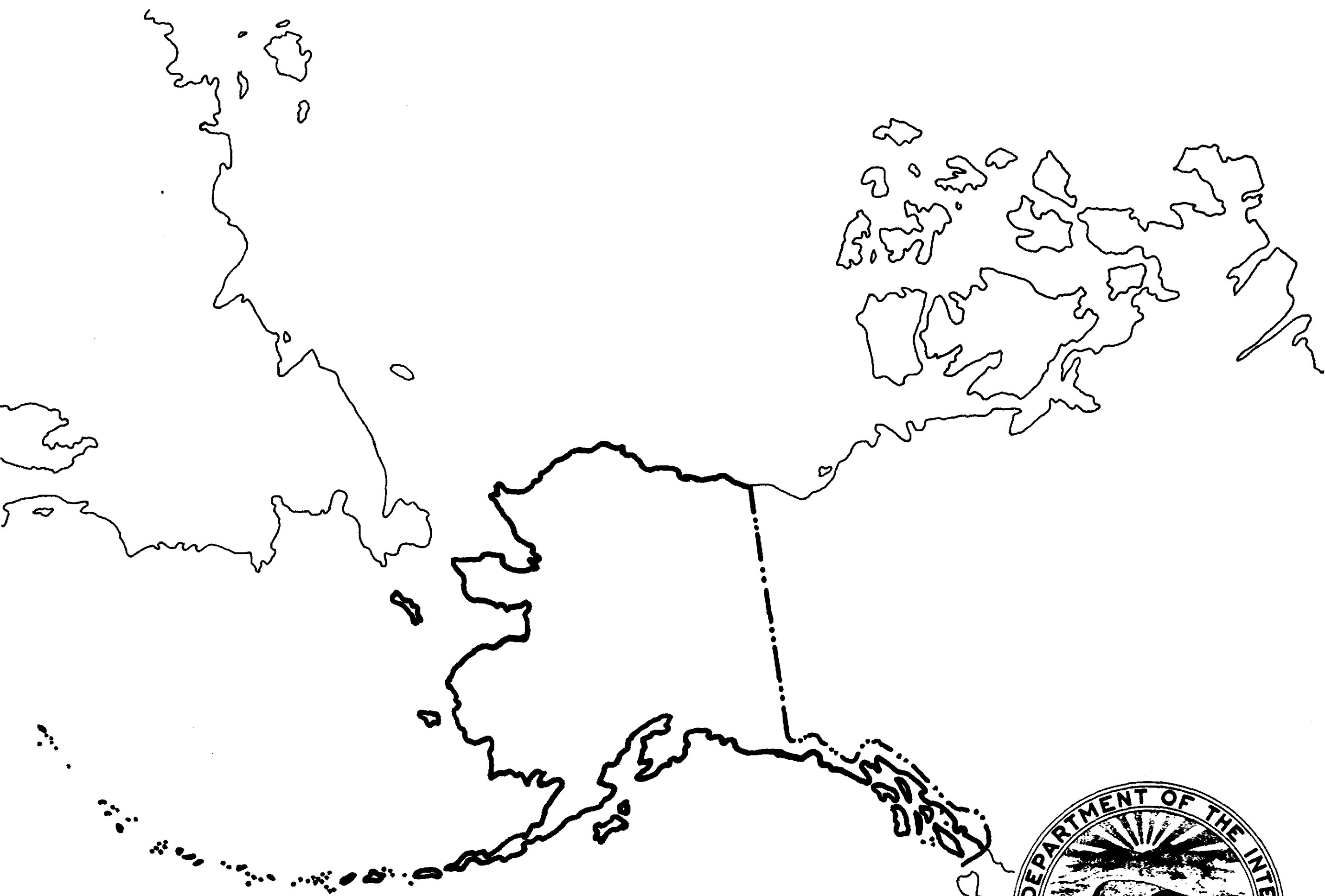
CIRC 939

THE UNITED STATES GEOLOGICAL SURVEY IN ALASKA: ACCOMPLISHMENTS DURING 1982



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The United States Geological Survey in Alaska: Accomplishments During 1982

Katherine M. Reed and Susan Bartsch-Winkler, Editors

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fabric in the quartzo-feldspathic schist and gneiss unit; (2) the syn- or late-tectonic intrusion of the biotite-hornblende granodiorite, tonalite, and quartz-diorite sills, which parallel the fabric of the schist and gneiss; (3) the invasion by the K-feldspar megacrystic biotite granodiorite; (4) the subsequent intrusion of the leucocratic biotite granite and granodiorite, which may be a preliminary phase, based on gradational contacts and similar composition, and (5) the biotite granodiorites emplaced as the main phase of the central granitic belt of the Coast plutonic-metamorphic complex.

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Reviewed by R. A. Loney and Cynthia Dusel-Bacon.

EXPLOSIVE LATEST PLEISTOCENE(?) AND HOLOCENE ACTIVITY OF THE MOUNT EDGECUMBE VOLCANIC FIELD, ALASKA

By James R. Riehle and David A. Brew

The Mount Edgecumbe volcanic field on Kruzof Island, west of Sitka (fig. 64), consists of lava flows and domes ranging from 47 percent to 70 percent SiO_2 (Brew and others, 1969; Myers and Marsh, 1981; Kosko, 1981) that are mantled by unconsolidated ash and lapilli. Part of the composite cone of Mount Edgecumbe, as well as the caldera of Crater Ridge and several smaller cones (fig. 64), are interpreted to have formed during eruptions that produced the unconsolidated mantle (Brew and others, 1969). An early Holocene age of the culminating eruptions is implied by radiocarbon ages of 10,300 ± 300 yr for peat beneath an ash layer at Juneau (Heusser, 1960) and 8,750 ± 300 yr for wood atop ash at Sitka (Yehle, 1974). Because of the unmodified morphology of Mount Edgecumbe, Myers (1979) suggested that some activity may have occurred in the past thousand years; supporting evidence exists in an undated, thin ash layer near Sitka (Yehle, 1974).

This study focuses on the culminating explosive activity of the field. Previous work on the unconsolidated deposits is restricted to descriptions of two samples by Brew and others (1969). In this preliminary report, we describe the remarkably wide range of compositions of the airfall deposits and present several new radiocarbon dates. Field stations are shown in figure 64. About 200 samples have been sieved, the size frequencies determined, and clasts examined under binocular microscope. Thin sections, together with 17 whole-rock analyses and 24 microprobe analyses of glass separates (fig. 65), comprise the data base; all chemical analyses are on hand-picked lapilli judged to be juvenile. The petrographic classification used herein (mafic, andesitic, dacitic, rhyolitic) is based solely on whole-rock SiO_2 content and is adopted for brevity.

Mafic tephra (<56 percent SiO_2, whole-rock).—The oldest preserved tephra layers consist of scoriaceous mafic clasts that are dark brown or gray to reddish gray. Phenocrysts total 25 to 40 percent; plagioclase is most abundant, followed by subequal clinopyroxene and olivine. The mafic tephra is entirely of airfall origin and is thickest (several tens of meters) adjacent to scoria cones northeast of Mount Edgecumbe. Granulometry suggests that some mafic tephra may also have originated from vents southwest of Mount Edgecumbe. The thicknesses of mafic-tephra layers are 30-40 cm at Sitka, about 15 cm on Partofshikof Island (inset, fig. 64), and 80-100 cm near Shelikof Bay (81-92, fig. 64); mafic tephra does not occur on Gornoi Island (inset, fig. 64). Mafic tephra comprises up to several layers, implying multiple eruptions.

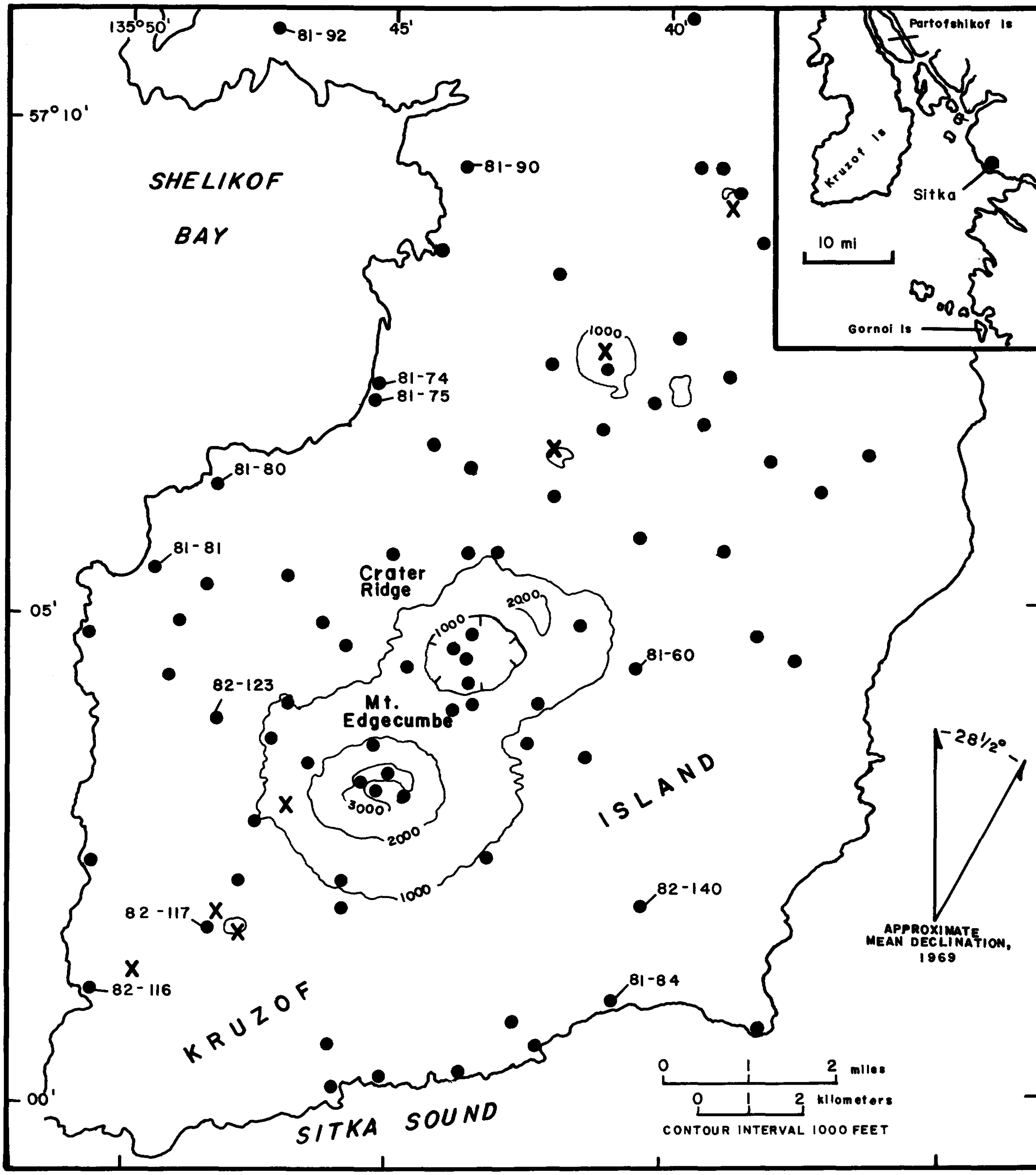

Figure 64.—Locations of stations occupied on Kruzof Island during 1981 and 1982. Smaller vents, primarily cinder cones, are shown by the symbol "x" (modified from Brew and others, 1969); the composite cone of Mount Edgecumbe and the caldera of Crater Ridge are outlined by the 1000-, 2000-, and 3000-ft contours. Labelled stations are those to which reference is made in the text. Base is from U.S. Geological Survey maps Sitka A-5 and A-6, 1951.

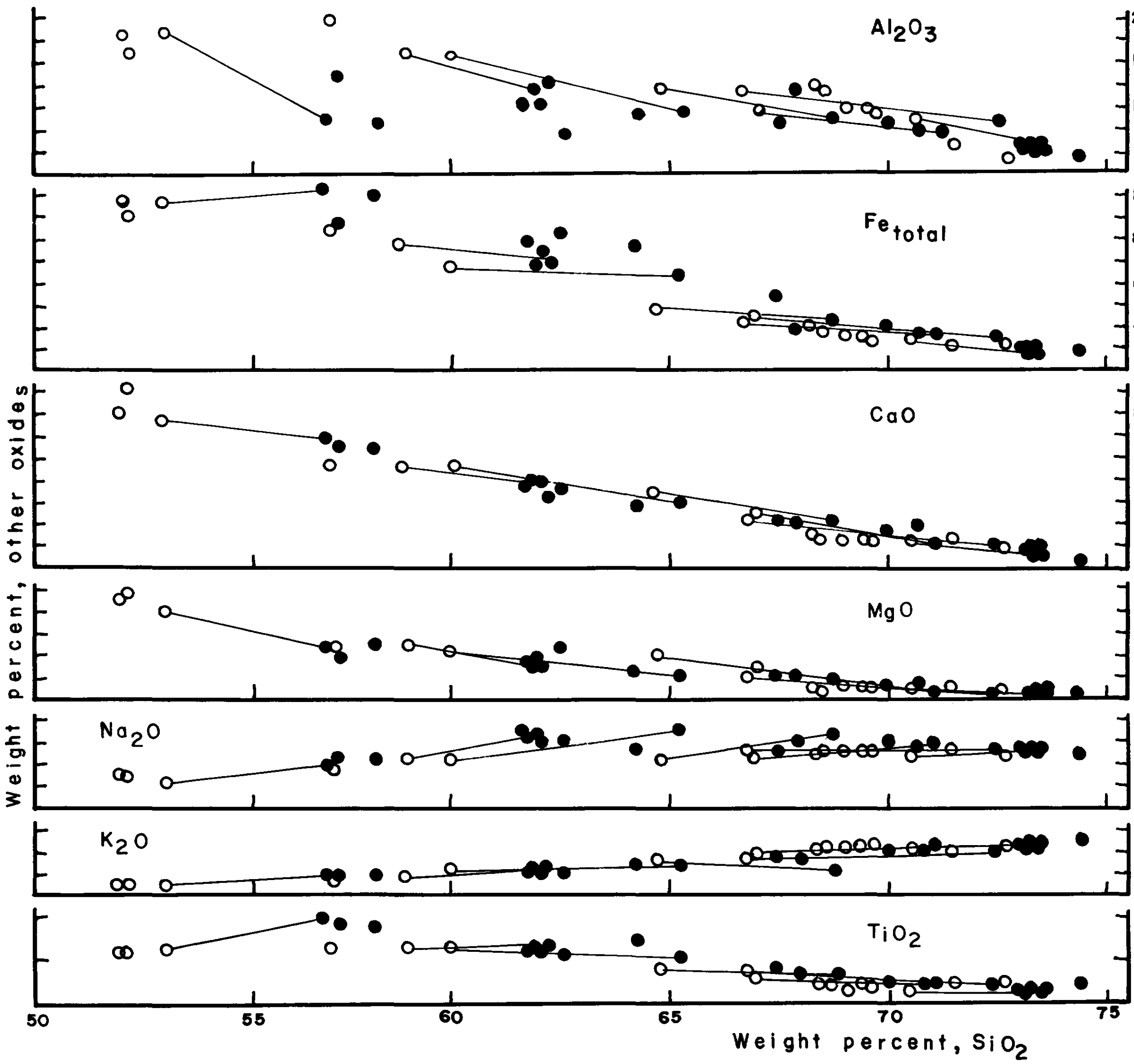

Figure 65.—SiO_2-variation diagrams showing compositions of 17 whole-rock samples (open circles) and 24 glass separates (solid circles), Mount Edgecumbe volcanic field. Most of the glass separates, analyzed by microprobe, probably include some microlites. Tie-lines are between whole-rock and glass analyses of the same sample. All analyses are of hand-picked pumice or scoria judged to be juvenile in origin. (Whole-rock analyses by Branch of Analytical Laboratories, USGS; analysts: A. Bartel, J. S. Wahlberg, J. Taggart, J. Baker. Microprobe analyses carried out on A. R. L. EMX-SM, USGS, Menlo Park; J. Riehle, analyst. All whole-rock analyses initially totalled between 99 and 101 percent, including P_2O_5, MnO, and loss on ignition; microprobe analyses initially totalled between 93 and 101 percent, including MnO. Values plotted here are recalculated to 100 percent on volatile-free basis).

Andesitic tephra (56-60 percent SiO_2, whole-rock).—Andesitic tephra comprises up to six layers of brown-gray to yellow-brown, vesicular airfall ash and lapilli which directly overlie mafic tephra. Phenocrysts total 20 percent; plagioclase exceeds subequal amounts of clinopyroxene and orthopyroxene. Andesitic tephra is locally interbedded with dacitic tephra (81-76, 81-90; table 22), implying either zoned eruptions from a single vent or separate vents. Maximum thicknesses (several tens of meters) occur southeast of Mount Edgecumbe; no significant sources of andesitic tephra appear north of Crater Ridge. The thicknesses of andesitic tephra are 20-30 cm at station 81-92, 10-15 cm on Partofshikof Island, and 35-50 cm at Sitka. A 2- to 4-cm-thick bed of fine ash on Gornoi

Table 22.—Generalized geologic columns selected to illustrate the variations in silica content and lithologic types among unconsolidated deposits of the Mount Edgecumbe volcanic field. Twenty-three of the 41 samples plotted on figure 65 are included. Locations of stations are shown on figure 64. SiO_2 contents of analyzed samples are shown at the right margin of each column; whole-rock analyses are underlined and glass separates are in parentheses. Total thickness of each station is given in parentheses.

81-60 (10 m)	81-81 (20 m)	81-75 (7.5 m)	81-90 (3 m)	81-76 (1.8 m) (Sitka)
multiple layers of airfall ash, including dense volcanic lithics and dacitic pumice	ash-flow deposit, dacitic pumice (73%)	lahar deposit	multiple layers of dacitic airfall pumice	black silt containing 1 or possibly 2 layers of very fine ash (73%)
lahar deposit	multiple layers of dacitic airfall pumice	multiple layers of dacitic airfall pumice	andesitic airfall scoria (61%)	pale grey pumice, probably colluvial (61%)
lahar deposit	lahar deposit	dark, fine air-fall ash	andesitic airfall scoria 57%	single graded airfall bed of dacitic ash and fine lapilli (73%)
airfall or ash-flow deposit; dacitic pumice 69%	fine, dark air-fall ash	vaguely stratified dacitic pumice, as airfall blocks to 25 cm diameter 66% (70%) (72%)	dacitic airfall pumice 60% (65%)	3 layers of dacitic air-fall ash (73%) (73%) (73%)
multiple layers of dacitic airfall pumice 68%	vaguely stratified dacitic pumice, as airfall blocks to 25 cm diameter	not exposed	multiple layers of mafic airfall scoria (57%)	several interbedded layers of dacitic pumice and andesitic scoria, airfall (67%) (62%) (64%)
ash-flow or lahar deposit; dacitic pumice 69%	not exposed		bedrock	several layers of mafic scoria, airfall (58%)
airfall or lahar deposit; dacitic pumice and dense volcanic lithics 69%				bedrock
not exposed				

Island is tentatively classified as andesitic tephra.

Dacitic tephra (60-72 percent SiO_2, whole-rock).—Dacitic tephra is predominant pumice with spherical to slightly elongate vesicles, ranging from yellow to pale brown, pink, or gray. Phenocrysts are less than 20 percent and consist, in decreasing order of abundance, of plagioclase, orthopyroxene, and clinopyroxene. Most dacitic tephra overlies the andesitic tephra, although some layers are interbedded (81-76, 81-90; table 22). A particularly thick (10 m) and coarse (up to 25 cm) unit of tephra crops out at Shelikof Bay (81-80, 81-81, fig. 64); welded tephra on the southwest flank of Mount Edgecumbe has the same composition (66 percent SiO_2, whole-rock), and both are probably airfall formed in a Plinian-type eruption of Mount Edgecumbe.

Dacitic pumice occurs in pyroclastic-flow deposits and with clasts of older volcanic rocks in lahar deposits on Kruzof Island. The thickest lahar deposits (several tens of meters) occur northwest and southeast of the ridge between Mount Edgecumbe and Crater Ridge caldera. Thin ash-flow deposits (1 to 3 m) crop out along the south shores of Kruzof Island and Shelikof Bay (81-84, 82-140, 81-81, 81-80; fig. 64). The sources of the ash flows and lahars are uncertain; clasts in the lahars are dominantly nonvesicular volcanic rocks which resemble older lavas truncated by Crater Ridge caldera. The simplest hypothesis is that the lahars originated in water-rich eruptions from Crater Ridge caldera (caldera lake?); if so, they may document its formation. Some tephra is compositionally similar to the ash-flow deposits, suggesting that the ash flows originated from an eruption column that vented from either Mount Edgecumbe or Crater Ridge caldera.

Dacitic tephra is 220 cm thick at station 81-92, 15-20 cm on Partofshikof Island, 1 m at Sitka, and 6-8 cm on Gornoi Island.

Rhyolitic tephra (>72 percent SiO_2, whole-rock).—A thin layer of tephra is separated by silt and peat from underlying tephra layers at several stations on Kruzof Island. The layer is a heterogeneous assemblage of dense volcanic rocks and pumice. The pumice contains 72 percent SiO_2 in whole-rock and 74 percent SiO_2 in the glass and is slightly more siliceous than samples classified herein as dacite (fig. 65). Maximum thickness (5 cm) and lapilli size (2 cm) occur southwest of Mount Edgecumbe (82-116, 82-117; fig. 64). The deposit is probably the result of a minor eruption of Mount Edgecumbe or Crater Ridge caldera; the pumice could be acces- sory material from an earlier unknown deposit incorporated in a largely phreatic eruption.

We found one tree trunk in a dacitic-pumice-bearing lahar deposit (81-74; fig. 64). The piece was vertical and had a frayed top and a flared base resembling the remains of a root system. We think that the tree was killed and transported by a lahar. A split sample yielded 9,180 ± 150 and 9,150 ± 150 yr B.P. (I-12,218; I-12,219). Horizontal wood fragments at the base of peat atop the tephras elsewhere on Kruzof Island yielded 5,690 ± 100 and 5,520 ± 100 yr B.P. (I-12,234; I-12,235); the rhyolite tephra was not identified at this locality. We interpret these results to mean that part of the dacitic tephra is greater than about 5,600 yr old.

Samples of peat from above and below the rhyolitic tephra (82-123; fig. 64) yielded 4,030 ± 90 and 4,310 ± 140 yr B.P., respectively (Beta-6004; Beta-6005); a single peat sample enclosing the rhyolitic tephra (82-116; fig. 64) yielded 5,760 ± 70 yr B.P. (Beta-6003). The discrepancy in ages suggests that there may have been two eruptions at about 4,200 and 5,700 yr B.P., which followed the last dacitic eruption after a hiatus. Supporting evidence for two eruptions of rhyolitic tephra is meager (for example, 81-76; table 22).

We have found no organic material in or beneath andesitic and mafic tephra. However, nowhere in 100 stations have we observed any evidence (erosional channels, soil profiles, peat) for a significant hiatus within or between layers of mafic, andesitic, and dacitic tephra. We believe that the entire tephra sequence, from mafic through dacitic, was erupted within a few hundred to a maximum of perhaps 2,000 years prior to 9,000 yr B.P. and that the rhyolitic tephra is the product of one or possibly two minor eruptions at about 5,000 yr B.P.

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