THE GEOLOGY OF GREAT SITKIN ISLAND VOLCANO
ALEUTIAN ISLANDS

by

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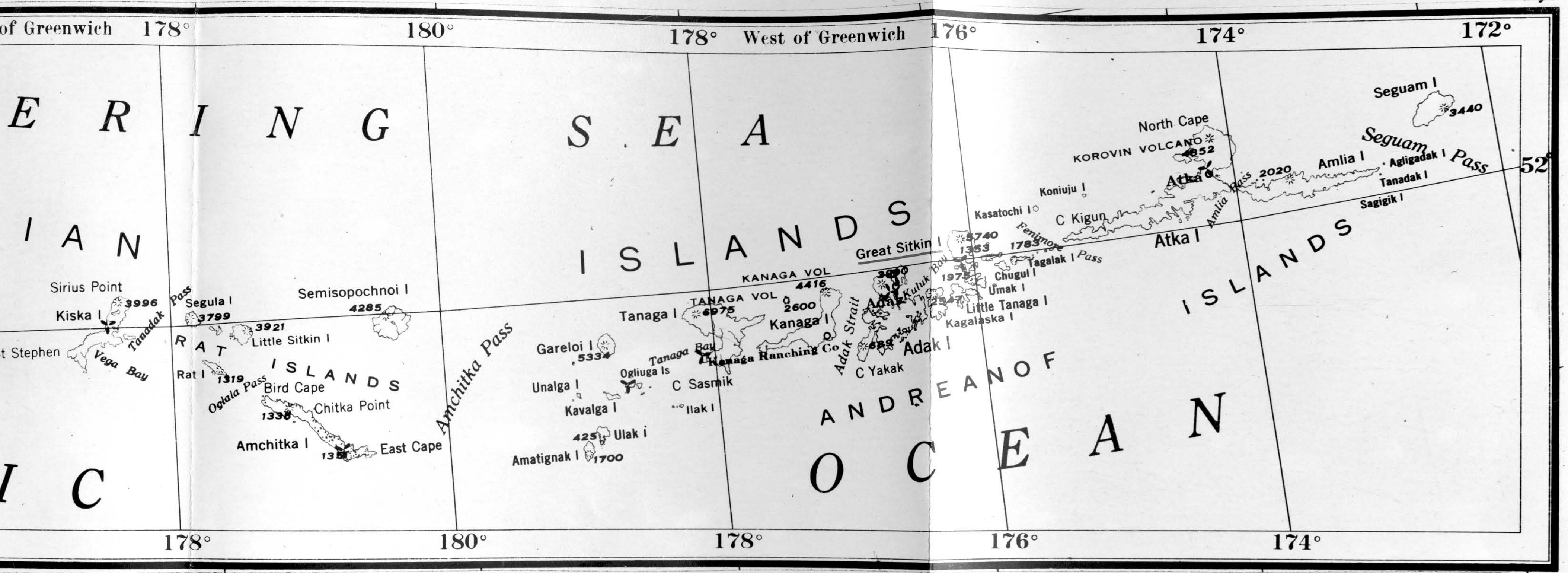
ALEUTIAN ISLANDS

INTRODUCTION

The Aleutian Islands, a group of islands extending westward from the Alaska Peninsula, are composed of four main island groups; the Fox Islands nearest the Alaska Peninsula, the Andreanof Islands, the Rat Islands, and the Near Islands which are the most westward group of the Aleutians. Great Sitkin Island is a member of the Andreanof Island group and has an area of approximately 15 square miles. It is a volcanic island, the volcano being considered still active due to the emission of steam and gases. The mountain rises 5700 feet above sea level and has a crater on the west slope, the elevation of the crater rim being 4800 feet. A large glacier on the south slope extends from about 3000 feet elevation to the south wall of the crater rim. The vegetation consists of tall grasses and reeds which form a thick cover to an elevation of about 1500 feet. There are no trees on the island, which is a peculiar characteristic of most of the islands of the Aleutian Chain, and seems to aid in giving Great Sitkin Island and the smaller islands to the


of Greenwich
178°
180°
178°
West of Greenwich
176°
174°
172°
52°
E R I N G
S E A
I A N
I C
O C E A N
ISLANDS
ANDREANOF
ISLANDS
RAT
ISLANDS
Sirius Point
Kiska I
3996
Vega Bay
Tanadak Pass
Segula I
3799
3921
Little Sitkin I
Semisopochnoi I
4285
Rat I
1319
Oglala Pass
Bird Cape
Chitka Point
1338
Amchitka I
East Cape
Amchitka Pass
Gareloi I
5334
Unalga I
Kavalga I
Ogliuga Is
Amatignak I
1700
Ulak I
Ilak I
C Sasmik
Tanaga Bay
Tanaga I
TANAGA VOL
6975
KANAGA VOL
4416
2600
Kanaga I
Kanaga Ranching Co
Adak Strait
Great Sitkin I
5740
Adak I
C Yakak
Kuluk Bay
1975
Chugul I
Umak I
Little Tanaga I
Kagalaska I
Kasatochi I
Koniuju I
Fenimore Pass
1783
Tagalak I Pass
C Kigun
Atka I
Atka
KOROVIN VOLCANO
4852
North Cape
Amlia Pass
2020
Amlia I
Seguam Pass
Agligadak I
Tanadak I
Sagigik I
Seguam I
3440
178°
180°
178°
176°
174°

INDEX MAP

south a monotonous and dismal appearance. At the present time there are no Aleuts living on the island. The only economic importance of Great Sitkin is the fox farming that is engaged in under government control, the blue foxes being allowed to run wild and abounding in caves along the shore.

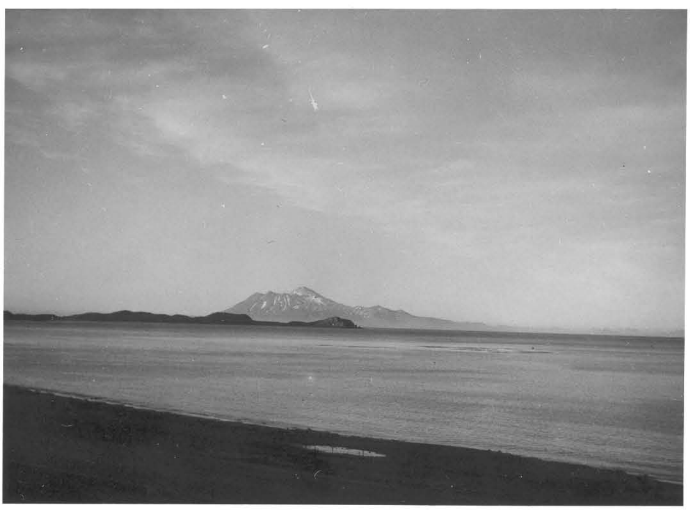
Until World War II very little geological work had been done in the Aleutian Islands. The war having shown the importance of the islands as military bases, more extensive work has been done in the last few years to attempt to determine what methods might be used to predict future eruptions so that military personnel stationed on the islands might be forewarned.

The field work for this report was done in the summer of 1946 while the writer was employed by the United States Geological Survey in Alaska. The material was later studied in the petrographical laboratories of the University of Washington.

PLATE II

Great Sitkin Peak.
Crater rim in left foreground.

PLATE III



View of Great Sitkin Island looking north-
east from Adak showing the steep north and
gentle south slope of the island.

CLIMATE

The climate of Great Sitkin Island and the other islands of the Aleutian chain is quite similar to that of southeastern Alaska, being moderate with fairly uniform temperatures and a heavy rainfall. The islands are geographically located where the warm Japanese current meets the cold air from the Bering Sea, resulting in almost constant fog. A similar climate exists throughout the length of the Aleutian chain and at Unalaska, 350 miles to the east, where weather data have been recorded, the mean annual temperature is about 38 degrees; the mean temperature for January, about 30 degrees; and for August, about 52 degrees. The highest and lowest temperatures recorded on the islands are 78 degrees and 5 degrees, respectively. Unalaska is said to have about 250 rainy days a year, the average annual rainfall being about 60 inches.

RECENT VOLCANIC ACTIVITY

Russian explorers discovered the Aleutian Islands in the middle of the eighteenth century so that with the exception of Aleut legends no historic record of volcanic activity exists prior to that time. The earliest known record of volcanic activity might be that of Isanotske Peak. R. H. Finch (3) states:

> "To the east of Shishaldin at a distance of only 10 miles is Isanotske Peak that rises to a height of 8,808 feet. According to evidence unearthed by Dall, Isanotske was left in its present form, except for later erosion, by a tremendous explosion in the early part of the last century."

The probability of sympathy of activity was suggested by C. N. Fenner (4) by the activity in 1883.

> "In October of that year, when New Bogoslof rose from the sea, Mount Augustine became active for the first time in recorded history. Both eruptions are described as violent. At the same time two other volcanoes, probably Shishaldin and Akutan, emitted smoke and steam. There is a suggestion here of sympathy of activity, though the phenomena may represent merely a coincidence."

In 1904 the north end of Kanaga was very active and Great Sitkin Volcano was reported fuming. Further activity occurred in May 1929, when Akutan Volcano erupted with an outpouring of lava which flowed two thirds of the way down the mountain, and three years later Shishaldin Volcano on Unimak Island became quite active with outpourings of hot cinders and mild explosions. On January 5, 1947, Akutan Volcano again erupted and continued to emit flame and lava for several days. This was accompanied by activity 100 miles to the east at Mount Shishaldin which showered ashes two inches deep on the village of False Pass, 20 miles away. This intermittent recurrence of activity along the Aleutian arc serves as an indication of the still active nature of the volcanic forces in that area.

GENERAL GEOLOGY

The Pacific Ocean is surrounded by a belt of volcanic mountains which is marked by a chain of volcanoes along the crest of the Andes in South America, continuing northward through Central America, Mexico, and the west coasts of the United States and Canada. In southeastern Alaska the volcanic belt swings westward through the Alaska Peninsula and Aleutian Islands, and from there southward through Japan and the Philippines.

The Aleutian Islands, an island chain which extends from the Alaska Peninsula to the island of Attu 950 miles to the west, are punctuated at short intervals by 42 volcanoes, some of which are still active and others so recently extinct that erosion has not yet destroyed their characteristic shape. / Along this island are the active or recently extinct volcanoes are at intervals not greater than 75 miles and for most of the distance they are separated by only 45 miles or less. The linear arrangement of the volcanoes has been interpreted as due to a large rift in the earth's crust. The presence of ocean "deeps" (1) both north and south of the Aleutians may indicate movement and be interpreted as due to depressional phases of crustal movement involving the relative settling or raising of great blocks as though by vertical forces.

As the Aleutian Islands were supposedly built upward from the ocean floor by volcanic activity, evidence for definitely dating the beginning of volcanism that resulted in the formation of the islands is lacking. The Cenozoic period was an age of great crustal disturbances and volcanic activity along the coasts of North and South America. Volcanic activity which began in the Eocene and was followed by a time of relative quiet was resumed in the Miocene and continued intermittently until Pleistocene time. The Aleutian Islands are considered as chiefly composed of Cenozoic volcanic rocks and with the exception of Attu Island no rocks have been found which definitely pre-date these volcanics. S. R. Capps (2), from evidence of volcanic materials found in Eocene beds near Mount Spurr, states:

> "Thus it is shown that volcanism in the belt including the Alaska Peninsula and Cook Inlet regions began sometime in the Eocene, and it seems fair to presume that volcanic activity in the Aleutian Islands began at about the same time.--- In the Aleutian Islands most if not all of the Tertiary fossils have been collected from volcanic tuffs that are certainly younger than the beginning of volcanic activity at those places. Among the localities where such fossiliferous Tertiary materials occur may be listed Umnak, Unalaska, Akutan, and Atka Islands. On the Alaska Peninsula there is abundant proof that a pre-Tertiary land mass existed, and that the volcanoes there broke through Jurassic and Cretaceous sediments. In the Aleutian Islands, so far as the writer knows, there are no unquestioned occurrences of pre-Tertiary rocks, and it appears likely that those islands did

> not come into existence until they were built to the surface of the ocean by volcanic activity, probably early in Tertiary time."

Field work on Great Sitkin disclosed no evidence that would make possible the dating of the rocks of the island. The lava flows show the possibility of two periods of volcanism. The Finger Bay series, which have been previously described as consisting of andesites, agglomerates, tuff breccias, and flow breccias, are highly propylitized, folded and faulted, and unconformably overlain by the Sand Bay volcanics which form the southern part of the island. The rocks of the composite cone have been termed the Great Sitkin volcanics and consist of flows and pyroclastic material. Four plug domes and one parasitic cone have been mapped by Dr. Robert R. Coates who made a reconnaissance of the island before the work was done on which this report is based. Lack of water transportation prevented correlation of the work done by Coates on the north coast of the island. A reconstruction of the profile of the mountain seems to indicate that the flows of the Sand Bay volcanics had their origin from a source higher than the present crater. The summit of the mountain is 1,700 feet higher than the present crater rim, which fact together with the smaller arc-shaped peaks that form a circular outline around the crater seems to indicate the existence of an old crater at a higher elevation and the formation of the present crater and caldera by explosion or collapse.

PLATE IV

View of the crater and head of the large glacier looking across the south rim.

PLATE V

View of the crater taken from the summit. Crater is approximately 4000 feet in diameter.

From Adak Island, 25 miles to the south, what appeared to be steam could be seen rising from the crater. Approaching the island by boat two days later, a darker, more smoke-like column could be seen. Observations made at the crater rim showed a pile of ash pushing upward and causing the ice to be crevassed in a radial pattern around the inner periphery of the crater with steam rising from the ash-pile. A sulphurous odor was noticed and the ice along the slope towards the summit had an acidic taste, probably caused by the chemical action of the sulphurous fumes with the ice. Signs of restricted activity are also shown by the exhalations of steam from the fumaroles on the south slope at 2,000 feet elevation.

PLATE VI

Fumaroles

GEOMORPHOLOGY

As the lack of fossil evidence precludes the dating of the flows of Great Sitkin Island no attempt will be made to date the periods of volcanic activity, and the phases of development of the island will be dealt with only as regards their probable sequence of events.

VOLCANIC LAND FORMS To understand the geomorphological development of Great Sitkin Volcano it is necessary to understand the various classifications and phases of development of a volcano. Many of the basaltic volcanoes of the Pacific Ocean area follow a certain pattern with regards to their phase of development and for this reason a brief review of the development and classification of volcanoes will be given.

The first or youthful phase of development of a volcano is characterized by the rapid outpouring of highly fluid basalts after a cone has been built above sea level. The basalts are characterized by an abundance of olivine and a scarcity of pyroxene phenocrysts.

The second or mature phase is characterized by continued volcanism and the gradual collapse of the volcano over the vent areas forming a caldera on the summit. There is no appreciable change in the composition of the lavas.

The third or old-age phase is characterized by the obliteration in part or in whole of the caldera because the volume of lava poured out exceeds the amount of collapse. The time interval between eruptions grows progressively longer and the composition of the lavas may change gradually to andesites and picrite-basalts, or abruptly to oligoclase andesites and trachytes.

In the fourth or rejuvenated phase there is a long erosion interval followed by extrusion of lavas which are unconformable upon the lavas of the three preceding phases. The lavas are usually nepheline basalts and olivine basalts with or without pyroxene.

Great Sitkin Volcano seems to have passed through a stage similar to the fourth or rejuvenated phase of volcanism which is characterized by the extrusion of lavas following a long period of erosion. The Finger Bay series, which form most of the promontories of the island, represent remnants of an older period of volcanism which subsequent erosion has nearly reduced to sea level. This series is unconformably overlain by the Sand Bay volcanics and offers evidence of the volcano having reached the rejuvenated phase.

As the type of eruptive activity is a function of the phase of development of a volcano, it might also be fitting to classify Great Sitkin Volcano on the basis of the manner in which it was formed and the material of which it is composed.

The "Hawaiian" type is the most quiescent and is characterized by the quiet emission of very fluid lavas which result in the formation of flat volcanic mountains and cones.

The second type, known as the "Strombolian" after Stromboli, one of the Lipari Islands north of Sicily, is characterized by both lava flows and fragmental material. The magma possesses a considerable measure of fluidity though more viscous than the Hawaiian type.

In the "Vulcanian" type, named after Vulcano, which is also one of the Lipari Islands, the magma is notably more viscous and generally acidic. There are longer intervals between eruptions during which time gases accumulate and gather strength which causes eruptions of correspondingly greater violence. The major eruptions of many volcanoes begin with a vulcanian phase whenever an obstructed vent has first to be cleared out.

The "Vesuvian" and "Plinian" types have been named and described by some writers as an extension of the Vulcanian and Strombolian, being still more violent in their character of eruption and finally reaching the "Pelean" type in which the limit of high viscosity and explosiveness is reached. In this type the magma is extremely viscous and one of the chief characteristics is the formation of "nuees ardentes".

It is not unusual for volcanoes to exhibit different kinds of activity, nor is it uncommon that they change from one type of activity to another even during the course of a single eruption. A volcano, therefore, may combine the characteristics of more than one type of eruption. Due to this tendency for volcanoes to exhibit different kinds of activity it is not always possible to readily place a volcano as to type. For this reason no positive assertion will be made but rather that from the evidence obtained Great Sitkin Volcano seems to more nearly satisfy the Strombolian type.

GLACIAL FEATURES Concerning glaciation on Adak Island, 25 miles to the south of Great Sitkin Island, Capps (2) states:

> "Adak Island as a whole shows severe glacial erosion and appears to have been almost entirely covered by a local ice cap at the time of its maximum glaciation."

Although no evidence of different glacial stages was obtained, physiographic features caused by glaciation are apparent on the south slopes of Great Sitkin Island. Features that may have existed on the north slope have been buried by the more recent accumulation of ash. Sharp-crested divides, termed aretes, have been formed by weathering and the plucking action of the glaciers, and at an elevation of 2300 feet near the center of the south slope of the island, a matterhorn peak has been formed by the bergschrund action of the ice. At present there are three small glaciers on the east slope which head a few hundred feet below the summit of the mountain and one larger glacier on the south slope that extends from the crater rim down to an elevation of 3000 feet.

RECENT FLOWS Comparatively recent flows are suggested from a study of a restricted topographic map. A ridge that extends from the top of the mountain southward to the base of the island appears to separate the land surface into two different stages of development. To the east of this ridge the mature development of the topography is shown by the dissection of the surface, erosion having progressed to a stage where the initial surface has been dissected with sharp ridges as divides between adjacent valleys. To the west the topography shows a more youthful development, having more gentle slopes and lacking the valley gorges and sharp divides to the east. This difference in topography makes it appear likely that the southwest part of the island has been covered by more recent flows which have therefore not undergone erosion for as long a period of time as the surface to the east.

An escarpment along the southwest part of the island that rises steeply to an elevation of 2500 feet might represent a wave-cut cliff or have been formed by faulting of the more recent flows.

DROWNED VALLEYS The valleys on the island have flat floors filled with alluvium indicating submergence, glaciation, or a combination of the two factors to have resulted in the formation of fiords. These fiords or drowned valleys were later filled with alluvium to their present level.

PLATE VII

Great Sitkin Island from the west.
Escarpment on the west side of island
in foreground.

PLATE VIII

Drowned valley filled with alluvium.

ROCKS OF GREAT SITKIN ISLAND

Very little geologic work had been done in the Aleutian Islands until the United States Geological Survey began its volcano program during World War II. J. E. Spurr (10) from a study of rocks collected in 1898 in southwestern Alaska noted peculiarities of many varieties and suggested a scheme of classification that included such proposed names as aleutyte and alaskyte. Aleutyte was defined as an extrusive characterized by feldspars intermediate between those of the dioritic family and those of the diabasic family, and alaskyte as a group consisting essentially of quartz and alkali-feldspar. In 1932 S. R. Capps accompanied the U. S. Navy on an expedition to western Alaska and the Aleutian Islands. His study of the specimens collected shows a preponderance of basaltic rocks on the Aleutian Islands and some tuffs and andesites with many of the rocks exhibiting extensive alteration.

No sediments or basement rocks were seen on Great Sitkin Island that are definitely older than the volcanic rocks of which the island is chiefly composed. Over 100 thin-sections of the volcanic rocks collected have been examined and these analyses together with the field evidence obtained have been used to classify the rocks into three groups.

<u>FINGER BAY SERIES</u> The Finger Bay series, which have been named from Finger Bay on Adak Island, represent the older volcanic rocks of the island. Their location on the island is limited to headlands that were not covered by later flows of the Sand Bay volcanics. Due to the thick cover of grass and reeds below an elevation of 1500 feet, the contact between the Finger Bay series and Sand Bay volcanics is difficult to determine. In many localities it can only be inferred from the aerial photographs which show a hummocky weathered surface to be a characteristic of these older rocks.

The rocks of the Finger Bay series consist of flows, agglomerates, tuff breccias, and flow breccias, all cut by dikes of porphyry. All the rocks of this series have been folded, faulted, and mineralized, and have undergone alteration so extensive that with many samples no accurate determination is possible. Megascopically the rocks vary considerably in color ranging from light greenish-gray to a greenish-black with the greenish tinge as a dominant characteristic and indicative of the alteration that has taken place. For the most part the rocks are aphanitic-porphyritic but amygdaloidal material is also present.

Due to the large diversity of the rocks in this series and the varying kinds of alteration that they have undergone no one specimen could be considered as representative of the series. A detailed report of the thin-section analyses of this series is considered to be beyond the scope of this report and instead a more general discussion will be given.

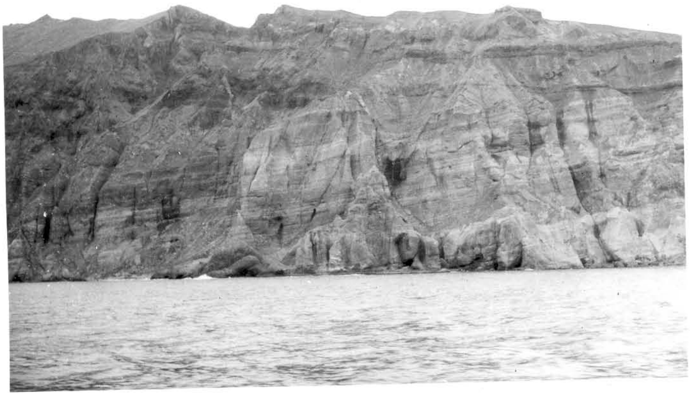
The alteration that these rocks have undergone has made the determination of the character of the plagioclase difficult if not impossible. Of 32 thin-sections examined only four contained plagioclase sufficiently unaltered to allow a reasonably accurate measurement of the extinction angles of albite twins. Using the statistical method of Michel-Levy the molecular percentage of albite-anorthite in the plagioclase in these four sections ranges from albite 40 percent and anorthite 60 percent to albite 30 percent and anorthite 70 percent, indicating basaltic rocks. In many specimens the plagioclase has been altered to sericite and secondary quartz. Some albitisation has also occurred resulting in the formation of rocks of the spitite type.

The ferro-magnesian constituents retain few if any of their original distinguishing characteristics, and are largely altered to hydrous silicates. Minerals of the chlorite group are present in almost all of the rocks examined and serpentine often occurs as pseudomorphs after olivine or pyroxene. Other mineral changes have resulted in the formation of calcite, epidote, and pyrite.

F. von Richthofen (11) gave the name propylite to certain greenstone-like rocks found in the Washoe district in the Sierra Nevadas. He considered them to be the oldest of the Tertiary extrusives, since they seemed to be overlain everywhere by younger Tertiary rocks. A propylite is now generally considered to be a rock, usually andesite, that has been so altered by hot water as to be green and yet to be determinable as an altered igneous rock.

With the exception of a few basalts and spilites previously mentioned, it appears that most of the rocks of the Finger Bay series are of the propylite type.

PLATE IX



Finger Bay series. Apparent dip to the west, actual dip to the north.

PLATE X

Olivine basalt of Finger Bay series. Note sharp borders of euhedral crystals with crystal form suggesting olivine. Some released quartz present. (X 17½)

PLATE XI

Tuff of Finger Bay series. Black rock fragment and crystal fragments shown. (X 17½)

PLATE XII

Propylyte. Light part of picture consists of glomeroporphyritic plagioclase. (X 17½)

PLATE XIII

Spilite (X 17½)

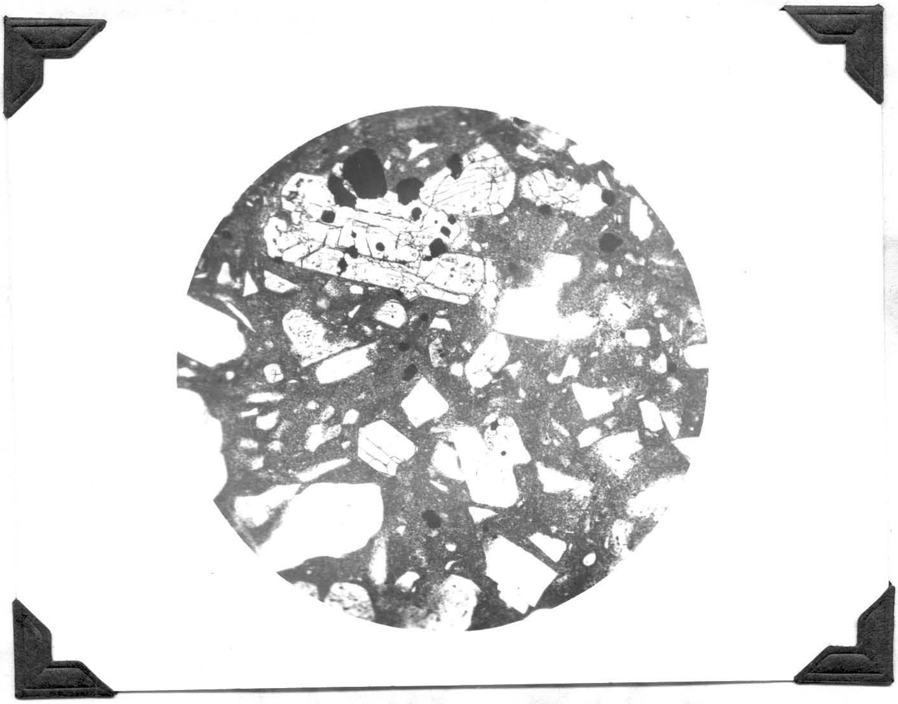
<u>SAND BAY VOLCANICS</u> The Sand Bay volcanics is the name that has been given to the rocks of the shield-type volcano which form the southern half of the island. Megascopically they also vary considerably in color, ranging from light to medium gray to black with gray as the predominating color. They are predominately aphanitic and occasionally show vesicular structure. The classification adopted in describing these rocks is based on the dominant ferro-magnesian minerals present and on this basis the rocks have been classified as hypersthene basalt, augite basalt, olivine basalt, and pigeonite basalt. There is no definite boundary between these types but a continuous variation exists from one to the other so that none of the four types can be distinguished from each other in the field.

<u>Hypersthene Basalts</u> The thin-section analyses of the Sand Bay volcanics showed hypersthene basalts to be the dominant rock type, constituting approximately 35 percent of the specimens examined. In the specimen chosen for this description the phenocrysts average about 0.5 mm. in length and are usually rectangular in shape. In the microphotograph the large phenocryst shows poikilitic structure with a reaction rim of augite enclosing a crystal of hypersthene which is about 1 mm. in length. The plagioclase phenocrysts range from 0.2 mm. to 2.7 mm. in length and exhibit albite twinning. Some of the plagioclase phenocrysts are quite clear and others speckled throughout with inclusions. By the statistical method of Michel-Levy the molecular percentages in

the plagioclase are albite 32 percent, anorthite 68 percent. The phenocrysts of hypersthene and labradorite together with some augite are contained in a merocrystalline groundmass of crystallites and microlites.

The groundmass constitutes approximately 60 percent of the rock, the labradorite phenocrysts about 25 percent, hypersthene phenocrysts 8 percent, and augite phenocrysts 5 percent. Inclusions of magnetite are present in the mafics and groundmass but are usually absent in the labradorite.

PLATE XIV

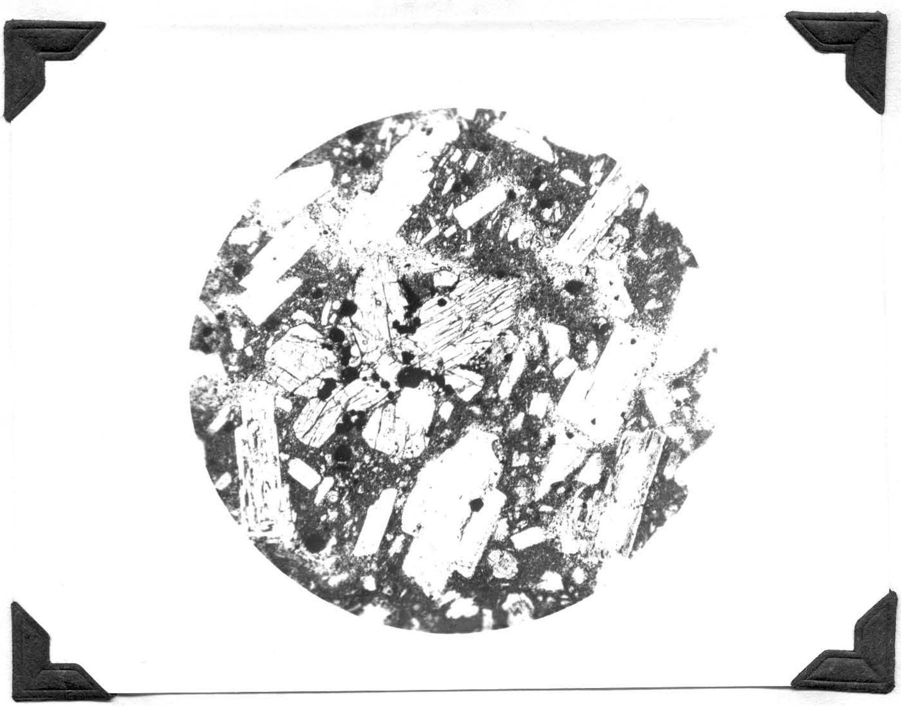


Hypersthene basalt (X 17½)

<u>Augite Basalts</u> Although not as common as the hypersthene basalts the augite basalts comprise approximately 25 percent of the thin-sections studied. A marked similarity to the hypersthene basalts is apparent with the principal difference being in the percent composition of augite and hypersthene. In these rocks augite is the principal ferro-magnesian mineral and a corresponding decrease in the amount of hypersthene is apparent.

The labradorite phenocrysts are approximately the same size as in the hypersthene basalt but contain a slightly lower percent of the anorthite molecule and more magnetite inclusions. The groundmass constitutes approximately 55 percent of the rock, the labradorite 30 percent, augite 9 percent, and hypersthene 4 percent.

PLATE XV

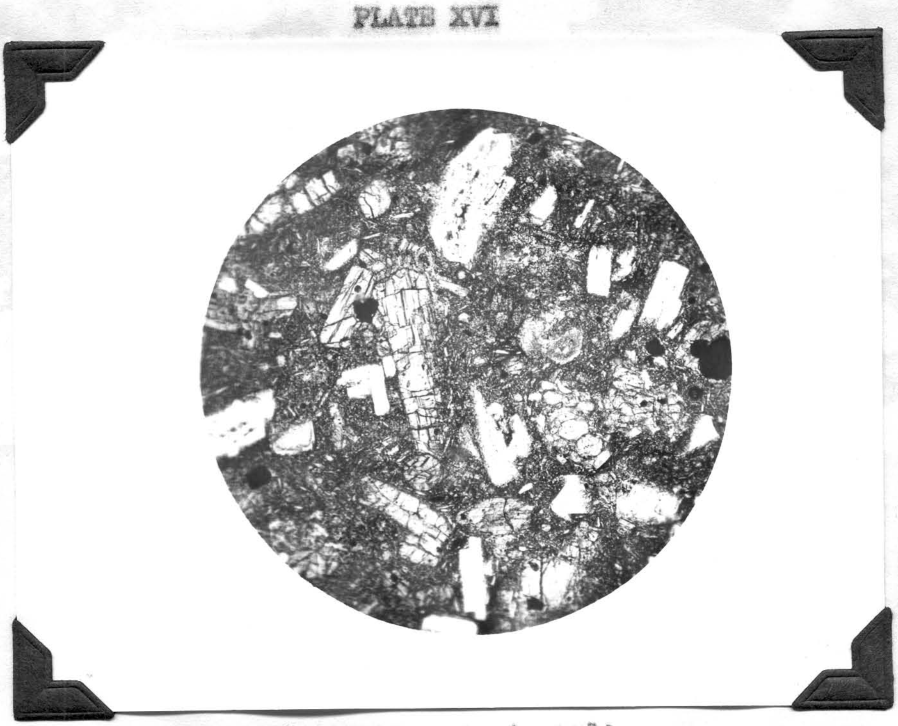


Augite basalt (X 17½)

Olivine Basalt Olivine basalts occur with about the same regularity as the augite basalts. Although many of the olivine basalts studied contain no other ferro-magnesian minerals than olivine, it is not uncommon to find both orthorhombic and monoclinic pyroxenes present. In the specimen chosen to illustrate this rock type, small amounts of pigeonite, augite, and hypersthene are present. Many of the sections show a partial alteration of the olivine to iddingsite.

In the accompanying photomicrograph the groundmass is practically holocrystalline, consisting of microlites of plagioclase, pyroxene, and olivine. The groundmass makes up about 65 percent of the rock, labradorite 20 percent, and olivine 8 percent, with smaller amounts of augite, pigeonite, hypersthene, and magnetite.

PLATE XVI

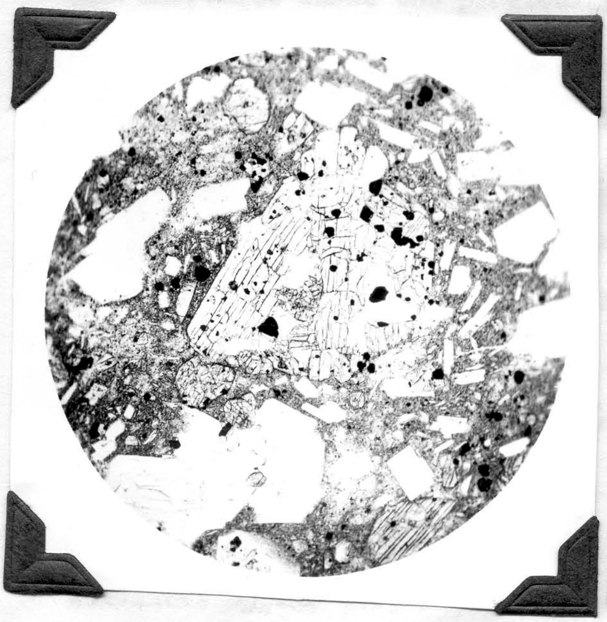


Olivine basalt (X 17½)

<u>Pigeonite Basalt</u> The presence of pigeonite was noticed in many of the thin-sections in small amounts and usually confined to the groundmass. In a few thin-sections its occurrence was in sufficient amounts to name the rock a pigeonite basalt.

In the photomicrograph of this specimen cumuloporphyritic texture is shown with pigeonite and labradorite enclosing a crystal of hypersthene. The second photomicrograph with nicols crossed shows the hypersthene in the extinction position. The surrounding pigeonite gives an interference figure with such a small 2V as to be quite easily mistaken for a uniaxial figure.

PLATE XVII



Plane light Crossed nicols

Pigeonite basalt (X 17½)

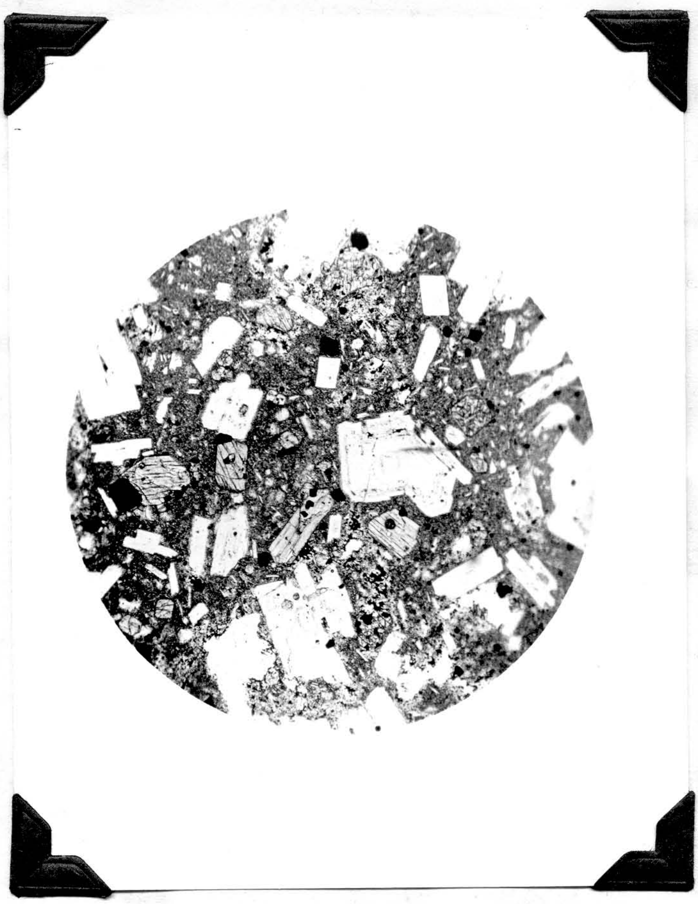
<u>GREAT SITKIN VOLCANICS</u> The rocks of the ash-covered cone have been termed the Great Sitkin volcanics by the U. S. Geological Survey. This is perhaps a good division on the basis of natural physiographic units into which the island seems to be divided. This division, however, does not necessarily indicate a different period of volcanism but might rather be the more recent expression of the same volcanism that produced the Sand Bay volcanics.

The Sand Bay volcanics and the lavas of the Great Sitkin volcanics appear to be identical megascopically. In thin-section a lower percentage of the albite molecule is apparent in many of the rocks of the Great Sitkin volcanics. The percentage of albite and anorthite shows the plagioclase to be low labradorite or high andesine in most of the specimens. This group therefore consists of both andesites and basalts. The ferro-magnesian minerals present in the Sand Bay volcanics are also present in the Great Sitkin volcanics in similar varying amounts and the naming of the andesite or basalt of this group has also been based on the principal mafic mineral present. This system of classification has resulted in many different rock types but shows hypersthene andesite to be the most common.

<u>Hypersthene Andesites</u> Microscopically the hypersthene andesites appear very similar to other rocks of this group differing only in the larger amount of hypersthene and the larger amount of the albite molecule. The phenocrysts of andesine range up to 1 mm. in length and often contain inclusions of magnetite, glass, and

pyroxene, parallel to the crystal faces. The phenocrysts of hypersthene, augite, and pigeonite average about 0.3 mm. in length and also contain magnetite inclusions. In the accompanying photomicrograph the groundmass is merocrystalline and makes up about 65 percent of the rock, plagioclase comprises about 22 percent, hypersthene 6 percent, augite and pigeonite 5 percent, and magnetite 2 percent.

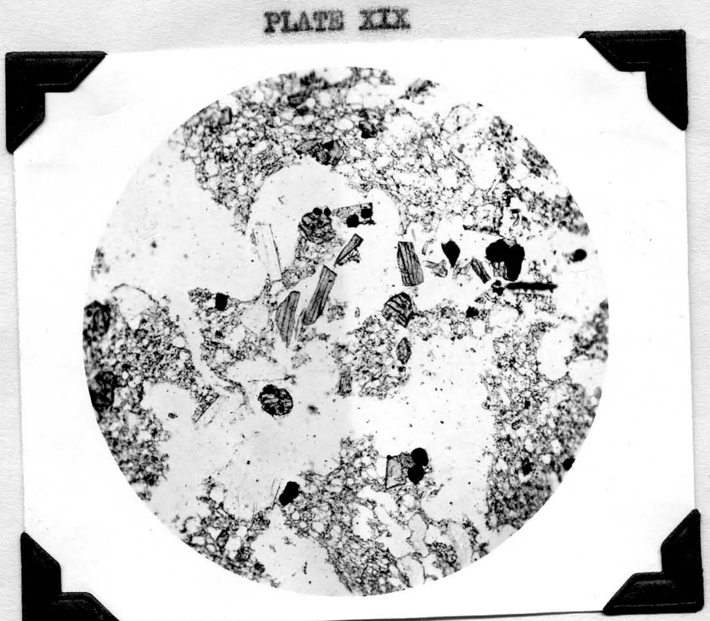
PLATE XVIII



Hypersthene andesite (X $17\frac{1}{2}$)

Pyroclastic Material On the south slope of the island at an elevation of about 1500 feet, vegetation becomes less abundant and there is a gradual change from a thick cover of grasses and reeds to a cover of pyroclastic material. The pyroclastic material of the composite cone consists mainly of volcanic ash with the fragments ranging in size from a few millimeters to 10 centimeters. Mixed with this material are fragments of a black vesicular rock that probably represent fragments torn from the sides of the volcanic vent during explosive activity. The ash has a grayish-buff color with crystals of feldspar and mafics disseminated through the scoriaceous matrix. The crystals range in size from 0.2 mm. to 2 mm. with the larger crystals often fractured. The predominant minerals in the ash are andesine, hypersthene, augite, pigeonite, and magnetite. The andesine occurs both as clear crystals with distinct albite twinning and as zoned crystals with inclusions of augite, magnetite, and glass.

PLATE XIX



Andesitic ash (X 17½)

CONCLUSIONS

1. Two periods of volcanism have occurred on Great Sitkin Island. One probably early Tertiary and represented by the Finger Bay series and the other middle or late Tertiary and represented by the Sand Bay volcanics and Great Sitkin volcanics.
2. The Finger Bay series have undergone extensive alteration.
3. An unconformity exists between the Finger Bay series and the Sand Bay volcanics.
4. The later volcanic rocks are mainly basalts and a few andesites.
5. The ash-pile which has recently risen in the crater of Great Sitkin Island might indicate sympathy of activity with the activity at Akutan Volcano and Mount Shishaldin in January of 1947.
6. Great Sitkin Island has undergone severe glaciation.
7. Partial submergence or extreme glaciation of the valleys is shown by the drowned valleys now filled with alluvium.

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