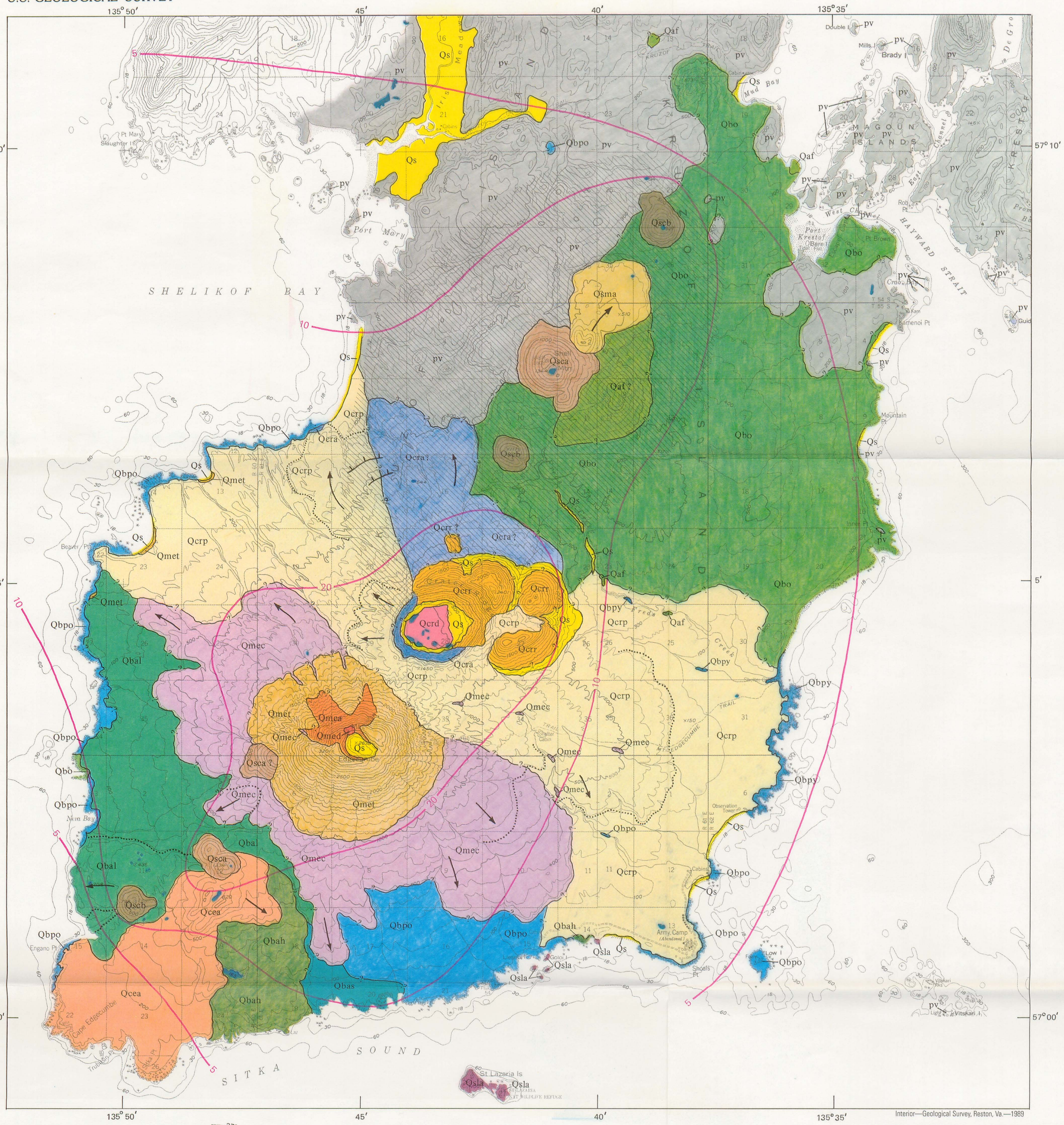


Base from U S Geological Survey, Sitka (A-5) and Sitka (A-6), 1951
Universal Transverse Mercator Projection

TRUE NORTH — MAGNETIC NORTH 27°
APPROXIMATE MEAN DECLINATION, 1989

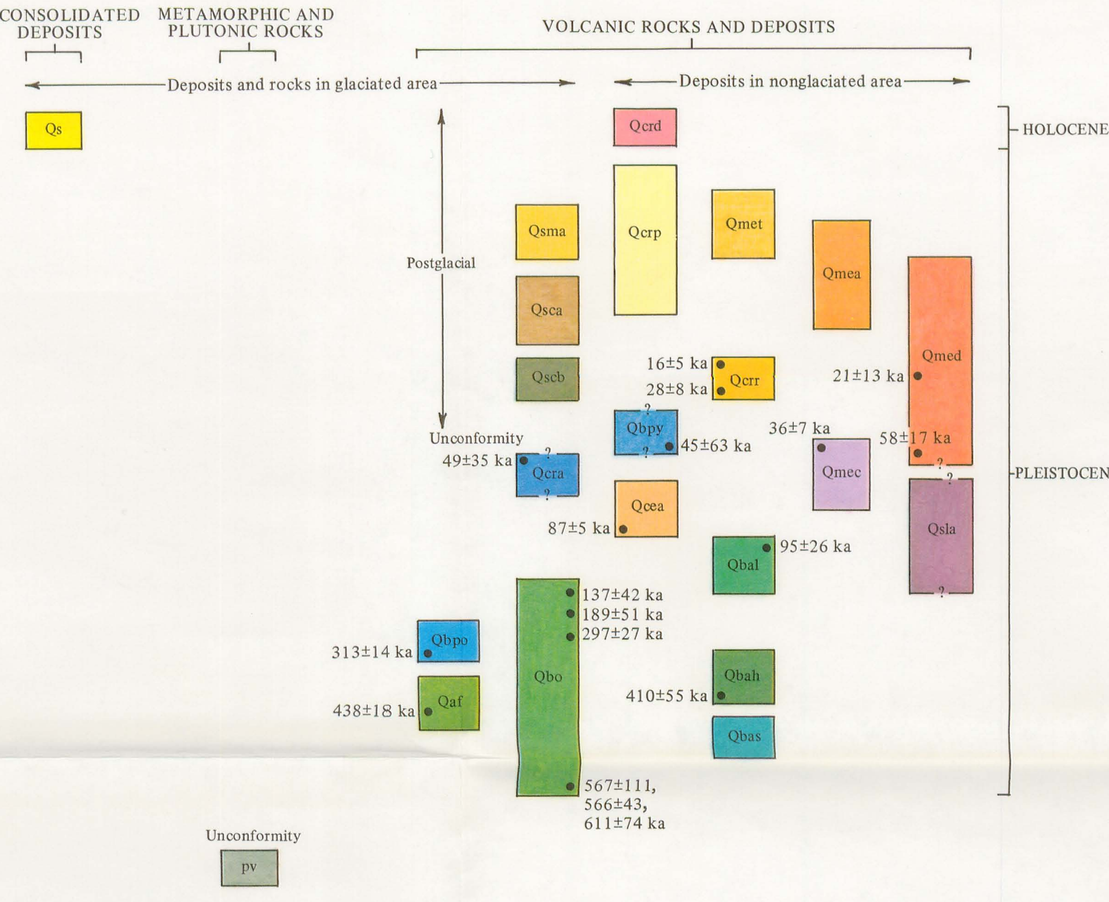
SCALE 1:63 360
CONTOUR INTERVAL 100 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

ALASKA — AREA OF MAP

Geology by D.A. Brew, 1981-86; D.E. Champion, 1985-86; M.A. Lanphere, 1985-86; and J.R. Riehle, 1981-86

Manuscript approved for publication, April 6, 1988

CORRELATION OF MAP UNITS [1]



[1] K–Ar ages shown in thousands of years B. P. are from table 2.

DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Qs — **Surficial deposits (Holocene)** — Consists primarily of alluvial, colluvial, and tidal-flat deposits. Poorly sorted deposits of blocks and sand derived by mass movement from adjacent slopes in the crater of Mount Edgecumbe and downslope from Crater Ridge domes. Moderately sorted sandy gravel and boulders in stream deposits; moderately to well-sorted sand and (or) gravel in beach deposits; silt and sand in tidal-flat deposits

METAMORPHIC AND PLUTONIC ROCKS

pv — **Prevolcanic bedrock (Tertiary and Cretaceous)** — Consists of the Sitka Graywacke (Cretaceous) and Kruzof Island pluton (early Tertiary). The Sitka Graywacke comprises low, glacially scoured knobs of steeply dipping, dark-gray argillite and interbedded medium-gray graywacke; moderate degree of contact metamorphism imparts slaty cleavage to argillite. The Kruzof Island pluton consists of light-colored outcrops of one- and two-mica granite, granodiorite, and adamellite. (Ages and modified descriptions: Sitka Graywacke, Johnson and Karl, 1982; Kruzof Island pluton, Loney and others, 1975)

VOLCANIC ROCKS AND DEPOSITS [1]

Qcrd — **Dacite lava flows of Crater Ridge crater (Holocene)** — Dark brownish gray, vesicular to diktytaxitic, plagioclase-phyric. Mainly massive but has local vague flow foliation. Forms hummocky topography (flow tops?). Subseriate porphyritic; foliated microcrystalline groundmass. Phenocrysts are plagioclase, 10-12 percent; orthopyroxene, 1-2 percent; clinopyroxene, 1-2 percent; opaque minerals, 0.1-0.3 percent. None of the air-fall units described below overlie lava flows of this unit

Qcrp — **Pryoclastic-flow deposits of Crater Ridge (Pleistocene)** — Pumiceous lapilli are low-silica rhyolite. Maximum thickness is >80 m on south wall of vent at Crater Ridge crater, where at least five major depositional units, some having internal stratification, are recognized. Near margins, unit consists of only one or two depositional units and is only 2-3 m thick. Deposits comprise poorly sorted silt, sand, rounded pumiceous lapilli, and angular blocks of dark-gray vitrophyre that are pieces of older Crater Ridge domes incorporated in explosive eruptions. Lapilli and blocks each range from 10 to 60 percent by volume. Thermal demagnetization experiments indicate that some beds were deposited at temperatures above 100 °C (Duane Champion, written commun., 1987), implying an origin as hot pyroclastic flows; however, unit includes some rhyolite air-fall beds. Mapped margins are approximate and gradational and are based partly on photointerpretation. Unit overlies the dacite air-fall tuffs of Mount Edgecumbe (unit Qmet)

Qmet — **Dacite air-fall tuffs of Mount Edgecumbe (Pleistocene)** — Pumiceous lapilli and ash. Lapilli are >75 percent glass by volume and are yellow, pale orange, or pale brown when dry. Deposit is compacted and agglutinated into dense gray and red bands of vitrophyre on rim of Mount Edgecumbe, where deposit is >50 m thick. Contact with andesite lava flows and breccias (unit Qmec) near base of Mount Edgecumbe cone is approximate and placed mainly at break in slope. Unit ranges from 0.5 to 15 m in thickness beyond this contact; for example, unit is 15 m thick at Shelikof Bay along major distribution axis of fallout, where unit is covered by pyroclastic-flow deposits of Crater Ridge (unit Qcrp). Unit is absent from steep slopes on north and west flanks of Mount Edgecumbe owing to erosion during and after deposition. Phenocrysts are plagioclase ≫ orthopyroxene=clinopyroxene>opaque minerals>apatite

Qsma — **Basaltic andesite lava flow of Shell Mountain (Pleistocene)** — Postglacial, heavily vegetated, and poorly exposed. Three samples are all porphyritic; total phenocrysts <15 percent (plagioclase ≫ orthopyroxene=clinopyroxene>olivine) in very fine grained, microvesicular groundmass. Blocks of probable flow carapace overlie unmapped air-fall beds of andesite, basaltic andesite, and basalt lapilli (units Qsca and Qscb)

Qmea — **Andesite air-fall tuffs of Mount Edgecumbe (Pleistocene)** — Red-brown and dark-gray, scoriaceous lapilli, breccia, and foliated vitrophyre inferred to be compacted and agglutinated air-fall deposits. Intruded(?) by andesite dome of Mount Edgecumbe (unit Qmed) but probably nearly contemporaneous with dome. Phenocrysts are plagioclase. 15-20 percent; orthopyroxene, 2-3 percent; clinopyroxene, 1-2 percent; opaque minerals, 0.1-0.2 percent. Glassy inclusions common in zones in plagioclase grains; plutonic inclusions ranging from <1 to >30 cm across also common

Qmed — **Andesite dome of Mount Edgecumbe (Pleistocene)** — Porphyritic, holocrystalline, dark-gray to brown lava having near-vertical foliation and rubbly appearance in outcrop. Locally vesicular. Phenocrysts are plagioclase, 10-15 percent; clinopyroxene, 3-5 percent; orthopyroxene, 2-4 percent; opaque minerals 0.1-0.3 percent. Grains mainly subhedral but include some that are rounded; glassy inclusions common in plagioclase grains. Groundmass grains are 0.05-0.1 mm across

Qsca — **Andesite air-fall tuffs (Pleistocene)** — Postglacial. Unit consists of dark- to medium-gray and grayish-brown, blocky, scoriaceous andesite lapilli. As mapped, unit consists of beds >50 m thick that comprise scoria cones at vents. Unmapped outcrops of unit <50 m thick locally overlie basalt and basaltic andesite air-fall tuffs (unit Qscb) which were erupted from other, adjacent vents. Mapped margins of unit arbitrarily placed at base of cones, although deposits range from 10 cm to 50 m in thickness beyond mapped contact

Qscb — **Basalt and basaltic andesite air-fall tuffs (Pleistocene)** — Postglacial. Unit differs from the andesite air-fall tuffs (unit Qsca) only in consisting essentially of mixed orange (basalt) and gray (basaltic andesite) scoriaceous lapilli

Qcrr — **Low-silica rhyolite domes of Crater Ridge (Pleistocene)** — Dark gray, commonly fractured, having scattered vesicles and (or) near-vertical foliation. Sparsely porphyritic; pilotaxitic, microcrystalline groundmass. Phenocrysts are plagioclase, 3-10 percent; clinopyroxene, 0-1 percent; orthopyroxene, 0-1 percent; rare opaque minerals. Andesite lapilli that may be unmapped outcrops <50 m thick of andesite air-fall tuffs (unit Qsca) and thick pryoclastic-flow deposits of Crater Ridge (unit Qcrp) overlie unit

Qbpy — **Younger plagioclase basalt flows (Pleistocene)** — Postglacial(?). Exposed mainly in intertidal zone near mouth of Freds Creek southward for 3 km, where flows engulf glacial erratics now comprising pebble-boulder beach deposits. Morphologically fresh, dark-gray flows having 1 to 3 m of relief on their upper surfaces, pressure ridges that range from 10 to 20 m across, ropy structures, small lava lakes, and columnar jointing ranging from 10 to 30 cm in diameter. Vesicular; vesicles, locally as much as 35 percent of rock, define bands. Individual to clustered plagioclase laths prominent. Glomeroporphyritic; holocrystalline to vitrophyric; groundmass grains <0.2 mm. Phenocrysts are plagioclase, 25-35 percent; olivine, 1-3 percent; clinopyroxene, 0-1 percent. Overlain (?) by unmapped basalt and basaltic andesite air-fall beds <50 m thick of unit Qscb

Qmec — **Andesite lava flows and breccias of Mount Edgecumbe cone (Pleistocene)** — Medium gray or grayish brown, locally vesicular, commonly having near-horizontal platy foliation. Subseriate porphyritic or glomeroporphyritic; trachytic or, less commonly, hyalopilitic groundmass with rare brown glass. Phenocrysts are plagioclase, 20-35 percent; clinopyroxene, 3-6 percent; orthopyroxene, 3-6 percent; trace of opaque minerals. Plagioclase grains commonly have zones of glassy inclusions. Lava flows high on flanks of cone probably include younger rootless flows formed of fused air-fall deposits (unit Qmea). Overlain by rhyolite pyroclastic-flow deposits of Crater Ridge (unit Qcrp). However, basalt and basaltic andesite air-fall tuffs (unit Qscb) <50 m thick have nowhere been found overlying this unit, although andesite and dacite air-fall tuffs (units Qmet and Qmea) are so thick that older air-fall deposits could easily have escaped detection

Qcra — **Andesite lava flows of Crater Ridge vent (Pleistocene)** — Glaciated(?). Gray or grayish brown, having near-horizontal platy foliation. Phenocrysts are plagioclase, 15-20 percent; clinopyroxene, 2-3 percent; orthopyroxene, 1-2 percent; trace of opaque minerals. Pilotaxitic groundmass; glassy inclusions common in subhedral plagioclase grains. Although major-element compositions are similar to those of andesite lava flows of Mount Edgecumbe cone (unit Qmec; see fig. 4), lava flows in this unit are inferred from photointerpretation to have clearly originated at Crater Ridge. Only known stratigraphic relations involving unit are with the overlying pyroclastic-flow deposits of Crater Ridge (unit Qcrp) and with the underlying older plagioclase basalt flows (unit Qbpo)

Qcea — **High-silica andesite lava flows of Cape Edgecumbe (Pleistocene)** — Sparsely porphyritic, thinly plated, dark-gray flows forming seacliffs as much as 60 m high. Local red blocky zones midway up some seacliffs are probable flow boundaries, implying closely succeeding flows each 15-30 m thick. Phenocrysts are <2 percent (plagioclase>orthopyroxene=clinopyroxene) in hyalopilitic to pilotaxitic groundmass. Flow foliation pervasive and highly variable in orientation. Unit clearly overlies high-silica basaltic andesite lava flows (unit Qbah) and, on basis of photointerpretation, probably overlies basaltic andesite lava flows (unit Qbal)

Qsla — **Andesite lava flows of St. Lazaria Islands (Pleistocene)** — Dark-gray lava pervasively jointed to equant blocks ranging from 10 to 30 cm across. Seriate porphyritic to hyalopilitic; also includes rare brown glass. Phenocrysts are plagioclase, 10-20 percent (larger grains anhedral, smaller subhedral); clinopyroxene, 2-4 percent; orthopyroxene, 0-1 percent; olivine, 0-1 percent; submicroscopic opaque dust. Domes(?) at vents implied by concave-down, radiating pattern of columnar joints in seacliff exposures

Qbal — **Basaltic andesite lava flows (Pleistocene)** — Thinly plated, dark gray, nearly aphyric. Locally vesicular. Porphyritic; trachytic microcrystalline groundmass. Phenocrysts are plagioclase, 8-10 percent; clinopyroxene, 0-1 percent; olivine, 0-1 percent; opaque minerals, 0-2 percent. Unit crops out mostly on southwest shore of Kruzof Island, but true extent is uncertain because mapped contacts with the underlying older plagioclase basalt lava flows (unit Qbpo), overlying lava flows of Mount Edgecumbe cone (unit Qmec), and the underlying(?) high-silica basaltic andesite lava flows (unit Qbah) are largely photointerpreted

Qbo — **Olivine basalt flows, breccias, and aquagene tuffs (Pleistocene)** — Unit crops out mainly north of Freds Creek, where locally overlain by thin deposits of glacial till; as mapped, also includes small outcrops of prevolcanic bedrock (unit pv) One small outcrop of olivine basalt is found on west shore of Kruzof Island, 2 km north of Neva Bay. A tuff containing lapilli of vesicular hyalopilitic basalt crops out 1 km south-west of head of Port Krestof on east coast of Kruzof Island; tuff contains marine macrofossils and benthic foraminifers that imply a Pleistocene age and water depth of 50-100 m (William Sliter, written commun., 1985). Lava-flow textures range between (1) medium gray, equigranular, vesicular to diktytaxitic, fine grained, diabasic, containing grains ranging from 0.3 to 1.0 mm across of plagioclase (50-60 percent), olivine (15-25 percent), subophitic clinopyroxene (15-25 percent), and trace of opaque minerals and (2) dark gray, vesicular, porphyritic to hyalopilitic, containing 50-100 percent mineral grains of plagioclase ≫ clinopyroxene=olivine. Such wide textural variation may reflect varying depths of exposure of multiple flows following glacial erosion. Marginally tholeiitic by chemical criteria (fig. 3)

Qbpo — **Older plagioclase basalt flows (Pleistocene)** — Highly vesicular, massive, dark gray. Holocrystalline, porphyritic. Phenocrysts are glomeroporphyritic plagioclase, 5-35 percent; olivine, 3-6 percent; clinopyroxene, 0.5-1 percent. Morphologically fresh flows having pressure ridges and columnar joints like those of the younger plagioclase basalt flows (unit Qbpy), but differing in that (1) groundmass grains of this unit (0.1-0.3 mm) are larger than those of the younger unit (<0.2 mm or glassy), (2) abundance of plagioclase phenocrysts ranges more widely in samples of this unit (5-35 percent) than in samples of the younger unit (25-35 percent), and (3) olivine abundance exceeds 3 percent in most samples of this unit but is less than 3 percent in all samples of the younger unit

Qbah — **High-silica basaltic andesite lava flows (Pleistocene)** — Dark gray; local bands of vesicles. Flow foliation near-vertical to concave-down semicircles that range from 10 to 20 m across in seacliff exposures. Minor rubbly, red-gray zones are presumably flow tops. Porphyritic and holocrystalline; trachytic groundmass. Phenocrysts are plagioclase, 10-15 percent; clinopyroxene, 0-3 percent; olivine 0-2 percent; orthopyroxene, 0-1 percent; opaque minerals, 2-4 percent. Plastically deformed xenolith of partially melted plutonic rock, which has glassy rims on mineral grains, found in beach exposure on south shore of Kruzof Island 2 km west of Shoals Point

Qaf — **Andesite lava flows and domes(?) (Pleistocene)** — Poorly exposed, widely scattered small outcrops. Dense, hard, dark gray; well-developed banding and foliation. Subseriate porphyritic; pilotaxitic groundmass. Phenocrysts are plagioclase, 2-13 percent; clinopyroxene, 0.5-2 percent; orthopyroxene, 0.3-1 percent; opaque minerals, 1-2 percent; rare olivine(?). Some clinopyroxene and orthopyroxene grains have reaction rims; small plutonic inclusions common. Marginally tholeiitic by SiO_2-$(FeO+.9Fe_2O_3)$/MgO and $(FeO+.9Fe_2O_3)$-MgO-(Na_2O+K_2O) relations, but calc-alkaline by Al_2O_3-normative An relations (fig. 3)

Qbas — **Low-silica basaltic andesite lava flows (Pleistocene)** — Dark gray, thinly plated, locally coarsely vesicular. Columnar joints 0.5 to 1 m in diameter. Porphyritic, holocrystalline; very fine grained groundmass. Phenocrysts are plagioclase, 2-15 percent; clinopyroxene (pigeonite?), 2-4 percent; olivine, 1-3 percent; opaque minerals 3-5 percent

Thick pyroclastic deposits — Bedrock exposures and morphologic expression of lava flows are obscured by exceptionally thick pyroclastic deposits

Contact — Queried where gradational and (or) photointerpreted

Photointerpreted morphologic boundary of lava flow

Direction of lava flowage as inferred by photointerpretation

Linear ridges inferred to be lateral moraines — Tick marks on side of glacier

Isopachs of aggregate thickness of air-fall pyroclastic deposits — Contours in meters. Deposits comprise numerous beds, basaltic andesite at base, overlain by andesite, dacite, and low-silica rhyolite at top

[1] Classification of rock types based on chemical composition (table 1); age of units based on potassium-argon age determinations (table 2).

DISCUSSION

The Mount Edgecumbe volcanic field on southern Kruzof Island was informally named by Berg and Hinckley (1963). The first petrographic descriptions and map of the volcanic deposits were provided by Brew and others (1969) whose report was based on reconnaissance sampling, primarily of coastal exposures, and photointerpretation. Two dissertations on the Mount Edgecumbe volcanic rocks were subsequently completed (Myers, 1979; Myers and Marsh, 1981; Kosco, 1981a, b); both focused on the major- and minor-element and isotopic compositions of the lava flows. The present study was undertaken with the following objectives: (1) to prepare a bedrock geologic map (this report), (2) to study the pyroclastic deposits that mantle much of southern Kruzof Island, including the lava flows (to be reported elsewhere), and (3) to determine, where feasible, the ages of the various deposits that comprise the Mount Edgecumbe volcanic field (this report).

The bedrock of southern Kruzof Island is obscured to an exceptional degree by rain-forest vegetation and a thick mantle of postglacial pyroclastic deposits. The pyroclastic deposits are mapped separately only where they are unusually thick near source vents (units Qmet, Qmea, Qsca, and Qscb) and (or) where the underlying bedrock is extensively covered (unit Qcrp). Outcrops, located from a low-flying helicopter, were found mainly in creek beds, where typically 10 to 100 m² of rock are exposed. Contacts, which were rarely seen, were drawn between outcrops of different lithologic types and along photointerpreted flow boundaries where possible. The degree of confidence in such contacts is least where exposures are far apart and where the morphology of flows is most obscured by pyroclastic deposits; the area of least confidence is indicated on the map by the diagonal pattern. Because of the reliance on photointerpretation, the present map is conceptually similar to the map presented by Brew and others (1969). The main difference is that in seeking all outcrops in the interior of the island, we have added nearly 200 stations (fig. 1) of which about 150 have yielded bedrock information. We have 85 new, major-element analyses and 150 new thin sections that we incorporate with all previously published petrographic and chemical data in this report.

Our rock classifications are based wholly on chemical composition (table 1). Our classification scheme is slightly modified from Le Bas and others (1986); namely, we have shifted the upper and lower boundaries of the basaltic andesite field from 57 percent to 56 percent silica and from 52 percent to 51 percent silica, respectively. The new field boundaries coincide better with natural breaks in the distribution of the silica content of our samples (fig. 2). According to the field boundaries of Irvine and Baragar (1971), both calc-alkaline and marginally tholeiitic compositions are present (fig. 3).

Potassium-argon ages were determined for 17 whole-rock samples from 15 localities in the Mount Edgecumbe volcanic field. Potassium oxide measurements were made by flame photometry following lithium metaborate fusion and dissolution (Ingamells, 1970). Argon (Ar) analyses were made by isotope dilution using equipment and techniques described by Dalrymple and Lanphere (1969). Potassium-argon ages and analytical data are given in table 2. Duplicate Ar measurements were made on 13 samples, and a weighted mean age was calculated for these samples where individual ages were weighted by the inverse of their variances. Calculated ages for most individual measurements have large uncertainties because of low percentages of radiogenic ^{40}Ar, typically less than 3 percent, and because of the young age of the lava flows.

Source vents of the nonglaciated lava flows and pyroclastic deposits obviously define a northeast-trending, linear zone that we infer to be the surface expression of a regional fracture. Sources of the older deposits are less readily identified, owing both to glacial erosion and to the absence of cone construction by the low-volume, fluid lava flows. Probable older vents are marked by three hills: (1) 1 km west of Mud Bay at the north end of the volcanic field, (2) approximately midway along a line between Crater Ridge crater and Port Krestof, and (3) immediately north of the mouth of Freds Creek. Other, possible older vents include the two small outcrops of the andesite lava flows and domes(?) (unit Qaf), the outcrop of older plagioclase basalt flows (unit Qbpo) at the north end of the volcanic field, the isolated exposure of olivine basalt flow (unit Qbo) 1 km north of Neva Bay, and the several outcrops of the andesite lava flows of St. Lazaria Islands (unit Qsla) off the south shore of Kruzof Island. Clearly most of the volume of the Mount Edgecumbe magmas was erupted from vents located along the main fracture; nearly all of the magmas in the field with more than 56 percent silica were erupted from such vents.

REFERENCES CITED

Berg, H.C., and Hinckley, D.W., 1963, Reconnaissance geology of northern Baranof Island, Alaska: U.S. Geological Survey Bulletin 1141-O, 24 p.

Brew, D.A., Muffler, L.J.P., and Loney, R.A., 1969, Reconnaissance geology of the Mount Edgecumbe volcanic field, Kruzof Island, southeastern Alaska: U.S. Geological Survey Professional Paper 650-D, p. D1-D18.

Dalrymple, G.B., and Lanphere, M.A., 1969, Potassium dating: San Francisco, W.H. Freeman and Company, 258 p.

Ingamells, C.O., 1970, Lithium metaborate flux in silicate analysis: Analytical Chemica Acta, v. 52, no. 2, p. 323-334.

Irvine, T.N., and Baragar, W.R.A., 1971, A guide to the chemical classification of the common volcanic rocks: Canadian Journal of Earth Sciences, v. 8, no. 5, p. 523-548.

Johnson, B.R., and Karl, S.M., 1982, Reconnaissance geologic map of the western Chichagof and Yakobi Islands Wilderness Study Area, southeastern Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1476-A, scale 1:125,000.

Kosco, D.G., 1981a, Part I, The Mt. Edgecumbe volcanic field, Alaska: An example of tholeiitic and calc-alkaline volcanism; Part II, Characteristics of andesitic to dacitic volcanism at Katmai National Park, Alaska: Berkeley, University of California, Ph.D. dissertation, 249 p.

———, 1981b, The Mt. Edgecumbe volcanic field, Alaska: An example of tholeiitic and calc-alkaline volcanism: Journal of Geology, v. 89, no. 4, p. 459-477.

Le Bas, M.J., Le Maitre, R.W., Streckeisen, A., and Zanettin, B., 1986, A chemical classification of volcanic rocks based on the total alkali-silica diagram: Journal of Petrology, v. 27, no. 3, p.745-750.

Loney, R.A., Brew, D.A., Muffler, L.J.P., and Pomeroy, J.S., 1975, Reconnaissance geology of Chichagof, Baranof, and Kruzof Islands, southeastern Alaska: U.S. Geological Survey Professional Paper 792, 105 p.

Myers, J.D., 1979, Geology and petrology of the Edgecumbe volcanic field, southeastern Alaska: Transform fault volcanism and magma mixing: Baltimore, Maryland, The Johns Hopkins University, Ph.D. dissertation, 205 p.

Myers, J.D., and Marsh, B.D., 1981, Geology and petrogenesis of the Edgecumbe volcanic field, SE Alaska: The interaction of basalt and sialic crust: Contributions to Mineralogy and Petrology, v. 77, no. 3, p. 272-287.

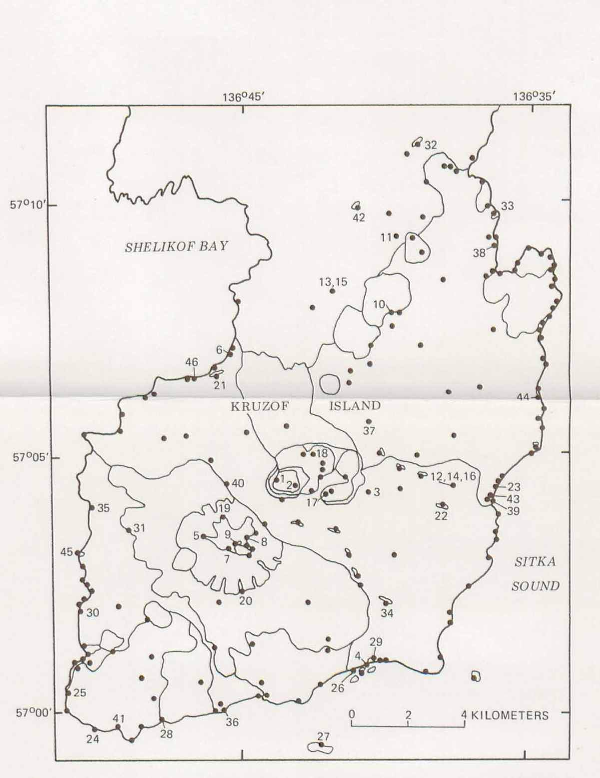


Figure 1. — Locations of stations examined on southern Kruzof Island (some locations represent more than one station). Numbers refer to samples listed in table 1 and (or) stations in table 2. Geologic contacts between map units shown.

Table 1. — *Major-element analyses of samples representative of the volcanic map units, Mount Edgecumbe volcanic field, Alaska*

[Analysis in weight percent. Analysts: A.J. Bartel, E. Brandt, P. Klock, S. Macpherson, R.V. Mendes, S. Neil, K. Stewart, J. Taggart, J. S. Wahlberg, U.S. Geological Survey. Methods: X-ray fluorescence for all species except FeO, which is by titration. n.d., not determined]

Map unit	Qcrd		Qcrp		Qmet		Qmea		Qmed	Qsma	Qsca		Qscb, orange		Qscb, gray		Qcrr		Qmec	
Sample no.	1	2	3	4	5	6	7	8[1]	9	10	11	12	13	14	15	16	17	18	19	20
Major element / Field no.	82Rj145	82Rj147	81Rj060h	81Rj084c	82Rj124	81Rj075a	83Rj284	62Db446	81Rj044	86Rj013	81Rj070e	83Rj280e	81Rj073a	83Rj280c	81Rj073a	83Rj280c	85Rj001	85Le015a	81Rj064a	84Rj032a
SiO_2	63.0	63.2	66.4	67.5	64.1	64.5	59.4	59.5	57.4	54.5	56.7	56.1	44.2	41.8	52.2	51.7	70.5	70.9	58.9	59.2
Al_2O_3	16.6	16.5	15.4	15.0	16.8	16.1	17.7	17.5	17.6	18.9	18.1	17.7	21.8	20.9	18.5	18.6	14.5	14.5	17.8	17.9
Fe_2O_3	1.14	1.19	0.96	0.97	1.59	1.32	3.70	1.2	1.41	1.50	3.30	1.98	7.12	7.59	3.26	4.06	0.85	1.05	1.65	1.69
FeO	3.93	3.94	2.32	2.26	2.74	2.84	2.54	4.7	5.18	6.00	3.99	5.85	3.07	1.99	5.49	4.99	2.37	2.14	4.21	4.25
MgO	2.57	2.68	0.52	0.53	0.94	1.01	3.48	3.6	4.41	4.10	2.38	3.73	4.32	3.39	5.10	5.06	0.58	0.43	3.13	3.28
CaO	5.39	5.35	2.10	2.13	3.10	3.25	6.73	6.8	7.28	8.74	5.47	7.53	7.61	6.27	9.31	9.07	2.27	2.13	6.59	6.77
Na_2O	3.99	3.96	4.39	4.25	4.47	4.36	4.13	4.2	3.80	3.60	4.03	3.74	2.49	2.14	3.38	3.47	4.53	4.93	3.96	4.13
K_2O	1.35	1.33	2.09	1.99	1.66	1.71	0.91	0.81	0.74	0.48	0.90	0.81	0.14	0.09	0.39	0.35	2.76	2.36	0.98	0.92
TiO_2	0.66	0.66	0.40	0.39	0.60	0.64	0.73	0.74	0.64	0.98	1.20	1.07	1.31	1.17	1.18	1.10	0.35	0.34	0.82	0.74
P_2O_5	0.20	0.18	0.09	0.11	0.20	0.19	0.28	0.32	0.29	0.32	0.46	0.36	0.37	0.40	0.33	0.35	0.10	0.09	0.28	0.29
MnO	0.08	0.08	0.06	0.05	0.06	0.07	0.10	0.12	0.11	0.13	0.11	0.13	0.12	0.08	0.18	0.19	0.05	0.06	0.09	0.09
H_2O^+	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.39	n.d.	(0.48)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	(0.47)	0.23	n.d.	n.d.
H_2O^-	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.09	n.d.	(0.11)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	(0.05)	0.07	n.d.	n.d.
CO_2	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	<.05	n.d.	(0.04)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	(0.12)	0.32	n.d.	n.d.
LOI[2]	0.56	0.71	4.41	4.16	3.88	3.53	0.61	n.d.	0.63	0.85	3.26	1.03	7.61	13.8	0.79	1.44	0.58	0.21	1.28	0.74
TOTAL	99.5	99.8	99.1	99.3	100.1	99.5	100.3	100.0	99.5	100.1	99.9	100.0	100.2	99.6	100.1	100.4	99.4	99.8	99.7	100.0

Map unit	Qcra	Qbpy		Qcea		Qsla		Qbah		Qbal		Qaf		Qbpo		Qbas	Qbo	
Sample no.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36[1]	37	38
Major element / Field no.	84Rj013a	84Db023a	84Rj001a	85Le014	84Db013b	85Le022a	86Rj019	85Le008a	85Db015a	84Rj014a	84Db037a	85Db010a	84Rj012	84Db019a	85Le004a	61Db725	84Db026a	84Rj011b
SiO_2	57.2	49.6	49.5	61.8	61.1	56.2	57.0	54.8	55.1	53.5	53.1	57.7	56.2	49.8	50.1	51.3	48.6	46.5
Al_2O_3	17.9	16.2	16.0	16.7	16.8	17.9	18.1	18.8	17.4	18.7	17.9	16.7	16.8	17.3	18.2	18.1	15.9	17.3
Fe_2O_3	1.84	2.03	2.33	1.84	2.46	1.22	0.94	2.33	1.57	1.60	3.56	1.98	2.02	2.23	1.82	2.0	1.88	2.79
FeO	5.74	8.06	8.06	4.68	4.01	6.07	6.04	5.43	6.24	6.35	5.20	6.95	6.96	6.98	6.65	6.1	10.2	7.01
MgO	2.84	6.96	6.99	2.21	2.30	4.12	3.20	4.02	4.57	4.61	4.77	2.69	3.53	6.76	6.92	6.5	7.13	9.34
CaO	7.21	11.2	11.1	5.49	5.46	8.07	7.40	8.59	8.36	8.93	8.98	6.54	6.98	11.4	11.6	10.2	10.6	10.6
Na_2O	4.09	3.33	3.36	4.72	4.65	3.57	3.60	3.69	3.38	3.68	3.57	4.15	3.96	3.30	3.21	3.3	3.14	2.44
K_2O	0.86	0.20	0.21	1.16	1.13	0.98	1.17	0.59	1.09	0.49	0.49	1.01	0.93	0.18	0.16	0.25	0.22	0.15
TiO_2	1.07	1.60	1.66	0.99	0.97	0.94	1.02	0.98	1.11	1.04	1.16	1.44	1.35	1.43	1.19	1.1	1.68	0.97
P_2O_5	0.36	0.26	0.30	0.40	0.40	0.31	0.32	0.35	0.37	0.36	0.36	0.41	0.40	0.25	0.20	0.34	0.17	0.12
MnO	0.12	0.17	0.18	0.10	0.10	0.12	0.12	0.13	0.13	0.13	0.15	0.15	0.15	0.15	0.14	0.16	0.21	0.16
H_2O^+	n.d.	n.d.	n.d.	(0.11)	n.d.	(0.53)	(0.62)	(0.25)	(0.64)	n.d.	n.d.	(0.04)	n.d.	n.d.	(0.14)	0.51	n.d.	n.d.
H_2O^-	n.d.	n.d.	n.d.	(0.01)	n.d.	(0.12)	(0.13)	(0.21)	(0.15)	n.d.	n.d.	(0.08)	n.d.	n.d.	(<.01)	0.10	n.d.	n.d.
CO_2	n.d.	n.d.	n.d.	(0.06)	n.d.	(0.03)	(0.06)	(0.12)	(0.09)	n.d.	n.d.	(<.02)	n.d.	n.d.	(0.04)	<.05	n.d.	n.d.
LOI[2]	0.58	0.85	0.81	0.55	0.67	0.95	0.97	0.89	0.94	0.70	0.99	0.70	1.06	0.75	0.67	n.d.	1.02	2.61
TOTAL	99.8	100.5	100.5	100.6	100.0	100.5	99.9	100.6	100.3	100.1	100.2	100.4	100.3	100.6	100.9	100.0	100.8	100.0

[1] From Brew and others (1969).
[2] LOI, loss on ignition; value is corrected for oxidation of FeO to Fe_2O_3 and comprises only volatiles such as H_2O^+, H_2O^-, CO_2, F, Cl, SO_2. Because H_2O^+, H_2O^-, and CO_2 are included in LOI, values of volatiles are in parentheses where LOI is also reported.

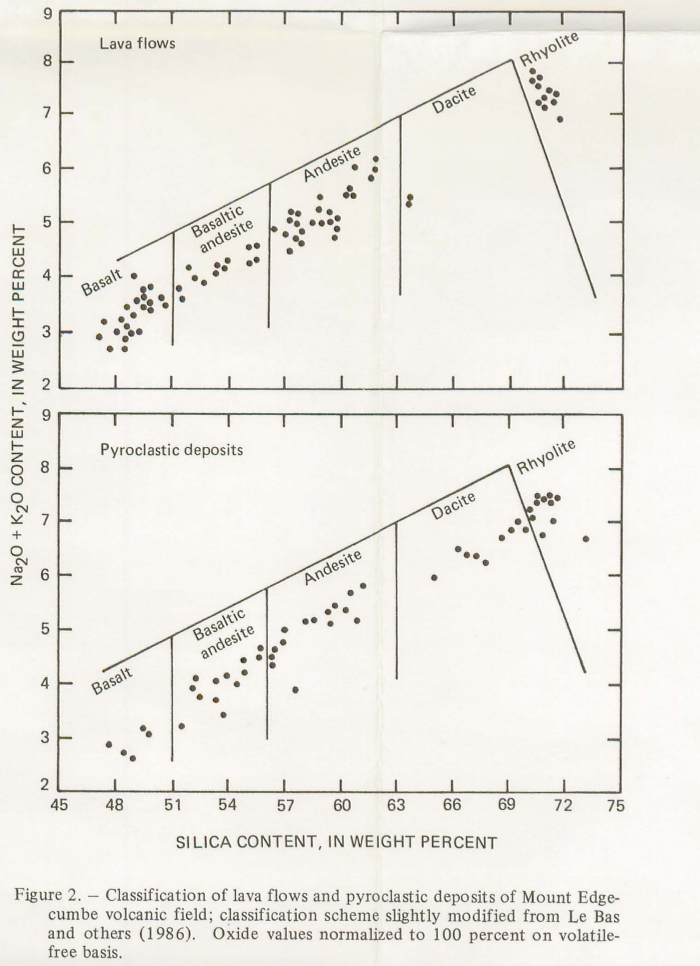


Figure 2. — Classification of lava flows and pyroclastic deposits of Mount Edgecumbe volcanic field; classification scheme slightly modified from Le Bas and others (1986). Oxide values normalized to 100 percent on volatile-free basis.

Table 2. — *Potassium-argon ages and analytical data for volcanic rocks from Mount Edgecumbe volcanic field, Alaska*

[Age determinations from whole-rock samples]

Station no.[1] (Field no.)	Map unit	K_2O (wt. %)[2]	$^{40}Ar_{rad}$ (mol/gr ×10^{-13})	$^{40}Ar_{rad}$(%)	Calculated sample age (10^3 yr)[3]	Weighted mean calculated age (10^3 yr)[4]
9 (85ALe018)	Qmed	1.030 ± 0.007	0.1430 0.9692	0.71 3.37	9.5 ± 15 65 ± 30	21 ± 13
9 (86ALe014)	Qmed	0.770 ± 0.003	0.7668 0.4886	2.69 1.51	69 ± 23 44 ± 25	58 ± 17
17 (86ALe013c)	Qcrr	2.468 ± 0.005	0.6349 0.5104	3.07 3.34	18 ± 7 14 ± 7	16 ± 5
18 (85ALe015)	Qcrr	2.483 ± 0.009	1.002	2.10	28 ± 8	
21 (85ALe001)	Qcra	0.950 ± 0.005	0.6700	0.60	49 ± 35	
28 (85ALe008)	Qbah	0.632 ± 0.002	3.951 2.942	1.39 1.11	435 ± 62 323 ± 116	410 ± 55
30 (85ALe006)	Qbal	0.537 ± 0.002	0.7387 0.7290	0.95 1.25	96 ± 46 94 ± 31	95 ± 26
32 (86ALe012b)	Qaf	0.999 ± 0.003	6.271	27.6	438 ± 18	
37 (85ALe013)	Qbo	0.144 ± 0.007	1.034 1.315	0.63 1.64	499 ± 158 634 ± 157	567 ± 111
39 (85ALe010)	Qbpy	0.223 ± 0.005	0.1832 0.1046	0.42 0.29	57 ± 90 33 ± 87	45 ± 63
40 (85ALe003)	Qmec	0.821 ± 0.005	0.4102 0.4944	1.04 1.02	35 ± 8 42 ± 18	36 ± 7
41 (85ALe009)	Qcea	1.188 ± 0.006	1.567 1.281	4.17 4.97	92 ± 6 75 ± 9	87 ± 5
42 (85ARj005a)	Qbpo	0.378 ± 0.002	1.781 1.465	5.42 5.14	327 ± 16 269 ± 29	313 ± 14
43 (85ALe012)	Qbo	0.160 ± 0.002	0.3187 0.3132	1.79 1.63	138 ± 60 136 ± 60	137 ± 42
44 (85ALe020)	Qbo	0.232 ± 0.002	1.839 1.982	5.09 3.68	551 ± 54 593 ± 72	566 ± 43
44 (85ALe021)	Qbo	0.239 ± 0.002	1.071 0.9196	2.52 3.59	311 ± 30 267 ± 44	297 ± 27
45 (85ALe005)	Qbo	0.208 ± 0.002	0.3997 0.9117	1.15 1.50	134 ± 58 305 ± 84	189 ± 51
46 (85ALe011)	Qbo	0.217 ± 0.005	1.823 2.172	7.02 3.50	583 ± 86 694 ± 148	611 ± 74

[1] Refers to numbers on station location map (fig. 1).
[2] Mean and standard deviation of four measurements.
[3] $\lambda_\epsilon = 0.581\times10^{-10}yr^{-1}$, $\lambda_\beta = 4.962\times10^{-10}yr^{-1}$, $^{40}K/K = 1.167\times10^{-4}$mol/mol. Errors are estimates of the standard deviation of analytical precision.
[4] For two analyses, weighting is by inverse of variance of individual measurements; uncertainty assigned is weighted standard deviation.

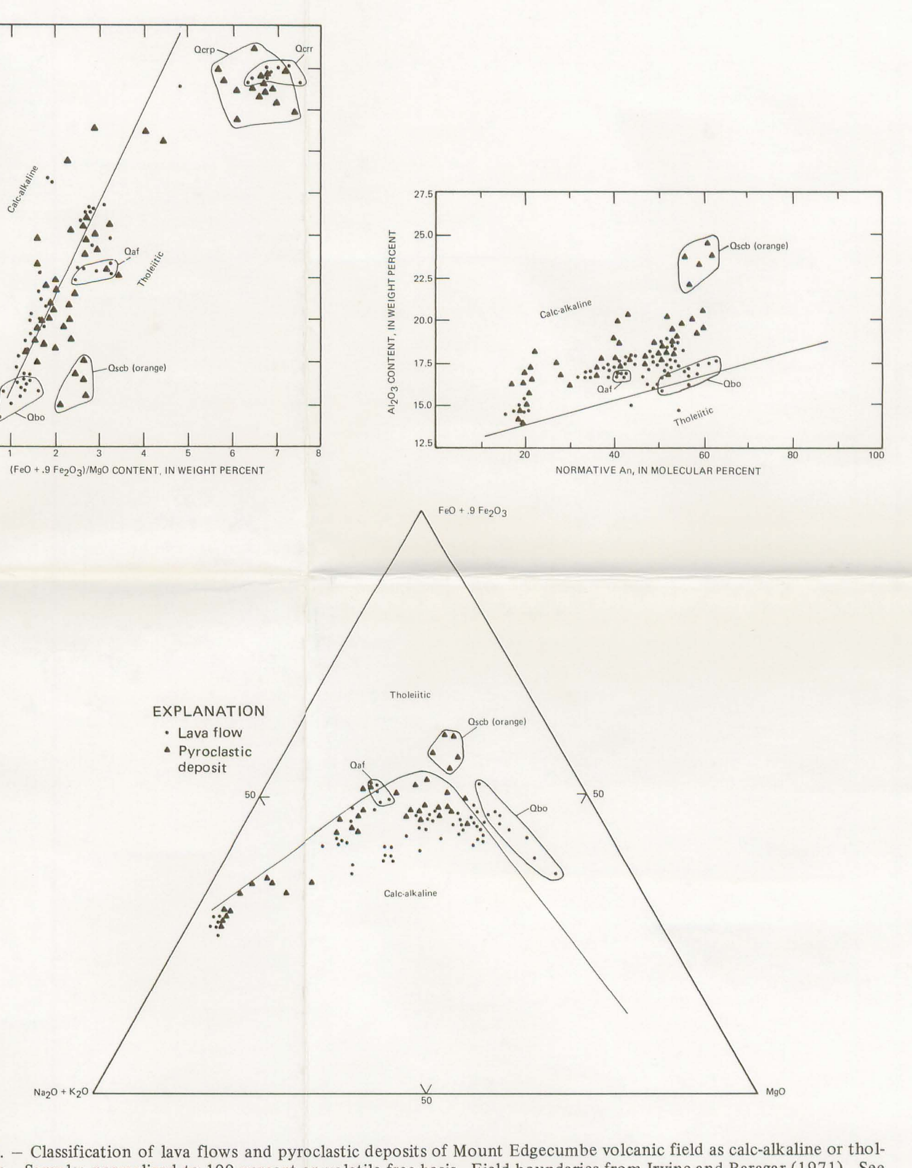


Figure 3. — Classification of lava flows and pyroclastic deposits of Mount Edgecumbe volcanic field as calc-alkaline or tholeiitic. Samples normalized to 100 percent on volatile-free basis. Field boundaries from Irvine and Baragar (1971). See "Description of Map Units" for identification of map-unit symbols.

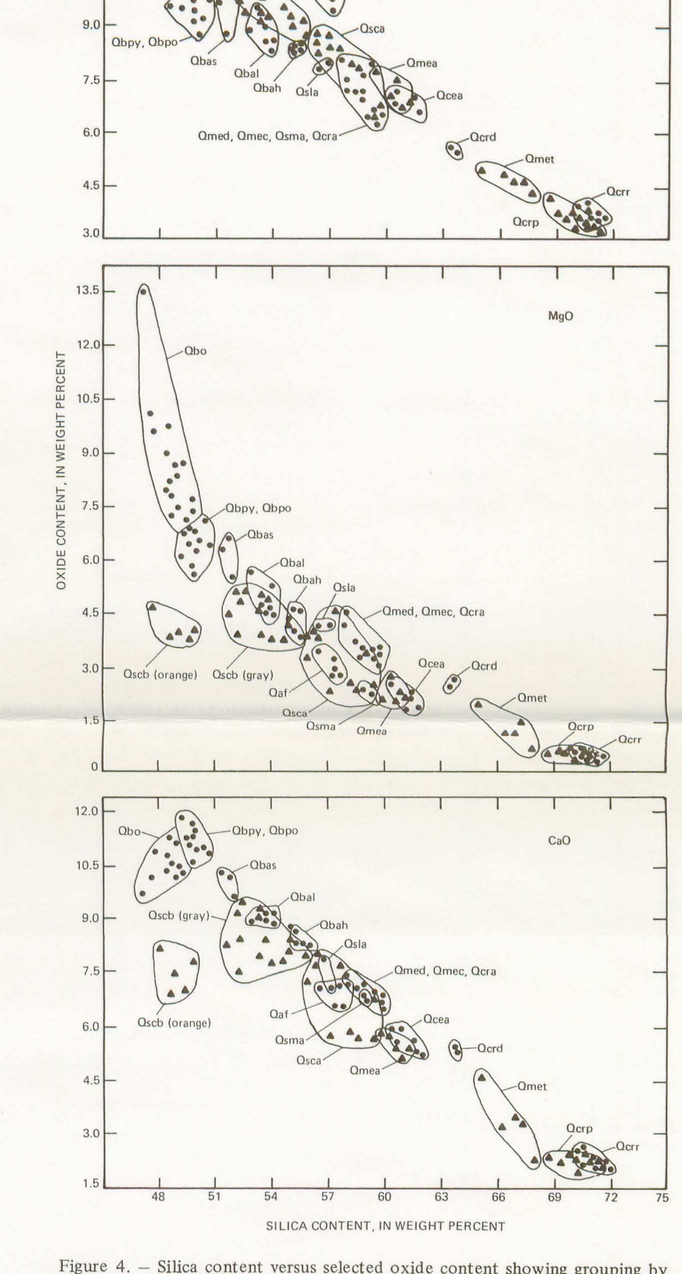


Figure 4. — Silica content versus selected oxide content showing grouping by map units of Mount Edgecumbe volcanic field. Dot, lava flow; triangle, pyroclastic deposit. Samples normalized to 100 percent on volatile-free basis. See "Description of Map Units" for identification of map-unit symbols.

GEOLOGIC MAP OF THE MOUNT EDGECUMBE VOLCANIC FIELD, KRUZOF ISLAND, SOUTHEASTERN ALASKA

By
James R. Riehle, David A. Brew, and Marvin A. Lanphere

1989

Any use of trade names in this publication is for description purposes only and does not imply endorsement by the U.S Geological Survey

For sale by U.S. Geological Survey, Alaska Distribution Section, New Federal Bldg., Box 12, 101 Twelfth Avenue, Fairbanks, AK 99701, and U.S. Geological Survey, Map Distribution, Box 25286, Federal Center, Denver, CO 80225