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VOLCANIC GEOLOGY OF MOUNT EREBUS, ROSS ISLAND, ANTARCTICA

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Abstract: Mount Erebus is an active volcano located on Ross Island, Antarctica, in an intraplate extensional tectonic setting. Reconnaissance geologic mapping has shown Mt. Erebus to be composed predominantly of anorthoclase phonolite lava flows and associated pyroclastic rocks. At the surrounding areas of Fang Ridge, Dellbridge Islands, Turks Head and Cape Barne, the lava flows and various pyroclastic deposits are predominantly intermediate in composition. Most of the lavas from Erebus and surroundings are strongly undersaturated and sodic, forming a continuous differentiation lineage consisting of basanite, Ne-hawaiite, Ne-mugearite, Ne-benmoreite and anorthoclase phonolite. These lavas are termed the Erebus lineage (EL) and are predominantly coarsely porphyritic with a similar phenocryst assemblage consisting of olivine, clinopyroxene, opaque oxides, feldspar, apatite and rare feldspathoids.

EL lavas are distinctly different from the lavas of the three predominantly basanite volcanic centers which radially surround Mt. Erebus (DVDP lineage; P. R. KYLE: J. Petrol., **22**, 451, 1981), and must have a different petrogenesis. Very minor volumes of less undersaturated benmoreite, phonolite and trachyte occur on Mt. Erebus and must also have evolved independently of the EL.

1. Introduction

The McMurdo Volcanic Group (MVG) (KYLE and COLE, 1974), on the western margin of the Ross Sea in Victoria Land, Antarctica, consists of late Cenozoic, intraplate, predominantly sodic, alkaline volcanics. The MVG lies in a major fault zone in the East Antarctic continental craton characterized by uplift of the Transantarctic Mountains and downwarping and rifting in the Ross Sea (KYLE and COLE, 1974; MCGINNIS *et al.*, 1985). The basement of the Ross Sea, 4–5 km below sea level (MCGINNIS *et al.*, 1983), consists of granitic, metamorphic and sedimentary rocks similar to those exposed in the Transantarctic Mountains, as evidenced from drill core (FORD and BARRETT, 1975) and xenoliths in volcanic rocks (THOMSON, 1916). The Transantarctic Mountains, rise to almost 4000 m, suggesting 8 km of vertical displacement along north-south trending faults.

A strong east-west gravity gradient across McMurdo Sound (SMITHSON, 1972) is attributed to pronounced crustal thinning, from 40 to 27 km, due to rifting in the Ross Sea (KYLE and COLE, 1974; BENTLEY, 1983). Evidence for rifting includes east-dipping listric faults in the basement of McMurdo Sound (MCGINNIS *et al.*, 1983), the Victoria Land basin in the western Ross Sea and the Rennick graben in northern Victoria Land, possible fault block and graben structures (COOPER and DAVEY, 1985;

KIM *et al.*, 1986). Thus, Victoria Land basin and the entire Ross embayment (Ross Sea and Ross Ice Shelf) are possible expressions of intracontinental extension similar to that occurring in the Basin and Range province, western U. S. A. and East African Rift, Kenya.

The MVG forms a discontinuous zone *ca.* 1400 km long and $\leq$150 km wide parallel to the eastern flank of the Transantarctic Mountains and developed along crustal faults and fractures in Victoria Land and the Ross Sea. The Erebus volcanic province (KYLE and COLE, 1974) is located in the McMurdo Sound area (Fig. 1). Lavas in the Erebus volcanic province are the most undersaturated in the MVG, comprising a broad basanite to phonolite sequence. Two major volcanic centers, Ross Island and Mt. Discovery, occur, each consisting of a large composite volcano radially surrounded by subsidiary volcanic centers (Fig. 1). This three-fold radial configuration around a central volcano may be controlled by radial fractures in the

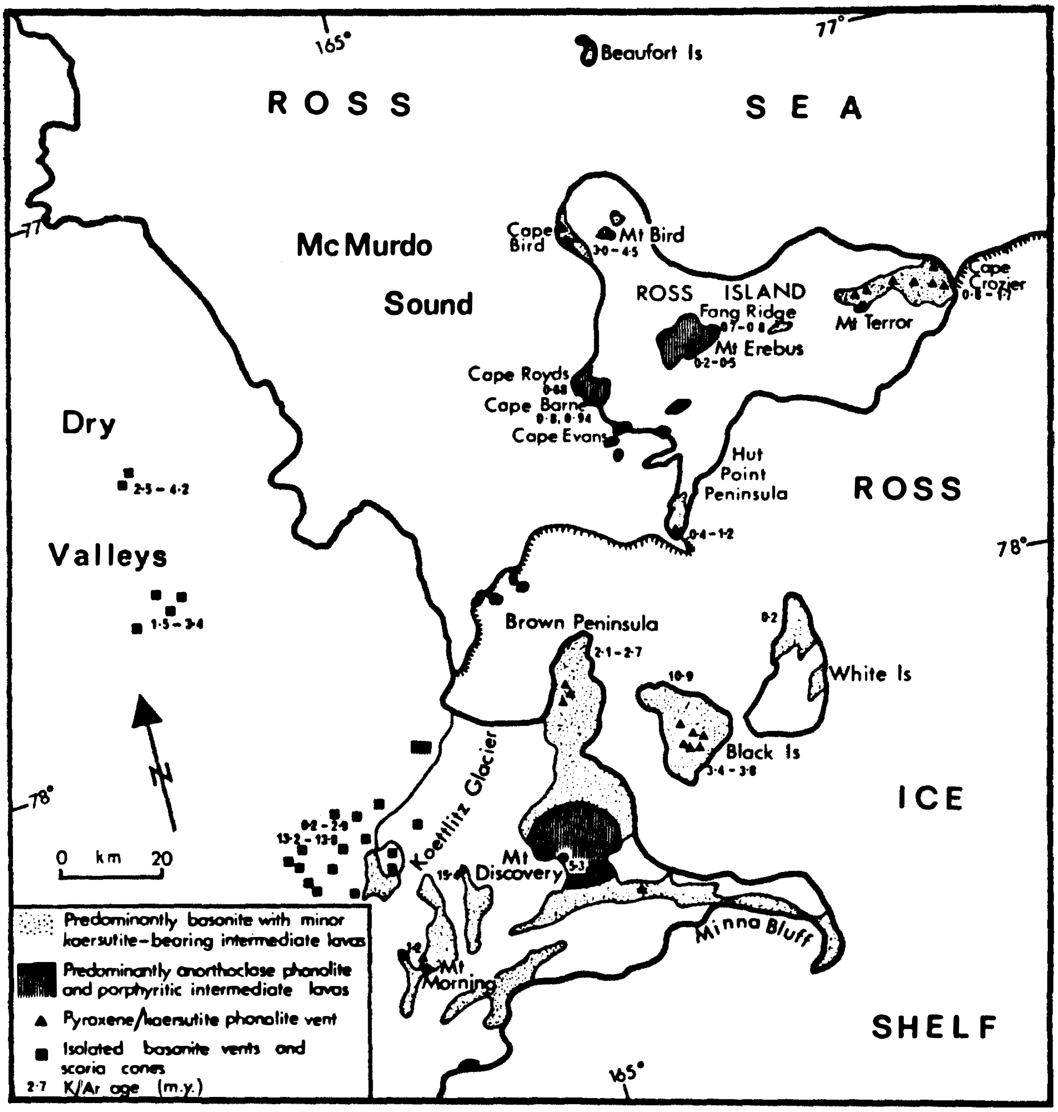

Fig. 1. Distribution and K/Ar ages of McMurdo Volcanic Group rocks in the McMurdo Sound area; showing the location of Mt. Erebus.

crust above a rising mantle diapir (KYLE and COLE, 1974). K/Ar age determinations on a number of samples from throughout the province (TREVES, 1968; FORBES *et al.*, 1974; KYLE and TREVES, 1974; ARMSTRONG, 1978; MUNCY, 1979) range from 18.7 to 0.08 Ma. The age determinations suggest the volcanism is the oldest in the MVG and has been continuous up to the present day (ARMSTRONG, 1978) with ongoing activity at Mt. Erebus on Ross Island (KYLE *et al.*, 1982; KYLE, 1986).

Three distinct lava lineages have been recognized on Ross Island from geochemical analyses of rock samples. The lavas at Mt. Bird, Mt. Terror and Hut Point Peninsula which surround Mt. Erebus consist mainly of basanite with minor intermediate differentiates and phonolite and are termed the DVDP lineage (KYLE, 1981). DVDP lineage lavas are predominantly microporphyritic, containing kaersutite, and were examined in detail in Dry Valley Drilling Project (DVDP) drillcore from Hut Point Peninsula.

The lavas of Mt. Erebus, in contrast to the DVDP lineage rocks, are predominantly phonolite with minor basanite and lavas of intermediate compositions. They are mainly coarsely porphyritic and lack kaersutite. These lavas are termed the Erebus lineage (EL) by KYLE (1976, 1981). Minor volumes of less undersaturated benmoreite, phonolite and trachyte also occur on Mt. Erebus, and are termed the enriched iron series (EFS). This paper describes the volcanic geology of Mt. Erebus and petrography of the lavas. Mineral chemistry, geochemistry and petrogenesis will be presented elsewhere.

2. Geology of Mt. Erebus

Mt. Erebus (3794 m) dominates the three smaller volcanic centers (Mt. Terror (3230 m), Mt. Bird (1766 m) and Hut Point Peninsula) which make up Ross Island (Fig. 1). The major rock type exposed on the surface is anorthoclase-phyric phonolite (henceforth called anorthoclase phonolite; the volcanic rock classification used in this study is explained below). Mt. Erebus is the most active volcano in Antarctica. Several small strombolian eruptions usually occur daily and it contains a persistent convecting anorthoclase phonolite lava lake (KYLE, 1986). An age determination of 0.94 Ma from an anorthoclase phonolite flow at Cape Barne (ARMSTRONG, 1978) (Fig. 1) is the oldest date from Mt. Erebus, suggesting the center is approximately 1 Ma old and therefore one of the youngest volcanic centers in the MVG.

2.1. Dellbridge Islands

This group of four tiny heavily eroded volcanic islands lies approximately 3 km off the southwest coast of Mt. Erebus (Fig. 2). Inaccessible Island (Fig. 3) has a basal unit of clinopyroxene-feldspar-phyric Ne-hawaiite 1 to 4 m thick. These are overlain by palagonitized pillow lavas, pillow breccias, and hyaloclastites which grade upward into a >60 m thick sequence of 1–10 m thick porphyritic feldspar-phyric Ne-hawaiite flows. The flows dip from 10° to 40° north and are associated with NNE-trending dikes. Interbedded in the sequence of feldspar-rich Ne-hawaiite flows are 10–15 m thick flows of finely porphyritic benmoreite and phonolite. Thin feldspar-phyric Ne-benmoreite flows cap Inaccessible Island.

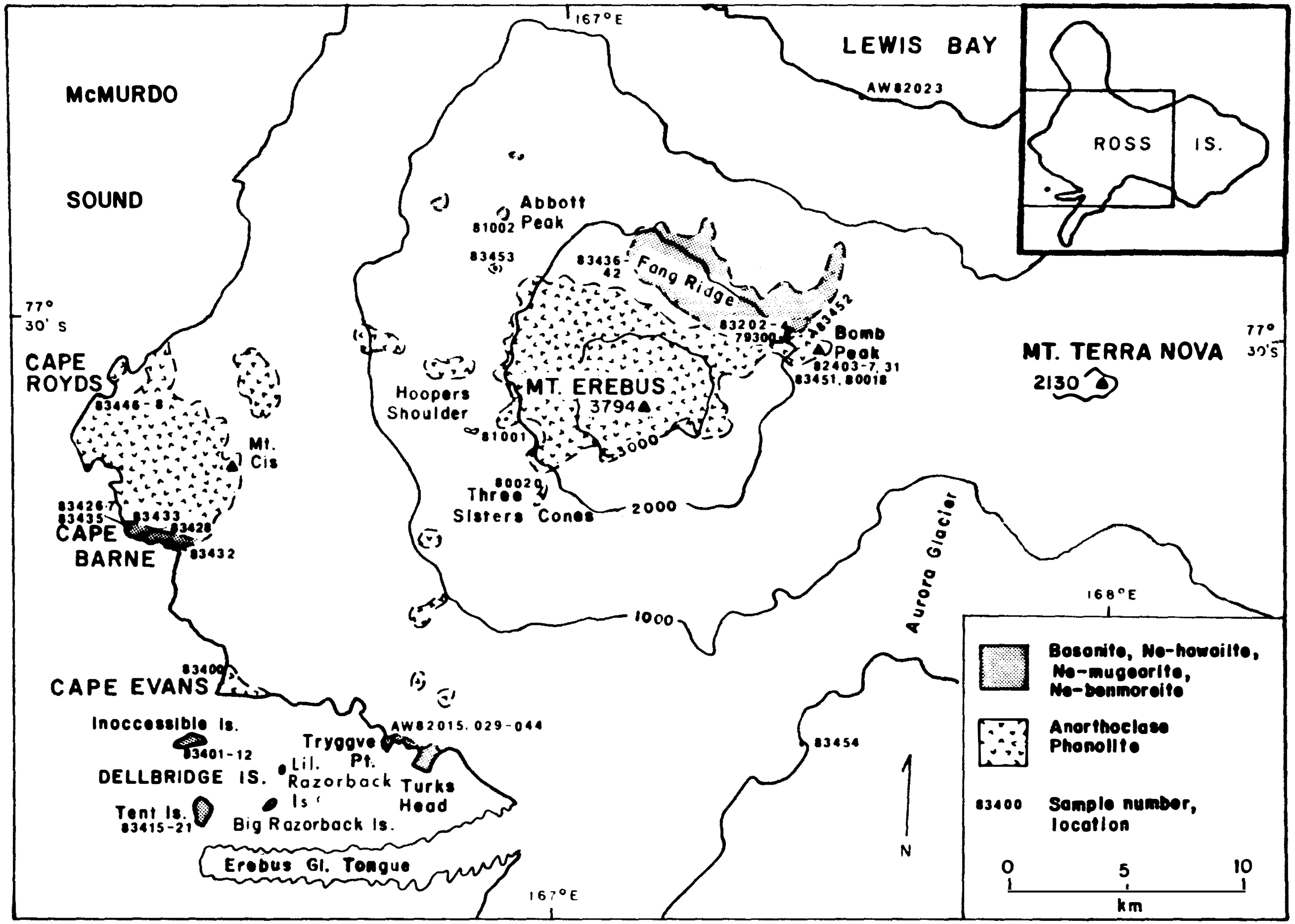

Fig. 2. Geologic sketch of Mt. Erebus, showing the distribution of various rock types and some sample locations mentioned in the text.

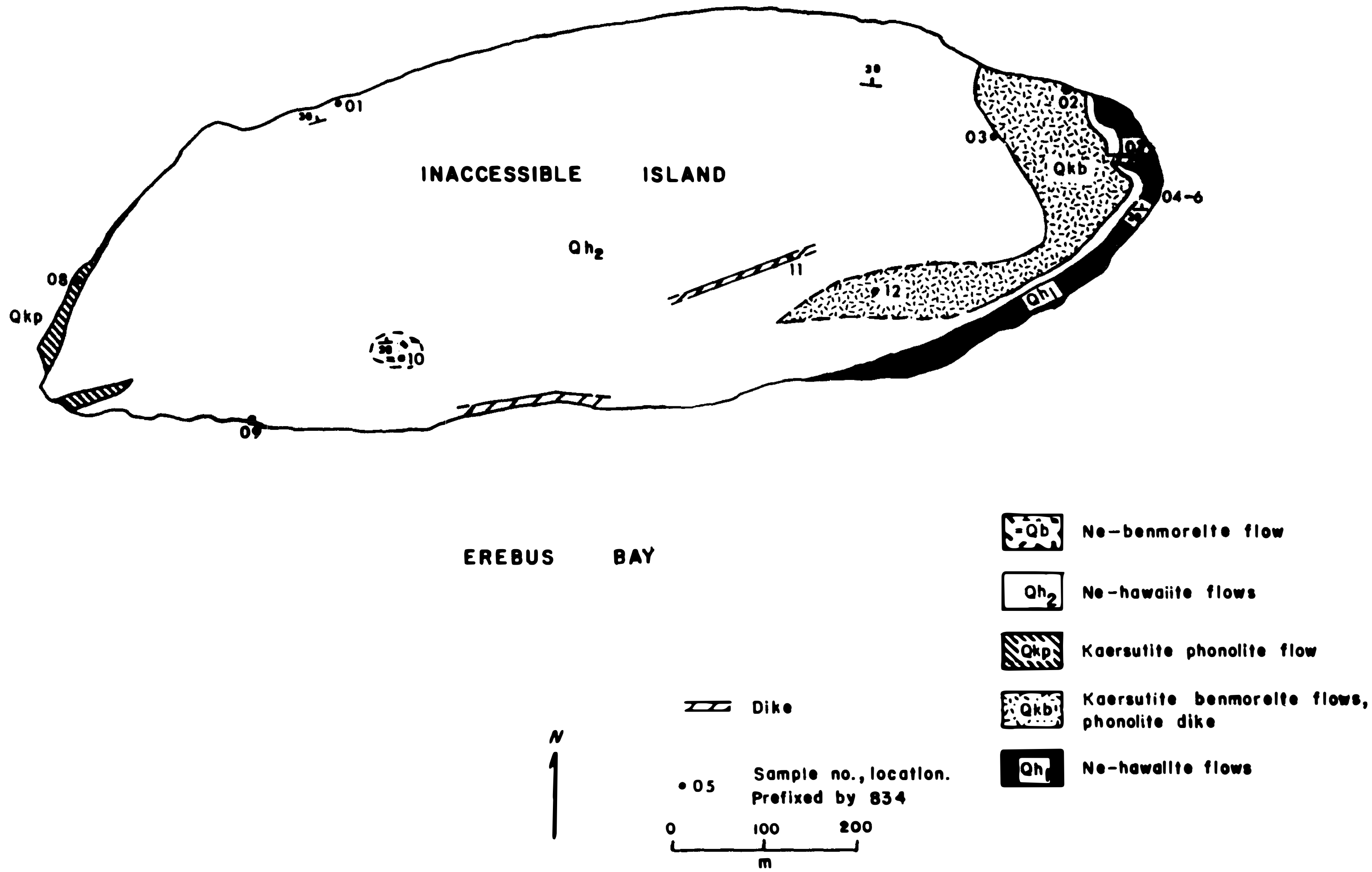

Fig. 3. Geologic sketch map of Inaccessible Island in Erebus Bay.

Tent Island, approximately 1 km south of Inaccessible Island (Fig. 4) has a basal unit of pillow lavas, lava flows and associated breccias of clinopyroxene-feldspar-phyric Ne-hawaiite. About 20 m of pyroclastic breccia, possibly laharic in origin, overlies a smooth, possibly glacially-formed unconformity above the Ne-hawaiite unit. Dikes of porphyritic Ne-mugearite intrude the tuff at the southern end of Tent Island and appear to be feeders to porphyritic feldspar-rich Ne-hawaiite lava flows overlying the tuff and dipping 10–20° southeast. Thin lava flows of porphyritic Ne-benmoreite similar to those at Inaccessible Island cap Tent Island.

East of Tent Island, Big and Little Razorback Islands (Fig. 2) are composed of clinopyroxene-feldspar-phyric Ne-hawaiite, Ne-mugearite and Ne-benmoreite lava flows 1 to 5 m thick and dipping 2–3° northwest (KYLE, 1976). A tower-shaped

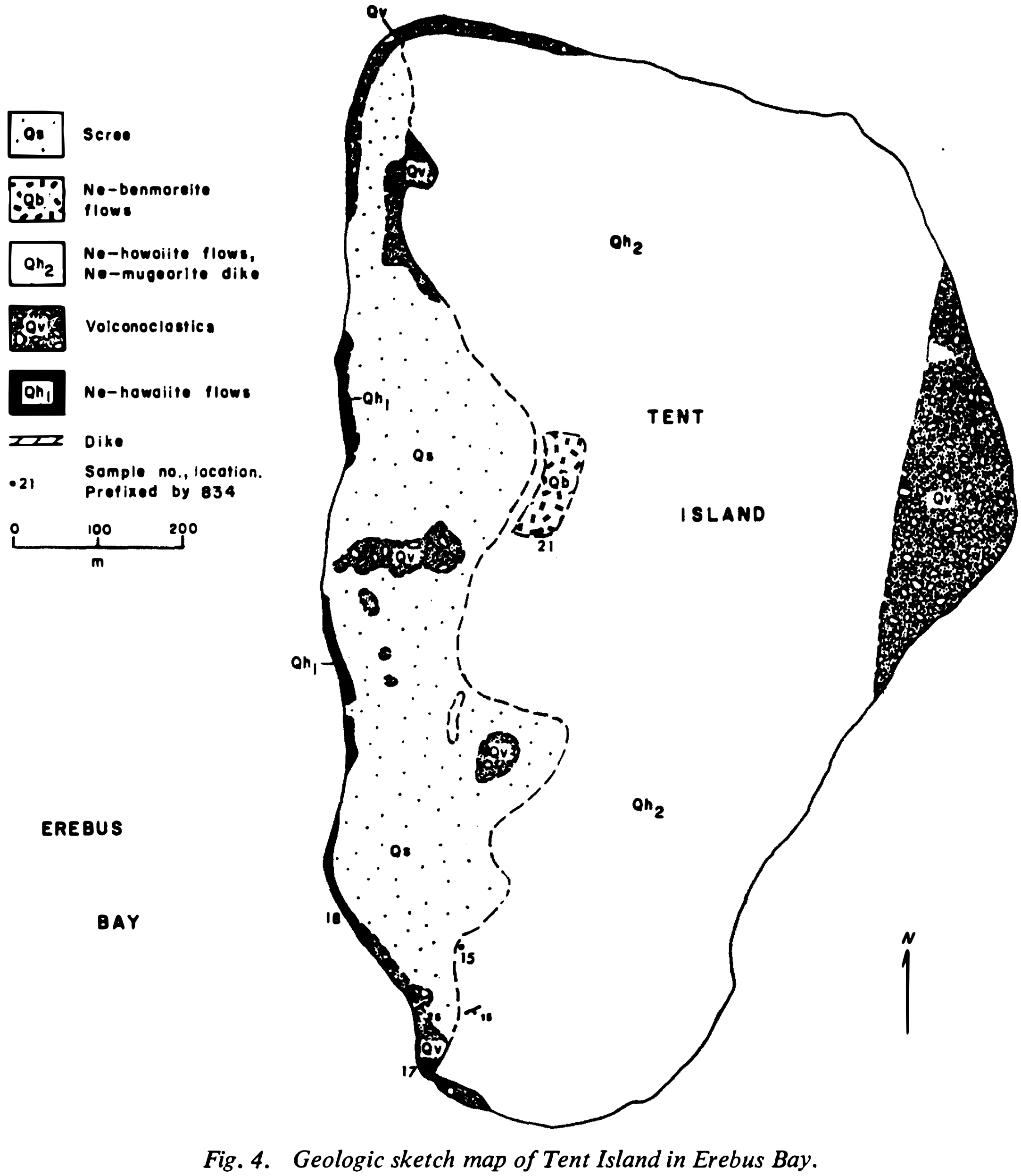

Fig. 4. Geologic sketch map of Tent Island in Erebus Bay.

intrusion at the southwest end of Big Razorback Island may mark the location of a vent.

The Dellbridge Islands appear to be remnants of cones formed by early activity of Mt. Erebus southwest of the present volcanic center. The age of the islands is considered to be <2 Ma, even though they are deeply eroded, because they are situated off the coast. Marine erosion is significant, whereas elsewhere erosion rates are extremely slow.

2.2. *Turks Head and Tryggve Point*

Turks Head and Tryggve Point are coastal headlands on the southwest side of Mt. Erebus (Figs. 2 and 5). Each consists of similar but probably independent subaqueous to subaerial volcanic sequences with a local dip of 30° north (LUCKMAN, 1974; WRIGHT *et al.*, 1983). At the base of the sequences are pillow lavas of feldspar-clinopyroxene-phyric Ne-hawaiite. These are overlain by thick, massive Ne-hawaiite pillow breccias and hyaloclastites grading upward into subaerial feldspar-phyric Ne-hawaiite lava flows at Turks Head and unconformably overlain by similar flows at Tryggve Point. The breccia units are cut by NW-trending dikes of clinopyroxene-feldspar-phyric Ne-benmoreite. Lava flows of anorthoclase-phyric Ne-benmoreite from Mt. Erebus unconformably overlie the Ne-hawaiite sequences of Turks Head and Tryggve Point.

The volcanics of Turks Head and Tryggve Point appear to have been erupted from the same center as the Dellbridge Islands and are believed to be the same age (KYLE, 1976). A K/Ar date of 0.86 ± 0.20 Ma was obtained on the uppermost Ne-hawaiite lava flow at Turks Head (Table 1).

2.3. *Lower slopes*

The flanks of Mt. Erebus below 1800 m slope *ca.* 10°, and outcrop is very limited except for extensive exposures of anorthoclase phonolite near the coast on the western side (Fig. 2). Cape Evans is composed of two anorthoclase phonolite lava flows each up to 15 m thick in places (TREVES, 1962). At Cape Barne two anorthoclase phonolite lava flows occur which thicken locally to over 20 m (KYLE, 1976). Numerous pressure ridges and lobes in the flows appear to have followed valleys or depressions in the underlying topography. The younger flow has a K/Ar age of 0.94 ± 0.05 Ma (ARMSTRONG, 1978).

On the south side of Cape Barne is a line of three cones of microporphyritic basanite and Ne-hawaiite probably erupted from a northwest-trending fissure (Fig. 6). A K/Ar age of 0.8 ± 0.2 Ma (ARMSTRONG, 1978) obtained from the middle cone is statistically similar to the age of the youngest anorthoclase phonolite flow at Cape Barne. However, the flow appears to lap up against the Ne-hawaiite cones, indicating the cones are older than the flow. The cones consist of palagonitized hyaloclastites, pyroclastic surge deposits, and pillow lavas overlain by bomb lapilli tuffs, lava flows and flow breccias. A number of dikes, including a basanite dike, trend northwest and dip vertical to 40° north.

A small cone of weakly undersaturated to oversaturated high-K trachyte called Mt. Cis occurs about 1 km east of Cape Barne (SMITH, 1954) (Figs. 2 and 6). The

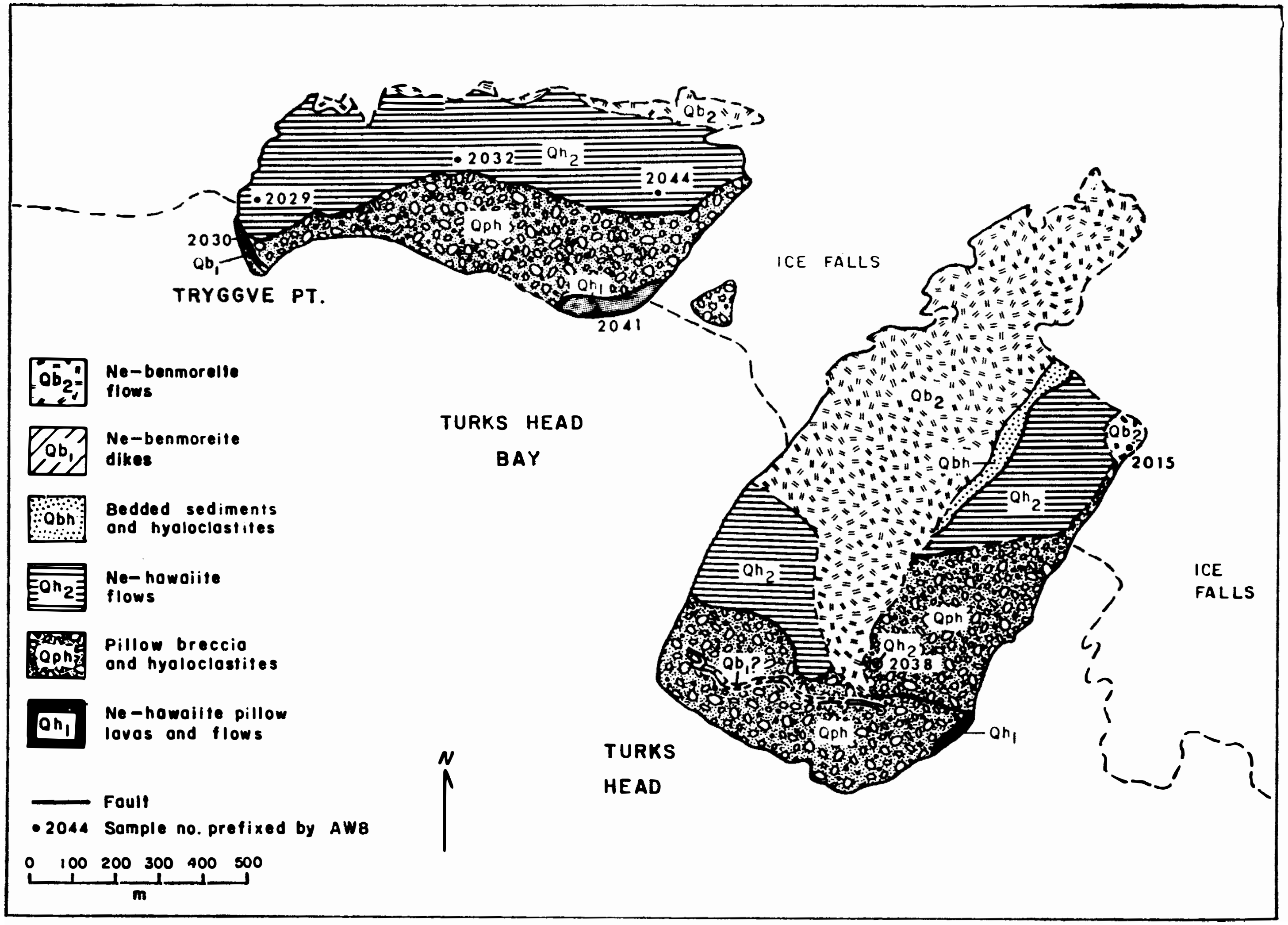

Fig. 5. Geologic sketch map of Turks Head and Tryggve Point on Ross Island. Based on field mapping by WRIGHT *et al. (1983).*

Table 1. K/Ar age determination of Ne-hawaiite lava flow from Turks Head.

Sample No.	% K	$^{40}Ar^*$ mol/g $\times 10^{11}$	$^{40}Ar^*$ % of total ^{40}Ar	Age Ma
AW82038	2.162	0.2816	1.78	
	2.141	0.2516	1.74	
	2.135	0.3322	2.29	
	2.169	0.3282	1.88	
		0.4052	2.82	
Average	2.152	0.3198		0.86±0.20

Whole rock sample used. See Fig. 5 for sample location. Uncertainty is at 68% confidence level. Constants used $^{40}K = 1.167 \times 10^{-2}$ atom % of K; beta decay constant $= 4.962 \times 10^{-10}$ y^{-1}; Ke decay constant $= 0.581 \times 10^{-10}$ y^{-1}.

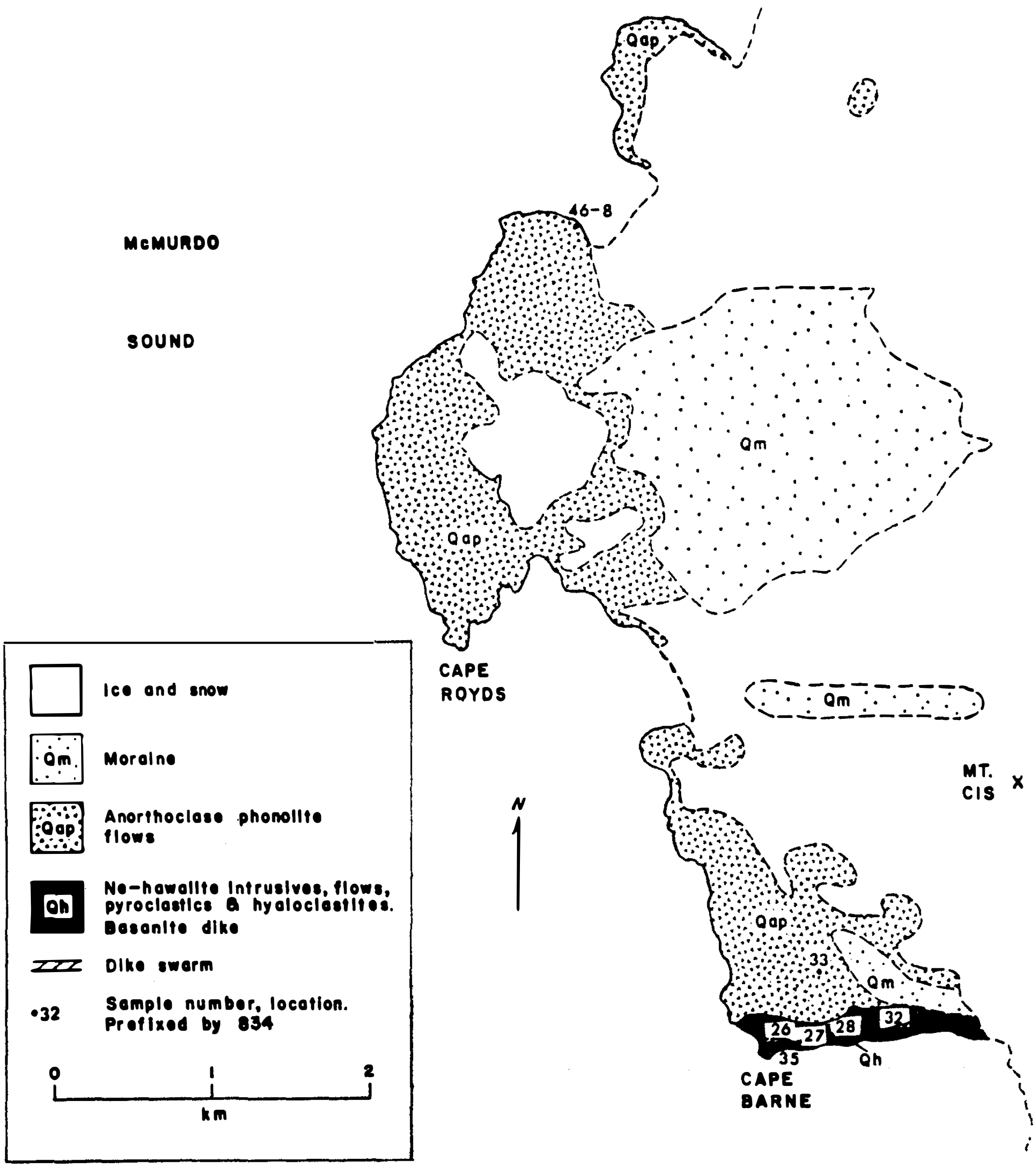

Fig. 6. Geologic sketch map of Cape Barne and Cape Royds on the flanks of Mt. Erebus.

trachyte contains numerous crustal xenoliths of sanidinite, weakly metamorphosed sandstone and dolerite (THOMSON, 1916).

Cape Royds (Figs. 2 and 6) is composed of at least four flows of anorthoclase phonolite. The flows locally reach 15 m in thickness and have numerous pressure ridges and pushup domes, similar to the anorthoclase phonolite flows at Cape Barne. Well-preserved glassy upper surfaces occur between the flows, suggesting they are of similar age. A K/Ar age of 0.68 ± 0.14 Ma was obtained from the uppermost flow (TREVES, 1968), suggesting they are younger than those at Cape Barne.

The extent of the anorthoclase phonolite flows on the western side of Mt. Erebus suggests a large outpouring of anorthoclase phonolite lava, sufficiently large to allow the viscous material to travel long distances over low slopes (KYLE, 1976). Thus the eruptive center was most likely near the present center of Mt. Erebus, *ca.* 20 km inland.

Ice-capped cliffs bordering Lewis Bay on the north side of Mt. Erebus (Fig. 2) consist of palagonitized volcanic breccias unconformably overlain by aphanitic benmoreite flows (A. WRIGHT, pers. commun.). Cliffs west of the Aurora Glacier on the southeast flank of Mt. Erebus (Fig. 2) expose a possible subglacial to subaerial trachyte sequence (W. MCINTOSH, pers. commun.). At the base are bedded tuffs which grade upward into trachyte hyaloclastites and flow lobes. Subaerial trachyte flows unconformably overlie this unit.

2.4. *Upper slopes*

Mt. Erebus between 1800 m and the rim of the summit plateau (*ca.* 3200 m; Fig. 2) slopes from 30–40° and consist of numerous 20–70 m wide anorthoclase phonolite flows, usually with only their flow levees exposed above the snow. The flows are highly vesicular and scoriaceous, with thick glassy crusts (KYLE, 1976). The freshness of this glass indicates they are young. A K/Ar age of 0.15 ± 0.05 Ma was obtained from a flow on the northern plateau rim (ARMSTRONG, 1978).

Six small parasitic cones occur at about 1800 m in elevation. Hoopers Shoulder, on the west side (Fig. 2) is built of short flows of nonvesicular glassy anorthoclase phonolite (KYLE, 1976). About 3 km to the south are the Three Sisters Cones, three small recent anorthoclase phonolite cones forming a southwest-trending line. Abbott Peak on the northwest flank of Mt. Erebus (Fig. 2) is a pyramid-shaped endogenous dome of kaersutite-phyric benmoreite.

Bomb Peak, on the eastern side Mt. Erebus (Fig. 2), is a dome of aphanitic comenditic trachyte and kaersutite-feldspar-phyric phonolite. The comenditic trachyte contains small anorthoclase phonolite xenoliths and is the only quartz-normative lava known on Mt. Erebus apart from Mt. Cis. Anorthoclase phonolite bombs scattered over the surface of Bomb Peak were probably erupted from a nearby, unexposed parasitic vent.

2.5. *Fang Ridge*

Fang Ridge is a *ca.* 4 km long spur rising to 3159 m in elevation on the northeast flank of Mt. Erebus (Figs. 2 and 7). The northeast side slopes at $>45°$ and consists of scree and ribs of rubbly flows and flow breccia. On the southwest or Erebus side of Fang Ridge is a near vertical cliff over 150 m high. The western end of Fang Ridge

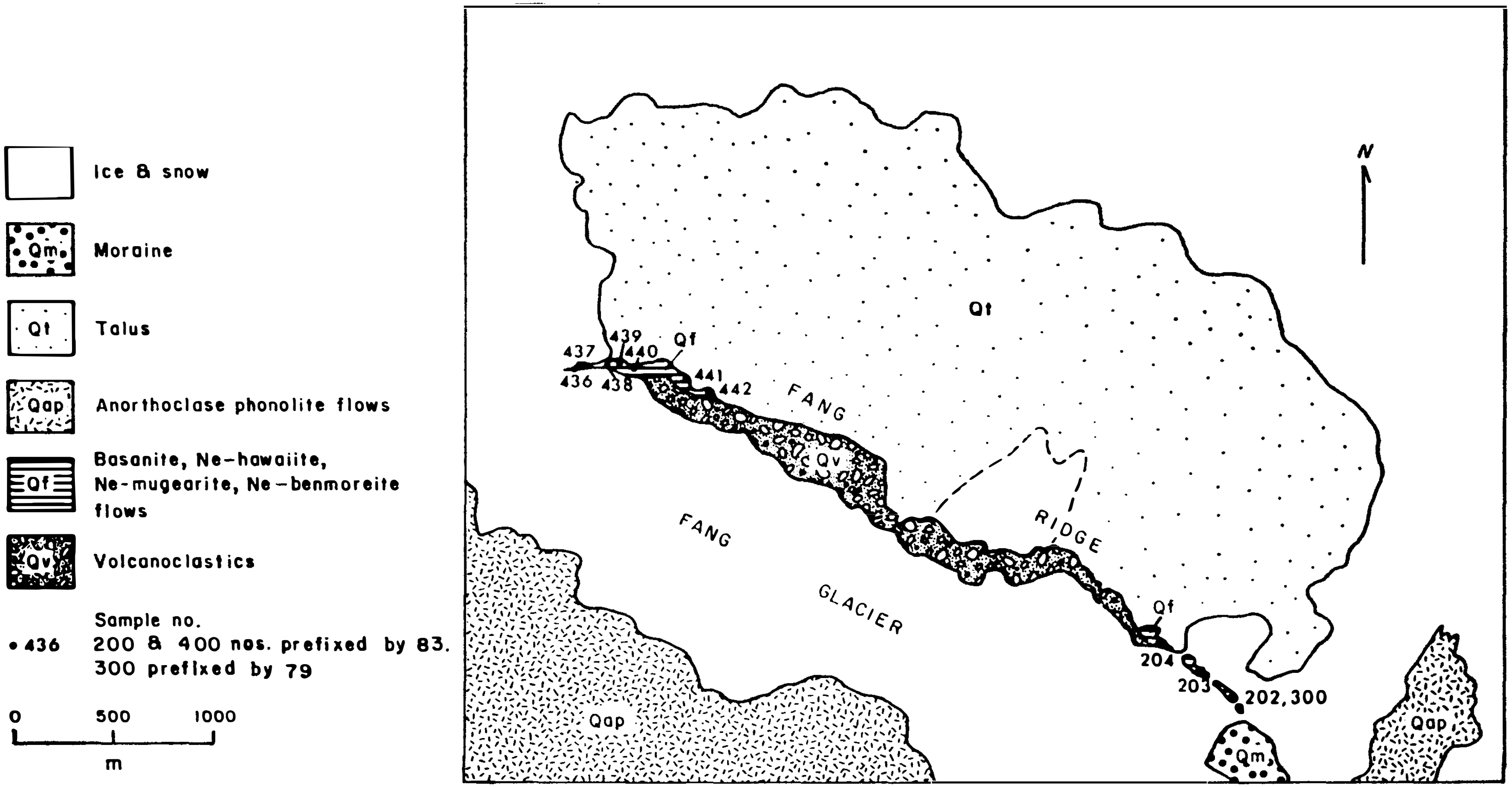

Fig. 7. Geologic sketch map of Fang Ridge, on Mt. Erebus.

consists of poorly bedded pyroclastic breccia, probably a lahar deposit, intruded by thin dikes and sills. The breccia is capped by scoriaceous clinopyroxene-feldspar-phyric lava flows dipping approximately 30° northeast at the northwest and southeast ends of Fang Ridge. These flows have an upward stratigraphic progression from basanite to Ne-hawaiite to Ne-mugearite and Ne-benmoreite.

Fang Ridge is most likely an eroded remnant of a large cone built on top of a juvenile Mt. Erebus (KYLE, 1976). K/Ar ages of 0.81 ± 0.02 Ma from the lowermost flow and 0.73 ± 0.07 Ma from the uppermost flow were obtained there (ARMSTRONG, 1978), consistent with stratigraphic positions.

2.6. *Summit area*

The summit region of Mt. Erebus is a gently sloping plateau with its rim at *ca.* 3200 m (Fig. 2), thought to be a caldera filled by anorthoclase phonolite lavas (KYLE, 1976). It is covered by jumbled sheets of anorthoclase phonolite flows, possibly formed as skins on lava pools and jumbled by later movement of the underlying lava. The active summit cone occurs on the south side of the plateau and rises steeply to 3794 m on its rim. It is mostly covered by partially decomposed lava bombs and a lag deposit of anorthoclase crystals. An elliptical crater (Main Crater) *ca.* 500 m in diameter and 160 m deep occurs within the cone. The vertical walls of this crater reveal that the summit cone is composed mainly of flows with the latest activity being more explosive, forming a pyroclastic breccia (agglomerate) capping. The anorthoclase phonolite lava lake occurs in the northern half a circular pit crater *ca.* 250 m in diameter and 100 m deep on the north side on Main Crater.

2.7. *Geologic evolution of Mt. Erebus*

The following model of the geologic development of Mt. Erebus is based on stratigraphy, geomorphology, age dates and magnetic survey data. Volcanic activity probably commenced with the deposition of hyaloclastites and pillow lavas on the floor of McMurdo Sound slightly greater than 1 million years ago. Early subaerial activity in the vicinity of Erebus Bay built Ne-hawaiite to Ne-benmoreite cones between 1 and 0.8 Ma. Minor amounts of microporphyritic benmoreite and phonolite were also erupted. The present volcanic center of Mt. Erebus was active at about the same time. Early activity of this center consisted of basanite and Ne-hawaiite eruptions along a northwest-trending rift at Cape Barne. Between 0.94–0.68 Ma, large volumes of anorthoclase phonolite were erupted, building a shield volcano which forms the lower slopes of Mt. Erebus today. Intermediate lavas erupted from a parasitic vent built a cone on top of this shield volcano. This cone collapsed, forming Fang Ridge, *ca.* 0.7 Ma ago. Small parasitic cones at Mt. Cis, Abbott Peak, Bomb Peak, Aurora Glacier and Lewis Bay erupted small volumes of benmoreite, phonolite and trachyte.

The large volume anorthoclase phonolite eruptions were followed by smaller eruptions after 0.69 Ma, during the Bruhnes normal polarity epoch (MCGINNIS *et al.*, 1974). These short anorthoclase phonolite flows built a steep summit cone, which collapsed, forming the caldera of the present summit. The caldera was filled by anorthoclase phonolite by 0.15 Ma. Flank eruptions formed Hoopers Shoulder and the Three Sisters Cones. The present summit cone has been built during the past 100000 years. The historic activity of Mt. Erebus has consisted mainly of strombolian eruptions of varying intensity and a permanent convecting anorthoclase phonolite lava lake within the summit crater (KYLE *et al.*, 1982).

3. Rock Nomenclature

Rock sample nomenclature (Table 2) is based on chemical composition and CIPW normative mineralogy and is similar to that discussed by KYLE *et al.* (1979) and COOMBS and WILKINSON (1969). The dominant rock types comprising Mt. Erebus form a continuous strongly undersaturated sodic differentiation lineage consisting of basanite,

Table 2. Nomenclature used to describe Mt. Erebus lavas.

Name	Classification criteria	
Basanite	An>50	Ne> 5%
Ne-hawaiite	An 30–50	Ne>10%
Ne-mugearite	An 10–30	Ne>10%
Ne-benmoreite	Di 65–75	Ne>10%
Benmoreite	Di 65–75	Ne>10%
Phonolite	DI>75	Ne>10%
Trachyte	DI>75	Ne<10%

Explanation: An=normative 100 An/(An+Ab); Ne=normative Ne; DI=differentiation index (normative Q+Ab+An+Or+Ne+Lc) of THORNTON and TUTTLE (1960). CIPW norms in weight % used throughout.

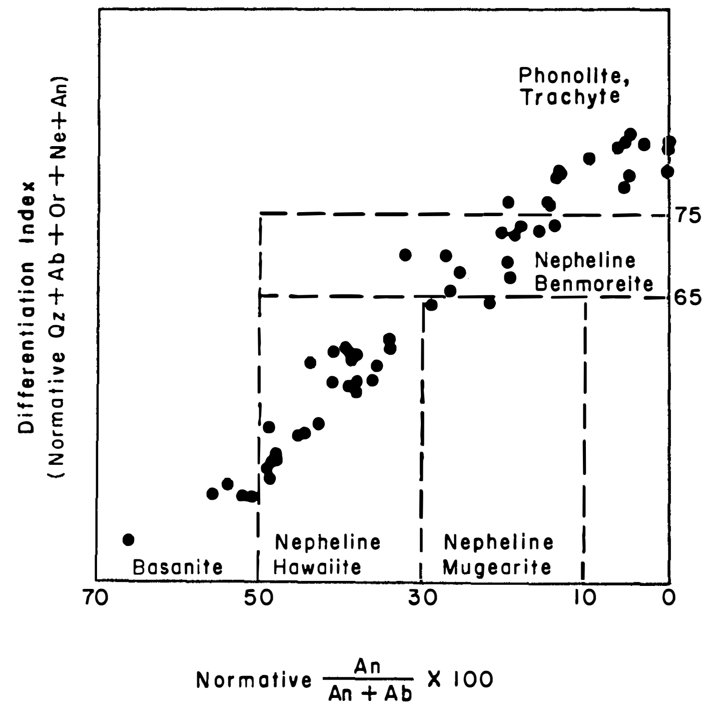

Fig. 8a. Plot of differentiation index (THORNTON and TUTTLE, 1960) against normative plagioclase showing nomenclature of lavas from Mt. Erebus and adjacent areas.

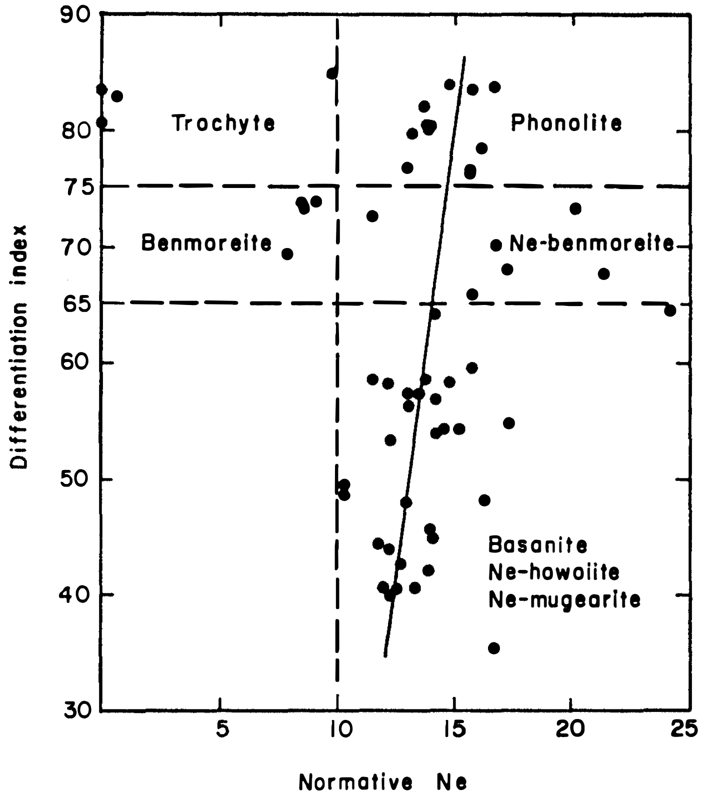

Fig. 8b. *Division of Mt. Erebus lavas into the strongly undersaturated (Ne>10%) Erebus lineage and weakly undersaturated (Ne<10%) benmoreites and trachytes of the enriched iron series.*

Ne-hawaiite, Ne-mugearite, Ne-benmoreite, and anorthoclase phonolite (Fig. 8). This series has previously been called the Erebus lineage by KYLE (1976) and will be referred to as such here.

Volumetrically insignificant amounts of benmoreite, phonolite and trachyte also occur on Mt. Erebus (Fig. 8). These lavas are termed the enriched iron series (EFS). Two trachyte samples are mildly quartz-normative and peralkaline and are classified as comenditic trachyte after the system of MACDONALD (1974).

4. Petrography

4.1. Basanites

The basanites are porphyritic with seriate phenocrysts (5 mm in size) of feldspar (bytownite-labradorite), olivine, opaque oxides, clinopyroxene, and apatite. Feldspar phenocrysts are mostly euhedral and unzoned. Olivine and opaque oxide phenocrysts are subhedral or euhedral but a few strongly embayed anhedral phenocrysts occur. Clinopyroxene phenocrysts are euhedral, discontinuously or oscillatory zoned, and purplish brown. Rare colorless cores occur. The groundmass is pilotaxitic and intersertal, consisting of similar phases as the phenocrysts with possible interstitial nepheline.

4.2. *Ne-hawaiites and Ne-mugearites*

Some Ne-hawaiites are finely porphyritic, containing seriate euhedral phenocrysts ≤ 2 mm in size of labradorite, olivine, opaque oxides, clinopyroxene and apatite. Most of the Ne-hawaiites and Ne-mugearites are coarsely porphyritic, containing seriate, often glomeroporphyritic phenocrysts of feldspar (labradorite-andesine), clinopyroxene, olivine, opaque oxides, apatite and rare nepheline. Feldspar phenocrysts (up to 3 cm) are euhedral or subhedral, oscillatory-zoned and commonly have resorbed cores and embayed rims. Clinopyroxene phenocrysts (up to 5 mm) are euhedral, purplish brown or brown, and oscillatory or discontinuously zoned. Olivine, magnetite and rare ilmenite phenocrysts are generally subhedral and partly resorbed. Minute blebs of pyrrhotite sometimes occur in magnetite phenocrysts. Euhedral apatite phenocrysts occur up to 1 mm in length and commonly contain melt inclusions. The groundmass is pilotaxitic and intersertal in most samples, consisting of similar phases as the phenocrysts. Interstitial alkali feldspar and nepheline occur in some samples.

4.3. *Ne-benmoreites*

The Ne-benmoreites, like the Ne-hawaiites, are coarsely porphyritic, containing seriate or hiatal phenocrysts of feldspar, olivine, opaque oxides, clinopyroxene and apatite. Feldspar phenocrysts, most commonly andesine, range up to 2 cm in length and generally are subhedral to anhedral, embayed and have thin discontinuous alkali feldspar rims. One Ne-benmoreite sample contains euhedral anorthoclase phenocrysts up to 2 cm. Other phenocryst and groundmass phases are similar to those in the Ne-hawaiites and Ne-mugearites.

4.4. *Anorthoclase phonolites*

The anorthoclase phonolites are porphyritic with seriate phenocrysts of anorthoclase, olivine, opaque oxides, clinopyroxene, apatite, and rare nepheline. Anorthoclase phenocrysts (up to 5 cm) form up to 40% of the mode and are euhedral and unzoned except for thin discontinuous sanidine overgrowths in some samples. Clinopyroxene phenocrysts (up to 5 mm) are subhedral and brown to greenish brown. Olivine and opaque oxide phenocrysts (≤ 2 mm) are subhedral and embayed. Pyrrhotite microphenocrysts occur, and pyrrhotite blebs are common in phenocrysts. Samples from along the coast on the western side of Mt. Erebus have intersertal felty-textured groundmasses consisting mostly of alkali feldspar, opaque oxides and clinopyroxene. Olivine, kaersutite, sodic amphibole, aenigmatite, apatite, sodalite, and nepheline are minor to accessory groundmass phases in some samples. In glassy samples from the upper slopes of Mt. Erebus, the groundmass is pilotaxitic, consisting of alkali feldspar, pale green clinopyroxene, opaque oxides and sodalite set in a matrix of brownish glass. Glass inclusions are common in phenocrysts.

4.5. *Benmoreites*

The benmoreites usually are microporphyritic, holocrystalline, and trachytic-textured, containing subhedral to euhedral microphenocrysts <1 mm in size of feldspar (andesine-oligoclase), opaque oxides and yellowish olivine. Scarce microphenocrysts of pale green to brown clinopyroxene, oxidized kaersutite and apatite also occur.

Rare xenocrysts (?) of corroded, embayed olivine, pale green clinopyroxene partly altered to kaersutite, and sieved-textured feldspar (labradorite-andesine) are observed in some samples. The trachytic-textured groundmass consists of alkali feldspar, opaque oxides and minor amounts of olivine, clinopyroxene and oxidized kaersutite. Benmoreite at Abbott Peak is porphyritic with euhedral to subhedral seriate phenocrysts of andesine, opaque oxides, pale green to brown clinopyroxene, kaersutite, olivine and apatite. Andesine phenocrysts (up to 4 mm) are heavily sieved and have alkali feldspar overgrowths. The groundmass is pilotaxitic, consisting of minute feldspar lathes set in brown glass.

4.6. *Phonolites*

Phonolites occur as a finely porphyritic trachytic-textured type at Inaccessible Island and a moderately porphyritic type at Bomb Peak. The trachytic-textured type contains seriate phenocrysts ≤ 3 mm in size of alkali feldspar, opaque oxides, yellowish olivine and accessory kaersutite and greenish clinopyroxene. Alkali feldspar is euhedral and sometimes has corroded resorbed andesine cores. Olivine, clinopyroxene and opaque oxide phenocrysts are subhedral to anhedral and embayed and kaersutite phenocrysts are extensively oxidized. The groundmass consists of trachytic-textured alkali feldspar and minor amounts of opaque oxides, pale green clinopyroxene, kaersutite and olivine. Phonolite at Bomb Peak contains seriate subhedral to euhedral phenocrysts of plagioclase feldspar, kaersutite, magnetite and accessory greenish brown clinopyroxene, olivine and apatite. Feldspar (≤ 1 cm) is zoned discontinuously from embayed, anhedral, possibly xenocrystic labradorite cores to andesine or oligoclase rims. Kaersutite (up to 2 mm) is partly oxidized. Olivine and magnetite microphenocrysts (≤ 1 mm) are embayed, and pyrrhotite inclusions occur in magnetites. The groundmass is pilotaxitic, consisting of alkali feldspar, opaque oxides, leucite and greenish clinopyroxene set in brownish glass.

4.7. *Trachytes*

The trachytes and comenditic trachytes contain rare phenocrysts <3 mm in size of alkali feldspar, bright green clinopyroxene probably aegirine augite, and opaque oxides. Occasional corroded microxenocrysts (?) of olivine occur. The groundmass is trachytic-textured, consisting predominantly of alkali feldspar, pale green clinopyroxene and opaque oxides. Some samples are glassy and flow-banded. Trachyte at Mt. Cis, described in SMITH (1954), is similar.

5. Summary

The active volcano Mt. Erebus occurs on Ross Island, Antarctica, in an intraplate extensional tectonic setting. Most of the lavas are strongly undersaturated and sodic, forming a continuous differentiation lineage (EL) consisting of basanite, Ne-hawaiite, Ne-mugearite, Ne-benmoreite and phonolite. Basanites and intermediate differentiates crop out in eroded cliffs on the coast and at Fang Ridge, a large remnant of a cone on Mt. Erebus. The major rock type comprising Mt. Erebus, and that currently being erupted, is anorthoclase phonolite.

EL lavas are predominantly coarsely porphyritic with a similar phenocryst assemblage consisting of olivine, clinopyroxene, opaque oxides, feldspar, apatite and rare feldspathoids.

Mt. Erebus is radially surrounded by three other volcanic centers, Mt. Bird, Mt. Terror and Hut Point Peninsula. In contrast to the EL, the lavas at these centers (DVDP lineage; KYLE, 1981) consist mainly of basanite with minor volumes of intermediate and felsic differentiates, and contain kaersutite phenocrysts. These lavas must have had a different petrogenesis than the EL. Very minor volumes of less undersaturated, predominantly microporphyritic and trachytic-textured benmoreites, phonolites and trachytes (EFS) occur on Mt. Erebus. These lavas also must have evolved independently of the EL.

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