Granite and in a septum crossing the Windy Creek pluton

PzpCa - Amphibolite (Precambrian to Mesozoic)

Rare rubble crop in the western Bendeleben Mountains of garnet amphibolite. Garnet surrounded by halo of symplektic intergrowth of feldspar and amphibole. Some pyroxene present relict from previous metamorphic event or igneous protolith

PzpCo - Orthogneiss (Precambrian to Mesozoic)

Light gray weathering fine- to medium-grained orthogneiss of the Kigluaik Mountains containing quartz, feldspar, white mica, biotite, ± garnet

ROCKS OF THE KUGRUK FAULT ZONE

TKs - Sandstone (Tertiary, Cretaceous)

Tan to light-gray siltstone, sandstone, and pebbly sandstone. Typically forms rubble-covered hills in the Bendeleben C-2 and A-1 quadrangles; best exposures are river-cliff outcrops along the lower reaches of Spruce Creek (Bendeleben C-2). Friable to well-indurated, calcite cement. Beds are 5 to 60 cm thick; sedimentary structures include graded bedding, channels, small scale ripples and cross-beds. Fine-grained layers are locally rich in carbonaceous plant debris. Locally coal seams are well developed. Poor to moderately well sorted, angular to rounded grains. Clast lithologies include: marble, dolostone, plagioclase, mono- and polycrystalline quartz, volcanic lithics (with felsitic and lathwork textures), blueschist facies metabasite, radiolarian chert, phyllite, quartz-mica schist, and amphibolite; carbonate clasts predominate at most localities. Clasts are derived from adjacent metamorphic rocks, but unit is strongly deformed (outcrops on Spruce Creek show vertical beds and are intruded by sills [Tm] of probable Tertiary or Cretaceous age). Two pollen collections have been obtained from this unit (61 APa 41 and 42); one is of Cretaceous age, the other of Tertiary (Eocene to early Miocene?) age. Equivalent in part to 'Kss', 'Kls', and 'TKs' of Sainsbury (1974)

TKc - Carbonate conglomerate (Tertiary, Cretaceous)

Light-gray-weathering conglomerate composed predominantly of marble, metalimestone and dolostone clasts. Minor associated sandstone and pebbly sandstone. Occurs as scattered outcrops east of the Darby Mountains (Bendeleben A-1, C-2; Solomon D-1; Norton Bay D-6). Forms rounded knobs up to 25 m high and more extensive areas of rubble crop. Bedding rarely discerned, but local sandy interbeds and crude grading present. Very poorly sorted, with a matrix of calcite cement and carbonate sand. Cobbles rounded and sub-rounded; largest cobble at a given outcrop ranges from 52 to 72 cm in diameter. Based on pebble counts, carbonate clast content ranges from a high of 98% in the Bendeleben A-1 quadrangle to a low of 81% in the Bendeleben C-2 quadrangle. Marble and metalimestone/dolostone ratios are variable, and range from 3:1 in the Bendeleben C-2 quadrangle to 1:2 in the Bendeleben A-1 quadrangle. Non-carbonate clasts include chert, mono- and polycrystalline quartz, quartz-mica schist, chlorite schist, and various greenstone lithologies, most commonly derived from the adjacent mylonitic metabasite.

Two small outcrops of mafic clast conglomerate underlie carbonate conglomerate in the Bendeleben C-2 quadrangle. Sorting is poor; clasts are rounded to angular and range up to 30 cm in diameter. Dominant clast lithologies are metavolcanic lithics (some containing blue amphibole); lesser lithologies include radiolarian chert, marble, quartz, and quartz-mica schist.

No fossils that pertain to depositional age of TKc have been obtained. The unit is deformed (vertical beds observed locally) but unmetamorphosed. Information is available on age of the source material. Carbonate clasts from six localities yielded 21 conodont collections. Ages of specific clasts include Middle to Late Ordovician, Early to Middle Silurian, Late Silurian and Early Devonian.

Depositional environment for TKc may have been a series of small alluvial fans. Equivalent to 'Klcg' of Sainsbury (1974) and 'Kc' of Miller and others (1972)

MzPzm - Mylonitic metabasite (Mesozoic, Paleozoic)

Rubble fields and poor outcrops of fine-grained, medium bluish-gray metabasite, commonly with well-developed foliation. Locally the foliation is even, laminar, and imparts a mm-scale color banding. In thin section rounded clinopyroxene grains are found in a finely foliated matrix of chlorite, actinolite, albite, ± crossite, lawsonite, pumpellyite, and epidote. Actinolite and epidote are more common in rocks found in the southern exposures of the unit, lawsonite and crossite in the northern. Rare samples retain gabbroic textures, and are medium-grained. Associated with serpentinite (MzPzs) at one locality. Equivalent of Pmv of Miller and others (1972) and Jv of Sainsbury (1974)

MzPzb - Metabasaltic rocks (Mesozoic, Paleozoic)

Rubble crop and rare outcrops of dark green, dark red and dark gray vesicular basalt and basaltic pyroclastic rocks metamorphosed to lower greenschist facies. Primary textures recognizable in outcrop and thin section. Epidote, pumpellyite, and chlorite common; relict plagioclase present

MzPzs - Serpentinite (Mesozoic, Paleozoic)

Rubble crop of light-green weathering dark greenish-black serpentinite. Found in two mappable lenses in the eastern Solomon quadrangle and in smaller bodies, up to 30 meters across, in beach cliffs on Kotzebue Sound. Southern lens is the largest and is closely associated with outcrops of the mylonitic metabasite (MzPzm)

MzPzt - Spruce Creek tonalite (Mesozoic, Paleozoic)

Scattered float and rubble along the middle to upper portions of Spruce Creek in the Bendeleben B-2 and B-3 quadrangles. Light tan to white weathering tonalite. Alkali feldspar is absent. Hornblende is preserved only in the northernmost exposures of the stock, along the west banks of Spruce Creek. Elsewhere, no primary mafic minerals are present; hornblende is altered to mixtures of chlorite, opaque minerals and epidote. An odd textural variety of the stock was found in one locality. Approximately 70% of this rock consists of concentrically radiating, spherulite-like intergrowths of plagioclase and quartz, often surrounding cores or nucleus grains of quartz or plagioclase. These intergrowths range from 0.7 to 1.7 mm in diameter and are not readily apparent in hand samples. The significance of this texture is not known. Several small exposures of an intrusive similar to the Spruce Creek stock occur along an unnamed stream that flows into the Kugruk River in the northwest corner of the Bendeleben C-1 quadrangle. Alkali feldspar is absent, and amphibole is completely altered to a mixture of chlorite, epidote and opaque minerals in most exposures

INTRUSIVE IGNEOUS ROCKS

Ta - Quartz latite (Tertiary)

Light tan to orange-weathering, altered, porphyritic dikes, sills and small plugs of uncertain age and composition. Mapped in the Bendeleben Mountains in the Bendeleben A-4 quadrangle. Approximately quartz latite in composition - may include rocks of rhyolitic to andesitic composition. May be, in part, equivalent to Kgl (quartz latite porphyry) and Khi (hypabyssal intrusive rocks) mapped by Miller and others (1972). Equivalent to "rhyolites of the western Bendeleben Mountains" of Turner and Swanson (1981). Whole rock K-Ar analyses of these altered rocks yielded late Cretaceous ages (Turner and Swanson, 1981) similar to tin granites of central and western Seward Peninsula (see Oonatut Granite). Textures in these dikes, sills and plugs indicate crystallization at shallower levels than the tin granites. However, active faults and Tertiary basins bounding the Bendeleben Mountains indicate that the country rocks to these felsites were at deeper crustal levels than the country rocks to the tin granites in late Cretaceous time. Intermediate to felsic dikes which crosscut Tertiary mafic dikes in the southern Darby Mountains are included in this unit due to their apparent youth rather than their compositional similarity to the altered bodies in the Bendeleben Mountains

Tm - Mafic dikes (Tertiary)

Undifferentiated mafic dikes and sills mapped in the Solomon C-4, D-1, D-4 and Bendeleben A-4, B-3, and C-2 quadrangles and noted in the Bendeleben and Kigluaik Mountains. Approximately basaltic to andesitic in composition. May be related to Tertiary volcanic activity; intrude 82 Ma Bendeleben pluton. May be, in part, equivalent to the lamprophyre dikes noted by Miller and others (1972) as intrusive into the Kachauik and Darby plutons

Kog - Oonatut Granite Complex (Late Cretaceous)

Pinnacle outcrops, rubble, and float exposed around Serpentine Hot Springs in the Bendeleben D-5 and D-6 quadrangles. Locally cut by the headwaters of Hot Spring Creek and the Fish River. Predominantly monzogranite with lesser syenogranite. K-Ar ages of 69.2±2 and 71.2±2 were obtained from biotite from semiporphyritic and porphyritic phases respectively (Hudson, 1979). Easternmost of the tin granites on the Seward Peninsula. Placer deposits of gold and cassiterite occur in streams draining portions of the granite. Mineralized dikes, veins, gossans, and soils are present immediately east of the pluton in the metamorphic country rocks. These appear to be fault localized occurrences, and contain anomalous amounts of Ag, As, Au, Cu, Hg, Pb, Sb, Sn, and Zn (Hudson, 1979)

Kp - Pargon pluton (Cretaceous)

Frost-riven rubble, talus, and rare outcrops exposed on ridges above the Pargon River in the Bendeleben A-4 quadrangle. Granodiorite and quartz monzonite are the dominant lithologies and appear to grade into each other. Lacks the migmatite zones common around the Bendeleben and Kuzitrin plutons. Assumed to be Cretaceous in age because of similarities to other intrusives of the Seward Peninsula

Kb - Bendeleben pluton (Cretaceous)

Outcrop, talus, rubble, and some cirque headwall exposures in the eastern Bendeleben Mountains in the Bendeleben A-2, A-3, B-2 and B-3 quadrangles. Monzogranite to quartz monzodiorite; the contacts between quartz-rich and quartz-poor phases appear sharp, but were not seen in outcrop. Inclusions of plagioclase-biotite-pyroxene-quartz schist are locally common, and spectacular exposures of large inclusions or blocks of schist are present on the northeast side of the ridge in section 7, township 3 south, range 19 west (Bendeleben A-2 quadrangle). Varying degrees of assimilation of this schist may account for the mineralogical and lithological variations observed in the pluton. The contact of the pluton with the surrounding metamorphic rocks is not sharp; beyond the main body of the pluton is a migmatite zone (PzpCg) of mixed metamorphic and granitic rocks. The percentage of granitic rocks in this zone decreases with distance from the main body of the pluton. A K-Ar date of 81.1±2 was obtained by Miller and Bunker (1976)

Kkz - Kuzitrin pluton (Cretaceous)

Exposed in the Bendeleben B-2, B-3 and C-3 quadrangles. Primarily talus and frost-riven rubble on the north flank of the Bendeleben Mountains and several small rubble fields in the southernmost Imuruk Lake basin. Predominantly monzogranite. The southern contact of the granite is not sharp. Surrounding the pluton is a migmatite zone (PzpCg) of mixed granitic and metamorphic rock rubble. This zone extends at least 2 km from the main body of the pluton, and the percentage of granitic rock decreases with distance from the pluton. This migmatite zone also surrounds the Bendeleben pluton, and is present throughout much of the eastern Bendeleben Mountains. The Kuzitrin and Bendeleben plutons have similar chemistry, mineralogy, and ages, and may be comagmatic intrusives. A sample from Sturgeon Ridge in the Bendeleben B-3 quadrangle has yielded an age of 83.0±1.4 Ma. Hopkins (1963) correlated the Kuzitrin pluton with a belt of intrusives that extend 32 km north of the pluton including the Nimrod Hill, Virginia Butte, and Crossfox Butte stocks. Based on differences in lithologies, chemistry and ages, this correlation is not adopted here

Kku - Kugruk pluton (Cretaceous)

Frost-riven rubble in the northeast corner of the Bendeleben C-2 quadrangle. Quartz monzonite to quartz monzodiorite. Green porphyritic rocks of approximately dioritic composition are present at the eastern margin of the pluton and may be a border phase. Aeromagnetics suggest that the pluton is larger than mapped. The age of the pluton is 94.9±2.9 Ma (T. P. Miller, oral commun., 1984)

Kae - Asses Ears stock (Cretaceous)

Frost-riven outcrops, rubble fields and float around Asses Ears in the Bendeleben C-3 and D-3 quadrangles. Monzogranite to syenogranite. Strikingly porphyritic with alkali feldspar phenocrysts 2 to 4 cm long

Kcb - Crossfox Butte stock (Cretaceous)

Frost-riven rubble 1 km south of Crossfox Butte in the Bendeleben D-3 quadrangle. Monzogranite to quartz monzonite. One piece of a leucocratic syenite was found which contains several percent purple fluorite, muscovite, and minor scheelite. Country rock rubble around the stock consists of hornfelsed marble and calc-silicate rocks. The calc-silicate hornfels locally contains minor scheelite. Called the American Creek granite by Herreid (1966)

Kvb - Virginia Butte stock (Cretaceous)

Scattered rubble fields and frost-riven outcrops south and east of Virginia Butte in the Bendeleben C-3 quadrangle. Quartz monzonite to syenite. A sample from the south flank of Virginia Butte yielded a date of 94.8±1.9 Ma

Knh - Nimrod Hill stock (Cretaceous)

Scattered rubble fields surrounded by tundra on Nimrod Hill in the Bendeleben C-3 quadrangle. The map pattern delineates the extent of float and rubble fields. Monzonite. Several blocks of a biotite-rich diorite were found near the southern portion of Nimrod Hill. Aeromagnetics suggest the stock extends to the west under Imuruk Lake and also suggests a possible connection with the Virginia Butte and Asses Ears stocks to the north. Assumed to be Cretaceous due to similarities to the Virginia Butte stock

Kd - Darby pluton (Cretaceous)

Elongate pluton 80 km long and 3 to 8 km wide, oriented N18E. Mapped in the Solomon B-2, C-1, C-2, D-1 and Bendeleben A-1 quadrangles. Outcrops are common in the northern part of the pluton; frost-riven rubble predominates elsewhere. Mostly monzogranite, locally granodiorite. Characterized by phenocrysts of alkali feldspar up to 5 cm long. Some gradual zonation of mineralogy: hornblende content decreases slightly to the north; and plagioclase content decreases slightly to the north with a corresponding increase in alkali feldspar and quartz contents. Locally cut by aplite dikes and lamprophyre dikes. Rounded or ellipsoidal inclusions of a mafic igneous rock are common. K-Ar ages range from 90.5±1.5 to 96.4±3 Ma (Miller and Bunker, 1976)

Kwc - Windy Creek pluton (Cretaceous)

Talus and frost-riven rubble at the north end of the Darby Mountains in the Bendeleben A-1 and A-2 quadrangles. Quartz monzonite. Locally cut by biotite granodiorite dikes. Miller and others (1971) found boulders of nepheline syenite in streams draining the east side of the pluton. Thought to be mid-Cretaceous based on similarities to the Granite Mountain pluton and other granitic rocks to the east (Miller and others, 1971). Blocks or roof pendants of metamorphic rocks are locally common, especially in the western portion of the pluton. A large block of marble, schist and calc-silicate hornfels is contained within the eastern portion of the pluton. Portions of the pluton are altered and veined. Alteration consists of limonite staining, weak to strong sericitization of plagioclase, and variable chloritization and sericitization of hornblende. Two types of veins are present: (1) rare pieces of quartz vein material up to 15 cm across containing several percent fluorite, 1 to 2 percent molybdenite, and galena and sphalerite; and (2) thin, mostly ≤ 3 mm but up to 1 cm, veinlets containing quartz and pyrite ± fluorite, molybdenite, scheelite and minor galena and sphalerite. Although these veinlets crosscut each other, they do not constitute a stockwork system

Kkd - Diorite (Cretaceous)

Hybrid diorite of the Kachauik pluton. Exposed in the Solomon B-2 quadrangle. Coarse grained and characterized by abundant biotite. May be a border phase of the monzonite-syenite (Kkms) of the Kachauik pluton (Miller and others, 1972)

Kkgm - Gneissic monzonite (Cretaceous)

Gneissic monzonite of the Kachauik pluton. Exposed in the Solomon C-2 quadrangle. Gneissic to trachytoid texture. May be a border phase of the monzonite-syenite (Kkms) of the Kachauik pluton (Miller and others, 1972)

Kkg - Granodiorite (Cretaceous)

Granodiorite-quartz monzonite phase of the Kachauik pluton. Frost-riven rubble, talus and outcrop in the Solomon C-2 and D-2 quadrangles. Cut by aplite, quartz latite porphyry, lamprophyre and alkaline dikes (Miller and others, 1972)

Kkms - Monzonite-syenite (Cretaceous)

Monzonite-syenite phase of the Kachauik pluton. Frost-riven rubble, talus and outcrop in the Solomon B-2, C-2 and D-2 quadrangles. Cut by aplite, quartz latite porphyry, lamprophyre, and alkaline dikes. 99.9±3 Ma (Miller and others, 1972; Miller and Bunker, 1976)

Kdc - Dry Canyon stock (Early Cretaceous)

Frost-riven rubble in the west side of the Darby Mountains in Solomon D-2 quadrangle. Nepheline syenite. 108±3 Ma (Miller, 1972)

Kad - Alkaline dikes (Cretaceous)

Frost-riven rubble in the Solomon C-2, C-3 and D-3 quadrangles. Intrusive into portions of the Kachauik pluton and adjacent marble. Nepheline syenite and pseudoleucite porphyry. The dikes are up to 10 m wide and have strike lengths up to 900 m. They strike mostly to the northeast and are vertical. The syenite of the Kachauik pluton is highly radioactive adjacent to the dikes, containing up to 0.15% U_3O_8, 1.05% ThO_2 and 2% rare earth elements (Miller and others, 1976). 96.3±3 Ma (Berry and others, 1976)

Kpg - Pegmatite (Cretaceous)

Dikes and sills most common in the western Bendeleben Mountains but also found in the Kigluaik and Darby Mountains. Commonly frost-riven rubble, rare in outcrop. Alkali feldspar granite to quartz monzodiorite. Pegmatitic pods and segregations are also common in Kgu. Not found in rocks of lower metamorphic grade. Assumed to be Cretaceous in age

Kfg - Foliated granite (Cretaceous)

Foliated lens- to sill-shaped bodies in the western Bendeleben Mountains in the Bendeleben A-4, A-5 and A-6 quadrangles. Exposed in outcrop and rubble fields. Mostly leucocratic syenogranite. Foliation is defined by the parallel alignment of biotite and feldspar. Grain-size layering occurs locally. Contacts are conformable to the foliation of the enclosing metamorphic rocks where exposed. Rocks mapped as orthogneiss (PzpCo) in the Kigluaik Mountains may be, in part, equivalent. Assumed to be Cretaceous in age

Kgu - Granitic rocks, undifferentiated (Cretaceous)

Undifferentiated granitic dikes, sills and small plugs. Occur mostly in the Bendeleben and Kigluaik Mountains, but also mapped elsewhere. Extremely variable accessory mineralogy. Assumed to be Cretaceous in age

APPENDIX B:

TABLE 1. MEGAFOSSIL COLLECTION LOCALITIES FROM THE SOLOMON, BENDELEBEN AND SOUTHERN KOTZEBUE QUADRANGLES.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS
83 AC1 96 (10746-SD)	Tabulate corals: Cladopora sp., Favosites spp. (2 or 3 species), Heliolites sp., syringoporoid. Rugose corals: Pseudamplexus sp., cerioid ptenophyllid, Sociophyllum? sp. Indeterminate stromatoporoids and bryozoa.	late Early or early Middle Devonian; microfauna collection at this locality yields a more restricted age of earliest late Early Devonian	W. A. Oliver, Jr.	Bendeleben A-1 65^0 05' 00" 162^0 06' 40"	Ddm	See sample 83 AC1 96, Table 2, for microfauna from this locality.
83 ADn 25 (10745-SD)	Stromatoporoids: Amphipora sp., laminar stromatoporoid, ramose form (large, no canal). Tabulate corals: Alveolites sp., Cladopora sp., Favosites spp. (2 or more spp.), favositoid, syringoporoid, Syringopora sp. A, Thamnopora? sp., thamnoporoid. Rugose corals: Phillipsastrea? sp., indeterminate solitary? form.	early Late Devonian (Frasnian)	W. A. Oliver, Jr.	Solomon D-1 64^0 49' 35" 162^0 17' 10"	Ddm	A slightly older conodont fauna was collected at this locality--see sample 83 ADn 25, Table 2. Possible explanations for this discrepancy are: 1) the conodonts are redeposited; 2) the conodont-bearing rocks are from a slightly older stratigraphic horizon than the megafossil-bearing rocks.
	Brachiopods: Calvinaria variabilis group.	early Late Devonian (Frasnian)	J. T. Dutro, Jr.			
83 ADn 34M	Bryozoans: trepostomes? (completely silicified).	Paleozoic?; microfauna from this sample restricts the age to Early-Middle Devonian.	O. L. Karklins	Bendeleben A-1 65^0 04' 10" 162^0 01' 20"	TKc	Sample is a clast in the conglomerate. Microfossil sample 83 ADn 34M (Table 2) is from this same clast.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS
68 AMm 442	Corals: *Thamnopora?* sp.	probably Middle Devonian or early Late Devonian (Frasnian)	W. A. Oliver, Jr.	Bendeleben D-2 65^{o} 47' 35" 162^{o} 45' 10"	Ddm	Reference: unpublished data of T. P. Miller. Microfossil collection 82 ADu 73 is from this locality (see Table 2).
70 AMm 199 (8731-SD)	Corals: *Cladopora* sp., *Thamnopora* sp. Stromatoporoid: *Amphipora* sp.	probably Middle or early Late Devonian (Eifelian to Frasnian)	W. A. Oliver, Jr.	Solomon D-1 64^{o} 52' 05" 162^{o} 11' 40"	Ddm	Reference: Miller and others, 1972; Oliver and others, 1975. Barren collection 82 ADu 18 is from this locality (see Table 3).
70 AMm 202 (8732-SD)	Corals: *Syringopora* sp., *Thamnopora?* sp. Massive stromatoporoid, indeterminate.	probably Middle or early Late Devonian; when combined with microfossil data from this locality, age is restricted to Middle Devonian	W. A. Oliver, Jr.	Solomon, D-1 64^{o} 50' 50" 162^{o} 13' 30"	Ddm	Reference: Miller and others, 1972; Oliver and others, 1975. Microfossil collection 82 ADu 17 is from this locality (see Table 2).
70 AMm 203	Corals? and/or crinoid stems?	indeterminate	W. A. Oliver, Jr.	Solomon D-1 64^{o} 49' 40" 162^{o} 13' 40"	Ddm	Reference: Miller and others, 1972. Very poorly preserved.
70 AMm 206 (8733-SD)	Corals: *Thamnopora?* sp. Stromatoporoids: *Amphipora* sp., *Idiostroma?* sp.	Devonian--almost certainly Middle or early Late Devonian (Eifelian to Frasnian); when combined with microfossil data from this locality, age is restricted to Middle Devonian	W. A. Oliver, Jr.	Solomon C-1 64^{o} 38' 25" 162^{o} 14' 00"	Ddm	Reference: Miller and others, 1972; Oliver and others, 1975. Microfossil collection 84 ADn 2 is from this locality (see Table 2).
73 APa 52 (9281-SD)	Corals: *Cladopora?* sp., thamnoporoid corals, and rugose corals, indeterminate.	Silurian or Devonian	W. A. Oliver, Jr.	Bendeleben C-6 65^{o} 38' 00' 164^{o} 34' 35"	Pzm	Reference: unpublished data of W. W. Patton, Jr. Fossils collected from stream gravels along Harris Creek near junction with Sunset Creek.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS
73 APa 54 (9294-SD)	Corals: ramose tabulate corals? Stromatoporoid: amphiporoid-like forms.	?Silurian or Devonian	W. A. Oliver, Jr.	Bendeleben C-6 65° 36' 10" 164° 38' 00"	Pzm	Reference: unpublished data of W. W. Patton, Jr. Fossils collected from stream gravels along North Fork of Kougarok River.
73 APa 56 (9284-SD)	Corals and/or stromatoporoids: Cladopora and/or Amphipora.	Silurian or Devonian	W. A. Oliver, Jr.	Bendeleben C-6 65° 33' 05" 164° 33' 40"	Pzm	Reference: unpublished data of W. W. Patton, Jr.
73 APa 79	Stromatoporoid (Amphipora?) or coral (Cladopora?).	Probably Silurian or Devonian	W. A. Oliver, Jr.	Solomon D-5 64° 54' 15" 164° 06' 05"	Pzm	Reference: unpublished data of W. W. Patton, Jr.
73 APa 106 (9285-SD)	Corals: Cladopora sp., Hexagonaria? sp., Peneckiella sp., Thamnopora sp. Stromatoporoids: Amphipora? sp.	Middle or Late Devonian; when combined with data from the microfossil collection here, the age is restricted to Middle through earliest Late Devonian.	W. A. Oliver, Jr.	Solomon D-3 64° 45' 10" 163° 28' 30"	Ddm	Reference: unpublished data of W. W. Patton, Jr. A very similar Peneckiella is known from the Skajit? Limestone in the Western Brooks Range (Oliver and others, 1975). Microfossil collection 83 ADn 5 is from this locality (see Table 2). Collier (1908) and Kindle (1911) describe earlier coral collections from this locality.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS
67 ASn 327	Stromatoporoid: Amphipora?	Middle to early Late Devonian	W. A. Oliver, Jr.	Bendeleben C-6 65° 37' 30" 164° 33' 00"	Pzm	Reference: unpublished data from C. L. Sainsbury. Microfossil collection 82 ADu 68 (see Table 2) and barren sample 84 AGe 140 (see Table 3) are from this locality. A coral fauna from Harris Creek, about one mile northwest of 67 ASn 327, is described in Collier and others (1908) and Kindle (1911), and is of Silurian to Middle Devonian age (J. T. Dutro, Jr. written communication, 1985).
68 ASn 130	Corals: syringoporoid, possible favositoid.	Ordovician to Mesozoic; microfossil collection from this locality is of Ordovician age.	W. A. Oliver, Jr.	Bendeleben D-5 65° 47' 00" 164° 10' 00"	Od	Reference: unpublished data from C. L. Sainsbury. Microfossil collection 84 ADn 80 is from this locality (see Table 2).
71 ASn 763	Corals: tabulates (Alveolites?).	Silurian or Devonian	W. A. Oliver, Jr.	Bendeleben D-1 65° 52' 20" 162° 27' 00"	Pzm	Reference: unpublished data from C. L. Sainsbury; Sainsbury, 1974. Boulder dredged from placer mine on Kugruk River; in Sainsbury (1974), this locality is shown as Mississippian(?) or Devonian.
71 ASn 917	Corals: Cladopora and other tabulates.	Silurian or Devonian	W. A. Oliver, Jr.	Bendeleben D-2 65° 55' 40" 162° 36' 00"	Ddm	Reference: unpublished data from C. L. Sainsbury. Microfossil collection 82 ADu 74 is from this locality (see Table 2).

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS
83 ATi 109C (10756-SD)	Rugose coral: phaceloid, dissepimented type--perhaps a phillipsastreid?	Paleozoic--Frasnian?	W. A. Oliver, Jr.	Solomon C-4 64^{o} 34' 05" 163^{o} 40' 00"	Ddm	Beach cobble near mouth of Koyana creek; similar but more poorly preserved forms are found in bedrock in the adjacent seacliffs.
84 ATi 8 (10974-SD)	Corals: *Coenites?* sp., *Favosites* sp., *Thamnopora* sp., "*Disphyllum*" sp.	Silurian-Devonian (probably Ludlow to Frasnian); microfossil data from this locality restricts age to late Early Devonian	W. A. Oliver, Jr.	Solomon C-1 64^{o} 34' 55" 162^{o} 22' 30"	Ddm	Microfossil collections 84 ATi 8AA and 8AB are from this locality (see Table 2).

TABLE 2. MICROFOSSIL COLLECTION LOCALITIES FROM THE SOLOMON, BENDELEBEN AND SOUTHERN KOTZEBUE QUADRANGLES.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
82 ACl 91	Conodonts: indeterminate simple cone fragments.	Ordovician through Devonian (probably Early-Middle Ordovician)	A. G. Harris	Solomon D-5 64^{0} 55' 12" 164^{0} 14' 36"	Pzm	CAI=5 to 6.
82 ACl 94 (9610-CO)	Conodont: Scolopodus gracilis.	middle Early Ordovician to earliest Middle Ordovician (Faunas D through 3)	A. G. Harris	Solomon D-5 64^{0} 57' 30" 164^{0} 26' 16"	Od	CAI=5 $1/2$. A recollection at this locality (83 ADn 11) was barren (see Table 3).
83 ACl 94 (9800-CO)	Conodonts: Drepanoistodus sp., Eucharodus parallelus, Glyptoconus quadraplicatus.	middle to late Early Ordovician (Faunas D through E)	A. G. Harris and J. E. Repetski	Bendeleben A-1 65^{0} 05' 15" 162^{0} 08' 00"	Od	CAI=5 $1/2$ to 6; species association indicates warm, shallow-water biofacies. These rocks were previously thought to be of Devonian age (Miller and others, 1972).
83 ACl 96 (10893-SD)	Conodonts: Icriodus taimyricus, Panderodus sp.	earliest late Early Devonian (earliest Emsian; P. dehiscens Zone)	A. G. Harris	Bendeleben A-1 65^{0} 05' 00" 162^{0} 06' 40"	Ddm	CAI=5 $1/2$; see Table 1 for megafauna from this locality (sample 83 ACl 96).
83 ACl 113B (10900-SD)	Conodonts: Belodella devonica, Panderodus spp., Polygnathus serotinus.	Lower/Middle Devonian boundary (latest Emsian to earliest Eifelian)	A. G. Harris	Bendeleben A-1 65^{0} 52' 42" 162^{0} 35' 05"	Ddm	CAI=5; shallow-water species association. Megafossils of Devonian age from this locality are mentioned but not described by Sainsbury (1974).

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
83 ACl 114 (9679-CO)	Conodonts: Acodus cf. A. deltatus, Drepanodus cf. D. arcuatus, Drepanoistodus forceps, Paroistodus cf. P parallelus, Protopanderodus sp., Scolopodus gracilis.	Early Ordovician (Fauna D to lowermost Fauna E)	A. G. Harris and J. E. Repetski	Bendeleben D-2 65° 53' 50" 162° 39' 10"	Od	CAI=5; species association is characteristic of the North Atlantic Province early to middle Arenig cool-water faunas. These rocks were previously thought to be of Devonian age (Sainsbury, 1974).
82 ADu 17 (10724-SD)	Conodont: Panderodus unicostatus.	Silurian-Middle Devonian; when combined with megafossil data from this locality, age is restricted to Middle Devonian	A. G. Harris	Solomon D-1 64° 50' 55" 162° 13' 30"	Ddm	CAI=5 1/2 ; see 70 AM 202 for megafauna from same locality (Table 1).
82 ADu 45 (10725-SD)	Conodonts: Ozarkodina confluens, Oulodus sp.	Middle-late Late Silurian (Wenlockian through part of Pridolian)	A. G. Harris	Bendeleben A-1 65° 00' 50" 162° 01' 20"	TKc	CAI=5; species association indicates relatively high energy, shallow-water depositional environment. Sample is a clast from the conglomerate.
82 ADu 53 (10723-SD)	Conodonts: Panderodus sp., Ozarkodina sp., Polygnathus sp.	middle Early Devonian-Middle Devonian (middle Siegenian-middle Devonian)	A. G. Harris	Bendeleben A-1 65° 09' 20" 162° 10' 00"	Ddm	CAI=5. These rocks were previously mapped as Precambrian (Sainsbury, 1974).
82 ADu 57	Conodont: Panderodus sp.	Middle Ordovician-Middle Devonian	A. G. Harris	Bendeleben A-1 65° 09' 05" 162° 08' 02"	Ddm	CAI=7.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
82 ADu 59 (10726-SD)	Conodonts: Polygnathus sp. indeterminate of the pirenae-dehiscens group.	middle to late Early Devonian	A. G. Harris	Solomon C-3 64^{o} 44' 58" 163^{o} 27' 28"	Ddm	CAI=5-6. A pelecypod fauna from White Mountain, four miles south of 82 ADu 59, is mentioned in Brooks and others, (1901), Collier and others (1908) and Kindle (1911); it is of probable Devonian age (J.T. Dutro, Jr., written communication, 1985).
82 ADu 63	Conodont: Polygnathus(?) sp.	probably middle Early to Middle Devonian	A. G. Harris	Bendeleben D-5 65^{o} 50' 20" 164^{o} 22' 10"	Ddm	CAI=5 1/2; Sainsbury (1974) mentions recrystallized fossils suggestive of the stromatoporoid Amphipora from this locality.
82 ADu 68	Conodont: Panderodus sp.	Middle Ordovician-Middle Devonian; when combined with megafossil data from this locality, age is restricted to Middle Devonian age.	A. G. Harris	Bendeleben C-6 65^{o} 37' 20" 164^{o} 33' 00"	Pzm	CAI=5 1/2. Megafossil collection 67 ASn 327 is from this locality (see Table 1), as is barren collection 84 AGe 140 (see Table 3).
82 ADu 69 (9611-CO)	Conodonts: Acodus oneotensis s.f., Clavohamulus densus, Juanognathus n. sp., Protopanderodus sp., Rossodus manitouensis, Scolopodus floweri, Scolopodus rex.	middle Early Ordovician (boundary interval of Faunas C and D)	A. G. Harris and J. E. Repetski	Bendeleben D-2 65^{o} 46' 05" 162^{o} 46' 05"	Od	CAI=5 1/2 to 7; species association is characteristic of very shallow, warm-water depositional environment. These rocks were previously thought to be Devonian (Sainsbury, 1974).

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
82 ADu 71 (9612-CO)	Conodonts: drepanodontiform elements, Panderodus sp., ramiform element of Early to early Middle Ordovician morphotype.	early Middle Ordovician	A. G. Harris	Bendeleben D-2 65^{0} 48' 00" 162^{0} 46' 00"	Od	CAI=6-7. These rocks were previously thought to be Devonian (Sainsbury, 1974). Barren samples 83 ADn 86 and 83 ADn 87 are recollections at this locality (see Table 3).
82 ADu 73 (10727-SD)	Conodonts: Belodella devonica, Belodella triangularis, Panderodus spp., Polygnathus sp. indet. of the P. dehiscens-P. perbonus group.	late Early Devonian (early Emsian)	A. G. Harris	Bendeleben D-2 65^{0} 47' 42" 162^{0} 44' 50"	Ddm	CAI=5-6 1/2. Megafossil collection 68 AMm 442 is from this locality (see Table 1).
82 ADu 74	Conodonts: Belodella devonica, Panderodus sp.	Middle Ordovician through Middle Devonian	A. G. Harris	Bendeleben D-2 65^{0} 55' 42" 162^{0} 35' 30"	Ddm	CAI=5-5 1/2. Recrystallized fossils suggestive of the stromatoporoid Amphipora are mentioned by Sainsbury (1974) as occurring at this locality; see also megafossil locality 71 ASn 917, Table 1.
82 ADu 75 (10728-SD)	Conodonts: Panderodus sp., Polygnathus sp.	late Early Devonian (Emsian) through Middle Devonian	A. G. Harris	Bendeleben D-2 65^{0} 54' 40" 162^{0} 35' 20"	Ddm	CAI=5. Recrystallized fossils suggestive of the stromatoporoid Amphipora are mentioned by Sainsbury (1974) as occurring at this locality.
82 ADu 76 (10729-SD)	Conodonts: Panderodus sp., Polygnathus sp. of the P. dehiscens-P. perbonus group.	late Early Devonian (early Emsian)	A. G. Harris	Bendeleben D-2 65^{0} 54' 00" 162^{0} 35' 20"	Ddm	CAI=5-5 1/2. Recrystallized fossils suggestive of the stromatoporoid Amphipora are mentioned by Sainsbury (1974) as occurring at this locality.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
82 ADu 78DD (10909-SD)	Conodonts: <u>Oulodus</u> sp., <u>Ozarkodina confluens</u>.	Middle-Late Silurian (Wenlock through part of Pridoli)	A. G. Harris	Bendeleben C-2 65^{0} 30' 30" 162^{0} 41' 10"	TKc	CAI=5; sample is a clast from the conglomerate.
82 ADu 78II (10894-SD)	Conodonts: <u>Kockelella</u> sp., <u>Ozarkodina excavata</u>, <u>Panderodus</u> sp.	Middle through early Late Silurian (Wenlock through Ludlow)	A. G. Harris	Bendeleben C-2 65^{0} 30' 30" 162^{0} 41' 10"	TKc	CAI=5-5 1/2 ; sample is a clast from the conglomerate.
82 ADu 78JJ (10901-SD)	Conodonts: distomodontiform elements, <u>Panderodus</u> spp.	Early through Middle Silurian	A. G. Harris	Bendeleben C-2 65^{0} 30' 30" 162^{0} 41' 10"	TKc	CAI=5 to 6; sample is a clast from the conglomerate.
82 ADu 78MM (9799-CO)	Conodonts: <u>Belodina</u> sp., <u>Panderodus</u> sp.	Middle through Late Ordovician	A. G. Harris	Bendeleben C-2 65^{0} 30' 30" 162^{0} 41' 10"	TKc	CAI=5 1/2 ; sample is a clast from the conglomerate.
82 ADu 78RR (10902-SD)	Conodont: Sa element of Silurian through Devonian morphotype.	Silurian through Devonian	A. G. Harris	Bendeleben C-2 65^{0} 30' 30" 162^{0} 41' 10"	TKc	CAI=4 1/2 ; sample is a clast from the conglomerate.
83 ADn 2	Pyritized and phosphatized spine steinkerns.	Phanerozoic	A. G. Harris	Solomon C-4 64^{0} 34' 05" 163^{0} 40' 45"	Ddm	These rocks were previously thought to be Precambrian (Sainsbury, 1974).
83 ADn 5 (10895-SD)	Conodonts: <u>Belodella devonica</u>, <u>Polygnathus linguiformis linguiformis</u>.	very latest Early Devonian through earliest Late Devonian; when combined with data from the megafossil collection here, age is restricted to Middle Devonian through earliest Late Devonian.	A. G. Harris	Solomon D-3 64^{0} 45" 15" 163^{0} 28' 30"	Ddm	CAI=5 1/2 ; megafossil collection 73 APa 106 is from this locality (see Table 1)

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
83 ADn 25 (10745-SD)	Conodonts: *Belodella devonica*, *Icriodus* sp. or *Pedavis* sp., *Panderodus* spp.	Middle Silurian through most of the Middle Devonian	A. G. Harris	Solomon D-1 64^{0} 49' 35" 162^{0} 17' 10"	Ddm	CAI=5; megafossil collection 84 ADn 25 is from this locality (see Table 1). The megafauna is slightly younger than the conodont fauna; possible explanations for this discrepancy are: (1) the conodonts are redeposited; (2) the conodont-bearing rocks are from a slightly older stratigraphic horizon than the megafossil-bearing rocks.
83 ADn 27 (10904-SD)	Conodonts: *Ozarkodina confluens*, *Panderodus* sp.	Middle-Late Silurian	A. G. Harris	Bendeleben A-1 65^{0} 02' 15" 162^{0} 05' 20"	Sd	CAI=5 $^{1}/_{2}$-6; species association indicates shallow, warm-water depositional environment. Barren sample 83 ADn 27A is from fine-grained black dolostone that structurally underlies 83 ADn 27 (see Table 3).
83 ADn 29A (9801-CO)	Conodonts: *Paltodus bassleri*, *Scolopodus sulcatus*.	middle Early Ordovician (Fauna C)	A. G. Harris and J. E. Repetski	Solomon D-5 64^{0} 56' 00" 164^{0} 18' 20"	Od	CAI=4; species association indicates a warm, shallow-water depositional environment. Black, fine- to medium-crystalline marble (Pzm; sample 29B) forms a rubble patch between two knobs of gray-to pink-weathering dolostone (Od); sample 29A is from the northern knob.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
83 ADn 29B (10905-SD)	Conodont: *Pelekysgnathus* sp.	Late Silurian through Devonian	A. G. Harris	Solomon D-5 64° 56' 00" 164° 18' 20"	Pzm	CAI=5 1/2 to 6 1/2. The occurrence of Pzm at this locality is too small to show at 1:250,000 scale. Smith (1910) reports poorly preserved coral and crinoid debris "near the head of Gander Creek" (less than one mile west of 83 ADn 29); this fauna is of probable Silurian or Devonian age (J. T. Dutro, written communication, 1985).
83 ADn 32 (10906-SD)	Conodont: *Ozarkodina* aff. *O. excavata*.	Middle Silurian through Early Devonian	A. G. Harris	Solomon D-5 64° 54' 30" 164° 27' 50"	Pzd	CAI=5. The sample is from a rubble patch of Pzd too small to show at 1:250,000 scale.
83 ADn 34H	Conodonts: *Oulodus* sp., *Panderodus* sp.	Middle Ordovician through Middle Devonian	A. G. Harris	Bendeleben A-1 65° 04' 10" 162° 01' 20"	TKc	CAI=5 1/2; sample is a clast in the conglomerate.
83 ADn 34I (10891-SD)	Conodonts: *Belodella devonica*, *Belodella triangularis*, *Panderodus* sp., *Polygnathus inversus*.	late Early Devonian (late Emsian)	A. G. Harris	Bendeleben A-1 65° 04' 10" 162° 01' 20"	TKc	CAI=5; sample is a clast in the conglomerate.
83 ADn 34L	Conodont: *Oulodus* sp.	Middle Ordovician through Devonian	A. G. Harris	Bendeleben A-1 65° 04' 10" 162° 01' 20"	TKc	CAI=5; sample is a clast in the conglomerate.
83 ADn 34M (10892-SD)	Conodonts: *Panderodus* sp., *Neopanderodus* sp.	late Early-Middle Devonian	A. G. Harris	Bendeleben A-1 65° 04' 10" 162° 01' 20"	TKc	CAI=5 1/2; sample is a clast in the conglomerate. See 83 ADn 34M, Table 1, for megafauna from this sample.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
83 ADn 34 O (10903-SD)	Conodonts: Ozarkodina sp. or Pandorinellina sp., Panderodus sp., Polygnathus cf. P. linguiformis, Polygnathus sp.	Middle Devonian	A. G. Harris	Bendeleben A-1 65^{0} 04' 10" 162^{0} 01' 20"	TKc	CAI=5 1/2 to 6; sample is a clast in the conglomerate.
83 ADn 44 (10907-SD)	Conodonts: Kockelella patula; Ozarkodina excavata, Oulodus sp., Panderodus sp.	middle Middle Silurian (middle Wenlock)	A. G. Harris	Kotzebue A-2 66^{0} 05' 25" 162^{0} 48' 20"	DObm	CAI=5 1/2 -7 1/2. These rocks were previously thought to be Mississippian(?) (Hudson, 1977; Sainsbury, 1974).
83 ADn 61 (10908-SD)	Conodonts: Belodella devonica, Panderodus spp., Polygnathus linguiformis linguiformis, Polygnathus sp.	Middle Devonian	A. G. Harris	Bendeleben B-1 65^{0} 15' 30" 162^{0} 17' 40"	Ddm	CAI=5 1/2.
83 ADn 73BB	Probable recrystallized Radiolaria.	Phanerozoic	K. M. Reed	Kotzebue A-2 66^{0} 05' 18" 162^{0} 47' 40"	DObm	Samples 73BB and 73C are from black siliceous argillite intercalated with black marble of the DObm unit.
83 ADn 73C	Probable recrystallized Radiolaria.	Phanerozoic	K. M. Reed	Kotzebue A-2 66^{0} 05' 18" 162^{0} 47' 40"	DObm	

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
83 ADn 74	Conodont: indeterminate simple cone fragment.	Ordovician through Devonian	A. G. Harris	Kotzebue A-2 66^{0} 05' 50" 162^{0} 45' 30"	Pzd	CAI=7. Kindle (1911) described lamellibranchs and corals from this locality; this fauna is of probable Silurian-Devonian age (J. T. Dutro, Jr., written communication, 1985). Hudson (1977) shows these rocks as Precambrian. T. Ryherd (written communication, 1985) considers this outcrop to represent a peri-platform talus accumulation that is part of the DObm package.
83 ADn 75 (10896-SD)	Conodonts: Ozarkodina sp., Panderodus sp.	Silurian through Middle Devonian	A. G. Harris	Kotzebue A-2 66^{0} 02' 15" 162^{0} 37' 10"	DObm	CAI=5 $1/2$ -6.
83 ADn 85 (10910-SD)	Conodonts: Belodella devonica, Belodella triangularis, Panderodus spp., Polygnathus sp.	late Early Devonian (Emsian) through Middle Devonian	A. G. Harris	Bendeleben D-2 65^{0} 53' 35" 162^{0} 35' 40"	Ddm	CAI=5-5 $1/2$; megafossils of Devonian age are mentioned but not described by Sainsbury (1974) from this locality.
83 ADn 88	Conodont: rotundiform simple cone element.	Ordovician through Devonian	A. G. Harris	Bendeleben B-1 65^{0} 16' 25" 162^{0} 15' 20"	Ddm	CAI=5-5 $1/2$.
83 ADn 92B (10836-SD)	Conodonts: Oulodus sp., Ozarkodina confluens, Panderodus unicostatus.	Middle to Late Silurian	A. G. Harris	Norton Bay D-6 64^{0} 58' 00" 161^{0} 57' 30"	TKc	CAI=5-5 $1/2$; species association indicates relatively high energy, shallow-water depositional environment; sample is a clast in the conglomerate.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
83 ADn 92AA	Conodont: Panderodus sp.	Middle Ordovician-Middle Devonian	A. G. Harris	Norton Bay D-6 64° 58' 00" 161° 57' 30"	TKc	CAI=5 to 5 1/2; sample is a clast from the conglomerate.
83 ADn 92BB	Conodont: Sc element, probably of Ozarkodina excavata.	Silurian-Permian (probably Middle Silurian-early Emsian)	A. G. Harris	Norton Bay D-6 64° 58' 00" 161° 57' 30"	TKc	CAI=6-7; sample is a clast from the conglomerate.
83 ADn 92CC	Conodont: Panderodus sp.	Middle Ordovician-Middle Devonian	A. G. Harris	Norton Bay D-6 64° 58" 00" 161° 57' 30"	TKc	CAI=5-5 1/2; sample is a clast from the conglomerate.
84 ADn 2 (10993-SD)	Conodonts: Belodella triangularis, Neopanderodus sp., Polygnathus linguiformis linguiformis. Ichthyoliths.	Middle Devonian	A. G. Harris	Solomon C-1 64° 38' 20" 162° 14' 10"	Ddm	CAI=5; see Table 1, sample 70 AMm 206, for megafauna from this locality.
84 ADn 3A (11030-SD)	Conodonts: Neopanderodus spp., Polygnathus linguiformis linguiformis; conodont pearls. Ichthyoliths.	Middle Devonian	A. G. Harris	Solomon C-1 64° 39' 03" 162° 12' 50"	Ddm	CAI=5-5 1/2. Smith and Eakin (1911) report abundant, but poorly preserved, Devonian or Carboniferous megafossils at many places along the seacliffs between Mt. Kwiniuk and Iron Creek, an area which includes this locality.
84 ADn 3B (10994-SD)	Conodonts: Neopanderodus sp., Polygnathus sp. (of Middle Devonian morphotype). Ichthyoliths.	Middle Devonian	A. G. Harris	Solomon C-1 64° 39' 03" 162° 12' 50"	Ddm	CAI=5-5 1/2; sample 3B is the same lithology as sample 3A, but is from 400 feet further north.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
84 ADn 5H (11058-SD)	Condonts: Distomodus? sp. indet., Oulodus? sp. indet., Pb element of post-Ordovician morphotype (possibly Ozarkodina excavata), Pa elements of Middle Silurian-Early Devonian morphotype.	Middle Silurian through Early Devonian (possibly Middle to early Late Silurian)	A. G. Harris	Solomon C-1 64^{o} 34' 45" 162^{o} 23' 30"	D€bm	CAI=5-6.
84 ADn 10A (11031-SD)	Conodonts: Oulodus sp. indet. or Kockelella sp. indet., Panderodus sp.	Silurian-Early Devonian	A. G. Harris	Solomon C-1 64^{o} 36' 57" 162^{o} 17' 00"	Pzd	CAI=5 1/2 .
84 ADn 16 (10995-SD)	Conodonts: Neopanderodus sp., Polygnathus sp. (of Middle Devonian morphotype).	Middle Devonian	A. G. Harris	Solomon C-1 64^{o} 39' 52" 162^{o} 23' 30"	Ddm	CAI=5-5 1/2 .
84 ADn 31 (11059-SD)	Conodonts: Ozarkodina sp. indet. or Pandorinellina sp. indet. of Late Silurian-Early Devonian morphotype, Panderodus sp.	Late Silurian-Early Devonian	A. G. Harris	Solomon C-1 64^{o} 44' 32" 162^{o} 18' 15"	D€bm	CAI=5 to 5 1/2 .
84 ADn 42	Conodont: sheared indeterminate fragment.	Ordovician-Triassic	A. G. Harris	Candle B-6 65^{o} 27' 00" 161^{o} 58' 42"	Pzd	CAI=5.
84 ADn 51K	Conodonts: indeterminate bar and blade fragments.	Ordovician-Permian	A. G. Harris	Norton Bay D-6 64^{o} 54' 35" 161^{o} 57' 55"	TKc	CAI=5 1/2 -6; sample is a clast from the conglomerate.
84 ADn 51M	Conodont: Pelekysgnathus sp.	Late Silurian-Devonian	A. G. Harris	Norton Bay D-6 64^{o} 54' 35" 161^{o} 57' 55"	TKc	CAI=5 1/2 ; sample is a clast from the conglomerate.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
84 ADn 51N	Conodont: Panderodus sp.	Middle Ordovician-Middle Devonian	A. G. Harris	Norton Bay D-6 64^{0} 54' 35" 161^{0} 57' 55"	TKc	CAI=5 to 5 1/2; sample is clast from the conglomerate.
84 ADn 51 0	Conodont: Panderodus sp.	Middle Ordovician-Middle Devonian	A. G. Harris	Norton Bay D-6 64^{0} 54' 35" 161^{0} 57' 55"	TKc	CAI=5 to 5 1/2; sample is clast from the conglomerate.
84 ADn 52B (11060-SD)	Conodonts: Neopanderodus sp., Panderodus sp., Polygnathus sp. indet.	late Early-Middle Devonian	A. G. Harris	Solomon D-1 64^{0} 59' 25" 162^{0} 03' 40"	TKc	CAI=5 1/2; sample is a clast from the conglomerate.
84 ADn 52C (11061-SD)	Conodonts: Neopanderodus sp., Panderodus sp., Polygnathus linguiformis linguiformis.	Middle Devonian	A. G. Harris	Solomon D-1 64^{0} 59' 25" 162^{0} 03' 40"	TKc	CAI=5 1/2 to 6; sample is a clast from the conglomerate.
84 ADn 54 (9897-CO)	Conodonts: Paltodus sp. s.f., Protopanderodus cf. P. elongatus, Rossodus? sp., ? Scandodus aff. S. furnishi, Scolopodus filosus, Scolopodus gracilis.	middle Early to earliest Middle Ordovician (probably middle Early Ordovician--Fauna D)	J. E. Repetski	Bendeleben A-1 65^{0} 03' 00" 162^{0} 10' 15"	Od	CAI=5 1/2-7; species association is characteristic of normal marine conditions. These rocks were previously thought to be Devonian (Miller and others, 1972).
84 ADn 57B	Conodont: Belodella sp.	middle Early Ordovician-Devonian (very probably Ordovician)	A. G. Harris	Bendeleben A-1 65^{0} 05' 55" 162^{0} 08' 08"	Od	CAI=7. Sample is a dark-gray dolostone that occurs structurally below barren sample 84 ADn 57A and structurally above barren sample 57C (see Table 3).
84 ADn 75Z (10059-CO)	Conodont: drepanodontiform element.	Ordovician	A. G. Harris	Solomon D-5 64^{0} 48' 03" 164^{0} 12' 35"	O€x	CAI=5 1/2-6. Sample is a medium-gray marble that occurs structurally above the black marble of barren sample 82 ATi 49Z (see Table 3).

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
84 ADn 79C (11062-SD)	Conodont: Kockelella cf. K. walliseri	Middle-early Late Silurian (possibly early-middle Wenlock)	A. G. Harris	Kotzebue A-3 66° 03' 55" 163° 12' 20"	DObm	CAI=5 1/2 to 6. Barren sample 84 ADn 79A was taken from the same lithology about 1/10 of a mile east of sample 79C (see Table 3). These rocks were previously thought to be Mississippian(?) (Hudson, 1977).
84 ADn 80A (9889-CO)	Conodonts: Erismodus sp., Panderodus sp., ?Paraprioniodus sp. fragments.	middle Middle Ordovician (Faunas 4 through 7; possibly Faunas 4 through 5)	A. G. Harris	Bendeleben D-5 65° 47' 00" 164° 10' 00"	Od	CAI=8; species association is characteristic of a rather shallow and warm-water biofacies of the North American Midcontinent faunal succession. See 68 ASn 130 (Table 1) for megafauna at this locality.
84 ADn 108D (9937-CO)	Phospnatic microfossil: Lapworthella sp.	Early through possibly early Middle Cambrian	A. G. Harris	Solomon D-5 64° 54' 56" 164° 29' 35"	€d	The problematic phosphatic microfossil Lapworthella indicates a shallow-water depositional environment.
85 ADn 2B (11229-SD)	Conodonts: Belodella sp., Kockelella sp. or Oulodus sp., Ozarkodina cf. O. excavata, Ozarkodina sp. (generalized, probably pre-O. remscheidensis form), Panderodus sp.	Middle to Late Silurian, probably Middle to early Late Silurian (Wenlockian through Ludlovian)	A. G. Harris	Norton Bay C-6 64° 44' 10" 161° 32' 20"	D€bm	CAI=5 1/2 -6.
84 AGe 133	Conodonts: indeterminate bar and coniform fragments. Phosphatic brachiopod valve.	Ordovician-Middle Devonian	A. G. Harris	Solomon C-5 64° 44' 43" 164° 25' 42"	O€x	CAI=6.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
70 AH 200B	Probable recrystallized Radiolaria.	Phanerozoic	K. M. Reed	Bendeleben A-2 65° 05' 46" 162° 32' 42"	O€x	The fossils occur in fine-grained quartz-graphite schist.
84 AKn 151	Phosphatic, nonconodont skeletal fragments.	Phanerozoic	A. G. Harris	Bendeleben C-5 65° 39' 55" 164° 20' 20"	O€x	
61 APa 41b, c, d (D3129)	Pollen: Abies, cf. Acer, Araucariacites australis, Betula, Ephedra cf. E. torreyana, Inaperturopollenites hiatus, Osmunda, Picea, Pinus, Polypodiumsporites, Sphagnumsporites, Ulmus	Tertiary (Eocene to early Miocene?)	E. B. Leopold (9/24/63)	Bendeleben D-1 65° 54' 40" 162° 25' 40"	TKs	Reference: unpublished data from W. W. Patton, Jr.
61 APa 42a (D3130)	Pollen: Abiespollenites sp., Araucariacites australis, Betulapollenites plicatus, Botryococcus sp., Classopollis classoides, Eucommiidites troedsonii, Lycopodiumsporites aegathaecus, Podocarpus sp.	Late Cretaceous	E. B. Leopold (9/24/63)	Bendeleben D-1 65° 50' 45" 162° 25' 35"	TKs	Reference: unpublished data from W. W. Patton, Jr.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
82 ATi 195B	Conodont: Polygnathus sp. (poorly preserved Pa fragments of Middle Devonian through earliest Mississippian morphotype).	Middle Devonian through earliest Mississippian (Kinderhookian)	A. G. Harris	Bendeleben C-6 65° 31' 54" 164° 36' 40"	Ddm	CAI=5 1/2. This sample is from a light-gray marble that structurally overlies a dark-gray marble with relict megafossils; the dark-gray marble (82 ATi 195A) was barren (see Table 3). 82 ATi 195 is from about two miles southwest of Baldy Mountain. Sainsbury (1974) mentions but does not describe Devonian megafossils from Baldy Mountain. Earlier coral collections from the summit of Baldy Mountain are described in Collier and others (1908) and Kindle (1911), and are of probable Devonian age (J. T. Dutro, Jr., written communication, 1985).
82 ATi 197B	Conodont: simple euconodont fragment with a posterior groove on the cusp.	Ordovician through Permian (most probably Ordovician)	A. G. Harris	Bendeleben C-5 65° 33' 05" 164° 25' 53"	Od	CAI=5. This sample is from dolostone (Od) that is surrounded by marble (Pzm); a sample from the marble (82 ATi 197A) was barren (see Table 3). The occurrance of Od at this locality is too small to show at 1:250,000 scale.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
83 ATi 102A	Recrystallized Radiolaria.	Phanerozoic; probably pre-Devonian	B. K. Holdsworth	Bendeleben A-2 65^{0} 04' 28" 162^{0} 32' 25"	O€x	The fossils occur in fine-grained quartz-graphite schist.
83 ATi 227 (29218-PC)	Conodont: juvenile Pa element of *Diplognathodus*? cf. *D. orphanus*.	Middle through Late Pennsylvanian	A. G. Harris	Bendeleben B-1 65^{0} 26' 45" 162^{0} 33' 42"	Pzd	CAI=5 1/2. Microfossil sample 84 ATi 88B and barren samples 88A and 88C (see Table 3) are recollections at this locality. 88B yielded a conodont of Middle Ordovician through Middle Devonian age. It is possible that Pennsylvanian and lower Paleozoic dolostones are juxtaposed at this locality. Alternately, the older conodont could be a product of reworking, or the younger conodont could have been introduced through laboratory contamination. Pending collection of more abundant faunas, these dolostones are included in unit Pzd.
84 ATi 8AA (10996-SD)	Conodonts: *Neopanderodus* sp. *Ichthyolith*.	late Early through latest Middle Devonian (Emsian-Givetian)	A. G. Harris	Solomon C-1 64^{0} 34' 55" 162^{0} 22' 30"	Ddm	CAI=5-5 1/2. Smith and Eakin (1911) report abundant but poorly preserved megafossils at many places along the seacliffs between Mt. Kwiniuk and Iron Creek, an area which includes this locality. Megafossil collection 84 ATi 8 is from this locality (see Table 1).

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
84 ATi 8AB (10997-SD)	Conodonts: Neopanderodus sp., Ozarkodina sp., Panderodus sp.; Pelekysgnathus sp.	late Early Devonian (Emsian)	A. G. Harris	Solomon C-1 64° 34' 55" 162° 22' 30"	Ddm	CAI=5-5 1/2. Sample 8AA is from coral-stromatoporoid packstone; sample 8AB is from wackestone that occurs between the packstone layers.
84 ATi 15Y	Conodonts: indeterminate fragments.	Ordovician-Triassic	A. G. Harris	Solomon C-1 64° 33' 30" 162° 27' 20"	D€bm	CAI=6. Sample taken from black marble in 5-10 cm thick layers. These rocks were previously thought to be Precambrian (Miller and others, 1972).
84 ATi 15Z (10213-CO)	Conodont: Protopanderodus sp.	middle Early through Late Ordovician (middle Arenig through Late Ordovician)	A. G. Harris	Solomon C-1 64° 33' 30" 162° 27' 20"	D€bm	CAI=5 1/2. Sample taken a few feet north of 15Y from black marble in 1-5 cm thick layers.
84 ATi 23 (11173-SD)	Conodonts: Oulodus sp., Ozarkodina cf. O. eberleini, Panderodus sp., Pandorinellina(?) sp. indet., Pelekysgnathus sp. indet.	middle Early Devonian	A. G. Harris	Solomon C-1 64° 37' 25" 162° 13' 52"	D€bm	CAI=5.
84 ATi 57 (10060-CO)	Conodonts: Protohertzina(?) sp., drepanodontiform element. Phosphatic microfossil: Lapworthella sp.	Early Cambrian	A. G. Harris and J. E. Repetski	Solomon C-1 64° 38' 30" 162° 22' 30"	D€bm	CAI=5. The problematic phosphatic microfossil Lapworthella indicates a shallow-water depositional environment. These rocks were previously thought to be Devonian (Miller and others, 1972).
84 ATi 88B	Conodont: Panderodus sp.	Middle Ordovician-Middle Devonian	A. G. Harris	Bendeleben B-1 65° 26' 45" 162° 03' 40"	Pzd	CAI=8. This sample is a recollection at microfossil locality 83 ATi 227.

FIELD NUMBER (USGS COLLN. NO.)	FOSSILS	AGE	IDENTIFIED BY	LOCATION	UNIT	REMARKS*
84 ATi 104B	Probable recrystallized Radiolaria.	Phanerozoic	K. M. Reed	Bendeleben A-2 65° 05' 30" 162° 35' 10"	O€x	The fossils occur in fine-grained quartz-graphite schist. Barren sample 84 ATi 104 (see Table 3) is from black marble intercalated with the schist.
84 ATi 112 (11057-SD)	Conodonts: *Belodella devonica* s.f., *Belodella triangularis* s.f., *Neopanderodus* sp., *Panderodus* sp., *Polygnathus linguiformis linguiformis*	Middle Devonian	A. G. Harris	Solomon D-1 64° 52' 52" 162° 09' 53"	Ddm	CAI=5-5 1/2.
84 ATi 224	Conodont: *Panderodus* sp.	Middle Ordovician to Middle Devonian	A. G. Harris	Bendeleben D-5 65° 46' 00" 164° 11' 00"	Od	CAI= 5. These rocks were previously thought to be Precambrian (Sainsbury, 1974).
84 ATi 281	Conodonts: drepanodontiform element of Arenigian-Middle Ordovician morphotype, coniform fragment.	Early (but not earliest) through Middle Ordovician	A. G. Harris	Solomon D-6 64° 49' 35" 164° 55' 20"	Oim	CAI=7.
83 SK 28A (10897-SD)	Conodonts: *Belodella devonica*, *Belodella triangularis*, *Belodella* spp. (adenticulate and minutely denticulate forms), *Neopanderodus* sp., *Panderodus* spp., *Polygnathus serotinus*. Ichthyoliths.	Early/Middle Devonian boundary	A. G. Harris	Solomon D-1 64° 52' 45" 162° 10' 45"	Ddm	CAI=5-5 1/2.
83 SK 31A (10898-SD)	Conodonts: *Belodella triangularis*, *Panderodus* sp., *Pandorinellina exigua*.	late Early Devonian (middle Siegenian through Emsian)	A. G. Harris	Solomon D-1 64° 57' 55" 162° 09' 00"	Ddm	CAI=5-5 1/2.

*CAI=4 indicates host rock reached at least 200°-250°C; CAI=4 1/2 (at least 250°C); CAI=5 (at least 300°C); CAI=5-5 1/2 (at least 300-350°C); CAI=5 1/2 (at least 350°C); CAI=5 1/2-6 (at least 350°-450°C or corroded and oxidized by fluids at lower temperature); CAI=7 (480°-610°C or corroded and oxidized by fluids at lower temperature); CAI=8 (>600°C or corroded and oxidized by fluids at lower temperature).

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TABLE 3. LOCALITIES WHICH YIELDED SAMPLES BARREN OF MICROFOSSILS FROM THE SOLOMON, BENDELEBEN AND SOUTHERN KOTZEBUE QUADRANGLES.

FIELD NUMBER	LOCATION	UNIT	REMARKS
82 AC1 32	Solomon D-5 64° 46' 23" 164° 01' 40"	O€x	
82 AC1 68C	Solomon D-6 64° 56' 52" 164° 57' 05"	O€x	
82 AC1 92	Solomon D-5 64° 55' 05" 164° 14' 14"	Pzm	
82 AC1 93	Solomon D-5 64° 54' 19" 164° 05' 46"	Pzm	
82 AC1 95	Solomon D-5 64° 49' 44" 164° 18' 50"	Pzm	
82 AC1 96	Solomon D-6 64° 47' 33" 164° 30' 56"	O€x	
82 AC1 97	Solomon D-6 64° 55' 13" 164° 45' 39"	O€x	
82 AC1 98	Solomon D-6 64° 54' 30" 164° 38' 51"	O€x	
82 AC1 99	Solomon D-6 64° 52' 38" 164° 34' 02"	O€x	

FIELD NUMBER	LOCATION	UNIT	REMARKS
82 ACl 100	Solomon D-6 64° 49' 32" 164° 43' 20"	Oim	
82 ACl 101	Solomon D-6 64° 48' 14" 164° 44' 44"	Oim	
82 ACl 106	Solomon D-5 64° 49' 12" 164° 12' 11"	O€x	
83 ACl 55	Solomon D-5 64° 56' 00" 164° 02' 15"	Pzd	Sample is from a rubble patch of Pzd too small to show at 1:250,000 scale.
83 ACl 81	Bendeleben D-1 65° 45' 50" 162° 26' 10"	O€x	
83 ACl 95	Bendeleben A-1 65° 05' 01" 162° 07' 00"	Ddm	
82 ADu 18	Solomon D-1 64° 52' 02" 162° 11' 40"	Ddm	Megafossil collection 70 AMm 199 is from this locality (see Table 1).
82 ADu 28	Solomon C-4 64° 35' 55" 163° 43' 05"	O€x	
82 ADu 60	Solomon C-3 64° 44' 15" 163° 26' 25"	Ddm	
82 ADu 70	Bendeleben D-2 65° 46' 25" 162° 46' 10"	Od	

FIELD NUMBER	LOCATION	UNIT	REMARKS
82 ADu 77	Bendeleben D-2 68° 52' 30" 162° 35' 50"	O€x	
82 ADu 78CC	Bendeleben C-2 65° 30' 30" 162° 41' 10"	TKc	Sample is a clast from the conglomerate.
82 ADu 78PP	Bendeleben C-2 65° 30' 30" 162° 41' 10"	TKc	Sample is a clast from the conglomerate.
83 ADn 1	Solomon C-4 64° 34' 08" 163° 39' 15"	Ddm	A recollection at barren locality 82 ATi 36.
83 ADn 11	Solomon D-6 64° 57' 30" 164° 26' 16"	Od	A recollection at micro-fossil locality 82 AC1 94 (see Table 2).
83 ADn 18	Solomon D-6 64° 48' 20" 164° 54' 05"	Oim	
83 ADn 26	Solomon D-1 64° 54' 40" 162° 10' 18"	Pzm	
83 ADn 27A	Bendeleben A-1 65° 02' 15" 162° 05' 20"	Sd	Microfossil collection 83 ADn 27 is from a fine-grained, light-gray to tan dolostone that structurally overlies 83 ADn 27A (see Table 2).
83 ADn 34J	Bendeleben A-1 65° 04' 10" 162° 01' 20"	TKc	Sample is a clast from the conglomerate.

FIELD NUMBER	LOCATION	UNIT	REMARKS
83 ADn 34K	Bendeleben A-1 65° 04' 10" 162° 01' 20"	TKc	Sample is a clast from the conglomerate.
83 ADn 34N	Bendeleben A-1 65° 04' 10" 162° 01' 20"	TKc	Sample is a clast from the conglomerate.
83 ADn 77	Bendeleben D-3 65° 51' 30" 163° 04' 45"	O€x	
83 ADn 86	Bendeleben D-2 65° 48' 00" 162° 46' 00"	Od	A recollection at microfossil locality 82 ADu 71 (see Table 2). Sample 86 consists of gray and pink mottled dolostone, the same lithology which yielded microfossil collection 82 ADu 71.
83 ADn 87	Bendeleben D-2 65° 48' 00" 162° 46' 00"	Od	A recollection at microfossil locality 82 ADu 71 (see Table 2). Sample 87 consists of dark-gray dolostone, a subordinate lithology at this locality.
84 ADn 32	Solomon C-1 64° 44' 11" 162° 09' 50"	Ddm	
84 ADn 41A	Bendeleben B-1 65° 29' 02" 162° 00' 58"	Pzd	Four samples were taken at locality 84 ADn 41. Each represents a different lithology; all lithologies occur as rubble and subcrop in an area several tenths of a mile in diameter along the crest of the ridge. Sample 41A is fine-crystalline black marble.

FIELD NUMBER	LOCATION	UNIT	REMARKS
84 ADn 41B	Bendeleben B-1 65^{o} 29' 02" 162^{o} 00' 58"	Pzd	Sample 41B is white-weathering dolostone (dominant lithology at this locality).
84 ADn 41C	Bendeleben B-1 65^{o} 29' 02" 162^{o} 00' 58"	Pzd	Sample 41C is tan-weathering dolostone with a streaky, mottled texture.
84 ADn 41D	Bendeleben B-1 65^{o} 29' 02" 162^{o} 00' 58"	Pzd	Sample 41D is black, very finely crystalline shaley marble.
84 ADn 46	Bendeleben A-1 65^{o} 07' 38" 162^{o} 08' 20"	Od	
84 ADn 51L	Norton Bay D-6 64^{o} 54' 35" 161^{o} 57' 55"	TKc	Sample is a clast from the conglomerate.
84 ADn 57A	Bendeleben A-1 65^{o} 05' 55" 162^{o} 08' 08"	Od	Sample is light-gray mottled dolostone that occurs structurally above dark-gray dolostone (microfossil sample 84 ADn 57B--see Table 2) and light tan dolostone (barren sample 57C).
84 ADn 57C	Bendeleben A-1 65^{o} 05' 48" 162^{o} 08' 18"	Od	
84 ADn 79A	Kotzebue A-3 66^{o} 03' 55" 163^{o} 12' 10"	DObm	Microfossil collection 84 ADn 79C is from this locality (see Table 2).
84 ADn 84C	Solomon D-6 64^{o} 52' 50" 164^{o} 55' 40"	O€x	

FIELD NUMBER	LOCATION	UNIT	REMARKS
84 ADn 107	Solomon D-6 64° 55' 30" 164° 30' 52"	€d	
84 ADn 110B	Solomon D-5 64° 52' 35" 164° 27' 00"	Pzm	Sample is tan to gray, fine-grained dolostone that forms a small rubble patch about one tenth of a mile north of the marble rubble which was sampled as 84 ADn 110C.
84 ADn 110C	Solomon D-5 64° 52' 30" 164° 27' 00"	Pzm	
84 ADn 111	Solomon D-5 64° 58' 28" 164° 17' 50"	Pzm	Sample is tan, fine-grained dolostone that forms a small rubble patch surrounded by rubble and outcrops of medium crystalline marble.
85 ADn 41	Bendeleben D-3 65° 54' 36" 163° 02' 45"	Pzm	
83 AGe 7	Solomon D-6 64° 54' 30" 164° 41' 40"	O€x	
83 AGe 133	Bendeleben C-1 65° 35' 20" 162° 21' 30"	Pzm	
84 AGe 116	Solomon C-5 64° 43' 48" 164° 24' 32"	O€x	
84 AGe 128	Solomon D-6 64° 53' 55" 164° 50' 30"	O€x	

FIELD NUMBER	LOCATION	UNIT	REMARKS
84 AGe 140	Bendeleben C-6 65° 37' 21" 164° 32' 58"	Pzm	Sample is black, finely crystalline marble, a subordinate lithology at this locality. Microfossil collection 82 ADu 68 and megafossil collection 67 ASn 327 are from the dominant lithology (medium-gray marble) at this locality (see Tables 1 and 2.)
84 AGe 202	Bendeleben C-5 65° 35' 00" 164° 21' 40"	OЄx	
84 AKn 17	Solomon C-5 64° 42' 40" 164° 18' 20"	OЄx	
84 APk 217	Bendeleben C-6 65° 42' 23" 164° 33' 50"	Pzm	
84 APK 230	Bendeleben C-5 65° 43' 20" 164° 16' 50"	Pzim	
82 ATi 3C	Solomon D-5 64° 49' 48" 164° 11' 25"	OЄx	
82 ATi 34	Solomon C-4 64° 34' 08" 163° 38' 32"	Ddm	
82 ATi 36	Solomon C-4 64° 34' 08" 163° 39' 15"	Ddm	
82 ATi 42Z	Solomon D-5 64° 49' 10" 164° 12' 10"	OЄx	A recollection at barren locality 82 ACl 106.
82 ATi 49Z	Solomon D-5 64° 48' 03" 164° 12' 35"	OЄx	Microfossil collection 84 ADn 75Z is from this locality (see Table 2).
82 ATi 190	Bendeleben B-6 65° 25' 12" 164° 52' 25"	OЄx	
82 ATi 195A	Bendeleben C-6 65° 31' 54" 164° 36' 40"	Ddm	Microfossil collection 82 ATi 195B is from this locality (see Table 2).
82 ATi 196	Bendeleben C-6 65° 33' 23" 164° 34' 04"	Pzm	
82 ATi 197A	Bendeleben C-5 65° 35' 05" 164° 25' 53"	Pzm	Microfossil collection 82 ATi 197B is from this locality (see Table 2).

FIELD NUMBER	LOCATION	UNIT	REMARKS
82 ATi 198	Bendeleben C-5 65° 35' 03" 164° 26' 41"	O€x	
82 ATi 200	Bendeleben C-5 65° 38' 43" 164° 12' 06"	Pzim	
82 ATi 208	Bendeleben D-3 65° 59' 10" 163° 10' 51"	Pzm	
82 ATi 209	Bendeleben D-3 65° 49' 00" 163° 14' 45"	O€x	
82 ATi 211	Candle C-6 65° 32' 31" 161° 59' 35"	Pzd	
82 ATi 212	Bendeleben B-1 65° 26' 27" 162° 27' 25"	Pzm	
83 ATi 61	Solomon D-5 64° 46' 40" 164° 00' 50"	O€x	
83 ATi 169	Kotzebue A-1 66° 04' 00" 162° 04' 30"	Ocs	
84 ATi 3A	Solomon C-1 64° 38' 40" 162° 13' 00"	Ddm	
84 ATi 36	Solomon D-3 64° 53' 42" 163° 28' 28"	Oim	
84 ATi 53A	Solomon C-4 64° 33' 40" 163° 56' 40"	Pzm	
84 ATi 60E	Solomon C-1 64° 40' 55" 162° 22' 30"	Ddm	
84 ATi 88A	Bendeleben B-1 65° 26' 45" 162° 03' 40"	Pzd	Three samples of the same lithology were taken in the vicinity of microfossil collection 83 ATi 227. Sample 84 ATi 88B was taken at about the same spot as 83 ATi 227 and contains conodonts (see Table 2). Barren samples 88A and 88C were taken 200 and 400 feet east, respectively, of sample 88B.
84 ATi 88C	Bendeleben B-1 65° 26' 45" 162° 03' 40"	Pzd	

FIELD NUMBER	LOCATION	UNIT	REMARKS
84 ATi 104	Bendeleben A-2 65° 05' 30" 162° 35' 12"	OЄx	Sample is graphitic, fine- to medium-crystalline marble that is intercalated with quartz-graphite schist. The schist contains local recrystallized Radiolaria (see microfossil sample 84 ATi 104B, Table 2).
84 ATi 106	Norton Bay D-6 64° 57' 17" 161° 53' 13"	Pzd	
84 ATi 176	Solomon C-5 64° 40' 20" 164° 26' 35"	OЄx	
84 ATi 238A	Bendeleben C-6 65° 35' 40" 164° 47' 00"	OЄx	
84 ATi 270	Solomon D-6 64° 56' 15" 164° 31' 45"	Єd	Sample 270 is orange- and gray-weathering, medium-gray dolostone (the dominant lithology at this locality).
84 ATi 270B	Solomon D-6 64° 56' 12" 164° 31' 45"	Єd	Sample 270B is dark-gray dolostone that occurs in rubble just south of where sample 270 was collected.
84 ATi 271	Solomon D-6 64° 54' 35" 164° 31' 35"	Єd	
84 ATi 300B	Bendeleben C-6 65° 36' 10" 164° 39' 50"	OЄx	
84 ATi 354	Solomon D-5 64° 55' 36" 164° 15' 00"	Pzm	
85 ATi 36	Solomon D-4 64° 47' 06" 163° 56' 48"	OЄx	
83 SK 33B	Bendeleben A-1 65° 03' 55" 162° 07' 20"	Ddm	