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REVIEW OF VOLCANIC ACTIVITY IN THE TERRITORY OF PAPUA-NEW GUINEA, THE SOLOMON AND NEW HEBRIDES ISLANDS. 1951-53.

by

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CANBERRA.

AUSTRALIAN NATIONAL COMMITTEE ON GEODESY AND GEOPHYSICS.

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RABAUL.

Some progress has been made in the re-establishment of the vulcanological observatory since 1951. The observatory building has been completed and instrumental equipment now includes Benioff seismometers and tiltmeters. As officer in charge of the observatory Mr. J.G. Best has supervised the reconstruction work and installations.

In addition to systematic observation of the Rabaul craters, the observatory is kept informed of seismic and volcanic activity throughout New Guinea-Papua and the New Hebrides by a system of special report forms which have been distributed to local observers throughout these regions. Since the writer's visit to the New Hebrides in 1951 information from that area has been obtained by courtesy of Mr. W. B. Roberts who, in the capacity of honorary vulcanological observer, has arranged a system of local observers for the group and carried out a number of valuable inspections of active centres.

Investigations of increased volcanic activity at a number of outlying centres has been carried out during the last three years.

Mount Lamington.

The explosive phase of this Pelean type volcano lasted five months. It ended in June, 1951. The subsequent effusive dome-building phase was characteristically long-continued and declined slowly. During 1952 the dome reached a maximum height of approximately 1900 feet above the old crater floor and further increase in the overall mass of this structure has since taken place. Dome movement was still perceptible during the latter part of 1953.

Gas emanations correspondingly declined during this period but there were fluctuations in volume from time to time.

The seismic activity had fallen to negligible proportions by the end of 1952 when the volcanological station was temporarily disbanded pending the arrival of equipment for permanent seismic observations in this area.

Submarine Activity.

On 24th November 1951 Captain Mellor of the vessel "Tarra"

reported a marine disturbance in a position 21 miles east-north-east of Karkar Island. A boiling, turgid expanse of sea covered an area with a perimeter of about 3 miles. Dead fish and marine growth were thrown up.

This was the first of a series of events which suggested the possibility of a regional pattern of reactivation.

Mount Langila.

Increased activity of this volcano was investigated by TAYLOR and BEST in the latter part of 1952. Vents in an old crater, which had been inactive when inspected by FISHER in 1939 were emitting high pressure gas at temperatures up to 240°C. The gas contained high concentrations of SO_2 and SO_3 and destroyed the forest on the leeward slopes of the mountain for a distance of a mile and a half. An analysis of one of the condensates collected from the vents gave the following composition:-

Suspended Matter	Milligrams per litre
Colloidal sulphur	4,386
Dissolved Matter	
Reaction	strongly acid
Total acidity (in terms of normality)	0.926 N.
Calculated as H_2SO_4	45,374
" " HCl	33,764
Total Residue on Evaporation	22,000
Sodium	present
Potassium	trace
Calcium	32
Magnesium	13
Iron (ferrous)	17
Selenium	not detected
Arsenic	1.5
Chlorides	
as Cl	14,057
as HCl	14,457
Carbon dioxide	not detected
Sulphides (and H_2S)	absent

Sulphur oxyacids

Sulphurous acid

Calculated as SO_2	7,306
" " H_2SO_3	9,349
" " S	3,653

Sulphuric acid

Calculated as SO_3	9,425
" " H_2SO_4	11,533
" " S	3,770

Polythionic Acids

Calculated as S	5,311
Fluorine	trace
Boric acid	trace

Deepseated rumbling was noticed during July and August while the party was encamped on the upper slopes. The low pitched rumbles were short and usually accompanied by a brief short-period ground movement which, on one occasion, included vertical bumping. No appreciable change in crater conditions accompanied these noises.

In October further observations revealed a slight fall in temperatures but no appreciable change in gas emission. A tiltmeter installed near the summit of the cone showed a variation of 8 minutes over a period of several days. Also, for prolonged periods, bubble movement indicated the existence of persistent long period groundwaves.

Readings taken at other locations, within 30 miles of the volcano, suggested that the focus for this crustal disturbance was centred on the nearby Umboi (Rooke) Island where a severe earthquake with very numerous and persistent after-shocks had occurred.

The next premonitory symptom of possible volcanic instability was reported from Manam island, 250 miles west of Langila.

Manam Island.

J.G. BEST (1954) examined this volcano in April and August 1953 following reports of increased gas emission and luminous effects from the crater. The last eruption from this centre had taken place in 1946-1947 when explosive activity spread dust and lapilli over most of the island and a blocky lava flow descended from the south-east side of the cone to reach the sea between the villages of Dugulava and Warisi.

Ascending the slopes of the terminal cone, which were covered with loose ash, scoria and lapilli, BEST reached the summit. He found two adjoining craters which were breached on the eastern side. Each crater contained one major active vent and secondary areas of hot ground. He reported (1954) "The vapour cloud rising from the northern fumarole is emitted without audible effects and billows up effectively blanketing the greater portion of the crater". On the other hand, he observed that, "the southern vent is much more active, explosions from within the vent at fairly regular intervals (half minute to one minute) shake the crest and hurl swirling clouds of vapour high in the air". Quite appreciable amounts of sulphur dioxide were present in the gas cloud.

Problems of accessibility prevented temperature measurements.

Long Island

When examined by FISHER (1939) and by BEST and TAYLOR in August 1952 no signs of volcanic activity were evident. The small cone, near the southern end of caldera lake, which was evident on air photos of 1943, was not visible in 1952.

On 8th May 1953 a column of smoke was seen rising from the island. When examined by aircraft the following day a horseshoe shaped ridge had been built up above the lake level by the products of explosive activity which was taking place. BEST(1954) reports that on the 12th May jets of black ash and steam were being thrown up by explosions at 15 to 20 second intervals. Within 4 or 5 days a cone standing 100 feet high and about 200 yards long had been formed above lake level.

A night inspection by R.A.A.F. aircraft on 14th May reported explosive ejection of incandescent material at 15 second intervals. A second vent had opened up to the north-west of the cone by the 19th of May and when inspected on 23rd May the dimensions of the ridge-like cone were approximately 400 yards by 100 yards and 100 feet high.

The crater was inactive when examined on 12th June, Spasmodic activity continued, however, during the following months. The last outburst was reported on 7th January, 1954.

Saint Andrew Strait

The only earlier report of volcanic activity in the Admiralty Group refers to an eruption in the vicinity of Lou Island in 1883.

No details are given.

At 11 p.m. 27th June 1953 a submarine explosion produced a column of vapour which emerged from the sea between the islands of Baluan and Lou. The associated disturbance of the sea did some minor damage on the adjacent island of Pam Mindian. On the morning of June 25th a vapour cloud stood 2000 feet above the area, and subsequent activity consisted of explosions at irregular intervals which "hurled jets of black ash and lapilli several hundreds of feet in the air." (BEST 1954) Large blocks of floating pumice littered the sea around the active area.

At night a glow could be seen over the area and intensification of the glow preceded explosions.

Seismic activity associated with this eruption was of a minor order and scarcely perceptible on the surrounding islands. A correlation between slight shocks and explosive activity was noticed by BEST during the course of the eruptions.

This first period of activity had ceased by 6th July. Further explosions occurred during the ensuing months. The last activity was reported on 18th February, 1954.

Mt. Bagana.

With its viscous lava flows, dome-plugged crater and frequent spasmodic explosive activity, which often produces glowing clouds, the characteristics of this volcano recall those Java's Merapi.

First examined by the writer in Dec. 1950, a few weeks after a particularly powerful explosive phase, Bagana's activity was confined to the emission of high temperature gas, extremely slow movement of a lava flow on the south-south-western flank and loud, deep-seated rumbles every few days. The forest on the southern side of the volcano had been flattened by the passage of a recent nuée for a distance of about 2 miles from the base of the mountain. The fallen tree trunks were orientated radially with regard to the crater, and the bark of standing stumps was bruised and pitted on the side facing the crater but charring effects were not observed.

On 29th February 1952 explosions from Bagana were reported to be sending ash clouds to 20,000 feet. BEST found the eruption

still in progress when he visited the area late in April and, during a brief period of observation of little more than a week he observed several glowing clouds which were probably of the type "nuées ardentes d'explosions vulcaniennes". Samples of ash from one of these nuées were still at incandescent temperatures when collected about an hour after deposition.

Daily explosions were reported at the end of June 1952.

In June 1953 the volcano was particularly noisy with loud roaring and rumbling. A new crater, reported to have formed on the northern slopes produced a series of powerful explosions. At night the lava flows moving down the slopes glowed brightly. Frequent earthquakes were associated with this activity. During July and August more powerful explosions with high dust clouds were reported.

Petrological examination of the lava from the 1950 flow suggests a more basic composition than the flow material examined by Baker (1949). The zoned plagioclase constitutes 65% of the phenocrysts in the brown glass groundmass and the composition is that of a bytownite. Olivine percentages ranged from one to two and the magnetite, pyroxene and hornblende constitute about 30% of the phenocrysts in this porphyritic lava.

SOLOMON ISLANDS

J.C. Grover (1954) Senior Geologist of the British Solomon Islands reports that intermittent submarine activity has been going on at one centre for some years. It is situated south of Vangunu Island in the New Georgia Group, Latitude 09°01'South, Longitude 157°57' East.

Numerous native stories of "fire on the water" in late 1950 were unconfirmed until one night, 15/16th April, 1952, the HV "BILIKI" sailed through a disturbed area of sea about a quarter of a mile diameter and narrowly missed being engulfed in columns of water and incandescent material which were being thrown up by submarine explosions. In May and June explosions with heavy detonations and roaring were taking place.

"The natives at Penjuku Village (at the extreme south-eastern end of the picturesque Maroro Lagoon) frequently observe the phenomenon. Sometimes it takes the form of a dome-shaped column

of water, sometimes a column of greater height, and frequently rising "mushroom" cloud of smoke. These latter are accompanied by most violent detonations and sometimes by earth tremors.

In late 1951 small tsunamis occurred frequently, but these have not occurred since."

Grover makes the interesting observation that native divers were unable to operate off the coast of an island twenty miles from the centre owing to the painful concussive effects on the ear drums caused by the submarine explosions.

On 11th November, 1952, the tip of the cone showed above the sea in the shape of a welded pile of angular blocks 100 feet long 20 feet wide and about 15 feet high. By December the island stood 100 feet high and frequent explosions were ejecting incandescent material. The island had disappeared by 19th January, 1953, but explosions were occurring at two minute intervals. The next day when circling the area by aeroplane Grover saw explosions lift "a white column of water about 400 yards in diameter to a height of several hundred feet. Sea waves 40 to 50 feet high were initiated and rolled out across the Pacific in everwidening circles."

During the latter months of 1952 the powerful explosive activity which built the cone above sea level coincided with reports of an unusual number of earthquakes in the western islands of the group.

NEW HEBRIDES

Ambrym.

Over the last 60 years this volcano appears to have produced a climactic eruption at intervals averaging about 12 years.

When the writer examined it in Nov. 1951, powerful explosive activity had been taking place over the previous eleven months. Ash deposits on the southern margins of the islands were not less than a foot deep and in the vicinity of the crater the depth of the ash was well in excess of 30 feet. Practically all the native population in the south had moved to the neighbouring islands of Epi and Malekula. The influence of the prevailing winds on the distribution of ejecta had limited the area of severe devastation to the southern portion of the island.

The activity had originated from the crater Benbow which is situated on the south-western rim of the ancient caldera plateau occupying the centre of the island. Unlike earlier eruptions no lava flows were associated with the activity and no external vents were involved. Ejecta consisted of a highly vesicular black scoria which ranged in size from blocks a foot in diameter to sand. Much of the material had a glassy surface and an iridescent sheen as evidence of its moulten state of the time of ejection.

The ash from the eruption had the following composition:-

	Percentage by weight
SiO_2	49.60
Al_2O_3	17.20
Fe_2O_3	3.97
FeO	7.85
MgO	4.98
CaO	10.12
Na_2O	2.24
K_2O	1.66
MnO	0.37
TiO_2	1.00
P_2O_5	0.40
H_2O -	nil
H_2O +	nil
Cl	trace
SO_3	nil
S (sulphide)	traces
S (total)	0.06
CO_2	nil
carbides	traces

Compared with an analysis of the lava from the 1913 eruption there is little variation in composition.

The vesicular scoria consisted a light brown-green glass (R.I. = 1.587) which contained angular inclusion of black glass (R.I. = 1.595). It contained phenocrysts of plagioclase, green augite, oliving and magnetite. The plagioclase had a composition An_{48-53} compared with the labradorite composition of earlier ejecta.

The records of an observer on the neighbouring island of

Paama suggested that the unusually prolonged and powerful eruption of Ambrym was accompanied by abnormal seismic activity. Investigation of this relationship has brought to light a very interesting correlation which will be described in a forthcoming paper.

After 9 months quiescence Ambrym resumed its explosive activity on 10th Aug. 1952. Intermittent activity ensured. The dust falls during this period were so heavy that by November the production from coconut plantations on the neighbouring island of Malekula were reported to be severely affected.

A marked increase in activity occurred again in May 1953 when a parasitic cone on the north east flank of Marum crater also became active and, later, a vent opened up on the southern side of Benbow.

ROBERTS made an ascent of Benbow in May and reported the presence of liquid lava in the crater. This was the first evidence of its presence in the crater since the climactic activity of 1951, and it suggests that the dust ejections of the previous months were due to the lava column rising through the debris-filled conduit that had been choked by material from the crateral collapse which followed the climactic explosions.

Karua.

Karua is situated between the islands of Tongoa and Epi. It was named after submarine explosive activity in 1948 and 1949 had formed an island in this locality. Earlier history reports the formation of a similar island here in 1897. Mawson (1905).

The activity of 1948 formed a low island which was eroded away during the south-east monsoon. More severe explosive activity in October 1949 built up a cone of fragmental material one mile in diameter and 300 feet high. This activity died out in December 1949. Once again marine erosion attacked the cone and by December 1950 it had disappeared.

On October 3rd 1952 several light explosions were reported, but the cone was not built above sea level on this occasion.

Submarine Eruption near Epi Island.

On 10th February 1952 a previously unknown submarine centre erupted off the coast of Epi ($16^{o}41'S$, $168^{o}22'E$). The disturbance was spread over an area of about a quarter of a square mile.

Explosions threw pumice and ash hundreds of feet in the air and a glow was seen over the area at night. The explosive activity ceased on 17th February. About 400 square miles of ocean were then covered with a pumice "raft". Boats could not pass between Lamen and Epi islands.

Soundings taken before this activity, revealed a prominence which stood 40 fathoms above the surrounding 120 fathom sea floor.

Mr. W.B. Dallwitz calls the pumice an olivine-bearing andesite. It is composed of glass containing phenocrysts of plagioclase, pale yellow-green augite, black iron ore and rare olivine. The plagioclase shows extreme oscillatory zoning and has the approximate composition of labradorite.

Matthew Island

On 8th October 1953 a passing ship sighted a new land mass beside Matthew Island.

Investigated by the French naval vessel TIARE on 30th October this new land mass was reported to consist of a basaltic rocks which was still warm. 465 feet high and between 400 and 500 yards in diameter, it was situated to the west of Matthew Island and connected with it by an isthmus of sand 20 yards wide.

A small crater, from which a lava flow had descended, was situated on the north-western side of the "cone". Mildly active vents in the crater were emitting white vapour and traces of sulphur were observed in the vicinity.

Yasour.

On Tanna Island, this volcano produces a mild strombolian type of activity which has been described by E. Auberte de la Rue (1937).

MR BANNISTER who has lived within two miles of the crater for some 20 years says that there has been no marked change in activity during his period of residence. When examined by the writer in December 1951 explosions were occurring at the rate of 30 per hour.

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Fig.1.

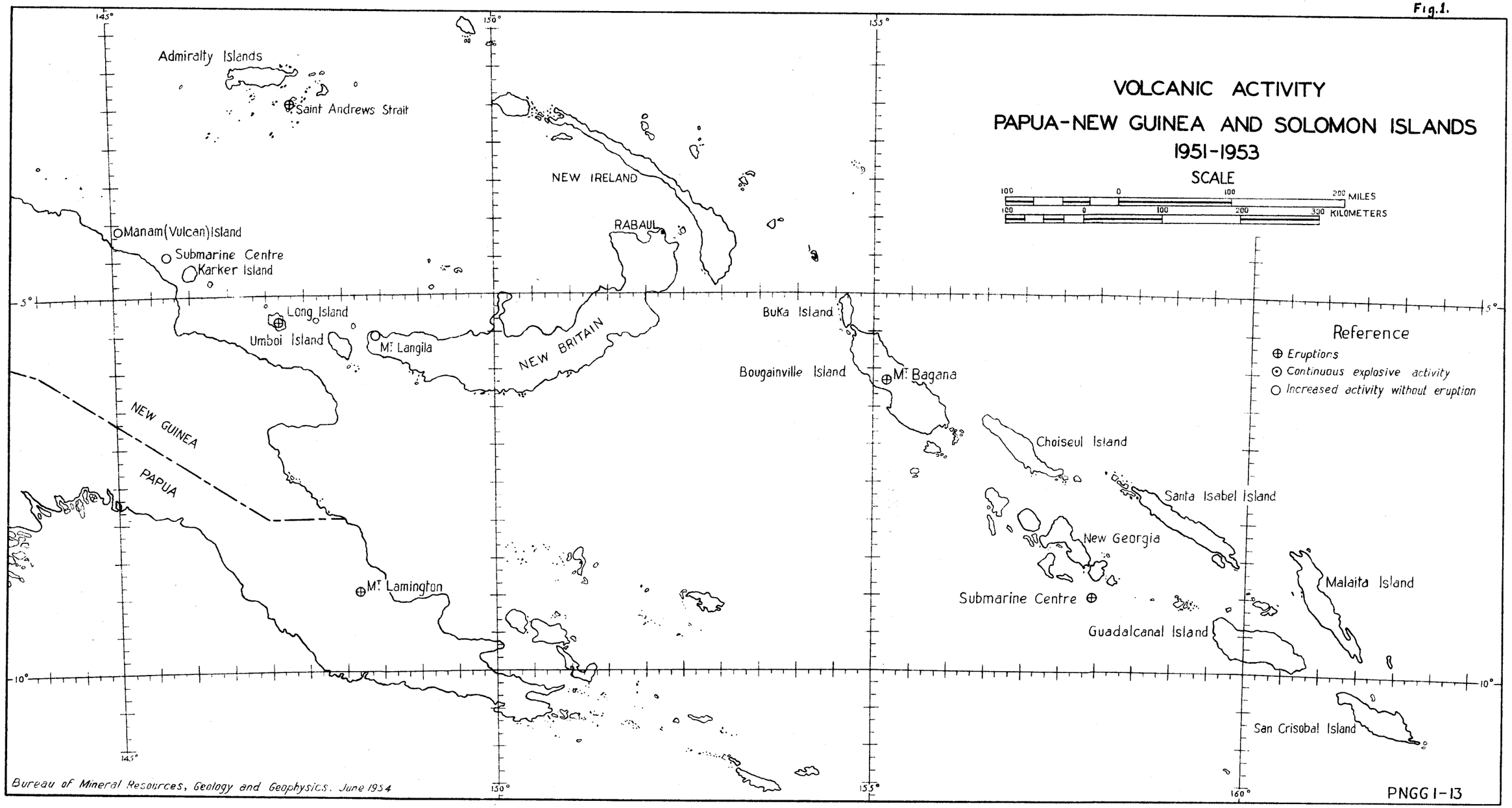
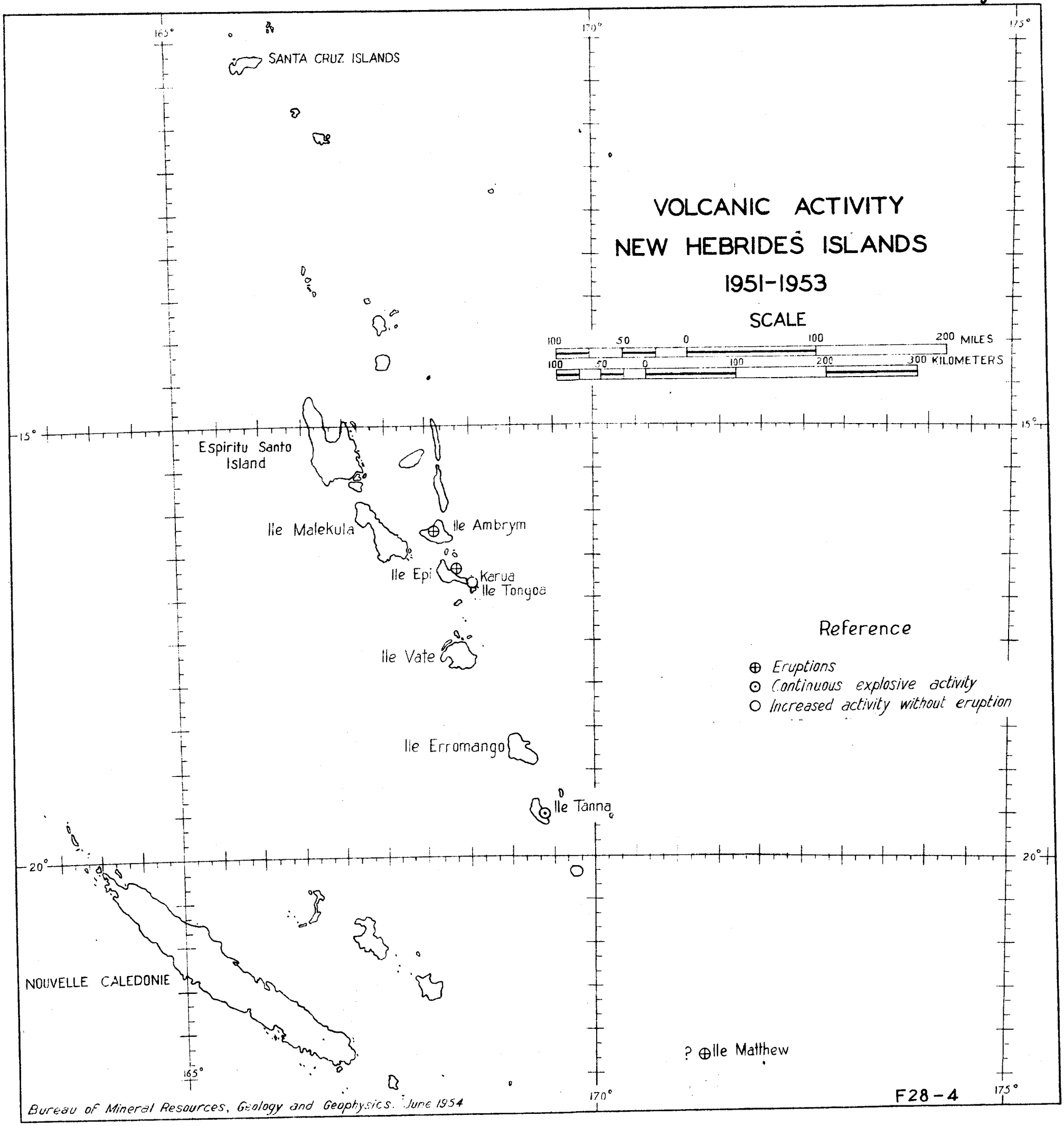
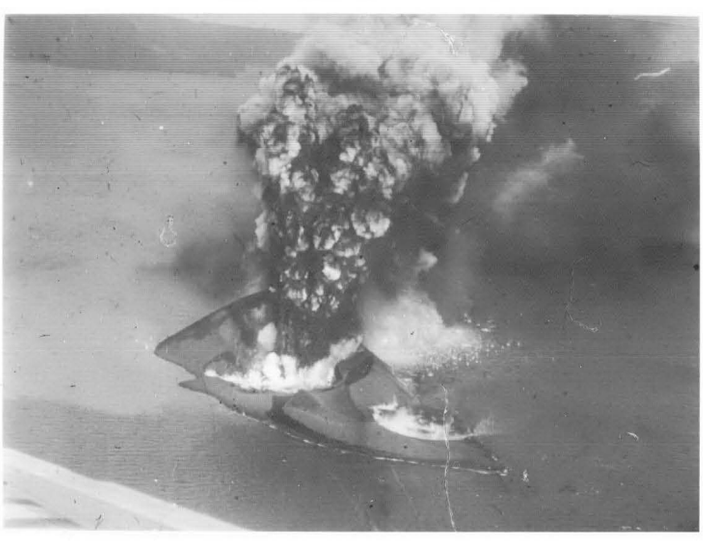

VOLCANIC ACTIVITY
PAPUA-NEW GUINEA AND SOLOMON ISLANDS
1951-1953
SCALE
100 0 100 200 MILES
100 0 100 200 300 KILOMETERS
Reference
⊕ Eruptions
⊙ Continuous explosive activity
○ Increased activity without eruption
Admiralty Islands
Saint Andrews Strait
NEW IRELAND
RABAUL
Manam(Vulcan)Island
Submarine Centre
Karker Island
Long Island
Umboi Island
Mt Langila
NEW BRITAIN
Buka Island
Bougainville Island
Mt Bagana
NEW GUINEA
PAPUA
Choiseul Island
Santa Isabel Island
New Georgia
Malaita Island
Submarine Centre
Guadalcanal Island
Mt Lamington
San Crisobal Island
145°
150°
155°
160°
5°
10°
Bureau of Mineral Resources, Geology and Geophysics. June 1954
PNGG 1-13

Fig. 2.


VOLCANIC ACTIVITY
NEW HEBRIDES ISLANDS
1951-1953
SCALE
100 50 0 100 200 MILES
100 50 0 100 200 300 KILOMETERS
SANTA CRUZ ISLANDS
Espiritu Santo Island
Ile Malekula
Ile Ambrym
Ile Epi
Karua
Ile Tongoa
Ile Vate
Ile Erromango
Ile Tanna
NOUVELLE CALEDONIE
? Ile Matthew
Reference
Eruptions
Continuous explosive activity
Increased activity without eruption
165°
170°
175°
15°
20°
Bureau of Mineral Resources, Geology and Geophysics. June 1954
F28-4

Activity from the two main vents of Manam Volcano.
Figure 3



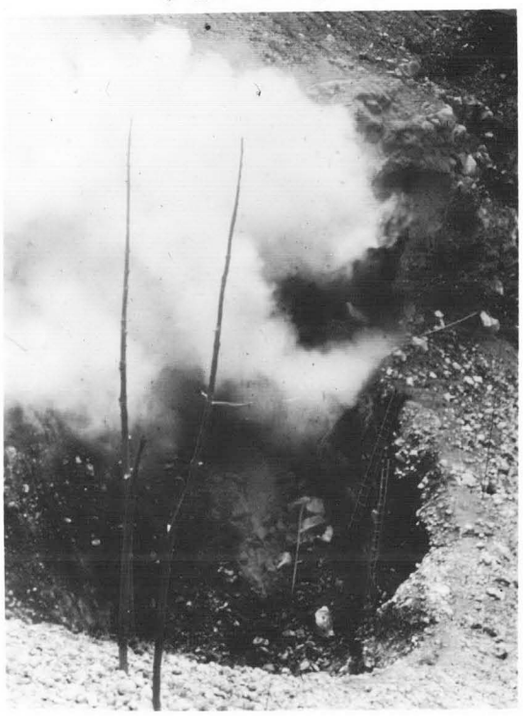
Explosions from cone raised in the Caldera lake of Long Island Volcano.
Figure 4

Steaming blocks of pumice floating in the sea around the active area in Saint Andrew Strait.

Figure 5

A nuée descending the slopes of Bagana Volcano.

Figure 6



A 40 feet access ladder to the vents on the floor of Langila Crater
Figure 7

Approaching Benbow crater of Ambrym volcano through the mudflow valleys in the new ash.
Figure 8