Addition of this volatile material to the mantle will cause instability and partial melting, with subsequent formation of rising diapirs(e.g . Green, 1972, 1973; Nicholls, 1974), the diapirs reflecting, and probably accentuating chemical variations in the parent mantle. Rise of the diapirs may be slowed by sinking of the slab, perhaps more so to the southwest where lower parts of the slab would sink more rapidly. This would be a delaying factor, and would also make the more southwesterly diapirs more likely to produce alkaline magmas by holding them at greater depths.

Large-scale crustal warping and uplift in the late Pliocene-earliest Pleistocene, centred on the northeastern part of the area of the volcanoes (Jenkins, 1974), could have triggered off large-scale adiabatic melting in the rising diapirs. If magma segregation occurred above the hornblende breakdown limit that is, the top of the top of the low velocity zone, the presence of hornblende in the residual phase could produce further enrichment in K relative to Na (Green, 1972). Magmas with the chemical variations inherited from the mantle below would then rise to the base of the crust, the thick, competent nature of which would resist their upward progress. Crystallization and crystal fractionation could then take place. Some basaltic magmas have escaped almost directly to the surface, probably **via** major fracture zones (Jenkins, 1974), while some remained to produce the andesites by removal of various amounts of phenocrystic olivine, pyroxene, probably amphibole (cf, Nicholls, 1974), and possibly biotite and plagioclase.

*The petrography, chemistry, and origin of the Quaternary volcanics will be discussed more fully by Mackenzie (in prep.).

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SOUTHEASTERN PAPUA – EVOLUTION OF VOLCANISM ON A PLATE BOUNDARY

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Eastern Papua straddles a minor plate boundary between the India plate to the south and the Solomon Sea plate to the north (Johnson & Molnar, 1972). This boundary is defined by a zone of weak, shallow, seismicity (Denham, 1969) and is clearly not particularly active at the present time. Nevertheless there is ample geological evidence for intense tectonic activity and volcanism at various times during the Cenozoic.

Three major tectonic events can be recognised in the area.
1) – rifting open of the Coral Sea basin; previously thought to have been a late Eocene event (Gardner, 1970; Davies & Smith, 1971), recent DSDP data (Burns & others, 1973) suggests that this took place during the early Eocene.
2) – overthrusting (obduction) of a segment of oceanic crust and upper mantle (the Papuan ultramafic belt, Davies (1971)) onto a dismembered sedimentary trough formerly adjacent to the Australian continental block. This event probably took place in late Eocene – early Oligocene times based on correlation with comparable tectonic events in northern New Guinea (Dow 1973) and evidence of folding in Eocene sediments in the Coral Sea basin (Burns & others, 1973).
3) – rapid uplift and block faulting; this was probably due at least in part to the bouyancy of sailic sediments thrust under the oceanic slab which were metamorphosed and rose isostatically to form the metamorphic core of the Papuan peninsula and some of the offshore islands. Uplift was accompanied in the late Tertiary and Quaternary by rifting and fragmentation of the emerging land mass. In southeastern Papua (east of about 148° 30′ E. longitude) and in the offshore islands, distinctive episodes of volcanic episodes are recognised.

The oldest volcanic rocks in southeastern Papua are slightly metamorphosed Upper Cretaceous submarine basalts of oceanic tholeiite type, which have been overthrust by the Papuan ultramafic belt and which apparently represent old sea floor on the India plate north of the Australian continental block prior to late Eocene – early Oligocene obduction. Similar, but unaltered, submarine basalts of mid-Eocene age make up the eastern tip of the Papuan peninsula. The exposed thickness of these basalts is of the order of 3 km and their chemical composition is clearly comparable to that of oceanic tholeiitic basalts. It has been suggested that these basalts represent new oceanic crust generated when the Coral Sea basin opened (eg Davies & Smith, 1971); however, unless the basin opened asymetrically these basalts are too young to have been erupted at that time and it seems likely that they were associated with a short-lived spreading episode along the northern margin of the newly formed Coral Sea basin.

Uplift of the volcanic basement in southeast Papua commenced during the late Oligocene. Volcanic and intrusive activity which occured during the early stages of uplift was high-potassium (shoshonitic) in character. This type of volcanism has generally been associated with the late stages in development of highly evolved island areas (eg Jakeš & White 1969);

the generation of high-potassium magmas under apparently oceanic crust in SE Papua does not fit some current ideas of island arc evolution.

Upper Tertiary and Quaternary volcanism in southeast Papua has been dominated by andesitic, calc-alkaline volcanism. The earliest record of this is found at the western end of the Louisiade Archipelago where the eroded remnants of a volcano have been dated at 11 my (Smith, 1973a). Andesitic volcanoes occur on the islands to the west and on the mainland where several centers have erupted within the last 100 years. Although age data are sparse (Smith, 1973b) calc-alkaline volcanism appears to have migrated westward from the Louisiade Archipelago in the late Miocene, through the intervening islands, to the active Quaternary volcanoes on the mainland. It is suggested, that the calc-alkaline volcanics represent migrating volcanism along an arc which has subsequently become fragmented by Quaternay rifting linked with opening of the Woodlark basin. Although other explanations are possible the presence of such an arc is indicative of an episode of limited subduction along the northeast coast of Papua and in the offshore islands, during the late Cenozoic. The polarity of this arc can only be guessed at but the presence of a poorly developed trough along the margin of the Solomon Sea basin north of eastern Papua suggests a southerly dip.

The most recent volcanism in the area has been eruption of peralkaline rhyolites in the eastern D'Entrecasteaux Islands. This type of volcanism forms no part of any island arc association, rather it is characteristic of the early stages of rift development. Peralkaline volcanism in the D'Entrecasteaux Islands was an anomaly in the circum-Pacific context until it was suggested (Milsom, 1970) that the Woodlark Basin which lies to the east is probably an actively rifting basin.

Because southeastern Papua straddles a circum-Pacific plate boundary the geology of the area has, in the past been interpreted in terms of island arc type tectonism and volcanism (eg Karig, 1972). In fact, of the four magma types represented in area only one, the Plocene to Quaternary andesitic volcanism, is of an island arc type. Southeastern Papua cannot be interpreted in terms of simplistic models of island arc development, the area is a complex plate boundary along which both compressional (obduction, subduction) and extensional (rifting, basin formation) episodes have occured several times during the Cenozoic. The sequence of volcanic rock types occuring on circum-Pacific plate boundaries is clearly not always the simple process of events we are sometimes led to believe.

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SUBDIVISION AND GEOCHEMISTRY OF TERTIARY INTRUSIVE COMPLEXES FROM PART OF THE NEW GUINEA MOBILE BELT

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Within the New Guinea Mobile Belt (Dow *et al.*,1968), orogeny reached a climax in mid-Miocene times with emplacement of calc-alkaline intrusive complexes and eruption of effusive equivalents (Page, 1971). The intrusive rocks have been collectively termed the 'Maramuni Diorite' (Dow *et al.*, 1967,1968).

In this paper, intrusions of the 'Maramuni Diorite' in the Western Highlands-South Sepik districts (see Fig. 1) are subdivided on the basis of geographic location, areal extent, and geochemical differences into the following masses:

a) The **Karawari Batholith,** which is fault-bounded on its northern and southern margins, is greater than 350 km^2 in area, and is composed principally of hornblende-clinopyroxene-quartz diorite and hornblende (-biotite) tonalite.

b) The **Lamant and Wale Stocks,** which comprise mafic cumulates, low-Si diorites, and hornblende grandiorites.

c) The **Yuat South Batholith,** which underlies more than 400 km^2, and is composed principally of hornblende granodiorite in the western part and hornblende-biotite granodiorite in the eastern part.

d) The **Yuat North Batholith,** which is greater than 375 km^2 in area, and is composed principally of hornblende-biotite-orthoclase-quartz diorite and biotite microadamellite.

Regional variations in mineralogy and chemistry within these dominantly calc-alkaline rock types are apparent. From south to north, a decrease in modal abundance of clinopyroxene and quartz is counterbalanced by an increase in alkali feldspar and biotite. Mineralogical changes are reflected in a **regional geochemical polarity** that is especially apparent in whole-rock variations of the large alkali and alkaline earth irons, the REE group, and niobium. Fig. 2 shows variation of K_2O and Ba with SiO_2. The rate of increase of K_2O with increasing SiO_2 increases from the Karawari Batholith trend (low- to intermediate-K suite), through the Yuat South Batholith trend ('normal' calc-alkaline trend), to the Yuat North Batholith trend (high-K calc-alkaline suite). A similar variation is observed in the plot of Ba against SiO_2. Generally, BA increases with increasing SiO_2, but for any given SiO_2 content, Ba increases from the lower-K suites through to the high-K suite. Two specimens from a marginal stock of the